VOLUME XLVI NUMBERS 85 AND 86

PROCEEDINGS

OF THE

Casualty Actuarial Society

ORGANIZED 1914

1959

VOLUME XLVI

Number 85 — May 20, 1959

Number 86 — November 19, 1959

1960 Year Book

Printed for the Society by
MAIL AND EXPRESS PRINTING COMPANY, INC.
225 Varick Street
New York 14, New York

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NOTICE

VOL. XLVI, Part I No. 85

PROCEEDINGS

May 20-22, 1959

COMPULSORY AUTOMOBILE INSURANCE IN EUROPE*

BY

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A study of this subject must be complex in view of the number of countries involved with differing civil codes and political ideologies. A patchwork result inevitably emerges but an effort will be made to paint a broad picture of the present legislative situation and to observe how each country has in its own way tackled the social problem of ensuring the compensation of the victims of accidents on the roads. The first to embark on legislation was Denmark in 1918, followed by other Nordic countries in the nineteen twenties, at which time laws also took effect in New Zealand and the state of Massachusetts in the U.S.A. Legislation has since become effective or is pending in many European countries and elsewhere. It is proposed to examine in some detail the British legislation and its practical application and development and thereafter to review more briefly the situation on the continent of Europe.

GREAT BRITAIN

Following the rapid increase in automobile traffic after the first world war, various attempts were made to introduce compulsory third party insurance in Great Britain following criticism by the judiciary and the public when injured third parties were unable to recover damages through motorists either having insufficient funds or being uninsured, but legislation did not reach the statute book until 1930. This followed recommendations of a Royal Commission on Transport[1] one of which was that every owner of a motor vehicle should be required to provide security by insurance or otherwise against legal liability to pay damages on account of the death of, or personal injury to, third parties sustained in connection with the use of motor vehicles on the roads. The Road Traffic Act of 1930 dealt with many aspects of the use of the roads and became effective on

* This paper presented by invitation.

[1] Report of Royal Commission on Transport, 1929.

the 1st January, 1931. Security in respect of third party automobile liability in Great Britain is now subject to the provisions of Part II of this Act, as amended by subsequent legislation contained in the Road and Rail Traffic Act, 1933, and the Road Traffic Act, 1934.

The 1930 act provides that it is unlawful for any person to use or to cause or permit any other person to use a motor vehicle on a road unless there is in force in relation to such use an insurance policy or security against third party risks which complies with the act. Excluded from this obligation are local authorities and police authorities or any person who keeps deposited the sum of £15,000[2] with the Supreme Court. It is not apparent why a deposit procedure, which amounts to limited self insurance, should be permitted whilst insurance must be unlimited in amount.

An insurance policy, in order to comply with the act, must be issued by an "authorised insurer" as defined in the Assurance Companies Act and cover the insured in respect of legal liability incurred for death or bodily injury caused by or arising out of the use of the vehicle on a road, with the exception that cover need not be provided in respect of accidents to third parties arising out of and in the course of their employment by the insured person, accidents to guest passengers and any contractual liability.

A security, in order to comply with the act, must be given either by an "authorised insurer" or by some body of persons which carries on in the United Kingdom the business of giving securities of a like kind and which has deposited with the Supreme Court the sum of £15,000[3] in respect of that business. The givers of the security undertake to make good (up to £25,000[4] in the case of public service vehicles and up to £5,000[5] in any other case) failure to discharge any liability as is required to be covered by an insurance policy. This procedure is in effect a guaranteeing of financial responsibility in respect of liability for bodily injury to third parties. In practice, the security procedure is rarely employed.

Neither an insurance policy nor a security is of effect for the purposes of the Act unless the insurer or the person granting the security delivers a "certificate of insurance" or a "certificate of security" in the prescribed form. Failure to hold a policy or security and certificate is punishable by a fine not exceeding £50[6] and/or imprisonment up to three months. The certificate must be produced to the police on demand and to the licensing authorities when applying to license an automobile. No elaborate central record of certificates is maintained, but the insurer must maintain a record and, in the event of dispute as to the validity of the cover, may be called to give evidence in court.

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[2] $42,000.
[3] $42,000.
[4] $70,000.
[5] $14,000.
[6] $140.

The 1930 act also laid down that any condition in a policy or security providing an escape of liability in the event of some specified thing being done or omitted to be done *after* the happening of an event giving rise to a claim should be of no effect in respect of such claim. This does not, however, prevent the insurer or giver of the security from recovering from the insured or the person to whom the security is given.

The 1933 act provides for liability to pay hospital charges where a payment is made arising out of the death of or bodily injury to a third party as defined in the 1930 act even where the payment has been made without admission of liability, subject to limits of £50[6] per person for in-patient treatment and £5[7] per person for out-patient treatment.

The 1934 act was designed to close certain gaps in the legislation. Although compulsory insurance had operated reasonably smoothly, some cases had arisen where the object of the law, namely the proper compensation of persons entitled to damages through death or injury negligently caused by the drivers of automobiles, had not been fulfilled. Loopholes in the law were revealed in circumstances such as repudiation of policies on the grounds that they were obtained by fraud, misrepresentation of material facts or non-disclosure, or repudiation of claims on the grounds of infringement of policy conditions, as for example the automobile being mechanically imperfect at the time of the claim or carrying more than the permitted load of passengers or goods.

Whilst the provisions of the 1934 act should be noted as they amend the basic 1930 law and represent the present statutory position, they are of only academic interest whilst the Motor Insurers' Bureau arrangements, to which reference will be made later, continue to operate. The measures taken in 1934 were threefold:

(1) The insurer was required to satisfy a judgment in respect of an act liability unless it obtained a declaration from a court of law that it was entitled to avoid the policy on the ground that it was obtained by the non-disclosure of a material fact or by a representation of fact which was false in some material particular. "Material" was defined as "of such a nature as to influence the judgment of a prudent insurer in determining whether he will take the risk and, if so, at what premium and on what conditions." The insurance company's position was thus safeguarded in circumstances where owing to fraudulent misrepresentation the contract was void *ab initio* but on the other hand it was not now possible to repudiate on the grounds of some minor technicality.

(2) In the event of the bankruptcy of the insured or upon a composition or arrangement with creditors or a liquidation, the rights under the policy vested in the third party.

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[7] $14.

(3) Any clause in a policy designed to restrict the insurance by reference to any of the following matters was to be of no effect so far as act liability claims were concerned,

(a) *the age or physical or mental condition of persons driving the vehicle; or*
(b) *the condition of the vehicle; or*
(c) *the number of persons that the vehicle carries; or*
(d) *the weight or physical characteristics of the goods that the vehicle carries; or*
(e) *the times at which or the areas within which the vehicle is used; or*
(f) *the horse power or value of the vehicle; or*
(g) *the carrying on the vehicle of any particular apparatus; or*
(h) *the carrying on the vehicle of any particular means of identification other than any means of identification required to be carried by or under the Roads Act, 1920.*

Any sum paid by an insurer by virtue of this provision was recoverable from the insured.

The only other section of the 1934 act materially to alter the liability of insurance companies was the requirement of a payment (twelve shillings and sixpence[8] plus a mileage allowance) by the user of a motor vehicle to medical practitioners who provide emergency treatment to persons sustaining injury arising out of the use of automobiles on the road. This payment is an absolute liability irrespective of negligence and cover in this respect is granted by the insurance policy.

The 1930 act had provided that an "authorised insurer" meant an insurance company who had complied with the Assurance Companies Act, 1909, as amended by the 1930 act with respect to deposits. The deposit for motor vehicle insurance business was fixed at £15,000,[9] but this safeguard did not prevent some insurers (fortunately very few) going into liquidation in the early years. Such cases naturally caused dissatisfaction both from the motorists who found themselves personally liable and from the third parties who failed to secure their proper indemnities. Accordingly the Assurance Companies (Winding Up) Acts 1933 and 1935 were passed giving to the Board of Trade powers to investigate the affairs of companies whose financial stability they had reason to doubt, and to present a petition to the court, if necessary, for the winding up of a company.

Following a few years' experience of the legislation, the Board of Trade set up in 1936 a Departmental Committee on Compulsory Insurance (not confined to automobile insurance) under the chairmanship of Sir Felix Cassel and known as the Cassel committee.[10]

[8] $2.

[9] $42,000.

[10] Report of Departmental Committee on Compulsory Insurance, 1937.

The committee recommended *inter alia* the establishment of a central fund financed by insurers to compensate persons unable to recover through gaps in the legislation, a tightening of the control of automobile insurance companies as regards licensing, deposits and returns and further limitations upon policy conditions and repudiation of liability by insurers.

The outbreak of war in 1939 prevented the implementation of the recommendations, but developments have since taken place making the report of little practical significance at the present time.

By the Assurance Companies Act, 1946, the control of insurance companies was materially tightened and, at the same time, the deposit procedure was superseded. Control is now exercised by setting a minimum standard for solvency. This prescribes a minimum paid up share capital of £50,000[11] and that the value of the assets must exceed the amount of the liabilities by whichever is the greater of £50,000[11] or one tenth of the general (i.e. non-life) premium income in the last preceding financial year. If an insurance company cannot meet this test, the Assurance Companies (Winding Up) Acts 1933 and 1935 apply and the Board of Trade can present a petition for its winding-up on the grounds of insolvency. These solvency requirements are much more flexible than a system of fixed deposits and are likely to be in the best interest of the maintenance of a sound market as a whole.

So far as concerns the establishment of a central fund, whilst the insurance market had agreed to accept this recommendation in principle at the time of the issue of the Cassel report, it was felt that it would be far better to set up a voluntary arrangement than to have one statutorily created. Following negotiation between the market and the government departments concerned, agreement was reached that if the market combined to create a voluntary instrument it would be accepted in substitution, provided it was effective. As a result in 1946 the Motor Insurers' Bureau was formed consisting of every authorised insurer in the country. The bureau entered into an agreement[12] with the Ministry of Transport which provided that if a third party sustained death or injury in circumstances which would form the basis for a compulsory insurance claim but no insurance policy was in force, it would satisfy the judgment. After so doing the bureau has the right of recovery against the motorist concerned, one of the conditions of satisfying a judgment being that the beneficiary would assign it to the bureau. Additionally, the members of the bureau entered into a domestic agreement[12] providing that where, at the time of an accident, a policy was in force, the member who issued the policy would handle the claim as the "insurer concerned" notwithstanding that by reason of a breach of the policy conditions liability under the policy could be denied. Here also the insurer has the right of recovery

[11] $140,000.

[12] Motor Insurers' Bureau (Compensation of Victims of Uninsured Drivers) Agreement, 1946.

from its insured. The bureau operates from levies made on its members proportionate to their automobile premium income to cover the claims and expenses, but where the claim is handled by the insurer as the "insurer concerned," it has to be paid out of the insurer's own funds subject to the right of recovery as previously mentioned but such rights are in practice of little material value. It was felt that outgo under this heading would for all practical purposes average out over a period and thus no individual insurer would become seriously prejudiced by a pooling operation not being applied. The agreement also provided that if visitors to Great Britain are insured against third party injury risks by an overseas branch or subsidiary of an authorised insurer, that insurer must act as the "insurer concerned" in the event of the visitor becoming a judgment debtor. The government, for its part, agreed to act as the "insurer concerned" in respect of its own vehicles.

It will be observed that by virtue of these arrangements any person protected by the act who sustains injury on the roads of Great Britain as a result of the negligent operation of an automobile upon a road is guaranteed compensation, the only exception being where the motorist is not traced. The Cassel report had indicated that the grant of a right of indemnity in such cases against a central fund might lead to serious abuse. Motorists who had injured third parties might attribute the accident to emergency measures taken on account of the act of another vehicle which could not be traced. In practice the bureau has agreed to give sympathetic consideration to claims presented where the negligent party cannot be traced. Where there is little doubt that if the owner or driver were traced a claim would lie the making of an ex-gratia payment to the victim or his dependents normally follows.

It will be appreciated that in undertaking to meet their responsibilities under the bureau arrangements insurers have voluntarily incurred considerable liabilities. In addition to the cases where no insurance is in force they have foregone all their rights under their policies, subject to the right of recovery from the insured. Insurance may have been obtained by fraud, misrepresentation or non-disclosure or policy conditions or limitations may have been breached. Even if the automobile may have been driven by an unauthorised person or by a thief the insurer must still satisfy the judgment. The practical effect is that if there is a policy in force on an automobile which causes injury to a third party, its conditions are overridden, whilst if there is no policy the market as a whole meets the claim. This was an achievement of no mean significance. It is impossible to say what the full cost of the arrangements is as it is unknown what amounts are paid away by insurers as "insurers concerned", but it is undoubtedly quite considerable and naturally in the long run is reflected in the premiums paid by the motoring community. The fact that the arrangements have been arrived at by voluntary agreement within the whole market, are working very satisfactorily and have not induced criticism either from government or public sources is cause for congratulation. The alternative of a central fund which would have involved legislation was, in the interests of the insurance market, to be avoided and the resultant solution is regarded as a particularly happy one.

There is no statutory control over the rating of automobile insurance in Great Britain. Insurers have complete freedom to charge what rates they please, but competitive influences are a guarantee that these rates are kept to a minimum. One section of the market, known as the tariff companies, belongs to the Accident Offices Association which prescribes minimum rating schedules based on collated experience on a wide basis and fixes premiums for fleet risks. The tariff companies, however, are quite free to charge higher premiums or impose excesses (deductibles) for cases where they consider that on account of claims experience or other factors the risk is subnormal. There is in addition a very large independent market, both companies and Lloyd's underwriters, who employ their own rating schedules, and the usual beneficial effects to the public of free competition apply. The responsible attitude of the market in the control of what is, in effect, a social service combined with the holding of costs and commission to a low level has kept criticism to a minimum.

In general, rates for liability insurance are based in the case of private type automobiles on the power of the engine, the purpose for which the vehicle is used and the location of the usual garage. In the case of goods vehicles, the rating factors are the carrying capacity, the purpose for which the vehicle is used and the garage address. These factors provide the basic rates at which the majority of business is written. Other factors, however, are taken into account in assessing the terms for the substandard risk. These would vary with the ideas of individual underwriters, but common causes of penalty terms in respect of regular drivers would include,

(a) a bad claims record with particular emphasis on frequency, or
(b) a poor record of driving convictions, or
(c) agedness or youth, or
(d) lack of driving experience, or
(e) physical disabilities which might affect the driving control, or
(f) an occupation in a class not generally favoured.

So far as the vehicle is concerned, these are not individually rated according to make, so penalties might be imposed on automobiles which have an exceptional performance in relation to their engine power or where they are very old. The treatment of these factors varies in the market and may involve compulsory excesses or increased premiums or both. In extreme cases cover may be restricted to the minimum required by the Road Traffic Acts, that is third party injury only, excluding liability to guest passengers.

Most private automobile insurance in Britain is written under what is known as a comprehensive policy which is much wider than the American policy of that name as it gives in effect an all risks cover on the vehicle (subject to a few essential exceptions) and unlimited third party cover both for property damage and for injury including guest passengers. In the case of commercial vehicles the third party risk is limited in amount as regards property damage (basically £10,000)[13] and passenger liability is not included without extra premium. A third party only policy is available and quite freely sold in respect of automobiles of low value excluding the physical damage element of the comprehensive policy and to this can be added fire, theft and other specific risks. The minimum and lowest rated cover is for Road Traffic Act liability only, but this is not advertised or sought and usually is only offered where the insurer wishes not to be responsible for keeping a motorist off the road by declining to offer insurance.

It is only in the rarest of cases that insurance is refused entirely. As there is a statutory liability to insure, insurers recognise that it is their duty to provide a market and that the responsibility for refusing driving facilities belongs properly to the licensing authorities and the courts. In practice, outright declinatures are rare indeed.

Thus far compulsory automobile insurance in Great Britain and its practical application in the insurance market has been surveyed briefly. When comparing this with other countries perhaps the most interesting features are that liability under the act is unlimited, there is no requirement to cover property damage (other than a special requirement in respect of London taxicabs) *, the freedom of underwriting and rating, the lightness but none the less effectiveness of the governmental control in obtaining the best out of a free and independent market, and the voluntary market agreement ensuring the success of the act in achieving its main purpose of adequately compensating the victims of negligent driving.

On the whole it can be said that the act has worked very well in that its objects have been achieved with a minimum of disturbance and interference in the private insurance market. To some extent the cost of claims has increased, as also has the frequency, and this tendency may have been accelerated by the knowledge that insurance cover is always behind the negligent motorist. Some claims may have been made, as for example between members of a family or friends, which might not otherwise have arisen, and whilst the courts may have in mind in assessing damages the certainty that they will be met, there is no reason to believe that the compensation awarded

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13 $28,000.

* London Cab Order, 1934 (S.R. & O. 1934 No. 1346) £10,000 (Horse Cab £1000) T.P.D.

is excessive. The fact that in twenty-eight years there has been only one recorded verdict in excess of £20,000[14] for personal injury to an individual arising from a road accident is some indication that the situation has not got out of hand. The general effect of the legislation may have been to increase the claims consciousness of the public, but to what extent it contributed to a tendency which may have developed in any event it is difficult to say.

Some comment is appropriate on the unlimited liability feature of the British act. Even before the act the unlimited concept was generally accepted in the British market. The view is held in some other quarters that it is wrong to grant high third party cover to a person in the lower stratum of society, on the grounds that without the knowledge that such cover is there the courts would scale the damages down to suit his financial capability. The reverse view, of course, is that the victim of a motorist's negligence is entitled to just compensation for his loss and it should not be a matter of chance who hits him. It can be argued that the purpose of compulsory insurance legislation is achieved if it ensures that compensation up to a reasonable limit is assured, and that beyond that it goes beyond a matter for social legislation. There is something to be said for this point of view, and it is interesting to note that whilst "unlimited" legislation applies in most countries of the British Commonwealth, in most other counries there are limits of varying amounts.

It is not possible to give a firm indication of the results of compulsory insurance in Britain from the viewpoint of its profitability to the insurers. This is because the bulk of the business is written under comprehensive or third party only policies and the premium for the compulsory section of the cover is not separately allocated. The amount of business written for act liability only is insufficient to give a credible experience, and in any event such business would not represent a proper cross section as normally it is only taken up by persons unable to obtain wider cover. The premiums for third party insurance have not increased as much as those for comprehensive cover, and it may be assumed that the increased cost and frequency of physical damage claims are major factors in such unfavourable trends as there are in the combined automobile experience. Automobile insurance statistics are clouded by the effect of "Knock for Knock" agreements which are universal between insurers in Britain and operate to the benefit of the third party only experience, as the insurer of a vehicle on a third party basis does not pay for collisions with other vehicles if they are insured against damage. It is worthy of note that over the last twenty years the number of persons injured in road accidents compared with the number of vehicles in use has been reduced by one half, but, whilst no statistics are available for non-injury accidents, it is believed that these have not reduced at

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[14] $56,000.

all. There is not much doubt that the damage risk is the greatest hazard to the British automobile insurer.

When the act was introduced there was an upward swing in injury claims, particularly in respect of trivial cases and there was a tendency for claims to be developed by some solicitors specialising in this type of work whenever road accidents occurred. These tendencies are now less noticeable and probably the changing attitude of mind between 1931 and today may be traced to the greater social security enjoyed by the population. The act was introduced during a period of severe depression and widespread unemployment but nowadays under conditions of prosperity and nearly full employment there is less incentive to make capital out of trivial injuries.

To summarise, the legislation is on an even keel, the purpose of the act is being fully achieved and control is sufficiently firm and flexible to ensure that in the long run losses do not unbalance the companies' overall prosperity.

REMAINDER OF THE UNITED KINGDOM

Before leaving Great Britain, mention should be made of the other parts of the United Kingdom which have their own compulsory insurance laws. These are Northern Ireland, the Isle of Man, and the Channel Islands of Jersey, Guernsey and Alderney. There are no vital differences between these laws and those operating on the mainland with the exception that the Northern Ireland Act does not provide for out-patient treatment and emergency treatment. The Motor Insurers' Bureau arrangements have been extended to the territories concerned.

OTHER EUROPEAN COUNTRIES WHERE FULL COMPULSORY INSURANCE APPLIES

Having now reviewed the British arrangements in fair detail, it remains to examine the situation in the remainder of Western Europe and in view of the number of countries involved and the diversity of the legislation, comment must of necessity be confined to a few salient points in each case. The countries where full compulsory insurance now applies are eleven in number:—Republic of Ireland, Denmark, Norway, Sweden, Finland, Belgium, Luxembourg, West Germany, Austria, Switzerland and Turkey.

REPUBLIC OF IRELAND

Compulsory insurance in the Republic of Ireland became effective on the 1st February, 1934, and the legislation is contained in the Road Traffic Act, 1933 (Eire). Whilst the law is in most aspects similar to the British and follows it in the principle of requiring unlimited indemnity for bodily injury, there is an additional requirement to insure against third party property damage, subject to a limit of

£1,000[15] any one event, but excluding property conveyed in the vehicle or in the insured's custody, damage to weighbridges and roads or anything below the road's surface due to weight or vibration and boiler explosion damage. Hospital payments are limited to £35[16] compared with the British £50[17], but there is an additional £15[18] for treatment whether or not in hospital by electrical or special apparatus or by massage. There are arrangements for the indemnification of the victims of uninsured motorists on similar lines to the British Motor Insurers' Bureau.

DENMARK

Turning now to Continental Europe, it seems appropriate to start with the Scandinavian countries which were first in the compulsory automobile insurance field. The law in Denmark is dated 20th March, 1918, and, as amended on the 25th May, 1950, it requires compulsory insurance for both injury and damage with an authorised insurer to the extent of Kr.60,000[19] in respect of motor vehicles and motor cycles and Kr.10,000[20] for each passenger for public passenger vehicles over six seats. Companies may not decline proposals but in special circumstances may quote higher rates than usual. There is an association established by authorised insurers for settling third party claims caused by uninsured or unidentified vehicles, and whilst all claims are settled in respect of uninsured vehicles only injury claims are settled in respect of unidentified vehicles. The association is kept in funds by the members proportionately to their premium income.

NORWAY

The compulsory third party automobile insurance law in Norway is dated 20th February, 1926, and as amended on the 4th October, 1950, it provides for limits of Kr.20,000[21] any one person, Kr.10,000[22] for property damage and Kr.60,000[23] any one accident. Larger limits must be insured in the case of vehicles carrying more than eight passengers. The guarantee may be in the form of a deposit of cash or securities or by an insurance policy from an approved insurer. If the guarantee is insufficient to meet all the claims arising from one accident, it is shared amongst the various claimants. The law also provides for the sharing amongst all insurers in proportion to their previous year's income of the cost of personal injury claims where the motorist is uninsured or unidentified, and the insurers have set up a claims settlement bureau for this purpose. In Norway a driver can

15 $2,800.
16 $98.
17 $140.
18 $43.
19 $8,700.
20 $1,500.
21 $2,800.
22 $1,400.
23 $8,400.

only escape full liability for injury or damage to third parties where the injured party has shown gross negligence or been guilty of a deliberate act, but an interesting sidelight is the provision that if injury is caused to a dog not on a lead, the driver is not liable for damages unless the injury was caused by his wilfulness or negligence. If two or more vehicles collide ordinary rules of negligence apply.

SWEDEN

Sweden was the next Scandinavian country to adopt the compulsory principle, the law being dated 10th June, 1929. The limits required under the law as amended are much higher than in Norway, being Kr.200,000[24] any one person, Kr.600,000[25] any one accident and Kr.50,000[26] for property damage. There is a government controlled organisation for the supervision of rates. A particular point of interest is that an insurer's profits from compulsory insurance may not exceed 3%. If this percentage is exceeded the surplus must be deposited with the government but any deficiency in succeeding years may be made good by withdrawals from such deposit but not more than to make the profit up to 3%. Here also the law requires injury claims caused by uninsured or unidentified motorists to be settled by the insurance market and the injured party may apply to any authorised insurer he likes. In practice an association of authorised insurers has been formed to handle such claims which are paid proportionately to the previous year's income.

It is interesting to note that liability to pay damage in respect of motoring accidents in Sweden is based upon the reverse rule of proof, the motorist having to prove that he was in no degree at fault. This naturally makes the position of the insurer more difficult, and bearing in mind controlled rates and limited profits, the business is not very attractive from the insurers' viewpoint.

FINLAND

The last Scandinavian country to be considered is Finland, where compulsory automobile insurance has been effective since 1937. The laws here bear marked differences from the other countries and it is to be noted particularly that there are stringent regulations providing for financial stability of insurers, whilst it is not permissible for foreign insurers to write third party automobile risks.

The traffic insurance law in Finland has the rare requirement in continental European countries that unlimited insurance must be carried, but it also provides that the amount payable for property damage shall not exceed M.1,000,000[27] and for death or personal injury an annuity of M.480,000[28], which may be divided between de-

[24] $38,600.
[25] $115,800.
[26] $9,700.
[27] $3,000.
[28] $1,500.

pendents in the event of death. Funeral expenses are payable in addition. In the case of injury medical expenses up to a maximum of M.200,000[29] are provided for.

As with the other Scandinavian countries, there is an association to handle claims in respect of unknown or uninsured vehicles for which the market is jointly liable. Premiums are fixed by the government and as the Act provides that these should be sufficient to pay for claims and costs there is no margin for profit other than by way of interest on reserves. In view of the unlimited insurance provisions of the law, it is of interest to note that there is a pool to cover catastrophes and membership of this is compulsory.

A plan was drawn up by a Government committee for the nationalisation of the business, but this was withdrawn owing to the opposition of the policyholders. From this one can infer that the operation of compulsory automobile business has been a success so far as the general public is concerned. The same probably cannot be said for the insurers who may regard it as a lesser evil than nationalisation, but it is understood that the class has continuously produced an underwriting loss.

Before leaving Scandinavia it should be noted that a committee has been sitting in Denmark with the object of making proposals for the uniformity of legislation in the four Nordic countries particularly with regard to limits and liabilities. It is possible that material changes in the laws in these four countries may be adopted at some future date.

BELGIUM

Two of the three Benelux countries now have full compulsory third party insurance, but Holland has not as yet adopted a full scale law. Before 1957, compulsory insurance in Belgium was confined to omnibuses, motor coaches, taxis, hire cars and goods carrying vehicles. By virtue of the law dated 1st July, 1956, the third party insurance of all mechanically propelled vehicles became compulsory from the 1st January, 1957. Notable features of the law are that the indemnity is required to be unlimited both for bodily injury and property damage, although it may be restricted to Frs.5,000,000[30] for third party fire and explosion damage, and that all passengers are required to be covered, other than the driver or person effecting the insurance, the spouse or close relatives of the insured living with him and employees of the insured covered by the workmen's compensation law. Goods carried in the vehicle need not be insured. It will be observed that the law is very wide in scope and it may also be noted that the injured third party has a direct right of action against the insurer and any restrictions avoiding liability are of no effect so far as third party

[29] $600.
[30] $100,000.

claims are concerned. The insurance has to be written on a standard form.

Insurers are required to maintain reserves consisting of cash, specified Belgian securities or real estate to cover the reserve for unexpired risks and outstanding claims, and these reserves must be not less than 60% of the previous year's income. The reserves are primarily for the benefit of persons injured in terms of the law. All approved insurers must subscribe to a central fund to compensate victims not protected by insurance. In view of the wide scope of the law this only arises in respect of motorists who are uninsured or who cannot be traced or where the car is driven by a thief. Such a fund had already been voluntarily created by insurers before the law came into force and the legislation permitted this voluntary fund to provide the machinery for the compulsory fund. The fund only applies to injury claims.

It is early yet to say how this stringent law has affected the loss experience, but it is comforting to know that, despite fears to the contrary, there has not as yet been an appreciable increase in the number of road accidents or in loss ratios.

LUXEMBOURG

Insurance has been compulsory in Luxembourg since 1932, but various modifications have been introduced and the present law is contained in the "Code de la Route, 1956". The policy is required to cover both injury and damage, and the combined limits must be at least Frs.4,000,000[31] for motorcycles and similar vehicles, Frs.6,000,000[32] for motor vehicles seating up to six and goods vehicles with a maximum weight of 3.500 Kg., Frs.15,000,000[33] for motor vehicles seating up to twenty and goods vehicles weighing over 3.500 Kg., and Frs.30,000,000[34] for motor vehicles seating more than twenty. If the claims exceed the policy limits, injury claims must be satisfied first. Fire and explosion property damage may be limited to Frs.4,000,000[35]. Children under 14 years of age count as half in the calculation of the number of people transported.

The law lays down a number of circumstances in which claims may not be repudiated (e.g. drunkenness, driver unlicensed, passenger vehicle overloaded so far as third parties other than passengers are concerned) and a particularly interesting feature is that the insured is required himself to pay all claims up to Frs.2,500[36] and the first Frs.2,500 of claims in excess of that amount. Despite this provision third party claims have to be paid in full and the insurer is required

[31] $80,000.
[32] $120,000.
[33] $300,000.
[34] $600,000.
[35] $80,000.
[36] $50.

to recover the insured's share, which right may not be renounced except in the case of insolvency. Insurance cover may be separately obtained in this respect.

The classes of persons required to be indemnified follow the Belgian law and here also there is a direct right of action by third parties against insurers. There is, however, no redress for the victim of the uninsured or unidentified motorist, as there is no central fund, although it is possible one may be formed to remedy this unusual omission from European practice.

GERMANY

Automobile insurance in Germany was compulsory before the war, and as from 1940 new conditions were laid down which are still operative so far as the German Federal Republic formed in 1949 from the union of the three Western Zones is concerned. These provide for minimum insurance in respect of private cars of DM.100.-000[37] for personal injuries and DM.10,000[38] for property damage, and for commercial vehicles DM.150,000[39] for personal injuries and DM.15,000[40] for property damage, with special limits for other types of vehicles, such as motor omnibuses, varying according to carrying capacity. The limit for private cars has recently been increased to DM.150,000[41]. Rates are subject to strict state supervision and risks cannot be declined.* Foreign visitors are required to comply with the law as from January 1957.

It should be noted also that there is compulsory insurance legislation in the Saar, requiring bodily injury cover for varying amounts between Frs.25,000,000[42] and Frs.100,000,000[43] according to seating capacity, with a limit as regards any one person of Frs.12,500,000[44]. The limit for commercial vehicles is Frs.62,500,000[45]. Material damage must be covered up to 10% of the minimum sum insured for personal injury.

AUSTRIA

In Austria also of the Germanic countries, third party insurance of automobiles is compulsory under the federal law of 6th July, 1955. The limits required for all vehicles other than omnibuses and lorries carrying more than nine persons are S.200,000[46] for personal injuries

37 $24,000.
38 $2,400.
39 $36,000.
40 $3,600.
41 $36,000.
42 $50,000.
43 $200,000.
44 $25,000.
45 $125,000.
46 $7,800.
* Recent results have been generally very unfavourable.

to any one person and S.600,000[47] for each accident, with S.60,000[48] for property damage claims. In Austria the possessor of a vehicle is entirely responsible for injury or damage caused unless he can prove circumstances beyond his control. Where the driver is to blame, the Civil Code requires unlimited liability, but if he is not to blame his responsibility is limited in amount by statute.

SWITZERLAND

Switzerland has experienced compulsory insurance since 1932. The federal law of that year required owners of automobiles and motorcycles to insure with an approved insurer for various limits. The personal injury limits are for motorcycles Frs.30,000[49] per person and Frs.60,000[50] per accident, for vehicles Frs.50,000[51] per person and Frs.100,000[52] per accident, and for heavy passenger vehicles higher amounts up to a maximum of Frs.500,000[53] where there are more than twenty seats. In the event of claims arising from one accident exceeding the limit, the compensation due to each victim is reduced proportionately.

For property damage the limits are very modest being Frs.3,000[54] for motorcycles and Frs.5,000[55] for all other vehicles.

The Swiss Civil Code is Germanic in origin and here also there is almost an absolute liability upon the motorist, and anyone in charge of a motor vehicle is held liable in respect of damage caused by its use irrespective of fault. There are exceptions, however. If the accident is caused by *force majeure* (Act of God) or through the serious and exclusive fault of the third party no liability is incurred, whilst some reduction in the indemnity may be allowed according to the discretion of the court if the victim is partially at fault. In the case of non-fare paying passengers no indemnity is payable unless there is negligence on the part of the driver. The victim of a road accident may proceed direct against the insurer, but in view of this statutory subrogation the claim can only be up to the limits provided by the law. Where the claim exceeds the statutory limit he may also sue the wrongdoer.

The Swiss arrangements do not make any provision for idemnification of the victims of untraced motorists, but where the driver is uninsured the victim obtains compensation under a special cover for uninsured drivers arranged by the Government and financed out of

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[47] $23,400.
[48] $2,300.
[49] $7,000.
[50] $14,000.
[51] $11,600.
[52] $23,200.
[53] $116,000.
[54] $700.
[55] $1,160.

the gasoline duty. This cover is restricted to death and personal injury.

TURKEY

As a final note on countries in the mainland of Europe outside the sphere of communist influence, where full compulsory automobile insurance prevails, it may be noted that in Turkey there is a law dated 27th September, 1954, which requires cover for personal injury for motorcycles up to £T.2,000[56] for private automobiles up to £T.5,000[57] and commercial vehicles up to £T.10,000[58]. For property damage the limits are for motorcycles £T.1,000[59] and for all other vehicles £T.2,000[60].

COUNTRIES WITHOUT FULL COMPULSORY AUTOMOBILE INSURANCE

FRANCE

At the date of this paper, insurance is compulsory in France only for the public transport of goods and passengers, but the public is also protected by a guarantee fund set up by law to provide compensation for bodily injuries received in road accidents where the motorist is unknown or he or his insurer is insolvent. This fund is financed by contribution on a prescribed scale from all insurers, all insured motorists and all uninsured motorists responsible for the accidents. To date the fund has been running at a considerable deficit.

A new law dated 27th February, 1958, has instituted compulsory third party automobile insurance for all vehicles and, by virtue of recently issued regulations, takes effect from the 1st April, 1959. The obligation is to insure against third party risks arising from death, bodily injury or material damage caused by a vehicle up to a minimum of Frs.50,000,000[61], except that in the case of the public transport of goods and passengers the indemnity must be unlimited.

Whilst the act permits the insurer to limit his cover in certain directions, the third party claimant must always be paid in full with a right of recovery against the insured. Non-residents in France must also produce an insurance certificate, for which the international green card serves. Failing this, insurance cover has to be obtained from the customs authorities.

There is provision for the setting up of a central rating bureau with the exclusive power of rating cases where insurers have declined or required higher rates. The bureau is to study the history of each case and then fix the premium which may be either at tariff or higher

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[56] $230.
[57] $580.
[58] $1,160.
[59] $110.
[60] $230.
[61] $100,000.

than tariff coupled with an excess. The decision is notified to the proposer and to the insurer who has to cover the risk on the terms indicated. If he fails to do so, his licence to write automobile business is likely to be withdrawn. The bureau is composed of equal membership of the insurers and of bodies representing the motorists, and at each meeting a government officer will be present as observer with power to request a re-study in the event of his not agreeing with any decision.

Whilst it is believed that only 5% of motorists are at present uninsured, the majority of "scooterists" (largely youngsters) and motorcyclists have not previously bothered with insurance and these will now be forced to pay their proper contribution towards the indemnification of injured persons, thus relieving the drain on the guarantee fund. Fines for failure to insure are to be increased by 50% in favour of the fund, which will continue to operate for bodily injury claims and will also handle cases where the insurer claims non-insurance on account of non-payment of the premium.

Automobile insurance in France has been notorious in its difficulties for insurers and the new law may make prospects in this field even bleaker. Throughout the last few years, because of the preoccupation of the government in trying to check the cost of living, it has in practice become extremely difficult for insurers to obtain approval for increased rates, despite ever worsening experience. Fairly substantial increases were authorised in 1958, but since then prices have again risen and this, together with the impact of compulsory insurance, may again eliminate the possibility of profitable underwriting. The new measure is understandably unpalatable to the French insurance industry and appears not only as a danger to financial stability in view of the introduction of the compulsory element with rating control, but also as another step in governmental interference in the affairs of the companies not yet nationalised, bringing them nearer to complete integration.

ITALY

In Italy there is still no law requiring compulsory automobile insurance; yet the results from operating automobile insurance in this country are more deplorable than in most, and the relation of claims to premiums has for some years usually been in the region of 90%. Not all the ills of operating an automobile account are necessarily linked with the compulsory aspect. A draft law for compulsory insurance has now been introduced, but it appears likely it will be some time before legislation takes effect. It has already been under consideration for some years. So bad have been the results without legislation, however, that it is difficult to believe they can become worse, but there are many uninsured motorists, and the increased volume in what is already the predominant account bodes ill for private insurance.

HOLLAND

As previously mentioned, Holland alone of the Benelux countries has not yet adopted full scale compulsory insurance. The law compels the insurance of liability to fare paying passengers up to Fls. 20,000[62] per passenger (maximum Fls. 400,000[63]) for personal injury and up to Fls. 5,000[64] for damage to passengers' property. At present negotiations are proceeding between Holland and Belgium with the intention of introducing a new law, and dependent upon the outcome a bill may be introduced shortly, although it is not possible to say when the law would become effective. It seems insurers will be at liberty to fix rates and that they will form a bureau for the indemnification of the victims of uninsured motorists.

SPAIN

There is no compulsory insurance in Spain, but there is one feature which merits mention. If a motorist is involved in an accident involving death of or serious injury to a third party, the judicial authorities may detain the driver until such time as he produces a financial guarantee for an amount determined by the court to take care of any claim which may be awarded against him or the automobile owner. It is possible to secure cover for this guarantee under the automobile policy on payment of an additional premium for what is known as the "Fianza clause." The insurer's lawyer acts in the legal proceedings and, if the motorist has been detained, secures his release. This cannot be termed compulsory insurance, but it certainly creates inducement to insure.

PORTUGAL

There is only limited legislation in Portugal. Insurance is compulsory for public passenger vehicles for passenger liability up to Esc. 10,000[65] per seat including driver and conductor and for goods vehicles up to Esc.25[66] per kilogram of the carrying capacity. Minors can only obtain driving licenses provided they are covered for third party risks up to Esc. 100,000.[67] In the event of an accident, if proof of third party insurance is not produced, a cash guarantee may be demanded or the vehicle detained. If the accident is serious the vehicle may be seized and the driver arrested whether there is insurance cover or not. It is also of interest to note that the Highway Code provides that persons injured by vehicles or animals on the road have a right to indemnity unless the injury or damage is due to *force majeure,*

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62 $5,300.
63 $106,000.
64 $1,300.
65 $350.
66 $0.90.
67 $3,500.

but if the accident is due to the fault of both parties the damages are proportionately reduced. Here also there is an inducement to carry insurance.

GREECE

Insurance is not compulsory in Greece, but in the event of an accident the police may impound the vehicle which will not be released until a letter of guarantee issued by an insurance company legally established in Greece is produced.

EASTERN EUROPE

The position regarding compulsory insurance in countries under communist control is perhaps only of passing interest to anyone engaged in private insurance, as in most if not all insurance is conducted by a state institution with no scope for commercial risk bearing. In view of their participation in the "Green Card" scheme referred to later, it may be noted that in Czechoslovakia the law compels third party bodily injury cover without limit and property damage cover limited to Kcs.50,000[68] for general property and Kcs.4,000[69] for moneys and/or valuables involved in one accident.

FOREIGN TRAVEL

To complete the European picture some reference must be made to the facilities which have been provided by international co-operation to ease the way for the motorist travelling from one country to another and requiring to conform to differing compulsory insurance laws as he goes on his way. Prior to 1953 when a journey across frontiers was contemplated the arrangements were somewhat piecemeal and cumbersome, often involving arrangements between individual insurers in different countries or negotiations conducted on the frontier to purchase short term insurance. A British suggestion for an international insurance agreement was accepted in 1948 by the road transport committee of the Economic Commission for Europe set up by the United Nations Organization and following negotiation it became effective on the 1st January, 1953. Under it insurers in the countries concerned formed national bureaux (in Britain there was already the Motor Insurers' Bureau in existence) to issue on behalf of insurers International Insurance Cards, colloquially known as "Green Cards," which are signed and carried by the driver as evidence of insurance in all the participating countries. In the event of an accident involving a claim for damages the bureau in the country where the claim arises handles it as though the insurance complied with the local compulsory legislation and their expenditure is recovered from the bureau issuing the Green Card, who in turn recover

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68 $7,000.
69 $560.

from their member company. The issue of a Green Card is obligatory for visitors to countries where compulsory insurance is operative and facilitates travel in that it ensures compliance with the law, takes care of questions of jurisdiction and service of process and avoids the necessity for purchasing insurance locally. In certain countries (Great Britain and Switzerland) a signed duplicate must be deposited with the authorities on entry. Green Cards are also issued for visits to countries where compulsory insurance is not effective as this simplifies procedure and may avoid official enquiries and in Greece or Spain may avoid the impounding of the car or detention of the driver. When an accident occurs the injured party normally lodges the claim with the bureau in his own country, who are authorised to accept service and pass the claim to a "handling member" for settlement. The cost of the claim is eventually recovered from the visitor's own insurers in his country of origin. If an insurer has an organisation for transacting automobile insurance in the country of the accident it can be arranged for this organisation to handle. It may be also noted that insurers who have no facilities for handling automobile insurance in Europe may make an agreement with any member of any bureau to obtain Green Cards from that member, subject to the consent of the bureau being first obtained and the member being responsible for the fulfilment of the financial obligations of the non-member insurer. The agreement has been subscribed by eighteen countries (Austria, Belgium, Czechoslovakia, Denmark, Finland, France, Germany, Great Britain and Northern Ireland, Greece, Republic of Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden and Switzerland) and has proved a remarkable achievement in the sphere of international cooperation. With the wide divergencies in the legal codes it is perhaps too much to expect that uniformity of legislation will follow.

From this review of the present or prospective legislation in Great Britain and the countries of Europe, it will be apparent that no clear pattern emerges. Some countries prescribe unlimited personal injury cover whilst others fix limits of widely diverging amounts. Some legislate for property damage and others do not. There are variations in the extent to which passengers are required to be covered. Some countries legislate for the indemnification of uninsured or untraced motorists. Others either achieve this by voluntary action of insurers or make no provision at all. There are variations in the degree of freedom of insurers to decline or to charge rates of their own choice. Methods of governmental control to ensure the stability of the insurance market are diverse. Most countries have legislative features unique to themselves, often influenced by the nature of the common law or civil code into which the statutory law must fit. There is only one completely common feature. In every country the legislation has been implemented with the cooperation of the private insurance market and none has seen fit to nationalise the business or to compete with the private market through a state insurance office. It seems the private insurance industry is performing its part in implementing the law to the general satisfaction.

In the few countries where compulsory insurance is either non-existent or not complete, either legislation is pending or there are regulations designed to protect the public and encourage insurance. The principle is thus becoming generally accepted in Europe as being in the public interest and the fact that in over forty years no country has seen fit to loosen the compulsory features or to introduce government monopoly or competition, indicates that on the whole the laws have been satisfactorily implemented. Whilst the spread of compulsory insurance may be a matter for some concern to insurers as legislation tends to bring in its train more difficult conditions in which to trade, the market is conscious of its duty to make the laws work and to keep the public cost of what is in effect a social service to the minimum and has generally cooperated well with the legislature in producing the desired result. With the ever increasing number of automobiles on the roads, the automobile section of the average insurer's accounts becomes increasingly important, and if it goes seriously into deficit over a long term, the insurer cannot prosper. The experience of compulsory insurance varies widely between different countries, and it is not wise to generalise on the results. It seems from such statistics as are available that automobile business is one of the least profitable classes, but to what extent this is contributed to by the compulsory element it is impossible to say.

Objections to compulsory insurance usually arise under two heads; first that it is wrong for government to force people to do what the prudent do voluntarily and second that the government should not provide both the compulsion and the market to satisfy it through state insurance offices. The second is the more distasteful to the insurance market and by swallowing the former and in general making the laws work well insurers in Western Europe have kept their independence and a worth while measure of freedom, although state intervention in rating is apparent in a few places. As long as government control is confined to ensuring that the legislation works by providing an indemnity to the innocent victims of road accidents, insurers have little to fear from it; it is when government also controls the premiums that trouble develops for the insurance industry. Political pressures often prevent the authorisation of basic rate increases shown by claims experience to be essential to preserve a sound market, whilst the prohibition of adequate premium penalties on those who cause the accidents mean that they are being subsidised by those who drive with care and also by the insurance market as a whole. When this situation develops the stability of the business becomes seriously threatened.

January, 1959.

NOTE: Dollar equivalents of European currencies quoted in footnotes are approximate at exchange rates ruling on 31st December, 1958.

LIABILITY INSURANCE FOR THE NUCLEAR ENERGY HAZARD

BY

RICHARD H. BUTLER

The process of thinking about liability insurance on nuclear energy exposures is helped considerably by bearing in mind that fundamentally most of this insurance is only an extension of lines that have been written by the companies for many years. The largest part consists of premises-operations and products liability exposures from the general liability line. The transportation of nuclear material brings in automobile, railroad, aircraft and marine exposures. It is also worth remembering that at this point in time the lighter and numerically common risks are still insured by the individual companies under normal liability insurance contracts. Only the more severe hazards are included mandatorially in the nuclear liability insurance pools in the United States and it seems likely that a similar pattern will appear abroad.

Nevertheless, there are five factors involved which have led to the development of a bewildering set of policy forms, rating procedures and mechanics. The first of these is a potential catastrophe hazard which is without parallel in past experience. Among other things, this makes rating difficult, but more importantly it is the source of the second factor. This is the very real need and demand for much higher limits of liability than have been written in the past and a system of government indemnity on top of those limits. Along with government indemnity comes factor three, which is the meshing of a liability policy with a federal law establishing the form and amount of financial responsibility required of the operator of a nuclear facility and protecting him with indemnity if he meets these requirements.

Factor four is the possible slow emergence of claims. Casualty insurance has encountered this problem before, and notably in the form of compensation for dust diseases and loss of hearing. However, it has not seen it in the degree to which it could exist following radiation injuries. This slow emergence can occur in an individual in the form of an ordinary disease of life such as leukemia, or it could even be a genetic case the results of which only manifest themselves in a later generation.

The last factor and the one least susceptible to intelligent assessment is the unreasoning concern of many persons about the possibility of radiation injuries. The public is not as concerned as it should be about the fact that 40,000 or so people are killed each year by the automobile, but let it be known that a bomb test in Nevada has caused a measurable but probably harmless increase in the background radiation in other parts of the United States and we find headlines in the newspapers.

It is these problems and the seemingly endless ramifications growing from them that the insurance industry has been struggling with, and at this point it is desirable to insert a brief chronological summary of events.

The Atomic Energy Act of 1954 opened the field of peaceful uses of nuclear energy to private industry. Shortly thereafter the top underwriters of liability insurance companies received tangible evidence of what was coming, and it took the form of serious inquiries about limits ranging anywhere from fifty to one hundred million dollars. At that time a five million dollar limit was a big deal, and a ten million dollar limit a major operation. It is a safe guess to say that the ultimate liability market here and abroad for any risk was twenty million dollars or less.

If this new need was to be met drastic steps would have to be taken. The first of these was the formation of the so-called Insurance Study Group, whose members were leaders of the property and liability insurance industries appointed by the Atomic Energy Commission. The study group visited a number of government installations and was briefed by the AEC on all information available at the time. It was they who concluded that the only solution was the formation of pools, and they did the work that brought these pools into being.

The constitutions of the liability pools were adopted in the spring of 1956. The stock pool is the Nuclear Energy Liability Insurance Association (NELIA), and the mutual pool is the Mutual Atomic Energy Reinsurance Pool (MAERP). The mutual pool is a combined property and liability pool, so it has a liability underwriting group that goes by the name Mutual Atomic Energy Liability Underwriters (MAELU) and this is the name you will usually see.

Late in 1956 the stock and mutual pools working closely together made their first filings of policy forms and rating procedures with the states for an effective date of February 1, 1957. The first risk was bound by NELIA in March, 1957.

The Joint Committee on Atomic Energy of the 84th and 85th Congresses held hearings on various proposals for indemnity bills in 1956 and 1957. In September, 1957 the Price-Anderson Bill was passed as Public Law 256 of the 85th Congress. In 1958, the Price-Anderson Law was amended to extend its application to the "Nuclear Ship Savannah" which is expected to be completed in 1960. Another 1958 amendment of interest to insurers affected non-profit educational institutions operating nuclear facilities.

In December, 1957 a first revision of the policy form for nuclear facilities was filed with and approved by the states. At this writing a second revision of this facility policy, an original supplier's and transporter's policy and a first revision of the nuclear exclusions for regular liability policies are about to be filed.

The Liability Pools

As has been said before, the stock and mutual nuclear liability insurance pools were formed in the spring of 1956. The stock pool, NELIA, presently has 141 members and an underwriting capacity per risk of $46,500,000. The mutual pool, MAERP, has 105 members and a liability underwriting capacity of $13,500,000. Both of these pools have slightly more capacity than the above figures, which are the amounts they offer to put at risk. The excess balance is held in reserve for two reasons. One of these is that they wanted to come up with the round total figure of $60,000,000 which had been referred to many times both in congressional hearings and in discussions with industry. More importantly, they wanted to have a reasonable amount as a cushion so that the total capacity of the pools could fluctuate without the need for corresponding adjustments in the limits on policies of those customers who bought total pool capacity.

NELIA's domestic capacity was assembled by the relatively simple expedient of writing to every stock company that was listed in "Best's Insurance Reports" as writing miscellaneous liability insurance in one or more states, and inviting all companies to join the pool. The only criterion used was to ask that any company which subscribed come in for a commitment of at least $25,000 per risk.

I am not familiar with the exact method used by MAERP to assemble its membership, but I assume that it was similiar to that followed by NELIA.

There is an ancient and unhappy history of pools formed by American casualty insurers to absorb optionally risks which the individual members were unwilling to carry for their own account. Such pools lost money and both NELIA and MAERP are set up on the premise that it would have been impossible to accumulate large capacity if the placing of risks in them were optional. Consequently, these pools are the exclusive agencies of their members in the United States for writing nuclear energy liability insurance on risks that are defined as "nuclear facilities." The types of exposures that constitute nuclear facilities are explored in some detail in the section of this paper devoted to the nuclear exclusion endorsement for regular liability policies. It is enough to say here that in general these are the risks with the more severe hazards. Risks that are not nuclear facilities are mostly retained in the individual companies' accounts. However, contrary to their position on nuclear facilities, NELIA and MAELU stand ready to quote on these latter cases on an optional basis where the risk is unable to assemble the limits it desires in normal markets or where the carrying company is disturbed about the particluar exposure and wishes to be relieved of it.

Unlike the United States property insurance pools and some foreign liability pools, NELIA and MAELU insure only the nuclear energy hazard, leaving normal liabilities in the hands of the regular carriers. This has the dual virtue of meshing with government indemnity under the Price-Anderson Law and creating a minimum disturbance in the business.

In order for the liability pools to realize their full potential, the companies joining them have accepted exclusions in their reinsurance treaties which correspond with the exclusions they have been attaching to their regular liability policies since March 1, 1958. This served to relieve the reinsurance markets of the world of the danger of doubling up on nuclear losses and permitted NELIA and MAERP to turn to these same markets for reinsurance of their own. Large additional capacity was obtained in this way and this is included in the figures mentioned above for total writing capacity of the pools. The exact distribution of capacity between primary writers and reinsurers changes slightly each year, but on the average approximately 70% of the capacity comes from primary writers' subscriptions and 30% from reinsurers' subscriptions.

So far as writings in the United States are concerned, the operations of NELIA and of MAELU are closely integrated. Each pool reinsures every risk written by the other one and the distribution is currently 77.5% to NELIA and 22.5% to MAELU. They employ identical policy forms, rates and rating procedures which have been jointly adopted by the National Bureau of Casualty Underwriters and the Mutual Insurance Rating Bureau. The pools make joint inspections of risks and have a joint claim committee which is developing procedures to be followed to handle claims in the event of a catastrophe. Similar cooperation exists in the accounting, statistical and payroll audit fields.

It should be pointed out here that the actual staffs of these liability pools are very small. Field work needed for inspection, claim and payroll audit is performed by personnel of pool company members on a reimbursement basis. Development work on forms, rating procedures, claim and inspection practices and accounting has been done by company committees without reimbursement and by the staffs of the National and Mutual Bureaus.

To date all the risks insured by NELIA and MAELU are land based exposures in the United States. However, both contemplate entering the marine and foreign fields.

In writing marine it is likely that the pools will act in concert in the same manner that they do in this country, and a joint quotation is outstanding on the "N. S. Savannah" to carry her through her trial runs in 1960.

In foreign operations the pools will operate independently rather than in concert. NELIA is presently considering requests from the Canadian, Belgian and Swedish pools for reinsurance. In the field of foreign product liability coverage for American manufacturers NELIA will probably issue its own policies on an indemnity basis.

In both the marine and foreign fields the pools will not only be operating on unfamiliar ground, but will also be without foreign reinsurance. Therefore, the total commitments will necessarily be a good deal less than the capacity offered in the United States.

While countless hours of labor have been devoted to the nuclear liability insurance program, the business itself is still in its infancy. For example, the gross premium writings of NELIA in 1959 will be more than $500,000 but show no prospect of reaching a figure as high as $1,000,000. In 1960 some of the large power reactors now under construction are expected to begin operation. In that event gross premium writings might reach the vicinity of $2,000,000. What the gross will be after 1960 is largely dependent on the ability of the nuclear industry to make itself competitive with more conventional methods of operation. It is possible that nuclear liability insurance may in due course become a sizable operation.

Having said that the liability pools are currently incurring heavy expense without producing very much premium, one more thing should be added. That is, that they have had no losses at all. Two minor incidents have been reported to NELIA. They are in the nature of losses of small quantities of relatively low hazard nuclear materials. To date no claims have resulted from these incidents.

The Involvement with Government Indemnity

What are the chances of the occurrence of a major reactor loss? If such a loss did occur, what would it cost? It is clear that no one knows the answers to these questions. No actuary has ever over-indulged enough to have a nightmare including an equation with so many unknowns and variables as there are here.

At the request of the Congressional Joint Committee on Atomic Energy, the Atomic Energy Commission took a stab at it and in March, 1957 published a report entitled "Theoretical Possibilities and Consequences of Major Accidents in Large Nuclear Power Plants." This report was largely prepared by the staff of the Brookhaven National Laboratory and usually goes by the name of "Brookhaven Report." I have looked it over from time to time and admit freely to not understanding the bulk of it. However, anyone can get an inkling from the letter that Acting Chairman Vance, of the Atomic Energy Commission, wrote to Congressman Durham when he transmitted the report to the Joint Committee. On the subject of the likelihood of any single large reactor having a serious loss in a given year, he says in effect that some experts consider the subject too vague and uncertain to reduce to numbers. Others while sharing this doubt mentioned figures from one in one hundred thousand to one in one billion.

Assuming that the accident did happen, the range of expected injury is equally wide. For injury to persons it goes from a minimum of no one killed or injured up to a maximum of 3,400 killed and 43,000 injured. Similarly, theoretical property damage could run from about $500,000 to $7,000,000,000. Mind you, this range of estimates is not for a relatively small excursion, but rather for the complete meltdown of a big reactor.

The above is by way of indicating that the full theoretical potential of the nuclear energy hazard is not something that liability insurers can presently cope with. Recognizing this, the industry has never opposed the principle of government indemnity over the level of available insurance, but has limited itself to resisting the intervention of the government in the area that private enterprise is best equipped to serve. That area, of course, is the initial sixty million of loss, and it can be expected to comprehend the great majority of nuclear exposures.

It is plain enough that if insurers are not in a position to assume the entire hazard, neither are the various segments of industry which have entered the atomic field able to put their own assets at risk for the exposure in excess of that which can be insured. If the development of peaceful uses of atomic energy is to go forward, then some sort of government subsidy or protection is implicit.

The Price-Anderson Law went through several draft versions before it became effective in September, 1957. It is not profitable here to trace the legislative history and it is enough to give a brief summary of the law as enacted.

The Price-Anderson Law is Public Law 85-256, effective September 2, 1957. The shortest statement I can make of it is that it does four principal things:

1. It deals only with the nuclear energy hazard and calls that the "radioactive, toxic, explosive or other hazardous properties of source, special nuclear, or by-product material."
2. It provides that certain licensees of the Atomic Energy Commission must meet a requirement of "financial protection" which is defined as "the ability to respond in damages for public liability and to meet the costs of investigating and defending claims and settling suits for such damages."
3. Once a licensee has provided financial protection, the Atomic Energy Commission is required to agree to indemnify the licensee and others against liability in excess of financial protection up to $500,000,000.
4. Because the potential cost of a major nuclear loss is unknown, the law goes on to cut off the legal liability of "persons indemnified" at a maximum of $500,000,000 plus required financial protection. It provides for court procedures to apportion these funds amongst claimants if the total loss should be in excess of this amount.

In addition to the above fundamentals, the Price-Anderson Law contains other points of interest, and sometimes concern, to insurers. These are:

1. A "person indemnified" is defined as "the person with whom an indemnity agreement is executed and any other person who may be liable for public liability." This means that an insurance policy which is to meet the requirement of "financial protection" must contain an omnibus definition of insured which protects not only the licensee and his designers, contractors, and suppliers of all kinds, but also any other person who may by chance become liable for a nuclear incident. The commonly used ex-

ample of this last is the proprietor of an airplane which sets off a nuclear incident by happening to crash on a reactor.

2. The term "public liability" is defined in part as "any legal liability arising out of or resulting from a nuclear incident, except claims under state or federal Workmen's Compensation Acts of employees of persons indemnified who are employed at the site of and in connection with the activity where the nuclear incident occurs, and except for claims arising out of an act of war." Most of this is routine enough when lined up with the announced principle of indemnifying anyone who may be liable. But note that one brand new concept has been brought in; that is, that the only workmen's compensation liabilities that have been excluded from the term "public liability" are those for employees at the site. Consequently, employees of a "person indemnified" who are away from the site come under the government indemnity and must be insured in some way in any policy meeting the requirements of financial protection. The background here is that a person indemnified may have entirely unrelated operations within easy range of a nuclear incident emanating from the installation. If public liability did not include this exposure, neither the person indemnified nor his insurers would have any recourse against the indemnity.

Having taken the plunge with respect to off-site workmen's compensation liabilties, Congress then went on to include in public liability damage to property belonging to a person indemnified which is away from the site. There is a proviso here that this property must also be covered under the terms of financial protection in order for the indemnity to apply.

The prime example of a beneficiary of these provisions is the university which sets a reactor down in the middle of its campus. In such a case most of the university employees and property near the reactor would have no connection with it and would be covered both by financial protection and by indemnity. It would be easy to cite a long list of other examples affecting not only the operators of reactors, but suppliers as well.

A part of this definition of "public liability" has come in for intensive study by all parties concerned. A careful reading of the language itself seems to extend government indemnity to suppliers and the like for liability that they may have for damage to the site itself. On the other hand, a review of the legislative history does not indicate that Congress intended to apply the indemnity to on-site property damage under any circumstances. It is possible that the solution to this may consist of the Atomic Energy Commission going to the 86th Congress and asking for clarification of the law.

These new concepts that a person indemnified may be liable to himself for his own off-site workmen's compensation and property exposures first came as somewhat of a shock to liability insurers. However, they have gradually assimilated them and at this time do not quarrel with them. NELIA and MAELU facility policy forms cover these exposures in the same way that government indemnity does.

3. In Section 170A, the law specifies in general terms which licensees must meet financial protection in order to be licensed and thereby at the same time establishes those which are entitled to government indemnity. The only licensees the law deals with on a mandatory basis are those who operate reactors, critical assemblies, chemical separation plants and gaseous diffusion plants. The last two categories do not exist yet in private industry, so that for practical purposes the law is talking about reactors and critical assemblies. Other licensees may be made subject to financial protection and indemnity at the option of the Atomic Energy Commission. Up to the present time the Commission has restricted itself to the mandatory cases and has not brought in any of the optional categories.

4. Section 170B is of more concern to the insurance industry than any other part of the law. This is the section which sets forth the criteria for establishing the amount of financial protection to be provided by any installation. It starts out by saying that this shall be the amount of liability insurance available from private sources. Then, near the close of this section, it says that the big power reactors (i.e. those with a capacity of 100,000 electrical kilowatts or more) must always provide this maximum amount. In between, it allows wide discretion to the Atomic Energy Commission by using these words ". . . the Commission may establish a lesser amount on the basis of criteria set forth in writing, which it may revise from time to time, taking into consideration such factors as the following:

   (1) the cost and terms of private insurance
   (2) the type, size and location of the licensed activity and other factors pertaining to the hazard
   (3) the nature and purpose of the licensed activity: . . ."

   Admittedly, as soon as the Price-Anderson Law became effective, the Atomic Energy Commission had to move fast in order to bring existing operators under the indemnity. To their credit, they published temporary regulations on financial protection within eight days, and in order to accomplish this they used a formula for amount of financial protection which consisted of a straight line and a minimum.

   By rule of thumb, an electrical kilowatt is about equivalent to four thermal kilowatts. Because the efficiency of installations varies, and because some of them are not used to produce electricity, it is easier to work with thermal kilowatts. Therefore, the Commission said that a reactor of 400,000 thermal kilowatts capacity must carry the announced maximum liability insurance capacity of $60,000,000. They then divided 400,000 into $60,000,-000 and obtained a figure of $150 financial protection per kilowatt. On this straight line they imposed a minimum amount of financial protection of $250,000.

Bearing in mind that the bulk of reactors now in operation in private hands are critical assemblies or research reactors with power levels below 1,000 thermal killowatts, the insurance industry found itself sitting with a capacity of $60,000,000 and the prospect that most of its immediate customers in the reactor field would need about as much insurance as many people carry on their automobile. To describe this as a blow is a restrained understatement. Had it not been for the commitment made to Congress with regard to the big reactors of the future and the liability insurance needs of concerns in the nuclear field who do not come under government indemnity, NELIA and MAELU might have accepted the fact that they were being driven out of business by administrative order and folded up then and there. At this writing, the limits carried by reactor operators are generally low, while some fuel fabricators have bought very high limits.

The Atomic Energy Commission has continued its study of the formula for amount of financial protection, looking towards the promulgation of a definitive regulation to replace the temporary regulation of September 10, 1957. The pools hope and have urged that the amounts of financial protection will be set at more realistic levels in the definitive regulation in order that private enterprise may occupy its rightful place in this program.

In all of this the Commission's task has been lightened by the enactment of Public Law 85-744, effective Angust 23, 1958. This is an amendment to the Price-Anderson Law in which nonprofit educational institutions are excused from the obligation to meet a financial protection requirement. Instead, government indemnity comes in for all public liability in excess of $250,000 and the educational institutions are left to decide for themselves how they will deal with liability below that point. The Commission is thus relieved of the need to find a solution to the problem caused by the fact that some of these educational institutions have statutory immunity from liability. In cases where this immunity cannot be waived the institutions have no right to assume liability or to purchase liability insurance so that they cannot meet the requirements of financial protection.

The last sentence in this famous Section 170B says that "financial protection may include private insurance, private contractual indemnities, self-insurance, other proof of financial responsibility, or a combination of such measures." Thus, nuclear industry has a variety of choices of means of meeting financial protection. However, up to this writing no concern has elected to do this by any means other than the purchase of a policy from NELIA or MAELU.

5. The last part of the original Price-Anderson Law I will mention here is the provision in Section 170C, which makes the $500,000,000 of government indemnity apply to "each nuclear incident." As will be seen later on, NELIA and MAELU policies are all on an aggregate limit basis and none of them contain provision for automatic reinstatement of the aggregate. This approach is necessary because of the indefiniteness of the words "accident" and "incident." If either of them were to be employed as a basis for application of limits in this new field, it is safe to say that no one would be very sure where the insurance started or stopped.

   The enactment of a government indemnity law on a per incident basis which is to apply as excess over insurance policies written on an aggregate basis has resulted in some mechanical complexities in matching the two. It is the considered opinion of the pools, however, that while it would be desirable for the law to be more specific on the point, the existing language and the legislative intent permit the Commission indemnity agreements to be drawn in such a way that no gap will appear in the protection to the public and to industry.

6. The introduction to this paper referred to indemnity for the "N. S. Savannah." Perhaps a little more detail about it is justified here. Public Law 85-602, effective August 8, 1959, amended the Price-Anderson Law to make reference to the "Savannah" by name. It is reasonable to assume that provision will be made for other nuclear merchant ships at a later date. The "Savannah" is scheduled for completion early in 1960, and when she goes into operation she will carry the $500,000,000 of government indemnity with her. As in the case of a land based private reactor, the indemnity will be over and above a yet to be established amount of required "financial protection." NELIA has tentatively offered a capacity of $10,000,000 but the combined capacity of NELIA and MAELU has not been established. A notable difference in the "Savannah" indemnity, which will need to be matched in the insurance, is that it covers nuclear incidents worldwide rather than in the United States, its territories, possessions, the Canal Zone and Puerto Rico, as is the case with land based reactors.

Policy Forms

At long last I can get down to the subjects of insurance coverage and rates, which is where I have wanted to be all along. However, I was unable to satisfy myself that a discussion of either one would make much sense in the absence of the preceding background material on the nuclear liability insurance pools and the law. Turning to coverage, it is necessary before examining the pool policies to see what had to be done to normal liability policies in the way of an exclusion in order to make the pool policies work.

Nuclear Energy Liability Exclusion Endorsement—Broad Form

On March 1, 1958, companies began attaching the broad form nuclear energy exclusion to all liability policies of business risks. A shorter endorsement consisting of the first section of the broad form endorsement was used on family automobile, comprehensive personal and related forms beginning June 1, 1958. These endorsements are most certainly used by the companies belonging to NELIA and MAERP because otherwise they would be doubling up through the pools on their commitments to nuclear risks. It is almost equally certain that the same endorsements are being used by non-pool members, because the reinsurance market faces this same doubling up problem and began inserting the exclusion in all the treaties as soon as the primary market acted. Thus, any company not employing the exclusion endorsement is likely to be operating without benefit of reinsurance.

Policies outstanding at this writing carry the original version of the exclusion endorsement. However, that is not discussed here because a clarified and somewhat liberalized revision of the exclusion is about to be filed with the states.

Because of the presently limited volume of pool coverage, a relatively small number of people have direct contact with pool policies. However, everyone in the liability insurance business who has occasion to discuss coverage is going to be exposed to the exclusion endorsement for regular liability policies. Therefore, its provisions are included here in full along with comments on their intent.

The objectives of the broad form exclusion endorsement may be broadly stated in eight points as follows:

1. To prevent overlap or doubling up in coverage between the pool contracts and normal liability insurance policies. This is necessary because of the unusual commitments of capacity made by pool members. Even if the members had been willing to face this, which they were not, the action would have been necessary to protect the reinsurance markets which would have been far more heavily exposed to double coverage.
2. For reasons similar to those in paragraph 1, it was necessary to take away any overlaps between regular liability policies and government indemnity, and between these policies and "financial protection" furnished by a reactor operator in the form of a medium such as self-insurance. Without such an exclusion it would be possible in the event of a major loss for the

insurance policies of a large number of suppliers to become involved.

3. To take away first aid and medical payments coverages in connection with losses arising out of the operation of a nuclear facility as defined. In their normal use these coverages are not dependent upon liability, and in the case of first aid there is no monetary limit on the amount of coverage. In a catastrophe situation it is conceivable that all liability policies in the area could be drawn in for very large sums of money.
4. To deny coverage in any event on:
   (a) Nuclear facilities as defined.
   (b) The possession or handling of spent fuel and high hazard waste materials.
   (c) Foreign coverage outside the United States and Canada.
   (d) Liability for damage to a nuclear facility itself arising out of a loss emanating from that facility.
5. To retain coverage in normal liability policies for exposures arising out of source material (a defined term) including the disposal of waste source material.
6. To retain coverage for the possession of and disposal of special nuclear material (another defined term) but not the processing of such material unless it is only done in very small amounts.
7. To retain coverage for the entire so-called commercial isotope hazard, including the disposal of these isotopes when they become waste.
8. To continue to give product liability insurance to suppliers in the nuclear field when the circumstances are such that they have neither picked up pool insurance, nor government indemnity, nor protection through self-insured financial protection.

There follows an examination in some detail of how the exclusion endorsement accomplishes these objectives. The endorsement is rather long and it should be pointed out that it could have been much shorter had it not been designed to leave in the regular liability policies the coverages described in Items 5 through 8 above.

The opening of the endorsement reads:

"It is agreed that the policy does not apply:

I. Under any Liability Coverage, to injury, sickness, disease, death or destruction

(a) with respect to which an insured under the policy is also an insured under a nuclear energy liability policy issued by Nuclear Energy Liability Insurance Association, Mutual Atomic Energy Liability Underwriters or Nuclear Insurance Association of Canada, or would be an insured under any such policy but for its termination upon exhaustion of its limit of liability; or"

This is perhaps the most important single paragraph in the exclusion. Note that it says that the policy involved does not apply if an insured has picked up insurance in NELIA, MAELU, or the Nuclear Insurance Association of Canada (NIAC). Many members of NELIA and MAELU have also become members of NIAC in the last year, so it is necessary to prevent overlap with the Canadian pool as well as with the U. S. pools.

Bear in mind that pool facility form policies carry complete omnibus insured clauses so that this exclusion paragraph is not limited to those people who have actually purchased pool insurance themselves. More often than not regular liability insureds will have picked up pool coverage indirectly through a pool policy purchased by someone else.

Sub-paragraph (b) of this section of the endorsement reads:

"(b) resulting from the hazardous properties of nuclear material and with respect to which (1) any person or organization is required to maintain financial protection pursuant to the Atomic Energy Act of 1954, or any law amendatory thereof, or (2) the insured is, or had this policy not been issued would be, entitled to indemnity from the United States of America, or any agency thereof, under any agreement entered into by the United States of America, or any agency thereof, with any person or organization."

The portion of the above language down to the number (2) deals with the situation where an operator required to provide financial protection under the Price-Anderson Law elects to do so by a means other than pool insurance, such as self-insurance. Financial protection so provided must give the same omnibus protection to suppliers and the like that pool policies give.

The last clause numbered (2) makes the exclusion operate when an insured has access to government indemnity for the same loss. This exclusion is of particular importance in connection with suppliers to contractors who operate government installations, such as the Oak Ridge National Laboratory in Tennessee or the Hanford Ordnance Works in Washington. A program is now under way to bring government installations under Price-Anderson indemnity without the use of underlying financial protection. In these situations sub-paragraph (a) is inoperative and if sub-paragraph (b) were not present the product liability insurance of all suppliers to these installations would be in force in direct competition with government indemnity and with potential exposure to maximum losses.

The language of the endorsement continues:

"II. Under any Medical Payments Coverage, or under any Supplementary Payments provision relating to immediate medical or surgical relief, to expenses incurred with respect to bodily injury, sickness, disease or death resulting from the hazardous properties of nuclear material and arising out of the operation of a nuclear facility by any person or organization."

This is the exclusion for medical payments and first aid running to losses from nuclear facilities. It requires no further comment than was made under Item 3 of the objectives of the endorsement already stated.

The next paragraph which is III is important because it lays down the conditions under which there is a flat denial of liability insurance in the policy to which it is attached regardless of the presence or absence of pool insurance or government indemnity. To be fully understood, it needs to be carefully read in conjunction with the definitions in Paragraph IV. Therefore, the entire balance of the endorsement is quoted immediately below:

"III. Under any Liability Coverage, to injury, sickness, disease, death or destruction resulting from the hazardous properties of nuclear material, if

(a) the nuclear material (1) is at any nuclear facility owned by, or operated by or on behalf of, an insured or (2) has been discharged or dispersed therefrom;

(b) the nuclear material is contained in spent fuel or waste at any time possessed, handled, used, processed, stored, transported or disposed of by or on behalf of an insured; or

(c) the injury, sickness, disease, death or destruction arises out of the furnishing by an insured of services, materials, parts or equipment in connection with the planning, construction, maintenance, operation or use of any nuclear facility, but if such facility is located within the United States of America, its territories or possessions or Canada, this exclusion (c) applies only to injury to or destruction of property at such nuclear facility.

"IV. As used in this endorsement:

'*hazardous properties*' include radioactive, toxic or explosive properties;

'*nuclear material*' means source material, special nuclear material or byproduct material;

'*source material*', '*special nuclear material*', and '*byproduct material*' have the meanings given them in the Atomic Energy Act of 1954 or in any law amendatory thereof;

'*spent fuel*' means any fuel element or fuel component, solid or liquid, which has been used or exposed to radiation in a nuclear reactor;

'waste' means any waste material (1) containing byproduct material and (2) resulting from the operation by any person or organization of any nuclear facility included within the definition of nuclear facility under paragraph (a) or (b) thereof;

'nuclear facility' means

(a) any nuclear reactor,

(b) any equipment or device designed or used for (1) separating the isotopes of uranium or plutonium, (2) processing or utilizing spent fuel, or (3) handling, processing or packaging waste,

(c) any equipment or device used for the processing, fabricating or alloying of special nuclear material if at any time the total amount of such material in the custody of the insured at the premises where such equipment or device is located consists of or contains more than 25 grams of plutonium or uranium 233 or any combination thereof, or more than 250 grams of uranium 235;

(d) any structure, basin, excavation, premises or place prepared or used for the storage or disposal of waste,

and includes the site on which any of the foregoing is located, all operations conducted on such site and all premises used for such operations;

'nuclear reactor' means any apparatus designed or used to sustain nuclear fission in a self-supporting chain reaction or to contain a critical mass of fissionable material;

With respect to injury to or destruction of property, the word *'injury'* or *'destruction'* includes all forms of radioactive contamination of property."

The short preamble of III contains no less than four defined terms. These are—"injury", "destruction", "hazardous properties" and "nuclear material". Unless you prefer to get lost, form the habit now of checking the definitions at every step.

Note that paragraph (a) repeats the defined term "nuclear material" and uses the defined term "nuclear facility". The definition of nuclear facility is particularly important here because sub-paragraphs (a) and (b) of this Paragraph III describe the risks which the membership of NELIA and MAELU have agreed to insure mandatorily in the pools. They will no longer write this business for their own account. Sub-paragraph (a) of III runs to the hazard of nuclear material in connection with the operation of a nuclear facility. In passing, I am not unaware that some of the language in the definitions is not wholly clear on a first reading. I will try to unravel it as I come to it, and hope that this may help to bring home the great significance of this part of the endorsement.

The defined terms in sub-paragraph (b) of III are "nuclear material", "spent fuel" and "waste". Again, watch the definitions to see what the endorsement is talking about, and note that this paragraph operates as a complete denial on any risk having to do with spent fuel or waste as defined.

Sub-paragraphs (a) and (b) of III have the effect, courtesy of the definitions, of retaining coverage for a number of operations while denying on others. Sub-paragraph (c) works in somewhat the same way in that it starts out as a flat denial of not only the operation of nuclear facilities, but also of product liability of suppliers in the broad sense of that word. It is not until near the end that one realizes that this is the exclusion of foreign operations and of damage to a facility itself.

Later on it will be seen that the policies issued by the pools themselves have this same denial of damage to the facility and a word or two here concerning the rationale behind this particular exclusion is appropriate. This paper says little about the pools formed by the property insurers to cover nuclear installations on an all risk basis, including contamination and other nuclear hazards. Nevertheless, it is assumed that the reader knows these pools exist, and that they have underwriting capacity even larger than that of the liability pools. The liability pools were formed to protect the public. In the presence of large direct damage capacity it is a fundamental principle of NELIA and MAELU that when a supplier or other "outsider" is liable for a nuclear loss at a facility, the capacity of the liability pools must not be used up in paying for the damage to the facility. Coming back to regular liability policies which are being dealt with here, NELIA and MAELU would have been unable to assemble large capacity if they had allowed coverage for damage to the facility to remain in such policies and thereby created for the membership and the reinsurers an area of doubling up with pool commitments.

Turning now to the definitions in Paragraph IV, the answers to a number of questions should appear.

"Hazardous properties" requires no comment.

"Nuclear material" should be taken together with the definitions of *"source material"*, *"special nuclear material"* and *"byproduct material"* immediately following. It may well be asked why these definitions are disposed of so abruptly by a reference to the Atomic Energy Act of 1954. There are two reasons for this. One is that the Act definitions are rather long and in technical terms. The other is that the Atomic Energy Commission has the right to alter these definitions by regulation, and if the insurance industry had attempted to use precise definitions they would not have been sufficiently flexible. For practical purposes, it is probably sufficient to say that *"source material"* is unenriched uranium or thorium and their ores. There is a

coverage point here. You will not find any language in the endorsement that excludes the possession, processing, etc. of source material as such. This means that regular liability policies continue to cover the entire segment of industry that is concerned with the mining and refining of uranium up to the point where it goes to plants, now only operated by the government, which enrich the material in the naturally fissionable isotope uranium 235 and thereby make it "special nuclear material". This coverage in regular liability policies also reaches out to the disposal of waste source material.

A similar coverage situation exists for thorium which at present is not used as extensively by the nuclear industry as uranium, but which has considerable use elsewhere. Small percentages of thorium are often alloyed with magnesium to improve the properties of that metal, and use of these alloys plus the disposal of their wastes is covered by the regular liability policies.

"Special nuclear material" somewhat simplified is uranium enriched in the isotopes 233 or 235 and plutonium. There is a coverage point here, too, and for discussion of it see the comments below on the definition of "nuclear facility".

"Byproduct material" is broadly defined in the Atomic Energy Act and includes both those useful isotopes which are employed in research, medicine and industry and also those which are nuclear waste. The insurance industry narrows the term in order to retain the so-called commercial isotope hazard in normal liability policies. The way in which this is done is discussed under the definition of "waste".

The definition of *"spent fuel"* is reasonably clear in itself, but a few comments may be useful. New (i.e. unused) fuel elements for reactors are made in a great variety of shapes and sizes. The fissionable material in them is typically natural or enriched uranium in metallic or oxide form and clad in various ways with other metals, such as aluminum or zirconium. As nuclear materials go, these fuel elements are not very dangerous. The greatest hazard is that enough of them might be brought together to form a critical mass and start a chain reaction where one was not intended to occur. The fact that a moderator, such as water, must also be present makes this fairly difficult to do by accident provided sensible precautions are taken.

However, after a fuel element has been in a reactor and subjected to neutron bombardment for a period of time it becomes a very different animal. A portion of the uranium has broken down and formed some plutonium which is highly toxic. Also, a variety of unhappy isotopes have been created of which the most famous is strontium 90. The whole element is now highly radioactive and emits gamma rays which are comparable to X-rays. Where new elements can be transported in any reasonable container that will protect them and keep them from getting close enough together to form a critical mass, spent elements can only be transported safely in heavy lead caskets. It is the desire of the insurance industry that any risks having to do with exposures to spent elements be insured only in the liability pools.

The definition of *"waste"* must be looked at in parts. The words "means any waste material" convey the meaning that in the first place this must be material which is intended to be disposed of, and not put to useful purpose. The words "containing byproduct material" are very significant and limiting in their effect. By including them the endorsement says that "source material" or "special nuclear material" which is to be disposed of and which is not in combination with byproduct material is not "waste". The reference in (2) to a nuclear facility has the effect of saying that even though something which is disposed of contains byproduct material it is not "waste" unless it comes from a nuclear facility as defined. The significance of this is that here is the spot where the endorsement leaves coverage in regular liability policies for the disposal of so-called commercial isotopes which have outlived their usefulness.

The definition of *"nuclear facility"* must also be taken in its individual parts and, as stated earlier, is important because it describes those installations and operations to which the flat exclusion of Paragraph III (a) of the endorsement applies.

The reference to "nuclear reactor" is clear enough, particularly when taken with the fact that this term itself is defined later in the endorsement.

The reference in (b) (1) to "separating the isotopes of uranium or plutonium" is talking about a gaseous diffusion plant. No such plant yet exists in private hands.

The reference to processing spent fuel in (2) is to a chemical separation plant. Again this is an operation not yet undertaken by private industry.

The reference to utilizing spent fuel in (2) does have immediate bearing. In the comments above on "spent fuel" it was pointed out that a used fuel element is a heavy gamma emitter. Gamma radiation is used by industry in various ways and a spent fuel element is a cheaper source than, for example, irradiated cobalt or a big X-ray machine. As a result a number of laboratories have been set up to employ usefully the gamma radiation from spent elements under closely controlled conditions. Because of the extreme toxicity of the material in a spent element, any break in the metal cladding could be very dangerous. For that reason these laboratories have been classified as "nuclear facilities" while coverage for laboratories using cobalt sources or X-ray machines is left in the regular liability policies.

The language in (3) simply says that anyone having to do with "waste" as defined in the endorsement is operating a "nuclear facility."

Sub-paragraph (c) of this definition is dealing primarily with the fabricators of new fuel elements for reactors. It is the intention that people actually engaged in this business shall be classified as "nuclear facilities". However, unless so-called "clean cold" special nuclear material is present in quantity, the nuclear hazard is relatively low. Therefore the definition says that unless the weights of the specified elements exceed the amounts stated, a concern working with them is not a "nuclear facility". The weights were selected as being well below the quantities required for a critical mass regardless of the degree of enrichment.

Sub-paragraph (d) of the definition requires little comment. It says simply that the place of disposal of high hazard material defined as "waste" is in itself a nuclear facility and must take pool coverage.

The definition of *"nuclear reactor"* has been mentioned before and is self-explanatory.

The definitions of *"injury"* and *"destruction"* were introduced because the reinsurers were not wholly satisfied with the terms used by the American primary insurers and desired this clarifying statement.

Nuclear Energy Liability Policy—Facility Form (2-1-57 edition, 2nd revision)

The natural step from the exclusion endorsement for regular liability policies is to the contracts used by NELIA and MAELU. There are two of these documents and both are well supplied with lengthy and complex verbiage. No effort is made here to examine all of their terms, as was done with the exclusion endorsement. This seemingly lazy approach gets support from two directions. First, any real analysis of the pool policy forms would stretch an already long paper beyond reader endurance, and second, it is by no means certain that such an analysis would serve a useful purpose. Nuclear industry receives much public attention, but, so far as actual operations go, it is still in the research and development stage. While everyone is exposed to the exclusion endorsement, only a relative few have to wrestle with the details of pool policies. It is enough to look at the major provisions and see why the drafters found them necessary.

The Facility Form is the basic contract used to insure those installations which the exclusion endorsement calls "nuclear facilities", and also the installations which are not mandatory pool risks, but which come in because they cannot find all the market they want in an individual company. This is also the policy that is broad enough to furnish the "financial protection" required of indemnified licensees by the Price-Anderson Law. For a facility operator the coverage of this policy is mostly premises-operations liability and transportation liability. For a typical supplier the primary exposures insured are product or completed operations liability and transportation liability. The word "transportation" is used because this policy does not draw the usual distinctions between automobile, rail, marine and air transport, but blankets them all.

The facility policy is issued by the primary writing members of NELIA as a group and by the 6 underwriting members of MAERP who make up MAELU. It is never issued by one company, and the obligation assumed by each signatory company is "several", not "joint". That is, a signing member is responsible only for its percentage of the policy limit as shown in the list of participations attached to the policy. It would have been impossible to accumulate large capacity on a joint basis.

The policy only insures against bodily injury and property damage caused by the nuclear energy hazard and leaves all other liability exposures to be insured by the individual carriers in the normal way. This limitation serves several practical purposes. For the facility operator who buys it, it causes a minimum disruption of his normal insurance or self-insurance program. The presence of an omnibus clause means that a single facility policy can cover literally thousands of interests and if it were to reach into their insurance beyond the nuclear energy hazard, chaos would result. Lastly, government indemnity and the requirement of "financial protection" run only to the nuclear energy hazard so that a policy which failed to match this would be unsuitable.

The unusual concepts of Price-Anderson relating to off-site property and employee exposures of a "person liable" are incorporated in the policy by three different devices.

The property problem is met by in effect deeming the off-site property to be property of another and therefore something for which a liability would exist.

The policy cannot provide workmen's compensation insurance because some statutes do not permit this liability to be limited or subdivided. Therefore, the desired objective is reached by handing a contractual subrogation right to the regular workmen's compensation carrier as to off-site employees. The last loophole is buttoned up by deeming a self-insurer to be a workmen's compensation carrier.

Off-site employers' liability is met by direct insurance in the facility policy, and this insurance is made primary ahead of other applicable insurance. This latter is to protect Coverage B of any standard workmen's compensation policy that may be outstanding on the same employees. Incidentally, don't look for this employers' liability coverage in the insuring agreements of the facility policy because it turns up as an exception to an exclusion and as a proviso clause in the "Other Insurance" condition.

The "Definition of Insured" is the broadest ever written. With the single exception of the United States, it covers the legal responsibility of anyone in connection with the facility. Although the United States is left out of this omnibus clause the policy nevertheless gives the Government a great deal of indirect insurance. All nuclear fuel belongs to the Government, and users of it must hold the United States harmless. This contractual obligation is covered without additional charge, and in addition the policy contains a waiver of subrogation against the United States.

When handling limits in ranges up to $60,000,000 liability underwriters feel a certain fear (equals polite term for stark terror) about any situation where the limits could double up or overlap. You will find protections against this sprinkled liberally throughout the facility policy, and the most intricate example lies in the Supplier's and Transporter's Form which is discussed later. There are two major illustrations worth recording here. Pool policies give continuous coverage and contain no expiration date. They are terminated only by cancelation or exhaustion of limit. They contain no per accident (or in nuclear language "per incident") limit, but only a policy aggregate limit which is impaired by every loss. There is no provision for automatic reinstatement, but the pools will arrange for negotiated reinstatement of the limit if investigation of a loss does not disclose an uninsurable condition.

Since the beginning of the liability business companies have insured against "accident", but they have never succeeded in precisely defining the term. Courts have tackled the job from time to time with varying results, so that situations have inevitably arisen in which insurers intended that a limit apply only once, but courts have found two or more accidents.

The term "incident" is no more susceptible to definition than "accident", and in fact some nuclear exposures can be so sneaky that they compound the difficulty. To have issued pool policies on an incident basis would have been an invitation to doubling up of limits, and the firm intention to avoid this is the prime reason for the employment of a single policy aggregate for bodily injury and property damage combined.

While on the subject of limits it should be pointed out that there is a difference in the handling of loss adjustment expense between pool policies and normal liability policies. In ratemaking allocated claim has been included with losses for many years and more recently it has been joined by unallocated claim. However, neither one was part of a policy limit until NELIA and MAELU came along and put them in. This was an unusual step, but the pools really had little choice.

Radiation injuries can be very slow in manifesting themselves and if potential genetic effects are to be considered the time could be measured in generations. If damaging but relatively mild overexposures were to take place, the whole thing could turn into an adjusters' nightmare. Records will be destroyed or difficult to unearth. Witnesses will have forgotten about events or have moved away or died. There will be conflicts of medical testimony because radiation can cause ordinary diseases of life. In short, a new body of case law may have to be created at great cost.

In this situation the pools said in effect that they would offer unprecedented capacity, but that since they were unable to command the services of a Cassandra who could tell them how this capacity should be divided between actual losses and loss adjustment expense, they would put everything in a single fund. This approach also made sense to Congress, and in the last weeks before the Price-Anderson Bill was passed it was amended to include loss adjustment expense within the $500,000,000 of government indemnity rather than leave it as an additional cost to be paid.

The second illustration of a double limits problem appears in the coverage for transportation. If each facility policy insured the transport of nuclear material without restriction, there would be double coverage every time such material moved from one facility to another. To cure this the pools adopted an initial premise that the only policy which would cover would be the one issued to the facility that the material was moving *away from*. This did not fit all situations and various refinements were tried out. For the purpose here there doesn't seem to be much profit in tracing the history of each version so only the current one is dealt with.

The thing works this way:

1. The policy form itself is drafted for a nuclear facility such as a fuel fabricator which does not qualify for government indemnity and therefore does not furnish proof of "financial protection" to obtain its license.
2. The actual language is tricky to follow, but the effect of it is to:
   (a) Cover transportation "from" the facility insured unless the material is going "to" a facility required to furnish "financial protection".
   (b) Not cover transportation "to" the facility insured unless the material is coming "from" a facility which is owned by the United States.

   The above looks like rather narrow transportation insurance, but very broad cover is given to facilities furnishing "financial protection", and bear in mind the omnibus clause that covers everyone in sight. Thus the protection a facility operator lacks on his own policy is picked up from the policy of another.
3. When a policy is issued to a facility furnishing "financial protection" it will be endorsed to enlarge the transportation cover and thus match the way the indemnity will run. When so revised the policy will cover transport both "from" and "to" the facility with the single exception that a shipment travelling from one indemnified facility to another indemnified facility is insured only by the policy of the facility it is going "from" in order to prevent overlap.

There is little reason for pride in the clarity of these three numbered statements, and the explanation is incomplete without the following illustrations.

1. An unindemnified facility receiving a shipment from:
   (a) A government location has protection from its own policy and in some cases from the indemnity.

(b) A non-profit educational institution has protection from the indemnity in excess of $250,000 and is otherwise dependent on any insurance the educational institution elects to buy.

Note: See earlier reference to 1958 Price-Anderson amendment excusing non-profit educational institutions from "financial protection".

(c) A facility furnishing "financial protection" has protection from the policy of that facility and from the indemnity.

(d) Another unindemnified facility has protection from the policy of that facility.

2. An unindemnified facility making a shipment to:
   (a) Is the same as 1.(a).
   (b) A non-profit educational institution has protection from its own policy and from the indemnity.
   (c) Is the same as 1.(c).
   (d) Another unindemnified facility has protection from its own policy.
3. A facility furnishing "financial protection" and receiving a shipment from:
   (a) A government location has protection from its own policy and from the indemnity.
   (b) A non-profit educational institution has protection from its own policy and from the indemnity.
   (c) Another facility furnishing "financial protection" has protection from the policy of that facility and from the indemnity.
   (d) An unindemnified facility has protection from its own policy and from the indemnity.
4. A facility furnishing "financial protection" and making a shipment to:
   (a) Is the same as 3.(a).
   (b) Is the same as 3.(b).
   (c) Another facility furnishing "financial protection" has protection from its own policy and from the indemnity.
   (d) Is the same as 3.(d).

So much for transportation coverage, and so much for grants of coverage in general, except to point out that the discovery period for losses is unlimited so long as one of these continuous policies remains in effect and then runs for two years after cancellation.

The exclusions are important and there are eight of them. However, two can be disposed of on the ground that they are designed to prevent overlap between a pool policy and a workmen's compensation policy. The six one could say are "for real" are:

> A partial exclusion of contractual liability. The policy covers contractual provided it runs only to liability imposed by law on the indemnitee. The part excluded may be "bought back" on a specified contract basis.
>
> An exclusion of the manufacture of nuclear weapons and a war risk exclusion.
>
> An exclusion (with a minor exception on vehicles) of damage to any property at the site of the nuclear facility.
>
> An exclusion of damage to nuclear material at the site or in the course of transportation to or from the site.
>
> A typical property exclusion running to failure to try to preserve property after a loss and tied down to the hermaphroditic coverage the policy gives for damage to off-site property of a person liable.

There are some nineteen conditions in the policy containing thousands of words that have a bearing on the contract. While it cannot be said that they should not be studied, there is not space to examine them all here. Attention is called to two of them.

Read Condition 3. "Limit of Liability" to find the language that brings loss adjustment expense into the policy limit. Note also that it subjects the policy to a single aggregate limit for its entire term and terminates the policy when the limit is exhausted.

Condition 4. "Limitation of Liability; Common Occurrence" is a special case because it bears on the familiar problem of duplication of limits. There are two general types of situations where the pools foresee the possibility of two or more facility policies becoming hopelessly entangled with each other.

One of these is where a single transport agency such as a freight train is carrying loads from several facilities at the same time. If a loss should take place there might be no way to identify which load started the trouble and all of the facility policies could be held to cover. Condition 4. says that when this happens the liability is the sum of the limits of the applicable policies. However, it goes on to impose an additional limitation to the effect that the total commitment on the loss shall not exceed pool capacity in any event (i.e. $46,500,000 for NELIA and $13,500,000 for MAELU).

An example of the other set of conditions with similar potential would be where contaminants were discharged over a period of time by several facilities into the same stream or watershed. If the contamination were identified many miles downstream, the source of the excess probably could not be traced. In that event Condition 4. again applies and the policy limits are added together, subject to an overall limit of pool capacity.

Nuclear Energy Liability Policy—Supplier's and Transporter's Form Edition—5-1-57

This form is also issued by NELIA and MAELU and is an outgrowth of the Facility Form just discussed. Shortly after the pools commenced operation it became apparent that there was going to be a demand for this kind of a policy. Some builders of reactors and both major and minor suppliers of nuclear equipment have a good deal more assets at risk than do certain of their customers. In the case of reactors and critical assemblies these suppliers have little to fear. They have access through the omnibus clause on the facility policy to the pool insurance purchased by the reactor operator and when the limits of that policy are exhausted they also have access to government indemnity. However, when they are supplying materials or services to risks such as fuel fabricators which do not come under government indemnity, they become dependent on the limits purchased by the facility operator. Since some suppliers normally carry liability insurance limits in the range of ten to twenty million dollars, and a facility operator, if he so wishes, may buy a limit as low as $250,000, the suppliers came to the pools and said that they wanted a means of keeping their own liability insurance limits at their customary levels. The Supplier's and Transporter's Form is designed to do this.

In many respects it follows the language of the Facility Form, but it also has some important differences. It is only these differences that need to be covered here.

Where the definition of insured in the Facility Form includes the complete omnibus clause previously described, this policy is a typical single interest contract. "Single Interest" is a loose term because in addition to the named insured the policy also covers such people as executive officers, employees, directors or stockholders, while acting within the scope of their duties as such. Further, it can be extended by endorsement to pick up other interests reasonably related to the named insured, provided, they are specifically named. At the same time it is impossible for the pools to go so far as to insure additional interests in such broad terminology as for example "subsidiaries and affiliates." This kind of language could sweep in a tremendous variety of concerns and there would be no means of knowing the extent to which all of these were involved in the nuclear industry or the number of supplier's and transporter's policies that might be covering a particular concern.

The pools consider facility insurance policies as primary insurance. That is where they intend to provide coverage in the first instance, and consequently every supplier's and transporter's policy is drawn as excess insurance over and above coverage available on any applicable facility policy.

Under the facility policy some space was devoted to discussion of the peculiar provisions which treat as liability insurance all injuries to off-site employees and damage to off-site property of a "person liable." These provisions were inserted in order to match in with Price-Anderson indemnity and if such indemnity is present no supplier needs this type of coverage. Therefore, the Supplier's and Transporter's Form contains none of it.

In the exclusions section there are a number of departures from the Facility Form. The more important of these are:

It will be recalled that the contractual coverage of the Facility Form is very broad. Actually, if one sets aside the subject of hold harmless agreements in favor of the United States, this does not involve a great deal in the way of assumption of additional liability. With the omnibus insured clause the whole world is on the policy, anyway. When the supplier's and transporter's policy reverted to single interest coverage as described contractual assumptions became very important. If unlimited contractual had been left in the policy any supplier could of his own generosity turn his supplier's and transporter's policy into a pretty good facsimile of a facility policy for every one of his customers.

Therefore, the only contractual that is given automatically in the supplier's and transporter's policy is that which the insured would get on a typical comprehensive general liability policy. The pools are willing to insure other assumptions of liability, but only on an individual agreement or type of agreement basis and for an additional charge.

There is language in some of these exclusions which bears directly on coverage of suppliers to nuclear ships like the "N. S. Savannah," or even the Navy's submarines. It is not discussed here because this paper must have some limitations, and its eyes are closed to the marine and foreign problems.

Unlike the facility policy, the supplier's policy contains an exclusion of losses in the area of government indemnity. The pools assume that the average supplier buys this contract in order to remove any uncertainty about the purchase of insurance by his customers. If conditions are such that a loss comes under the indemnity, this uncertainty is taken care of. However, private insurance has an enviable record over the years of prompt and efficient action and it may be taken as a compliment that people place a value on this. This exclusion is removable for a price so that the supplier's policy can be made to perform regardless of the presence or absence of indemnity and a number of suppliers have elected to buy it this way.

There is a removable exclusion of disposal of nuclear wastes. The pools are willing to insure this type of operation, but they are a little nervous about it and they wish to know definitely each time they take on such a risk.

Lastly, there is an exclusion of any loss for which any form of the "financial protection" required by the Price-Anderson Law is available. This is designed primarily to take care of the situation where a facility operator elects to self-insure his "financial protection." The omnibus provision of self-insured "financial protection" must be just as broad as that of insured "financial protection" and it is not intended that the supplier's and transporter's policy take precedence over self-insured "financial protection."

Our old friend double limits or cumulation of limits is very prominent in the Supplier's and Transporter's Form. If suppliers buy the volume of this insurance which they are showing a tendency to do, it will be possible for a number of policies to become involved in a single loss at a single facility. In the absence of protective language the pool memberships could find themselves committed far beyond their intended maximum participations. The problem is dealt with in Condition 4 of the policy, "Limitation of Liability; Multiple Policies." The adopted language is not particularly long, but it is probably fair to say that before this final form emerged more man hours were devoted to this subject than to any other single part of the nuclear liability insurance program.

Every word of this condition drips with sweat, and it has earned the right to be quoted in full. It reads:

"*Limitation of Liability; Multiple Policies.* With respect to any occurrence or series of occurrences for which insurance is afforded under this policy and for which insurance (a) is afforded to any person or organization whether or not an insured under this policy, under any other nuclear energy liability policy issued by the companies, or (b) would be afforded under any other such policy but for its termination upon exhaustion of its limit of liability:

(1) the total aggregate liability of the companies under all Nuclear Energy Liability Policies (Supplier's and Transporter's Form), including this policy, affording insurance for such occurrence or series of occurrences shall be the sum of the limits of liability of all such policies, the limit of liability of each such policy being as determined by Condition 3 thereof, but in no event shall such total aggregate liability of the companies be greater than the amount by which $46,500,000 exceeds the sum of the limits of liability stated in the declarations of all Nuclear Energy Liability Policies (Facility Form) issued by the companies and affording insurance for such occurrence or series of occurrences, provided each such Nuclear Energy Liability Policy (Facility Form) issued by the companies shall, solely for the purpose of computing the total aggregate liability of the companies, be deemed to be in effect notwithstanding it has terminated upon exhaustion of its limit of liability; and

(2) if in the performance of the companies' obligations with respect to such occurrence or series of occurrences and in payment for expenses incurred in connection with such obligations the total of the payments made by the companies under any

Nuclear Energy Liability Policy or Policies (Supplier's and Transporter's Form) shall exhaust such total aggregate liability of the companies, all liability and obligations of the companies under this policy with respect to such occurrence or series of occurrences shall thereupon terminate and shall be conclusively presumed to have been discharged, whether or not any of such payments have been charged against this policy.

The provisions of this condition shall not operate to increase the limit of the companies' liability under this policy."

If you take the preamble first and strip it of all the nuances in the language it may be said to read: "If two or more policies issued by the same pool insure the same loss the following conditions apply." (Courts take notice. You are not entitled to this stripping operation.) Using this simplified approach and with the same admonition to the courts, the paragraph numbered one may be said to do three things:

(a) The available limits of all supplier's and transporter's policies applicable to the loss are added together.

(b) The total limit produced in (a) may not exceed the amount by which total pool capacity exceeds the sum of the limits in all applicable facility policies issued by the same pool.

(c) For this purpose of figuring limits any applicable facility policy issued by the same pool is deemed to have its original limit still in effect, regardless of whether or not that limit has actually been depleted or exhausted by this or prior losses.

The substance of all this is that neither pool intends to commit itself for more than its total capacity at any one facility regardless of the policies it may have outstanding and applying to that facility.

Examination of the paragraph numbered (2) shows that it does just one thing. Baldly and undiplomatically stated, it can be paraphrased to say, "The mere presence of a supplier's and transporter's policy in your hands is in no sense an unconditional guarantee that you have any insurance." In the event of an actual loss of major proportions, the pools will have no way of knowing which interests claimants will elect to bring their actions against. Therefore, it is impossible for them to make an advance proration of coverage between all policyholders. A conceivable sequence of claims might run like this. The facility operator is the most likely candidate, particularly if so-called strict liability is held to apply. Claimants turn to him until his policy limit is exhausted. The major facility designer or constructor might be next in line, so that a supplier's and transporter's policy held by him would come under fire. Depending upon the fact situation involved a variety of other interests could be attacked and somewhere along the line total pool capacity would be exhausted. All this could happen in such a way that some supplier's and transporter's policies would not pay a single dollar of loss. If subsequent claims were brought against the holders of these policies they just wouldn't have any insurance. At first blush this result may appear inequitable. At the same time it is submitted that in practice it would be impossible to draft a contract in any other manner and still meet the vital requirement that the signatory companies shall not be committed for more than their total capacity at any single facility.

The above brings to a close the subject of coverage offered by NELIA and MAELU. Admittedly, the analysis of the Supplier's and Transporter's Form is, if anything, sketchier than that of the Facility Form. However, an understanding of the points that have been touched on will go a long way toward bringing this new kind of insurance into focus.

Pricing Systems—Ratemaking

No one has contended that the rating of the nuclear energy liability hazard in the present state of the art is not largely a matter of "flying by the seat of your pants." Over the years it has not been uncommon for liability ratemakers to face unusual situations, but it is doubtful if there have been many before where a concrete answer is as elusive as it is here.

All existing experience is on government installations and it is very good indeed. The few losses that have occurred in the United States have usually been instances of accidental criticality, most commonly resulting from operations that are not yet carried on by private industry. A small number of people and some government property have been involved, but no member of the public has ever been injured by radiation or contamination from a major installation. We know about losses in Great Britain and Canada that have been more expensive than anything that has occurred here. In the case of the Windscale loss in England the public was involved in that milk production from cows who ate grass contaminated with radioactive iodine was condemned and the milk disposed of in the ocean. The dollar cost of this has not been published. We are told that something fairly serious happened in a critical assembly at Vinca in Yugoslavia, but that is all we know about it. Whether similar losses can take place in the United States remains to be seen, but experts in reactor safety seem inclined to the belief that somewhere, somehow, we will eventually have an incident.

How do you rate this? The pool committees did some exploration of property insurance where there are existing examples of very high insurable values with small likelihood of loss. Two of these would be the collection of large suspension bridges around New York City and the major ocean liners. It cannot be claimed that anything conclusive was drawn from these analogies.

The pools also gave thought to the well founded principle that an underwriter must get some premium for placing large amounts of assets at risk regardless of the remoteness of the hazard. For this purpose comparisons were made to existing charges for upper layers in the excess insurance market and to the charges which banks make for stand-by loans. In a stand-by loan the money is not actually furnished to the borrower, but a promise is given that when the time comes that the borrower needs the money it will be loaned to him at the going rates for commercial loans. The pools were told that rates for stand-by loans ranged from an absolute prime figure of one-quarter of one percent up to a more common figure of one-half of one percent. In terms of dollars related to sixty million, these rates produce annual charges ranging from $150,000 to $300,000. For comparison, the pools have quoted annual rates for sixty million limits on nuclear facilities ranging from $30,500 a year to $364,000.

When the pools were first formed, all discussion of rating revolved around prices for reactors. Economic power reactors are the prime objective of the nuclear industry and both industry and Congress pressed the insurance carriers for quotations on them. Following the preliminaries described above, the pools then worked out a procedure based on rating a reactor which does not exist and then relating the prices for all other reactors to it. There is a formula involved here, but at this stage it is impossible to refine it enough to produce actual prices in all cases. Therefore, the complete details of it have not been published. However, the elements that go into the formula are public information. A value is established for each reactor and five factors are taken into consideration in setting up each of these values. These factors are:

Type of Reactor. There are various kinds of reactors, such as swimming pools, boiling water, pressurized water, liquid metal cooled, gas cooled, etc. Insurers believe there is a variation in hazard amongst these types.

Use of the Reactor. Reactors are used for various purposes, such as research, materials testing, production of radioactive isotopes and power. There is probably more hazard connected with a reactor which is started up and shut down frequently than with one which is started and then operated more or less continuously. Also, it is likely that there are proportionately more members of the public around research and test reactors than there are around power reactors. For example, the operation of a research reactor in a university is frequently observed by students.

The Power Level of the Reactor. Power level is a pretty fair measure of the amount of damage a reactor could do if it should let go. Since all reactors are not used to produce power this power level is measured in thermal kilowatts, rather than electrical kilowatts.

Location of the Reactor. It is obvious enough that a major reactor incident in the middle of a large desert would not cause the same injury to persons and property that would result from the same failure of a reactor located in or near a population center. Factors now in use are a good deal more refined than this example and it is reasonable to expect that even greater refinements will come with increased knowledge and experience.

The Containment of the Reactor. Every reactor in the licensee program of the Atomic Energy Commission is supposed to be designed in such a way that it will contain what is called the "maximum credible incident." In other words, if there is a serious loss in the reactor it is hoped that there would still not be any release of contamination to surrounding areas. The pictures you see of the power reactors that are now being constructed in various parts of the country always show a dome-like structure as part of the plan. This is the outer reactor shell, or containment, which is intended to withstand any incident that might occur within the reactor. If underwriters find containment is either not present or inadequate in their opinion, this will naturally have an affect on the price quoted.

All of the above is used in establishing the price for the first million of limit. Procedures have been set up so that once that is done the rules take over and the rest of the prices are produced automatically. For additional millions on reactors, and for limits below one million, there are standard gradations as follows:

1st Million	Base
Next 4 "	50% of base each
" 5 "	20 " " "
" 10 "	10 " " "
" 20 "	5 " " "
" 20 "	2.5 " " "

Limits below one million:

750,000	90% of base
500,000	75 " "
250,000	50 " "

The pools have minimum prices per million of insurance so that regardless of the base price they never charge less than $1,000 per million on power reactors and $500 per million on research and test reactors regardless of the layer of limits involved.

For test and research reactors there is a special loading of 50% of the base price which applies only to the first million or fraction thereof. This loading is to recognize the fact that there is a greater likelihood of members of the public being near these reactors or working around them than there would be in the case of power reactors.

The lowest reactor price the pools have quoted is $1,500 for the first million dollars of limit on very small research reactors. On such a reactor the price for all additional millions would be $500 each, because of the 50% loading on the first million. The highest price so far quoted is for a large power reactor, which probably will not go into operation until 1961. That price is $56,000 for the first million with the standard gradation applying. This produces the previously mentioned total figure of $364,000 per year for sixty million of coverage.

Critical assemblies are sometimes referred to as zero power reactors. Usually they consist of a tank-like installation which is used for research and testing of fuel assemblies. The fuel is placed in the critical assembly and a moderator introduced to bring it just to the point of criticality. The reaction is never intentionally carried beyond this point and the hazard of these installations is relatively low. They are rated on the reactor schedule, but the price for the first million is always $2,000. Therefore, the next four million would be at a rate of $1,000 each and all subsequent millions at a rate of $500 each. Sixty million costs $33,500.

One thing the development of the reactor schedule did was to set the flat charge as the pattern for the premium base for nuclear liability insurance. Casualty insurance also uses a variety of other premium bases such as units, payroll, sales, area, etc. which automatically do part of the job of measuring variations in exposure. In the nuclear field the background information is so thin that no way could be found of easing the ratemaking job by incorporating one of these variable premium bases. Thus hazards are measured for each risk on the best available information and a price per million of limit quoted. In the absence of significant interim changes the quotations are refigured annually.

Fuel fabrication operations have a rating schedule of their own. It is a simplified outgrowth of the reactor rating system, which takes into account the location and the amount and kind of special nuclear material used. Prices for the first million range from $1,000 to $5,000 unless the risk is working with plutonium or the 233 isotope of uranium, in which event the prices would be higher. The price for the second million is a varying percentage of the first million price, depending on the presence or absence of powder metallurgy in the operation and all millions above the second are charged for at the rate of $500 each.

Some rather complicated procedures have been used in the rating of supplier's and transporter's policies, and it is perhaps enough to say that many of them have a relationship to either the reactor or fuel fabrication rating systems. It is interesting to note that the concept of charging for prior sales which was in vogue in product liability insurance some years ago has been revived here for some of the major supplier exposures.

Where two or more installations defined as nuclear facilities are found at the same location, they are insured under a single facility policy and share the limits of that policy. In recognition of this, there is a system of discounting the rates for all facilities in excess of one.

There is another discount that applies when a facility is shut down for an extended period of time.

Breakdown of the Premium Dollar

The distribution of the premium dollar is rather simple. 10% is assigned to long term catastrophe reserves and profit. Another 10% is assigned to company expenses and is broken down into 5% for administration plus any claim expense which is not identifiable, and 5% for inspection. Note that the inspection figure is higher than the normal general liability loading of 3.5%. This is because inspections of nuclear energy installations have to be made by specially trained personnel and the number of qualified people is limited. Both the cost of their time and the travel expense incurred are considerably above normal.

Taxes are included at the standard liability figure of 3%.

Acquisition expense is graded by size of risk and the loadings are as follows:

1st	10,000	of	premium	10%
next	15,000	"	"	5
"	75,000	"	"	3
Excess over	100,000	"	"	1

The balance of the premium which ranges from 67% to about 75%, depending on risk size, is held by the pools in special funds for the payment of losses and loss expense. This same loss fund is subject to the application of the long term Industry Credit Rating Plan which is discussed immediately below.

Industry Credit Rating Plan

The great need in the nuclear energy liability insurance pools is to have a means of accumulating reserves against a major catastrophe. If unexpended loss dollars were to be subject to normal income tax, a big bite would be taken out of them and it would be necessary to charge very high premiums in order to salvage any material net amounts for reserves. Therefore, at an early stage pool representatives met several times with the Internal Revenue people. A plan was developed whereby unused loss dollars could be held for ten years in the reserve for retrospective returns to policyholders. This plan works as follows:

As mentioned before, dollars from the loss and loss expense portion of the premium which are not actually paid out are placed in special funds by NELIA and MAELU. These funds are accumulated for the first ten years of operation without any other action being taken.

In the eleventh year of operation a process of gradual return of unexpended funds to policyholders will begin. The method of this return may be stated as follows:

1. From the ten years accumulation of loss dollars deduct actual

incurred losses and loss expense. The balance is the total returnable premium.

2. Determine the accumulated earned premium for the full ten year period.
3. Determine the ratio of earned premium in the first year of operation to the ten year earned premium.
4. Apply the ratio obtained in 3. to the total returnable premium obtained in 1. to obtain the actual dollars returnable to policyholders who contributed to the earned premium in the first year of operation.
5. Distribute the dollars obtained in 4. to policyholders in the first year of operation in proportion that the earned premium of each policyholder bears to the total earned for that year.

There are three things about the plan that are probably obvious enough. First, it is an industry plan and not a risk plan. If a return becomes available for a given year, it is paid both to policyholders who have had losses and those who have not. Second, this is an all credit plan with no provision for additional payments if experience is unfavorable. Third, if the special loss funds of the pools show negative balances after the tenth or any subsequent year, there is no money to give back and no further distribution will be made until such time as the funds again show positive balances.

The plan has been accepted by the Internal Revenue because the money in it can never become the property of the pool memberships. If it is not used to pay losses and loss expense, it ultimately finds its way back to the policyholders.

An exhibit is attached and is marked "Appendix 1". This has been lifted gratefully and with permission from a memorandum written by Harry Williams and Frank Hope of the Hartford Accident and Indemnity Company. Note that it not only illustrates 15 years of pool operation, but it also shows the ultimate "run-off" of the plan if for any reason the pools were to discontinue operation.

The column headings of the exhibit are largely self-explanatory, but a few comments may be useful.

The word "provisional" in Columns (2) and (3) has a specific meaning. It refers to the premiums originally charged by the pools from year to year. The actual or final premiums are considered to be those which apply after ten years have elapsed and any available returns have been made.

Note that the cumulative premiums in Column (3) revolve on a ten year basis. For example, at the end of the eleventh year the provisional premium for the first year is dropped and that for the eleventh year added.

The "returnable premium cumulative" in Column (8) does not revolve, but goes on forever. The positive or negative amounts in Column (7) respectively increase or reduce it, and the amounts in Column (9) reduce it ultimately to zero.

The basic charge ratio of .30 in Column (5) is an assumed average of the expense and catastrophe portions of the premium described earlier in this paper.

While the operation of the Industry Credit Rating Plan as between the pools and their customers is relatively simple, the internal pool accounting is quite the opposite. So far there have been minor changes in company participations for each year of operation and there is no reason to believe that these fluctuations will cease in the future. This could produce some neat problems if incurred losses exceeded the fund balances and assessments became necessary. Another problem to be solved is the one involved in making certain that this rating plan should not operate as an incentive for a company to retire from a pool following the emergence of a heavy loss.

A plan of accounting exists which the writer believes will meet every contingency. No description is offered here because the pools have not adopted it yet.

In closing, it is worth pointing out that while the Industry Credit Rating Plan was conceived as a solution to a tax problem, a secondary benefit has flowed from it. There has been some conversation by people outside the insurance business to the effect that some of the prices quoted by the pools look high. The pools feel strongly that these criticisms are unfair in view of the potential risks involved, but the whole subject is so intangible that it comes down to dealing with conflicting opinions with few concrete facts for either side to point to. The rating plan has the virtue of providing an automatic correction if, after a period of time, it is proven that current rate quotations are too conservative.

APPENDIX 1

(1) Year	(2) Provisional Premium (Annual)	(3) Provisional Premium 10 Year Cumulative	(4) Incurred Loss and Loss Expense	(5) Basic Charge .30 × (2)	(6) Formula Premium (4) + (5)	(7) Premium Available for Future Losses or Return (2) — (6)	(8) Returnable Premium Cumulative	(9) Return Premium (In Year Assigned)
1	$ 1,000,000	$ 1,000,000	$ 100,000	$ 300,000	$ 400,000	$ 600,000	$ 600,000	$ 440,000
2	2,000,000	3,000,000	5,200,000	600,000	5,800,000	— 3,800,000	— 3,200,000	938,560
3	2,000,000	5,000,000	200,000	600,000	800,000	1,200,000	— 2,000,000	None
4	3,000,000	8,000,000	300,000	900,000	1,200,000	1,800,000	— 200,000	129,322
5	3,000,000	11,000,000	300,000	900,000	1,200,000	1,800,000	1,600,000	319,064
6	3,000,000	14,000,000	300,000	900,000	1,200,000	1,800,000	3,400,000	479,249
7	4,000,000	18,000,000	400,000	1,200,000	1,600,000	2,400,000	5,800,000	641,124
8	4,000,000	22,000,000	400,000	1,200,000	1,600,000	2,400,000	8,200,000	644,026
9	5,000,000	27,000,000	500,000	1,500,000	2,000,000	3,000,000	11,200,000	802,038
10	5,000,000	32,000,000	500,000	1,500,000	2,000,000	3,000,000	14,200,000 — 440,000	802,705
11	5,000,000	36,000,000	500,000	1,500,000	2,000,000	3,000,000	16,760,000 — 938,560	800,782
12	5,000,000	39,000,000	20,500,000	1,500,000	22,000,000	—17,000,000	— 1,178,760	800,782
13	5,000,000	42,000,000	500,000	1,500,000	2,000,000	3,000,000	1,821,440 — 129,322	799,982
14	5,000,000	44,000,000	500,000	1,500,000	2,000,000	3,000,000	4,692,118 — 319,064	801,183
15	5,000,000	46,000,000	500,000	1,500,000	2,000,000	3,000,000	7,373,054 — 479,249	801,183
16		43,000,000					6,893,805 — 641,124	
17		39,000,000					6,252,681 — 644,026	
18		35,000,000					5,608,655 — 802,038	
19		30,000,000					4,806,617 — 802,705	
20		25,000,000					4,003,912 — 800,782	
21		20,000,000					3,203,130 — 800,782	
22		15,000,000					2,402,348 — 799,982	
23		10,000,000					1,602,366 — 801,183	
24		5,000,000					801,188 — 801,183	
25		0					—	
	$57,000,000		$30,700,000	$17,100,000	$47,800,000	$ 9,200,000		$9,200,000

SOME FURTHER NOTES ON ESTIMATING ULTIMATE INCURRED LOSSES IN AUTO LIABILITY INSURANCE

BY

FRANK HARWAYNE

In a previous paper I described how auto liability incurred losses emerged in New York State on the average. One of the puzzling notes about that paper may be Equation (4) (see Volume XLV, 1958 *Proceedings* of the Casualty Actuarial Society) :

$$\log_{10} y = 2.0674t^{-.80599}10^{-.248411t}$$

which has the extraordinary virtue of being able to describe how much of the total losses incurred has been paid as of a given time but does not describe the forces which contribute to the total amounts paid.

This paper is concerned with a summarization of the contributory forces which act to produce total loss cost. Those forces are the number of claims paid and the average size of claim payment. A substantial degree of success was achieved in determining the number of claims paid, the corollary seasonal forces and the construction of policy year by definition; somewhat less success was encountered in deriving the average paid claim cost.

With respect to the number of claims paid expressed as a function of time, it was first observed from Exhibit I of Mr. Tapley's paper (Pages 166-198, Volume XLIII, 1956 Proceedings of the Casualty Actuarial Society) that the emergence of number of claims paid tended to become smaller with the passage of time as measured from the time of accident. This suggested

1. that the "easier" claims are settled first and
2. that the number of claims paid during a particular time interval is functionally related to the number of claims outstanding at the beginning of that time interval.

It was also realized that the rate of emergence of countrywide claims for an insurance carrier such as the State Farm Mutual Insurance Company was probably quite different from the rate of emergence of New York claims for stock and mutual carriers in the aggregate.

Fortunately, some limited data for members and subscribers of the National Bureau of Casualty Underwriters and the Mutual Insurance Rating Bureau was available in the form of paid number of claims for policy years 1951 and 1952 reported as of December 31, 1952 and rereported as of March 31, 1953. By relating these number of claims to a later reporting of the incurred number of claims for these policy years a distribution of four values according to approximate time after the average accident was formulated. This distribution is as follows:

Age of Average Accident	*% of Claims Paid*
3.5 months (approx.)	28%
6.5 months (approx.)	45
12.0 months (approx.)	65
15.0 months (approx.)	74

It was found that the foregoing values are reasonably satisfied by a formula for paid increments comprised of 9% of the amount outstanding as of the beginning of each month. Stated differently it was observed that this is a problem in "force of decrement". The solution was found to be

$$N = 1 - e^{-1.08 t_A} \qquad \text{I}$$

where N = the cumulative number of claims paid and

t_A = the time in years measured from the time of accident.

This equation can be more precisely written as

$$N = 1 - e^{-1.08(t_R - t)} \qquad \text{II}$$

where measurement is taken between the time of review t_R and the time of accident t_A.

The accident year data exhibited by the State Farm Mutual Insurance Company is noteworthy for its evidence of seasonal distribution of accidents. There appears to be a relative dearth of claims in the first quarter of the year, a piling up of claims in the last quarter and almost an average distribution of claims in the two middle quarters. A little reflection convinces us that this is not unreasonable. Relatively more driving is done during the months when good weather and holidays prevail than during other months. With more driving there exists a greater exposure to accident.

These observations are reinforced by the record of personal injury accidents reported in New York State. For the year 1955, the distribution of accidents is, approximately:

1955 Quarter	*Personal Injuries*
1	21.08%
2	24.52
3	25.49
4	28.91
Total	100.00%

We are interested in ascertaining whether or not our equation for N fits certain observed values for policy year 1956 private passenger claims paid for members and subscribers of the National Bureau of Casualty Underwriters and the Mutual Insurance Rating Bureau. The number of claims paid during each quarter of 1956 may be expressed as percentages of the total number of claims paid as of December 31, 1956.

Our first step in developing such a comparison was to find a curve which fits the quarterly distribution of personal injuries. Since the distribution of accidents for the first half of the policy year may be expressed as the accident year weighted by the time t, summed up over the time interval, we constructed a polynominal of the following form

$$Y = At^3 + Bt^2 + Ct \qquad \text{III}$$

By factoring out t, which corresponds to the policy year weight, we were left with a second degree equation. The constants for this latter equation were obtained by setting the summation for the first quarter, the fourth quarter and the entire year equal to the respective values in the table of personal injuries. It was found that

$$Y = .48t^3 + .018t^2 + .831t \qquad \text{IV}$$

We are now able to write the general expression for the number of claims paid on accidents incurred to time t of the policy year and observed at time t_R. That expression is:

$$F(t) = \int_0^t (.48t^3 + .018t^2 + .831t)\,[1 - e^{-1.08(t_R - t)}]dt \qquad \text{V}$$

When t lies between 0 and 1 the solution is:

$$\begin{aligned} F(t) &= .12t^4 + .006t^3 + .4155t^2 \\ &\quad - e^{-1.08(t_R - t)}\,[.44444t^3 - 1.21790t^2 + 2.80075\,(1.08t - 1)] \\ &\quad - 2.80075e^{-1.08t_R} \end{aligned} \qquad \text{VI}$$

The foregoing expression gives the percentage of claims paid as of the observed time of review t_R, from the beginning of the policy year to any time through December 31 of that same year. For purposes of comparison a table of derived values is shown below together with the policy year 1956 observed percentage of claims paid at monthly intervals for National Bureau member and subscriber companies, policy year 1956. In both instances the total number of claims paid through December 31 has been used as a base:

Policy Year Comparison of Number of Claims Paid
January through December 31, 1956 = 1.0000

	No. Claims Paid	
January 1, 1956 thru	*Observed*	*Calculated*
January, 1956	.0005	.0006
February, 1956	.0040	.0048
March, 1956	.0138	.0159
April, 1956	.0352	.0372
May, 1956	.0759	.0719
June, 1956	.1247	.1235
July, 1956	.1992	.1953
August, 1956	.2977	.2911
September, 1956	.4177	.4149
October, 1956	.5885	.5496
November, 1956	.7734	.7384
December, 1956	1.0000	1.0000

A comparison of cumulative quarterly totals of policy year 1956 for members and subscribers of the National Bureau of Casualty Underwriters and the Mutual Insurance Rating Bureau is shown below together with the comparable values calculated from the definite integral, equation V:

Members and Subscribers of NBCU and MIRB
Policy Year 1956 Private Passenger Auto Liability Experience
Comparison of Number of Claims Paid
January through December 31, 1956 = 1.0000

	No. Claims Paid	
January 1, 1956	*Observed*	*Calculated*
March, 1956	.016	.0159
June, 1956	.134	.1235
September, 1956	.433	.4149
December, 1956	1.000	1.0000

A comparable expression for the emergence of the number of paid claims resulting from accidents occurring during the second half of the policy period may be derived. That expression is given by the following:

$$G(t) = \int_1^t (2\text{-}t)\ [.48\ (t\text{-}1)^2 + .018\ (t\text{-}1) + .831]\ [1\text{-}e^{-1.08(t_R-t)}]dt \qquad \text{III}$$

Its solution is

$$\begin{aligned} G(t) &= .12t^4 + .634t^3 - 1.58889t^2 + 2.586t \\ &\quad - e^{-1.08(t_R-t)}\ [-.44444t^3 + 2.99568t^2 - 8.48921t + 10.25483] \\ &\quad - 1.5115 + 4.31686e^{-1.08(t_R-1)} \qquad \text{VIII} \end{aligned}$$

By utilizing equations VI and VIII and selecting t_R as March 31 of the appropriate year the theoretical percentage of claims paid may be found.

The observed private passenger figures for members and subscribers of the National Bureau of Casualty Underwriters and the Mutual Insurance Rating Bureau covering policy years 1951 and 1952 are compared with the theoretical values:

Members and Subscribers of NBCU and MIRB
Policy Years 1951 and 1952 Private Passenger Auto Liability Experience

Comparison of Number of Claims Paid
1952 Incurred as of 12 months = 1.00
1951 Incurred as of 24 months = 1.00

		No. of Claims Paid	
Policy Year	*Valued As of*	*Observed*	*Calculated*
1952 (12 Months)	12 Months	28%	26%
1952 (12 Months)	15 Months	45	43
1951 (24 Months)	24 Months	65	62
1951 (24 Months)	27 Months	74	71

Having established that the theoretical equations for expressing the policy year emergence of number of claims paid fits the actual observations, it is now possible to derive the number of claims paid at any time, t_R. An exhibit of such values is shown in Table A. Also, the paid amounts in Exhibit VII of the previous paper is reproduced here as Table B.

By dividing the values in Table A into those contained in Table B for the appropriate period of time we can obtain values for the average paid claim cost expressed as a percentage of the average incurred claim cost. Further, by taking the amounts and the number of claims paid during a particular time interval it becomes possible to express the average paid claim cost during that time interval in relation to the final incurred average claim cost.

SUMMARY

We have seen that there are four main forces at work in the evaluation of total loss cost.

The first results from the familiar definition of the policy year for one year policies. The earned portion of the policy year is proportional to the time during the first 12 months of the policy year and is proportional to one minus the time during the second 12 months. This is equivalent to the parallelogram constructed on a time line which is sometimes used by the rating organizations in computing factors to adjust for rate level changes. It is also equivalent to the proportionate parts of the policy year earned which may be expressed as 1/24, 3/24, 5/24 . . . 23/24, 23/24, 21/24, ... 3/24, 1/24. Excepting as other forces may need to be considered the occurrence of losses should approximate the manner in which premium is earned.

The second force to be considered is the seasonal variation. Seasonal variation may come about in a variety of ways. Weather conditions are one element. Holidays are another and vacation schedules may be a third. Each of these contributing factors has its impact upon the extent of driving done during a particular calendar period. The net effect of these influences becomes evident in the accident records which may be compiled. Mr. Tapley's paper (pages 166-198, Volume XLIII, 1956 Proceedings of the Casualty Actuarial Society) indicates that such seasonal variation exists. A review of records of personal injury accidents in New York State likewise indicates substantial seasonal variation. These latter records indicate that approximately ½ of the annual reported accidents occur between April and September, equally distributed between the two quarters. Only 21% of the actual accidents are reported during the first quarter while 29% are reported during the last quarter of the year. Based upon this information it is possible to construct a second degree equation which represents the seasonal movement of reported accidents. The combination of this second degree equation with the first force representing the construction of the policy year furnishes reasonably close approximations to claims occurrences during the policy year. The combination, however, is best made in two parts, summing up separately for the first 12 months of the policy year and for the second 12 months of the policy year. In doing so it is necessary to use t-1 instead of t for the second half of the policy year.

The third element is the emergence of the number of claims paid expressed as a function of the time t. This is readily achieved by observing that the number of claims paid during the relatively small interval of time is proportional to the number of claims outstanding at the beginning of that time interval. The resulting equation is the natural logarithm base, e, to a power of t, with appropriate constants which express the rate at which claims are being paid. In this connection it is of course interesting to note that t is here measured from the time of occurrence. Since the time of occurrence is spread throughout the policy year it becomes necessary to make a transformation which will then enable all three forces to be combined along a common time line. This transformation is achieved by a substitution of $t_R - t$ for the time of accident, t_A where t_R is the time of review or observation while t is measured from the beginning of the policy year.

The fourth force is the size of average claim payment. Measured from the time of occurrence, those claims which are paid immediately are paid at an average cost well below the incurred average claim cost. From observation of all the available data it would appear that there is a minimum size of average claim even immediately after the occurrence of the claim. As time goes on the average size of claim payment increases. It appears to increase rapidly until it approaches the average incurred claim cost and then slows down for a time. After it has risen above the average incurred claim cost its size again begins to increase rapidly. This suggests some type of monotonic growth curve with a minimum value, an inflection point, and increasing throughout. Measured from the time of occurrence, the average paid claim cost increases with time. It is left to the reader to speculate on the effect which might result if a company made every effort to clear out its claims quickly.

Unfortunately very limited average claim cost data are available. Whatever is available is a hybrid of claims paid during a calendar period relating to claims whose occurrence is spread over the policy year. Attempts at formulating an expression which is consistent with the observations indicate that such an expression is complex. Alternative methods of solving this problem might be the subject of further study by other members of the society.

When these four forces are combined to form the policy year, close approximations to the observed policy year payments is seen. In the process a new element has been introduced, namely t_R. This conforms to the policy year construction made by the rating organizations which requires that loss experience for a policy year be reported as of March 31. It is found that not only does the final result approximate the financial data of the Insurance Expense Exhibit, but it also closely approximates the ratemaking data reported as of March 31. This latter observation reinforces the thought that financial data can be effectively used as a supplement to normal ratemaking data.

TABLE A
Proportion of Total Claims Paid, P
As of Specified Time, t_R
[From Equations VI and VIII]

t_R	P	t_R	P	t_R	P
1 mo.	.0001	1 yr. 9 mos.	.5137	5 yrs.	.9853
2 mos.	.0007	1 yr. 10 mos.	.5533	5 yrs. 6 mos.	.9915
3 mos.	.0022	2 yrs.	.6260	6 yrs.	.9950
4 mos.	.0052	2 yrs. 2 mos.	.6876	6 yrs. 6 mos.	.9971
5 mos.	.0101	2 yrs. 4 mos.	.7390	7 yrs.	.9983
6 mos.	.0173	2 yrs. 6 mos.	.7820	7 yrs. 6 mos.	.9990
7 mos.	.0273	2 yrs. 8 mos.	.8179	8 yrs.	.9994
8 mos.	.0407	2 yrs. 10 mos.	.8479	8 yrs. 6 mos.	.9997
9 mos.	.0580	3 yrs.	.8730	9 yrs.	.9998
10 mos.	.0798	3 yrs. 2 mos.	.8939	10 yrs.	.9999
11 mos.	.1068	3 yrs. 4 mos.	.9114	11 yrs.	1.0000
1 yr.	.1398	3 yrs. 6 mos.	.9260	12 yrs.	1.0000
1 yr. 2 mos.	.2171	3 yrs. 8 mos.	.9382	13 yrs.	1.0000
1 yr. 4 mos.	.3010	3 yrs. 10 mos.	.9484	14 yrs.	1.0000
1 yr. 6 mos.	.3874	4 yrs.	.9569	15 yrs.	1.0000
1 yr. 8 mos.	.4726	4 yrs. 6 mos.	.9749	16 yrs.	1.0000

TABLE B
Proportion of Total Amounts Paid, y
As of Specified Time, t
(From $\log_{10} y = 2.0674t^{-.80599}10^{-.248411t}$)

t	y	t	y	t	y
1 mo.	.0000	1 yr. 9 mos.	.3281	5 yrs.	.9282
2 mos.	.0000	1 yr. 10 mos.	.3592	5 yrs. 6 mos.	.9495
3 mos.	.0000	2 yrs.	.4201	6 yrs.	.9643
4 mos.	.0001	2 yrs. 2 mos.	.4776	6 yrs. 6 mos.	.9747
5 mos.	.0005	2 yrs. 4 mos.	.5309	7 yrs.	.9821
6 mos.	.0019	2 yrs. 6 mos.	.5802	7 yrs. 6 mos.	.9872
7 mos.	.0052	2 yrs. 8 mos.	.6252	8 yrs.	.9909
8 mos.	.0110	2 yrs. 10 mos.	.6658	8 yrs. 6 mos.	.9935
9 mos	.0201	3 yrs.	.7025	9 yrs.	.9953
10 mos.	.0326	3 yrs. 2 mos.	.7355	10 yrs.	.9976
11 mos.	.0487	3 yrs. 4 mos.	.7648	11 yrs.	.9987
1 yr.	.0681	3 yrs. 6 mos.	.7912	12 yrs.	.9993
1 yr. 2 mos.	.1158	3 yrs. 8 mos.	.8146	13 yrs.	.9997
1 yr. 4 mos.	.1718	3 yrs. 10 mos.	.8353	14 yrs.	.9998
1 yr. 6 mos.	.2332	4 yrs.	.8538	15 yrs.	.9999
1 yr. 8 mos.	.2966	4 yrs. 6 mos.	.8977	16 yrs.	1.0000

NOTES ON SOME ACTUARIAL PROBLEMS OF PROPERTY INSURANCE

BY

LAURENCE H. LONGLEY-COOK

1. *Introduction*

Following the extension of the Objects of the Casualty Actuarial Society to embrace property insurance, two papers on fire insurance rate making were presented at a meeting of the Society in 1951: one by the author, formerly a life actuary[1]; and one by a casualty actuary[2]. Since then, the author has made a number of actuarial studies of various aspects of fire insurance and has brought some of the studies together in the following "notes."

Fire insurance has a very long history and many of its practices have often more historical than scientific foundation. These notes are mainly concerned with testing these foundations to inquire whether they can safely continue to support the vast edifice which rests upon them.

2. *The General Problem Of Fire Insurance Rate Making.*

In order to obtain a clear picture of the problem of rate making in fire insurance, it is necessary to consider, briefly, the basic principles involved in making rates for any class of insurance. The most straightforward example of rate making is a one-year temporary life insurance policy, providing for the payment of a fixed sum on the death of the insured within a year. The probability of death occurring within a year is available from past actuarial studies and, hence, the net or pure premium for the policy is immediately available by multiplying the sum payable by this probability. The gross or office premiums for the policy is then obtained by adding fixed or percentage loadings (or a combination of the two) for expenses and adding, also, a provision for profits.

The steps involved in this example of rate making are:

(1) The actuarial investigation of relevant past data, including the classification of the data. (In this case, according to age.)

(2) The use of judgment in examining and interpreting the data, including where desirable the use of development and projection factors or other such adjustments to convert past experience to current, or expected future conditions. (This adjustment is not often employed in life insurance.)

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[1] "Problems of Fire Insurance Rate Making"—L. H. Longley-Cook, C.A.S. XXXVIII p. 94.

[2] "A Casualty Man Looks at Fire Insurance Rate Making"—M. H. McConnell, C.A.S. XXXVIII p. 103.

(3) The development, therefrom, of probabilities of loss suitable for rate making.

(4) The calculation of net or pure premiums to provide for expected losses.

(5) The addition of expense and profit loadings.

Practically every type of life insurance premium, however complicated the coverage, is developed in the same basic manner except that, since premiums and benefits may not be payable until a date many years hence, the probabilities of death and survival must be modified to reflect the operation of interest[3].

For most classes of casualty insurance, a slight modification to the above general method is necessary because the amount of benefit payable in event of loss is not fixed, as in life insurance, but varies according to the severity of the accident. For this reason, in step 3 "the expected amounts of loss" is substituted for the "probabilities of loss". The expected amount of loss is the average loss which may be expected to arise if a large number of similar risks were insured. In mathematical parlance, it is the integral of the various possible amounts of loss multiplied by the probability of each amount occurring.

In property insurance, the expected amount of loss will vary according to so many factors—occupancy, constructional features, fire protection facilities, size of risk, etc.—that it is nearly always impossible to develop a classification scheme which will subdivide our data into practical homogeneous groups. The finer we classify our data the nearer we approach homogeneity, but the smaller the amount of data in each group: What we gain in homogeneity we lose in credibility of our loss experience. Presented with the impracticability of developing useful expected amount of loss figures for property insurance, we cannot develop pure premiums and a completely different method of rate making has to be employed.

The method of rate making used in property insurance is known as the loss ratio method. In this method, sets of premiums or schedule rating plans are initially set up on a pure judgment basis. For example, a set of premiums for brick protected dwellings may be established with different rates for different classifications of protection. Premium and loss experience for brick protected dwellings are developed which enables the rates for this class of risk to be adjusted upwards or downwards to insure that the rates in total are correct. No attempt is made to provide any check on the individual rates for a particular class of protection and, hence, the judgment feature of property insurance rates continues indefinitely. To take another example, a schedule rating plan with numerous credits and debits for favorable and

[3]See for example "Life and Other Contingencies" Vol. 1—Hooker and Longley-Cook-Cambridge University Press 1953—or any other textbook on Life Contingencies.

unfavorable features may be established for a certain class of mercantile or manufacturing classification. Rate level adjustments, based on loss ratio developments will be made to insure the overall adequacy of the rates, but the individual credits and debits continue to be based on judgment alone. Unless this feature of property insurance rate making is fully understood, little progress can be made in understanding many of the technical problems of fire insurance.

3. *The Building-Contents Rate Differential In Fire Dwelling Insurance.*

There can be no possibility of establishing by statistical methods the appropriate charge to be made in a schedule rating plan for, let us say, an unprotected floor opening and this is true of practically all debits, credits and rate differentials in fire insurance. There is one rate differential, the difference in premium rate between contents and building insurance for identical dwellings, for which ample statistical data are available and a discussion of it provides an example of what can sometimes be achieved by the analysis of loss ratio data. Separate statistics by state are available for buildings and contents insurance on dwellings subdivided into brick protected, frame protected, brick unprotected and frame unprotected.

In any particular group, say, "brick protected dwellings in Pennsylvania", there will normally be more than one premium rate, based on various degrees of protection and, in the case chosen, the part of the state in which the risk is located. However, it is possible to establish from census, housing or sample studies, reasonable figures for the ratio of the contents premium rate to the dwelling premium rate in each of the some 200* breakdowns of the nationwide data available; and hence, by reference to the actual loss ratios, what ratio of contents premiums rate to dwelling premium rate would be required to develop an equality of loss ratios for each breakdown. A study made on these lines some years ago indicated that equal loss ratios for building and contents would have been developed in practically all states and for each of the four subdivisions of construction and protection if contents rates were approximately 1.4 times building rates. It is of considerable interest to compare this rough rule, which is at least based on statistical study and which can be repeated by any fire rating bureau at any time, with the actual rate structure employed. It will be found that rate differentials are almost always less than that indicated by the statistical study and that, in many states, building and contents rates for unprotected dwellings are identical. It is believed that the use of identical rates for building and contents insurance on unprotected dwellings is based on the theory that, if the dwelling is unprotected, every fire will lead to a total loss. Much of the structure of fire insurance rates is based on such theorizing because of the lack

* Four breakdowns by construction and protection combined with 48 states plus New York City, Cook County and District of Columbia.

of statistical data. It may be noted that lack of insurance to value is more prevalent in contents insurance than in building insurance on dwellings and this influences the loss experience.

4. *Dwelling Rating Plans*

The foregoing remarks which illustrate the inherent difficulties of the loss ratio method of insurance rate making suggest a general reassessment of the method of developing rates for dwelling insurance, which, because of the marked similarities in the units involved and their large numbers, appears to offer the best field for a more scientific approach to fire insurance rate making.

It is clearly impractical to inspect each dwelling for favorable and unfavorable fire insurance features as the cost of such inspections would absorb too great a percentage of the premium. In dwelling insurance, a simple rating plan is, therefore, desirable. In the past, a large number of protection gradings have been used in certain states and a number of credits and debits have been allowed for such features as a lightning rod and a nonstandard flue. In other areas, the study of a complex series of maps is still necessary to determine the appropriate protection grading of an individual risk.

It is most doubtful that the variations in the fire fighting facilities of fire departments, important as these are for the protection of large mercantile and manufacturing buildings, have as much effect on the burning ratio for dwellings, where speed in getting to the fire and the availability of water are the only two factors of great importance. Unfortunately, it is not possible to prove this idea statistically because fire statistics are broken down into two classifications of protection only—protected and unprotected.

Similarly, two main subdivisions of construction, brick (including stone) and frame, are probably adequate and additional classifications according to roofing material or other features are hardly justified. While a wood shingle roof would appear to increase the fire hazard and contributed greatly to the severe losses of the great conflagrations of the past, what statistics are available, although not particularly credible, seem to indicate this feature is now unimportant. (It may be noted that shingle roofs are less susceptible to wind damage.) Similarly, a lightning rod will have some bearing on the hazard, but it is believed that its importance is insufficient to justify special rate treatment. Other features, such as the state of the electrical wiring and the state of the furnace, which can be determined only by inspection, are likely to be of greater importance.

The author has been concerned with the design of a system of dwelling rating classification which is both simple to apply and which provides a sufficiently small number of breakdowns to enable the experience of each classification to be coded and analyzed separately. The following is the outline of such a plan:

Protection (4 classes)

A Risks located within the boundaries of well protected towns (which can be suitably defined or listed).

B Risks located within 600 feet of a fire hydrant *and* 3 miles of a fire department, not included in A.

C Risks located within 600 feet of a fire hydrant *or* 3 miles of a fire department, not included in A or B.

D Other risks

Construction (2 classes)

1 Brick

2 Frame

Debits and Credits

Nil

This plan, or variants of it, has been tried successfully in a number of states. With such a plan, each rate can have its own individual justification and much of the judgment taken out of the dwelling rating schedule. The plan is equally applicable to Homeowners business.

5. *Actuarial Aspects of Schedule Rating.*

The standard textbooks on Schedule Rating were mostly written some years ago. A. F. Dean's "The Rationale of Fire Ratios" published in 1900 is more satisfactory for the student than his later 3 volume work "The Philosophy of Fire Insurance". Other books which should be studied are: "The Experience Grading and Rating Schedule" by E. G. Richards, Revised Edition, 1924; "The Making of the Fire Insurance Rate" by E. R. Hardy, 1926; "The Principles and Mechanics of Fire Insurance Rating as Incorporated in General Basic Schedule", J. K. Woolley, 1928; "Fire Insurance Rating in Pennsylvania", M. W. Mays, 1935. The author and Mr. T. O. Carlson attempted to provide a very brief description of the principles involved in "Multiple-Line Insurance" by G. F. Michelbacher, published in 1957. The actuary finds himself rather overawed by the rate schedules even for an individual state which, with their instructions, would encompass a whole volume if bound together. The schedules vary appreciably from state to state. Some states start from the Dean system; some the Universal and one or two states use a more modern development—the Uniform Grading Schedule, but changes and additions have been made from time to time to meet national and local problems.

Fundamentally, each schedule has a key rate or key rates, to which constant or percentage credits and debits are applied to provide for a very large number of favorable and unfavorable features which are known to affect the probability or the extent of the loss. There is no statistical basis for the key rate or for the various adjustments but, as experience develops for a certain classification in an individual state, the rates may be adjusted upwards or downwards, either by a revision in the key rate or, more usually, by a percentage adjustment to the rates produced by the schedule for a particular class of risk.

To an actuary there is apparent a fairly close parallel between schedule rating in fire insurance and the numerical system of rating used in life insurance underwriting. Both systems have credit and debit points for favorable and unfavorable features. Life actuaries have managed to develop able statistical studies to support many of the credit and debit charges, and it is not unreasonable to assume that, despite the many differences between fire and life insurance, at least some statistical support for the fire rating schedules is not beyond our skill with modern electronic equipment.

It is interesting to note some of the results which arise from the technical complexity and the inexactitudes of the system. First, we have certain classes, or sub-classes of business, which the experienced underwriter knows to be inadequately rated. He tries to discourage the acceptance of too much of this business by fixing unusually low company retentions or line levels. Similarly, preferred business may be encouraged by high line levels or increased commission rates. It must not be thought, however, that retention limits reflect only the underwriters' views on the adequacy of the rates; other considerations are often more important as, for instance, the catastrophe hazard.

Secondly, each leading company has to maintain a large "technical staff", skilled in the method of schedule rating, who can advise prospective insureds how they can obtain a reduced rate by removing or reducing fire hazards. While for the community as a whole, this fire prevention work is most valuable, it introduces an unusual competitive feature into fire insurance.

It is of interest to draw up a list of the steps which would be required to introduce a more accurate method of schedule rating of fire insurance. Such a plan will, of course, reflect the personal bias of the author.

1. Substitute a single nationwide rating bureau for the individual state bureaus.
2. Standardize the rate making schedules. (Territorial rate adjustment factors will be necessary.)
3. Simplify the schedules by omitting minor debits and credits.
4. Revise the fire statistical plan so that the classifications coincide with the various rating schedules and the major subdivisions of occupancy within those schedules.
5. Subdivide the statistical data, within the classifications, according to three broad classifications; non-hazardous, medium hazard and severe hazard; thus, providing an overall check on the spread of the rating plan.
6. Use nationwide data to maintain rate levels and hazard differentials (where practical) subject to territorial credits and debits.

It is, of course, appreciated that the work involved in carrying out such a plan would be stupendous and such changes could only be carried out gradually over a long period of time.

A fitting quotation to close this brief note comes from the first paper[4] presented to the Casualty Actuarial Society on Fire Insurance Rate Making:—"If to the problem of a statistical basis for the making of fire insurance rates we can bring the skill of the Actuary and also the scientific outlook, much, I believe, can be accomplished". This paper was presented in 1924 and I do not believe fire insurance was again considered in the proceedings of the Society until 1951.

6. *Term Rule, Installment Plans, etc.*

In order to understand some of the difficulties in interpreting fire insurance statistics for rate making and other purposes, a clear picture of the operation of the term rule and also the installment and other premium payment plans is necessary.

For very many years, a three-year policy was sold in nearly all states for 2½ times the annual premium and a five-year policy for 4 times the annual premium. Certain classes of business were originally excluded from the operation of the rule, but these restrictions have now largely disappeared. It is not possible to justify discounts of this size on expense savings and in 1957, steps were taken to modify the rule to 2.7 times the annual premium for a three-year policy and 4.4 times the annual premium for a five-year policy.

The size of the discounts and the unwillingness of the industry to modify the term rule led in 1945 to the introduction of an installment plan which originally provided for the three-year premium of $250. (corresponding to $100. annual premium) to be payable in three annual installments of $100., $78., $78. This installment plan was modified in some states and was further modified when the three-year term discount was altered as just described.

In certain states, the "annual renewal plan" was introduced as an alternative to, or instead of, the installment premium plan. This plan provides that an annual policy may be renewed at 78%, 80%, 88% or 90% of the one-year premium, the percentage varying from state to state.

On the West Coast, a new installment plan has been introduced which provides an initial one-year installment less than the one-year premium rate!

It is not at all surprising that, with the many changes in term, installment and annual renewal plans which have occurred in recent years, the written-paid loss ratios developed by the National Board of Fire Underwriters are not immediately useful for rate making and even the earned-incurred loss ratios cannot always be accepted at their face value.

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[4] "Some Random Thoughts Concerning Fire Insurance. Is a Statistical Basis for Rating Possible?" E. R. Hardy, C.A.S. Vol. X p. 119.

Because of a New York Insurance Department regulation (since withdrawn), many companies entered three-year and five-year installment business as though it were a series of one-year policies. If the first installment on this basis is $100. and subsequent installments are $78., $100. is earned in the first year and $78. in subsequent years. One or two companies took steps to avoid this by treating the excess of the first year premium over the subsequent annual premium as a term policy, others applied a percentage adjustment to the unearned premium reserve, but the vast majority followed the annual booking plan. The effect of this was to increase earned premiums appreciably above their true figure in the years immediately after the introduction of the installment plan or annual renewal plan in any state, and part of the bad underwriting experience in the years 1957 and 1958 can almost certainly be attributed to reductions in premium rates based on the incorrect interpretation of loss data developed in this manner.

7. *Earned-Incurred Loss Ratios*

The National Board develops calendar year earned premiums and incurred losses by state, class, construction and protection on the assumption that writings are evenly spread over the year and that cancellations and alterations of premiums occur on a policy anniversary, so that all policy terms are expressible in exact number of years. These assumptions are perfectly acceptable, except for the error arising from the treatment of installment business as a series of one-year policies which was discussed in the preceding note.

A serious error arises, however, in adjusting earned premiums to the current rate level. One method used extensively proceeds as follows:

(1) Calculate a series of factors to adjust the rate level in force for each of the previous calendar years to current rate levels

(2) Apply these factors to the earned premiums in successive years developed by the National Board.

A similar procedure is described by C. O. Shaver[5]. In this case, step (2) becomes:

Calculate the adjusted written premiums for each calendar year and multiply the total earned for the 5-year period under review by the ratio of Adjusted Written Premiums to Actual Written Premiums.

Both procedures produce serious errors when rate revisions of any magnitude are involved since they ignore the fact that premiums earned in any year are a result of writings in earlier years. It is of some interest to illustrate this point mathematically. Let us assume a level volume of business, all on a 3-year basis subject to a rate revision of –20% as at 1/1/1956. Written premiums will be

[5] "Revision of Rates Applicable to a Class of Property Fire Insurance"—C. O. Shaver, C.A.S. Vol. XLIV p. 63.

assumed to be $600,000. prior to the revision and $480,000. (i.e., $600,000. x 80%) after the revision. Clearly, if current rate levels had always applied, writings would have always been $480,000. per annum and earned premiums a similar sum. The methods described above would develop the following figures:

Method I

Year	*Written Premiums*	*Earned* Premiums*	*Rate Reductions*	*Adjusted Earned Premiums*
1953	$600,000.	$600,000.	–20%	$ 480,000.
1954	600,000.	600,000.	–20%	480,000.
1955	600,000.	600,000.	–20%	480,000.
1956	480,000.	580,000.	0	580,000.
1957	480,000.	540,000.	0	540,000.
				$2,560,000.

Method II

Year	*Written Premiums*	*Adjusted Written*	*Earned* Premiums*
1953	$ 600,000.	$ 480,000.	$ 600,000.
1954	600,000.	480,000.	600,000.
1955	600,000.	480,000.	600,000.
1956	480,000.	480,000.	580,000.
1957	480,000.	480,000.	540,000.
	$2,760,000.	$2,400,000.	$2,920,000.

Adjusted earned premiums

$$\$2{,}920{,}000. \times \frac{\$2{,}400{,}000.}{\$2{,}760{,}000.} = \$2{,}539{,}130.$$

*Calculated by National Board Statistical Plan for Earned Premiums using factors of 1/6, 1/3, 1/3 and 1/6[6].

With true earned premiums of $2,400,000., it will be seen that Method I will overstate the earned premiums and understate the loss ratio by 6.7% and Method II by 5.8%. Errors of this magnitude are most unsatisfactory.

To obtain correct earned premiums the written premiums must be adjusted to current rate levels *before* the earned premiums are calculated.

A further consideration of some importance is that when the "written premiums" for a particular year include subsequent installments on policies written in prior years, even the application of rate level adjustment factors to written premiums is incorrect[7].

In conclusion, much of the current inadequacy of the rate levels in fire insurance may be attributed to the following snowball effect:

[6] "Statistics of the National Board of Fire Underwriters"—J. H. Finnegan, C.A.S. Vol. XLIII p. 82.

[7] "Rate Revision Adjustment Factors"—L. J. Simon, C.A.S. Vol. XLV p. 196.

(1) the recording of installment business on an annual basis leading to overstatement of earned premiums and an understatement of loss ratios

(2) the reduction in premium rates as a result of (1)

(3) the further overstatement of earned premiums and understatement of loss ratios because of the inaccurate method of calculating adjusted earned premiums where there has been a previous downward rate revision.

(4) the further reduction in rates or inadequate increase in rates as a result of (3).

It is hoped that the change in the term rule which was made in many states in 1957-8, and represented an increase in rates of about 6%, will be sufficient to offset these reductions.

8. *Rate Revision Techniques.*

In 1955, the Inter-Regional Insurance Conference prepared a set of basic principles for the guidance of Fire Rating Organizations[8]. They were

1. The principle of a 6% underwriting profit factor (5% profit plus 1% catastrophe) as set forth in the 1921 Profit Formula of the National Board of Fire Underwriters as modified in the 1949 Sub-Committee Report of the NAIC shall be maintained. No overall rate level adjustment shall be made if the indicated profit is within a tolerance zone of two percentage points above or below such 6% factor.
2. Review of overall rate level shall be annual; however, it is not the intent to require annual adjustment of rate levels.
3. Underwriting profit as referred to above shall be determined with use of direct earned premiums and incurred loss and incurred expense figures without regard to reinsurance.
4. As to loss experience, all available and relevant premium and loss statistics, including loss adjustment expenses, shall be used, to include both member and subscriber (including deviating) Company figures adjusted to reflect current rate levels. Due consideration shall also be given to other available and relevant statistics in the interest of securing the widest possible base of loss experience. In the case of fire rate levels, the loss experience of not less than the most recent five-year period shall be used, while in the case of windstorm or extended coverage including the windstorm peril, the loss experience of not less than the most recent ten-year period shall be used.
5. As to expenses other than loss adjustment expenses, only the experience of member and subscriber stock Companies during

[8]"Rate Making for Fire Insurance"—J. J. Magrath, C.A.S. Vol. XLV p. 176.

the most recent period of years shall be used, reflecting comparable methods of operation and acquisition costs. Such expense figures shall not be separated as between commissions and premium taxes and all other expenses.

6. Due consideration shall be given to loss experience, expenses and to credibility and all other relevant factors within and outside the State, including the important element of informed judgment in reflection of economic trends, social conditions, new processes and inventions and other factors which may affect prospective loss experience and expenses.

Some of these principles call for critical comment.

The third principle will seem strange to actuaries as it means that *all* expenses are to be expressed as a ratio to earned premiums. To relate commissions and taxes to earned premiums is most difficult to justify. Taking the New York Department stock company aggregate expense ratios, this would mean that the expense ratio of Homeowners business in 1956 was 98% with commissions and taxes absorbing 64½% of the premiums. Clearly, an impossible basis for rate making. Further, with the continued increase in Homeowners and Commercial Multiple Line, pure fire premiums are likely to decline and earned premiums for fire insurance will be greater than written premiums, owing to the run-off of business. The use of earned premiums as the basis for measuring profit could, therefore, lead to inadequate fire rates in the future.

There can be no doubt that commissions and taxes should be related to written premiums. For Other Acquisition and General Expenses, written premiums are, I believe, the generally preferable basis, but the greater stability of earned premiums makes their use sometimes desirable, particularly for Bureau filings.

The fourth principle is open to criticism in that it advocates the use of stock and mutual loss experience combined. Provided the experience of these two groups is the same (except for chance variation) the use of the combined figures provides a broader base and is to be preferred. However, in many states, the local mutual companies concentrate on certain classes of risk with particularly favorable loss ratios. In lines where the mutuals write, say, 25% of the business with, say, a 10 percentage point more favorable loss ratio, this procedure produces unfortunate results. Thus, if the rate making formula is:

Provision for Losses	47.5%
Provision for Expenses	46.5%
Provision for Profit and Catastrophe	6.0%
	100.0%

we can assume that the overall loss ratio for stock and mutual companies will be keyed to 47.5%. On the assumptions mentioned, this can be achieved only as follows:

	Stock		*Mutual*
Loss Ratio	50%		(50-10)% = 40%
Proportion of Business	75%		25%
Combined Loss Ratio		47.5%	

Hence, for stock companies we have:

Provision for Losses	50.0%
Provision for Expenses	46.5%
Provision for Profit and Catastrophe	3.5%
	100.0%

An actual provision for profit and catastrophe of 3.5% is very different from the 6% loading intended.

With regard to the fifth principle, the use of only stock company expense is, of course, essential if the agency stock companies are to operate at a profit. In general, mutual companies operate at a lower expense ratio than stock companies and these savings are passed on to the members in the form of dividends. It is not practical to take dividends into account in rate making and, hence, mutual expenses must be excluded.

In 1957, Inter-Regional adopted a recommendation by its Actuarial Subcommittee on Trends that the most recent 6 years' ratios of incurred losses to earned premiums adjusted to current rate level should be used, weighted as follows:

Latest Year	30%
2nd Latest Year	25%
3rd " "	15%
4th " "	10%
5th " "	10%
6th " "	10%
	100%

The figures for the latest year are available only from the annual statements of the companies and the inclusion of this year in addition to the 5 years for which classified data are available is sound.

In view of the eminent actuaries who served on the Subcommittee, it is with considerable diffidence that the author criticizes this plan. If the loss ratios adjusted to current rate level could be accepted at their face value, the plan would be entirely satisfactory, but when we remember the errors which can occur in these ratios due to recording installment business yearly and the current inaccurate method of passing to adjusted earned premiums, I dread to think of the inadequate rates which may develop after two years of particularly favorable experience. I strongly believe that in the current state of development of fire insurance rate making, trends must be allowed for on a judgment basis rather than by any formula.

9. *Credibility*

What do we mean by credibility? Credibility is nothing more or less than the credence that the rate maker believes should be attached to a particular body of experience. Clearly, if we only have one loss in a year in a particular classification and territory, practically no credence can be attached to the loss experience for rate making, while if we have a thousand losses, the loss experience will have considerable credibility.

If data are given 100% credibility, we imply that if it were possible to study a larger volume of similar data, the rates developed from such larger volume of data would be no more accurate than the rates developed from the actual data. In other words, the data are sufficiently extensive to remove for practical purposes the effects of chance variation due to sampling. 0% credibility, or no credibility, implies that the data are too limited to be of any use for rate making. Occasionally, one hears a reference to the credibility of expense data. It follows from what has been said above that this expression is meaningless.

Given two bodies of experience, each with the same premiums, rates and total amount of losses, but one consisting of a large number of small losses and the other a smaller number of large losses, the former will have the higher credibility. Unfortunately, we do not normally have available the number of losses in fire insurance statistics so that this most important measure of credibility is not available. Because a number of companies may each insure part of a risk, there does not appear to be any practical way of developing this data for the combined experience of a number of companies.

Theoretically, it should be possible to establish from a study of the distribution of losses by size, a scale showing the number of losses required to meet a particular statistical tolerance standard, and it would be valuable to have some studies of this calculated from a plausible model. In practice, it is usual to accept, as has been customary for some years in New York State, some arbitrary standard measured by the premium volume. In New York, 100% credibility was originally fixed at $5,000,000. in written premium over a 5-year period, but was increased in 1953 to $6,000,000. Because credibility depends on number rather than the amount of loss, a lower limit should be used for dwelling risks than for commercial risks[9].

An alternative approach to this subject, which on its face is most attractive, is to examine earned-incurred loss ratios year by year in a particular classification[10]. The loss ratios should be first adjusted for trend as indicated by the all classifications' loss ratios and also for

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[9] "A Credibility Framework for Gauging Fire Classification Experience"—R. L. Hurley, C.A.S. Vol. XLI p. 161.

[10] The approach was, I believe, first suggested in 1949 in a memorandum prepared by Mr. Carlyle H. Hill, Executive Manager of the Middle Department Association of Fire Underwriters.

rate revisions. If more confidence could be placed in the calculation of these loss ratios, the variance in the loss ratio would provide an excellent measure of credibility. However, changing conditions could cause this test to suggest a lack of credibility where the volume of business should make the results fully credible.

In general, the Fire Rating and Advisory Bureaus have apparently given little attention to the question of credibility. A notable exception is a report by an actuarial subcommittee on credibility for Homeowners business. However, these proposals in this report were revised quite drastically by the introduction of a "seasoning factor" before being released as an industry report[11].

10. *Extended Coverage*

The first uniform extended coverage endorsement was introduced in 1937 replacing the supplemental contracts which varied considerably from territory to territory. The endorsement is attached to fire insurance policies and provides coverage against windstorm, hail, explosion, riot, aircraft vehicle and smoke damage. The peril of windstorm is by far the most important peril covered. At the present time, about 60% of the business is in respect of insurance on dwellings. The business was first recorded on a separate line in the Annual Statement in 1940.

The volume of extended coverage business has risen very rapidly in recent years so that the annual premiums of all stock companies now exceed $500,000,000. which is approximately 40% of the total pure fire premiums. The business has, however, proved unprofitable. Earned premiums for the 18 years, 1940-57, amounted to $3,840,000,000. and incurred losses to $2,170,000,000. giving a loss ratio of 56.5%. Adding 9.5% for loss adjustment expenses, this gives 66.0% for loss and loss adjustment. Stock Company expenses (other than loss adjustment) for the years 1951 to 1957, inclusive, averaged 47.5% and, if this percentage is considered suitable for the whole period, the total loss plus expense ratio is 113.5%. This represents a loss by the Companies on the business of $520,000,000. compared to the "expected" 5% profit of $190,000,000.

The expense figures used above were those prepared by the New York Insurance Department and may be considered slightly unrealistic for an expanding line, since they relate "Other Acquisition and General Expenses" to earned premiums. Using a written premium base for all expenses other than loss adjustment expenses, the expense ratio is reduced to 45.3%, the total loss plus expense ratio becomes 111.3%, and the loss on the business to $430,000,000.

Following the severe hurricane losses of 1954, in particular, rates have been increased considerably and deductibles have been intro-

[11] "Proposed Rating Procedure. Homeowners Policy" Multiple Peril Insurance Conference 1958, discussed in Mr. Dudley M. Pruitt's Presidential Address to the Casualty Actuarial Society. 1958. C.A.S. Vol. XLV p. 11

duced in nearly all states, and it is hoped the business can be profitable in the future.

Rate making for extended coverage abounds with interesting actuarial problems many of which have received little attention. Since windstorm is by far the major peril, it is important to realize that owing to the correlation between losses—one storm involving many thousands of losses—normal standards of credibility do not apply. This is being recognized by using 10 years rather than 5 years loss experience for rate adjustment. However, in states exposed to hurricanes, the 10-year loss experience may have an abnormal or subnormal number of such storms, and even longer term weather studies make it difficult to establish the normal frequency of hurricanes. The problem is further complicated by the conflicting views of weather men on the relative bearing on trends of sunspot cycles and longer term climatic changes.

Except for certain sea coast territories, a single rate is charged for all dwelling risks in a state. This is in marked contrast to the large number of classifications of fire insurance rates. An attempt is at last being made to compare the experience of building and contents insurance, as there can be no question that the use of the same rate for these two classes of risk is most inequitable. It seems inevitable that if rating is to become scientific, territorial zones will be required for most states and possibly different rates for urban and rural risks. What little data are available suggest that the risk for rural dwellings is rather greater than for cities in the same area.

11. *Conclusion*

No attempt has been made to cover all the actuarial problems of property insurance in these notes. In particular, the most interesting problems of the Homeowners policy have been excluded as they would provide the material for a whole paper of their own.

Can any conclusions be drawn from this brief examination of the foundations of the vast edifice of fire insurance? The author is drawn irresistibly to the following conclusions:

(1) In much of the rating work, complexity has been accepted as synonymous with accuracy;

(2) Insufficient use has been made of the statistical data which are available;

(3) There is a real need for the employment of actuarial talent at the highest level in determining future rate making techniques and in developing more useful statistics for rate making.

OCEAN MARINE RATE MAKING

BY

D. DOUGLAS ROBERTSON

The subject of rating for Ocean Marine Insurance is a complex one. Also, the same complexities exist in Marine Insurance which, in addition to ocean carriage, embraces a considerable volume of true Marine Insurance in respect to vessels and cargoes operating not only on the Great Lakes but on other inland lakes and waters such as the McKenzie River System and the St. Lawrence River. To deal with the subject properly, it is essential to divide it into at least two major categories, i.e., Cargo Insurance and Hull Insurance.

CARGO INSURANCE

Unlike a majority of underwriters of other forms of insurance, cargo underwriters are, by and large, individualists who not only have little if any desire to pool their knowledge of the business with competitors, but who actively resist efforts put forward on occasion to achieve such a pooling of results.

The reason for this is simple. There are many different types of cargo which can be insured for anything from very limited to very broad insuring conditions, even including in some instances inherent vice or defect. An underwriter may experiment with a certain commodity at certain rates insured against certain perils and discover that such a basis, which might be quite different from the generally accepted practice in that particular trade, works out quite satisfactorily and therefore gives him specialized knowledge not generally known to his competitors. This may permit him to expand his writings in that particular field.

Cargo underwriting is very competitive. This is partly due to the fact that on a large account shipping to or from many parts of the World one can with justice say he is competing with cargo underwriters the World over. This is due to the fact that a large percentage of ocean trade is done under Contracts of Sale where insurance can be arranged either by the shipper or the consignee, depending upon which of the two parties involved can secure in his home insurance market the better contract either rate-wise or cover-wise, or both. This is another good reason for not making specialized knowledge the common property of all underwriters.

There are, of course, exceptions or partial exceptions to this practice, particularly in fields where the volume of traffic is exceptionally heavy, such as the transportation of grain where World-wide practice, to a large degree at least, dictates certain standard insuring conditions possibly set by the principal marketing Associations dealing in such commodities. In the case of grain shipments, the bulk of such shipments are insured under Corn Trade Association (an English organization) clauses which provide comparatively limited coverage. Due to the volume of business involved and the restricted insuring terms granted in this trade, rates are low and have a tendency to keep getting lower and lower over a period of years as one office competes with another until, either after a disastrous year due to a number of total losses or a general acceptance of the fact that all profit or even hope of profit has long disappeared, most underwriters will put drastically increased rates into effect. Then within a fairly short time the same old cycle of competition is repeated all over again.

Cargo rates basically depend on the experience of the individual accounts. Accounts handling similar commodities on similar trade routes can have widely dissimilar experience. This could be accounted for by various factors:

(a) Difference in the quality of packing. One might use cartons, another wood cases.

(b) Recoveries from carriers. One concern might do an excellent job in recovering all they can from steamship carriers before calling on their underwriters to pay, whereas another might just present their claims to their insurance company and let the company exercise their subrogation rights against carriers. Naturally, the importer or exporter has a bigger stick to wield against carriers than any insurance company has. The shipper can threaten to ship by some other line if the carrier does not honour his obligations.

(c) Salvage of damaged merchandise. Losses can be minimized on certain commodities (i.e., cherries or olives in brine) by prompt action on the part of the importer in rebrining slack barrels promptly on arrival at destination. Some importers are more prone to cooperate with underwriters in such matters than others.

(d) Absorption of claims. Some importers claim for every loss no matter how minor, whereas others absorb the smaller claims without reference to their underwriters.

These factors and others can have considerable influence in making an account profitable or otherwise and eventually they are reflected in reduced rates for the better accounts and increased rates for the poorer ones.

Underwriters and claims adjusters continually carry on an education campaign to teach insureds how to keep losses down or, if they do occur, how to minimize them or assist in recovery work against third parties if the claims are of the type which should be paid for by the steamship carriers or others who might be held responsible such as stevedores, rail or highway carriers.

It is, of course, not feasible to take major losses such as total loss of vessel or a serious general average loss into account and immediately revise rates on individual accounts which might suffer from such occurrences. It is necessary, however, annually to check accounts and see that a sufficient margin of profit is left over after paying the "mill run" losses and expenses, so that a backlog of profit is built up to pay the anticipated total loss or serious general average claim which on a large active account might be anticipated once every 15 to 20 years.

As a rule, the individual account records are examined annually and those with loss ratios, exceeding say 55%, are then examined in detail to ascertain the type of loss which has been occurring. In some cases remedies other than increased rates can be suggested. Accounts with exceptionally good records over the past five-year term can expect reductions in rate.

Many factors, other than "perils of the sea," such as fires, collisions, strandings, sinkings, explosions, or sea-water damage caused by excessive violence of the elements can produce cargo losses. A few of the better known perils are theft, pilferage, non-delivery, hook damage, oil damage, other cargo damage, fresh water damage, leakage, breakage, ullage, seepage, rats, rot, vermin infestation, scratching, marring and denting, ship's sweat, heating, etc. Some commodities are more susceptible to certain perils than others. Commodities, such as cameras, nylons, whiskey and lighters for example, are more likely to be stolen or pilfered than bags of flour or cement. Sea-water will do more damage to machinery than it will to a cargo of ore. Perishable foodstuffs are more susceptible to a host of perils such as infestation, other cargo damage, ship's sweat and heating than lumber would be.

All these factors and many others are reflected in rating. For example, a cargo of grain in bulk from Montreal to London, England might be rated as low as 10¢ per $100.00, whereas the rate on flour in cotton bags which are susceptible to tearing, taint from other cargo and stevedores' hooks might require a rate of 30¢ per $100.00 to produce any hope of profit. On the same voyage, polystyrene in 5-ply paper bags which sounds innocent enough would probably prove unprofitable at any rate lower than 75¢ per $100.00.

Many ports in the World are such that cargo, or at least a portion of it, requires lightering from ship to shore by small craft. At some few so-called ports the lighters have to land on a beach through heavy surf. As a result, serious water damages result, particularly at the surf landing points. The incidence of thievery is much greater in some areas of the World than others. Currency difficulties in certain countries necessitate the retention of much merchandise in customs; often housed (if housed at all) in inadequate premises for periods of months beyond a normal period of transit. Strikes at a port or in a country can delay delivery of property beyond normal periods or cause the overcarriage of cargo not unloaded back to the country of origin and finally back to the original destination. All these are factors in rating.

World conditions such as wars, whether they be local or World wars, are reflected in marine cargo underwriting. A review of a marine cargo open policy which had been in force continually, say from 1929 to the present time, without being rewritten would reflect in part at least the history of the World during that period of time. It would include endorsements dealing with War Risk coverage which came into being due to the Shanghai invasion in 1930, the Spanish Civil War, Italy's war against Ethiopia, numerous happenings during World War II, and later developments. Most insureds carry insurance against War Risks and rates for such protection are subject to change from time to time depending on World events. During 1942, at the peak of the submarine campaign, rate changes were almost daily affairs. The highest rate paid, for example, reached 35% for a two-week period during 1942 for shipments to India involving a transshipment. Rates of 10% to 20% during 1942 were very common and even at such high rates War Risk coverages during 1942 proved to be extremely unprofitable to underwriters on this side of the Atlantic.

In general, a cargo underwriter's rate making is based on his own past experience reflected in his statistical records which are produced (a) on an account basis and (b) on a commodity basis. To some degree the average cargo underwriter will compare notes with some of his friendly competitors. To some degree, particularly when dealing with large individual risks or exceptionally large individual policies, rates can be influenced by the availability of reinsurance markets.

HULL INSURANCE

The subject of hull insurance rating is one on which I am not as qualified to talk on as some others would be as I have had little to do with rating hulls in recent years. I am, however, more or less familiar with current practice.

There are many different types of hull insurance where coverage can range from the minimum of "Absolute total loss of vessel only" to very broad forms of coverage which are practically an All Risk form comparable (although the words used will differ greatly) to the broad form of protection available under certain Inland Marine forms of policy with which you gentlemen will be familiar.

The variations in hull insurance are endless as there are many standard forms of wording used in different trades, fields, areas, countries and then many variations of these standard forms by the use of varying franchises or deductibles or other limitations or extensions. Some smart broker or underwriter is always coming up with a new angle in this field and many are the experiments which are tried. To attempt to give you anything worthwhile would require a rather large book, so I will limit my remarks to one or two facets of this field.

Basically, hull insurance is rated on a fleet basis and to a large degree the individual fleet owner makes his own rate. In other words, experience based on the last five-year premium and loss record will dictate the rate for renewal. Competition either in the underwriter's own local market or in some other market can also play a large factor in rating. For example, a broker placing a large ocean fleet may have placed his lead line in some market, let us say London, and may not like the proposition he gets for renewal from his leading underwriter. He may try some other underwriter in the same market in an effort to produce a better basis or he might try some other market, say New York or Toronto. Not infrequently some other broker who is trying to secure the account may produce a better lead than the broker who controls the business and the controlling broker conceivably could be forced to find a similar market if he wishes to retain the account. By and large, however, rates go up or down depending largely on the actual record of the business during the last five-year period of time.

Certain markets, such as London, have certain rating understandings or agreements which are followed, at least as a rule, by most underwriters in that market and may to a very large degree be honoured by underwriters in other World markets. Some markets, such as New York, have certain hull syndicates which meet and set rates for their members at least on some categories of hull business.

Another factor which complicates the rating of ocean hull business to a substantial degree has to do with the state of World trade. For example, at the time of the Suez crisis ships which would normally use the short route through the Suez Canal when trading to Far Eastern Ports found it necessary to go around the Cape of Good Hope, thereby prolonging the length of their trips very substantially. There was a general shortage of World tonnage which resulted in much higher freight rates being paid and greatly increased values being placed on vessels as a consequence, with the result that insurance values were increased on many vessels very substantially. At the present time, with World trade being more or less in the doldrums, many ship owners are radically reducing insured hull values which calls for remaking of rates. While the total loss possibilities are substantially diminished in amount, the partial loss probabilities do not change in amount to any substantial degree. Naturally if a hull which has been insured on the basis of a hull value of say $2,000,000.00 is suddenly reduced to say $1,200,000.00 because of such a factor, the underwriters on the line cannot afford to reduce their premium on a straight pro rata basis. Fortunately, total losses by comparison with partial losses are infrequent. Partial losses from many causes, the most common of which are strandings, fires, collisions, machinery breakdown, heavy weather damage, and sinkings are occurring all the time. It is therefore necessary to have not only a total loss rate in mind but a partial loss rate depending on the coverage granted.

Experience between individual fleets varies very widely. Some operators are either much better than others or possibly just more fortunate.

Another major factor having to do with the rating of hulls is the fact that for the past twelve to fifteen years the cost of hull repairs has kept rising practically without a break in all corners of the globe. The rate of increase will, of course, vary with economic conditions in the different countries. As many temporary repairs are made which will make a vessel seaworthy with the permanent repairs possibly deferred for a quite lengthy period of time, rising hull repair costs can and do have a material bearing on hull insurance rates. An estimate of say $150,000.00 set up in 1955 where permanent repairs may not be completed until 1958 could quite easily result in an actual payment of say $200,000.00. If an underwriter or his claims adjuster is not smart enough to revise his estimates upwards year-by-year in inflationary times where there is any substantial unrepaired damage involved, he may suddenly find himself with an account which he thought had produced a modest profit which in actual fact was unprofitable.

While I have only skimmed the surface of this subject, I trust that what I have written will be of some interest to you.

A REVIEW OF THE EXPERIENCE OF MASSACHUSETTS WORKMEN'S COMPENSATION EXPERIENCE RATED RISKS

BY

WALDO A. STEVENS

Introduction

Experience Rating Plans for Workmen's Compensation insurance have been in effect in Massachusetts since 1916. Although these plans have varied considerably, the present Plan, which is the 1940 National Council Experience Rating Plan, has been in effect in Massachusetts since December 31, 1940 without substantial revision with respect to basic underlying principles. Inasmuch as this Plan has been in effect for a number of years, many concepts have developed, some of which stem more from underwriting usage than from statistical fact.

Where at one time the selection of a risk was to a great extent dependent on the risk's loss ratio, now one of the principal factors seems to be whether or not the risk is a "debit" risk or a "credit" risk under the Experience Rating Plan. Opinion ranges from complete reluctance of writing risks with debit modifications to the concept that it is much better, or at least safer, to write "credit" risks. This does not necessarily imply that all underwriters look askance at debit risks. On the contrary, there are some "venturesome" underwriters who concentrate their attention on debit risks and, where other things are equal, prefer writing debit risks. This philosophy is that the risks have had their fortuitous losses and should have good future experience. Nevertheless, in general, there appears to be a natural hesitancy to underwrite high rated risks whether it be due to high individual modifications or high hazard classifications.

The concept that it is safer to write credit risks stems from the fact that in any ratemaking procedures, past experience suitably adjusted and projected, if necessary, is used to determine the price of insurance. In the case of individual risk experience rating, a body of past experience, usually three years, is used to determine the relationship of the individual risk experience to the experience of all risks classified in a similar manner. For the most part, if a risk has better than average experience, a credit modification will result, and conversely if the risk has worse than average experience a debit modification will result. That such is not always the case is due more to a definition of what constitutes better or worse experience.

To some, the loss ratio is the determining factor. This relationship of losses incurred to premiums is naturally of considerable importance in the insurance business on an overall basis; however, on an individual risk basis, the losses must be considered with respect to the elements of frequency and severity. A risk with a high frequency of small losses and with a low loss ratio can be considered much less desirable than a risk with low frequency of large losses with a high loss ratio unless, of course, consistency of one or the other is such to establish credible evidence that the risk does not fall within the normal pattern.

Under the Experience Rating Plan, the degree to which a risk is considered better or worse than average is measured more by the frequency of losses than by the severity of the losses. It does not always follow that a risk with a high loss ratio is a debit risk or that a risk with a low loss ratio is a credit risk under the Experience Rating Plan. And so, depending upon who is making the decision, the desirability of writing a risk is not always judged by the same criteria.

Theoretically, the Experience Rating Plan is designed to bring the loss ratios of all eligible risks more closely to the average all risk loss ratio. Assuming that the manual rates are correct, that is, that they will reproduce the permissible loss ratio, then all of the credit risks should reproduce the permissible loss ratio, and equally all of the debit risks should reproduce the permissible loss ratio. If the Plan is meeting this objective, then the concept that it is less desirable to write debit risks is clearly wrong.

Preparation of Necessary Data

To statistically investigate this concept, it was necessary to either sample a proper number of experience rated risks and review the experience of these risks over many years, or to review all of the experience of experience rated risks for a given period. Inasmuch as a random sample of experience rated risks would produce a large number of small risks, i.e., risks which just meet the eligibility requirement and therefore have low credibility assigned to their experience and which would require many years of review to attain credible results, it was decided to review the experience of all risks for a given policy year*. The year chosen was 1955 policy year, being the latest complete policy year of experience available.

After deciding to use 1955 policy year as the study year, it was necessary to use two sets of statistical data. First, cards are punched from the statistical data which are developed from the experience rating calculation sheets. These data are used primarily to test the "off-balance" of the Plan and to test the ratios of primary to total losses which are reviewed annually in connection with the filing of rates, expected loss rates and primary ratios. These cards contain the necessary identification data by risk together with the actual and expected incurred losses broken down into primary, excess and total together with the risk modification factor which was the important element in so far as this study was concerned. Secondly, the individual risk experience is punched on cards from the unit statistical reports filed with the Bureau under the Workmen's Compensation Statistical Plan. The volume represented over 14,000 individual experience rating statistical cards and more than 70,000 individual risk experience cards punched from the unit statistical reports.

Since the premium reported on the unit reports is a standard pre-

* Of the risks eligible for experience rating in Massachusetts, 42% are of an annual premium size of between $500 and $1,000 but constitute only 9% of the premium volume eligible for rating.

mium, i.e., including the effect of the experience rating modifications but excluding the effect of premium discounts and the retrospective rating plans, and the card punched therefrom does not include the experience rating modification, it was first necessary to match the unit cards with the experience rating statistical cards in order to be able to transfer the modification from the experience rating statistical card to the unit risk card. To properly determine the effects of the experience rating plan, it required a comparison of the risk experience on a manual premium basis and on a modified premium basis.

An interesting side result of this first operation was the fact that of approximately 14,700 experience rating statistical cards, some 400 did not match to a unit risk card. In other words, some 400 rating modifications were promulgated which were not applied to risks. An investigation of these risks indicated that most of the risks were interstate rated risks for which no Massachusetts exposure developed. Of the remaining, some had gone out of business or had material changes of ownership.

The next step in the processing of the data was to calculate for each risk the unmodified premium or manual premium. This was accomplished by dividing each risk's modified premium by the risk's modification. At this point, the punch card for each risk contained the essential identifying data; Payroll, Standard Premium, Experience Rating Modification, "Manual" Premium, Indemnity Losses and Medical Losses. In order to calculate incurred loss ratios, it was necessary to cross foot the Indemnity and Medical Losses to obtain Total Incurred Losses which were then divided by the Standard Premium and the Manual Premium to obtain the Standard Loss Ratio and the Manual Loss Ratio.

These calculations were made on the punch cards of each of the 14,000 plus experience rated risks by using an I.B.M. 602A Calculating Punch. Although the 602A cannot compare in speed or performance with the later versions of electronic computers, it can perform all the necessary basic calculations, and although it required hours of calculating and set-up time, the job would not have been undertaken if the calculations had had to be performed manually.

With all necessary calculations performed, the cards were then ready to be tabulated in any manner that was devised to review the data.

Inasmuch as the intent of this study was to review the entire experience of experience rated risks, it became necessary to segregate the experience of interstate rated risks as the experience of such risks compiled for Massachusetts does not include all of the interstate experience upon which interstate experience rating modifications are based. Although the experience of interstate rated risks is not relevant to the principal purpose of this study, such experience does add to the overall experience rating picture as applicable in Massachusetts.

The experience of the rated risks for 1955 policy year separated as to interstate and intrastate together with the experience of non-rated risks is set forth below:

Type of Risks	*(1) No. of Risks*	*(2) Standard Premium*	*(3) Manual Premium*	*(4) Average Modification (2)÷(3)*	*(5) Losses Incurred*	*(6) Loss Ratios Standard (5)÷(2)*	*(7) Loss Ratios Manual (5)÷(3)*
Intrastate Rated	11,325	$28,900,641	$27,940,381	1.034	$14,725,920	.510	.527
Interstate Rated	3,006	25,680,503	27,917,974	.920	12,610,882	.491	.452
Total Rated	14,331	54,581,144	55,858,355	.977	27,336,802	.501	.489
Non-Rated	56,683	14,141,119	14,141,119	-	7,930,291	.561	.561
Total All Risks	71,014	68,722,263	69,999,474	.982	35,267,093	.513	.504

Interstate Experience Rated Risks

From the above figures it is of interest to note that although the number of interstate rated risks constitutes only 21% of the total number of rated risks, the Massachusetts premium volume of such risks constitutes almost 50% of the total, and that the experience of these large sized interstate risks is substantially better than either the intrastate rated risks or the non-rated risks.

Of particular interest is the difference in the average modification or "off-balance" for the interstate rated risks and the intrastate rated risks. As is well known, in Massachusetts the correction for the off-balance resulting from the application of the Experience Rating Plan is taken up entirely within the Plan; that is, the off-balance factor is applied to every risk modification after calculating the modification but before application of the modification to the manual rates*. In theory then the average modifications would include the off-balance factor which was in 1955 and is currently 1.03. Such is the case with respect to the intrastate rated risks; however, with respect to the interstate rated risks, only that portion of the off-balance which represents the percentage of Massachusetts expected losses to the risks' total all states expected losses is included within the modification. If the interstate modification as applied to the Massachusetts portion included the full Massachusetts off-balance, the difference in the average modifications for intrastate risks of 1.034 and interstate risks of .920 would be less since the interstate risks' average modification of .920 would be higher.

It does not necessarily follow that the total rated average modification, in this instance, .977, upon which the off-balance factor is determined is unreasonably affected by the inclusion of interstate modifications determined in part by experience other than Massachusetts experience. The facts are that the interstate rated risks are on the average much larger risks and that the Massachusetts experience of such risks is much better than the experience of the intrastate rated risks.

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* For Massachusetts rated risks the formula for determining the risk modification is as follows:

$$\text{Modification} = \frac{\text{Ap} + \text{B} + \text{W Ae}}{\text{Ep} + \text{B} + \text{W Ee}} \times \text{Off-Balance Factor}$$

Where Ap = Primary Actual Losses.

B = The B Value, stabilizing element, or ballast, for each risk.

W = A specified percentage applicable to the excess losses for each risk in order to bring excess losses back into the rating formula.

Ae = The excess of the risk actual losses over the primary actual losses.

Ep = Primary Expected Losses.

Ee = The excess of the risk undiscounted expected losses over the primary expected losses.

The procedure, whereby the Massachusetts off-balance factor is included within the overall interstate experience rating, was adopted presumably to have the same modification apply to all of the states' rates of an interstate risk rather than have a separate modification for application to Massachusetts rates which would result if the off-balance factor of 1.03 were applied to the interstate modification for the Massachusetts application. Under this procedure the effect of the Massachusetts off-balance factor is charged to the risk but on an overall interstate premium basis, and such procedure assumes that the distribution of expected losses of the experience period will remain unchanged through the period to which the modification applies. The method is obviously an attempt to make the best of an administrative difficulty brought about by a Massachusetts exception; however, the solution does result in producing a quirk with respect to the Massachusetts experience rating statistics. The more obvious solution, of course, is to eliminate the Massachusetts exception.

Correction for Experience Rating Off-Balance

The fact that the correction for the off-balance resulting from the application of the Experience Rating Plan is applied only to the premiums of experience rated risks in Massachusetts has caused certain controversy and practical administrative difficulties, particularly with the adoption of interstate experience rating in Massachusetts as outlined above. Inasmuch as this study was not primarily aimed at the off-balance problem, it is not appropriate to attempt to review all of the arguments both pro and con with respect to this problem. However, as an additional result to the review of the actual experience of 1955 policy year experience rated risks, it becomes obvious that the experience of experience rated risks is much better than the experience of non-rated risks. The manual loss ratio of the rated risks for 1955 policy year is .489, whereas the loss ratio of the non-rated risks is .561. Whether the better experience of the rated risks is due to the fact that they are rated or because the rated risks are of a larger premium size does not alter the fact that the experience is better and that loading of the correction for off-balance, which is due for the most part to this difference in experience on the better risks, does not seem to coincide with the ratemaking standard of charging costs as accurately as possible in the way in which they are incurred.

The application of the off-balance factor to the modification occasionally produces a rather difficult situation; that is, the situation whereby a risk with clear loss experience is subject to a debit modification. This is not a frequent occurrence and can only occur where risks have small premium volume and the applicable classifications have low primary expected losses. That it occurs at all can be somewhat embarrassing, particularly if a risk requests an explanation of his experience rating modification. And even though the situation rarely happens, it does point up the irrationality of taking up the off-balance exclusively in the plan. To put it another way, a risk which just meets the eligibility requirements of the plan may pay more than manual premium even though under the theoretical operation of the plan it should pay less than manual premium. Whereas, the risk which just fails to meet the eligibility requirements is subject to manual premiums regardless of its past experience.

A situation which somewhat parallels this Massachusetts Workmen's Compensation procedure for the correction for off-balance is the procedure for offsetting the short term charges applied to vehicles insured after the first of the year for Compulsory Automobile Liability Insurance. This is again a unique Massachusetts application since all Massachusetts motor vehicle compulsory liability policies expire on December 31. In this instance, the experience of risks insured after the first of the year is considerably worse than the experience of those vehicles insured as of January 1, and such experience is reflected to some extent by increased charges in the short term table. To offset the increased premium collected from the application of the short term charges, the manual rates are reduced by a factor which measures the difference between the pro rata premium and the short term premium*. It would appear then that the only time a correction or offset factor can be applied to manual rates is when such factor is negative and will reduce manual rates.

Experience of Experience Rated Risks by Interval of Modification

The table of experience rating statistics based on the data used to determine the modifications is set forth in Exhibit 1 for intrastate rated risks by interval of modification. Exhibit 1A sets forth similar data for the Massachusetts portion of interstate rated risks. These statistics are based on policy years 1951, 1952 and 1953 from which the experience modifications were calculated to apply to the premium of policies written for 1955 policy year. These data for intrastate rated risks which indicate that for "credit" risks the ratio of actual losses to expected losses was .345, and that for "debit" risks was 1.797, tend to give the impression that it is not only better to write a "credit" risk, but dangerous to write a "debit" risk, particularly when the average modification for credit risks was only .865 and for debit risks 1.214.

That this impression is deceptive can be well realized when it is noted that the risks categoried as debit or credit are so categoried because their experience for this specific period is better or worse than average, and the future experience of such risks as a whole will not be consistently better or worse. To go to extremes, some credit risks with clear loss experience for the experience period will have losses in the future rate period, and some debit risks with losses during the experience period will have clear loss experience in the future rate

* Actually the offset factor is calculated by comparing the pro rata premium determined by extending the exposures by the manual rates to the total collected premium. This results not only in offsetting the short term charges, but also the short rate cancellation charges and any minimum premium charges.

period. This fact emphasizes the fickleness of frequency, particularly with respect to the smaller risks. Even though Workmen's Compensation insurance is considered to be a relatively high frequency line of insurance, it does not have a frequency high enough to make it possible to reasonably predict every individual risk's future experience.

To test the actual effect of the Experience Rating Plan, however, the experience of the risks to which the modifications were applied must be reviewed.

A tabulation of the 1955 policy year unit report risk experience cards by interval of modification for the same risks as shown in Exhibits 1 and 1A is set forth in Exhibits 2 and 2A. These tabulations indicate for credit risks and debit risks the number of risks, the Standard Premium as reported, the Manual Premium as calculated, the Incurred Losses and the Incurred Loss Ratios at Manual Premium and Standard Premium. These tabulations set forth, therefore, the actual 1955 policy year experience by the modifications actually applied to the premiums of that year, such modifications having been developed from the individual risk experience of policy years 1951, 1952 and 1953.

A summary of the figures shown in Exhibit 2 is set forth below:

1955 Policy Year Experience
of Massachusetts Intrastate Experience Rated Risks

	(1) No. of Risks	(2) % of Total	(3) Standard Premium	(4) Manual Premium	(5) Average Mod. (3)÷(4)	(6) Incurred Losses	(7) Loss Ratio Standard (6)÷(3)	(8) Loss Ratio Manual (6)÷(4)
Credit	6,018	53	$12,548,103	$14,448,018	.868	$ 6,033,340	.481	.418
Debit	5,307	47	16,352,538	13,492,363	1.212	8,692,580	.532	.644
Total	11,325	100	28,900,641	27,940,381	1.034	14,725,920	.510	.527

From the above experience it is clear that the Experience Rating Plan does play an important role in the determination of the cost of Workmen's Compensation insurance. 6,018 credit risks were charged approximately $1,900,000 less than if the Plan had not been in effect, and debit risks were charged $2,860,000 more. It is also clear from the actual experience that the returns and charges were appropriate for the respective groups.

In the case of the credit risks, the resulting modified loss ratio of .481 was closer to the average manual loss ratio for all experience rated risks of .527, and the permissible loss ratio of .600, than was the manual loss ratio for the credit risks of .418. With respect to the debit risks, the modified loss ratio of .532 was closer to the average manual loss ratio for all experience rated risks of .527; however, the modified loss ratio was not as close to the permissible loss ratio as was the manual loss ratio of .644, nor was the overall modified loss ratio for all experience rated risks of .510 as close to the permissible loss ratio as was the overall manual loss ratio of .527. Thus, one of the objectives of the Plan, that is, to bring the loss ratios of risks more closely to the average loss ratio of all risks by charging more or less premium based on the individual risk's experience, is proven by this experience. More often than not, however, it is stated that the Plan will bring the rated risk loss ratios closer to the permissible loss ratio. This is not so when the actual experience departs from the expected experience or the permissible loss ratio. The above experience does show that the Plan brings the loss ratio of risks rated more closely to the average experience.

This actual experience of intrastate experience rated risks by type of modification also shows that the loss ratio of the credit risks, .481, was better than the loss ratio of the debit risks, .532, indicating that the concept that it is better to write a credit risk is justified on an overall loss ratio basis by these statistics. However, it should not follow from these statistics that it is not safe to write debit risks. On the contrary, the overall loss ratio of the debit risks of .532 compares well with the permissible loss ratio of .600 and the non-rated risk loss ratio of .561, and does not compare too badly with the overall, all risk (rated and non-rated) standard loss ratio of .513. Furthermore, within the all debit risk loss ratio of .532, which consists of 5,307 risks, 4,278 risks or 80.6% have loss ratios under .600 producing an aggregate loss ratio of only .197.

Experience of Experience Rated Risks by Loss Ratio Interval

The complete tabulation of intrastate rated risks by standard loss ratio interval is set forth in Exhibit 3. Exhibit 3A sets forth the experience of the credit risks by standard loss ratio interval, and Exhibit 3B sets forth the experience for the debit risks. These tabulations were made, having determined that with respect to loss ratios the experience of credit risks was better than debit risks, in order to demonstrate that, within the average, risks would vary both upward and downward ("better" or "worse"), and to determine how many credit risks turned out to be better than average risks and how many debit risks were better than average risks.

As would be expected from any breakdown of a large number of risks in a relatively low frequency line, the individual risk experience covers a wide range with a high percentage of the risks being in the lower end of the range. A review of these statistics for the debit risks might surprise some debit conscious underwriters, particularly the fact that 17.6% of the debit risks had clear loss experience and 61.4% of the risks had loss ratios under 20%. To some, the fact that 15.4% of the credit risks had loss ratios at the permissible loss ratio level or in excess of the permissible level, and that 10.0% of the credit risks had loss ratios in excess of 100.0%, might be cause to question open acceptance of credit risks.

These statistics continue to demonstrate, however, that on the average it was safer to write credit risks. Where 84.6% of the credit risks had loss ratios under the permissible loss ratio, only 80.6% of the debit risks had loss ratios under the permissible loss ratio.

Experience of Experience Rated Risks by Size of Risk

A further look at the experience of experience rated risks is set forth in Exhibits 4 through 9. Exhibits 4 and 5 set forth the data used to determine the modifications by size of Expected Losses broken down for credit risks, debit risks and total debit and credit risks separately for intrastate rated risks and interstate rated risks. Exhibits 6 and 7 set forth the actual experience by standard premium size for credit, debit and total credit and debit risks separately for intrastate and interstate rated risks. Exhibit 8 sets forth the total Massachusetts data upon which the modifications were based for interstate and intrastate rated risks combined by size of expected loss, and Exhibit 9 sets forth the actual Massachusetts experience by standard premium size for the combined interstate and intrastate rated risks.

It has been well established through studies of risk experience by size of risk that the experience of the larger sized risks is more favorable than that of the smaller sized risks. The data set forth in Exhibits 6, 7 and 9 also demonstrate that point, even though these exhibits include only data of experience rated risks. From these exhibits, it can be seen that not only are the manual loss ratios more favorable as the size of risk increases, but also the modified or standard loss ratios are more favorable.

A summary of the figures shown in Exhibit 6 is set forth below:

1955 Policy Year Experience
Massachusetts Intrastate Experience Rated Risks
By Standard Premium Size

Standard Premium Size	*No. of Risks*	*Standard Premium*	*Average Standard Premium*	*Manual Premium*	*Average Manual Premium*	*Losses Incurred*	*Loss Ratios Stand.*	*Loss Ratios Man.*	*Average Modification*
Under $1,000	4,343	2,861,827	659	2,844,379	655	1,643,184	.574	.578	1.006
$1,000 & Over	6,982	26,038,814	3,729	25,096,002	3,594	13,082,736	.502	.521	1.038
Total	11,325	28,900,641	2,552	27,940,381	2,467	14,725,920	.510	.527	1.034

These figures again emphasize the inequity of applying the off-balance of the Experience Rating Plan entirely to experience rated risks. They also indicate that despite the fact that the eligibility requirements have been shrinking through the impact of inflation, the plan as applied to the smaller risks is accomplishing its purpose of bringing the loss ratios closer to the average or permissible loss ratio.

The fact that each year more risks become eligible for experience rating, and hence a consequent additional expense is incurred, does not offset the practical advantages of having more risks experience rated just as long as the plan is effectively accomplishing its purpose. Experience rating is a form of merit rating and, as is well known, the demand for merit rating is increasing, particularly in lines of compulsory social insurance.

With the growth of social insurance, the enactment of benefit increases and the apparent attendant growth of trade and professional associations, more insurance customers are taking a closer look at the costs of insurance. The explanation of how the costs of insurance are determined is not easily absorbed by the ordinary individual. The use of averages is always "unfavorable" to an irate risk. But the modification of the average to the risk's individual experience, is usually greeted by the risk with the feeling of receiving special attention. The knowledge that the cost of insurance can be in some degree controlled by an individual provides many practical and psychological benefits to the risk and to the insurance industry.

As more risks become eligible for experience rating and understand the effects of experience rating, the less intense becomes the problem of the insurance industry with respect to the filing of rate changes and the subsequent processes that attend such requests for changes. The administrators of trade associations, who interpret their responsibilities to their membership as requiring their vigorous opposition to any rate change whether it be up—"unreasonable"—or down—"not enough", are less apt to push their opposition to the full extent when they realize the effects of experience rating. That experience rating can cause wide risk variations within a classification or within an individual risk from year to year is more acceptable when it is realized that the individual risk can, to some extent, control these variations. With approximately 80% of the premium volume now affected by experience rating, proposed manual or base rate changes become less significant to the rated risk or the trade associaton which might otherwise condemn the insurance industry just on general principles.

To the degree then that the Experience Rating Plan has become universally accepted and has whetted the appetite of those hungry for merit rating, it is important that the Plan be carefully and periodically reviewed to see that it continues to fulfill its objectives, both to the insurance industry and the insurance customers. The fact that the ratio of primary losses to total losses is dropping constantly, so that now less than 50% of the losses are primary losses, requires a revaluation of the relationships and the resulting factors and values of the plan. Also, the spread between a debit loss ratio of .532 and a credit loss ratio of .481, although not a serious imbalance, does indicate that perhaps the plan could be brought more closely into balance, particularly in the area of the small risks which barely meet the eligibility requirements. It is in this area where the largest number of risks are rated and also where the standard loss ratio is higher. It is also interesting to note from Exhibit 3 that the risks with clear experience are of a considerably smaller average premium size. These facts seem to indicate that for these small risks the debit modifications for risks with losses are not high enough to offset the credit risks with clear experience, or, to put it another way, not enough of the losses are being used in the ratings.

Throughout this entire study of the experience of experience rated risks, the principal goal has been to establish whether or not the reluctance of some underwriters to accept debit risks had any foundation in statistical fact. The study stemmed partially from administering an experience rating plan where contact with underwriters seeking experience rating information on individual risks has led to the conclusion that, in many instances, the deciding factor as to whether or not a risk is acceptable, depends on whether or not the risk has a debit modification and to what degree. Of course, the concept that it is not wise to accept debit risks, or that it is better to write credit risks, has been viewed with a somewhat critical eye inasmuch as it does not coincide with the underlying and objective theory of the plan. The plan should be in balance theoretically. The modified loss ratio of all the credit risks should not be any better than the modified loss ratio of all the debit risks.

That the results of this study indicated that the loss ratio of the credit risks was better than the loss ratio of the debit risks was somewhat disturbing from the point of view of trying to prove a point, and yet, the closeness to the average of all debit and credit risks more than justified the application of the plan. It seems somewhat amazing that a mathematical plan can work so effectively, particularly where psychological elements are involved. For example, are not some credit risks apt to rest on their laurels and let down on safety standards, and are not some debit risks apt to become discouraged and decide that the additional insurance charge is a smaller price to pay than the price of adopting more rigid safety standards? However, the Plan, even with this imbalance between the experience of debit and credit risks, is certainly better than no plan at all. For the most part the Plan does function as it was designed to function. The use of past experience of a risk as a guide to predicting the future experience of such a risk is more than amply justified by a review of these statistics.

Whatever the cause for this imbalance, the experience of the debit risks is not sufficiently worse to cause a blanket rejection of all debit risks. It might better be said that the experience of credit risks is somewhat better than that of the debit risks inasmuch as the experience of the debit risks for this policy year is certainly favorable and, that as a whole, such experience would make a nice underwriting portfolio. Furthermore, the experience modification is only a guide as to whether or not a risk is desirable or merely acceptable. By no means can a modification derived under the Experience Rating Plan be the only criterion of whether or not a risk is desirable. Many other factors—physical, moral and psychological—have as important or more important a role to play as the experience rating modification. The experience rating modification is merely another guide, one designed to bring a risk's loss ratio more closely to the average loss ratio. It is not infallible. With proper underwriting and engineering, it can continue to be a profitable guide.

EXHIBIT 1

1955 Policy Year
Experience Rating Statistics

By Interval of Modification

Intrastate Rated Risks

Modification Interval	(1) No. of Ratings	(2) Actual Losses	(3) Expected Losses	(4) Average Size of Expected Losses	(5) Modified Expected Losses	(6) Ratio: Actual to Expected Losses (2)+(3)	(7) Average Modification (5)+(3)
.60 & Under	13	195 898	738 461	56 805	366 732	.265	.497
.61 - .65	23	149 306	508 654	22 115	321 483	.294	.632
.66 - .70	48	139 068	615 254	12 818	419 039	.226	.681
.71 - .75	83	206 833	874 761	10 539	641 909	.236	.734
.76 - .80	190	467 814	1 555 724	8 188	1 219 529	.301	.784
.81 - .85	396	999 682	2 778 670	7 017	2 310 497	.360	.832
.86 - .90	810	996 390	3 110 285	3 840	2 746 201	.320	.883
.91 - .95	2 154	1 641 191	4 973 853	2 309	4 631 761	.330	.931
.96 - .99	2 301	1 885 550	4 204 863	1 827	4 086 386	.448	.972
1.00 - 1.04	1 287	2 334 823	3 091 796	2 402	3 150 800	.755	1.019
1.05 - 1.09	933	3 271 253	3 267 998	3 503	3 493 169	1.001	1.069
1.10 - 1.14	671	3 252 993	2 251 625	3 356	2 525 873	1.445	1.122
1.15 - 1.19	633	4 472 278	2 672 476	4 222	3 141 028	1.673	1.175
1.20 - 1.24	538	4 112 704	1 723 583	3 204	2 098 596	2.386	1.218
1.25 - 1.29	321	2 960 092	1 229 987	3 832	1 561 073	2.407	1.269
1.30 - 1.34	256	2 748 794	1 184 407	4 627	1 563 056	2.321	1.320
1.35 - 1.39	172	2 007 375	861 737	5 010	1 178 071	2.329	1.367
1.40 & over	496	8 892 191	2 661 100	5 365	4 285 524	3.342	1.610
Under 1.00	6 018	6 681 732	19 360 525	3 217	16 743 537	.345	.865
1.00 & over	5 307	34 052 503	18 944 709	3 570	22 997 190	1.797	1.214
Total	11 325	40 734 235	38 305 234	3 382	39 740 727	1.063	1.037

EXHIBIT 1A

1955 Policy Year
Experience Rating Statistics

By Interval of Modification

Interstate Rated Risks

Modification Interval	(1) No. of Ratings	(2) Massachusetts Actual Losses	(3) Massachusetts Expected Losses	(4) Average Size of Massachusetts Expected Losses	(5) Modified Expected Losses	(6) Ratio: Actual to Expected Losses (2)÷(3)	(7) Average Modification (5)÷(3)
.60 & Under	60	904 949	2 496 159	41 603	1 136 366	.363	.455
.61 - .65	50	2 641 711	4 281 058	85 621	2 726 133	.617	.637
.66 - .70	81	776 492	1 696 259	20 941	1 162 716	.458	.685
.71 - .75	117	1 437 205	2 254 346	19 268	1 650 181	.638	.732
.76 - .80	165	1 622 185	2 603 840	15 781	2 042 907	.623	.785
.81 - .85	223	2 659 100	3 846 267	17 248	3 171 078	.691	.824
.86 - .90	300	2 901 744	3 733 938	12 446	3 285 193	.777	.880
.91 - .95	338	2 559 971	3 036 920	8 985	2 822 877	.843	.930
.96 - .99	289	2 295 871	2 775 795	9 605	2 704 556	.827	.974
1.00 - 1.04	249	2 590 992	2 474 865	9 939	2 522 779	1.047	1.109
1.05 - 1.09	239	1 952 851	1 855 485	7 764	1 981 613	1.052	1.068
1.10 - 1.14	206	2 249 415	1 783 072	8 656	1 994 651	1.262	1.119
1.15 - 1.19	153	2 366 872	1 750 162	11 439	2 040 237	1.352	1.166
1.20 - 1.24	116	1 966 821	1 200 007	10 345	1 460 422	1.639	1.217
1.25 - 1.29	91	1 618 793	1 030 702	11 326	1 305 231	1.571	1.266
1.30 - 1.34	72	1 116 533	596 350	8 283	783 895	1.872	1.314
1.35 - 1.39	56	909 912	419 062	7 483	572 589	2.171	1.366
1.40 & Over	201	5 444 020	2 268 913	11 288	3 717 022	2.399	1.638
Under 1.00	1 623	17 799 228	26 724 582	16 466	20 702 007	.666	.775
1.00 & Over	1 383	20 216 209	13 378 618	9 674	16 378 439	1.511	1.224
Total	3 006	38 015 437	40 103 200	13 341	37 080 446	.948	.925

EXHIBIT 2

1955 Policy Year

Experience of Experience Rated Risks by Interval of Modification

Intrastate Rated Risks

Modification Interval	(1) No. of Ratings	(2) Standard Premium	(3) Manual Premium	(4) Average Modification (2)+(3)	(5) Average Manual Premium Size (3)+(1)	(6) Incurred Losses	(7) Loss Ratios Standard (6)+(2)	(8) Loss Ratios Manual (6)+(3)
.60 & Under	13	253 994	518 337	.490	39 872	104 768	.412	.202
.61 - .65	23	213 749	338 194	.632	14 704	88 145	.412	.261
.66 - .70	48	270 505	396 796	.682	8 267	136 207	.504	.343
.71 - .75	83	486 127	663 623	.733	7 995	319 332	.657	.481
.76 - .80	190	904 388	1 153 907	.784	6 073	358 282	.396	.310
.81 - .85	396	1 708 368	2 055 704	.831	5 191	794 698	.465	.387
.86 - .90	810	1 964 312	2 224 214	.883	2 746	862 733	.439	.388
.91 - .95	2 154	3 543 690	3 803 620	.932	1 766	1 824 015	.515	.480
.96 - .99	2 301	3 202 970	3 293 623	.972	1 431	1 545 160	.482	.469
1.00 - 1.04	1 287	2 381 351	2 337 931	1.019	1 817	1 303 116	.547	.557
1.05 - 1.09	933	2 485 870	2 325 728	1.069	2 493	1 450 587	.584	.624
1.10 - 1.14	671	1 795 520	1 601 165	1.121	2 386	841 123	.468	.525
1.15 - 1.19	633	2 189 267	1 864 022	1.174	2 945	1 338 285	.611	.718
1.20 - 1.24	538	1 475 246	1 211 101	1.218	2 251	758 613	.514	.626
1.25 - 1.29	321	1 058 015	834 289	1.268	2 599	494 876	.468	.593
1.30 - 1.34	256	1 064 315	806 712	1.319	3 151	566 584	.532	.702
1.35 - 1.39	172	806 836	590 000	1.368	3 430	428 489	.531	.726
1.40 & over	496	3 096 118	1 921 415	1.611	3 874	1 510 907	.488	.786
Under 1.00	6 018	12 548 103	14 448 018	.868	2 401	6 033 340	.481	.418
1.00 & over	5 307	16 352 538	13 492 363	1.212	2 542	8 692 580	.532	.644
Total	11 325	28 900 641	27 940 381	1.034	2 467	14 725 920	.510	.527

EXHIBIT 2A

1955 Policy Year

Experience of Experience Rated Risks by Interval of Modification

Interstate Rated Risks

Modification Interval	(1) No. of Ratings	(2) Standard Premium	(3) Manual Premium	(4) Average Modification (2)÷(3)	(5) Average Manual Premium Size (3)÷(1)	(6) Incurred Losses	(7) Loss Ratios Standard (6)÷(2)	(8) Loss Ratios Manual (6)÷(3)
.60 & Under	60	840 025	1 825 927	.460	30 432	414 428	.493	.227
.61 - .65	50	1 896 990	2 980 537	.636	59 611	914 217	.482	.307
.66 - .70	81	815 923	1 193 308	.684	14 732	389 338	.477	.326
.71 - .75	117	1 311 812	1 792 462	.732	15 320	519 738	.396	.290
.76 - .80	165	1 420 954	1 813 888	.783	10 993	716 471	.504	.395
.81 - .85	223	2 086 893	2 533 406	.824	11 361	839 589	.402	.331
.86 - .90	300	2 383 289	2 709 429	.880	9 031	1 330 385	.558	.491
.91 - .95	338	1 811 951	1 946 927	.931	5 760	1 002 248	.553	.515
.96 - .99	289	1 774 875	1 821 831	.974	6 304	845 414	.476	.464
1.00 - 1.04	249	1 691 741	1 659 996	1.019	6 667	828 615	.490	.499
1.05 - 1.09	239	1 422 639	1 332 726	1.067	5 576	805 671	.566	.605
1.10 - 1.14	206	1 373 917	1 228 993	1.118	5 966	641 249	.467	.522
1.15 - 1.19	153	1 637 125	1 405 579	1.165	9 187	827 596	.506	.589
1.20 - 1.24	116	996 084	820 184	1.214	7 071	489 138	.491	.596
1.25 - 1.29	91	981 941	775 216	1.267	8 519	530 629	.540	.684
1.30 - 1.34	72	427 535	325 115	1.315	4 515	174 180	.407	.536
1.35 - 1.39	56	399 424	292 011	1.368	5 214	138 163	.346	.473
1.40 & Over	201	2 407 385	1 460 439	1.648	7 266	1 203 813	.500	.824
Under 1.00	1 623	14 342 712	18 617 715	.770	11 471	6 971 828	.486	.374
1.00 & Over	1 383	11 337 791	9 300 259	1.219	6 725	5 639 054	.497	.606
Total	3 006	25 680 503	27 917 974	.920	9 287	12 610 882	.491	.452

EXHIBIT 3

Total Debit and Credit Intrastate Rated Risks
By Standard Loss Ratio Interval

Standard Loss Ratio Interval	(1) No. of Risks	(2) %	(3) Standard Premium	(4) Average Standard Premium Size (3)÷(1)	(5) Manual Premium	(6) Average Manual Premium Size (5)÷(1)	(7) Incurred Losses	(8) Standard Premium Loss Ratio (7)÷(3)	(9) Manual Premium Loss Ratio (7)÷(5)	(10) Average Modification (3)÷(5)
.000	2 390	21.1	$ 2 125 260	$ 889	$ 2 108 205	$ 882	$ -	-	-	1.008
.001 - .199	5 095	45.0	11 972 129	2 350	11 845 374	2 325	981 125	.082	.083	1.011
.200 - .299	777	6.8	3 033 648	3 904	2 859 751	3 681	738 212	.243	.258	1.061
.300 - .399	485	4.3	2 435 822	5 022	2 315 918	4 775	826 542	.339	.357	1.052
.400 - .499	343	3.0	1 442 542	4 206	1 298 449	3 786	663 785	.460	.511	1.111
.500 - .599	279	2.5	1 314 556	4 712	1 236 220	4 431	737 166	.561	.596	1.063
.600 - .699	241	2.1	1 358 675	5 638	1 239 916	5 145	879 046	.647	.709	1.096
.700 - .799	201	1.8	801 219	3 986	746 871	3 716	609 328	.761	.816	1.073
.800 - .899	123	1.1	606 243	4 929	595 845	4 844	513 313	.847	.861	1.017
.900 - .999	123	1.1	516 287	4 197	480 654	3 908	493 798	.956	1.027	1.074
1.000 & Over	1 268	11.2	3 294 260	2 598	3 213 178	2 534	8 283 605	2.515	2.578	1.025
Total	11 325	100.0	28 900 641	2 552	27 940 381	2 467	14 725 920	.510	.527	1.034

EXHIBIT 3A

Intrastate Rated Risks With Credit Modifications
By Standard Loss Ratio Interval

Standard Loss Ratio Interval	(1) No. of Risks	(2) %	(3) Standard Premium	(4) Average Standard Premium Size (3)÷(1)	(5) Manual Premium	(6) Average Manual Premium Size (5)÷(1)	(7) Incurred Losses	(8) Standard Premium Loss Ratio (7)÷(3)	(9) Manual Premium Loss Ratio (7)÷(5)	(10) Average Modification (3)÷(5)
.000	1 454	24.1	$ 1 228 154	$ 845	$ 1 319 222	$ 907	$ -	-	-	.931
.001 - .199	2 774	46.1	5 700 324	2 055	6 609 787	2 383	440 108	.077	.067	.862
.200 - .299	373	6.2	1 125 663	3 018	1 300 666	3 487	276 777	.246	.213	.865
.300 - .399	220	3.7	1 084 373	4 929	1 247 290	5 670	362 320	.334	.290	.869
.400 - .499	150	2.5	420 610	2 804	493 159	3 288	184 945	.440	.375	.853
.500 - .599	120	2.0	486 513	4 054	555 474	4 629	269 110	.553	.484	.876
.600 - .699	114	1.9	387 754	3 401	447 424	3 925	247 844	.639	.554	.867
.700 - .799	97	1.6	296 872	3 061	344 118	3 548	222 374	.749	.646	.863
.800 - .899	55	.9	229 383	4 171	286 646	5 212	195 848	.854	.683	.800
.900 - .999	60	1.0	180 167	3 003	210 140	3 502	171 899	.954	.818	.857
1.000 & Over	601	10.0	1 408 290	2 343	1 634 092	2 719	3 662 115	2.600	2.241	.862
Total	6 018	100.0	12 548 103	2 085	14 448 018	2 401	6 033 340	.481	.418	.868

EXHIBIT 3B

Intrastate Rated Risks with Debit Modifications
By Standard Loss Ratio Interval

Standard Loss Ratio Interval	(1) No. of Risks	(2) %	(3) Standard Premium	(4) Average Standard Premium Size (3)÷(1)	(5) Manual Premium	(6) Average Manual Premium Size (5)÷(1)	(7) Incurred Losses	(8) Standard Premium Loss Ratio (7)÷(3)	(9) Manual Premium Loss Ratio (7)÷(5)	(10) Average Modification (3)÷(5)
.000	936	17.6	$ 897 106	$ 958	$ 788 983	$ 843	$ -	-	-	1.137
.001 - .199	2 321	43.7	6 271 805	2 702	5 235 587	2 256	541 017	.086	.103	1.198
.200 - .299	404	7.6	1 907 985	4 723	1 559 085	3 859	461 435	.242	.296	1.224
.300 - .399	265	5.0	1 351 449	5 100	1 068 628	4 033	464 222	.343	.434	1.265
.400 - .499	193	3.6	1 021 932	5 295	805 290	4 172	478 840	.469	.595	1.269
.500 - .599	159	3.0	828 043	5 208	680 746	4 281	468 056	.565	.688	1.216
.600 - .699	127	2.4	970 921	7 645	792 492	6 240	631 202	.650	.796	1.225
.700 - .799	104	2.0	504 347	4 849	402 753	3 873	386 954	.767	.961	1.252
.800 - .899	68	1.3	376 860	5 542	309 199	4 547	317 465	.842	1.027	1.219
.900 - .999	63	1.2	336 120	5 335	270 514	4 294	321 899	.958	1.190	1.243
1.000 & Over	667	12.6	1 885 970	2 828	1 579 086	2 367	4 621 490	2.450	2.927	1.194
Total	5 307	100.0	16 352 538	3 081	13 492 363	2 542	8 692 580	.532	.644	1.212

EXHIBIT 4

1955 Policy Year

Experience Rating Statistics by Size of Expected Losses

Total Intrastate Rated Risks

(1) Size of Expected Loss	(2) No. of Ratings	(3) Actual Losses	(4) Expected Losses	(5) Modified Expected Losses	(6) Ratio: Actual to Expected Losses (3)÷(4)	(7) Average Modification (5)÷(4)
Under 600	134	65 882	68 800	71 484	.958	1.039
600- 999	2 247	2 031 406	1 914 123	1 978 653	1.061	1.034
1,000- 1,499	2 832	3 817 042	3 450 908	3 574 934	1.106	1.036
1,500- 2,499	2 522	5 326 006	4 840 998	5 027 596	1.100	1.039
2,500- 3,999	1 505	5 540 955	4 728 927	4 964 976	1.172	1.050
4,000- 5,999	825	4 093 896	4 009 139	4 155 611	1.021	1.037
6,000- 7,499	328	2 277 251	2 201 739	2 295 168	1.034	1.042
7,500- 9,999	300	2 898 600	2 586 232	2 730 976	1.121	1.056
10,000- 11,999	155	1 757 993	1 697 550	1 787 173	1.036	1.053
12,000- 14,999	139	2 160 883	1 864 940	2 055 320	1.159	1.102
15,000- 24,999	208	4 322 323	4 004 912	4 271 735	1.079	1.067
25,000- 39,999	77	2 458 015	2 411 428	2 470 084	1.019	1.024
40,000- 59,999	28	1 105 924	1 367 627	1 302 856	.809	.953
60,000- 99,999	17	1 182 983	1 319 835	1 276 031	.896	.967
100,000-149,999	4	330 251	444 999	365 283	.742	.821
150,000-199,999	1	67 310	181 446	74 393	.371	.410
200,000-349,999	2	534 946	549 356	550 347	.974	1.002
350,000 & Over	1	762 569	662 275	788 107	1.151	1.190
Total	11 325	40 734 235	38 305 234	39 740 727	1.063	1.037

EXHIBIT 4A

1955 Policy Year

Experience Rating Statistics by Size of Expected Losses

Credit Intrastate Rated Risks

(1) Size of Expected Loss	(2) No. of Ratings	(3) Actual Losses	(4) Expected Losses	(5) Modified Expected Losses	(6) Ratio: Actual to Expected Losses (3)+(4)	(7) Average Modification (5)+(4)
Under 600	52	1 317	28 258	27 825	.047	.985
600- 999	1 269	88 936	1 083 983	1 047 832	.082	.967
1,000- 1,499	1 554	209 448	1 885 888	1 791 878	.111	.950
1,500- 2,499	1 361	408 036	2 608 150	2 409 446	.156	.924
2,500- 3,999	743	464 486	2 325 501	2 072 429	.200	.891
4,000- 5,999	419	630 991	2 035 127	1 767 662	.310	.869
6,000- 7,499	170	461 987	1 142 006	972 692	.405	.852
7,500- 9,999	149	690 052	1 286 586	1 089 778	.536	.847
10,000- 11,999	81	417 368	888 358	736 417	.470	.829
12,000- 14,999	59	377 823	794 421	659 512	.476	.830
15,000- 24,999	94	931 753	1 813 554	1 513 215	.514	.834
25,000- 39,999	37	656 030	1 167 042	937 328	.562	.803
40,000- 59,999	17	479 360	830 572	666 006	.577	.802
60,000- 99,999	8	304 182	630 879	437 075	.482	.693
100,000-149,999	3	175 462	318 169	213 087	.551	.670
150,000-199,999	1	67 310	181 446	74 393	.371	.410
200,000-349,999	1	317 191	340 585	326 962	.931	.960
Total	6 018	6 681 732	19 360 525	16 743 537	.345	.865

EXHIBIT 4B

1955 Policy Year

Experience Rating Statistics by Size of Expected Losses

Debit Intrastate Rated Risks

(1) Size of Expected Loss	(2) No. of Ratings	(3) Actual Losses	(4) Expected Losses	(5) Modified Expected Losses	(6) Ratio: Actual to Expected Losses (3)+(4)	(7) Average Modification (5)+(4)
Under 600	82	64 565	40 542	43 659	1.593	1.077
600- 999	978	1 942 470	830 140	930 821	2.340	1.121
1,000- 1,499	1 278	3 607 594	1 565 020	1 783 056	2.305	1.139
1,500- 2,499	1 161	4 917 970	2 232 848	2 618 150	2.203	1.173
2,500- 3,999	762	5 076 469	2 403 426	2 892 547	2.112	1.204
4,000- 5,999	406	3 462 905	1 974 012	2 387 949	1.754	1.210
6,000- 7,499	158	1 815 264	1 059 733	1 322 476	1.713	1.248
7,500- 9,999	151	2 208 548	1 299 646	1 641 198	1.699	1.263
10,000- 11,999	74	1 340 625	809 192	1 050 756	1.657	1.299
12,000- 14,999	80	1 783 060	1 070 519	1 395 808	1.666	1.304
15,000- 24,999	114	3 390 570	2 191 358	2 758 520	1.547	1.259
25,000- 39,999	40	1 801 985	1 244 386	1 532 756	1.448	1.232
40,000- 59,999	11	626 564	537 055	636 850	1.167	1.186
60,000- 99,999	9	878 801	688 956	838 956	1.276	1.218
100,000-149,999	1	154 789	126 830	152 196	1.220	1.200
200,000-349,999	1	217 755	208 771	223 385	1.043	1.070
350,000 & Over	1	762 569	662 275	788 107	1.151	1.190
Total	5 307	34 052 503	18 944 709	22 997 190	1.797	1.214

EXHIBIT 5

1955 Policy Year

Experience Rating Statistics by Size of Expected Losses

Total Interstate Rated Risks

(1) Size of Expected Loss	(2) No. of Ratings	(3) Actual Losses	(4) Expected Losses	(5) Modified Expected Losses	(6) Ratio: Actual to Expected Losses (3)+(4)	(7) Average Modification (5)+(4)
Under 600	386	183 563	109 130	106 175	1.682	.973
600- 999	224	232 546	182 769	178 030	1.272	.974
1,000- 1,499	280	431 379	348 292	356 304	1.239	1.023
1,500- 2,499	407	807 163	798 878	809 500	1.010	1.013
2,500- 3,999	340	1 382 498	1 098 877	1 158 222	1.258	1.054
4,000- 5,999	294	1 782 624	1 440 500	1 523 747	1.238	1.058
6,000- 7,499	141	1 060 376	950 437	992 099	1.116	1.044
7,500- 9,999	193	1 814 859	1 651 889	1 683 137	1.099	1.019
10,000- 11,999	85	1 020 418	937 139	963 096	1.089	1.028
12,000- 14,999	113	1 680 541	1 530 641	1 595 409	1.098	1.042
15,000- 24,999	204	4 008 533	3 902 595	3 939 763	1.027	1.010
25,000- 39,999	130	4 520 771	4 058 667	4 196 990	1.114	1.034
40,000- 59,999	85	4 163 468	4 275 945	4 180 520	.974	.978
60,000- 99,999	69	4 840 542	5 350 950	5 008 909	.905	.936
100,000-149,999	24	2 645 164	2 873 012	2 720 853	.921	.947
150,000-199,999	14	1 894 624	2 512 745	2 030 902	.754	.808
200,000-349,999	9	1 613 252	2 402 404	1 778 424	.672	.740
350,000 & Over	8	3 933 116	5 678 330	3 858 366	.693	.679
Total	3 006	38 015 437	40 103 200	37 080 446	.948	.925

EXHIBIT 5A

1955 Policy Year

Experience Rating Statistics by Size of Expected Losses

Credit Interstate Rated Risks

(1) Size of Expected Loss	(2) No. of Ratings	(3) Actual Losses	(4) Expected Losses	(5) Modified Expected Losses	(6) Ratio: Actual to Expected Losses (3)÷(4)	(7) Average Modification (5)÷(4)
Under 600	228	57 657	63 718	53 096	.905	.833
600- 999	141	29 658	114 626	99 790	.259	.871
1,000- 1,499	150	63 363	184 902	163 708	.343	.885
1,500- 2,499	226	165 546	444 022	393 009	.373	.885
2,500- 3,999	163	221 824	519 958	449 685	.427	.865
4,000- 5,999	138	309 191	667 729	580 822	.463	.870
6,000- 7,499	71	294 109	477 678	414 049	.616	.867
7,500- 9,999	95	508 845	818 022	684 116	.622	.836
10,000- 11,999	42	293 980	468 485	380 111	.628	.811
12,000- 14,999	58	450 088	786 355	629 326	.572	.800
15,000- 24,999	102	1 236 887	1 964 839	1 585 199	.630	.807
25,000- 39,999	68	1 501 215	2 138 835	1 777 591	.702	.831
40,000- 59,999	52	1 875 749	2 626 146	2 169 320	.714	.826
60,000- 99,999	46	2 602 510	3 543 017	2 870 341	.735	.810
100,000-149,999	15	1 316 364	1 831 462	1 428 821	.719	.780
150,000-199,999	11	1 325 874	1 994 054	1 386 233	.665	.695
200,000-349,999	9	1 613 252	2 402 404	1 778 424	.672	.740
350,000 & Over	8	3 933 116	5 678 330	3 858 366	.693	.679
Total	1 623	17 799 228	26 724 582	20 702 007	.666	.775

EXHIBIT 5B

1955 Policy Year

Experience Rating Statistics by Size of Expected Losses

Debit Interstate Rated Risks

(1) Size of Expected Loss	(2) No. of Ratings	(3) Actual Losses	(4) Expected Losses	(5) Modified Expected Losses	(6) Ratio: Actual to Expected Losses (3)+(4)	(7) Average Modification (5)+(4)
Under 600	158	125 906	45 412	53 079	2.773	1.169
600- 999	83	202 888	68 143	78 240	2.977	1.148
1,000- 1,499	130	368 016	163 390	192 596	2.252	1.179
1,500- 2,499	181	641 617	354 856	416 491	1.808	1.174
2,500- 3,999	177	1 160 674	578 919	708 537	2.005	1.224
4,000- 5,999	156	1 473 433	772 771	942 925	1.907	1.220
6,000- 7,499	70	766 267	472 759	578 050	1.621	1.223
7,500- 9,999	98	1 306 014	833 867	999 021	1.566	1.198
10,000- 11,999	43	726 438	468 654	582 985	1.550	1.244
12,000- 14,999	55	1 230 453	744 286	966 083	1.653	1.298
15,000- 24,999	102	2 771 646	1 937 756	2 354 564	1.430	1.215
25,000- 39,999	62	3 019 556	1 919 832	2 419 399	1.573	1.260
40,000- 59,999	33	2 287 719	1 649 799	2 011 200	1.387	1.219
60,000- 99,999	23	2 238 032	1 807 933	2 138 568	1.238	1.183
100,000-149,999	9	1 328 800	1 041 550	1 292 032	1.276	1.240
150,000-199,999	3	568 750	518 691	644 669	1.097	1.243
Total	1 383	20 216 209	13 378 618	16 378 439	1.511	1.224

EXHIBIT 6

1955 Policy Year

Experience of Experience Rated Risks by Premium Size

Total Intrastate Rated Risks

(1) Standard Premium Size	(2) No. of Risks	(3) Standard Premium	(4) Manual Premium	(5) Losses Incurred	(6) Loss Ratios Standard (5)+(3)	(7) Loss Ratios Manual (5)+(4)
$ 499 & Under	828	265 840	264 604	163 729	.616	.619
500- 999	3 515	2 595 987	2 579 775	1 479 455	.570	.573
1,000- 1,999	3 444	4 804 028	4 746 019	2 591 456	.539	.546
2,000- 2,999	1 332	3 223 197	3 144 966	1 615 837	.501	.514
3,000- 4,999	1 020	3 829 155	3 754 609	1 964 513	.513	.523
5,000- 9,999	722	4 920 550	4 727 303	2 697 855	.548	.571
10,000-19,999	324	4 284 444	3 994 451	1 863 613	.435	.467
20,000-29,999	83	1 921 668	1 831 658	864 662	.450	.472
30,000-39,999	27	886 548	855 811	417 649	.471	.488
40,000-49,999	13	558 863	462 222	223 853	.401	.484
50,000-59,999	7	390 735	492 018	151 357	.387	.308
60,000-69,999	3	204 054	203 435	176 338	.864	.867
70,000-79,999	2	149 782	126 050	93 719	.626	.744
80,000-89,999	1	88 761	82 954	46 311	.522	.558
90,000-99,999	1	94 644	49 552	11 825	.125	.239
100,000 & Over	3	682 385	624 954	363 748	.533	.582
Total	11 325	28 900 641	27 940 381	14 725 920	.510	.527
Under $1,000	4 343	2 861 827	2 844 379	1 643 184	.574	.578
$1,000 & Over	6 982	26 038 814	25 096 002	13 082 736	.502	.521

EXHIBIT 6A

1955 Policy Year

Experience of Experience Rated Risks by Premium Size

Credit Intrastate Rated Risks

(1) Standard Premium Size	(2) No. of Risks	(3) Standard Premium	(4) Manual Premium	(5) Losses Incurred	(6) Loss Ratios Standard (5)÷(3)	(7) Loss Ratios Manual (5)÷(4)
$ 499 & Under	522	169 838	177 569	94 555	.557	.532
500- 999	2 123	1 541 594	1 624 230	766 784	.497	.472
1,000- 1,999	1 859	2 567 175	2 787 241	1 309 341	.510	.470
2,000- 2,999	606	1 450 135	1 637 762	695 877	.480	.425
3,000- 4,999	446	1 665 679	1 939 436	731 768	.439	.377
5,000- 9,999	300	2 023 249	2 388 478	1 060 150	.524	.444
10,000-19,999	115	1 485 196	1 779 795	599 754	.404	.337
20,000-29,999	30	700 342	885 790	349 107	.498	.394
30,000-39,999	8	268 365	365 613	151 614	.565	.415
40,000-49,999	3	131 816	172 652	41 171	.312	.238
50,000-59,999	4	220 418	340 485	112 427	.510	.330
60,000-69,999	1	68 393	82 401	38 574	.564	.468
100,000 & Over	1	255 903	266 566	82 218	.321	.308
Total	6 018	12 548 103	14 448 018	6 033 340	.481	.418
Under $1,000	2 645	1 711 432	1 801 799	861 339	.503	.478
$1,000 & Over	3 373	10 836 671	12 646 219	5 172 001	.477	.409

EXHIBIT 6B

1955 Policy Year

Experience of Experience Rated Risks by Premium Size

Debit Intrastate Rated Risks

(1) Standard Premium Size	(2) No. of Risks	(3) Standard Premium	(4) Manual Premium	(5) Losses Incurred	(6) Loss Ratios Standard (5)+(3)	(7) Loss Ratios Manual (5)+(4)
$ 499 & Under	306	96 002	87 035	69 174	.721	.795
500- 999	1 392	1 054 393	955 545	712 671	.676	.746
1,000- 1,999	1 585	2 236 853	1 958 778	1 282 115	.573	.655
2,000- 2,999	726	1 773 062	1 507 204	919 960	.519	.610
3,000- 4,999	574	2 163 476	1 815 173	1 232 745	.570	.679
5,000- 9,999	422	2 897 301	2 338 825	1 637 705	.565	.700
10,000-19,999	209	2 799 248	2 214 656	1 263 859	.451	.571
20,000-29,999	53	1 221 326	845 868	515 555	.422	.545
30,000-39,999	19	618 183	490 198	266 035	.430	.543
40,000-49,999	10	427 047	289 570	182 682	.428	.631
50,000-59,999	3	170 317	151 533	38 930	.229	.253
60,000-69,999	2	135 661	121 034	137 764	1.016	1.138
70,000-79,999	2	149 782	126 050	93 719	.626	.744
80,000-89,999	1	88 761	82 954	46 311	.522	.558
90,000-99,999	1	94 644	49 552	11 825	.125	.239
100,000 & Over	2	426 482	358 388	281 530	.660	.786
Total	5 307	16 352 538	13 492 363	8 692 580	.532	.644
Under $1,000	1 698	1 150 395	1 042 580	781 845	.680	.750
$1,000 & Over	3 609	15 202 143	12 449 783	7 910 735	.520	.635

EXHIBIT 7

1955 Policy Year

Experience of Experience Rated Risks by Premium Size

Total Interstate Rated Risks

(1) Standard Premium Size	(2) No. of Risks	(3) Standard Premium	(4) Manual Premium	(5) Losses Incurred	(6) Loss Ratios Standard (5)+(3)	(7) Loss Ratios Manual (5)+(4)
$ 499 & Under	497	140 026	172 996	46 740	.334	.270
500- 999	383	290 242	302 807	240 833	.830	.795
1,000- 1,999	512	742 322	753 237	407 425	.549	.541
2,000- 2,999	282	670 798	685 942	427 062	.637	.623
3,000- 4,999	347	1 360 851	1 393 777	778 328	.572	.558
5,000- 9,999	416	2 884 296	2 973 299	1 520 277	.527	.511
10,000-19,999	265	3 721 735	3 754 604	2 070 405	.556	.551
20,000-29,999	120	2 914 909	3 119 970	1 398 297	.480	.448
30,000-39,999	65	2 261 569	2 372 159	1 080 470	.478	.455
40,000-49,999	26	1 172 072	1 213 524	594 515	.507	.490
50,000-59,999	30	1 666 165	1 855 943	733 846	.440	.395
60,000-69,999	17	1 126 047	1 117 094	495 651	.440	.444
70,000-79,999	10	735 452	857 500	359 940	.489	.420
80,000-89,999	9	756 529	857 219	242 819	.321	.283
90,000-99,999	2	195 378	151 456	111 968	.573	.739
100,000 & Over	25	5 042 112	6 336 447	2 102 306	.417	.332
Total	3 006	25 680 503	27 917 974	12 610 882	.491	.452
Under $1,000	880	430 268	475 803	287 573	.668	.604
$1,000 & Over	2 126	25 250 235	27 442 171	12 323 309	.488	.449

EXHIBIT 7A

1955 Policy Year

Experience of Experience Rated Risks by Premium Size

Credit Interstate Rated Risks

(1) Standard Premium Size	(2) No. of Risks	(3) Standard Premium	(4) Manual Premium	(5) Losses Incurred	(6) Loss Ratios Standard (5)÷(3)	(7) Loss Ratios Manual (5)÷(4)
$ 499 & Under	313	96 495	135 539	34 609	.359	.255
500- 999	239	182 813	209 370	173 057	.947	.827
1,000- 1,999	269	384 261	441 031	179 674	.468	.407
2,000- 2,999	148	349 080	408 732	267 182	.765	.654
3,000- 4,999	177	694 481	828 440	489 633	.705	.591
5,000- 9,999	199	1 382 316	1 736 895	666 458	.482	.384
10,000-19,999	110	1 576 128	1 986 280	861 868	.547	.434
20,000-29,999	66	1 600 596	2 040 621	762 437	.476	.374
30,000-39,999	38	1 319 935	1 579 022	708 427	.537	.449
40,000-49,999	11	510 603	697 481	273 716	.536	.392
50,000-59,999	18	998 990	1 350 034	379 829	.380	.281
60,000-69,999	6	399 622	523 154	149 713	.375	.286
70,000-79,999	5	368 895	526 763	166 316	.451	.316
80,000-89,999	6	510 977	640 465	149 666	.293	.234
100,000 & Over	18	3 967 520	5 513 888	1 709 243	.431	.310
Total	1 623	14 342 712	18 617 715	6 971 828	.486	.374
Under $1,000	552	279 308	344 909	207 666	.744	.602
$1,000 & Over	1 071	14 063 404	18 272 806	6 764 162	.481	.370

EXHIBIT 7B

1955 Policy Year

Experience of Experience Rated Risks by Premium Size

Debit Interstate Rated Risks

(1) Standard Premium Size	(2) No. of Risks	(3) Standard Premium	(4) Manual Premium	(5) Losses Incurred	(6) Loss Ratios Standard (5)+(3)	(7) Loss Ratios Manual (5)+(4)
$ 499 & Under	184	43 531	37 457	12 131	.279	.324
500- 999	144	107 429	93 437	67 776	.631	.725
1,000- 1,999	243	358 061	312 206	227 751	.636	.729
2,000- 2,999	134	321 718	277 210	159 880	.497	.577
3,000- 4,999	170	666 370	565 337	288 695	.433	.511
5,000- 9,999	217	1 501 980	1 236 404	853 819	.568	.691
10,000-19,999	155	2 145 607	1 768 324	1 208 537	.563	.683
20,000-29,999	54	1 314 313	1 079 349	635 860	.484	.589
30,000-39,999	27	941 634	793 137	372 043	.395	.469
40,000-49,999	15	661 469	516 043	320 799	.485	.622
50,000-59,999	12	667 175	505 909	354 017	.531	.700
60,000-69,999	11	726 425	593 940	345 938	.476	.582
70,000-79,999	5	366 557	330 737	193 624	.528	.585
80,000-89,999	3	245 552	216 754	93 153	.379	.430
90,000-99,999	2	195 378	151 456	111 968	.573	.739
100,000 & Over	7	1 074 592	822 559	393 063	.366	.478
Total	1 383	11 337 791	9 300 259	5 639 054	.497	.606
Under $1,000	328	150 960	130 894	79 907	.529	.610
$1,000 & Over	1 055	11 186 831	9 169 365	5 559 147	.497	.606

EXHIBIT 8

1955 Policy Year

Experience Rating Statistics by Size of Expected Losses

Total Interstate and Intrastate Rated Risks

(1) Size of Expected Loss	(2) No. of Ratings	(3) Actual Losses	(4) Expected Losses	(5) Modified Expected Losses	(6) Ratio: Actual to Expected Losses (3)+(4)	(7) Average Modification (5)+(4)
Under 600	520	249 445	177 930	177 659	1.402	.998
600- 999	2 471	2 263 952	2 096 892	2 156 683	1.080	1.029
1,000- 1,499	3 112	4 248 421	3 799 200	3 931 238	1.118	1.035
1,500- 2,499	2 929	6 133 169	5 639 876	5 837 096	1.087	1.035
2,500- 3,999	1 845	6 923 453	5 827 804	6 123 198	1.188	1.051
4,000- 5,999	1 119	5 876 520	5 449 639	5 679 358	1.078	1.042
6,000- 7,499	469	3 337 627	3 152 176	3 287 267	1.059	1.043
7,500- 9,999	493	4 713 459	4 238 121	4 414 113	1.112	1.042
10,000- 11,999	240	2 778 411	2 634 689	2 750 269	1.055	1.044
12,000- 14,999	252	3 841 424	3 395 581	3 650 729	1.131	1.075
15,000- 24,999	412	8 330 856	7 907 507	8 211 498	1.054	1.038
25,000- 39,999	207	6 978 786	6 470 095	6 667 074	1.079	1.030
40,000- 59,999	113	5 269 392	5 643 572	5 483 376	.934	.972
60,000- 99,999	86	6 023 525	6 670 785	6 284 940	.903	.942
100,000-149,999	28	2 975 415	3 318 011	3 086 136	.897	.930
150,000-199,999	15	1 961 934	2 694 191	2 105 295	.728	.781
200,000-349,999	11	2 148 198	2 951 760	2 328 771	.728	.789
350,000 & Over	9	4 695 685	6 340 605	4 646 473	.741	.733
Total	14 331	78 749 672	78 408 434	76 821 173	1.004	.980

EXHIBIT 9

1955 Policy Year

Experience of Experience Rated Risks by Premium Size

Total Interstate and Intrastate Rated Risks

(1) Standard Premium Size	(2) No. of Risks	(3) Standard Premium	(4) Manual Premium	(5) Losses Incurred	(6) Loss Ratios Standard (5)÷(3)	(7) Loss Ratios Manual (5)÷(4)
$ 499 & Under	1 324	405 866	437 600	210 469	.519	.481
500- 999	3 898	2 886 229	2 882 582	1 720 288	.596	.597
1,000- 1,999	3 956	5 546 350	5 499 256	2 998 881	.541	.545
2,000- 2,999	1 614	3 893 995	3 830 908	2 042 899	.525	.533
3,000- 4,999	1 367	5 190 006	5 148 386	2 742 841	.528	.533
5,000- 9,999	1 138	7 804 846	7 700 602	4 218 132	.540	.548
10,000-19,999	589	8 006 179	7 749 055	3 934 018	.491	.508
20,000-29,999	203	4 836 577	4 951 628	2 262 959	.468	.457
30,000-39,999	92	3 148 117	3 227 970	1 498 119	.476	.464
40,000-49,999	39	1 730 935	1 675 746	818 368	.473	.488
50,000-59,999	37	2 056 900	2 347 961	885 203	.430	.377
60,000-69,999	20	1 330 101	1 320 529	671 989	.505	.509
70,000-79,999	12	885 234	983 550	453 659	.512	.461
80,000-89,999	10	845 290	940 173	289 130	.342	.308
90,000-99,999	3	290 022	201 008	123 793	.427	.616
100,000 & Over	28	5 724 497	6 961 401	2 466 054	.431	.354
Total	14 331	54 581 144	55 858 355	27 336 802	.501	.489
Under $1,000	5 223	3 292 095	3 320 182	1 930 757	.586	.582
$1,000 & Over	9 108	51 289 049	52 538 173	25 406 045	.495	.484

AUTOMOBILE PHYSICAL DAMAGE RATEMAKING

BY

LUTHER L. TARBELL, JR.

The Automobile Physical Damage line of insurance embraces the more commonly known coverages of Automobile Fire, Automobile Fire and Theft, Automobile Comprehensive, (which encompasses Fire and Theft plus additional coverages) and Automobile Collision. The manual rates for these coverages are made for a great majority of insurance companies by the National Automobile Underwriters Association. The present ratemaking procedure of the NAUA was established in 1952. Prior to its adoption, automobile physical damage rates had been developed under a so-called "50/50 formula" wherein all expenses (except allocated claim expense which was handled as an element of loss) were stated as a percentage of the premium dollar and indicated state rate changes were developed by comparing a permissible loss ratio (50%) with an experience loss ratio. This paper proposes to set forth the procedures now followed under the "needed premium revenue" method of ratemaking presently in effect. Where practicable the steps of a rate revision will be illustrated with exhibits relating to a typical revision, the 1957 revision of automobile physical damage rates for the state of Connecticut.

Source Data

The NAUA is the statistical bureau for all states (except Louisiana, North Carolina, Texas and Virginia), the District of Columbia, Alaska and Puerto Rico.[1] Member companies of the NAUA are obligated to report their experience on all risks written in these jurisdictions, while subscriber companies are to report their experience in any states and territories in which they are subscribers. Any subscriber writing at deviating rates must report its premium writings adjusted to a manual basis. Companies which are neither members nor subscribers may report their experience under the approved plan where the proper authority in the state has made such provision.

Statistical Plan

Statistical reportings of the data necessary for ratemaking purposes are required under the approved "Automobile Statistical Plan for Fire, Theft, Comprehensive, Collision and Allied Coverages" of the NAUA. This plan became effective July, 1956 and makes available, on a direct basis, all written premiums and exposures and all paid losses involving any automobile physical damage coverage. Pre-

[1]The NAUA has been appointed a statistical agent for the states of Louisiana, North Carolina, Texas, Virginia and Hawaii and experience *may* be reported, using the special codes applicable in these states, through the NAUA.

mium writings may be reported monthly on unit premium punch cards or quarterly on summary punch cards giving the following essential information:

1. Company code number
2. Accounting month and year
3. Identification (Policy Number)
4. Effective month and year
5. Expiry month and year
6. Exposure in car months
7. Risk location—State & Territory
8. Class
9. Age group
10. Form
11. Encumbrance
12. Transaction code (plus or minus entries)
13. Coverage code
14. Premiums
    a. Other than Collision
    b. Collision only

A code number has been assigned to each state and the territories within each state are defined and assigned codes. The class code for private passenger automobiles depends upon the collision class plan in effect in a given state and upon the symbol assigned the vehicle insured. Most states employ the three class collision plan which involves:[2]

Private Passenger Automobiles (Individually Owned)	*Premium Class*[3]
No Male Operator Under Age 25	
Non-Business Use	1
Business and Non-Business Use	3
Male Operator Under Age 25—Business and Non-Business Use	
Neither Owner nor Principal Operator or Owner or Principal Operator—Married	2A
Owner or Principal Operator—Unmarried	2C

The class codes assigned commercial automobiles are based upon the original cost new (complete car—chassis and body) and the use of the vehicle as to local, intermediate or long distance hauling. Class codes are also assigned Public Automobiles (taxis, livery, buses etc.) and Miscellaneous type vehicles (snowplows, street sweepers, motorcycles, etc.).

The symbols assigned private passenger vehicles, which are actually a part of the class code, are based upon the FOB list price and are shown in the Automobile Physical Damage Manual of the NAUA. The original cost new is used to group commercial vehicles into

[2]New Hampshire employs a no collision class plan (essentially one class). Special class plans are in effect in Texas and Puerto Rico.

[3]In addition to classes 1, 2A, 2C and 3 there are Farm classes of 1F, 2AF, and 2CF for use where farmer credit is in effect.

similar categories. The purpose of these groupings is to establish relativities between the differently priced makes and models of motor vehicles so that rates which reflect the values at risk may be developed. Age group codes are assigned to the vehicles, depending upon the number of months prior to the date the insurance attaches that the vehicle was purchased new. Private passenger automobiles are assigned age group codes as follows:

Automobiles Purchased New Prior to Date Insurance Attaches:	*Code*
Not more than 6 months	1
More than 6 months, not more than 18 months	2
More than 18 months, not more than 30 months	3
More than 30 months	4

Commerical vehicles written under actual value policies take the same codes as above, while those written under the stated amount forms are coded as either new (code 1—not more than 18 months) or old (code 3—more than 18 months). Public vehicles take the same age group codes as private passenger automobiles while buses and miscellaneous types are grouped as either new or old. Both dealers risks and fleet rated risks require no age group coding.

Fire, Theft, and Comprehensive (excluding collision) coverages may be written for both private passenger cars and commercial vehicles on either a stated amount or an actual value basis, except for fleet rated risks and antique automobiles which must be written under the stated amount form. Where the stated amount form is used the rates per $100 of insurance are applied to the amount of insurance stated in the policy to arrive at the premium to be charged. Under the actual value form of policy, premium charges are calculated and published by the NAUA for each symbol and age group of automobile by territory. The method of determining actual value premiums is to average the values at risk for each symbol and use a percentage of this value, depending upon the age group of the auto, to develop a premium from the stated amount rates.[4]

The following table shows the percentages of the value for any private passenger automobile symbol or commercial vehicle cost grouping used in calculating actual value comprehensive premiums:

Age Groups	*Private Passenger*	*Commercial*
1	Mfg. Price at Factory	Original Cost New (chassis & body)
2	90% of " " " "	75% of " " " " " "
3	75% of " " " "	50% of " " " " " "
4	60% of " " " "	35% of " " " " " "

[4]In the development of Commercial actual value premiums the fire rate for age groups 3 and 4 is increased by 50% before multiplying by the average value at risk.

Collision coverage is written on an actual value basis only; therefore, the manual carries premiums to be charged by territory, classification, symbol or original cost new, and age group. These premiums are calculated in the same manner as the actual value premiums for Comprehensive, using average values at risk and percentages of these values based on the age group of the vehicle.

The following table shows the percentage of the value for any private passenger automobile symbol or commercial vehicle cost grouping for local hauling used in calculating collision premiums.[5]

Age Groups	*Private Passenger*	*Commercial—Local Hauling*
1	Mfg. Price at Factory	Original Cost New (chassis & body)
2	95% of " " " "	" " " " " "
3	90% of " " " "	80% of " " " " " "
4	85% of " " " "	80% of " " " " " "

Coverage codes are used to split the premiums being reported into (a) Other than Collision (i.e. Fire, Fire and Theft, Comprehensive, etc.) and (b) Collision only (i.e. Full Coverage, $50 Deductible, etc.).

Paid losses are to be reported monthly on unit loss punch cards giving the following information:

1. Company number
2. Accounting month and year
3. Effective month and year
4. Expiry month and year
5. Loss month and year
6. Risk location—State & Territory
7. Class
8. Age group
9. Encumbrance
10. Coverage
11. Cause of loss
12. Number of losses
13. Loss payment

Loss reportings must also designate catastrophe losses as defined by the association. When, in the opinion of the staff of the NAUA, any event could produce losses for non-collision coverages estimated to exceed one-half of the amount necessary to classify the event as a catastrophe, code numbers will be assigned to each state involved and losses arising from this event will be so designated. Losses from a single event which amount to 5% or less of the annual statewide premium volume for non-collision coverages will be treated in the usual manner and included in the experience. When losses from a single event exceed 5%, up to a maximum of 25% of the annual statewide premium volume, that portion of the losses in excess of 5% will be distributed over the three year period used for ratemaking on the basis of one-half for the first year, one-third for the second year and one-sixth for the third year. Where catastrophe losses are in excess of 25% of the annual statewide premium volume the losses in excess of 25% shall be disregarded in the rating of the state. To provide for this exclusion of losses in excess of 25% a 1% catastrophe loading

[5]There is no age differential for intermediate or long distance hauling.

shall be included in the rate for those non-collision coverages which are subject to a catastrophe hazard.

Special Annual Reports

In addition to the regular reportings under the Statistical Plan, two supplemental "calls" are also issued. One requires an analysis of Direct Taxes, Licenses and Fees Incurred by State and also Direct Written Premiums by State for the Auto Physical Damage coverages. The other requests the automobile physical damage experience shown in the Insurance Expense Exhibit compiled annually by each company plus the following countrywide items not available in this exhibit:

1. Unearned Premiums, December 31, previous year
2. Unearned Premiums, December 31, current year
3. Net losses paid current year

In analysing the statistics reported under either of these supplemental calls aggregate comparisons are made with the data gathered under the continuous reportings of the Statistical Plan and any significant discrepancies are reconciled.

Ratemaking Procedure

The ratemaking procedure of the NAUA can be outlined by the following steps:

1. Determination of an overall statewide rate level change.
2. Distribution of this indicated change to the various coverages based upon the experience of the coverage.
3. Distribution of the indicated change by coverage to territories based upon the experience by territory.
4. Distribution of the territorial indicated change to classification based upon the classification relativities established from experience.

Statewide Rate Level

The first step in a revision of rates is the determination of the required change in the statewide rate level for all coverages and classes combined. This indicated change is obtained by comparing the weighted average actual premiums earned for the experience period adjusted to current rates with "needed premium revenue" for the same period.[6] Calendar year statistics are used since most physical damage losses develop and are paid within a relatively short period of time. The experience of the years being reviewed is weighted on the basis of 70% for the latest year, 20% for the first previous year

[6] The method of adjusting to current rates the calendar year's actual earned premiums is through the use of comparative areas as outlined in Mr. Ralph Marshall's article "Workmen's Compensation Insurance Ratemaking" P. C. A. S., Volume XLI, pp's 30-32.

and 10% for the second previous year.[7] Since the largest weight is given the latest year's experience the economic conditions reflected by this period tend to become incorporated in the rate revision at nearly full value.

Calculation of the "Needed Premium Revenue"

The "needed premium revenue" is composed of the following dollar amounts:

1. Losses incurred
2. Loss adjustment expenses incurred
3. Company expenses incurred

increased by percentage loadings for the following items:

4. Acquisition
5. Taxes
6. Profit and contingencies

and is developed from the statistics gathered under the Statistical Plan and from the experience received through the special calls.

Losses and Loss Adjustment Expenses

Paid loss data by state is available from the unit punch card reportings of the Statistical Plan. In order to produce incurred values for each state the experience received from the special call for Insurance Expense Exhibit data is utilized. By relating countrywide losses incurred to losses paid (Exhibit I) a factor is developed which is used to adjust the statewide paid loss data to an incurred basis (Exhibit II, Line 3).

Loss adjustment expenses paid and incurred as reported in the Insurance Expense Exhibit include both allocated and unallocated claim expense. The relationship between paid losses and paid loss adjustment expense on a countrywide basis develops a ratio (Exhibit I) to apply to statewide paid losses (Exhibit II, Line 9) to arrive at statewide allocated and unallocated loss adjustment expense paid. By relating countrywide loss adjustment expenses paid to incurred another ratio (Exhibit I) is derived which is applied to the statewide paid figure (Exhibit II, Line 12) to produce statewide allocated and unallocated loss adjustment expense incurred.

Losses incurred, as calculated above, are adjusted through the use of a trend factor to bring them as closely as possible in line with current price levels as of the date of the revision. The present factor used is based upon the automobile repair cost figures compiled by the U. S. Bureau of Labor Statistics as part of their Consumers' Price Index. Previously the factor was developed from the Consumers'

[7]The experience period has recently been revised to two years giving the latest year's experience 70% weight and the first previous year's experience 30%. This change was incorporated because of the inflationary trend of our economy in an attempt to give the most current experience greater effect in the ratemaking procedure.

Price Index. This Index is developed using the 1947-1949 period as the base. The Index is recorded as of the 15th of each month and a moving average of the previous twelve months is calculated. As of the date of a rate revision the current Index is related to the twelve month averages for the three years being used in the ratemaking and a factor to adjust each year's losses to current price levels is developed (Exhibits III and IV).

Company Expenses

The items of expense shown in the Insurance Expense Exhibit which comprise company expenses incurred are also calculated as dollar amounts to be included in the "needed premium revenue". Countrywide data for these expenses are available from the special call for Insurance Expense Exhibit Statistics and by relating this data to the countrywide Earned Premiums a factor to apply to earned premiums is developed (Exhibit I). It is then necessary to develop statewide earned premiums from the Statistical Plan reportings of written premiums. To accomplish this the ratios of unearned premiums to written premiums as of December 31st of available calendar years are calculated. Ratios for periods of other than a calendar year are secured by interpolation for those states for which rate revisions are scheduled for June or September 30.[8] To calculate the statewide earned premiums for any twelve month period the unearned ratio for the previous twelve month period is applied to the written premium for that period and added to the product of the written premiums and the complement of the unearned factor for the period under consideration. For example: Earned Premium for Calendar Year 1955 = 1954 Unearned Ratio X 1954 Written Premium + 1955 Written Premium X (1.00 − 1955 Unearned Ratio). Having thus established statewide earned premiums, the countrywide ratios to earned premiums of Company Expenses Incurred are applied to develop the corresponding statewide expenses (Exhibit II, Lines 13-15).

Under a pure premium system of ratemaking any rate revision due to a change in the pure premium underlying the rate automatically carries with it a revision of the dollar provision for expenses in the rate. This is due to the fact that expenses are treated as percentages of the premium dollar and the expense allowance thus varies directly with an increase or decrease in rate. The "needed premium revenue" system treats all items of loss and expense (except taxes, acquisition, and profit and contingencies) as dollar amounts so that actual experience is used for both losses and expenses.

[8]The schedule of rate revisions is staggered throughout the year under the following system:

1. NAIC Zones 1 and 2—fiscal year ending June 30
2. NAIC Zones 3 and 4 including Oklahoma and excluding Wisconsin—fiscal year ending September 30
3. NAIC Zones 5 and 6 excluding Oklahoma and including Wisconsin and Alaska—calendar year

Taxes, Acquisition and Profit and Contingencies

The data supplied under the special call which requests an analysis of Direct Taxes, Licenses and Fees Incurred by State is used to develop a percentage of earned premiums which reflects taxes incurred for any specified state (Exhibit II, Line 17). By combining this percentage with the budgetary allowance of 20% for Acquisition and 5% for Profit and Contingencies a total loading is calculated to be used in the "needed premium revenue" (Exhibit II, Line 18—As of the date of the Connecticut revision the provision for Acquisition was 25%).

Indicated Statewide Rate Level Change

The combination of the dollar amounts developed for losses, loss adjustment expenses and company expense incurred all loaded by dividing this total by unity minus the percentage provision for Taxes, Acquisition, and Profit and Contingencies previously determined, produces the "needed premium revenue" for each year of the experience period under consideration. The statewide indicated rate level change is found by comparing the weighted three year "needed premium revenue" with the weighted actual earned premiums brought up to present rate level (Exhibit II—The indicated change of +29.50% was modified to +16.71% to reflect the hurricane losses incurred in 1954 and 1955 which were not excluded from the ratemaking procedure at that time). An additional step not contained in the Connecticut filing is now incorporated in order to bring in the one percent charge for the limitation of catastrophe losses for those lines subject to such losses.

By weighting the latest available twelve months written premium for Comprehensive, Fire and Theft, and related coverages by the indicated change due to experience and the one percent provision for catastrophes and adding the written premiums for all other coverages weighted only for the experience change developed, a total statewide indicated change is calculated (Exhibit II, Page 2). This indicated statewide change is based upon all classes and all coverages and must next be distributed to territory and coverage.

Distribution to Coverage—Private Passenger

Rates for the major private passenger automobile coverages—full comprehensive, $50 deductible comprehensive, $50 deductible collision and $100 deductible collision—are determined separately using the following procedure. The average adjusted loss ratio for the entire state for the three year period of experience being used is calculated (60.93% excluding hurricane experience). This loss ratio represents the experience of all classes and all coverages of automobile physical damage experience and is directly comparable with the indicated change in rate level developed above. By dividing this loss ratio by unity plus the indicated percentage change in statewide rate level

(+16.71% excluding hurricane experience) an adjustment factor is developed ($60.93 \div 1.1671 = 52.21$). Loss ratios for each major coverage by territory, adjusted to current rate levels, are developed for each year of the experience period (Exhibit V—Cols. 14, 15, 16).* From these loss ratios a three year weighted average coverage loss ratio is calculated (Exhibit V—Col. 17) and divided by the factor developed above to compute an indicated change by coverage (Exhibit V—Col. 22). In effect the use of this adjustment factor compares an indicated statewide loss ratio (a loss ratio which varies from year to year depending upon the expense and loss provisions which go into the "needed premium revenue") with an adjusted coverage loss ratio to develop the percentage change in rates indicated for a coverage. The percentage change by coverage based on loss ratio experience thus developed is used to modify the territorial changes indicated by loss costs.

Distribution to Territories—Private Passenger

The territorial losses and allocated loss adjustment expenses paid for each coverage as compiled under the Statistical Plan are divided by the earned car years (written car years developed to earned by applying the factors previously used to develop written premium to earned) to arrive at the loss costs, or pure premiums, by territory for each of the three years experience being reviewed (Exhibit V—Cols. 18, 19, 20). The three year weighted average loss costs (Exhibit V—Col. 21) are then multiplied by the reciprocal of the factor (or loss ratio on indicated rate level) developed above ($1 \div 52.21 = 1.9153$) to produce an average premium indicated by the loss costs (Exhibit V—Col. 23). By comparing this indicated premium with the present average premium as determined from the existing schedule of rates (Exhibit V—Col. 28) an indicated percentage change is developed (Exhibit V—Col. 24). We now have two indicated changes, one developed from a comparison of loss ratios and one derived from loss costs. The distribution to territory is now made based on the indicated change developed from loss costs by coverage and territory modified so that for the coverage the change will be that developed by the comparison of loss ratios. This is accomplished by dividing unity plus the loss ratio indicated change for a coverage (for Comprehensive 1.931) by unity plus the total loss cost indicated change for a coverage (for Comprehensive 1.949) and multiplying each territorial average indicated premium developed from the loss cost by the resultant (for Comprehensive $1.931 \div 1.949 = .991$) (Exhibit V—Col. 26). A comparison between the average premium developed under the existing schedule of rates by territory and the indicated average premium by territory produces the indicated rate level changes. The next step is to select a table or schedule of rates which most closely reflects these indicated changes.

* Exhibit V, see page 147.

Distribution to Classification—Private Passenger

The relativity between the different makes and models of automobiles as defined by the symbol groupings has been established for comprehensive and for collision using countrywide experience. These relativities are reviewed periodically and any marked deviations from the existing tables are adjusted. Using these tables of relativities, premium and rate schedules for each symbol or group of symbols have been developed. For example: the comprehensive rate for a symbol J, age group 1 automobile is $.22 per 100 dollars under schedule #2 (producing a premium of $5) while under schedule #32 the rate is $3.52 per 100 dollars (producing a premium of $72). For a symbol N, age group 1 automobile the corresponding rates would be $.19 (producing a premium of $7) and $2.96 (producing a premium of $111). Thus, within the limits imposed by rounding, the same relativity between symbols is maintained regardless of the level of rates in effect.

Using the latest available countrywide exposure distribution, the average premium developed by each schedule is calculated and an exhibit showing the percent effect of a change from one schedule to another is prepared. If, for example, the indicated change developed for a territory presently using the rates and premiums of comprehensive schedule #5 should be an increase of 55%, schedule #9, which produces an average premium 53.6% greater than that of schedule #5, might be used. In the selection of the revised schedule to be used factors other than the indicated increase developed by the ratemaking procedure are considered. For example, in the 1957 revision in Connecticut, the indicated statewide increase for comprehensive coverage was 93.1%. However, since this increase was developed from experience for the three years ending June 30, 1956 which included catastrophe losses (which at this time were not excluded from the ratemaking procedure) suffered during the hurricanes and floods of 1954 and 1955, the change was limited to an increase of 53.6%.

The original tables of relativities were developed for Fire coverage and for Theft coverage with Comprehensive being determined by combining these schedules and loading them for the additional hazards covered under this form of policy. Since comprehensive has become the major coverage (accounting for more than 90% of the "other than collision" private passenger premium) the tables are now designed to reflect the relationship between various symbols for comprehensive coverage. Fire rates and Fire and Theft rates are now quoted as percentages of comprehensive rates so that they retain the same relativity as the comprehensive rates.

Collision schedules are designated by amounts in dollars (i.e., $27 Schedule, $28 Schedule, etc.) and are developed to reflect a uniform relationship between age, price and form of deductible coverage depending upon the classification plan in effect in the state for which the revision is being promulgated. The relativity between classes of the three class collision plan is given in the following table:

Class	*Relativity to Class 3*
1	80% of Class 3
2A	115% of Class 3
2C	150% of Class 3
3	100% of Class 3
1F	70% of Class 1 = 56% of Class 3
2AF	70% of Class 2A = 80.5% of Class 3
2CF	70% of Class 2C = 105% of Class 3

The above mentioned schedules are developed from countrywide statistics of the distribution and experience of automobiles by symbol, age and coverage groups so that the actual rates or premiums developed by the ratemaking procedure vary by territory and state according to the experience, but the relativities between symbols and age groups are standard.

Private passenger coverages, other than those for which rate changes are determined separately, are expressed as percentages or averages of the major lines. Such coverages as Full Collision, $25 Deductible Collision, etc. do not develop sufficient experience to have credible statistics and, therefore, their rates or premiums are expressed as functions of the major coverages. The following table gives these relationships:

Coverage	*Premium Calculation*
Full Coverage Collision	400% of $ 50 Deductible Premium
$ 25 Deductible Collision	160% of $ 50 Deductible Premium
$ 75 Deductible Collision	50% of the sum of $50 & $100 Deductible Premium
$ 150 Deductible Collision	80% of $100 Deductible Premium
$ 250 Deductible Collision	60% of $100 Deductible Premium
$ 500 Deductible Collision	40% of $100 Deductible Premium
$1000 Deductible Collision	20% of $100 Deductible Premium
80% Convertible Collision	180% of $ 50 Deductible Premium
Convertible Collision (Initial Prem.)	200% of $ 50 Deductible Premium

Of these coverages the $150 and $250 Deductible Collision are the only ones for which premiums are calculated and published in the Automobile Physical Damage Manual. The remainder are of slight volume and may be calculated using the above rules when an insured requests this coverage.

Fire, and Fire and Theft coverage are related to the Comprehensive rates so that any change developed for Comprehensive is reflected in these rates. The experience for Fire, and Fire and Theft is reviewed on a statewide basis and the relationship percentages adjusted as the experience of these coverages follows or differs from that of Comprehensive coverage.

Commercial Vehicles

The experience for commercial vehicles is relatively slight so that a formula approach to ratemaking such as that used for private passenger coverages must be tempered with underwriting judgment. Since the majority of the commercial coverage written is for Local Hauling vehicles, only these coverages are reviewed in statistical detail on a statewide basis. Experience for Intermediate and Long Haul vehicles is reviewed on a regional basis supplemented by available Fleet experience. The major coverages available to commercial vehicles are: Fire; Fire and Theft (with and without Combined Additional Coverage); Fire, Theft and Windstorm; Comprehensive; and Collision. In reviewing the statewide experience for the non-collision coverages the weighted average three year loss ratio[9] on current level for each coverage is compared with an "adjustment factor" (the statewide loss ratio for all classes and all coverages on indicated rate level) to develop an indicated rate level change. These indications are used as guides for the pitching of the rate levels by coverage. The rates for the non-collision coverages are developed by combining separate rates for Fire, Theft, a Comprehensive loading, and a Combined Additional Coverage charge so that the rate for a given coverage can be modified by revising one of its elements. If, for example, the coverage experience should indicate an increase for Comprehensive and decreases for Fire and Theft, and Fire and Theft with Combined Additional Coverage, the Fire portion of the rate could be reduced while the Comprehensive loading could be increased. This would reduce the Fire and Theft rate and the rate for Fire and Theft with Combined Additional Coverage while the Comprehensive rate would be increased.

The Fire rates and Comprehensive loadings for Intermediate and Long Distance Hauling are pitched to their own experience. The Fire rates for old vehicles are 50% greater than those for new, and credits are given to vehicles powered by other than gasoline or liquefied petroleum gas. Theft rates and Windstorm rates for commercial vehicles are the same for all radii of operation and for gasoline or diesel powered vehicles since these hazards are not functions of the distance of operation nor of the type of fuel used. From these rates premiums are developed and published for each cost and age grouping using average values at risk and percentages of these values depending upon the age group as previously described.

The $50 and $100 Deductible Collision coverages for Local Hauling vehicles are reviewed on a statewide basis by comparing the adjusted

[9]The experience period currently in use is two years weighted 70% for the latest year and 30% for the first previous year.

average loss ratios with the "adjustment factor," and the rate schedules which produce the indicated rate level change are proposed. Regional experience, supplemented by Fleet experience, is employed in determining levels for the Intermediate and Long Haul classes. Premium charges are published for the more common coverages such as $50, $100, $250 and $500 Deductible Collision and the formulae for the calculation of any other desired Deductible are printed in the Manual. The collision premiums for Local Hauling vehicles reflect the age differentials previously outlined while Intermediate and Long Hauling take the same premium regardless of the age of the vehicle. This is done because most of the large vehicles used in this type of hauling are constantly being overhauled and repaired and it is felt that age does not become a factor in the insuring of these vehicles.

Public Vehicles

The experience for public vehicles is reviewed on the same basis as that of commercial vehicles. Certain classes of these vehicles have rates defined by the manual rules as functions of the private passenger or commercial rates so that they are directly affected by any rate revisions for these classes. Public vehicles, except buses, develop their own Fire rates and Theft rates and are charged collision premiums of three (3) times the private passenger class 3 collision premium for similar symbol and age groups. Buses are classified as either "Defined Buses" and "All Other Buses." Here again the Fire rate and the Theft rate are developed from the actual experience of the group. Comprehensive, which cannot be written for taxis, livery autos and jitneys, is available for buses and the rate is determined by combining the Fire rate and the Theft rate plus a loading for the "unrateable hazard" covered under Comprehensive. Collision premiums for "Defined Buses," except school buses, are the regular Local Hauling-Commercial Automobile Collision premiums, while school buses take premiums of 50% of the regular Local Hauling-Commercial Automobile Collision premiums. "All Other Buses" are classified according to distance of operation (operation under 150 miles and operation over 150 miles) and use the premiums applicable to Intermediate and Long Distance commercial automobiles.

Other Vehicles and Miscellaneous Coverages

Miscellaneous types of vehicles such as: Fire or Police Department Automobiles, Ambulances, Armored Cars, Bookmobiles, Motorcycles, Snow Plows, Trench Diggers etc. take rates and premiums defined by the NAUA manual rules as functions of private passenger or commercial comprehensive and/or collision rates. The experience of these vehicles is reviewed annually on a countrywide basis in order to determine if any classification differs significantly or has increased in volume sufficiently to develop credible rates on its own experience. Miscellaneous coverages, such as: towing and labor costs, personal effects, flood or rising waters, etc. are reviewed annually on a countrywide basis.

Comprehensive and Fire and Theft Fleet Rating Plans

Two fleet rating plans for Comprehensive and Fire and Theft are available—Formula "A" and Formula "C". Formula "A" is applicable to risks which meet the following criteria:

A. Under one ownership or under lease or rental agreement as defined by the plan
B. Have been previously insured for at least one year and nine months
C. Consist of at least 50 automobiles or of less automobiles if at least 25 buses are covered.

Formula "C" is applicable to all other fleet risks providing they are:

A. Under one ownership or under lease or rental agreement as defined by the plan.
B. Comprised of not less than 5 or more than 49 automobiles
C. Comprised of more than 50 automobiles or of less number if at least 25 buses are covered *and* have not previously been insured at least one year and nine months.

In developing the rate to be charged under either Formula, the following information for the experience period to be used in the rating is required:

1. Net written premiums for each year of the experience period for each coverage
2. Incurred losses (exclusive of loss adjustment expense) for each policy year
3. The rates (for each coverage and class of automobile) at which policies were written each year
4. Form of latest year's policy—perils insured, reductive clauses or restricted forms
5. Total of net liability written or the number of cars insured each year.

The basic experience period is three years (where the experience for the latest policy period is not obtainable, experience for at least the first nine months shall be filed). In the event only two years experience is available the modification shall be two-thirds of the three year modification.

Under Formula "A" the three year experience loss ratio is calculated and a percentage modification applicable to last year's rates for all classes is obtained from a table of debits and credits. These modifications range from a debit of 75% for a three year loss ratio of

88% and over to a credit of 50% for a three year loss ratio of from 0 to 0.9% (Exhibit VI). Where incurred losses for any one year exceed the following:

Latest Year's Experience—2 times the earned premium
First Prior Year's Experience—1½ times the earned premium
Second Prior Year's Experience—1 times the earned premium

such excess losses shall be considered catastrophe losses and be excluded from the rating. Formula "A" is designed to experience rate the large risk which has previously been insured.

Under Formula "C" the rate to be charged is the base fleet rate (each classification of vehicle is given a base rate which is usually a manual rate or function of a manual rate), modified by the application of a size credit plus or minus an experience credit or debit. (Exhibit VII)

The basic experience period is two years and nine months (where only one year and nine months experience is available the experience debits or credits shall be two-thirds of the basic experience period modification). Where experience for at least one year and nine months is not available under Formula "C" only the size of fleet credit shall be applicable.

Incurred losses are limited (treated as catastrophe) where they exceed the following:

Latest Nine Months' Experience—3 times the adjusted premium (written for period adjusted to earned)
First Prior Year's Experience —2 times the earned premium
Second Prior Year's Experience—1 times the earned premium

Collision Fleet Rating

Collision fleet rating is also available for those risks which qualify. The criteria for qualification are as follows:

1. Under one ownership or under lease or rental agreement as defined by the plan
2. Consist of not less than 5 automobiles (including trailers and semi-trailers)
3. Have been previously insured for a period of at least one year
4. All vehicles owned by the insured must be covered against collision.

The information necessary to rate a fleet is as follows:

1. Net written collision premiums received each year
2. Collision losses incurred (exclusive of all loss adjustment expenses) allocated to policy year
3. Any premium reduction for size of risk experience and/or schedule rating applied in each year.

The basic experience period shall be two years and nine months (where only one year and nine months' experience or nine months' experience is available, the modification shall be two-thirds or one-third of the basic period modification). The modifications for experience and size of risk are combined into one table. Fleets are grouped into five size categories (5-10; 11-25; 26-50; 51-100; over 100) with modifications ranging from 21% to 56% credit for risks with three year loss ratios between 0% and 5% and from 25% to 92% debit for three year loss ratios of over 100% (Exhibit VIII). Incurred losses for any period are limited where they exceed the same criteria as outlined under Formula "C" for Comprehensive and Fire and Theft.

Schedule Rating

Schedule rating for collision is also available to any risk which qualifies for experience rating. The purpose of the Schedule Rating Plan is to supply a means of modifying manual premiums (in addition to any experience modification) to recognize any specific characteristics of a risk which are not reflected by experience rating. The following schedules give the range of modifications available for various aspects of a risk:

	Range of Modification		
	Credit		*Debit*
Management	5%	to	5%
Employees	5	to	5
Equipment	5	to	10
Safety Organization	10	to	5

Retrospective Rating

As of July 1957 it became permissible to retrospectively rate Automobile Physical Damage coverage under the provisions of Retrospective Rating Plan D. Under this plan the premium for the Physical Damage coverages is determined after the policy period has expired and is developed from a combination of the risk's losses and basic expenses subject to a maximum premium and a minimum premium.

Countrywide

Exhibit I
August 1956

FROM "INSURANCE EXPENSE EXHIBITS"
PART II — ALLOCATION TO LINES OF BUSINESS

Consolidated Experience of National Automobile Underwriters Association Members and Stock Company Subscribers (exclusive of companies specializing in writing insurance for a finance company or companies)

	Column 9 & 10 Line No.	*1953*	*1954*	*1955*
Net Premiums	1	676,037,565	636,114,955	645,242,503
Premiums Earned	2	646,024,679	650,933,696	636,856,424
Losses Paid	3a	294,092,473	278,118,108	289,749,389
Losses Incurred	3	291,656,577	272,330,489	294,904,024
Ratio to losses paid		.991 717	.979 190	1.017 790
Loss Adjustment expenses paid	4	40,653,508	41,288,019	41,486,407
Ratio to losses paid		.138 234	.148 455	.137 691
Loss Adjustment expenses incurred	5	40,918,779	41,195,553	41,948,143
Ratio to loss adjustment expenses paid		1.006 525	.997 760	1.011 130
Acquisition Incurred	6	177,212,676	167,693,123	172,580,248
Company expenses incurred	7 & 13	66,961,907	68,396,878	70,337,191
Ratio to premiums earned		.103 653	.105 075	.110 444
Taxes, licenses and fees incurred	14	18,070,458	17,142,560	17,435,787
Total Expenses excluding Federal income and real estate taxes (lines 5, 6, 7, 13 and 14)	15	303,163,820	294,428,114	302,301,369
Gain from underwriting (line 2 minus 3 minus 15)	16	51,204,282	84,175,093	39,651,031
% of Premiums Earned		7.93	12.93	6.23

Connecticut

Exhibit II

APPLICATION OF RATE FORMULA FOR 3 YEARS ENDING SEPTEMBER 30, 1956

		Year Ending September 30 1954	1955	1956	*3 Yr. Wghted Average (10-20-70)*
1.	Losses Paid	9,093,273	11,695,643	13,423,476	
2.	Ratio Losses Inc. to Losses Pd.	.991 717	.979 190	1.017 790	
3.	Losses Incurred	9,017,953	11,452,257	13,662,280	
4.	Losses Incurred	9,017,953	11,452,257	13,662,280	
5.	Factor to Adjust to Current Price Level	1.024 348	1.029 720	1.019 913	
6.	Losses Inc. Adj. " " " "	9,237,522	11,792,618	13,934,337	13,036,312
7.	Losses Paid	9,093,273	11,695,643	13,423,476	
8.	Ratio Loss Adj. Exp. Pd. to Losses Pd.	.138 234	.148 455	.137 691	
9.	Loss Adj. Exp. Paid	1,256,999	1,736,277	1,848,292	
10.	Loss Adj. Exp. Paid	1,256,999	1,736,277	1,848,292	
11.	Ratio Loss Adj. Exp. Inc. to Loss Adj. Exp. Pd.	1.006 525	.997 760	1.011 130	
12.	Loss Adj. Expenses Incurred	1,265,201	1,732,388	1,868,863	1,781,202
13.	Premiums Earned	19,557,664	19,257,635	20,199,354	
14.	Ratio Company Expenses to Premiums Earned	.103 653	.105 075	.110 444	
15.	Company Expenses Incurred	2,027,210	2,023,496	2,230,897	2,169,048
16.	Total Losses & Expenses (Excl. Taxes, Licenses & Fees) Incurred (Lines 6 + 12 + 15)	12,529,933	15,548,502	18,034,097	16,986,562
17.	Ratio Taxes, Licenses & Fees Inc. To Needed Premium Revenue	.02739	.02767	.02850	
18.	Ratio Total Losses & Expenses (Excl. Taxes, Licenses & Fees) Inc. to Needed Premium Revenue (.70000 minus line 20)	.67261	.67233	.67150	
19.	Needed Premium Revenue (Line 16 ÷ Line 18)	18,628,824	23,126,295	26,856,436	25,287,647
20.	Premiums Earned, Adjusted to Current Rates	18,281,000	18,544,000	19,987,000	19,527,800
21.	Overall Adjustment Indicated	+1.90%	+24.71%	+34.37%	+29.50%

State________________________________ Exhibit II — page 2

COMPUTATION OF TOTAL OVERALL INDICATED CHANGE <u>*INCLUDING*</u> PROVISION FOR CATASTROPHES

Coverages	*Year Ending* *Written Premiums*	*Indication from Exhibit II* %	*Amount*	*Provision for Catastrophes* %	*Amount*	*Total Indicated Change* %	*Amount*
Comprehensive; Fire; Fire & Theft; Fire Theft and Miscellaneous Added Coverages							
All Other Coverages							
Total Overall							

Exhibit III

December 1956

CONSUMERS' PRICE INDEX
(COST OF LIVING INDEX)
U. S. BUREAU OF LABOR STATISTICS

Calculation of Factors to adjust the Losses Incurred to the current price level. Based on the new Series Index (1947-1949 = 100)

Factors applied to the experience for States in NAIC Zones 1 and 2 in Association jurisdiction:

Connecticut	New York
Delaware	Ohio
Dist. of Columbia	Pennsylvania
Maine	Rhode Island
Maryland	South Carolina
Massachusetts	Vermont
New Hampshire	West Virginia
New Jersey	

12 Months Average as of 9-30-54	115.0	Actual as of 11-15-56	
9-30-55	114.4	117.8	
9-30-56	115.5		

$$\frac{117.8}{115.0} = 1.024348$$

$$\frac{117.8}{114.4} = 1.029720$$

$$\frac{117.8}{115.5} = 1.019913$$

Exhibit IV

CONSUMERS' PRICE INDEX
(COST OF LIVING INDEX—ALL ITEMS)
U. S. BUREAU OF LABOR STATISTICS

NEW: 100 = 1947-49

	As of 15th of Month	*Average previous 12 Months*	*As of 15th of Month*	*Average previous 12 Months*	*As of 15th of Month*	*Average previous 12 Months*
	1950		*1951*		*1952*	
Jan.	100.6	101.6	108.6	103.5	113.1	111.4
Feb.	100.4	101.5	109.9	104.3	112.4	111.6
Mar.	100.7	101.4	110.3	105.1	112.4	111.8
Apr.	100.8	101.3	110.4	105.9	112.9	112.0
May	101.3	101.3	110.9	106.7	113.0	112.2
June	101.8	101.2	110.8	107.4	113.4	112.4
July	102.9	101.4	110.9	108.1	114.1	112.7
Aug.	103.7	101.5	110.9	108.7	114.3	113.0
Sept.	104.4	101.7	111.6	109.3	114.1	113.2
Oct.	105.0	102.0	112.1	109.9	114.2	113.4
Nov.	105.5	102.3	112.8	110.5	114.3	113.5
Dec.	106.9	102.8	113.1	111.0	114.1	113.6
	1953		*1954*		*1955*	
Jan.	113.9	113.6	115.2	114.6	114.3	114.8
Feb.	113.4	113.7	115.0	114.7	114.3	114.7
Mar.	113.6	113.8	114.8	114.8	114.3	114.7
Apr.	113.7	113.9	114.6	114.9	114.2	114.5
May	114.0	114.0	115.0	114.9	114.2	114.5
June	114.5	114.0	115.1	115.0	114.4	114.5
July	114.7	114.1	115.2	115.0	114.7	114.5
Aug.	115.0	114.1	115.0	115.0	114.5	114.4
Sept.	115.2	114.2	114.7	115.0	114.9	114.4
Oct.	115.4	114.3	114.5	114.9	114.9	114.5
Nov.	115.0	114.4	114.6	114.9	115.0	114.5
Dec.	114.9	114.5	114.3	114.8	114.7	114.5

	1956	
Jan.	114.6	114.6
Feb.	114.6	114.6
Mar.	114.7	114.6
Apr.	114.9	114.7
May	115.4	114.8
June	116.2	114.9
July	117.0	115.1
Aug.	116.8	115.3
Sept.	117.1	115.5
Oct.	117.7	115.7
Nov.	117.8	116.0

Exhibit VI

FORMULA "A" EXPERIENCE MODIFICATIONS

APPLY TABLE SEPARATELY TO FIRE AND TO THEFT AND TO THE COMPREHENSIVE ADDITIONAL RATE

Three Years Experience Loss Ratio	*Percentage Modification All Classes*	*Three Years Experience Loss Ratio*	*Percentage Modification All Classes*	*Three Years Experience Loss Ratio*	*Percentage Modification All Classes*
	Increase		*Increase*		*Reduction*
88% & over	75%	58.0 – 58.9%	16%	29.0 – 29.9%	31.0%
87.0 – 87.9	74	57.0 – 57.9	14	28.0 – 28.9	32.0
86.0 – 86.9	72	56.0 – 56.9	12	27.0 – 27.9	33.0
85.0 – 85.9	70	55.0 – 55.9	10	26.0 – 26.9	34.0
84.0 – 84.9	68	54.0 – 54.9	8	25.0 – 25.9	35.0
83.0 – 83.9	66	53.0 – 53.9	6	24.0 – 24.9	36.0
82.0 – 82.9	64	52.0 – 52.9	4	23.0 – 23.9	37.0
81.0 – 81.9	62	51.0 – 51.9	2	22.0 – 22.9	38.0
80.0 – 80.9	60	50.0 – 50.9	0	21.0 – 21.9	39.0
79.0 – 79.9	58		*Reduction*	20.0 – 20.9	40.0
78.0 – 78.9	56	49.0 – 49.9	1.5	19.0 – 19.9	40.5
77.0 – 77.9	54	48.0 – 48.9	3.0	18.0 – 18.9	41.0
76.0 – 76.9	52	47.0 – 47.9	4.5	17.0 – 17.9	41.5
75.0 – 75.9	50	46.0 – 46.9	6.0	16.0 – 16.9	42.0
74.0 – 74.9	48	45.0 – 45.9	7.5	15.0 – 15.9	42.5
73.0 – 73.9	46	44.0 – 44.9	9.0	14.0 – 14.9	43.0
72.0 – 72.9	44	43.0 – 43.9	10.5	13.0 – 13.9	43.5
71.0 – 71.9	42	42.0 – 42.9	12.0	12.0 – 12.9	44.0
70.0 – 70.9	40	41.0 – 41.9	13.5	11.0 – 11.9	44.5
69.0 – 69.9	38	40.0 – 40.9	15.0	10.0 – 10.9	45.0
68.0 – 68.9	36	39.0 – 39.9	16.5	9.0 – 9.9	45.5
67.0 – 67.9	34	38.0 – 38.9	18.0	8.0 – 8.9	46.0
66.0 – 66.9	32	37.0 – 37.9	19.5	7.0 – 7.9	46.5
65.0 – 65.9	30	36.0 – 36.9	21.0	6.0 – 6.9	47.0
64.0 – 64.9	28	35.0 – 35.9	22.5	5.0 – 5.9	47.5
63.0 – 63.9	26	34.0 – 34.9	24.0	4.0 – 4.9	48.0
62.0 – 62.9	24	33.0 – 33.9	25.5	3.0 – 3.9	48.5
61.0 – 61.9	22	32.0 – 32.9	27.0	2.0 – 2.9	49.0
60.0 – 60.9	20	31.0 – 31.9	28.5	1.0 – 1.9	49.5
59.0 – 59.9	18	30.0 – 30.9	30.0	0.0 – 0.9	50.0

Exhibit VII

FORMULA "C"

TABLE OF SIZE CREDITS AND EXPERIENCE CREDITS AND DEBITS

	Size of Fleet Number of Automobiles including trailers and semi-trailers as per Conditions of Eligibility for Formula "C"		
	5-10	*11-25*	*26-49**
Size Credit	*15%*	*20%*	*25%*
Experience Credit Earned/Incurred Loss Ratio			
0.0% – 4.9%	30%	30%	30%
5.0 – 9.9	27	27	27
10.0 – 14.9	23	23	23
15.0 – 19.9	20	20	20
20.0 – 24.9	17	17	17
25.0 – 29.9	14	14	14
30.0 – 34.9	10	10	10
35.0 – 39.9	7	7	7
40.0 – 44.9	3	3	3
45.0 – 49.9	0	0	0
Experience Debit			
50.0% – 54.9%	0%	0%	0%
55.0 – 59.9	3	3	3
60.0 – 64.9	7	7	7
65.0 – 69.9	10	10	10
70.0 – 74.9	14	14	14
75.0 – 79.9	17	17	17
80.0 – 84.9	20	20	20
85.0 – 89.9	23	23	23
90.0 – 94.9	27	27	27
95.0 & Over	30	30	30

NOTE: *Use the credits and debits in this column for rating fleets of over 49 automobiles including trailers and semi-trailers (over 24 buses) which are not eligible for rating under Formula "A".

Exhibit VIII

COLLISION FLEET EXPERIENCE ADJUSTMENTS

Manual Loss Ratio	*Size of Fleet* 5-10	11-25	26-50	51-100	Over 100
0 – 5	.79	.76	.70	.60	.44
5 – 10	.81	.79	.74	.65	.51
10 – 15	.83	.81	.77	.70	.59
15 – 20	.86	.84	.81	.75	.66
20 – 25	.88	.87	.84	.80	.73
25 – 30	.90	.90	.88	.85	.81
30 – 35	.93	.92	.92	.90	.88
35 – 40	.95	.95	.95	.95	.96
40 – 45	.97	.98	.99	1.00	1.03
45 – 50	1.00	1.01	1.02	1.05	1.10
50 – 55	1.02	1.03	1.06	1.10	1.18
55 – 60	1.04	1.06	1.09	1.15	1.25
60 – 65	1.07	1.09	1.13	1.20	1.33
65 – 70	1.09	1.12	1.16	1.25	1.40
70 – 75	1.11	1.14	1.20	1.30	1.47
75 – 80	1.14	1.17	1.24	1.35	1.55
80 – 85	1.16	1.20	1.27	1.40	1.62
85 – 90	1.18	1.23	1.31	1.45	1.70
90 – 95	1.21	1.25	1.34	1.50	1.77
95 – 100	1.23	1.28	1.38	1.55	1.84
Over 100	1.25	1.31	1.41	1.60	1.92

Exhibit V

OSALS:	
SENGER	$+3,749,284
MMERCIAL	- 52,127
IER	
AL +17.79%	$+3,697,157

PRESENT:

FIRE	FIRE & THEFT
20%	40%

PROPOSED:

FIRE	FIRE & THEFT
15%	30%

(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
	PRESENT		VOLUME LATEST YEAR		PROPOSALS		EFFECT	
ST STED ATIO % IANGE	TABLE OR SCHED.	AVERAGE PREMIUM	WRITTEN PREMIUMS ($000's)	NUMBER OF LOSSES	TABLE OR SCHED.	AVERAGE PREMIUM	%	DOLLARS
991								
48.3	#5	8.61	930,622	12,571	#9	13.23	+53.6	
81.6	#5	8.61	960,037	12,941	9	13.23	+53.6	
73.4	#5	8.61	693,961	11,045	9	13.23	+53.6	
75.5	#5	8.61	137,786	2,943	9	13.23	+53.6	
23.3	#5	8.61	865,501	12,376	9	13.23	+53.6	
93.1		8.61	3,587,907	51,876			+53.6	+1,923,119
014								
11.0	$21	49.30	2,825,742	7,196	$23	53.85	+ 9.2	+259,968
15.7	21	49.30	3,096,157	7,890	24	56.15	+13.9	+430,366
17.2	22	51.60	2,661,344	7,121	25	58.50	+13.4	+356,620
24.4	22	51.60	430,695	1,222	25	58.50	+13.4	+57,713
17.5	22	51.60	3,198,314	8,247	25	58.50	+13.4	+428,574
15.7		50.49	12,212,252	31.676			+12.6	+1,533,241

ENTIRE STATE-OVERALL

CONNECTICUT

INCL. CATASTROPHE INDICATIONS: +29.50% $ +6,131,582

EXCL. CATASTROPHE INDICATIONS +16.71% $ +3,473,177

PRIVATE PASSENGER

PRO
P
C
O
T

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)		(22)	(23)	(24)	(25)
RATE HISTORY							EXPERIENCE - 3 YEARS ENDING June 30, 1956														COVERAGE AND TERRITORY	INDICATIONS			
IOR O 54	6-7-54		6-13-55		5-16-56		LOSS FREQUENCY			AVERAGE LOSS			ADJUSTED LOSS RATIOS			3 YR. WGHTD AVER.	LOSS COSTS			3 YR. WGHTD AVER.		% CHANGE INDICATED BY LOSS RATIO	AVERAGE PREMIUM INDICATED BY LOSS COST	% CHANGE INDICATED BY LOSS COST	LOSS C INDIC. AD. TO LOSS AVERAGE PREMIUM
	NEW LEVEL	% OF CHANGE	NEW LEVEL	% OF CHANGE	NEW LEVEL	% OF CHANGE	1954	1955	1956	1954	1955	1956	1954	1955	1956		1954	1955	1956						
MPREHENSIVE														FACTOR 52.21				FACTOR 1.9153			ENTIRE STATE-OVERALL				
#4	#4	-	#4	-	#5	+5.8	11.3	11.6	11.2	34	51	65	43.4	69.2	84.3	77.77	4	6	7	6.73	HARTFORD COUNTY	+49.0	12.89	+49.7	12.77
4	4	-	4	-	5	+5.8	11.1	12.1	11.6	41	64	76	49.7	88.4	100.6	93.72	4	8	9	8.24	FAIRFIEDL COUNTY	+79.5	15.78	+83.3	15.64
4	4	-	4	-	5	+5.8	13.6	13.7	13.3	38	47	64	58.3	74.1	99.1	90.79	5	6	9	7.87	NEW HAVEN COUNTY	+73.9	15.07	+75.0	14.93
4	4	-	4	-	5	+5.8	16.1	15.2	17.9	33	44	152	61.4	77.3	317.8	250.36	5	7	27	21.57	WATERBURY	+379.5	41.31	+379.8	40.94
4	4	-	4	-	5	+5.8	10.8	12.1	11.6	40	66	98	48.0	92.2	132.4	117.17	4	8	11	10.13	REM. OF STATE	+124.4	19.40	+125.3	19.23
					5	+5.8	11.7	12.4	12.1	38	57	80	49.7	81.2	112.2	100.80	4	7	10	8.76	TOTALS	+93.1	16.78	+94.9	16.63
0 DED. COLLISION																									
23	$22	-4.2	$21	-4.4	$21	-	11.9	11.7	12.7	218	218	230	51.9	51.3	60.3	57.77	26	25	29	28.18	HARTFORD COUNTY	+10.6	53.97	+ 9.5	54.73
23	22	-4.2	21	-4.4	21	-	12.5	12.4	13.6	216	218	220	52.7	54.1	61.8	59.45	27	27	30	29.38	FAIRFIELD COUNTY	+13.9	56.27	+14.1	57.06
23	22	-4.2	22		22	-	13.7	12.3	14.2	220	211	230	57.4	50.2	64.4	60.99	30	26	33	31.13	NEW HAVEN COUNTY	+16.8	59.62	+15.5	60.45
23	22	-4.2	22	-	22	-	14.0	12.3	15.6	215	200	228	56.9	47.3	70.0	64.40	30	25	26	30.04	WATERBURY	+23.3	63.28	+22.6	64.17
23	22	-4.2	22	-	22	-	11.9	11.4	12.8	245	241	253	56.5	54.5	65.6	62.56	29	27	32	31.23	REM. OF STATE	+19.8	59.81	+15.9	60.65
		-4.2		-2.1			12.5	11.9	13.4	225	222	234	54.7	52.5	63.6	60.41	28	26	31	30.09	TOTALS	+15.7	57.63	+14.1	58.44

VOL. XLVI, Part II No. 86

PROCEEDINGS

November 19-20, 1959

ST. VITUS'S DANCE

PRESIDENTIAL ADDRESS BY DUDLEY M. PRUITT

"After all, those in the (insurance) business who do other than routine work, are paid about half for what they do and half for what they endure."

Kenneth O. Force in The National Underwriter
October 2, 1959

On a dismal morning of the year 1374 in the German town of Aachen hundreds of men and women came together on the streets and, forming circles, hand in hand, danced hysterically for hours on hours till they fell exhausted and insensible on the cobblestones to be left where they fell or pushed aside to make way for others who were still bouncing and jiggling like puppets on a string. It was thought that these poor people were possessed of demons and prayers were said by the holy for their healing. This is the picture given of one incident in the dancing mania which afflicted Germany during the years following the Black Death.

The years of the Black Death had taken their frightful toll, wiping out half the population of Europe and then, at the very moment of release, when the grip of the plague was at last relaxing, the hysteria of the dancing mania took hold. It was born out of physical and spiritual exhaustion, out of an emotional desperation that had benumbed the wits and depraved the reason. It was "catching," as any mass hysteria is "catching," propagated by the sight of the sufferers, like a demoniacal epidemic. Here was the origin of the name St. Vitus's Dance, for St. Vitus it was who had been granted specific powers for the healing of the mania.

We are, I suspect, witnessing in the automobile insurance business a parallel to the dancing mania of Germany in the Middle Ages. For several long years our business has had the insurance equivalent of the plague; many of us have been suffering severe underwriting losses in the private passenger lines; we have appealed to higher authority for rate relief over and over again and been rebuffed; and just as the picture begins to look clearer, just as the rate situation seems to be brightening, we begin whirling and jiggling, hopping and prancing in a maniacal, competitive dance of policy forms and rating methods.

The picture, of course, was not really becoming clearer with the increased rates approved and the reduced commissions being allowed during the past year. One might almost imagine that these necessary corrective measures have aggravated the situation. The underlying disease, whatever it has been, is not cured. Quite recently the Bureau received considerable criticism to the effect that a major reason for the success of the direct writers in getting the preferred business is because the Bureau rates favored the youthful driver at the expense of Class 1 business. The Bureau vehemently denied such favoritism and implied that a company charging Bureau rates should be just as glad to write insurance on a car owned by a youth as on a car owned by a man of mature years; should be, in fact, happier to do so because, with the larger premium involved, there would be more dollars in the profit allowance. The trouble has been that, although the Bureau was undoubtedly right actuarially, the carriers have continued to show an irrational resistance to youthful drivers and have shown a keen preference for Class 1 business despite its smaller average premium. The direct writers have, in fact, been willing to make those premiums still smaller.

Every year a prominent analyst makes a careful study of the underwriting results of the big four direct writers: Allstate, the State Farm, the Nationwide, and the Farmers Exchange. His annual conclusion is that so long as these four carriers can continue to pay their producers less they can charge less for their wares. This gives them a competitive advantage and makes it possible for them to be very selective, resulting, of course, in lower loss ratios, which allows them to charge still less for their wares, and so on round and round. And to rub salt into the wounds, the salesmen, who get paid less in percentage, earn a good living on volume.

Some years ago a method of operation was devised within the American Agency System which was calculated to save the agent and his carrier before the big four got all the business. This is frequently referred to as the Safeco plan in recognition of the originating carrier. The agents have not generally relished this form of salvation, preferring, if possible, to live in original sin. The plan attempts to meet the big four competition by adapting their methods to independent agency operation. It involves a signed application, giving improved control over selection and classification assignment, and such money saving devices as a lower-than-normal commission rate and the requirement that the premium be paid in advance of effective date. In order to make the commission reduction more palatable the plan also includes automatic machine renewal and direct collection of the renewal premium by the carrier. One of the advertised inducements has been that the agent could take his smaller commissions and devote his energies to new production confident that the company machinery would keep the renewal certificates endlessly flowing to the assured with the cash flowing back, and the direct writers vanquished. It really has worked.

The lower rates produced the same sort of competitive leverage for the Safeco plan companies as it has for the direct writers. In the last two or three years there has been a great burgeoning of "economy plans" competing vigorously for the best of this low premium business that has theoretically less profit built into it than the big fat youthful driver business. There has been, however, no observable indication that the big four felt the slightest jolt from the growth of the Safeco plan. The two chief sufferers have been the so-called tariff or Bureau companies and the assigned risk plans, the former out of dearth of business and the latter out of surfeit.

Shakespeare once wrote, "The smallest worm will turn, being trodden on," and in this case the victim of the treading was hardly a small worm. Every indication today points to the certainty that the Bureau companies have had enough. They are doing something about it besides cutting commissions.

The new merit rating plan jointly sponsored by the National Bureau and the N.A.U.A. has now been introduced into several states. It is an attempt to meet what a Bureau spokesman described as "a public demand of long standing for a safe driver insurance plan which will produce a substantial difference in the price paid by insureds who are not accident prone vs. those who are. . . . The plan is designed to produce more competitive rates for the better classes of risks so that bureau companies will not be faced with an ever worsening cross-section of business."

With this move on the part of the bureaus the Black Death was ended and the dancing mania began. Every day has brought its new manifestations. When the Travelers withdrew from the National Bureau the insurance world was as shocked as the average American would be if ex-President Truman were to withdraw from the Democratic Party. Several other outstanding company groups also withdrew in order to be free to try out their own individual steps. The independents, with their various "economy" plans, found overnight their happiness gone, their complacency shattered, and were seized with an acute realization that new ideas were needed fast. The automobile insurance industry is in a competitive struggle of titans. I see no reason why Senators Kefauver and O'Mahoney need fear for the freedom of the automobile insurance enterprise at the moment. For the past several months the insurance page of the Journal of Commerce has carried daily stories of new plans and projects. I quote a few headlines:

"NBCU FIRMS TO PUSH NEW AUTO PLANS"

"TRAVELERS LAUNCHES NEW AUTO PLAN IN NEBRASKA"

"AMERICAN CASUALTY HAS NEW AUTO COVER PROGRAM"

"ST. PAUL VETOES NBCU AUTO PLAN"

"MICH. STUDIES MERIT RATING"

"MARYLAND AGENTS REQUEST ADOPTION OF MERIT RATING"

"LOSSES SEEN AS MAIN COST DIFFERENTIAL"

"ALLSTATE SAYS 'REVOLUTION' BENEFITS INSURING PUBLIC"

And about the same day that three major plans were announced on one page, there was also displayed a large want ad by one of America's larger fire and casualty fleets, appealing persuasively for an actuary of mature experience and judgment capable of assuming the duties of vice president.

I wish I had space here to deal also with that other dementia that has seized our industry, the rate and coverage evolution taking place in the homeowners' business. Where are those wise men who promoted the multiple line approach on the theory that when the casualty lines went bad the property lines would save us by being good, and vice versa? Suffice it to say that many of the points discussed here in connection with automobile apply equally to homeowners'.

There has been considerable favorable comment in the local press as the merit plans have been introduced in various states. It is a very popular concept that "good drivers" should not have to share in the losses caused by the "poor drivers who have the accidents." The lower rate for the better record seems reasonable and just to most people. A fairly representative reaction as expressed by an insurance commissioner was to the effect that merit rating supplies what our young people have wanted for a long time—to be treated as individuals and not as a group of helter-skelter irresponsible undesirables. In fact there has been so much demand for the new plan that the Bureau has been constrained to ask for time. The plan is frankly experimental and needs maturing.

There are also those who take a very dim view of all automobile merit rating plans. At one time the Bureau was not nearly so sanguine about the practice as it seems to be today. In Best's Insurance News of January, 1952, a paper entitled "Merit Auto Rating" appeared, sponsored by the National Bureau of Casualty Underwriters and the Mutual Insurance Rating Bureau in collaboration. This paper cites twenty "administrative and rating difficulties to be encountered" in any program of merit rating for private passenger automobiles in 1952 and closes with the profoundly actuarial statement that "the extremely small exposure in a single private passenger car risk does not lend itself to self-analysis in terms of rate making as the element of chance overshadows a credibility expectancy." Perhaps it is unfortunate that the paper has this year been republished as a part of the *Readings in Property and Casualty Insurance,* edited by H. Wayne Snider, for it would seem that most of the twenty difficulties to be encountered in 1952 are still difficulties in 1959 with a few more added by the processes of time and the specific characteristics of the current plans.

A serious current criticism of the new plans is that they are far too difficult to administer, depending as they do on information that must be obtained from state motor-vehicle departments and that this difficulty brings the plans into direct conflict with the rapidly developing mechanization of automobile risk rating and policy issuance. This may turn out to be a decisive factor.

Another and widely held criticism attacks the plan at its actuarial foundations. This stands on the principle that insurance is a pooling of potential losses, that there must, of course, be some separation of risks into reasonable rating classifications, which are usually interpreted to mean the present classifications by use, and that any attempt to separate those who have accidents from those who do not breaks down the pooling principle and thus does violence to the "mathematical science of insurance." This has been a rather common charge and one that has the surface look of truth. It has, however, serious actuarial blemishes.

While insurance is certainly based on the principles of pooling, it has none of the elements of charity and very little in common with Marxism. The maxim, "From each according to his abilities, to each according to his needs," is from Karl Marx and not from Lloyds of London. The mathematical science underlying the insurance business, it has always seemed to me, is the science of finding mathematical measures of hazard, of determining the bounds of reasonable probability of an occurrence, including, to the extent practicable, a quantitative differentiation of such circumstances as who, where, and when. You have all heard the story of the horse-and-rabbit stew—"one rabbit, one horse." Such a stew has none of the elements of mathematical averaging. Surely, if you are certain to have no loss and I am certain to have a loss I can hardly expect you to pool your insurance with me on an equal, or in fact on any, basis. The impossibility of effecting a workable private flood insurance program is a clear illustration of this principle. And certainly if it can be demonstrated that you are less apt to have a loss than I, you would be the giver of pure charity and I would be the taker if we pooled our hazards on a fifty-fifty basis. As much as is possible the predisposition to loss is a proper subject for fair discrimination; only the operations of chance are the proper subject for averaging.

We are apt to cry discrimination rather readily in the insurance business, saying quite properly that it is unfair to discriminate between risks of essentially the same hazard. But over two thousand years ago Plato pointed out the other side of discrimination very clearly when he said that the greater injustice is to treat unequal causes equally. A single automobile liability rate for the entire state of Massachusetts, as has been at times politically proposed, would be unfairly discriminatory in the extreme. There is no need to labor this point further. I think we will all agree, when we look at the subject objectively, that insurance rates should be related as nearly as is feasible to the hazard of the risk, and that a proliferation of classifications which actually do measure hazard, though it may complicate the business of insurance, does no more violence to its mathematical principles than does the betting on different odds do violence to the mathematics of gambling. In fact the pari mutuel is the very essence of mathematics.

Classifications can, however, complicate the business, and I suspect that most of the noncompetitive complaint within the industry about the merit plan is based on this problem of administration. There is always the compromise between the proper and the feasible. One of my friends, an eminent psychologist, has assured me that he could quite certainly discover the accident-prone and rather accurately measure the degree of proneness if he were permitted to examine personally all my company's applicants for automobile insurance. I believe he is essentially correct; but it is not out of perversity that the insurance carriers have failed to replace their underwriters and actuaries with psychologists; there would seem to be no feasible way to bring together car drivers and psychologists. This does, however, suggest the possibility of the carriers' employing a reasonable number of these learned men to help devise some less exact and possibly less drastic method of discovering the accident-prone. Perhaps with every application for insurance we should also demand a signed interpretation of one of Rorschach's ink blots.

What the Industry so desperately seeks is a simply-manipulated device for determining and mathematically evaluating the risk of accident inherent in a motor vehicle owner or operator. That this has not yet been found I believe even the promoters of the various merit rate plans will agree. That it ever can be found is extremely doubtful. It seems to me clear that in this area, as in so many others, simplicity and accuracy are mutually antagonistic. To the degree that we require a mathematical and clearly defined accuracy we must perforce sacrifice simplicity and ease of operation. There is no harder task than to make the intangible tangible.

Here I believe is the crux of the problem. Our statutes say, quite properly, that rates shall not be excessive, inadequate or unfairly discriminatory. In the abstract these three principles are ideal; in their specific administration, however, we find them far too broad and indeterminate. It is a bit like legislating that men shall not be niggardly, over-generous, or unfairly prejudiced. How can anyone know truly that a given rate for a given risk is neither excessive, nor inadequate, nor unfairly discriminatory? We are justly proud that ours is a government of laws and not of men, but an excess of zeal for legal safeguards beyond the needs of the circumstance can destroy the effectiveness of such natural safeguards as judgment and self-discipline.

Because we are so firmly committed to the regulation of rates rather than the supervision of their administration, we find ourselves taking an unrealistic and essentially Procrustean approach to rating philosophy. We imagine that all risks can be fitted into a limited number of specific classifications, subject to exact definition, and that by the mere fact of fitting risks to a definition which describes their tangible attributes we can make them homogeneous. This is at times in direct conflict with the clear evidence of experience and judgment. I recommend to all insurance men a rereading of that immortal classic "Pigs is Pigs," by Ellis Parker Butler. There is something profoundly prophetic about Mr. Flannery's position:

> "Pigs is pigs. Guinea-pigs or dago pigs or Irish pigs is all the same to the Interurban Express Company an' to Mike Flannery. Th' nationality of the pig creates no differentiality in the rate."

Of course this has worked badly. Procrustes found that all men did not, after all, fit his standard-sized bed, and was forced to resort to stretching some and lopping others. I have a theory, which I shall call the Procrustean Law of Classification Stability, that classifications tend to produce their expected experience; in other words, the experience of any class accommodates itself to the pure premium for that class. While this may be partly due to the effect of underwriting selection as it adjusts to the adequacy of the rate, there also seems to be a tendency in our business, which will probably be honestly denied by all concerned, to let the risk's inherent hazard, arrived at intangibly, determine the assigned classification. Since the results are relatively reasonable and uniform, I must conclude that this reprehensible practice does in fact produce a less unfair discrimination as to risks of the same hazard than could prevail by a careful adherence to the definitions.

Our classifications are broad bands of hazard; each one with a wide spectrum of good and bad risks. They overlap to the point where the best of the worst classification produces a lower loss cost than the worst of the best classification. Under our present rating concept the only discrimination allowed a carrier between the best and the worst within the same rate group, or even between the better and the worse, is by selection. If accepted they must be charged the same rate. Under discrimination by selection the risk, which because of the intangibles should fall into a worse classification than is indicated by the tangibles, has difficulty obtaining any insurance at all and will finally have to pay a higher rate either from a non-preferred risk carrier or through the assigned risk plan. That this selection is valid is vouched for by the experience of the so-called "clean" risks in the assigned risk plans, which has been found to be as bad as or even at times worse than the surcharged business at the same rate level. In the main it is pure underwriting selection on the basis of intangibles that places a risk without accident or conviction record in the assigned risk plan. (Incidentally this clean assigned risk experience could cast some doubt on the complete validity of the various merit plans currently competing in the market place.)

I can see no fundamental reason why discrimination by selection should be considered socially preferable to discrimination by rate. Both can be fair and both can be unfair. Discrimination by rate has the one advantage that it keeps the market open, and, in general because of competition, causes each risk to pay a premium fairly commensurate with its hazard. Discrimination by selection, besides being a thoroughly annoying practice to the public, is the basic cause of the assigned risk program, that great Procrustean leveler where all risks are treated in a most unfairly nondiscriminating manner.

Because our present regulatory system has grown up gradually and because we have all breathed this atmosphere from our beginnings in the business, we accept it as appropriate and inevitable. Our friends in Great Britain, however, have grown up in a somewhat more liberal insurance rating atmosphere. Apparently they place more trust than we do in competition and sane judgment. The following rather amusing letter was published in the Manchester (England) Guardian Weekly for July 30, 1959:

> "Your article on car insurance contains one statement which calls for correction. Your correspondent says that insurance companies accept possession of a valid driving license as the only qualification necessary for the granting of 3rd party insurance.
>
> "As an actor I have found that this is not so. Although I have had a clear driving license for 5 years I have on several occasions found that my proposal for 3rd party insurance has been refused outright because of my occupation. I finally obtained 3rd party only, passenger liability excluded, and the premium 'loaded.' Comprehensive, I was told, was out of the question except for a fantastic premium.
>
> "Even worse, in my opinion, is the state of affairs described to me by an actor who owns a self-drive car hire firm. In the first place insurance cover for his business was difficult enough to get because he was connected with the 'entertainment industry,' but further, he was required not to hire his cars to, among others, actors, publicans, jockeys, pilots, ice cream vendors, and log merchants!
>
> "And most absurd of all are the car dealers who are keen to sell you their cars and who are also insurance agents. They find it necessary to suggest as I have had done to me, that if I describe myself as, perhaps, an 'interpreter' (dramatically, I suppose) or 'Commercial Artist' all will be well. No doubt it would be until the first court case, when such falsification might leave the customer uninsured and criminally guilty and the agent untouched.
>
> "Surely, if the law requires us to have 3rd party insurance it should be available to all on equal terms with our fellow-motorists."
>
> "Yours &c
> "Paul Whitsun-Jones
> "12 Flask Walk
> "London NW 3"

In this country, though his premium would not be arbitrarily "loaded", Mr. Whitsun-Jones would be in the assigned risk plan and even more unhappy. I quote this letter merely to show that automobile insurance can be operated on a different plan from ours. It is my impression that, in spite of Mr. Whitsun-Jones's dissatisfaction, there is more justice and less turmoil in British insurance than in ours.

I believe the insuring public would be better served, the premiums charged would be more equitable (by which I mean more nearly commensurate with the inherent hazard involved), and there would be a much more open and healthy competitive atmsophere in the private passenger automobile insurance market if carriers were permitted the exercise of some judgment in individual risk rate determination within the framework of over-all state supervision of rating administration.

There remains still the fear that unregulated rates in the face of keen competition will be inadequate rates from the point of view of company solvency, thus endangering the very security of our system. Under today's operating procedures, however, the safety of a carrier is irretrievably given over to the judgment of its underwriting organization through the authority to accept and reject. A company can sink into insolvency with tragic speed through bad risk selection even with every rate charged strictly according to manual. Why should we expect our staffs, which we trust to exercise adequate restraint in risk selection, to cast that restraint to the winds if given some limited discretion in rate assignment?

Some will accuse me at this point of selling my actuarial profession down the river. I plead "not guilty." It has always seemed to me that when the law is too pervasive the atmosphere breeds shysterism. The present regulatory climate makes actuarial shysterism a distinct, though, I hope, as yet an unrealized, possibility. When the rating laws or their administration in any state is unrealistic or pettifogging the temptation is very strong for the actuary to forget his professional obligation which is to seek the best estimate of a future rate and instead, to become the protagonist who uses his skill to argue his client's cause regardless of merit. In the three-cornered contest produced by current conditions, with the carriers, the agents, and the insurance departments all employing actuaries to interpret and promote their parochial points of view, the temptation has at times become well-nigh irresistible.

There would be adequate place for the actuary in a freer rating climate. The freedom I suggest does exist in the life insurance business where the actuary seems to do very well, and, although the actuarial problems in life insurance differ materially from those in fire and casualty insurance, there is a common need in both fields for rational analysis and the tempering of what is competitively wished for by what has a reasonable hope for success. The actuary can and does supply technical skill and logical perspective to the solution of problems involving insurance rating and risk evaluation. These attributes grow in usefulness as the carriers gain in freedom.

But let us never make the basic mistake of considering the actuary a brake on competition. The current automobile situation clearly demonstrates that competition is alive in our business and that the actuary should be in the thick of it. With his analytical training, his interest in discovering relationships, and his familiarity with the substantive data of the business, he is uniquely placed for the exercise of creative imagination. He should be the source of new ideas and of new approaches to old ones. Such talents are much in demand in a free competitive system and the freer the system the greater should be the demand. In the current automobile dancing mania the Bureau actuaries have come in for a great deal of criticism from both the fearful and the offended. Some day in the future we shall all know just how good or bad this latest creation of theirs has turned out to be. Certainly I am no prophet. But one thing I know: their action has been in the best actuarial tradition; it has been logically developed, honestly presented, and saturated with the competitive spirit. I salute them for it.

AN ACTUARIAL NOTE ON THE CREDIBILITY OF EXPERIENCE OF A SINGLE PRIVATE PASSENGER CAR

BY
ROBERT A. BAILEY AND LEROY J. SIMON

The experience of the Canadian merit rating plan[1] for private passenger cars provides a means of evaluating the experience rating credibility of the experience of one car. The Canadian experience includes the experience of virtually every insurance company operating in Canada and is collated by the Statistical Agency (Canadian Underwriters' Association—Statistical Department) acting under instructions from the Superintendent of Insurance.

Merit ratings in Canada depend on the number of full years since the insured's most recent accident or since the insured became licensed. The ratings of A, X, Y and B correspond to three or more, two, one, and no years since the most recent accident or since licensing.[2] A + X would be the experience for two or more accident-free years and A + X + Y would be the experience for one or more accident-free years. Table 1 presents the data upon which this study is based. Earned premiums are converted to a common rate basis by use of the relationship in the rate structure that A:X:Y:B = 65:80:90:100. Other calculations in the table are self-explanatory. The authors have chosen to calculate Relative Claim Frequency on the basis of premium rather than car years. This avoids the maldistribution created by having higher claim frequency territories produce more X, Y, and B risks and also produce higher territorial premiums.

The experience rating formula commonly used may be expressed in the form:

$$\text{Modification} = ZR + (1 - Z) \quad \text{where}$$
$$Z = \text{credibility} \quad \text{and}$$
$$R = \text{the ratio of the actual losses to the expected losses.}$$

If the modification is made equal to the subsequent experience of experience-rated risks relative to the average experience of all risks, and if R is made equal to the past experience on which the experience rating is based relative to the average of all risks, then the formula can be solved for the credibility. Where R = 0 as it is for accident-free risks, the credibility equals 1 — Modification. Referring to Table 1 and setting the Modification equal to the "Relative Claim Frequency", the credibilities obtained for a private passenger car for experience pe-

[1] See also "The Canadian Merit Rating Plan for Individual Automobile Risks," Herbert E. Wittick, P. C. A. S. XLV, pg. 214.

[2] Class 1A Select was introduced effective September 1, 1959 and uses a five-year period, but such risks are still a part of Class 1A in data used in the paper.

riods of one, two, or three years are shown in Table 2. For example, in Class 1A the Modification = .920 which gives Credibility = .080 as shown in Table 2 for a three-year period. As another example, in Class 5, A + X + Y, the Modification = .962 which gives Credibility = .038 as shown in Table 2 for a one-year period.

Table 2 also shows the average claim frequency of each class and the ratio of the three-year credibility to the annual claim frequency. If the variation of individual insureds' chances for an accident were the same within each class, the credibility (for experience rating) would be expected to vary approximately in proportion to the average claim frequency.[3] Classes 2, 3, 4 and 5 are more narrowly defined than Class 1, and the fact that the ratios in the last column of Table 2 for these classes are less than the ratio for Class 1 confirms the expectation that there is less variation of individual hazards in those classes. This also illustrates that credibility for experience rating depends not only on the volume of data in the experience period but also on the amount of variation of individual hazards within the class.

Table 3 shows the credibility of a two or three-year period in relation to the credibility for one year. If an individual insured's chance for an accident remained constant from one year to the next and if there were no risks leaving the class or no new risks entering the class, the credibilities for experience periods of one, two and three years would be expected to vary approximately in proportion to the number of years.[4] It should be remembered that experience rating is a procedure to find the deviation of an individual risk from the average risk and is different from class rate-making, which is a procedure to find the average and where an increase in the volume of the experience increases the reliability of the indication only in proportion to the square root of the volume. The fact that the relative credibilities in Table 3 for two and three years are much less than 2.00 and 3.00 is partially caused by risks entering and leaving the class. But it can be fully accounted for only if an individual insured's chance for an accident changes from time to time within a year and from one year to the next, or if the risk distribution of individual insureds has a marked skewness reflecting varying degrees of accident proneness.

If Class 1B risks have an average of 1.044 accidents in the year prior to the rating[5] the credibility for 1B risks for a one-year experience period is found to be:

$$\text{Modification} = \text{ZR} + (1 - \text{Z})$$

$$1.476 = \text{Z}\,\frac{1.044}{.087} + 1 - \text{Z}$$

$$\text{Z} = .043$$

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[3] See Appendix I.

[4] See Appendix I.

[5] See Appendix II.

This gives an interesting confirmation to the credibility of .046 produced by considering the combined A + X + Y group.

Tables 1, 2 and 3 are based on accident frequency in order to reduce chance fluctuations caused by variations in the size of claims. However, we noticed that B risks had an average claim cost consistently higher than average and A risks consistently lower. This tends to increase the credibility. Table 4 shows for Class 1, which has enough volume to make the average claim cost reliable, the same data as is presented in Tables 1, 2 and 3 except that losses are used instead of number of claims.

In summary, we feel that the Canadian merit rating data for private passenger cars leads to the following conclusions:

(1) The experience for one car for one year has significant and measurable credibility for experience rating.

(2) In a highly refined private passenger rating classification system which reflects inherent hazard, there would not be much accuracy in an individual risk merit rating plan, but where a wide range of hazard is encompassed within a classification, credibility is much larger.

(3) If we are given one year's experience and add a second year we increase the credibility roughly two-fifths. Given two years' experience, a third year will increase the credibility by one-sixth of its two-year value.

TABLE 1

Canada excluding Saskatchewan

Policy Years 1957 & 1958 as of June 30, 1959

Private Passenger Automobile Liability—Non-Farmers

Merit Rating	*Earned Car Years*	*Earned Prem. at Present B Rates*	*No. of Claims Incurred*	*Claim Freq. per $1000 of Prem.*	*Relative Claim Freq.*
Class 1 — Pleasure — no male operator under 25					
A	2,757,520	159,108,000	217,151	1.365	.920
X	130,706	7,910,000	13,792	1.744	1.175
Y	163,544	9,862,000	19,346	1.962	1.322
B	273,944	17,226,000	37,730	2.190	1.476
Total	3,325,714	194,106,000	288,019	1.484	1.000
A + X	2,888,226	167,018,000	230,943	1,383	.932
A + X + Y	3,051,770	176,880,000	250,289	1.415	.954
Class 2 — Pleasure — Non-principal male operator under 25					
A	130,535	11,840,000	14,506	1.225	.932
X	7,233	712,000	1,001	1.406	1.070
Y	9,726	944,000	1,430	1.515	1.153
B	21,504	1,992,000	3,421	1.717	1.307
Total	168,998	15,488,000	20,358	1.314	1.000
A + X	137,768	12,552,000	15,507	1.235	.940
A + X + Y	147,494	13,496,000	16,937	1.255	.955
Class 3 — Business use					
A	247,424	25,846,000	31,964	1.237	.920
X	15,868	1,783,000	2,695	1.511	1.123
Y	20,369	2,281,000	3,546	1.555	1.156
B	37,666	4,129,000	7,565	1.832	1.362
Total	321,327	34,039,000	45,770	1.345	1.000
A + X	263,292	27,629,000	34,659	1.254	.932
A + X + Y	283,661	29,910,000	38,205	1.277	.949
Class 4 — Unmarried owner or principal operator under 25					
A	156,871	18,450,000	22,884	1.240	.901
X	17,707	2,130,000	3,054	1.434	1.041
Y	21,089	2,523,000	3,618	1.434	1.041
B	56,730	6,608,000	11,345	1.717	1.247
Total	252,397	29,711,000	40,901	1.377	1.000
A + X	174,578	20,580,000	25,938	1.260	.915
A + X + Y	195,667	23,103,000	29,556	1.279	.929
Class 5 — Married owner or principal operator under 25					
A	64,130	5,349,000	6,560	1.226	.941
X	4,039	345,000	487	1.412	1.084
Y	4,869	413,000	613	1.484	1.139
B	8,601	761,000	1,291	1.696	1.302
Total	81,639	6,868,000	8,951	1.303	1.000
A + X	68,169	5,694,000	7,047	1.238	.950
A + X + Y	73,038	6,107,000	7,660	1.254	.962

TABLE 2

Class	Credibility 1 year	2 years	3 years	Claim Frequency per car year	Ratio 3 year cred. to annual claim frequency
1	.046	.068	.080	.087	.920
2	.045	.060	.068	.120	.567
3	.051	.068	.080	.142	.563
4	.071	.085	.099	.162	.611
5	.038	.050	.059	.110	.536

TABLE 3

RELATIVE CREDIBILITY

Class	*1 year*	*2 years*	*3 years*
1	1.00	1.48	1.74
2	1.00	1.33	1.51
3	1.00	1.33	1.57
4	1.00	1.20	1.39
5	1.00	1.32	1.55

TABLE 4

Canada excluding Saskatchewan

Policy Years 1957 & 1958 as of June 30, 1959

Private Passenger Automobile Liability—Non-Farmers

Merit Rating	*Earned Premiums at Present B Rates*	*Incurred Losses*	*Loss Ratio*	*Relative Loss Ratio*
Class 1—Pleasure—no male operator under 25				
A	159,108,000	63,191,000	.397	.911
X	7,910,000	4,055,000	.513	1.177
Y	9,862,000	5,552,000	.563	1.291
B	17,226,000	11,809,000	.686	1.573
Total	194,106,000	84,607,000	.436	1.000
A + X	167,018,000	67,246,000	.403	.924
A + X + Y	176,880,000	72,798,000	.412	.945

Credibility

Class	*1 year*	*2 years*	*3 years*
1	.055	.076	.089

Relative Credibility

Class	*1 year*	*2 years*	*3 years*
1	1.000	1.38	1.62

APPENDIX I

To illustrate that the credibilities would vary approximately in proportion to the number of years* for the first few years and for typical frequencies, consider a model in which 100,000 risks have an inherent hazard, as measured by their true claim frequency, of .05, 100,000 risks have a claim frequency of .10 and 50,000 risks have a frequency of .20. The number of persons claim-free for the past t years assuming a Poisson approximation to the distribution is as follows:

Frequency	$t = 0$	$t = 1$	$t = 2$	$t = 3$
.05	100,000	95,123	90,484	86,071
.10	100,000	90,484	81,873	74,082
.20	50,000	40,937	33,516	27,441
Total	250,000	226,544	205,873	187,594

The number of claims in the subsequent year will be:

Frequency	$t = 0$	$t = 1$	$t = 2$	$t = 3$
.05	5,000	4,756	4,524	4,304
.10	10,000	9,048	8,187	7,408
.20	10,000	8,187	6,703	5,488
Total	25,000	21,991	19,414	17,200
Claim frequency of total group	.10000	.09707	.09430	.09169
Relative to $t = 0$	1.0000	.9707	.9430	.9169
Credibility		.0293	.0570	.0831
Relative credibility		1.000	1.945	2.836

APPENDIX II

Class 1B risks are known to have had one or more claims in the past year. Using the Poisson distribution as an approximation to the risk distribution (another curve which we have used in practice fits more exactly, but for theoretical considerations such as these, the Poisson is a good approximation), we observe that the number of persons having no claim last year is Ne^{-m}, where m is the claim frequency of the class and N is the radix or total number of persons in the population under consideration. Therefore, $N(1\text{-}e^{-m})$ persons produce the one or more claims with which we are concerned. The number of claims produced by the entire group is Nm. Hence the average number of claims produced by those risks which have one or more claims is $Nm/N(1\text{-}e^{-m})$ or $m/(1\text{-}e^{-m})$.

In our specific problem, the Class 1 claim frequency is .087 per car which means that risks that had one or more claims last year (and are Class 1B this year) had an average of $.087/(1\text{-}e^{-.087}) = 1.044$ claims.

* This illustration may be used equally as well to demonstrate that the credibilities vary approximately in proportion to the average annual frequency because in the Poisson distribution an increase in the annual frequency has the same effect as an increase in the length of time.

SOME CONSIDERATIONS ON AUTOMOBILE RATING SYSTEMS UTILIZING INDIVIDUAL DRIVING RECORDS

BY

LESTER B. DROPKIN

INTRODUCTION

With the recent introduction of automobile rating systems which modify an otherwise applicable rate by utilizing some form of individual driving record, a number of questions presented themselves. On the one hand it was felt that a mathematical description of a phenomenon—in this case risk distributions by number of accidents—is intrinsically of value and constitutes an advance. The first part of this paper is concerned with the presentation of such a description. A frequency distribution, known as the negative binomial distribution is utilized in these first sections.

Of considerable and immediate importance is the question: What is the probability that an individual rated according to a given "driving record sub-classification" has been correctly classified? The answer to the question as phrased is actually an objective and, as such, is not specifically answered here. Rather, we have utilized a simple type of segregating system, based on the number of traffic violations only without regard to the type of violation involved.[1] In the concluding parts of this paper an analysis of this simple model is made and conclusions drawn. As is there pointed out, this paper has as one of its prime intents, the introduction and utilization of certain approaches to the problem. While an extrapolation of some of these conclusions to the actual rating systems currently being introduced by the rating bureaus and others is made, this paper is by its nature preliminary. It is hoped that the near future will produce more extensive investigations.

THE RATIONALE OF USING THE NEGATIVE BINOMIAL DISTRIBUTION

Of those individuals who have no accidents during an experience period some will be persons with a high loss-causing propensity but have been "lucky", some will be persons with a very low propensity and have seen their "expectations" realized, and conversely. All this we know (or assume). The attempt is here made to unravel some of these threads and to gain a means of approach whereby some of the probabilities involved may be set forth.

In discussions of the distributions of risks by number of accidents it has been traditional to base such discussions on the Poisson fre-

Note 1. For a description of the California study which constitutes the basic data for this paper, see the paper by F. Harwayne entitled "Merit Rating in Private Passenger Automobile Liability Insurance and The California Driver Record Study."

quency function, $P(x)$. That is, if we let n be a random variable (equal to the number of accidents) we have assumed that the probability that $n = x$, where $x = 0, 1, \ldots$ is given by:

(1) $P(x) =$ prob. that n equal $x = (m^x e^{-m}) / x!$

In dealing with a given body of experience the parameter m is set equal to the observed mean because in the Poisson distribution $E(x) = m$.

A test of goodness of fit by use of the chi-square distribution will, however, often indicate a significant deviation. A much improved fit will often result by considering that n is distributed in accordance with the two parameter frequency function:

(2) $N(x) =$ prob. that n equals $x = \left(\frac{a}{1+a}\right)^r \binom{-r}{x} \left(\frac{-1}{1+a}\right)^x$

where $x = 0, 1, \ldots$

This frequency function is known as the *negative binomial distribution.*[2] For this function $E(x) = r/a$ and $\sigma^2 = (r/a)\ [(a+1)/a]$ as will be shown subsequently. In fitting observed data to eq. (2) the observed mean and variance are set equal to r/a and $(r/a)\ [(a+1)/a]$ respectively, whence the parameters r and a can be determined by solving the two equations simultaneously. Upon solving we get that $r = m^2/\ (\sigma^2 - m)$ and $a = m/\ (\sigma^2 - m)$. In actually using $N(x)$ with a given body of data it is usual to use the following expanded form in which the values are obtained when $\left(\frac{a}{1+a}\right)^r$ is multiplied by the terms of the sequence:

$$\left\{1,\ \frac{r}{1+a},\ \frac{r\ (r+1)}{2!\ (1+a)^2},\ \frac{r\ (r+1)\ (r+2)}{3!\ (1+a)^3}, \ldots\right\}$$

That is, the probability that $n = 0$ is $\left(\frac{a}{1+a}\right)^r \cdot 1$;

that $n = 2$ is $\left(\frac{a}{1+a}\right)^r \bullet \frac{r(r+1)}{2(1+a)^2}$

The rationale of the applicability of $N(x)$ to distributions by number of accidents results from the following considerations: If we assume that the parameter m in eq. (1) is itself a (continuous) random variable with the frequency function $T(m)$ then the probability that n takes on any given value x is:

Note 2. See Appendix B for a comparison of the fit achieved by the use of the negative binomial and by the Poisson. The Chi-square test on the Poisson and the very good fit of the negative binomial was called to my attention by F. Harwayne.

$$(3) \qquad \int_0^{\infty} P(x) \ . \ T(m) \ dm$$

Without for the moment specifying the form of T(m), the introduction of a variable m can be interpreted as a way of accounting for the variation of risk among the members of a given population. That is, it is assumed that

(a) the individual chances vary from one person to another but (for the given individual) remain constant throughout the experience period, and

(b) these initial propensities are distributed in the population in a simple curve, T(m).

The negative binomial, N(x) results from assigning to T(m) the specific form:

$$(4) \qquad T(m) = \frac{a^r}{\Gamma(r)} m^{r-1} e^{-am} \qquad \text{(a, r positive)}$$

which is a Pearson Type III. The Type III curve being selected because of its skew form and because it leads to conveniently simple equations for fitting. It is also possible if a frequency is expressible by a Type III curve to express the chance of a variation within a given limit by utilizing Pearson's *Tables of the Incomplete Gamma Function.* This enters into later considerations.

The mathematics of these considerations is given in Appendix A.

THE EFFECT OF SEGREGATING BY DRIVING RECORD

As indicated in the Introduction we have dealt here only with a simple segregation by traffic violation; i.e., we have used only the data appearing in the California Study.

While the average accident involvement generally increases with increasing number of violations (see F. Harwayne, op. cit.) it does appear that for the groups with 5, 6, 7, 8 and 9 or more violations, the mean accident frequencies have become relatively stable. (The respective means are .557, .508, .502, .545 and .656).

The fact that the negative binomial fits the data for the total group indicates that there is a real spread, that is, a distribution, of the probability of having an accident. From the construction of the negative binomial we have seen that this distribution is describable by a Type III curve.

Now it is clearly the function of a segregating system to split up the total heterogeneous group into homogeneous groups. The question is therefore raised as to whether or not, or to what degree, a segregating system based on traffic violations does split up the total group.

If the system we are dealing with here accomplished this purpose totally, then the distributions by number of accidents of the individual groups should be describable by Poisson curves. Now if the variance of the separate groups were less than the Binomial variance[3], then Poisson curves would indeed be indicated. However, Appendix C shows that this is not the case. In every instance the variance is greater than the Binomial variance. This would seem to indicate that the desired segregation was not achieved.

We can, however, go further. Since a Poisson distribution is not indicated for the distributions by number of accidents, a negative binomial is indicated. But a negative binomial for the distribution by number of accidents is describable by a Type III curve. Now if we can picture these individual Type III curves, we can see in which groups, if any, the probability of having an accident is highly concentrated about the mean probability for that group. In other words, if we can determine what portion of the distribution is within stated deviations from the mean, then we can see how closely a given mean probability (of having an accident) approximates a constant probability and thus how closely the segregating system under consideration achieves its aim.

The required areas (or rather portion of total area) under the various Type III curves can be determined through a utilization of Pearson's *Tables of the Incomplete Gamma Function.* (See Appendix D for details.)

Appendix E sets forth, by individual group, the portion of the distribution within stated deviations from a given mean probability of having an accident. The deviations utilized are plus and minus 20%, 30%, 40%, 50%.

REVIEW, SUMMARY AND CONCLUSIONS

We have in a certain sense conceptually separated this paper into two parts. This was done in order to emphasize what to us seems to be the importance of the negative binomial distribution as a valuable instrument in its own right. It is our belief that this distribution can be an equally useful tool in attacking numerous other actuarial problems. It is also believed that many worthwhile results can flow from a utilization of the general approach illustrated by eq. (3). This equation is typical of the general theory of processes random in time (stochastic processes) and we believe that this theory will come to be of particular value to the actuary.

It is also important to emphasize here that there are two distributions which enter into our considerations. On the one hand there is the distribution of the probability of having an accident. On the other hand there is the distribution of risks by number of accidents. If the first distribution is a constant, then the second is a Poisson. If the first is a Type III, then the second is a negative binomial. Since the two parameters of the negative binomial are also the two para-

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Note 3. The Binomial variance is equal to the product of the mean and the complement of the mean.

meters of the component Type III we can use the sample mean and variance to determine them. From a knowledge of the values of these parameters we can determine the spread about the mean probability of having an accident. If there is little spread then the segregating system has performed its function. A review of the figures shown in Appendix E indicates that in no group was there a real concentration about the mean. Thus for the group with 1 violation only about 25% of the group can be expected to lie within plus or minus 20% of the mean, 62% can be expected to fall outside of an interval of plus or minus 30% of the mean, etc. Notice too, that for the group having no violations, which represents 58.7% of the total number of individuals in the study, only a little over 25% of the group can be expected to lie in an interval of plus and minus 40% of the mean.

It is also very instructive to look at the question of overlapping. We see that about 25% of each of the groups having 1, 2, 3 or 4 violations can be expected to have a probability of having an accident greater than or equal to the mean probability for the succeeding group. As examples: The mean probability in group 3 is .354; the portion of group 2 having a probability of .356 (= 1.3 times the mean of group 2) or more is .25 (= 1–.75). The mean probability in group 5 is .553; the portion of group 4 having a probability of .554 (= 1.3 times the mean of group 4) or more is .26 (= 1–.74).

There is, in addition, considerable overlapping in the other direction. Thus, for example, the mean probability in Group 1 is .194; the portion of Group 2 having a probability of .192 (= .7 times the mean of group 2) or less is .36. For Group 2, therefore, about 60% of the group may be expected to have a probability of having an accident which is either less than the mean of the preceding group or greater than that of the following group. Similar figures obtain for other groups.

If in asking these questions we were to think of an interval about the means of the preceding and following groups, the amount of overlapping would of course be greater.

Having now performed these calculations, what are our conclusions? We are, it would seem, to conclude that the segregating system here considered does not function to effectively separate the total into groups sufficiently homogeneous to merit modifications of the rate.

We may well expect, a priori, that a segregating system which is based on only certain violations rather than all violations, that introduces a weighting process for these violations and that includes accident record as well as violation record, will produce a separation into groups more homogeneous than we have seen here. We must, however, also note that the use of 2 years' experience instead of the 3 years which form the data for this study, will act to decrease whatever sharpness of separation the foregoing will presumably introduce.

While it is dangerous to extrapolate, it would appear from the results presented in this paper that two conclusions of general application may be drawn. These are that

(a) after a certain point an increase in the number of violations does not contribute proportionately to an increase in the average number of accidents, and

(b) the effect of segregating according to driving record is less effective than might be heretofore thought.

It is clear that the general area with which this paper is concerned is of current importance and is obviously a fertile field for many future papers. Presentations dealing with models more closely approximating the actual rating systems in use and with utilizations of the negative binomial distribution in other areas are earnestly to be desired.

APPENDIX A

Mathematics of the Negative Binomial

We here display the mathematics of the considerations set forth in the first part of the paper. By substituting in eq. (3) the specific forms P(x) and T(m) given by eqs. (1) and (4) we derive therefrom the equation for N(x) given by eq. (2). Following this we show that:

(a) $\sum\limits_{x=0} N(x) = 1$

(b) $E(x) = r/a$

(c) $E(x^2) = \frac{1}{a}\left(\frac{a+r+1}{a}\right)$ and that therefore

(d) $\sigma^2 = E(x^2) - [E(x)]^2 = \frac{r}{a}\left(\frac{a+1}{a}\right)$

Derivation of N(x)

From eq. (1), $P(x) = (m^x e^{-m})/x!$ and from eq. (4), $T(m) = (a^r m^{r-1} e^{-am})/\Gamma(r)$ we are to derive N(x). We proceed as follows:

$$N(x) = \int_0^\infty \frac{m^x e^{-m}}{x!} \cdot \frac{a^r m^{r-1} e^{-am}}{\Gamma(r)}\, dm \tag{5}$$

$$= \int_0^\infty \frac{a^r}{x!\,\Gamma(r)} \cdot m^{(x+r-1)} \cdot e^{-m(1+a)}\, dm \tag{6}$$

$$= \frac{a^r}{x!\,\Gamma(r)} \cdot \frac{(x+r-1)!}{(1+a)^{x+r}} \qquad \text{[see Pierce \#493]} \tag{7}$$

$$= \left(\frac{a}{1+a}\right)^r \cdot \frac{1}{(1+a)^x} \cdot \frac{(x+r-1)!}{x!\,\Gamma(r)} \tag{8}$$

Now since the last factor in eq. (8) can be transformed as follows:

$$\frac{(x+r-1)!}{x!\,\Gamma(r)} = \frac{(r+x-1)!}{x!\,(r-1)!} = \frac{r(r+1)\ldots(r+x-1)}{x!}$$

$$= \frac{(-r)[-(r+1)][-(r+2)]\ldots[-(r+x-1)](-1)^x}{x!}$$

$$= (-1)^x \binom{-r}{x} \tag{9}$$

we have that

$$(10)\qquad N(x) = \left(\frac{a}{1+a}\right)^r \cdot \frac{1}{(1+a)^x} \cdot (-1)^x \cdot \binom{-r}{x}$$

which is equation

$$(2)\qquad N(x) = \left(\frac{a}{1+a}\right)^r \binom{-r}{x} \left(\frac{-1}{1+a}\right)^x$$

From this it immediately follows that

$$(11)\quad \sum_{x=0} N(x) = \left(\frac{a}{1+a}\right)^r \left(1-\frac{1}{1+a}\right)^{-r} = \left(\frac{a}{1+a}\right)^r \left(\frac{a}{1+a}\right)^{-r} = 1$$

Derivation of $E(x)$, $E(x^2)$ and σ^2

By definition, $E(x) = \sum_{x=0} x \cdot N(x)$, whence

$$(12)\quad E(x) = \sum_{x=0} x \cdot N(x) = 0 + \sum_{x=1} x \cdot N(x)$$

$$(13)\qquad = \sum_{x=1} \left(\frac{a}{1+a}\right)^r \left(\frac{r}{1+a}\right) \binom{-(r+1)}{x-1} \left(\frac{-1}{1+a}\right)^{x-1}$$

$$(14)\qquad = \left(\frac{a}{1+a}\right)^r \left(\frac{r}{1+a}\right) \left(1 - \frac{1}{1+a}\right)^{-(r+1)}$$

$$(15)\quad E(x) = \left(\frac{a}{1+a}\right)^r \left(\frac{r}{1+a}\right) \left(\frac{a}{1+a}\right)^{-(r+1)} = \frac{r}{1+a}\left(\frac{a}{1+a}\right)^{-1} = \frac{r}{a}$$

Similarly from $E(x^2) = \Sigma x^2 \cdot N(x)$ and $\sigma^2 = E(x^2) - [E(x)]^2$, we have:

$$(16)\quad E(x^2) = \sum_{x=0} x^2 \cdot N(x) = 0 + \left(\frac{a}{1+a}\right)^r \left(\frac{r}{1+a}\right) + \sum_{x=2} x^2 \cdot N(x)$$

By writing $[x(x-1)+x]$ for x^2, we get

$$(17)\quad E(x^2) = \left(\frac{a}{1+a}\right)^r \left(\frac{r}{1+a}\right) + \sum_{x=2} x(x-1)N(x) + \sum_{x=2} x \cdot N(x)$$

But since $\sum_{x=1} x \cdot N(x) = r/a$ it follows that

$$\sum_{x=2} x \cdot N(x) = r/a - \left(\frac{a}{1+a}\right)^r \left(\frac{r}{1+a}\right)$$

Accordingly (17) becomes

$$(18)\quad E(x^2) = \frac{r}{a} + \sum_{x=2} x(x-1)\left(\frac{a}{1+a}\right)^r \binom{-r}{x} \left(\frac{-1}{1+a}\right)^x$$

$$(19)\quad = \frac{r}{a} + \sum_{x=2}\left(\frac{a}{1+a}\right)^r \cdot \frac{r(r+1)}{(1+a)^2}\binom{-(r+2)}{x-2}\left(\frac{-1}{1+a}\right)^{x-2}$$

$$(20)\quad = \frac{r}{a} + \left(\frac{a}{1+a}\right)^r \cdot \frac{r(r+1)}{(1+a)^2} \cdot \left(1 - \frac{1}{1+a}\right)^{-(r+2)}$$

$$(21)\quad E(x^2) = \frac{r}{a} + \frac{r(r+1)}{a^2} = \frac{r}{a}\left(\frac{a+r+1}{a}\right)$$

From this it immediately follows that

$$(22)\quad \sigma^2 = \frac{r}{a}\left(\frac{a+r+1}{a}\right) - \left(\frac{r}{a}\right)^2$$

$$(23)\quad \sigma^2 = \frac{r}{a}\left(\frac{a+1}{a}\right)$$

APPENDIX B

Comparison of Fit by Poisson and Negative Binomial for Total Group

Number of Accidents	*Observed Freq.* No.	*Observed Freq.* %	*Theoretical Frequency* *Negative Binomial* No.	*Negative Binomial* %	*Poisson* No.	*Poisson* %
0	81714	86.07	81726	86.086	80655	84.959
1	11306	11.91	11273	11.874	13147	13.848
2	1618	1.71	1647	1.735	1072	1.129
3	250	.26	245	.258	58	.061
4	40	.04	37	.039	3	.003
5 or more	7	.01	7	.008	—	—
	94935		94935		94935	

Mean = .163 $\sigma^2 = .193$ Binomial Variance = .136

For fitting the neg. binomial: $r = .8927$; $a = 5.472$; $\frac{a}{1+a} = .8455$

For fitting the Poisson: $e^{-.163} = .84959$.

APPENDIX C

Group (Violations)	*Mean*	*Variance*	*Binomial Variance**
0	.087	.096	.079
1	.194	.207	.156
2	.274	.299	.199
3	.354	.395	.229
4	.426	.501	.245
5 or more	.553	.610	.247
Total	.163	.193	.136

* Equals the product of the mean and its complement.

APPENDIX D

The determination of the ratios of $\int_0^t T(m)\,dm$ to $\int_0^\infty T(m)\,dm$ with $T(m)$ as defined in equation (4), is accomplished by utilizing the *Tables of the Incomplete Gamma Function* prepared under the direction of Karl Pearson in 1922.

The complete gamma function $\Gamma(p+1)$ is defined as $\int_0^\infty e^{-x}x^p dx$ while the incomplete gamma function $\Gamma_x(p+1)$ is defined as $\int_0^x e^{-x}x^p dx$.

If $I(x,p)$ denotes the ratio of the incomplete to the complete gamma function, then $I(x,p)$ gives the portion of the curve to the left of x. However $I(x,p)$ has not been published. Instead a variable $u = x/\sqrt{p+1}$ is used and it is these equivalent tables of $I(u,p)$ which were prepared by Pearson. That is

$$I(u,p) = \frac{\int_0^{u\sqrt{p+1}} v^p e^{-v} dv}{\int_0^{\infty} v^p e^{-v} dv}$$

In order to use the tabulated values of $I(u,p)$ it is necessary to proceed as follows:

We first recall that $\int_0^{\infty} T(m)\,dm = 1$ so that we are looking for values of $\int_0^{t} T\ (m)\,dm$ and recall that:

$$\int_0^{t} T\ (m)\,dm = \int_0^{t} \frac{a^r m^{r-1} e^{-am}}{\Gamma(r)}\ dm$$

Now let $v = am$ so that $m = a^{-1}v$ and $dm = a^{-1}dv$. The integral thus becomes:

$$\int_0^{at} \frac{v^{r-1}e^{-v}}{\Gamma(r)}\ dv$$

Now let $p = r-1$; we then have:

$$\int_0^{at} \frac{v^p e^{-v}}{\Gamma(p+1)}\ dv$$

But this is precisely $I(u,p)$ with $at = u\sqrt{p+1}$; from this we get that

$$u = at/\sqrt{p+1} = at/\sqrt{r}$$

Since we know a and r from the data for a given t we have the values of u and p with which to enter the tables. One could for example determine values with $t =$ mean, mean $\pm$ 5%, mean $\pm$ 10%, mean $\pm$ 20%, etc.

APPENDIX E

When the procedures indicated in Appendix D are carried out, for values of t = 50%, 70%, 80%, 120%, 130%, 140% and 150% of the mean, separately for each individual group, the following results are obtained:

PORTION OF CURVE WITHIN INTERVAL SHOWN FOR GROUP SHOWN

	Group (Violations)					
Interval	*0*	*1*	*2*	*3*	*4*	*5 or more*
0 to $.5\bar{x}$	.45	.18	.20	.19	.23	.10
0 to $.6\bar{x}$	.50	.25	.28	.27	.31	.17
0 to $.7\bar{x}$	.54	.32	.36	.35	.39	.26
0 to $.8\bar{x}$	.59	.40	.43	.43	.46	.36
0 to $1.2\bar{x}$	.71	.65	.70	.70	.70	.72
0 to $1.3\bar{x}$	.73	.70	.75	.75	.74	.78
0 to $1.4\bar{x}$	.76	.74	.79	.79	.78	.83
0 to $1.5\bar{x}$	.78	.78	.83	.83	.81	.88
$.5\bar{x}$ to $1.5\bar{x}$	.33	.60	.63	.64	.58	.78
$.6\bar{x}$ to $1.4\bar{x}$	.26	.49	.51	.52	.47	.66
$.7\bar{x}$ to $1.3\bar{x}$	.19	.38	.39	.40	.35	.52
$.8\bar{x}$ to $1.2\bar{x}$	.12	.25	.27	.27	.24	.36

THE ACTUARIAL ASPECTS OF BLUE CROSS PLANS

BY

J. EDWARD FAUST, JR.

(I) FOREWORD

As most readers are aware, the growth of Blue Cross plans in the last fifteen years has been phenomenal.

Not only have such plans grown in terms of numbers of persons covered but also in terms of complexity of operation.

The actuarial problems of Blue Cross plans have also increased. There is a large variety of coverages available and premiums must be computed so that they are both adequate and competitive.

The purpose of this paper is to outline the actuarial aspects of a typical Blue Cross plan.

Contrary to the belief of some, there is no national Blue Cross organization for underwriting this form of protection.

There are 86 separate Blue Cross organizations in the United States, one in Puerto Rico and five in Canada. Each of these organizations has a fixed, defined geographical area of operation and each operates autonomously.

Some of the Blue Cross plans are incorporated as non-profit institutions, while others are incorporated as insurance companies. Some plans fall under the supervision of the State Insurance Departments in the states where they operate; while others do not. Where plans are supervised by insurance departments the degree of supervision varies because state laws are different.

The United States and Puerto Rico have been divided into 11 districts while Canada is one district. The plans in each district meet regularly to discuss problems in their areas of operation.

Each plan provides coverage to those living in their geographical area of operation. They may also cooperate with other plans in their district or with plans that are not in their districts in providing groups with Blue Cross protection.

For example, the St. Louis Blue Cross plan would cooperate with the Columbus, Ohio Blue Cross plan in underwriting a St. Louis, Missouri employer who has a plant or branch in Columbus, Ohio.

The actuary for a specific Blue Cross plan therefore is not only confronted with the problem of pricing programs covering only those in a given area but also programs that will be written on a district or multiple district basis.

This paper, however, will confine itself to the problems of rating local programs.

Blue Cross plans are rather unique in that they cover such a large percentage of the population nationally and locally as the following table reveals:

Percentage of Population Covered by Plan	*Number of States*
1% to 20%	19
20% to 30%	12
30% to 40%	6
40% to 50%	3
50% to 60%	3
60% and over	3

In other words, in 19 states Blue Cross plans cover from 1% to 20% of the population; in 12 states they cover 20% to 30% of the population; etc.

For the United States as a whole, Blue Cross plans cover 31.2% of the population and the plan which serves as a statistical basis for this paper covers 30% of the population in its operating area. As can be deduced from the above table, Blue Cross data form a very credible basis for rate-making. Indeed, how many insurance companies write as much as 30% of the potential market for a given form of coverage in a given area?

It is fortunate that Blue Cross plans have this high degree of credible experience because the gross premium formula is such that the net premiums must be extremely accurate.

Nationally, and for the plan which serves as a statistical basis for this paper, benefit payments amount to about 90% of Gross Income, Operating Expense is 6.0% to 6.5% of Gross Income and Underwriting Gain is 3.5% to 4.0% of Gross Income.

The net premium obviously must be determined with extreme care.

The following discussion of rate-making procedures applies to coverages written on a Group basis such as thru an employer or union. 75% of those covered by Blue Cross plans are covered thru Group Plans. Only 3% of those covered by Blue Cross plans are covered under Non-Group contracts which are made available to those individuals who are not members of a group which qualifies under enrollment requirements of Group coverage.

22% of those covered by Blue Cross plans are covered under Group Conversion Contracts which are made available to those who leave a Group plan and are individually issued contracts.

(II) BLUE CROSS BENEFITS

Blue Cross contracts may differ in detail from one Blue Cross plan to another but all of them in essence have the following features: The charge of the hospital for a semi-private room is provided up to a specified number of days per hospital confinement or per contract year. Charges made by the hospital for other services such as X-ray, operating room, drugs, etc. are covered.

Blue Cross reimburses the hospitals for the care of their members on the basis of a predetermined reimbursement formula. In other words, benefit payments are not made to the policyholder. Group Hospital Expense Insurance contracts underwritten by insurance companies provide a certain maximum number of dollars per day (e.g. up to $10) for Room and Board charges for a fixed number of days and a fixed number of dollars (e.g. $250) for hospital charges other than for Room and Board.

Under Group Hospital Expense Insurance payments in cash to the limits of the contract are made to the certificate-holders. In recent years, however, there has been an increased use of assignment forms whereby the certificate-holder assigns his benefits to the hospital so that the insurance company may pay the hospital directly.

(III) THE RATE-MAKING PROCESS

(A) *Ascertaining Calendar Year Incurred Losses & Current Rate Level*

Since Blue Cross rates are quite sensitive to current economic conditions the latest calendar year's or fiscal year's experience is a good basis for rate-making.

Since the rates must be revised before the close of the calendar or fiscal year the first step is to estimate the annual loss ratio on the basis of a partial year's experience.

In estimating the annual income care must be exercised to take into account the effect of any rate changes made during or before the calendar or fiscal year. For all practical purposes earned income equals written income since most of the premiums are on a monthly payment basis.

Incurred losses for the year may be estimated from the paid losses for a part of the year by several methods. Two of these methods are set forth below.

(1) *Loss Development Method*

Month of Calendar Year or Fiscal Year	*Percent of Incurred Losses Represented by Payments to End of Month*
1st	2.3%
2nd	8.2%
3rd	17.0%
4th	25.0%
5th	32.8%
6th	41.9%
7th	49.8%
8th	59.6%
9th	67.0%
10th	74.3%
11th	83.8%
12th	91.9%

The above table is representative of the experience of one large Blue Cross plan, as is the following table under "Seasonal Trends":

(2) *Seasonal Trends*

By using the incurred losses for each calendar month and a table such as the following, an estimate of the annual incurred losses can be made:

Month of Year	*Incurred Losses for Month as a Percent of the Incurred Losses for the Year*
January	8.2%
February	8.5%
March	9.2%
April	8.6%
May	8.5%
June	8.1%
July	8.4%
August	7.8%
September	8.4%
October	8.2%
November	8.0%
December	8.1%

An evaluation of the estimated incurred losses for the year under study could be made at the end of the 6th, 7th, 8th and possibly 9th month under each of the above methods and the mean or median of indications could be taken as the final estimate of the annual incurred losses.

With the estimate of the Earned Income and Incurred Losses for the year the expected loss ratio can be determined.

This expected loss ratio for the year divided by the desired permissible loss ratio gives the adjustment needed to bring current income to current loss levels.

Thus far, the over-all change in loss level has been determined.

The next step is to determine the current rate level for each type of contract issued by the plan. Two rates must be determined for each contract—an Individual rate and a Family rate. The Individual rate applies to all unmarried employees and the Family rate applies to those who have their eligible dependents covered.

In the case of Group Hospital Expense Insurance, Employee rates apply to employees whether they be single or married and Dependent rates apply to dependents of employees.

The difference between these two rating systems will be analyzed in detail later in this paper.

The loss ratio for Individuals and for Families for each type of contract is then determined. Current rates are then multiplied by the ratio of the loss ratio to the permissible loss ratio (e.g., 90%).

By knowing the number of Individual and Family contracts under each type of contract the over-all adjustment to income is determined.

If this over-all adjustment is different from the over-all adjustment first determined above, each of the above rates are adjusted so that the first over-all adjustment is obtained.

(B) *Future Rate Level*

After having brought the Individual and Family rates to the level of current losses, the next step is to bring them to the level expected during the period of time the rates will be effective.

It may be expected that future loss levels could be estimated on the basis of the reimbursement formula between the hospital and Blue Cross plan since these formulae provide for a maximum amount of reimbursement per day for Blue Cross members. This is an unsatisfactory projection method since the average payment per patient-day tends to increase more rapidly than the increase in the maximum per diem reimbursement allowance.

Much experimentation was done to find a criterion for forecasting future loss levels.

It was found that economic indices such as the Consumer Price Index could not be used because hospital costs do not lag or change with the cost of living but usually run concurrent with changes in living costs.

It was found, after much research, that one of the best criteria for measuring losses is the Average Annual Cost per Participant (person covered) for the previous 12 months. This is determined each month by dividing the total losses paid in the previous period of 12 months by the average number of participants covered.

These monthly values are plotted on a graph such as shown in Exhibit I. In the graph on Exhibit I the ordinate is the average annual net cost per participant for the previous 12 months and the abscissa is the terminal date of the 12-month period.

In order to estimate future loss levels all that needs to be done is to extrapolate the curve graphically out to the terminal date during which rates are to be effective.

The rates determined in Section (A) above are then multiplied by the ratio of the value of the Average Net Annual Cost per Participant for the terminal date during which rates are to be effective to the value at the end of the experience period under study.

For example, let us assume that the rates in Section (A) above were developed from experience for the 12-month period prior to January 1, 1958 and that the new rates are to be effective until January 1, 1959.

The Average Net Annual Cost per Participant for the 12-month period prior to January 1, 1958 from the graph is $21.50. By extrapolating the curve it appears this value will be $23.50 for the 12-month period prior to January 1, 1959. The rates in Section (A) above would then be multiplied by the ratio of $23.50 to $21.50 or by 1.093.

As is the case of any rate-making process good judgment must supplement statistical data. For example, an increase in the number of hospital beds in the area served by the Blue Cross plan should be taken into account in fixing future rates.

(IV) SHOULD BLUE CROSS RATES VARY BY THE SIZE OF THE GROUP?

Most insurance companies writing Group Accident and Health Insurance grade their rates by the volume of premium expected to be generated by the group during the year. These discounts increase with premium volume and can be as much as 15%.

These discounts are based on the theory that the administrative cost of insuring a person decreases as the size of the group increases. This is true because the fixed cost represents a smaller percent of the premium volume as the premium volume increases. Furthermore, in the case of Group Accident and Health Insurance, the commission rate decreases with an increase in premium volume.

In the case of Blue Cross there are no commissions paid so that the sales expense can be considered to be proportional to premium volume on each group. The cost of handling claims also can be considered to be proportional to the number covered in the group and therefore to the premium volume.

There are certain administrative costs which are fixed and which do not vary with the number in the group.

Theoretically these fixed administrative costs could be expressed in terms of a fixed number of dollars regardless of the size of the group covered. While this would produce some graduation by size of group, it would not be as severe a graduation as can be justified for Group Hospital Expense Insurance.

Blue Cross rates usually are not graduated by size of group and in view of the above discussion this creates little, if any, inequity.

(V) AN ANALYSIS OF BLUE CROSS RATES

As pointed out above, an Individual and Family rate is developed for each type of contract underwritten by a given plan. These rates usually do not vary by the age, sex or marital status of the members of the group.

In order to study the effect of these factors a comprehensive study was made of the experience of a large Blue Cross plan.

63,960 contracts were studied. Data was collected on paid losses during the calendar year of 1956.

The net annual premiums were found for each age bracket, sex and marital status and were divided by the appropriate net annual premiums for Individual and Family contracts.

The following table was obtained:

Ratios to Net Premium for all ages and both sexes

Age of Subscriber	*Individual Contracts* *Male*	*Female*	*Female/Male*	*Family Contracts* *Male*	*Female*
up to 25	0.55	0.55	1.00	1.05 (0.60)	0.60 (0.45)
26 to 35	0.55	0.55	1.00	1.00 (0.70)	0.90 (0.85)
36 to 45	0.65	0.80	1.23	0.95 (0.95)	1.00 (1.05)
46 to 55	0.90	0.85	0.94	0.95 (0.95)	1.00 (1.05)
56 to 65	1.35	1.00	0.74	1.05 (1.20)	1.40 (1.65)
66 and over	1.65	1.65	1.00	1.40 (1.65)	1.40 (1.65)

An illustration of the calculation of the ratios for males under individual agreements is set forth in the Appendix at the end of this paper. All other factors and ratios cited in this paper were obtained from data of a similar nature.

Under the Family contracts, in this study, maternity benefits are provided on the same basis as non-maternity benefits.

The ratios under Family contracts shown above in parentheses are for a plan without maternity and the ratios are to the rates for a plan without maternity benefits. The other ratios for Family contracts are for a plan which includes maternity benefits and the ratios are to rates with maternity benefits.

The following are some other facts that the study revealed:

(1) For all ages combined the net cost for the single male is about equal to that for the single female.

(2) The cost of married male employees is 55% of the cost of single male employees.

(3) The cost of married female employees, excluding maternity benefits, is 90% of the cost of single female employees.

In the case of coverage for single employees, there is a distinct graduation in cost by age. The cost of those over age 65 is about three (3) times the cost for those under age 35.

The cost pattern for single persons between the sexes by age is also interesting. Up to age 36 the cost for both sexes is about the same. Between ages 36 and 46 the female cost is greater than the male cost; between ages 46 and 65 the male cost is greater than the female cost, and over age 65 the cost for both sexes is about the same.

As pointed out above, the cost for a married male employee is about 55% of the cost for a single male employee. It could be that a single male is more inclined to go to the hospital since he usually cannot rely on home care when he is ill or injured, as can a married male. By contrast, it is interesting to note that the cost for a single female employee is about the same as the cost of married female employees excluding maternity benefits.

The cost pattern by age for Family coverage is of interest. In the table set forth above the column entitled Male means that the husband is the employee and the wife, if any, is covered as a dependent whereas the column entitled Female means that the wife is covered as an employee and the husband, if any, is covered as a dependent.

Where the husband is the employee, and where pregnancy is covered the same as a non-maternity hospital confinement, it is interesting to note that the cost of Family coverage is practically constant up to age 65.

Where the wife is the employee under a Family contract it will be noted that the cost under age 25 is quite low. This is due to the fact that the cost of maternity coverage under age 25 for the employed wife is only about one-third the cost where the wife is covered as a dependent under her husband's contract.

The Family cost where the female is the employee is relatively constant between ages 26 and 55.

Where maternity coverage is not provided there is the same marked graduation of cost by age for Family coverage as there is for Single Person coverage.

The ratio of the cost for those over 65 to the cost for those under 25 is about the same 3 to 1 ratio that exists for Single Person coverage.

The relative importance of these costs on the total cost of a group can be seen from the following table based on the 63,960 contracts studied.

Coverage	*Percent of all Contracts*
Single Males	11%
Single Females	25%
Male Employee with Family coverage	54%
Female Employee with Family coverage	10%

Family contracts issued to male employees constitute about 85% of all Family contracts. Since the cost for Family coverage issued to a male employee is fairly constant up to age 65, it is reasonable and equitable that the rate for Family coverage is the same for all ages up to age 65 where maternity confinements are payable on the same basis as non-maternity confinements.

Single Person contracts constitute 36% of the total number of contracts.

Although charging the same rate for all age groups for Family contracts is fairly equitable, the above analysis justifies grading rates for Single Person coverage by attained age.

(VI) BLUE CROSS RATING SYSTEM VERSUS GROUP HOSPITAL EXPENSE INSURANCE RATING SYSTEM

As pointed out before, Blue Cross plans have one rate for single employees and another rate for employees with dependents.

Insurance companies under Group Hospital Expense policies provide Employee coverage and Dependent coverage. Therefore, they have a rate for Employee coverage and a rate for Dependent coverage.

The rate for coverage for a family equals the rate for Employee coverage plus the rate for Dependent coverage in the case of Group Hospital Expense Insurance.

There are actually two Employee rates, a female employee rate and a male employee rate. The rate for a female employee, without maternity benefits, is usually 150% of the male employee rate.

From the data developed from the study of the 63,960 contracts mentioned above in Section (V) it was possible to determine a male employee rate, a female employee rate and a dependent rate.

The following results were obtained:

(1) The Male Employee rate is 65% of the Single Employee rate and 35% of the Family rate with maternity coverage.

(2) The Female Employee rate is 95% of the Single Employee rate and 50% of the Family rate with maternity coverage.

(3) The Dependent rate, where the male is the employee, is 70% of the Family rate.

(4) The Dependent rate, where the female is the employee, is 50% of the Family rate.

The Single Employee and Family rates referred to above are according to the definition used by Blue Cross plans.

The above reveals several interesting facts.

The ratio of the female employee rate (without maternity) to the male employee rate is 95/65 or 1.46, which confirms the validity of the use by the insurance companies of a factor of 1.50, as pointed out above.

The percent of females in a group has a significant effect on the cost of Employee coverage, but a negligible effect on Single Employee coverage.

The following table shows the comparative cost of Single Employee coverage as provided by Blue Cross and the Employee cost as provided by insurance companies under Group Hospital Expense policies assuming the cost of Single employee coverage to be $100:

Relative Cost of

Age	*Single Male*	*Single Female*	*Male Employee*	*Female Employee*
Up to 25	$ 55	$ 55	$ 65	$ 95
26 to 35	55	55	65	95
36 to 45	65	80	65	95
46 to 55	90	85	65	95
56 to 65	135	100	65	95
66 and over	165	165	65	95

The above table shows at what ages the Employee rate used by insurance companies is more or less than the Single Person rates used by Blue Cross if they were graded by age.

The following is a similar table showing a comparison in cost of Family coverage as provided by Blue Cross and the Employee plus Dependent coverage as provided by insurance companies under Group Hospital Expense policies assuming the cost of Family coverage to be $100:

	Relative Cost of			
Age	*Male—Family Coverage*	*Female—Family Coverage*	*Male Employee With Dependents*	*Female Employee With Dependents*
Up to 25	$105	$ 60	$105	$100
26 to 35	100	90	105	100
36 to 45	95	95	105	100
46 to 55	95	95	105	100
56 to 65	105	140	105	100
66 and over	140	140	105	100

Note: Male—Family Coverage means the husband is the insured employee whereas Female—Family Coverage means the wife is the insured employee.

In summary, it can be said that the rate for all employees, married and single, is less than the rate for single employees only, but that the Employee plus Dependents rate is greater than the Family rate.

APPENDIX

(1) Computation of Ratios for Males under Individual agreements.

(a) Male Employees without dependents—
Blue Cross Benefits excluding Ancillaries.*

Age Group	*Blue Cross Benefits Paid*	*Number of Agreements*	*Net Annual Premium (N.A.P.) per agreement*
up to 25	$ 8,677.80	517	$16.78
26-35	14,994.55	1,236	12.13
36-45	18,493.89	1,047	17.66
46-55	32,581.08	1,285	25.35
56-65	43,930.31	1,185	37.08
66 and over	80,306.22	1,548	51.88
Total	$198,983.85	6,818	$29.18

* The term Ancillaries as used above, includes professional services rendered by physicians in a hospital such as X-ray, pathology, anesthesia, etc.

(b) Male Employees without dependents—
Blue Cross Ancillary Benefits.*

Age Group	*Blue Cross Benefits Paid*	*Number of Agreements*	*Net Annual Premium (N.A.P.) per agreement*
up to 25	$ 1,212.60	329	$3.69
26-35	1,744.00	690	2.53
36-45	1,656.50	549	3.02
46-55	2,972.50	719	4.13
56-65	3,558.00	616	5.78
66 and over	3,149.00	565	5.57
Total	$14,292.60	3,468	$4.12

Special Note: Due to the relatively small exposure for the age group Up to 25 and because other studies have shown a rather constant ratio up to age 35, it was decided to combine the Up to age 25 and the 26-35 age groups into one group Up to age 35, as follows:

(i) from (a) above

Benefits paid Up to 35	=	$23,672.35
Number of agreements	=	1,753
Net Annual Premium per agreement	=	$13.50

(ii) from (b) above

Benefits paid Up to 35	=	$2,956.00
Number of agreements	=	1,019
Net Annual Premium per agreement	=	$2.90

(c) Combination of (a) and (b) above

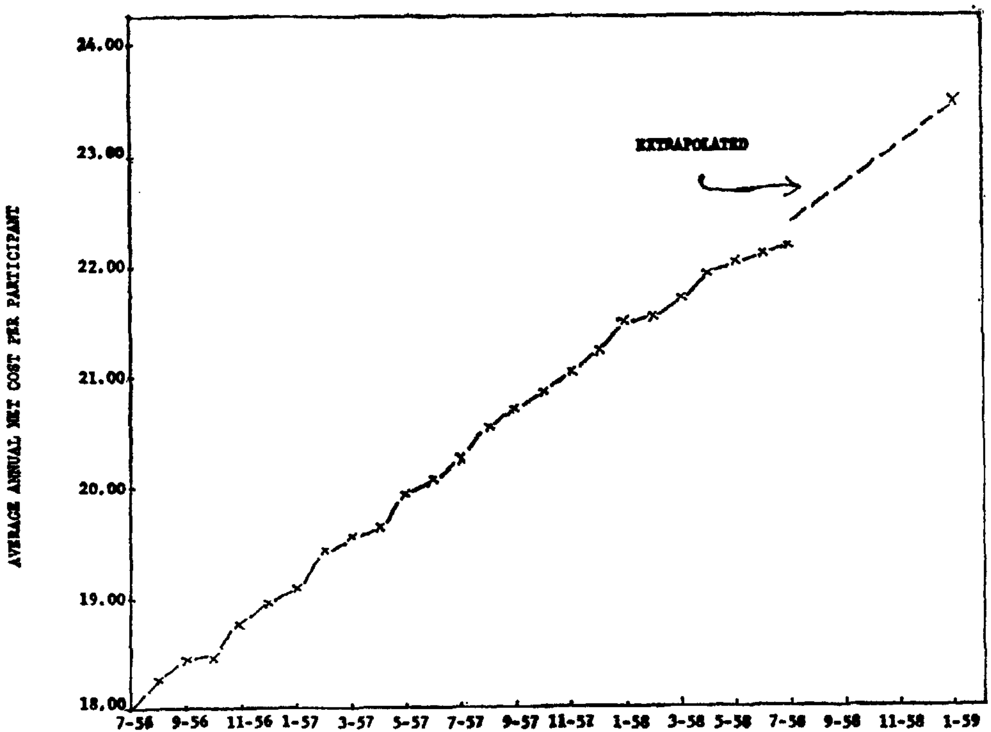
Age Group	*Net Annual Premium per agreement*	*Net Annual Premium (N.A.P.) ÷ $31.87***
up to 35	$16.40	0.52 (rounded to 0.55)
36-45	20.68	0.65
46-55	29.48	0.92 (rounded to 0.90)
56-65	42.86	1.34 (rounded to 1.35)
66 and over	57.45	1.80 (combined with female exposure)
Total	$33.30	

* The term Ancillaries as used above, includes professional services rendered by physicians in a hospital such as X-ray, pathology, anesthesia, etc.

** $31.87 equals the combined N.A.P. for single males and females for Blue Cross benefits ($27.76) and for Ancillaries ($4.11).

Note: Due to the relatively small exposure for those over 65 and because other studies have tended to show that there is little if any difference between male and female costs over age 65 the costs for males and females over 65 were combined.

EXHIBIT I


AVERAGE ANNUAL NET COST PER PARTICIPANT
24.00
23.00
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19.00
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EXTRAPOLATED

MERIT RATING IN PRIVATE PASSENGER AUTOMOBILE LIABILITY INSURANCE AND THE CALIFORNIA DRIVER RECORD STUDY

BY

FRANK HARWAYNE

For a great many years individual automobile risk merit rating has existed in various parts of the world. A workable system has been in use in the British Isles for many years. Messrs. Bohlinger and Morrill report that in England a policyholder is entitled to a "no claim rebate" if he makes no claim under the policy. "If no claim is made for a single policy year, the reduction is 10% upon renewal; if no claim is made for two years consecutively, the reduction is 15% and if no claim is made for three consecutive years, 20%."[1]

They report that New York State used a merit rating plan in 1929. This was shortly abandoned because of defects in administration and abuses in its application which defeated the purpose for which it was intended.

No-claim bonus plans have a great mass appeal and have found common acceptance in some European countries as well.

In 1938 a safe driver reward plan came into being in many states. In New York State, however, a safe driver reward plan which rewarded accident free drivers was not adopted. Instead a preferred risk rating plan which penalized drivers with accident records was used. Both of these plans were abandoned during the war when gasoline rationing came into being. They were not resurrected after the war. New York State, however, reverted to the preferred risk rating plan during the early 1950's.

During the early 1950's the Canadian merit rating plan was adopted for use in Canada. This plan affords a rate benefit according to the length of time that the risk has been accident free. (Five[2] years produces the maximum credit.)

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[1] Page 35 of "Insurance Supervision and Practices in England". Report by Deputy Superintendents Alfred J. Bohlinger and Thomas C. Morrill to Robert E. Dineen, Superintendent of Insurance, State of New York Insurance Department, 1948.

[2] Originally three years produced the maximum credit. Effective September 1, 1959, however, a new class with rates 20% less than 1A was established under the name of "Class 1A Select" and defined as follows:

a. Pleasure and
b. Applicant 25 years of age and over and
c. No accident involving the applicant or the automobile or any automobile for which it has been substituted for the past 5 years and
d. No proof of financial responsibility required and
e. Rating information statement form on file with insured which states
   1. Permit to drive held for past 5 years.

Footnote 2 Continued Next Page

There is a general belief on the part of those insurance companies engaged in the utilization of such plans that merit rating is a sound, effective tool for adjusting the premium commensurate with the hazard according to individual risk.

Part of the uneasy feeling in the United States with respect to merit rating rests on credibility considerations. The argument runs something as follows:

With an expected accident frequency of less than 10% per year, the fact that an individual is involved in an accident in a particular year is considered fortuitous and ought not to be given special consideration for the purpose of adjusting the rate charged to that risk.

The proponents of the use of the preferred risk rating plan approach use the notion that an individual should be considered innocent of extra hazard potential until proven guilty via his actual past accident record. The risk which has been accident free pays the slightly less than average rate which most individuals in his class pay. When he shows via his past accident record that he qualifies, then a surcharge is imposed. The magnitude of this surcharge depends upon the caliber of his record.

More recently, individual insurance companies have adopted what is known as the California type plan. This is a plan which was promulgated by the National Bureau of Casualty Underwriters for application in California and more recently in other states as well. It rests upon the previous accident and driving record of drivers in the state. It came into being in answer to the need for recognition of the driving performance of individuals. The cornerstone of this plan is a statistical research effort made by the State of California. It is well to describe the findings of that study in some detail.

The State of California, Department of Motor Vehicles, Division of Driver's Licenses under the direction of Chief Fred P. Williams, recently concluded a driver record study as part of a long range research program directed toward evaluation and appraisal of the state's various programs directed toward public safety on the highways. A sample of 94,935 individuals (1.3% of all drivers) was selected for study and evaluation.

The study was based entirely upon the records of the Department of Motor Vehicles. Despite the lack of total records under existing procedures (failure to report accidents or failure to completely record abstracts of convictions for traffic violations), the results of this study are meaningful. Although it is generally believed that professional driving groups such as chauffeurs, salesmen, etc. tend to accumulate more convictions and accidents than the average driver, the Depart-

Footnote 2 Continued

2. No male driver under 25.
3. Automobile not used for driving to and from work.
4. Average and anticipated mileage not exceeding 10,000 per annum.
5. Not more than two drivers per automobile in the household.

ment's study does not attempt to evaluate this factor of road exposure.

In summarizing the findings of this study the Department indicates that a definite relationship exists between the number of abstracts (records of convictions for traffic violations) in a driver's record and the number of accidents he is likely to have. Analysis of the data shows a consistent tendency toward an increase in the number of accidents with an increase in the number of abstracts. For example, on the average, those individuals with no abstracts in the record had an average frequency of accident involvement of 8.6% while those with five or more abstracts had a frequency of 55.31%. The average frequency of accident involvement for all drivers in the study was 16.31%. Thus it is seen those with 5 or more abstracts had an accident involvement frequency 239% more than the grand average.[3] There is a clear and definite increase of the average accident involvement according to the number of abstracts. The relationship is almost linear as the figures in Exhibit I indicate.

Although there are many ways in which information might be summarized with respect to age, sex or type of license (chauffeur's or operator's) the study, in the main, concentrates upon the relationship of abstracts of conviction of traffic violation and accident involvement. This most recent study verifies and enlarges the results of a previous study made in April 1954. Very little difference is noted in the distribution of the record of accidents between the two studies and some difference is noted in the distribution of abstracts. It may be that the enforcement levels changed between 1954 and 1958 resulting in an increase in the proportion of drivers having abstracts of driving violations and convictions. The accident record improved slightly.

The detail of the methodology used indicates that the differentiating factors taken from each driver's record were as follows:

1. The driver's license number prefix
2. Type of license (operator or chauffeur)
3. Sex
4. Age
5. Quantity of "failure to appear" notices attached to the record

This information was taken off for the three year period ending in 1958. Following that, the quantity of accidents, abstracts and double count abstracts for each of three years individually was entered and, in addition, the total quantity of abstracts for the full three year period was entered according to the total quantity of accidents. Briefly the records show better performance by women than men. 91.78% of female drivers had no accident records whereas 82.65% of male drivers had clear records. As to abstracts, 75.75% of women drivers had no abstracts compared to 48.5% of male drivers with none.

[3] But see footnote 6 for a slight modification of this figure.

Over 60% of operators had no abstracts while only 36.1% of chauffeurs had similarily clean records. With regard to accidents, 87% of the operators had no accidents while 77% of the chauffeurs showed no accidents. Additionally, drivers who hold both operator's or chauffeur's licenses had a poorer performance as indicated by abstracts than those holding chauffeur's licenses only. Almost 70% of those in the "both" category had one or more abstracts in record.

The study indicates a clear trend toward improving driving performance with increase in age. For example, male drivers in the 22 year old bracket showed only 22.9% were free of convictions whereas 56 year old men showed 59.23% in the no abstract category. This tendency appears to be true for other age groups as well.

In keeping with traditional notions that the probability of accident involvement is fairly small the data was reviewed in the light of Poisson theory. Surprisingly enough the application of a Chi-Square test showed that the Poisson distribution did not fit the California data too well. The author found after some experimentation that the data virtually fell into place when a negative binomial distribution[4] was substituted for the Poisson. This led to a reconsideration of the nature of the underlying data. When the expectation varies from trial to trial as appears to be the case with accident records in this state, then the negative binomial distribution gives results superior to the Poisson distribution.[5] Exhibit II shows the data, by number of abstracts together with the mean frequency, the variance and the ratio of the variance to the mean frequency.[6]

What is the importance of the finding of a distribution which fits the California data? It enables us to do several things:

1. To the extent that abstract records are an accurate linear magnifier of potential accident involvement, such abstract records can be used for individual risk rate adjustment.

2. Inferences as to parameters other than the mean claim frequency may be made (e.g. the California study shows the variance is 1.18 times the mean accident frequency for all abstracts and 1.11 times for 0 abstracts). Tables of expected distributions can be formed.

3. The average claim frequency in a territory, together with an

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[4] The author's discovery is developed mathematically in *Some Considerations on Automobile Rating Systems Utilizing Individual Driving Records* by L. Dropkin.

[5] It may be shown that when the expectation from trial to trial is made constant the negative binomial distribution degenerates into the Poisson distribution.

[6] It occurred to the author that some individuals in the 0 abstract category may continue to renew their license although they are not actually drivers and therefore cannot be involved in accidents. Inquiry of the California Department of Motor Vehicles brought forth the reply that there is no known estimate of what proportion of the total such individuals are. Exhibit III indicates the effect of assuming 0%, 5% and 10% of license holders belong in this category. Both the mean and variance tend to increase but the ratio decreases. On a 5% assumption basis those with five or more abstracts would have an average accident involvement frequency 222% higher than the grand average.

estimate of the variance can be used to develop an assumed risk distribution based on the negative binomial distribution. The effect of the application of specific charges can then be predicted.

4. A company which utilizes a merit rating program could then make reasonable predictions of its expected distribution of business in each category and may attempt to measure the success of its individual risk rating program against theoretical expected distributions.

5. Improvements in rules, definitions, underwriting, etc. may be indicated by 4. The mean frequency and variance for each sub-group of the class should be in the same relative rank as the respective rates. Further, the ratio of variance to mean frequency may be used as one test of the homogeneity of the sub-group definition. Such ratio for each of the sub-groups should be less than that of the class as a whole.

Suppose a company determined to use abstracts as a measure of accident potential for ratemaking purposes. Further, suppose the plan which it developed were to be applied to a class and territory where the accident frequency was 10%. In line with Exhibit I, the selected mean accident frequency for risks with no abstracts would be .53 of 10% or 5.3%. Assuming a ratio of variance to mean frequency of 1.10 (the actual Exhibit II figure is 1.113), the estimated variance is 5.8%. Using the negative binomial distribution one should expect the risks to fall into the following grouping:

Number of Accidents	*Risks*
0	95.1%
1	4.6
2 or more	0.3
All	100.0%

Similarly, expected distributions might be computed for 1 and 2 abstracts, etc.

After the plan had been in use, its efficiency might be appraised against the theoretical yardsticks. Again, suppose that actual experience of the company showed the mean frequency to be 5.3% but that the proportion of risks in the no accident category was less than expected and in the one and two or more accident category significantly more than expected. At this point, the company should look to a reconsideration of its rules, definitions, underwriting, practices, etc. as applied to its plan.

It is believed this hypothetical description indicates that a method is at hand for utilization of the negative binomial distribution in a practical way so that the avenues for improved underwriting are opened up. Further exploration of application of the negative binomial distribution in connection with merit plans should be most welcome.

EXHIBIT I

STUDY OF ACCIDENT INVOLVEMENT OF DRIVERS IN CALIFORNIA FOR THREE YEARS ENDED IN 1958 COMPARISON BY NUMBER OF ABSTRACTS

No. of Abstracts	*Accident Involvement* *Average*	*Ratio to Total*
None	.0866	.531
1	.1935	1.186
2	.2737	1.678
3	.3535	2.167
4	.4262	2.613
5	.5572	3.416
6	.5076	3.112
7	.5022	3.079
8	.5451	3.342
9 or more	.6563	4.024
5 or more	.5531	3.391
TOTAL	.1631	1.000

EXHIBIT II

ACCIDENT INVOLVEMENT ACCORDING TO NUMBER OF ABSTRACTS ON RECORD FOR THE THREE YEAR PERIOD ENDING IN 1958

(FROM THE CALIFORNIA DRIVER RECORD STUDY—1958)

Number of Accidents	*0 ABSTRACTS* *No. of Drivers*	*1 ABSTRACT* *No. of Drivers*	*2 ABSTRACTS* *No. of Drivers*
0	51,365	17,081	6,729
1	3,997	3,131	1,711
2	357	353	262
3	34	41	44
4	4	6	6
5 or more	—	1	1
Total	55,757	20,613	8,753
A. Mean Frequency	8.661%	19.352%	27.37%
B. Variance	9.643%	20.672%	29.93%
C. Ratio B ÷ A	1.113	1.068	1.094

EXHIBIT II (Cont.)

Number of Accidents	*3 ABSTRACTS No. of Drivers*	*4 ABSTRACTS No. of Drivers*	*5 OR MORE ABSTRACTS No. of Drivers*	*ALL ABSTRACTS No. of Drivers*
0	3,098	1,548	1,893	81,714
1	963	570	934	11,306
2	221	138	287	1,618
3	31	34	66	250
4	6	4	14	40
5 or more	1	3	1	7
Total	4,320	2,297	3,195	94,935
A. Mean Frequency	35.35%	42.62%	55.31%	16.313%
B. Variance	39.52%	50.05%	60.96%	19.294%
C. Ratio B ÷ A	1.118	1.174	1.102	1.183

EXHIBIT III

STUDY OF ACCIDENT INVOLVEMENT ADJUSTED FOR EXCLUSION OF NON-DRIVERS ESTIMATED AT 0%, 5%, 10% OF GRAND TOTAL

(BASED ON THE CALIFORNIA DRIVER RECORD STUDY—1958)

ITEM	*EXCLUDING NON-DRIVERS ESTIMATED AT PER CENT OF GRAND TOTAL* 0%	5%	10%
		ALL ABSTRACTS	
Number Excluded	0	4,747	9,493
Total Less Excluded Non-Drivers	94,935	90,188	85,442
A. Mean Frequency	.16313	.17172	.18126
B. Variance	.19294	.20162	.21108
C. Ratio B ÷ A	1.183	1.174	1.165
		NO ABSTRACTS	
Number	0	4,747	9,493
Total Less Non-Drivers	55,757	51,010	46,264
A. Mean Frequency	.08661	.09467	.10438
B. Variance	.09643	.10465	.11436
C. Ratio B ÷ A	1.113	1.105	1.096

MULTIPLE PERIL RATING PROBLEMS — SOME STATISTICAL CONSIDERATIONS*

BY

ROBERT L. HURLEY

1. INTRODUCTION

Few will fail to appreciate the misgivings with which a technician approaches a popular excitement like "Multiple Peril Rating." The very name, whatever its inadequacies semantically, can stir up such partialities that the rational approach is often overwhelmed in an arena of turbulent emotions. But this is not a milieu unprecedented for researchers. Early in the day of modern mathematics, Gauss withdrew from many of the then popular contentions to avoid the "clamor of the Boeotians." And from his Holland retreat, two centuries earlier, Descartes sadly observed that common sense was reputed a commodity of which even the most feeble felt they had no lack.

There is something pathetically childlike in the picture of the scholar railing against the busy world from his high chair of scorn. It would appear unseemly for technicians not to attempt some contribution to the industry's needs in the field of multiple peril insurance. Since it is only on the rarest occasion (if we can believe in its possibility at all) that any worthwhile contribution can ever be considered as the sole responsibility of one human's urge to truth, we shall expect that many of the thoughts expressed herein will seem to the reader only some imperfect image of his own ideas. And those other notions, if any, which appear strange in unwanted trappings may encompass valid concepts possibly of some practical value, once they have been analyzed and refined within the exchange of our professional society.

It is proposed that the Homeowner's policy will serve as our point of departure for exploring certain statistical aspects of multiple peril rating. Our search may occasionally lead into speculations a bit afield . . . but never, we hope, away from the essential problem.

2. PLACE OF STATISTICS IN MULTIPLE PERIL UNDERWRITING

Let us start out by carefully assessing what cannot be done. Now, the realm of the impossible may well be the narrowest of kingdoms —and its borders may still be contracting until the circle which would ring this principality ultimately will shrivel to an isolated point in an imaginary plane. But, the impossible has not yet disappeared as those whose faith outrun their reason will soon discover if they let their "likings" dictate their logic. Even in the insurance field there is an outer bound beyond which we should not let our fancy stray.

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* We should like to acknowledge our indebtedness to the late Dr. Henry D. Locke for his inspiration and guidance in the preparation of this paper.

Ours is fundamentally a "figure" business, although our results in certain segments of the industry have not yet attained the precision of the mathematical science. It has long been characteristic in fire insurance underwriting to seek out the risk which will not burn. In the search for this ideal structure, little analysis has been made of the basic consideration of rate with its concomitant postulate of "likelihood of loss." The traditional approach to fire insurance underwriting much resembles the medieval alchemist's quest for the Philosopher's Stone which would turn all things to gold. And yet, were his dream realized, the storied alchemist would be no better off than the unemployed fire insurance underwriters hedged in on all sides by an incombustible world.

Thus, our first demarcation of the impossible. Without losses there can be no insurance business which fundamentally is protection of policyholders against the consequences of loss. Insurance performs, both by providing an accumulation of funds to indemnify for accident occurrences and a prevention service to reduce the likelihood of such occurrences. In an economic sense, loss prevention is the productive service which insurance renders. As a corollary the premium rate, albeit conceivably a fallible approximation to the likelihood of loss, is in the final analysis of even greater importance to the underwriter than the physical characteristics of a particular risk. And the function of our system of statistics presumably is to yield the premium rate structure for the underwriter's use.

The second reality is a realization that fire and wind insurance demands a substantial number of exposures because the individual risk has only a significantly small probability of loss. Many have been the schemes for scaling credibilities. Actuaries have investigated the Bernoullian, the Lexis and the Poisson distributions. They have searched the many variations of the Pearson Curves and the Charlier systems. Sometimes it has seemed that the range or the median offered more promise than the mean and the deviations therefrom. But heated as may have been on occasions the defense for each of the various partialities, there has always been a basic understanding that the believability of the loss experience tended not to be independent of the sample size—and that the required exposures must in some way be related to the probability of loss. In interpreting the statistics, the knowledgeable underwriter must establish for himself a meaningful scale of credibilities (judgments).

3. CAN "INDIVISIBLE MULTIPLE PERIL" BE A USEFUL AND MEANINGFUL STATISTICAL CONCEPT?

It is said that the Homeowner's policy introduced glamor to the insurance business. Unquestionably, the merchandisers soon recognized the potentialities in concepts as nebulous as "multiple peril" and "packaged policy" and were quick to marshal popular slogans to support their cause. At a certain high plane, there was probably ample justification for enthusiasm. The production forces of the industry and the general public, as well, have evidently welcomed this development with a truly remarkable premium growth.

We should not be surprised that in an industry so dependent on "paper work" there would be many to grasp at a plan promising to cut "red tape" and "all those unnecessary details." Moreover, to the typical policyholder the one indivisible rate for all the coverages in the package seems refreshingly straightforward and clear. His is a transfer solely of dollars for protection. Whatever his potential curiosity as to the justification for the dollars charged, he is seldom eager enough to persist through the technical make-up of the insurance charges. And this is as it should be . . . for the policyholder to concentrate on the total dollar price and purposely neglect the troublesome problems of ascertaining the costs involved in the various elements of protection.

On the other hand, the technician responsible for rate adequacies cannot dismiss in cavalier fashion the fundamental link between protection and price. For him there can be no easy retreat behind the popular obscurities of "Multiple Peril Packages." He might well reflect that a package is supposedly a neat and trim contrivance for handling a small number of items . . . not a bulky crate into which is squeezed a multiple assortment of oddities. He himself does not fail to see that two is a multiple of one. At the same time he recognizes that, in the popular fancy, "Multiple Peril" has acquired an extension hardly to be confined within any limit short of an indefinitely large number of perils.

From years of training and experience, the technician fully appreciates that it is only by recording our experience according to a logical frame work that we are able to move forward from and, because of, the accumulated knowledge of the past. In his philosophical writings, J. S. Mill analyzes the terms or elements of classification systems according to their:

1. denotation . . . the extension or the scope of entities to which the term may be applied.
2. connotation . . . the qualities or characteristics, the possession of which implies the entities as proper members of the class or term.

It is observed that as the denotation or extension is increased, the connotation or specification is decreased. This appears a two-way rule. Possibly at one end position, the single note of existence is possessed by all things . . . and at the other extreme, a complete enumeration of characteristics reduces the class to a single member, specified in all its individual details.

As classification systems approach either extremes, it would seem that the statistics thereon become less meaningful and less useful. While we cannot expect the definitions of our "Multiple Peril" classifications to be launched with the precision of the logician's standards, it would seem that care might be exercised to avoid, if possible, egregious errors which cannot help but rob much of the meaning from our summaries of loss experience.

Possibly the technician should not squander a disproportionate share of his concern on the imprecision of "Multiple Peril" as an entity per se. There appears, at least at the present time, possibly an even greater danger in the constant reassemblings of the policy perils . . . now adding, now subtracting, now adding and substracting simultaneously. "In" yesterday, "Out" today, "Back" tomorrow with his troublesome brother . . . such is the prospect for "Childe Coverage" in the topsy-turvy land of "Multiple Peril." The situation has now or will shortly reach the point where evaluation of loss experience becomes most confusing.

Everyone must surely know that statistics are useless and even devoid of meaning without a significant degree of stability. In all scientific endeavors (and the research statistician's field is no exception) our definitions of classifications must maintain a basic consistency in use and in time. Deliberately to superimpose switches in classification definitions upon the normal uncertainties surrounding our langage understandings is to invite a degree of chaos that no prudent technician would care to contemplate.

Thus in summary of this section: the concept "Multiple Peril" is sufficiently ambiguous, in itself, to warrant the strongest representations for a logical determination of coverage definitions . . . with no less regard for the insurance industry's innate need for continuity of consistent statistics than for the legitimate demands of the buying public.

4. INTERPLAY OF EXPERIENCE AND RATES BETWEEN MULTIPLE PERIL AND INDIVIDUAL POLICIES

For a number of years now, fire underwriters have been warning of a sharp upturn in loss ratios on dwelling fire coverage (i.e., when written on the traditional . . . individual policy basis) with the increasing popularity of the Homeowner's policy. A study of the trend in fire classification loss ratios will testify to the accuracy of this prediction. But the sequence of the events does not necessarily demonstrate an underlying causality, since we tend to shy away from "post hoc ergo propter hoc" arguments.

By implication the underwriter might have us believe that the purchaser of a Multiple Peril dwelling policy is a better fire risk than the the other homeowners. While there may be no ready loss cost data statistically significant to substantiate this conclusion, one would not be at loss to find easy rationalizations of a most persuasive tenor.

On the other hand, we estimate that there was an 11.4% decline in dwelling rates over the 5 years (1953-57), the period covered by the latest available industry data. This figure is based on our company's geographical distribution of business, and insurers with different premium mixes will undoubtedly come up with different answers. However, we suspect that few technicians will fail to agree that there was a significant erosion in fire dwelling rates over the studied period. Admittedly there were various attempts to match these fire rate reductions with decreases in Homeowner's premium charges. But it might be argued that this action has no bearing on dwelling fire loss ratios, per se, and anyway, few raters would attempt to adjust the fire portion from the overall Homeowner's rate with any substantial degree of confidence.

It is also important to consider that the ratio of insurance to value may be significantly less for dwelling fire than for Homeowner's policies. "Under insurance" could be thought a function of the time interval from the original purchase of the policy. On such a theory we would expect a significantly smaller ratio of insurance to value on the fire dwelling policy, a contract of long standing compared to the Homeowner's which started only in the middle 1950s. And with time, as the argument would go, the Homeowner's too will begin to suffer more and more from "under-insurance" . . . and, in this regard at least, be no better than the dwelling fire policy.

The statistician can listen to such arguments with a Horatian "unice securus" . . . sublimely indifferent to their underwriting justifications. He does not, however, fail to appreciate the importance to his company and to his own fortunes of the underwriter's ability to select better risks than provided for in average rates. And he would help by pointing out the dangers of unsupported generalizations and statistical systems founded thereon.

To statistical theory, it makes no difference whether the risk "Homeowner" is better than the risk "Dwelling Fire", or vice versa. In either case there is a logical necessity for the establishment of separate classes and subclasses . . . only if the elements which go to make up the class Homeowner are significantly different, and have a natural bond and/or barrier which distinguishes them from the Dwelling Fire risks.

Contrariwise, the statistical design and the underwriting distinctions established thereon can fail if these two conditions are not met. If there are only chance variations in pure premiums, the rates based thereon will gyrate haphazardly one to the other. Consequently, there could be traffic "in" or "out" of the class Homeowner's depending upon the rate relativities prevailing at the moment. As to the second consideration, even if there were a significant difference between the constituent elements of the original classes, the statistical plan would become progressively inoperative . . . if the risks in one class could switch to the other class solely as personal considerations dictated, without any significant modification in the characteristics of the elements constituting the class.

In summary of this section: the technician will probably be unconcerned in theory as to the effect of the withdrawal of the "better" risks from the fire dwelling to the Homeowner's policy as long as there are statistics to indicate the necessity for the resulting higher rates. On the other hand, he would be much concerned if the classification system were vulnerable to the arbitrary determinations of the very elements which were supposed to make up the respective classes. His misgivings would even increase, if he had some indication that the relative movement of the subsidiary coverages, package to individual policies, were responsive primarily to chance variations.

But time may prove that there are both distinguishing notes and compelling reasons for membership in one as contrasted with the other class. Moreover, if some of the component coverages of the Homeowner's fluctuate loss-wise solely by chance vis-a-vis the corresponding individual policies, it may be that the force of the random variation would not "swallow-up" the inherent difference in loss cost between the two modes of affording protection to the respective policyholders. No thoughtful person would assume that chance might whip the loss patterns for each sub-coverage of the policy along according to the same time schedule. It is sometimes reassuring to reflect that bad fortune itself is fickle.

5. BASIC STATISTICAL MEASURES FOR MULTIPLE PERIL POLICIES

The basic statistical measure for the Homeowner's policy is the ratio of the dollar losses to the dollar premiums. This loss ratio technique was lifted with hardly a change from the fire insurance field. The plan for a subsidiary measure based on the number of policies was short-lived. There were many to argue that the policy count is an unsatisfactory measure of exposure. Moreover, the "dollars of premium" standard is automatically processed through the accounting and statistical routines of the company. It is subject to ready and relatively inexpensive verifications. The concept is understood and easily handled by the many non-technicians with whom the insurance industry must work. While this "loss ratio" approach proved unserviceable for many important casualty lines, it has long been used in the fire field to no detriment of the companies or of the composite of their policyholders.

The ultimate reality of the insurance venture must be the dollars "taken in" compared to the dollars "paid out". For economic enterprises, outgo cannot exceed income indefinitely. If one can gauge the total dollar losses, he can tell what the overall minimum premium must be. It is conceivable that in a static economy, one might run an insurance operation solely on losses with no advertence to exposures. If, however, there are significant variations in exposure in time; or if there is a demand for exact equities among classes of risks, an exposure measure becomes a useful and perhaps an indispensable tool.

The notion of exposure is traditional in the development of mathematical probabilities. Without a knowledge of the possible numbers of happenings in the Chevalier de Méré's gaming exercises, Pascal and Fermat could never have conducted the original research into mathematical probabilities. From these first beginnings, elaborate techniques have been devised; fundamental concepts have been investigated and refined; and further modifications in methodology have often resulted from the added precision and extensions in the basic notions. Also in this continuing evolution of the science which underlies the insurance business, no thoughful students have denied the reality of the "event" or the necessity of an "exposure element" which must precede the event. Admittedly, modern statistical theory regards the possible numbers in the universe as an unknowable entity . . . but it is customary to posit a ratio of favorable to possible happenings . . . and then in experimentation observe the actual number of occurrences out of the total number of trials (i.e. exposures).

The familiar event (a counting of units out of total possible occurrences . . . devoid of any mark other than that of "happening") is obviously very simple compared with demands for an exposure count in insurance statistics. For the Homeowner's policy, the exposure should attempt to gauge as a minimum the composite of the number of units susceptible to loss, the sum of the values on these risks, and the length of time for which the risks are exposed.

Of the number of fine papers (listed in the appended bibliography), two treated in considerable detail on the inadequacies of the earned premium as an exposure measure in the fire insurance field. These observations likely apply *a fortiori* to the Homeowner's policy. Even on a policy which affords a more or less single uniform coverage like the fire insurance contract, the premium exposure measure is fraught with limitations. It is not easy to turn written to earned premiums on a classification basis. And to adjust for rate changes and annual payment plans, the corrections become most difficult, even for the accomplished actuary. In passing, we must mention that the premium becomes all tangled up with term credits, special rating plans, deviations . . . all of which tend to invalidate the premium as a usable standard for exposure, despite its eminent qualifications as an accounting tool.

Losses by cause (provided by the Homeowner's statistical plan) to total earned premiums is a most deceptive measure. What should be allowed by cause, it is not easy to say. How many of the dollars collected should be reserved for windstorm losses and for how long a period is most baffling. It is a paltry contribution to the sum of insurance knowledge to record that for a given period, one fourth of the dollar volume of losses are chargeable to wind, a third to fire, 12% to crime, 10% to liability, and the balance to an assortment of changing coverages. Such knowledge is most academic, a technician might observe, if the rate is to be determined solely by the totality of losses. If one does not know or cannot admit what portion of the total rate must be reserved for windstorm losses, what good are analyses of losses by subsidiary coverages?

In rebuttal, one might observe that losses by each cause can be expressed in points contribution to the overall Homeowner's loss ratio. As an alternative, a company can sample its business by state . . . and using rates (discounted) for subsidiary coverages, project its probable premium breakdowns by major coverage components. Underwriters might use such experience projections in a first review of their results.

But now, if losses are to be related to exposed annual dollars, it may be another matter entirely. If a known portion of the basic ECE rate should be earmarked for windstorm losses (and only chance knows when) then maybe this segment of the necessary premium dollars can be set aside and not dissipated when supervisory authorities take the insurance companies at their word and adjust rates to a 54% loss ratio overall.

In summary of this section: for a Multiple Peril policy, the statistical system should allow for analysis by cause of loss. With the ever-present likelihood of changes in the package of coverages, it becomes imperative, rate-and underwriting-wise, to know the loss distributions at least according to major hazards. This analysis by cause of loss will, however, be of only limited value unless losses are measured against consistent exposure elements which will be free of the limitations cited for the standard accounting of earned premiums.

6. STATISTICAL PLANS FOR COLLECTING MULTIPLE PERIL EXPERIENCE BY CLASSIFICATION

Now granted first that a valid distinction can be maintained between the general Homeowner's and Non-Homeowner's risks and secondly that the statistical design affords an analysis of losses by subsidiary coverage causes against a meaningful and consistent exposure measure, we are then led to possible finer breakdowns of the genus Homeowner's according to various classification schemes. It is conceivable that these further investigations might lead to formal rate differentials by classification, but it is more likely that at least initially such knowledge will be reserved by the underwriter chiefly as another guide for risk selections.

The skillful underwriter much resembles a mathematical intuitionist beset with a restless curiosity. He constantly lives with his portfolio of business. He is forever speculating on the characteristics of his risks which produce losses. He will readily support and often initiates programs for testing his underwriting theories. The researcher can, in such an environment, make a significant contribution to his company's underwriting fortunes when dealing with a relatively new policy like the Homeowner's about which so little is as yet actually known.

We suspect that the present statistical plan under which the Homeowner's classification experience is published by the industry and filed by the companies may be somewhat too sketchy to satisfy for very long the more imaginative underwriter. If the Homeowner's were to be a small volume line, there would be no reason for any detailed analysis of risk characteristics. The underwriter might be satisfied to review his experience simply by policy form by certain geographical areas on a line like the PPF which will average industry-wide only some $50 million dollars in annual earned premiums, even twenty years after it was originally designed.

But on the Homeowner's, which within five years has spiralled to a volume greater than the entire Inland Marine coverage, of which the PPF is only a modest fraction, every underwriter is faced with a challenge he cannot afford to dismiss. It may not be enough for the underwriter to know the "B" Policy in a certain state has produced an adverse loss ratio . . . with few or no facts with regard to the identity or the characteristics of the risks producing the losses. While each underwriter will want to create his own system, the following is a partial list of possible variants for a subsidiary classification plan: occupation of the assured, income level, size of family, its standard of living, the assured's personal character, the size of the home, its age, its upkeep, the economic and social level of the community, its prospects for the future.

In summary of this section: the emergence of a formal classification plan to measure inherent risk characteristics and set appropriate rate schedules for the Homeowner's policy may still be far in the future. This fact in itself, plus the indication that the Homeowner's will be a major element in the personal lines field is sufficient incentive to start the skillful underwriter probing for facts. The actuary has, therefore, a real opportunity to help in the formulation of his company underwriting policy in this area . . . and particularly to guard against the creation of underwriting policies inconsistent with statistically significant findings.

7. CREDIBILITY AND STATISTICS

Under "Insurance Credibilities" is bedded an expectation of consistency. Those pre-notional images of ours of successive runs of non-irregular happenings merge subconsciously into a mental disposition wherein we instinctively seek to evaluate events in terms of various tests thought responsive to a "law of large numbers."

Now, no attempt will be made herein to apply to insurance credibilities the various interpretations of the logical foundations for probability. We shall note, *en passant,* only that the argument continues unabated at a most austere and recondite scholarship between the behaviorists championed by Von Mises, R. A. Fisher and earlier by Venn and the axiomatic theories of Carnap and Jeffreys. The first tend to view probability as an empirical concept to be applied only in cases wherein the relative frequency in an infinite sequence would approach a limiting value. The latter may possibly be typified as holding that probability in the number value to be assigned to the logical truth or analytic consistency of two given propositions . . . which may be designated as the statements of evidence and conclusions. Personally, the writer feels that the two schools contain basic elements which are not mutually contradictory at all levels of understanding.

But to the scholar as well as to the layman probability usually presupposes, in some fashion or other, an ordered randomness. On occasions the underlying pattern emerges only after years of study. Frequently, the merits of the statistical indications are widely accepted before the precise mathematical relationships are determined.

Fire loss frequencies (an important coverage under the Homeowner's policy) afford a very pertinent example of the ordered randomness underlying insurance probabilities. The writer and certain of his colleagues have attempted to express the relationship mathematically. Our efforts thus far are considered unsatisfactory in that the resulting equations were not readily handled algebraically, nor easily explained. But the statistics seemed to indicate a fundamental underwriting character of fire insurance risks. The following tables give the percentage distribution of our Fire PD losses by individual loss size over the 10 years 1949-1958 . . . for all classifications combined.

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Number of Losses			*Amount of Loss Payments*		
Year	*Under $100*	*$100 to 9,999*	*$10,000 & Over*	*Under $100*	*$100 to 10,000*	*Over $10,000*
1949	.742	.251	.007	.072	.547	.381
1950	.735	.255	.010	.051	.418	.531
1951	.752	.241	.007	.070	.496	.434
1952	.757	.233	.010	.052	.400	.548
1953	.755	.237	.008	.051	.444	.505
1954	.751	.241	.008	.056	.460	.484
1955	.750	.244	.007	.057	.424	.519
1956	.723	.267	.010	.043	.360	.597
1957	.692	.301	.007	.050	.487	.463
1958	.696	.297	.007	.046	.472	.482
Mean	.735	.257	.008	.055	.452	.493

We would not expect that corresponding samples for other companies would reproduce the above tabular indications. However, we would be even more surprised at any radical variations. Seemingly, our competitors would soon be out of business if their results on our risk distribution should reverse our columns (1) and (3). This, in the nature of things, cannot happen . . . no more than the sun can fail to rise one morning . . . without the world ending.

We should like to cite a second experiment with the inherent, "ordered randomness" to be encountered in Fire & Allied Lines statistics. This time, the series can be shown to observe a usable and familiar mathematical equation. The series involves windstorm losses, specifically the number of hurricane losses each year reaching the continental United States. We shall, later in this section, return to these data in attempting to generalize on the possible credibility requirements for Multiple Peril coverage, specifically the Homeowner's policy.

The mathematical series is the Poisson exponential which has been documented in a number of fine papers in our Proceedings as a reasonably satisfactory representation of loss probabilities on certain important casualty lines. We have tested the goodness of fit with Karl Pearson's Chi-Square test developed at the turn of the present century and still employed widely in certain comparisons of experiment to expectation. It will suffice to indicate these familiar equations with reference in the bibliography hereto for those who may wish to recheck the mathematical derivations.

Poisson Exponential

m = mean of observations

r = observed number of successes

e = 2.72 approx.

$$P = \frac{e^{-m}.m^r}{\underline{|r}}$$

Chi-Square (X^2) Distribution

$$T_{k-1}\ (x^2)d(x^2) = \frac{(x^2)^{\frac{k-3}{2}} . e^{\frac{-x^2}{2}}\ d\ (x^2)}{2^{\frac{k-1}{2}}\ \Gamma\left(\frac{k-1}{2}\right)}$$

$$\text{where } \Gamma\ (n) = \int_o^\infty y^{n-1}. e^{-y}\, dy$$

When $n>o$

Where (k-1) = degrees of freedom

$$x^2 = \frac{(f_o\text{-}f_e)^2}{f_e} \text{ and } \begin{array}{l} f_o = \text{observed frequency} \\ f_e = \text{expected frequency} \end{array}$$

The fit of the number of annual losses to the Poisson exponential is remarkable. The agreement of actual with expected may not only delight the theorist but even disconcert those with no faith in figures. The mathematics supporting the "Null Hypothesis" suggests that our findings (a x^2 of 3.61) lies between a "P" of .70 for 3.000 and a "P" of .50 for a x^2 of 4.351. There is no mathematical evidence indeed, according to the Pearson test, to discard the "Null Hypothesis" . . .

in this case that the number of annual windstorms reaching the Continental United States fits the Poisson distribution.

Tropical Windstorms Reaching the U. S. (1915-56)
U. S. Department of Commerce—Weather Bureau

Number of Storms	*Observed Frequency*						$\frac{(f_o-f_e)^2}{}$
r	f_o	rf_o	r^2f_o	P	f_e	f_o-f_e	f_e
0	5	0	0	.153	6	—1	0.17
1	11	11	11	.287	12	—1	.08
2	13	26	52	.269	12	+1	.08
3	10	30	90	.169	7	+3	1.28
4	3	12	48	.080	3	0	0
5 & More	0	0	0	.042	2	—2	2.00
Total	42	79	201	1.000	42	0	3.61

$$m = {}^{79}\!/_{42} = 1.88$$

$$\sigma = \sqrt{\frac{\Sigma r^2 f_o}{\Sigma f_o} - \left(\frac{\Sigma r f_o}{\Sigma f_o}\right)^2} = \sqrt{\frac{201}{42} - \left(\frac{79}{42}\right)^2} = 1.12$$

$$P = \frac{e^{-m}. m^r}{\underline{|r}} \begin{cases} r = o \\ P = .153 \end{cases}$$

$x^2 = 3.61$ Degrees of freedom (N-1) $= 5$
<u>Probability of Null Hypothesis</u>
.70 for $x^2 = 3.000$
.50 for $x^2 = 4.351$

In the following abstract, we show the results of applying the same tests (Poisson exponential and Chi-Square) to the number of Fire catastrophes of $2,500,000 in the United States 1914-1958. This time the fit is poor. The figures suggest that this particular series does not follow the Poisson exponential. A study some ten years earlier from different source data produced a better fit. It is thought that monetary inflation has possibly had a disturbing effect on our mathematical measure for severe fires. While raw data were not readily available, we might have expected a better fit if the frequencies had been corrected for changes over the years in the building cost series. The same observation can be made for the Liberty loss frequency data cited above.

Fire Catastrophes—Over $2,500,000

1914-1958

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Number of Losses r	*Observed Frequency* f_o	rf_o	r^2f_o	P	f_e	f_o-f_e	$\frac{(f_o-f_e)^2}{f_e}$
0	18	0	0	.252	11	+7	4.46
1	13	13	13	.348	15	—2	0.28
2	5	10	20	.240	11	—6	3.28
3	2	6	18	.110	5	—3	1.80
4	3	12	48	.037	2	+1	
5	3	15	75	.010	1	+2	5.35
6	1	6	36	.002	0	+1	
7 & Over	0	0	0	.001	0	0	
Total	45	62	210	1.000	45	0	15.17

$$\text{mean} = {}^{62}\!/_{45} = 1.38$$

$$\sigma = \sqrt{\frac{\Sigma r^2 f_o}{\Sigma f_o} - \left(\frac{\Sigma r f_o}{\Sigma f_o}\right)^2} = \sqrt{\frac{210}{45} - \left(\frac{62}{45}\right)^2} = 1.66$$

$$P = \frac{e^{-m}.m^r}{\underline{|r}} \begin{cases} r = o \\ P = .252 \end{cases}$$

$x^2 = 15.17$ Degrees of freedom $(N\text{-}1) = 4$

Probability of Null Hypothesis

.01 for $x^2 = 13.277$

.001 for $x^2 = 18.465$

It is thought that the previous statistics suggest that at least on two major coverages (Fire & Wind) of the Homeowner's policy, the underlying loss frequencies may be responsive to an "ordered randomness". However, these two series, as every underwriter knows, may not follow identical pure loss expectancies.

It may be argued that an ordered distribution of fire losses by size may, per se, imply some pattern in the ratio of any loss size greater than zero to the total exposures (i.e., zero plus non zero losses). "Pure expectancy" can be viewed as solely a finer graduation by loss size . . . simply the transition from zero to "*e*" loss size, where "*e*" may be thought the smallest possible loss size greater than zero.

But we are reluctant to translate the reasoning that any similarity in graduations for the middle and upper registers between Fire & Wind necessarily means a persistency of this relationship as the probability of loss for the respective series approach zero. We shall, therefore, make no further attempt to dissect the obvious (which may be right). Let us accept what every fire underwriter knows that while not responsive to the identical pure loss expectancy. Windstorm losses are thought to occur much less frequently per annual exposed risk than fire losses.

It is surmised that losses from other coverages of the Homeowner's policy may also be responsive to some ordered randomness. We have fair evidence in the case of crime losses. Others probably have more complete documentation for CPL losses. We suspect that neither the loss patterns nor the pure expectancies are identical for all component coverages of the Homeowner's policy.

A single credibility table has been proposed to evaluate the total Homeowner package experience . . . with no distinction for the various coverage components. The plan for a single credibility table for all coverage losses is not theoretically unsound if:

1. the frequency distribution and the pure loss expectancies tend not to vary significantly by coverage, or

2. coverages with significant variations constitute only a relatively trivial portion of the total package losses.

If these conditions are not substantially fulfilled, one might as well be prepared for strange and unacceptable rate indications. And the more frequently judgment must be used as a crutch to carry the burden of imperfect statistical indications, the greater the weakening of confidence in the tabular values. As an end position, the inaccurate table itself might prove the only obstacle to the exercise of sound judgment.

Possibly the theory can be presented more forcibly by what might prove to be an all too realistic prediction of the future. Let us suppose an East Coast state with $5,000,000 earned premiums over a five-year period, and there are many such. The state has been running a 50% loss ratio thru 1964; and in 1965 it is hit with a $25,000,000 hurricane. Obviously, the Homeowner is not going to accept an increase in his $200 premium to $2,000. He will swing back to individual policies—dropping the ECE if necessary . . . or at least paring it down to a minimum. In such a situation the companies would not follow the credibility table indications, and would rather propose a much lesser rate increase. Of course, the somewhat pathetic aspect of the story is the fact that the same faulty credibility table was the factor which afforded substantial rate credits (unwarranted as proved later) for the artificially favorable experience of prior years.

The proposed table sets 100% credibility at $5,000,000 earned premiums over 5 years. We have noted before certain limitations of earned premium as a standard for anything other than an accounting measure of dollars collected at the price levels prevailing at various periods in the past. Our Proceedings contain a number of comments on the propriety of reducing credibility values when the sum total of the annual exposures (i.e. earned premiums) have been collected over a lesser time (yearly) interval than the magic number "5". Since the table grants 80% credibility for \$3.2 million earned premiums and 30% for 450,000 earned premium, one might imagine that the designers selected a square root formula ($KZ^2=N$) to graduate down from 100% credibility. In the normal course of events, we would seriously examine graduation problems only after the philosophy of and the standards for 100% credibility had been established on other than some arbitrary basis.

In summary of this section: credibility in the Fire and Allied Lines field is a most difficult problem, and we may be yet far away from its final solution. We would most earnestly recommend that the industry not commence its investigations of credibility from an entrenched, unalterable position. We must be ready to revise our rudimentary notions on credibility before disaster does it for us.

8. SOME STATISTICAL CONSIDERATIONS OF MULTIPLE CLAIMS PER POLICYHOLDER

At the present time, the interest in repeaters (i.e., an assured with a history of a number of individual losses over the Homeowner's policy period) is confined primarily to underwriting risk evaluations. Someday the emphasis may spread to possible rate differentials . . . if the auto merit rating plans work out successfully.

It would be idle to consider individual policyholder loss frequency as a ratable element for a dwelling fire or an EC contract. The loss expectancies are normally too small to impute any ratable significance to the experience of individual dwelling policyholders. However, when the residence fire and EC policy is joined to a CPL, to a Crime, and to a Miscellaneous Damage policy, the assured's loss record over the policy period may begin to acquire some significance.

Fire underwriters working with the Homeowner's policy are reexamining their ideas on multiple claims over a policy period. While still scrutinizing for the claims-conscious assured, they are aware that the policy affords a multiple of coverages . . . some, of course, with only a very low order probability. Underwriters realize that multiple claims must be interpreted in the light of the fact that the assured could well have had over a three- or five-year period a claim on several of the individual policies which have since been packaged together into the Homeowner's.

Our company research on Homeowner's loss frequency, while still in the exploratory stage, affords data of some possible value. The ratio of 12-months-ending losses paid to estimated annual exposure in policies has been edging upwards over the some 30 months under review. With an adjustment for suspense cases and unreported losses, we estimate that approximately 20 losses occur for every 100 policies exposed to loss over the 12-month period. Now this is the average result from policyholders with no, or one, or two, or up to "n" losses in the year.

On our first trial, we imagined our universe to consist of risks with an underlying constant probability to loss. From tabulations of some 11,000 paid losses on 60,000 exposed policies, we set up polynominal equations on the assumptions successively that our universe was limited to risks that had only one, then one and two, then one, two, three, then one to "n" independent losses (i.e., of constant probability).

Subsequently, we sampled our renewals for their loss frequencies over the expired policy period. The fit was not good. Our sample results were then set up against the expectations from the Poisson exponential with the same mean.

Number of Losses	*Sample*	*Poisson*
0	0.701	0.616
1	.184	.299
2	.066	.073
3	.036	.011
4 & Over*	.013*	.001
Total	1.000	1.000

The Sample to Poisson also evidences not a good fit according to the Chi-Square test. We are still carrying on the experiment. The number of our samples thus far has been small . . . and not yet as random as we plan for our final summaries. However, even at this relatively early stage, there is at least some suspicion of a variation in the results by offices. It could well be that some sections of the United States are more claims-disposed than others.

In summary of this section: it is observed that multiple claims either are not now or soon will not be considered a rarity. There is at least the possibility that the frequency distribution of multiple claims will not follow the Poisson or other statistical series. In other words, the repeater losses may prove not to be the product solely of pure chance, but rather may be due to significant characteristics of the particular assureds. If continuing research proves this to be true, the underwriters will be interested in locating as soon as possible the areas and risk characteristics (i.e., classifications) which evidence a tendency to greater loss frequencies than expected solely on the basis of mathematical probabilities.

9. GENERAL SUMMARY

To recap the various sections of this paper:

A. The traditional attitudes in the fire insurance business towards losses, statistics, and rates are being reassessed and adapted to cope with the challenges presented by the Multiple Peril policy.

* Combined since the occurrences in the higher frequency classes become very few because of the limited number of samples collected thus far in this research.

B. The fundamental concept, Multiple Peril, is sufficiently ambiguous that the greatest forethought and care must be exercised in developing contracts and devising the statistical plans under which the loss experience is to be collected and reviewed.

C. There is some danger of traffic "in" and "out" of the coverages "Multiple Peril" and "Individual Policies" on solely arbitrary rather than on logical determinations . . . however, we cannot be sure that the class "Multiple Peril" will not hold together with sufficient consistency to operate a reasonably scientific insurance venture . . . time alone may be the final arbiter.

D. It may be necessary for both underwriting and rating purposes to find a substitute exposure measure for the present collected earned premiums.

E. Underwriters will evidence an ever-increasing interest in probing their experience beyond the present simple classification system under which the Homeowner's experience is currently being filed.

F. The current plans for Homeowner's credibility can be considered as most rudimentary and experimental . . . subject to reappraisal on an early occasion.

G. The possibility of multiple claims under the Homeowner's will acquire increasing importance underwriting—and even rating—wise in the years to come.

As noted in the introduction to this paper, technicians have a responsibility to point up and discuss the implications of administrative, sales, and underwriting actions in the Multiple Peril area. No technician can ever be assured that he will be "right" in his analysis of any given problem. It is well never to forget that the great D'Alembert incorrectly assigned two-thirds as the probability of a head at least once in two successive throws with a homogeneous coin in his article for Diderot's Encyclopedia.

The men who have developed Multiple Peril insurance must be respected for their enthusiasm and their determination . . . and nothing in this paper is to be construed in any manner derogatory of their inspiration. But over and above all aspirations and accomplishments of executives and individual technicians stands the necessity of knowledge which, in time, will wear away all tinsel and gloss. It is thought that in matters of insurance, as in scholarly disciplines generally, basic understandings are best advanced through the exchange of ideas by those whose prime interest transcends all special pleading.

HOMEOWNERS

CREDIBILITY TABLE

Experience Premium	Credibility Factor	Experience Premium	Credibility Factor	Experience Premium	Credibility Factor
$ 500	.01	$ 578,000	.34	$2,178,000	.66
2,000	.02	612,500	.35	2,244,500	.67
4,500	.03	648,000	.36	2,312,000	.68
8,000	.04	684,500	.37	2,380,500	.69
12,500	.05	722,000	.38	2,450,000	.70
18,000	.06	760,500	.39	2,520,500	.71
24,500	.07	800,000	.40	2,592,000	.72
32,000	.08	840,500	.41	2,664,500	.73
40,500	.09	882,000	.42	2,738,000	.74
50,000	.10	924,500	.43	2,812,500	.75
60,500	.11	968,000	.44	2,888,000	.76
72,000	.12	1,012,500	.45	2,964,500	.77
84,500	.13	1,058,000	.46	3,042,000	.78
98,000	.14	1,104,500	.47	3,120,500	.79
112,500	.15	1,152,000	.48	3,200,000	.80
128,000	.16	1,200,500	.49	3,280,500	.81
144,500	.17	1,250,000	.50	3,362,000	.82
162,000	.18	1,300,500	.51	3,444,500	.83
180,500	.19	1,352,000	.52	3,528,000	.84
200,000	.20	1,404,500	.53	3,612,500	.85
220,500	.21	1,458,000	.54	3,698,000	.86
242,000	.22	1,512,500	.55	3,784,500	.87
264,500	.23	1,568,000	.56	3,872,000	.88
288,000	.24	1,624,500	.57	3,960,500	.89
312,500	.25	1,682,000	.58	4.050.000	.90
338,000	.26	1,740,500	.59	4,140,500	.91
364,500	.27	1,800,000	.60	4,232,000	.92
392,000	.28	1,860,500	.61	4,324,500	.93
420,500	.29	1,922,000	.62	4,418,000	.94
450,000	.30	1,984,500	.63	4,512,500	.95
480,500	.31	2,048,000	.64	4,608,000	.96
512,000	.32	2,112,500	.65	4,704,500	.97
544,500	.33			4,802,000	.98
				4,900,500	.99
				5,000,000	1.00

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A COMPARISON OF AUTO LIABILITY EXPERIENCE UNDER A COMPULSORY LAW AND UNDER FINANCIAL RESPONSIBILITY LAWS

BY

MILTON G. McDONALD

In this comparison the experience of all companies is included in the Massachusetts figures. For Connecticut and New Jersey the experience reflects that of all companies filing with the N. B. C. U. and the M. I. R. B. for private passenger cars. The Connecticut commercial car experience is that of all companies reporting to the M. I. R. B. and members and subscribers of N. B. C. U. The New Jersey commercial car experience includes all companies.

The New Jersey and Connecticut data available included all loss adjustment expense. Massachusetts loss figures, as reported, exclude all loss adjustment expense. The Massachusetts loss data has been adjusted by a factor of 1.062 for private passenger cars and 1.067 for commercial cars to include allocated loss adjustment expense. To add unallocated loss adjustment expense a factor of 1.11 was applied to loss and allocated loss adjustment figures.

Similarly, since the law in Massachusetts requires only coverage on the ways of the Commonwealth and does not include guest coverage, it was necessary to combine the optional coverages with the statutory for comparison. The combination might produce some distortion, but in view of the fact that approximately 95% of those carrying compulsory coverage voluntarily purchase the optional coverages, the distortion would be slight. In addition, claim costs for the optional lines average higher than for statutory and their inclusion serves only to slightly inflate the combined average claim cost. On the other hand, frequency for the optional lines is relatively small (0.5 per hundred for private passenger cars and 0.4 for commercials). Therefore, the comparatively high frequency in Massachusetts is basically on the compulsory portion.

The three-year private passenger car exposure is approximately 3.6 million cars for Massachusetts, 3.3 for New Jersey and 1.3 for Connecticut. The five-year commercial car exposure is approximately 600 thousand cars for Massachusetts, 400 thousand for New Jersey and 150 thousand for Connecticut. The experience then is credible.

New Jersey was one state chosen for comparison with Massachusetts because it is most often referred to in other fields as a similar state in size, population and industry. Connecticut, an abutting state to Massachusetts, was selected to reflect any geographic conditions, such as climate which might have an effect on frequency, or economic standards affecting costs.

The investigation initially was to compare private passenger car bodily injury experience only, but in view of the results, property damage experience was introduced, then commercial experience as necessary facets for a reasonable solution. Logic then necessitated the addition of a study by size of loss. Since such data was not available by state except for New York and Massachusetts, countrywide figures were employed.

Under compulsory law in Massachusetts it is apparent that bodily injury claim frequency is over double that of the other two states for both classes of vehicles. On the other hand, property damage frequency is less than 30% lower for private passenger cars and less than 10% lower for commercial cars in Connecticut and New Jersey.

Bodily injury average claim costs are substantially higher in Connecticut and New York, and property damage less than 10% lower. It is frequency then that develops the comparatively high pure premiums in Massachusetts. The question then arises as to claim consciousness of the people under a compulsory law. The analysis of loss by size of risk is indicative. The percentage of claims under $500 in Massachusetts is approximately double that of New York or countrywide excluding New York. On the other hand, the percent over $4,000 is about half of that of New York or countrywide excluding New York.

In conclusion, I quote from a Special Commission Report, Senate #466, 1959, the result of eighteen months study of automobile insurance in Massachusetts. "In view of the claim frequency being higher in this Commonwealth than in any other state in the nation, there must of necessity be a serious question as to whether or not a substantial number of these claims are unwarranted, exaggerated, or in some instances are even fraudulent. The problem is entirely a moral one, and it has long been axiomatic that it is useless to attempt to legislate morals."

"The claim consciousness unquestionably results from compelling all motorists to carry liability insurance on their vehicles. There can be no question but that inducement to file a claim on the slightest provocation, or even on no grounds at all, is inherent under a compulsory insurance system, and this statement should not be construed as an unfair reflection on the morals of Massachusetts people. It is nothing more than a recognition that Massachusetts people are only human, and in this connection it will be of interest to note what develops in the claim frequencies of the state of New York, whose compulsory system went into effect in February of 1957, and of North Carolina, where compulsory insurance became operative on a trial basis on January 1, 1958."

EXHIBIT I

BASIC LIMITS—PRIVATE PASSENGER—ALL CLASSES COMBINED

PURE PREMIUMS

	Bodily Injury			*Property Damage*		
	Conn.	*N. J.*	*Mass.*	*Conn.*	*N. J.*	*Mass.*
1954	30.68	17.82	36.78	11.73	10.77	15.64
1955	33.46	18.50	42.66	12.44	11.57	17.03
1956	34.02	21.10	50.35	14.09	14.00	19.93
1954-6	32.78	18.93	43.50	12.80	12.02	17.60
3 Yr. Index	0.754	0.435	1.000	0.727	0.683	1.000

CLAIM FREQUENCY

1954	3.1	2.5	6.5	9.2	8.5	12.2
1955	3.2	2.7	6.9	9.1	8.7	12.1
1956	3.7	3.1	7.7	9.7	9.7	13.4
3 Yrs.	3.3	2.7	7.0	9.3	8.9	12.6
3 Yr. Index	0.471	0.386	1.00	0.738	0.706	1.000

AVERAGE CLAIM COST

1954	1005	704	565	128	126	128
1955	1034	724	614	137	133	141
1956	915	734	660	146	144	149
3 Yrs.	979	721	617	137	135	140
3 Yr. Index	1.587	1.169	1.00	0.979	0.964	1.000

Note: All Loss Adjustment Expense Included.

EXHIBIT II

COMMERCIAL CARS

BASIC LIMITS — ALL CLASSES COMBINED

	Bodily Injury			*Property Damage*		
	Conn.	*N. J.*	*Mass.*	*Conn.*	*N. J.*	*Mass.*
PURE PREMIUMS						
1951	42.15	30.22	46.22	29.81	32.25	33.28
1952	42.27	29.76	47.01	29.22	31.35	35.54
1953	39.52	31.51	47.70	31.65	31.63	35.73
1954	49.30	37.10	50.14	32.01	33.18	34.88
1955	35.69	41.05	53.52	29.10	31.23	35.60
1951-55	42.73	32.77	48.81	30.54	32.03	35.00
5 Yr. Index	0.875	0.671	1.000	0.873	0.915	1.000
CLAIM FREQUENCY						
1951	4.1	4.1	9.2	28.4	29.6	33.0
1952	3.9	3.8	8.9	27.3	28.1	32.6
1953	3.8	3.8	8.1	27.9	27.4	33.0
1954	4.7	4.3	8.2	26.9	28.0	27.8
1955	4.5	4.9	8.2	24.0	25.6	26.8
1951-55	4.1	4.1	8.6	27.4	28.1	30.0
5 Yr. Index	0.477	0.477	1.00	0.913	0.937	1.00
AVERAGE CLAIM COST						
1951	1027	737	495	105	109	100
1952	1087	784	515	107	112	109
1953	1038	836	576	113	116	119
1954	1060	855	609	119	118	126
1955	786	845	649	121	122	134
1951-55	1034	807	566	112	114	117
5 Yr. Index	1.827	1.426	1.000	0.957	0.974	1.000

Note: Includes All Loss Adjustment Expense.

EXHIBIT III

DISTRIBUTION OF LOSSES BY SIZE

	Mass.		*N. Y. State*		*Countrywide Ex. N. Y.*	
Size of Loss	*% of Total*	Σ	*% of Total*	Σ	*% of Total*	Σ
1-49	.3	.3	.4	.4	.7	.7
50-99	1.1	1.4	.7	1.1	1.1	1.8
100-199	3.7	5.1				
200-299	5.9	11.0				
300-399	8.5	19.5				
400-499	7.5	27.0				
100-499	25.6	27.0	13.7	14.8	11.5	13.3
500-999	24.3	51.3	18.6	33.4	13.3	26.6
1000-1999	16.5	67.8	19.5	52.9	17.5	44.1
2000-2999	10.0	77.8	12.0	64.9	13.4	57.5
3000-3999	6.5	84.3	8.4	73.3	10.7	68.2
4000 & over	15.7	100.0	26.7	100.0	31.8	100.0

Note: 1. Massachusetts — 1956 Policy Year.

2. N. Y. and countrywide, excl. N. Y., either Incurred Losses for accident year 1956 or losses on cases settled during any 12-month period of 1956-57.

3. Data available only for Massachusetts in 100-199, 200-299, 300-399, and 400-499 brackets.

4. No guest or extra-territorial losses included in Mass. Distribution.

OASDI COST ESTIMATES AND VALUATIONS

BY

ROBERT J. MYERS

The need of our labor force for economic security upon retirement, forcefully brought to public attention by the depression of the '30s, led President Roosevelt to appoint a study committee which suggested a retirement program limited initially to industrial and commercial employees. The system enacted by Congress in 1935 was extended in 1939, following study by an Advisory Council, to include dependents of retired workers and survivors of workers covered by the program. After two further extensive Congressional studies, coverage was extended in 1950 to most non-farm self-employed persons and to certain domestic workers, farm laborers, and employees of the Federal, State, and local governments and of non-profit institutions. In 1954, further legislation extended coverage to self-employed farmers. The scope has since been extended to include benefits for disabled workers and their dependents, so that the official title of the system is "Old-Age, Survivors, and Disability Insurance," abbreviated to OASDI.

This paper discusses the general nature of long-range actuarial cost estimates for the OASDI and similar programs, with a history of the estimates made in the past quarter century and the actuarial basis of the program now and in the past. The effect of the cost estimates on the development of the program is also discussed.

The term "reserve" is not used here for the accumulated assets of the system since, to a certain extent, this might imply that full actuarial reserve financing is practiced or attempted, whereas—quite properly—this is by no means the case. However, in this respect, mention should be made that in the original Social Security Act of 1935, the accumulated assets of the system were referred to as the "Old-Age Reserve Account;" this term was replaced in the 1939 Amendments by "Trust Fund."

VALUATION METHODS

Two different methods of presenting actuarial valuations are in common use. Many systems make use of the "balance sheet" method, which to some extent follows standard accounting procedures. This involves the setting up of assets and liabilities, both actual and potential, as of a given date. Under one approach the future assets are valued in accordance with the actual scheduled contribution rates and are compared with the computed liabilities; the resulting deficit or surplus (in monetary units or as related to payroll) is then derived. Under another approach the assets and liabilities are "balanced" by determining the contribution rate needed to achieve this result.

The nomenclature "balance sheet method" is used here for any valuation following this general procedure—using service tables and commutation columns—even though the results may not be presented in an actual balance sheet, but rather in dollar or percentage-of-payroll cost figures.

The other procedure, the "projection" method, has been used consistently for OASDI cost estimates. This method involves a presentation of year-by-year figures in the future (perhaps at quinquennial or decennial intervals) of such statistics as covered workers, beneficiaries, covered payroll, contribution income, interest income, benefit disbursements, administrative expenses, and balance in the fund.

The main advantage of the "balance sheet" method is its ease of preparation. In most cases well-established actuarial techniques which permit the use of existing tables and computational short-cuts are followed. This is particularly important when dealing with small systems, for which extensive work is not warranted, but only when "static" assumptions are made as to the various cost factors. If "dynamic" assumptions such as continuously improving mortality are used, the "projection" method might well prove less difficult for any system.

It is sometimes claimed that under the "balance sheet" method there is no need to make assumptions for experience extending many years into the future. Actually, this is not so. Under either method, the costs for a social insurance plan are figured into perpetuity because of the assumption of continuing new entrants. In fact, the "balance sheet" method may be less realistic because it generally assumes static future conditions as to new entrants, mortality and retirement rates, etc.

Most laymen look upon "balance sheet" valuations with complete mystification, perhaps even scepticism. Often, they comment that figures from such valuations are "only actuarial costs and do not represent real costs." This probably occurs because cost figures in regard to total long-range benefit disbursements are much higher than current costs. Under the "projection" method, such criticism is greatly lessened. The immediate and near-future situation is clearly recognized, lending credibility to the figures as extended into the more distant future by easily understood processes.

An argument often made in favor of the "balance sheet" method over the "projection" method is that the former must be used when there is a sparsity of experience data. Under such circumstances the actuary often must use previously prepared tables and rates from the experience of other systems. This argument is not valid—with sufficient ingenuity, the "projection" method can be used under any circumstances where a "balance sheet" valuation is possible.

It may perhaps be helpful to give a concrete illustration of these two different methods of presenting actuarial valuations, using as a basis the cost estimates for the OASDI system made at the time of the enactment of the 1958 Amendments. The cost estimates are prepared primarily and fundamentally by the "projection method", but through certain approximate and short-cut computational procedures it was possible to prepare a "balance sheet" valuation. The figures presented are for the intermediate-cost estimate, although low-cost and high-cost estimates have also been prepared and are—as indicated in the next section—of great importance.

Table 1 summarizes the cost analysis by the "balance sheet" method, giving information separately for present members and new entrants (into perpetuity). The percentage-of-payroll cost figures are developed on the basis of the employer-employee tax rate, taking into account that the self-employed pay only 75% thereof. More detailed data could, of course, be presented to show the present value of the disbursements by type. For example, the subdivision of the cost of 8.99% of payroll for benefits and administrative expenses combined for the total coverage is as follows:

Item	*Cost*
Old-Age Benefits (retired workers)	5.92%
Disability Benefits (disabled workers)	.43
Wife's Benefits (in respect to retired workers)	.57
Wife's Benefits (in respect to disabled workers)	.03
Child's Benefits (in respect to retired workers)	.05
Child's Benefits (in respect to disabled workers)	.03
Widow's Benefits (aged 62 or over)	1.23
Mother's Benefits (widows of deceased workers)	.11
Child's Benefits (in respect to deceased workers)	.38
Parent's Benefits (in respect to deceased workers)	.02
Lump-Sum Death Payments	.12
Administrative Expenses	.10
Total	8.99

The type of presentation in Table 1 clearly shows what might be said to be the almost obvious fact, from a quantitative standpoint, that the present members do not "pay their own way" from their contributions and those that employers make on the wages of covered employees. Rather, this deficiency must be made up by the contributions of, or in respect to, new entrants. In actuality this situation can be rationalized by saying that a portion of the employer contributions in respect to new entrants is used to meet the deficiency cost for present members. Thus, it can be said that the employee contribution rate in respect to new entrants is 4.44% of payroll (obviously quite close to the ultimate tax rate of 4½%, but slightly lower because, until 1969, some new entrants will pay a lower rate), or well below the new-entrant benefit cost of 5.23% of payroll. The difference between these two figures is, of course, met by part of the employer contributions for new entrants, with the remainder thereof going to meet the deficiency for present members.

It will be observed from Table 1 that the system as a whole shows an actuarial deficit of about ¼% of payroll according to this estimate, but it is considered that because of the variability of such long-range actuarial cost estimates, the system is substantially in actuarial balance. In fact, an informal yardstick has been developed by the Congressional committees concerned that a variation in the actuarial balance of about ¼% of payroll is considered permissible, at least for a temporary period, pending further experience, study, and analysis. Likewise, this balance sheet shows the system to have a deficit in monetary terms of $26 billion, or slightly more than the existing fund. Again, for a long-range social insurance program intended to operate into perpetuity, this is not a dangerous matter since this actuarial lack of balance, being a residual item, can fluctuate very considerably, depending upon the long-range cost assumptions made.

The "balance sheet" analysis set forth in Table 1 was prepared under the method that is described as the "deficit for present members" basis. This merely means the amount required at the present time, that together with the existing fund and the present value of future contributions from present members, will support future benefits for those on the roll, for present members, and for survivors of previously deceased members who have not reached the minimum eligibility age for survivor benefits. In other words, this is a "closed group" concept under which the system would be continued for present members, but would have no new entrants and no employer contribution income in respect to new entrants.

Another possible concept and one that is widely used in valuations of private pension plans is the "entry-age-normal-cost" method. Under this basis, the normal contribution rate is that which is just sufficient to support the benefits for new entrants so that, in essence, this group can be disregarded in all further consideration. It is then assumed that this rate is applicable in the future to the present members, and the accrued liability is then computed, part of which, of course, is funded by the monies already on hand. The remaining unfunded accrued liability can be met in varying ways—by amortization over a fixed period of years or by level payments (either in monetary terms or as a percentage of payroll) into perpetuity. The latter procedure would seem to be appropriate for a long-range national social insurance program.

In the particular example considered here, the normal cost of the OASDI system, as shown by Table 1, is 5.23% of payroll. If present members were to pay this level contribution rate instead of the graded schedule now in the law (5% as the combined employer-employee rate in 1959, 6% in 1960-62, 7% in 1963-65, 8% in 1966-68, and 9% thereafter), there would be less income to the system since for present members the level-premium equivalent of the present contribution schedule is 7.65%. As a result, under this method of valuation, the accrued liability is higher than under the "deficit for present members" basis, being $385 billion, of which $362 billion is unfunded. The level-premium equivalent of such unfunded accrued liability is 3.54% of payroll, representing in essence the portion of future employer contributions (in respect to both present members and new entrants) that must be used to support the value of the benefits paid to present members which is in excess of the normal cost.

It should not be assumed, however, as indicated previously, that present members (taking into account also the employer contributions on their wages) pay only the new entrant cost. In fact, it might be considered under this "entry-age-normal-cost" method that an "average" present member contributes 3.83% and that the other 1.40% of the normal cost comes from his employer, with all remaining employer contributions being used to help finance the unfunded accrued liability.

Table 2 presents the corresponding cost analysis according to the "projection" method, which is the normal type of presentation of the cost estimates for this system. By showing the year-by-year picture, a much clearer display of the problems involved in the rising cost trend is given. Table 3 makes a summary presentation of the actuarial balance of the OASDI system as derived from the "projection" cost analysis. The old-age and survivors insurance portion of the program has an actuarial deficit of about ¼% of payroll, while the disability insurance portion of the program is in almost exact balance.

The interesting and important fact is brought out that the OASI Trust Fund, despite being not in exact actuarial balance, will grow for many years and will not reach a peak until about 70 years from now, although thereafter it will decline fairly rapidly, as must naturally follow. This indicates that the demonstration of an actuarial deficiency—the only available analysis under the "balance sheet" method—is not of sole significance, but rather also it is important (and perhaps even much more important) to consider the year-by-year progress so as to determine when and to what extent the future cost impact will be.

The DI Trust Fund, on the other hand, grows steadily and levels off eventually since the system is, by coincidence, almost exactly self-supporting according to this particular estimate. In this respect, it may be noted that cost estimates made in the latter part of 1959 indicate that the costs of the disability insurance program are somewhat lower than has been indicated in the preceding paragraphs—largely because of lowered estimates as to the number of persons having the necessary insured status requirements and because of assuming lower disability incidence rates for women (on the basis of experience to date, although loaded upward to some extent as a safety factor).

VARIABILITY OF ACTUARIAL COST ESTIMATES

Long-range actuarial cost estimates and valuations cannot be precise no matter how accurately and meticulously they are made. Considerable differences will inevitably arise between future actual experience and the assumptions. Nonetheless, such estimates must be made to portray future cost trends.

Since it is inevitable that the actual experience will differ from the actuarial assumptions, cost estimates and valuations for social insurance plans can best serve their purpose when presented on a range basis. This procedure does involve enough extra work that its use is not always practicable. Even where the "range" procedure is adopted, a single "intermediate" estimate is sometimes required for establishing long-range contribution rates. This is not necessarily any more accurate or "probable" than either of the "range" estimates.

HISTORY OF COST ESTIMATES FOR OASDI

This section is concerned with the nature of the cost estimates that have been developed for the OASDI system over the years. Emphasis is on the general methods of development and presentation and on the over-all results, rather than on specific figures, which can be obtained from official documents.

ORIGINAL COST ESTIMATES

In 1934-35, the Committee on Economic Security made the studies underlying the original Social Security Act. The financing philosophy recommended was that a contingency fund should be established with the income from a graded tax schedule and that eventually the system should be financed in part by a Federal contribution. Ultimately, some 40 years after the inception of the system, the Federal contribution was estimated to be about two-thirds as large as the combined contributions (or taxes) from employers and employees. The cost estimate was a "single" one of the year-by-year projection type, showing both income and outgo separately by source and carrying forward the accumulated fund.

In 1935, the House of Representatives, after considering the recommendations of the Committee on Economic Security, enacted somewhat different legislation. The appropriations authorized to the fund were, by statute, not specifically measured by the taxes collected, but rather were amounts "determined on a reserve basis in accordance with accepted actuarial principles." Constitutional reasons made a definite division between the taxes collected and the benefits paid seem desirable. In actual practice, however, this language was interpreted as meaning that the net tax receipts, after deduction of administrative expenses, would be appropriated to the fund.

The House bill did not mention a Government contribution although according to its language there would be this Governmental responsibility. The estimated size of the fund, without any allowance for Government contribution, was shown to increase for a number of years, to reach a peak in about 1970, and then to decline.

The legislation finally enacted followed the House bill, except that benefits were limited to those who retired from covered employment, rather than being payable automatically at age 65. No pertinent experience was available as to retirement rates. It was computed that if the average effective retirement age were 67½, the system would be in balance; this seemed to be a reasonable assumption. Such procedure in the estimates emphasized the Congressional philosophy that the system be self-supporting. Thus, the estimated fund built up gradually to an ultimate level in 1980 of almost $47 billion, a figure that received much attention from the general public.

After the system went into effect in 1937, several actuarial cost estimates using different assumptions were prepared. The projection method continued to be used and has been used in all subsequent cost estimates, except for a few "balance sheet" estimates made by the Treasury Department before 1940. One of these new alternative cost estimates was termed a "probable maximum cost estimate" since it combined assumptions producing relatively high costs — for example, an assumption of an average retirement age of 66. When this estimate and the original one were considered concurrently, a range, of course, was present. Ever since this time, a range in cost estimates has been shown. The terminology, however, has been changed to "low-cost" and "high-cost" estimates.

COST ESTIMATES FOR 1939 AMENDMENTS

The 1939 Amendments made several important financing changes. The appropriation basis was revised so that an amount equal to the tax income goes into the trust fund; benefit payments continue to be paid from the trust fund, while the administrative expenses too are made payable directly from the trust fund, instead of indirectly by deducting them from the tax receipts before determining the appropriation to the trust fund. This practice has since been followed. No specific provision was made for any Federal contribution to the system.

The presentation of the actuarial cost estimates was on a range basis, and it was pointed out that this was done because of the belief that precision in such long-range estimates was impossible. The low-cost estimate indicated that the system was practically self-supporting, while the high-cost estimate showed that additional financing would eventually be necessary. As in all previous cost estimates, it was assumed that maturity of the program — the point when income and outgo would stabilize — would come in 1980.

With the drastic economic changes during and after World War II and with the refinements possible as operating data became available, new cost estimates were prepared from time to time. These differed somewhat from the earlier ones in that — following intensive study — the point at which "maturity" was assumed to be reached was advanced to the year 2000. According to the estimates made in the late 1940's, the system was more than self-supporting under the low-cost assumptions, but a need for additional financing eventually was indicated under the high-cost assumptions.

COST ESTIMATES FOR 1950 AMENDMENTS

The 1950 legislation made several important changes in the financing basis, one of which has had a lasting, significant effect on the cost estimates. In the Congressional hearings and committee reports, the intent was expressed that the system should be completely self-supporting from the contribution income developing from the tax schedule contained in the law. Consequently, the amendments eliminated a provision for potential Government contributions, incorporated in 1943. It was necessary, accordingly, to modify the procedure of presenting the actuarial cost estimates on a range basis since obviously the contribution schedule in the law could not be on a range basis. Therefore, an intermediate cost estimate was developed for measuring the actuarial balance of the program on the basis of the benefits to be provided and the contributions scheduled. This intermediate-cost estimate was obtained by a simple arithmetic average of the low-cost and high-cost estimates.

Following this practice, a contribution schedule was developed for the 1950 Amendments that made the system self-supporting, according to the intermediate-cost estimate. As would be anticipated, the system was shown to be more than self-supporting for the low-cost estimate and not nearly self-supporting for the high-cost estimate.

The Congressional committee reports recognized that long-range cost estimates cannot be precise and that, therefore, future adjustments in the tax schedule may be necessary. Further, it was accepted that, while the actuarial cost estimates should be continued on a range basis because of the uncertainties involved in the underlying assumptions, an intermediate estimate was necessary for determination of the tax schedule.

Under the philosophy adopted in the law and set forth in the committee reports, the tax schedule would be adjusted in the future so that the development of the trust fund in the direction indicated by either the low-cost or high-cost estimate would not occur. Thus, if actual experience tended toward the low-cost estimate, the contribution rates would probably be adjusted downward, or perhaps would not be increased in future years according to schedule. On the other hand, if the experience followed the high-cost estimate, the rates would have to be raised above those scheduled.

COST ESTIMATES FOR AMENDMENTS SUBSEQUENT TO 1950

The same basis of presenting the actuarial cost estimates has been followed in years subsequent to 1950. Revisions have been prepared from time to time as additional operating experience became available and also as the program was revised (with significant amendments occurring every second year). Beginning with cost estimates made in 1953, the projections were extended 50 years, to the year 2050. Upon analysis and consideration, especially when viewing the long-range effects of the "baby boom" that began in World War II and has continued ever since, it was decided that demographic maturity could not occur before 2050, although it might conceivably be closely approached from a cost standpoint some 25 years earlier.

When the cost estimates were revised in 1958, and the result indicated a significant actuarial deficit — somewhat more than ½% of payroll on a level-premium basis — Congress took note of this fact. Thus, in the 1958 Amendments, the contribution schedule was revised upward, in part to finance certain benefit liberalizations and in part — as stated in the title of the legislation — "to improve the actuarial status of the Trust Funds."

ECONOMIC ASSUMPTIONS FOR COST ESTIMATES

Throughout the entire history of the program, the cost estimates have been based on level economic conditions, except for experimental calculations not used as the basis for legislative consideration. At first glance, this might seem unrealistic — some criticism of this procedure has come from economists — since earnings levels have increased so significantly during the 25 years of operation of the program (as well as before its inception). It does not seem appropriate to use rising earnings assumptions in the cost estimates, rather than level ones, since the system of benefits and also the earnings base for contributions has been established on the economic foundation of the existing level. If the earnings level changes, the program can be adjusted correspondingly — as it has been in a number of instances. Of course, instead of this *ad hoc* procedure, a system could be established with automatic adjustments as has been done in the West German program in 1957 and in the Swedish program in 1959.

It does not seem proper to make assumptions inconsistent with the provisions in effect at the time the valuation is made. This is precisely what is done if rising earnings are assumed because, after some years, the benefit adequacy would be seriously impaired or completely destroyed, assuming that there are certain maximum limits on benefits and on earnings or income subject to contributions. Thus, if static conditions are assumed as to the provisions of the system — and it does not seem possible to do otherwise because the future action of Congress cannot reasonably be predicted — static economic assumptions must likewise be assumed. Such considerations, of course, do not prevent having a reasonable range in the other cost factors used — namely, those based primarily on demographic considerations.

The OASDI system has a weighted benefit formula since those with lower earnings receive proportionately larger benefits than those with higher earnings. Accordingly, as the earnings level rises, the average benefit represents a relatively lower proportion of the average earnings, and the cost of the system — expressed as a percentage of payroll — is lower than anticipated. A certain margin of reduced cost is thus available to adjust benefits upward when the earnings level changes, both for existing beneficiaries and for those who will come on the roll in the future. Hence, costs relative to payroll may remain the same. The increased monetary income resulting from the larger payroll is not entirely offset by the increased monetary outgo for higher benefits resulting from the higher earnings, leaving a margin to be utilized for liberalization of benefits.

The text accompanying actuarial estimates that are based on a level earnings assumption should contain sufficient safeguards. The reader should realize that the actuary is familiar with economic trends and not ignoring them, but setting them aside because their inclusion is not appropriate under the circumstances.

Any savings or reductions in cost due to rising earnings or taxable income can, and no doubt will, be utilized to maintain the relative benefit adequacy. Conversely, a rising earnings or income assumption will result in *apparent* low costs not likely to be realized. If economic conditions change as assumed, the benefit level will lose its relative adequacy and will have to be adjusted upward, thus absorbing the original apparent reduction in costs.

ACTUARIAL BASIS OF OASDI

Understandably, the question of the actuarial soundness of the system has provoked much discussion (and confusion, too) over the years. There is not agreement among actuaries as to whether the term "actuarial soundness" can be applied to a national compulsory system with virtually universal coverage.

At one extreme, a plan may be said to be "actuarially sound" if the existing fund is at least as large as the value of all accrued benefit rights. This basis is, of course, satisfied by legal reserve life insurance companies but not by many private pension plans that have assumed considerable liabilities for prior service. Some actuaries define an "actuarially sound" private pension plan as one "where the employer is well informed as to the future cost potential and arranges for meeting those costs through a trust or insured fund on a scientific, orderly program of funding under which, should the plan terminate at any time, the then pensioners would be secure in their pensions and the then active employees would find an equity in the fund assets reasonably commensurate with their accrued pensions for service from the plan's inception up to the date of termination of plan."[1] This definition permits a long period before all the past-service credits are fully funded.

Other actuaries have a less stringent definition of an actuarially sound system: "One which sets forth a plan of benefits and contribu-

[1] Dorrance C. Bronson, "Pension Plans—The Concept of Actuarial Soundness," *Proceedings of Panel Meeting, "What is Actuarial Soundness in a Pension Plan,"* sponsored jointly by the American Statistical Association, American Economic Association, American Association of University Teachers of Insurance, and Industrial Relations Research Association, Chicago, December 29, 1952.

tions to provide these benefits, so related that the amount of the present and contingent liabilities of the plan as actuarially computed as of any date will at least be balanced by the amount of the present and contingent assets of the plan actuarially computed as of the same date."[2]

How do these concepts apply to OASDI? The first definition means that it is not actuarially sound, but rather that it is indeterminate from this standpoint; the second definition would say that it is actuarially sound. My personal view is that the second definition can be used and that it is the intent and understanding of Congress that the program has been developed, and should continue, on this basis.

Even though it is generally agreed by actuaries that the first and more restrictive definition of actuarial soundness does not apply to OASDI, it may be of interest to compute certain quantities pertinent to it.

Such calculation can readily be made, and this has been done on an approximate basis, even though it is recognized that the resulting figures can be misunderstood and misused. One concept of measuring the actuarial condition of a pension plan is to develop the "deficit for present members." Under this concept, as of the end of 1958, based on the intermediate-cost estimate at 3% interest, the following situation existed for the OASDI program:

Item	*Amount (billions)*
1. Present Value of Future Benefits and Expenses	$544
2. Present Value of Future Contributions	232
3. Existing Trust Fund	23
4. Net Balance, (2) + (3) − (1)	−289

Under this concept there was thus an actuarial deficit of almost $300 billion (some 12½ times the amount of the existing trust fund), which, it should be realized, is only of theoretical interest and not of true significance under a long-range social insurance program.

Still another concept of actuarial soundness applicable to private pension plans may be considered in respect to the OASDI system, namely, the present value of all benefits in current payment status. In a sense, this corresponds to the terminal funding concept of private pension plans. At the beginning of 1959, after the benefit increases provided in the 1958 Amendments had become effective, benefits in current payment status were running at the rate of $760 million a month. These had a present value of about $75 billion, somewhat more than 3 times the then-existing trust fund. But it should be kept in mind that this relationship has no direct bearing on the actuarial soundness of the program, although it is an interesting summary measure of the obligations incurred and does facilitate comparisons with other systems.

[2] George B. Buck, "Actuarial Soundness in Trusteed and Governmental Retirement Plans," *ibid.*

The original 1935 legislation did not provide for any Federal contribution to the system even though this had been the recommendation of the Presidential committee that studied the matter. The "single" cost estimate indicated that the system would be self-supporting from the contributions of employers and employees. There was—and still is—considerable misunderstanding of the financing basis since many people believed that a full actuarial reserve system was being developed—especially since the estimated ultimate fund of $47 billion seemed so large, slightly greater than the national debt at that time. Such was not the case, however, because the cost estimates showed the system to be self-supporting only when it was considered as operating into perpetuity. At any particular date, the fund available would by no means be sufficient to meet the accrued liabilities without the help of the scheduled future contributions.

The 1939 Amendments changed the financing basis to what was generally believed to be a pay-as-you-go basis, or more properly a contingency fund basis. The Advisory Council of 1937-38 had recommended the development of a relatively small contingency fund with Government contributions eventually. However, the law did not specifically adopt this recommendation, and the program has not developed in this pattern. The 1939 Amendments "froze" the tax rate for the 3 years 1940-42 at the initial level (2% for employer and employee combined), and subsequent Congressional action continued this freeze throughout the 1940's. This action further strengthened the belief of many persons that the system was being financed—or would be financed—on a pay-as-you-go basis despite the fact that, because of the economic situation due to the war, income was very considerably in excess of outgo and a sizeable fund accumulated.

No specific provision was made in the 1939 Act for any Federal contribution despite the fact that some individuals thought a contingency reserve approach had been adopted. However, the 1943 legislation continuing the 2% employer-employee tax rate incorporated a provision authorizing any appropriations to the trust fund from general revenue needed to finance the program. No appropriations were made under this provision since the trust fund grew rapidly and none seemed to be required.

The Advisory Council of 1947-48, somewhat paralleling the action of the previous Advisory Council, recommended a financing basis under which a relatively small contingency fund would develop, with eventual Federal contributions equal to half the combined employer-employee contributions. This Advisory Council also recommended an immediate increase in the contribution rates despite the fairly sizeable fund that was continuing to develop. This action was based, in large part, on "psychological" grounds, in order that the general public would realize that the considerably liberalized benefits recommended meant additional costs and consequently higher contribution rates.

Congress in enacting the 1950 Amendments did not concur in the financing recommendations made by the Advisory Council but instead quite clearly and strongly expressed the intent that the system be completely self-supporting from the tax income provided. This basis has subsequently been maintained. The contribution schedule has been revised from time to time as additional benefits have been provided and in accordance with needs indicated by revised actuarial cost estimates.

The OASDI contribution schedule reaches its ultimate level within a decade (1969, under present law), while benefit disbursements rise for a number of decades. In accordance with the self-supporting financing basis of OASDI, this means that a sizeable fund will develop. In fact, in the intermediate-cost estimates made from time to time, the ultimate size of the trust fund is well in excess of $100 billion (it was about $23 billion at the end of 1958).

Up to the present point, reference has been made to "trust fund" in discussing the OASDI program. Actually, following the 1956 Amendments, there are two separate trust funds—one for the Old-Age and Survivors Insurance benefits and the other for the Disability Insurance benefits. This subdivision has no real significance in regard to the financing of the program but was adopted as a "guarantee and assurance" that the newly provided disability benefits would not bankrupt the OASI Trust Fund in the event that disability experience proved much less favorable than the intermediate-cost estimate.

USE OF COST ESTIMATES IN DEVELOPMENT OF OASDI SYSTEM

Over the years, the actuarial cost estimates prepared in the Social Security Administration have been used by the Congress as the basis for their consideration of changes in the OASDI program. Particularly, since the positive recognition and adoption of the self-supporting principle in 1950, the cost estimates have tended to play a very important role in its legislative development.

Before any legislative action, Congress carefully studies the cost of proposed benefit liberalizations in the light of the financial situation of the existing system and any additional financing necessary. At times Congress has determined that such liberalizations were too costly, and they have been trimmed down or eliminated. For example, in 1956, the House voted to pay full benefits at age 62 (instead of at age 65) to all categories of female beneficiaries and to provide monthly disability benefits beginning at age 50; this was to be financed by a 1% increase in the combined employer-employee contribution rate in all future years. Perhaps the controlling reason for restricting disability benefits to those aged 50 and over was the cost aspect. The Senate, however, was not in favor of an increase in the contribution schedule as large as 1% and so provided actuarially reduced, rather than full, benefits for women workers and wives (but full benefits for widows) claiming them before age 65. This action, permitting the increase in the combined employer-employee contribution rate to be held to ½%, was agreed to by the House and was enacted.

Although in some quarters there has been considerable criticism of the fact that every two years since 1950 legislative action has liberalized the OASDI system, there is one important point that should be kept in mind. Each time there has been legislative activity, the Congress—particularly, the important, controlling legislative committees concerned—has very carefully considered the cost aspects of all proposed liberalizations. Any changes made have been carefully financed according to the best actuarial cost estimates available. Thus, Congress has attempted to keep the system on a self-supporting basis by keeping benefit costs very closely in balance with contribution income. The Committees have always been anxious to be able to say that the program is "actuarially sound." In my opinion, this is true under the second, less restrictive definition of "actuarial soundness," which is fully satisfied by the self-supporting basis of the system. Certainly, the program can be said to have staunch financial safeguards as long as Congress continues to be cost-conscious, as it has been in the past, and to finance benefit liberalizations adequately.

TABLE 1

BALANCE SHEET COST ANALYSIS OF OASDI SYSTEM UNDER PROVISIONS OF 1958 AMENDMENTS, INTERMEDIATE-COST ESTIMATE AT 3% INTEREST, AS OF BEGINNING OF 1958

Item	*Amount (billions)*	*Equivalent Level Percentage of Payroll*
Present Value of Payrolls		
Present Members	$3,038	
New Entrants	7,202	
Total Coverage	10,240	
Present Value of Benefits and Administrative Expenses		
Present Members	$544	17.91%
New Entrants	377	5.23
Total Coverage	921	8.99
Present Value of Scheduled Contributions		
Present Members	$232	7.65%
New Entrants	640	8.88
Total Coverage	872	8.52
Existing Fund		
Present Members	$23	.75%
New Entrants	—	—
Total Coverage	23	.23%
Actuarial Balance, Surplus (+) or Deficit (—)		
Present Members	—$289	—9.51%
New Entrants	+ 263	3.65
Total Coverage	— 26	— .24

Note: Present members include beneficiaries on the roll at the beginning of 1958 and those who will come on the roll in the future on the basis of earnings credits obtained before 1958. New entrants include those participating in the system at any time in the future who had no earnings credits before 1958.

TABLE 2

PROJECTION COST ANALYSIS OF OASDI SYSTEM UNDER PROVISIONS OF 1958 AMENDMENTS, INTERMEDIATE-COST ESTIMATE

(in millions)

Calendar Year	*Contributions*	*Benefit Payments*	*Administrative Expenses*	*Financial Interchange*[a]	*Interest on Fund*[b]	*Fund at End of Year*
		Old-Age and Survivors Insurance Trust Fund				
1957[c]	$6,826	$7,347	$162	—	$557	$22,393
1960	10,621	10,027	166	—$196	590	21,794
1965	13,830	12,333	181	— 160	820	28,762
1970	19,404	15,030	201	— 70	1,406	50,330
1980	22,301	20,874	246	12	2,856	98,678
2000	29,695	29,672	332	192	4,762	163,448
2020	36,124	40,716	426	192	8,379	285,282
		Disability Insurance Trust Fund				
1957[c]	$702	$57	$3	—	$7	$649
1960	991	492	23	—$20	59	2,402
1965	1,059	796	25	— 34	126	4,437
1970	1,141	1,052	27	— 34	165	5,686
1980	1,311	1,380	30	— 22	201	6,844
2000	1,745	1,649	40	— 2	383	13,194
2020	2,125	2,330	51	1	521	17,764

[a] A positive figure indicates payment to the trust fund from the Railroad Retirement Account, and a negative figure indicates the reverse.

[b] At 3%, except 2.6% in 1958, 2.7% in 1959, 2.8% in 1960, and 2.9% in 1961.

[c] Actual data. The administrative expense figure for the OASI Trust Fund is artificially high—and that for the DI Trust Fund correspondingly low—because reimbursements between the funds to provide proper allocation of such costs were not made in the year.

TABLE 3

ACTUARIAL BALANCE OF OASDI SYSTEM UNDER PROJECTION COST ANALYSIS, FOR PROVISIONS OF 1958 AMENDMENTS, AS OF BEGINNING OF 1958, INTERMEDIATE-COST ESTIMATE AT 3% INTEREST

	LEVEL-PREMIUM EQUIVALENT	
Item	*Old-Age and Survivors Insurance*	*Disability Insurance*
Contributions	8.02%	.50%
Benefit Payments[a]	8.40	.49
Administrative Expenses	.09	.01
Existing Trust Fund	.22	.01
Net Balance[b]	—.25	+.01

[a] Including the effect of the financial interchange provisions with the Railroad Retirement system.

[b] Contributions plus existing trust fund less benefit payments and administrative expenses.

CREDIBILITY OF 10/20 EXPERIENCE AS COMPARED WITH 5/10 EXPERIENCE

BY

LEWIS H. ROBERTS

Summary

Because of the admission of larger amounts on individual claims into the losses, experience subject to limits of $10,000 per claim and $20,000 per accident will be subject to more fluctuations arising from the relatively infrequent large claims than experience subject to $5,000/10,000 limits. On the basis of a study of New York State private passenger car experience it is estimated that somewhat over 40%, possibly 50%, more claims are needed for experience under the higher limits to have the same actuarial credibility as it would have under the lower limits.

In the conduct of this study, account was taken of the frequency distributions of claims by size and of accidents by number of claims. For the purpose of dealing with the subject of credibility in an analytical way, it was necessary to investigate the mathematical basis for credibility factors and to derive formulas for the coefficient of variation, or relative sampling error, of losses experienced.

In essence, both of these formulas are an extension of the Poisson theory, under which the variance of the number of independent random events occurring is equal to the expected number of events. The need for extension arises from the unequal weight that must be given to different events (due to variation between claims) and the only partial independence of events (due to multiple-claim accidents).

Technical Aspects

Because existing literature does not contain formulas for the coefficient of variation (C.V.) of losses as a function of claims it was necessary to derive such a formula. The formula showed that certain parameters or "constant" statistics descriptive of the distribution of accidents by number of claims were needed. It was possible to make only upward-biased estimates of these parameters from available experience, hence calculations were made both with the computed values of these parameters and with their theoretical minimum possible values in order to indicate the range of possible error in estimates of the C.V. of losses.

Because the C.V. of losses depends not only on the number of claims but on the C.V. of individual claims it was necessary to estimate the latter under 5/10 and 10/20 limits. Available data did not permit reflection of the change in accident limit, with the result that calculations somewhat over-estimate the relative credibility of 10/20 experience. The over-estimate arises because the distribution used (New York State Private Passenger B.I., Stock and Mutual, acc. yr.

1956) reflects an underlying accident limit of $20,000 or more both for a $5,000 claim limit and a $10,000 claim limit. Data necessary to adjust for the change in accident limit are not available. Because the reported distribution went only as high as $5,000 it was necessary to extrapolate to $10,000. Special methods were devised for this purpose to give protection against the danger of gross error inherent in extrapolation.

DETAILS OF THE STUDY

Nature of the Problem

Some Fundamental Considerations

In essence what we require is a comparison of the extent to which chance fluctuations, such as the occurrence of unusually large claims or accidents, reduce the statistical reliability of losses when the limits on individual claims and accidents are substantially increased. This comparison must then be interpreted in terms of the effect such a reduction in statistical reliability should have on the relative weight to be given to indications of experience.

This problem, the statement of which is so simple, involves a number of subtle theoretical considerations as well as the technical complications that may be expected when solutions are attempted to problems for which necessary data are incomplete or useable only in a very indirect way.

We shall implicitly define credibility through the following postulates:

> Let t be the ratio of the observed value of a characteristic (e.g., loss ratio, pure premium, etc. indicated by a body of experience) to the theoretical long-run average or expected value of that characteristic. Let P_1 be the probability that $|t-1|>k$ for one body of experience, while P_2 is the corresponding probability for a second body of experience:
>
> *Postulate I:*
>
> The credibility of the first body of experience is greater than, equal to, or less than that of the second as P_1 is respectively less than, equal to or greater than P_2 for all values of k.
>
> *Postulate II:*
>
> The relative credibilities of the two bodies of experience are indeterminate in the absence of further information when the equality or inequality between P_1 and P_2 depends on k.

For fairly large volumes of experience the mathematical derivation of credibility rests upon Postulate I. For small volumes of experience, this postulate suffices to show that 10/20 losses for a given volume have lesser credibility than 5/10 losses. Measurement of the degree to which it is less, however, proves to be indeterminate. This is so because when we attempt to ascertain what greater volume of experience under 10/20 limits would have the same credibility as a given volume under 5/10 limits we find that the hypothesis of Postulate II is fulfilled. This paragraph is amplified in Exhibit A.

For large bodies of experience, that is, where the number of claims developed is sufficient that losses have a practically normal probability distribution, credibility can be calculated in terms of the coefficient of variation (C.V.) under 5/10 and 10/20 limits. This is true because in such a case probabilities have a nearly uniform correspondence with this parameter. For small volumes, however, this uniform correspondence disappears. In terms of the probability of a chance deviation exceeding a small or moderately large percentage, the drop in credibility for 10/20 vs. 5/10 experience is less than would be indicated by the normal curve for the corresponding increase in the C.V., but at the same time the probability of a really large chance deviation is disproportionately greater.

These relationships can be appreciated from consideration of the effect of a single large claim on small bodies of experience. So long as no large claims occur, losses will exhibit fluctuations under 10/20 limits not necessarily in excess of those exhibited under 5/10 limits. Yet a very large claim or accident will obviously have twice as much effect on indications with 10/20 limits as with 5/10 limits. For example, consider an expected number of claims equal to 11, which under our present table would correspond to 10% credibility. Calculations based on the Accident Year 1956 Size of Claim Data, N. Y. State Private Passenger B. I., Stock and Mutual Combined, indicate an average claim cost of $732 with policy limits of $5,000 per claim and $827 with policy limits of $10,000 per claim (accident limitation of $20,000 on more in each instance). Expected losses would then be $8,052 with 5/10 limits and $9,097 with 10/20 limits. In the first instance an additional claim equal to the claim limit would result in a formula increase in rates of 6.2%, while in the second instance the formula increase would be 11.0% using 10% as the credibility in both cases. The formula increases with an additional accident equal to the accident limit would of course be much greater.

To appraise the significance of such a comparison it is worthwhile to look at probabilities. To simplify matters, we shall consider it as given that 12 claims are incurred and the first eleven produce total losses equal to the expected, then compute the probability that the twelfth claim is (a) as large as $5,000 and (b) as large as $10,000. These probabilities according to Exhibit A are the complements of .970 and .987 respectively, or .030 and .013. In view of these low probabilities, moderate errors in appraisal of credibility for small volumes of experience will so infrequently produce significant departures from theoretically proper formula rates (whatever such may be) that we are justified in treating credibilities under the hypothesis of Postulate II as equal for our purposes. This assumption will enable us to calculate credibilities in terms of the C.V. of losses for all volumes of experience.

Formula

Previous formulas for the C.V. losses were expressed in terms of the number of accidents rather than the number of claims for theoretical reasons (the Poisson assumption is considered to be valid in liability insurance for accidents but not for claims). A formula expressed in terms of claims is needed, however, because it is the number of claims, rather than of accidents, which is reported. The formula (derived in Exhibit C) is:

$$V_L^2 = \frac{V_c^2 + E\mathrm{m}(1 + V_m^2)}{E\mathrm{N}} \tag{1}$$

the symbols being defined as follows:

V = Coefficient of variation of its subscript variable

L = Losses

m = Number of claims per accident

N = Number of claims

C = Size of claim

E = Denotes expected value of variable following

The parameters, Em, V_m^2 and V_c^2 are constants which must be determined in advance. Values of N are reported. EN may be estimated as equal to N (the most accurate estimate where N is large enough) or may be estimated in other ways.

Description of Calculations

We do not have adequate data immediately available for calculation of Em, V_m^2 and V_c^2, but the following calculations have been made from what data there are:

Calculation of Em and V_m^2

From a distribution of accidents by size based on New York State Private Passenger B.I. experience for accident year 1957 we have computed that for accidents producing excess losses Em = 1.7 and V_m^2 = 1.0. (Exhibit F.) These values should be regarded as high estimates since accidents producing excess losses, by reason of their severity, would be expected to produce more claims and a greater variation in the number of claims, than other accidents.

Calculation of V_c^2

The value of V_c^2 has been estimated from the 1957 call for Size of Claim Data, Private Passenger Cars, B.I., for New York State, Stock and Mutual Combined (Accident Year 1956). It was necessary to employ certain artifices in this calculation because the data used were not strictly what was needed. Actually, two size of claim distributions were needed, one with an underlying accident limitation of \$20,000 and showing claims at least up to \$10,000, and the other with an underlying accident limitation of \$10,000 and showing claims at least up to \$5,000. The reported data showed claims up to \$5,000 and had underlying accident limitations of \$20,000 or more.

The calculation of V_c^2 for a \$5,000 limitation was straight-forward and is described in Exhibit B. This would appear to be a high estimate because the underlying accident limitations were \$20,000 or more, rather than \$10,000, and with the lower accident limitation some claims would be reduced in size. If it be assumed that claims involving excess losses by reason of the accident limitation have a larger average than all claims combined, the pro-rata scaling down of claims under an accident limitation would tend to reduce V_c^2. This seems reasonable to expect, hence we have assumed an upward bias in the calculation of V_L^2 for a \$5,000 claim limit.

The calculation of V_c^2 for a \$10,000 claim limit required extrapolation. Since this is a "dangerous" type of calculation, special measures were taken to protect against serious error. The value of V_c^2 as a function of $\hat{c}$, the claim limit, was expressed in terms of two logarithmic transformations of $\hat{c}$ to yield two curves, one concave upward and the other concave downward. Extensions of secants constructed through the last two data-supported points (\$4,000 and \$5,000 size of claim) on these curves provided upper and lower limits to the estimate of V_c^2 for a \$10,000 claim limit. These limits were 3.51 and 3.33, their mean being 3.42 before adjustment for grouping error and 3.45 after this adjustment. This calculation appears on Exhibit D.

An independent calculation was made by finding a transformation of the claim-size variable that would bring the cumulative distribution of claims into agreement with the integral of the Normal Curve at \$3,000, \$4,000 and \$5,000. The distribution of claims from \$5,000 to \$10,000 and the proportion of claims that would be limited to \$10,000 was then calculated from the Normal Curve. This calculation yielded a value of 3.47 for V_c^2 with a \$10,000 limit. This value (rounded to 3.5) was used in subsequent calculations since it is the most precise determination made and falls within the previously established upper and lower limits. (Exhibits B and E.)

Calculation of V_L^2

Values of V_L^2 were calculated by means of Eq. (1) using the values of 1.7 for Em, 1.0 for V_m^2, 2.2 for V_c^2 with a $5,000 limit and 3.5 for V_c^2 with a $10,000 limit. Because of the upward bias in the values used for Em and V_m^2, calculations were also made setting Em equal to 1.0 and V_m^2 equal to zero, these being the minimum possible values of these parameters since they correspond to the condition that every accident consists of a single claim.

Although the values used for Em and V_m^2 have a marked effect on V_L^2, they have little effect on the ratio of the value of V_L^2 developed with a $5,000 claim limit to the value of V_L^2 developed with a $10,000 claim limit.

Calculation of Relative Credibility

The theoretical justification for basing credibility on V_L has been mentioned above in connection with the relation of this statistic to probability. A brief discussion of this question from the point of view of controlling the contribution of indicated rates to the mean square error of formula rates is given in Exhibit G.

In accordance with these concepts, the comparative credibilities of 10/20 and 5/10 experience have been estimated from the ratio of the value of V_L with a $5,000 claim limit to the value of V_L with a $10,000 claim limit. This ratio is .84 with $E\text{m} = 1.0$, $V_m^2 = 0$, and .90 with $E\text{m} = 1.7$, $V_m^2 = 1.0$.

As mentioned earlier, the values of V_c, hence of V_L, computed for a $5,000 claim limit, reflect the same underlying accident limitations as the values computed for a $10,000 claim limit ($20,000 or more), rather than an accident limitation half as great as the accident limitation associated with a $10,000 claim limit. Therefore values of V_L for a $5,000 claim limit as well as the ratios just given must be regarded as biased upward. In view of this bias, the credibility of 10/20 experience should be somewhat less than 85%, perhaps 80%, as great as the credibility of 5/10 experience.

If we express these results in terms of the number of claims, we find that 10/20 experience would require at least 40% more claims for full credibility to retain the same statistical reliability as 5/10 experience. It will be noted that the increase in claim requirements is more than proportional to the decrease in credibility. This is because of the inverse square relationship between claims and credibility.

EXHIBIT A
Sheet 1

COMPARISON OF PROBABILITY DISTRIBUTIONS OF CLAIMS AND OF LOSSES WITH $5,000 AND $10,000 CLAIM LIMITS

I. Basic statistics on individual claims

	$5,000 Limit	*$10,000 Limit*
(a) Mean	$ 732	$ 827
(b) Coefficient of variation	1.48	1.86
(c) Standard deviation	1,080	1,540

II. Tabulation for selected ranges above and below the mean *in units of standard deviation,* based on individual claims

	Dollar Range		*Fraction of Distribution Within Range*		
No. of σ's	*$5,000 Limit*	*$10,000 Limit*	*$5,000 Limit*	*$10,000 Limit*	*Normal Curve*
.1	624 – 840	673 – 981	.087	.106	.080
.2	516 – 948	519 – 1,135	.181	.223	.159
.5	192 – 1,272	5 – 1,597	.531	.757	.383
1.0	0 – 1,812	0 – 2,367	.900	.920	.683
1.5	0 – 2,352	0 – 3,137	.921	.945	.866
2.0	0 – 2,892	0 – 3,907	.940	.959	.955
2.71	0 – 3,659	0 – 5,000	.954	.970	.993
3.95	0 – 4,999.99	0 – 6,910	.970	.980	.99995
	0 – 5,000		1.000		
5.96		0 – 9,999.99		.987	
		0 – 10,000		1.000	

III. Tabulation for selected ranges of *percentages of the mean* above and below the mean, based on individual claims

	Dollar Range		*Fraction of Distribution Within Range*	
Percent	*$5,000 Limit*	*$10,000 Limit*	*$5,000 Limit*	*$10,000 Limit*
10%	659 – 805	744 – 910	.060	.034
20	587 – 878	662 – 992	.120	.112
50	366 – 1,098	414 – 1,241	.323	.312
100	0 – 1,464	0 – 1,654	.875	.890
200	0 – 2,196	0 – 2,481	.912	.922
300	0 – 2,928	0 – 3,308	.940	.947
400	0 – 3,659	0 – 4,135	.954	.961
500	0 – 4,392	0 – 4,962	.964	.969
583	0 – 4,999.99	0 – 5,648	.970	.974
	0 – 5,000		1.000	
1109		0 – 9,999.99		.987
		0 – 10,000		1.000

EXHIBIT A
Sheet 2

The points to be noted are that: (1) In units of standard deviation the more skewed claim distribution developed with a $10,000 claim limit shows more concentration around the mean until the $5,000 limit is reached, while beyond that limit the $10,000 claim limit permits 3% of claims to take on larger values than $5,000. (2) In terms of percentage deviation from the mean the $10,000 claim limit shows more concentration around the mean only from ± 100% of the mean to the $5,000 limit.

With losses (random aggregates of claims) developed in successive experience periods under the same conditions of hazard, the comparison would be qualitatively similar but the characteristics of the two distributions would become less and less distinct as they converged toward the normal distribution with increasing numbers of claims expected in each experience period. If the probability of a variate falling in a given range of one distribution is sometimes greater and sometimes less (depending on the size of the range) than the probability of the variate of the second distribution falling within the range, then the hypothesis of Postulate II, page 236, is satisfied. [It may be remarked that increased volume required under 10/20 limits to yield a C.V. equal to the C.V. for a given volume under 5/10 limits would partially offset the greater kurtosis and skewness of the 10/20 claim distribution. It would not completely offset them, however, because the effect of the claims over $5,000 on the higher moments of the distribution is necessarily greater than their effect on the C.V.]

EXHIBIT B
Sheet 1

DISTRIBUTION OF CLAIMS BY SIZE NEW YORK STATE PRIVATE PASSENGER BODILY INJURY INSURANCE

Stock and Mutual Carriers Combined

Accident Year 1956 or 12 Months in 1956-1957

(1) Size of Claim At Least	(1) Size of Claim Less Than	Number of Claims (2) Within Interval	Number of Claims (3) Accumulated Up	Proportion of Claims (4) Within Interval	Proportion of Claims (5) Accumulated Down	(6) Losses Within Interval	(7) Average Claim Cost Within Interval
	25	4,820		.0547	.0547	45,395	9.42
25	50	5,548	83,272	.0630	.1177	197,983	35.69
50	100	7,396	77,724	.0840	.2017	486,057	65.72
100	250	16,239	70,328	.1843	.3860	2,542,915	156.59
250	500	18,311	54,089	.2079	.5939	6,315,379	344.90
500	1,000	17,932	35,778	.2035	.7974	11,939,730	665.83
1,000	2,000	9,444	17,846	.1072	.9046	12,548,756	1,329.
2,000	3,000	3,267	8,402	.0371	.9417	7,787,658	2,384.
3,000	4,000	1,589	5,135	.0180	.9597	5,421,409	3,412.
4,000	5,000	872	3,546	.0099	.9696	3,856,389	4,422.
5,000	6,000	551	2,674	.0063	.9759	2,975,000	5,400.
6,000	7,000	370	2,123	.0042	.9801	2,368,000	6,400.
7,000	8,000	273	1,753	.0031	.9832	2,020,000	7,400.
8,000	9,000	203	1,480	.0023	.9855	1,705,000	8,400.
9,000	10,000	158	1,277	.0018	.9873	1,485,000	9,400.
Sub-Total		86,973		.9873			
Over 10,000		1,119	1,119	.0127			
Grand Total		88,092		1.0000			

See Sheet 2 for explanation of the calculation of V_c^2.

Derivation of column entries:

Col. (2) As reported up to 5,000 size of claim. Computed by differencing col. (3) beyond 5,000.

(3) Computed by accumulating col. (2) up to 5,000; beyond 5,000, entries equal (5) $\times \Sigma$ (2) $= 88{,}092 \times$ (5).

(4) Computed by differencing col. (5).

(5) Up to 5,000, entries equal the downward accumulation of (2) divided by Σ (2). Beyond 5,000, entries are as computed on Exhibit E.

(6) As reported up to 5,000 size of claim. Beyond 5,000, entries equal (2) $\times$ (7).

(7) (6) $\div$ (2) up to 5,000 size of claim. Beyond 5,000, entries are selected at 400 above the lower limit of the interval in consideration of the positions of the averages within the 3,000-4,000 and 4,000-5,000 interval.

EXHIBIT B
Sheet 2

The formula used for computing V_c^2 for each claim limitation is $V_c^2 = [(\Sigma FC^2)/N - (EC)^2] \div (EC)^2$ where V_c^2 is the squared coefficient of variation, C represents claim cost, EC is the mean of the claim costs, F is the number of claims in each interval, and N is the total number of claims. Each C value used is the average claim cost in the interval. To compute V_c^2 for a specified claim limitation, all claim sizes greater than the limitation were assigned the value of the limitation. For example, let us refer to Sheet 1 to illustrate the computation of V_c^2 for a \$250 claim limitation. To obtain EC, the items items in column (6) were summed for claim sizes less than \$250. The corresponding item in column (3), 54089, representing the number of claims whose size is greater than \$250, was multiplied by \$250 and added. This result was divided by the total number of claims, 88,092, to obtain EC. To compute the value of $\frac{\Sigma FC^2}{N}$, the items in column (7), average claim cost, were squared, multiplied by the corresponding items in column (2), claim frequency in interval, and added for all claim sizes less than \$250. The corresponding item in column (3) was multiplied by $(250)^2$ and added. This result was divided by the total number of claims, 88,092. For the limits of \$5,000 and \$10,000, .04 and .03 respectively were added to the values so calculated to offset the reduction in variance introduced by grouping. The final values were rounded to 2.2 and 3.5 respectively.

EXHIBIT C

Derivation of Formula for Relative Variance, or Squared Coefficient of Variation, of Losses as a Function of the Number of Claims

Definition of Symbols

L = losses
N = number of claims
n = number of accidents
m = number of claims per accident
$\bar{m}$ = average number of claims per accident = N/n
C = cost per claim
$\bar{\mathrm{C}}$ = average cost per claim = $\mathrm{L/N}$
S = standard deviation of subscript variable
E = expected value of variable following
V = coefficient of variation of subscript variable, e.g., $\mathrm{V}_u = \mathrm{S}_u/Eu$. V^2 is the relative variance.

Since losses are a sum of claims

(1) $\mathrm{L} = \mathrm{C}_1 + \mathrm{C}_2 + \ldots + \mathrm{C}_\mathrm{N}$

(2) $\quad = \mathrm{N}\bar{\mathrm{C}}$

(3) $E\mathrm{L} = E\mathrm{N}E\mathrm{C}$
if average claim cost and the number of claims are independent in their random fluctuations, as may ordinarily be expected in automobile liability insurance.

(4) $E\mathrm{L}^2 = E(\mathrm{C}_1 + \ldots + \mathrm{C}_\mathrm{N})^2$

(5) $\quad = E(\mathrm{C}_1^2 + \ldots + \mathrm{C}_\mathrm{N}^2 + \Sigma \mathrm{C}_i\mathrm{C}_j)$;
there being $\mathrm{N}(\mathrm{N}-1)$ cross products with $i \neq j$.
To the extent that each claim is statistically independent of the others we are justified in taking the sum of the cross products as $\mathrm{N}(\mathrm{N}-1)(E\mathrm{C})^2$.

Then for any particular value of N

(6) $E\mathrm{L}^2 = \mathrm{N}E\mathrm{C}^2 + (\mathrm{N}^2 - \mathrm{N})(E\mathrm{C})^2$
and over all N

(7) $E\mathrm{L}^2 = E\mathrm{N}E\mathrm{C}^2 + (E\mathrm{N}^2 - E\mathrm{N})(E\mathrm{C})^2$

(8) $\quad = E\mathrm{N}[(E\mathrm{C})^2 + \mathrm{S}_\mathrm{C}^2] + [(E\mathrm{N})^2 + \mathrm{S}_\mathrm{N}^2 - E\mathrm{N}](E\mathrm{C})^2$

(9) $\mathrm{S}_\mathrm{L}^2 = E\mathrm{N}(E\mathrm{C})^2 + E\mathrm{N}\mathrm{S}_\mathrm{C}^2 + (E\mathrm{C})^2(\mathrm{S}_\mathrm{N}^2 - E\mathrm{N})$
since $\mathrm{S}_\mathrm{L}^2 = E\mathrm{L}^2 - (E\mathrm{L})^2$ as a consequence of its definition as $E(\mathrm{L} - E\mathrm{L})^2$, the value of $E\mathrm{L}$ being taken from Eq. (3).

EXHIBIT C *(Continued)*

Then on division by the value of $(EL)^2$ we have

$$(10) \qquad V_L^2 = 1/EN + V_C^2/EN + V_N^2 - 1/EN = V_C^2/EN + V_N^2$$

But since $N = n\overline{m}$, if the number of accidents and the average number of claims per accident are statistically independent a similar argument with N, n and m standing in the places of L, N and C respectively leads to

$$(11) \qquad V_N^2 = V_m^2/En + V_n^2$$

If the number of accidents, though not necessarily of claims, has a Poisson probability distribution we can substitute in Eq. (10)

$$(12) \qquad V_L^2 = V_C^2/EN + V_m^2/En + 1/En$$

And since we have taken n and $\overline{m}$ to be statistically independent, $EN = EnEm$ and we can write

$$(13) \qquad V_L^2 = \frac{V_C^2 + Em(1 + V_m^2)}{EN}$$

For single-claim accidents $Em = 1$ and $V_m^2 = 0$, in which case

$$(14) \qquad V_L^2 = (V_C^2 + 1)/EN$$

the last equation being in agreement with Mr. Arthur Bailey (P.C.A.S. Vol. XXIX, page 60)*.

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* It is evident that the approximation given in (1.5), page 58 of the writer's paper, "Graduation of Excess Ratios by the Method of Moments", (P.C.A.S. Vol. XLIV) could have been made exact by omission of the term V_a^2/m^2, that expression being cancelled out by the dropped quantity mentioned in Note †, page 57 of that paper, derived from the small negative correlation between n^2 and $\bar{a}^2$. The writer is indebted to Mr. Robert Bailey, as a result of whose insistence that this term is extraneous, the correlation was recognized. The latter has found that Eq. (14) above is also consistent with his own calculations as well as with those of R. E. Beard, "Analytical Expressions of the Risk Involved in General Insurance", Transactions of the XVth International Congress of Actuaries, 1957, Vol. II, page 233.

EXHIBIT D

CALCULATION OF ESTIMATED VALUE OF V_c^2 WITH A $10,000 CLAIM LIMIT, BY EXTRAPOLATION WITH LIMITING SECANTS

Claim Limitation $= \hat{c}$ (1)	Square of Coefficient of Variation $= V_c^2$ (2)	$Log(2) = Log\ \hat{c}$ (3)	$Log[(3) - 2] = Log(Log\ \hat{c} - 2)$ (4)	$[Log(2)] + 2 = Log\ V_c^2 + 2$ (5)	$\frac{\Delta 5}{\Delta 3}$ (6)	$\frac{\Delta 5}{\Delta 4}$ (7)
$ 25	.0223	1.39794		.34830		
					.923	
50	.0423	1,69897		.62634		
					1.021	
100	.0858	2.00000	— ∞	.93349		
					.882	0
250	.1926	2,39794	—.40018	1.28466		
					.857	1.055
500	.3489	2.69897	—.15554	1.54270		
					.816	1.580
1,000	.6144	3.00000	0	1.78845		
					.802	2.112
2,000	1.071	3.30103	.11429	2.02979		
					.784	2.505
3,000	1.472	3.47712	.16942	2.16791		
					.741	2.627
4,000	1.822	3.60206	.20468	2.26055		
					.7146	2.715
5,000	2.137	3.69897	.23019	2.32980		
6,000						
7,000						
9,000						
10,000	3.51*	4.00000	.30103	2.5449		
10,000	3.33ø	4.00000	.30103	2.5221		
10,000	3.42 (Median Estimate)					
	3.45 (Median Estimate + Adjustment for Grouping)					

* Extrapolated from concave-downward curve (column (3) is independent variable)

3.51 = Antilog (2.5449 — 2)
2.5449 = 2.32980 + .7146 (4.00000 — 3.69897)

ø Extrapolated from concave-upward curve (column (4) is independent variable)

3.33 = Antilog (2.5221 — 2)
2.5221 = 2.32980 + 2.715 (.30103 — .23019)

EXHIBIT E

EXTRAPOLATION OF CLAIM DISTRIBUTION FROM \$5,000 LIMIT TO \$10,000 LIMIT BY TRANSFORMATION OF THE VARIATE

Maximum Claim Size (Thousands of Dollars) $= \hat{c}$ *(1)*	*Transformation of* $\hat{c}$ $= u$ *(2)*	*Cumulative Distribution (Fraction)* $= F(c)$ *(3)*	*Standard Normal Variate* $= t$ *(4)*	*Cumulative Distribution (Number) 88,092* $\times$ *(3) (5)*	*Range Distribution (6)*
3	.57788	.9417	1.5692	82,957	
					1,589
4	.69085	.9597	1.7475	84,546	
					872
5	.77172	.9696	1.8750	85,418	
					551
6	.83478	.9759	1.975	85,969	
					370
7	.88601	.9801	2.056	86,339	
					273
8	.92941	.9832	2.124	86,612	
					203
9	.96695	.9855	2.183	86,815	
					158
10	1.00000	.9873	2.235	86,973	

Col. (2) $= .5 \{ \log(1) + \log[1 + \log(1)] \}$

Col. (3) is taken from Exhibit B for $\hat{c} = 3$, 4 and 5. For $\hat{c}$ beyond 5, values are taken from the normal curve to correspond to Col. (4).

Col. (4) is taken from the normal curve to correspond to Col. (3) for $\hat{c} = 3$, 4 and 5. For $\hat{c}$ beyond 5, t values are determined from the relationships: $t = (u - \bar{u})/\sigma_u$; $\sigma_u = (u_4 - u_3)/(t_4 - t_3)$; $\bar{u} = u_3 - t_3\sigma_u = u_4 - t_4\sigma_u$. The value of t_5 given by $t_5 = (u - \bar{u})/\sigma_u$ checks with the value corresponding under the normal curve to Col. (3) and thus confirms the validity of the transformation in this region of the distribution.

EXHIBIT F

CALCULATION OF MEAN AND COEFFICIENT OF VARIATION OF THE NUMBER OF CLAIMS PER ACCIDENT

Source: 1958 Call for Automobile Liability Experience, Accident Year 1957, Private Passenger Bodily Injury, National Bureau Members and Subscribers, Accidents Producing Excess Losses

m No. of Claims	*f(m)* No. of Accidents
1	2,072
2	301
3	165
4	120
5	69
6	50
7	15
8	8
9	6
10	4
24	1
28	1
39	1
Total	2,813

$$\frac{\Sigma \mathrm{mf(m)}}{\Sigma \mathrm{f(m)}} = E\mathrm{m} = 1.652 = 1.7$$

$$\frac{\Sigma \mathrm{m^2f(m)}}{\Sigma \mathrm{f(m)}} = E\mathrm{m}^2 = 5.411$$

$$E\mathrm{m}^2 - (E\mathrm{m})^2 = 2.68 = \sigma^2_{\mathrm{m}}$$

$$\mathrm{V}^2_{\mathrm{m}} = \frac{\sigma^2_{\mathrm{m}}}{(E\mathrm{m})^2} = .98 = 1.0$$

EXHIBIT G

EFFECT OF CREDIBILITY WEIGHTING ON THE MEAN SQUARE ERROR IN FORMULA RATES

If credibility is proportional to $1/V_L$, the direct contribution of indicated rates to mean square error of formula rates remains fixed at the same amount as selected for 100% credibility. If a power of V_L less than the first is used in the denominator, the contribution of indicated rates to mean square error increases without limit as credibility approaches zero. On the other hand, if a power greater than the first is used, less information is taken from indicated rates than may be safely used; hence there is an unnecessary sacrifice of responsiveness. This is true because the direct contribution of credibility-weighted indicated rates to mean square error in formula rates is $z^2\sigma_L^2$ where z is credibility and σ_L^2 is the mean square error of the indicated rate. If $z = k/\sigma_L$ then $z^2\sigma_L^2 = k^2$ regardless of z while if $z = k/\sigma_L^a$, $a < 1$, then $z^2\sigma_L^2 = k^2\sigma_L^{2(1-a)}$ which increases without limit as $z \rightarrow 0$ and $\sigma_L \rightarrow \infty$ correspondingly (See Note 2). On the other hand, if $z = k/\sigma_L^a$, $a > 1$, z will be less for any given volume, short of full credibility, than if $a = 1$ and the indication will receive less weight, hence yield less information, then with "a" equal to one, which we have already shown to be a safe procedure.

NOTE 1:

Use of $z = k/V_L$ rather than $z = k/\sigma_L$ is a practical strategem. Since $V_L = \sigma_L/EL$, the direct contribution of indicated rates to mean square error in formula rates is therefore $k^2(EL)^2$ rather than just k^2, but $k^2(EL)^2$ is also a fixed quantity.

NOTE 2:

Even where $a < 1$, in practice a finite upper limit is placed (on the contribution of indicated rates to the mean square error of formula rates) by the adoption of a table of discreet values for z, so that zero credibility applies where σ_L exceeds some finite limit. This procedure does not, however, justify the use of values of "a" lower than one because the contribution of indicated rates to mean square error of formula rates will be larger at the low end of the credibility scale than at the high end and there seems to be no a priori reason for accepting a larger contribution at one time than at another. Furthermore, a credibility table which cannot be extended downward as close to zero as we please without producing dangerously large mean square error in formula rates is mathematically inconsistent.

COMMUTATION FUNCTIONS FOR INDIVIDUAL POLICIES PROVIDING FOR HOSPITAL, SURGICAL AND MEDICAL CARE BENEFITS AFTER RETIREMENT

BY

HENRY W. STEINHAUS, Ph.D.

INTRODUCTION

On March 5, 1958, the New York State Legislature enacted four new health insurance laws which went into effect on July 1, 1959. One of these laws provided that, if the employer so elects, his workers covered for 3 months or more by a group policy are entitled to convert to an individual policy from the same insurance company whenever they leave their jobs to retire or for any other reasons. The individual policy must provide a benefit of at least $10 per day for hospital room and board, up to 21 days; at least $100 for other hospital expenses and, at a minimum, surgical benefits under the $200 surgical schedule. In case of death of the worker, the law also extends this conversion privilege to the worker's wife or child.

As a consequence of this legislation which may spread into other states, health insurance benefits must be provided for the retired, through conversion of group insurance certificates to individual policies.

The purpose of this paper is to explore the health insurance experience available here and abroad for persons 65 years of age or over that might serve as a basis for rate calculations.

I. THE NEW YORK 1957 STUDY

The subject matter of costs of health insurance for older people has actually been under concentrated study ever since legislation was considered, involving non-cancellable* health insurance for the aged. In December 1956, the Governor of New York called a special conference on financing health costs for the aged, which was severely handicapped by the absence of factual data on which to base cost calculations. As a consequence, the Superintendent of Insurance of the State of New York initiated a study which brought together all available information as of 1957 and which was published as a report on the problem of continuation of medical care benefits for the aged in

* Originally the legislative demand was for policies which are non-cancellable except for non-payment of premiums. This was later modified to permit the use of so-called "guaranteed renewable" policies where the insurer reserves the right to increase premiums by class. As finally enacted and administered, the law allows the use of policies which can even be terminated by class although obviously this privilege cannot be used to negate the intent of the law.

New York State under the title "Voluntary Health Insurance and the Senior Citizen." This study is hereinafter referred to as the 1957 Study.

Unfortunately, the available information relating to persons over 65 years of age was not very useful for cost determination of individual policies. There were several reasons:

1. Most of the experience in this study was of a group nature. Persons over 65 included in this study were employees universally covered, without selection as to health or financial condition.
2. Since extension of insurance protection for persons 65 years and over has a relatively short history, of about 10 years, and since the privilege of continuance of protection after retirement was usually extended only to persons retiring *after* the date of adoption of such extension, the exposure is mainly in the age groups from 65 to 75 and decreases rapidly with increasing age.
3. Most individual policies utilized in the 1957 study contained cancellation privileges of the insurer that were not exercised. Therefore, the cancellable policies reported would have a more favorable experience than guaranteed renewable ones.
4. Employers who extended benefits to retired employees represented usually the wealthier corporations that do not require employee contributions, or only limited contributions, towards this health insurance coverage with the effect that there was no unfavorable selection on inception or termination.
5. With respect to surgical coverage no attempt was made to utilize the fragmentary information on costs, and it was arbitrarily assumed that the surgical rate as well as the average surgical claim will remain constant from age 65 on, and identical for both sexes.

Since this study was completed, later figures have been presented by Mr. E. J. Faulkner, on behalf of the Health Insurance Association of America and its Life Company Affiliates, at a hearing before the House Ways and Means Committee on the Forand bill (HR4700). These figures, based on insured lives of 1959, did not deviate greatly from the 1957 figures and are subject to the same limitations. I should like to stress that these figures are certainly useful for the purpose of estimating costs on a population basis (which checked out well for New York State as a whole), but not necessarily for cost studies of individual policies for retired lives. To overcome this deficiency the actuaries of the 1957 study increased the net premiums by an arbitrary 10% to reflect the effect of selection upon termination.

II. THE GERMAN EXPERIENCE

Private health insurance has flourished in Germany for many decades, partly because social health insurance limited its coverage to employees and workers earning less than a certain income which left excess earners without coverage except private insurance, and partly because salaried employee groups are permitted to contract out from the social health insurance system if they had an approved private substitute. Paralleling the experience in the United States where pending legislation brought about an intensive study of the problem, German tax laws and regulations brought about a concentrated review of the claim experience of all private health insurance carriers.

A judgment of the highest German Tax Court against one of the private casualty companies* indicated that actuarial proof of future obligations was necessary to establish the need for reserves under level premium contracts. As a consequence, the association of private sickness insurance carriers proceeded with the collection of voluminous statistics. The chief problem was, of course, the utilization of base material containing numerous benefit variations and often representing distinct social classes of policyholders, such as teachers.

Fortunately, as we shall see, most of the complexities of the solutions disappear if we limit our comparison to retired lives, say, age groups 65 and over. The basic formula we shall use for the net level annual premium is

$$P_x = \frac{\sum_x^{99} \frac{1}{2}\,(D^i_x + D^i_{x+1})\, h^i_x\, c^i_x}{\sum_x^{99} D^i_x}$$

where h_x represents the frequency of the occurrence of the risk (which varies by age and sex), and c^i_x the average cost (or charge) for each occurrence (which varies also by age and sex), both subject to parameter i representing benefit scales which in turn reflect income groups. As usual, $D^i_x = l^i_x v^x$ where $l^i_x = l^i_{x-1}\ (1—q_{x-1}—w_{x-1})$, w representing the probability of voluntary termination of the contract.

In combining the experience of different benefit scales, it became necessary to operate with units such as $1 daily room and board benefit. However, it was also found that as benefits rise, costs rise disproportionately. The average first class patient went to the hospital more often and stayed longer than the ward patient. It became necessary to add the parameter i representing the income group variations.

At the outset, benefit scales for retired lives should be set at minimum levels, and while higher income groups would still stay longer,

* June 22, 1949—A.Z.I. 174/43 S.

and go more often, there is an element of co-insurance since the individual will have to bear the difference between charges and benefit, and this difference rises with income levels. No premium differentiation can be made by income groups in case of conversions from group coverage, but individual policies should contain some safety margins.

In passing, it should be noted that for retired people, income does not represent the best criterion of health demands. A combination of income, wealth and social position would be more responsive. In the case of a retired person, income may be an insignificant factor in relation to either personal wealth, or the requirements of social position, financed, in the absence of income and wealth, by relatives or friends. For these reasons a benefit scale differentiation is a better indication of the selection exercised by income factors.

The termination probabilities w were inserted for two reasons. First, in case of level premiums, reserves are accumulated if the cost rises with age. In case of termination, policyholders may expect the insurer to return any positive reserves. Insertion of some termination discount would obviate the necessity for cash surrender values.

The second reason involving use of termination probabilities is that claim costs rise with years of issue since selection against the insurer is exercised upon termination. If all costs averaged 10 per individual, the variation by persistency was:*

COST RATIOS

# of years	*All Ages*		*Age Group 71-75*	
in Effect	*Male*	*Female*	*Male*	*Female*
2-4	7.51	8.77	13.36	12.85
5-9	9.27	9.83	24.19	13.24
10-14	10.37	9.94	17.26	14.80
15-19	11.92	10.37	18.36	13.88
20 and over	14.16	12.72	18.15	14.52

The above figures indicate that the persistency problem is not important for older age groups. For long term contracts beginning at younger ages, these factors would affect calculation of reserves (the main subject of the German investigations) but premium calculations which took into account these separation selections did not reveal prominent changes in level premiums. The more detailed analysis by type of benefit, which follows, indicates that for the purpose of determining costs for retired lives we can utilize the actual German frequencies.

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*D. G. Jaeger, Die versicherungs technischen Grundlagen der deutschen privaten Krankheitskostenversicherung—1958, p. 114 Dunker & Humboldt.

III. *Frequencies and Annual Costs*

A. *Hospitalization*

Hospital claim frequencies below age 65 of the 1957 study, conform to comparable German experience. The latest German figures* show the following hx ratio changes centered at age group 41-45.

Age Group	*hx Ratio*	*Age Group*	*hx Ratio*
16-25	.95	56-60	1.45
26-30	.90	61-65	1.70
31-35	.925	66-70	2.00
36-40	.96	71-75	2.35
41-45	1.00	76-80	2.75
46-50	1.10	81-85	3.25
51-55	1.25	Over 85	4.00

Superimposing these values on annual rates of hospitalization of the 1957 study shows identical values up to age 65, but higher values thereafter. We can therefore see no objection to extrapolation of American values below 65 to the higher age groups by the use of applicable German experience. We shall use the average cost figures of the New York 1957 study, since German costs would not be applicable.

Tables 2 to 9 show the commutation columns for the various benefits, Tables 2 and 3 the hospitalization values for both sexes. The first column, the net annual claim costs, Sx, is the product of the frequencies and the average costs. In order to permit full use of the 1957 study for ages below 65, the identical life experience was utilized, namely the U. S. population study of 1949-51, with 3% interest, as shown in Table 1. A mental note should be made that in extending these new commutation columns to ages below 65, utilizing the 1957 study, the Kx values below 65 have to be recalculated. This can be done merely by adding the Hx values of the 1957 study for all $x < 65$ to the K_{65} value of this study. The following special comments may be of interest:

1. With regard to hospital usage, current American experience is now being compiled for the older age groups by a few companies pioneering in this field. After the original clean-up period has passed, reliable figures should become available. Preliminary indications from one company are that the 1957 study frequencies are too low.
2. The English experience was studied too, and while not directly applicable to individual policy frequency deter-

* Furnished privately by Dr. A. Tosberg in letter of Jan. 29, 1959.

mination, reveals one fact of great importance, namely that single, widowed and divorced individuals make about double the demand on hospital services that their population ratio would justify. Married people can care for each other, and perhaps prefer to do so, and therefore have proportionately smaller claims. The figures are:*

DISTRIBUTION OF HOSPITAL OCCUPANCY
ALL HOSPITALS

	Males 65 & Over		*Females 65 & Over*	
Status	*% of Pop.*	*% of Bed Usage*	*% of Pop.*	*% of Bed Usage*
Single	9%	30%	16%	32%
Married	66	38	35	23
Widowed and Divorced	25	32	49	45

As a consequence, family policies for the older age groups can have lower rates as long as the individuals involved occupy the same household.

3. In determining the cost of hospitalization, the basic $1 benefit costs would be multiplied by the basic benefit offered, say $10, but in addition, by 40% of the reimbursement offered to physicians for in-hospital visits. Assuming a charge of $3, and reimbursement for 1 visit per day, the basic benefit costs should be multiplied by 11.2 representing 40% of $3 added to the $10 basic benefit. The assumption that there would be one visit for each 2½ days of hospitalization is the currently accepted standard.

4. The definition of *hospital* must be tightened to avoid the use of rest homes for non-acute illnesses. How much of this may be involved, might be gleaned from another English study, which details the principal diseases of the aged diagnosed over a one-year period, 1955-56.** Table 10 summarizes the frequencies of the main disease headings, according to which senile and nervous conditions represent some 25% of all diagnoses. The study shows

* The cost of the National Health Services in England & Wales, Brian Abel-Smith and R. M. Titmuss, Cambridge University Press, 1956, p. 146.

** Morbidity Statistics from General Practice—Volume I General Register Office, Studies on Medical & Population Subjects #14 by Logan & Cushion, H.M.S.O.

more detailed tables which may be useful for companies wishing to experiment with special policies restricted to some specific diseases.

B. *Incidental Hospital Services*

With respect to allowances for Special Hospital Services, we use the 1957 study average charges per admission where the maximum is $150. The 1957 study set the daily hospital benefit at $15 and therefore the maximum for incidental services at 10 times this figure. The use of the New York study costs simplifies the utilization of their figures for ages below 65. The frequencies are naturally determined by those of hospitalization. Commutation columns are shown in Tables 4 and 5.

C. *Surgical Expenses*

For surgical expense costs we also used the average surgical benefit of the New York 1957 study which in turn is derived from a surgical schedule with a $325 maximum. A lower maximum, such as $200 required for New York conversion, would introduce a safety margin against the increasing frequency of complex operations (such as heart) requiring maximum reimbursements.

With respect to frequencies after age 65, the German experience was used, although the German rates below 65 are lower than the American rates. To evaluate the accuracy of the figures the number of insured were compiled from a previous study by age groups:*

	No. of Insured	
Age Group	*Male*	*Female*
65-69	10,218	15,852
70-74	7,468	10,523
75-79	3,579	4,915
80 and over	1,060	1,483

The greater number of female insured reflects the greater proportion of females in these population groups.

The frequency rates used are based on a later study by Dr. Jaeger** (p. 61), involving about twice the exposure shown above. These exposures are large enough to produce satisfactory frequencies, which were used in Tables 6 and 7, as follows:

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* Journal of the German Society of Actuaries (Deutscher Aktuarverein), Oct. 1953, entirely devoted to a basic morbidity study by Adolf Tosberg, pp. 30, 37, 44, 50, 57, 63. See also issue of March 1956, page 431. The German title is: Blaetter der Deutschen Gesellschaft fuer Versicherungsmathematik.

** Cf: Die versicherungs, etc.

	Annual Rate of Surgery	
Age	*Male*	*Female*
65	.108	.108
70	.119	.095
75	.125	.085
80	.122	.077
85	.096	.065
90	.083	.048
95	.039	.024

As was pointed out before, the 1957 study assumed an identical frequency of surgery for all ages and both sexes. The German experience shows a general decrease of surgery with advancing age, which is uninterrupted for females after a period of operations related to the menopause, but which begins for males only after the 70's when operations reach a peak, partially due to prostate conditions. The decline is actually logical, since operations are generally avoided with increasing age and are not even attempted for the oldest age groups. Therefore, as a working hypothesis the frequency rates have been mechanically smoothed to produce zero frequency at age 100.

A word of warning is necessary with respect to reserve calculations if policies are involved related to surgical benefits for males only. If level premiums are used, negative reserves will result for some ages, since the level premiums anticipate the later decline of the frequencies, and therefore become insufficient to handle the temporary rise. If sold in connection with the other benefits which rise uniformly, this problem will not become important.

D. Physician's Services

The 1957 study does not attempt to calculate costs for physician's services, but the material compiled contains some useful figures from the Health Insurance Plan of New York (H. I. P.).

As a pre-retirement base from which to extrapolate, we shall use the H. I. P. figures since they check well with those from the English study. For instance, for those over 65, there were in England 586 home and office contacts per 100 male enrollees, and 641 per 100 female enrollees, compared to 594.4 for both sexes in an H. I. P. study of 1954 (1957 study, p. 186). Both H. I. P. and the English experience are group experiences, and the definition of "services rendered" are practically the same in H. I. P., the English and the German studies. The German experience produces the annual claim rates S_x shown in Tables 8 and 9, per $1 for each service.

The determination of the actual average charge depends, naturally, on the distribution of services by type, and the scale of payment for each type. As an example we show the most recent German average distribution of 100 services:

Type of Service	*German % of Total (1)*	*Assumed Payment per Service (2)*	*Total Cost (1) × (2)*
Routine Office Visits	34	$ 3	$102
Home Visits	18	5	90
Special Office Visits, involving antibiotic or other injections, sprains, etc.	38	5	190
Therapeutic treatments	8	10	80
X-Ray, or E. C. Diagnosis	2	20	40
	100%		$502

or an average of $5 per service. Since medical societies are generally interested in helping the aged and are recommending to their members that charges be reduced, the above scale may be considered reasonable. The English study comments on the number of telephone consultations which take the place of office consultations for the non-ambulatory aged, but are not reimbursable—as yet! It is fully realized that this is a new field in which experience is needed, but experiments are necessary if experience is to be gained, and these figures may serve as a starting point. Since such medical care benefits are not yet a conversion requirement, experiments can be undertaken subject to change of benefit scales and premiums.

IV. MONETARY RESULTS

The total cost of such a program has been calculated. The net annual level premiums for an individual age 65 are:

	Male	*Female*
For $10 Hospital R & B up to 31 days	$ 26.370	$ 27.670
For Hospital Incidentals, up to $150	24.165	25.101
For Surgical Benefits up to $325	12.790	9.910
For Physician's services, $5 average charge	37.785	43.200
For In-Hospital visits at $3, one a day	3.164	3.320
	$104.274	$109.201

As mentioned before, the 1957 study proposes to add about 10% of the net premium to reflect termination selection. This is not necessary here since the German figures already reflect selection results.

The 1957 study also proposes to add for conversion policies an extra 10% of the gross premium to cover the special medical selection arising from automatic conversion. There is no indication what this addition should be, and until further studies become available each insurer must decide for himself whether to absorb conversion costs or charge some estimated amount against the group from which the conversion arose.

Some employers will prefund the entire cost with techniques similar to funding of pensions. This in turn may lead to demands for single premium policies which have to the insurer the advantage of no terminations, but the disadvantage of no rate adjustment. Where the prefunding provides only for the monthly or annual premiums as they become due (similar to an annuity) there would be no termination selection. On this basis the conversion charges could be reduced or waived.

Other expense loading would depend on insurance company practices such as those relating to commissions or contributions to surplus, and on State premium taxes. A flat loading of $5 plus 25% of gross would result, in our example, in a gross annual level premium of $146 for males and $152 for females. An average monthly charge of about $12 for these medical expenses after retirement would not seem unreasonable, but it is high for retired people particularly when one considers that this includes no provision for drugs, appliances, or dental care. Moreover, the cost of medical services is likely to rise, not only in line with the similar trend of rising prices and wages, but even more importantly due to the increased cost of ever more complex services. This underlines the wisdom of prefunding some of the costs through paid-up individual policies.

TABLE 1

LIFE COMMUTATION COLUMNS

Basis for Formation: 3% Interest and l_x's from
NATIONAL OFFICE OF VITAL STATISTICS—NOV. 2, 3, 1954—VOL. 41, No. 1
Table 2 Life Table for Total Males: United States, 1949-1951
Table 3 Life Table for Total Females: United States, 1949-1951

	MALES			FEMALES		
AGE	$D_x = v^x l_x$	$\frac{1}{2}(D_x + D_{x+1})$	$N_x - N_{100} = \sum_x^{99} D_x$	$D_x = v^x l_x$	$\frac{1}{2}(D_x + D_{x+1})$	$N_x - N_{100} = \sum_x^{99} D_x$
65	9,014	8,729	94,910	10,852	10,580	130,034
66	8,443	8,165	85,896	10,307	10,039	119,182
67	7,887	7,616	77,453	9,770	9,505	108,875
68	7,345	7,082	69,566	9,239	8,977	99,105
69	6,819	6,564	62,221	8,714	8,454	89,866
70	6,309	6,062	55,402	8,193	7,936	81,152
71	5,814	5,575	49,093	7,678	7,423	72,959
72	5,336	5,106	43,279	7,167	6,915	65,281
73	4,875	4,653	37,943	6,662	6,414	58,114
74	4,431	4,218	33,068	6,165	5,921	51,452
75	4,004	3,801	28,637	5,677	5,439	45,287
76	3,597	3,404	24,633	5,200	4,968	39,610
77	3,210	3,028	21,036	4,735	4,509	34,410
78	2,845	2,674	17,826	4,283	4,065	29,675
79	2,502	2,343	14,981	3,847	3,638	25,392
80	2,184	2,037	12,479	3,429	3,230	21,545
81	1,890	1,755	10,295	3,031	2,843	18,116
82	1,620	1,497	8,405	2,654	2,478	15,085
83	1,374	1,263	6,785	2,302	2,139	12,431
84	1,152	1,053	5,411	1,975	1,825	10,129
85	953	865	4,259	1,675	1,540	8,154
86	777	701	3,306	1,404	1,283	6,479
87	624	559	2,529	1,161	1,054	5,075
88	493	439	1,905	946	853	3,914
89	384	339	1,412	759	679	2,968
90	293	257	1,028	598	530	2,209
91	221	192	735	462	406	1,611
92	163	141	514	350	305	1,149
93	118	101	351	260	224	799
94	83	71	233	188	161	539
95	58	49	150	133	113	351
96	39	33	92	92	77	218
97	26	22	53	61	51	126
98	17	14	27	40	33	65
99	10	8	10	25	21	25

TABLE 2

BASIC TABLES FOR MONETARY CALCULATIONS

Daily Hospital Benefit of $1—31-Day Maximum—Men

AGE	*NET ANNUAL CLAIM* *COST* $= S_x$	*COMMUTATION COLUMNS* $H_x = \frac{1}{2}(D_x + D_{x+1})S_x$	$K_x = \sum_x^{\infty} H_x$
65	1.88	16,411	250,264
66	1.97	16,085	233,853
67	2.06	15,689	217,768
68	2.16	15,297	202,079
69	2.27	14,900	186,782
70	2.38	14,428	171,882
71	2.49	13,882	157,454
72	2.61	13,327	143,572
73	2.74	12,749	130,245
74	2.88	12,148	117,496
75	3.03	11,517	105,348
76	3.18	10,825	93,831
77	3.34	10,114	83,006
78	3.51	9,386	72,892
79	3.69	8,646	63,506
80	3.87	7,883	54,860
81	4.07	7,143	46,977
82	4.29	6,422	39,834
83	4.56	5,759	33,412
84	4.95	5,212	27,653
85	5.92	5,121	22,441
86	5.92	4,150	17,320
87	5.92	3,309	13,170
88	5.92	2,599	9,861
89	5.92	2,007	7,262
90	5.92	1,521	5,255
91	5.92	1,136	3,734
92	5.92	835	2,598
93	5.92	598	1,763
94	5.92	420	1,165
95	5.92	290	745
96	5.92	195	455
97	5.92	130	260
98	5.92	83	130
99	5.92	47	47

TABLE 3

BASIC TABLES FOR MONETARY CALCULATIONS

Daily Hospital Benefit of $1—31-Day Maximum—Women

AGE	NET ANNUAL CLAIM COST $= S_x$	COMMUTATION COLUMNS $H_x = \frac{1}{2}(D_x + D_{x+1}) S_x$	$K_x = \sum_x^{99} H_x$
65	1.88	19,890	359,788
66	1.97	19,777	339,898
67	2.06	19,580	320,121
68	2.16	19,390	300,541
69	2.27	19,191	281,151
70	2.38	18,888	261,960
71	2.49	18,483	243,072
72	2.61	18,048	224,589
73	2.74	17,574	206,541
74	2.88	17,052	188,967
75	3.03	16,480	171,915
76	3.18	15,798	155,435
77	3.34	15,060	139,637
78	3.51	14,268	124,577
79	3.69	13,424	110,309
80	3.87	12,500	96,885
81	4.07	11,571	84,385
82	4.29	10,631	72,814
83	4.56	9,754	62,183
84	4.95	9,034	52,429
85	5.92	9,117	43,395
86	5.92	7,595	34,278
87	5.92	6,240	26,683
88	5.92	5,050	20,443
89	5.92	4,020	15,393
90	5.92	3,138	11,373
91	5.92	2,404	8,235
92	5.92	1,806	5,831
93	5.92	1,326	4,025
94	5.92	953	2,699
95	5.92	669	1,746
96	5.92	456	1,077
97	5.92	302	621
98	5.92	195	319
99	5.92	124	124

TABLE 4

BASIC TABLES FOR MONETARY CALCULATIONS

Allowances for Special Hospital Services—$150 Maximum—Men

	NET ANNUAL CLAIM	*COMMUTATION COLUMNS*	
AGE	*COST* $= S_x$	$H_x = \frac{1}{2}(D_x + D_{x+1})S_x$	$K_x = \sum_x^{99} H_x$
65	18.6	162,359	2,293,527
66	19.4	158,401	2,131,168
67	20.2	153,843	1,972,767
68	21.0	148,722	1,818,924
69	21.9	143,752	1,670,202
70	22.8	138,214	1,526,450
71	23.7	132,127	1,388,236
72	24.6	125,608	1,256,109
73	25.6	119,117	1,130,501
74	26.6	112,199	1,011,384
75	27.7	105,288	899,185
76	28.8	98,035	793,897
77	29.9	90,537	695,862
78	31.1	83,161	605,325
79	32.3	75,679	522,164
80	33.5	68,240	446,485
81	34.7	60,899	378,245
82	36.0	53,892	317,346
83	37.3	47,110	263,454
84	40.2	42,331	216,344
85	45.9	39,704	174,013
86	45.9	32,176	134,309
87	45.9	25,658	102,133
88	45.9	20,150	76,475
89	45.9	15,560	56,325
90	45.9	11,796	40,765
91	45.9	8,813	28,969
92	45.9	6,472	20,156
93	45.9	4,641	13,684
94	45.9	3,259	9,043
95	45.9	2,249	5,784
96	45.9	1,515	3,535
97	45.9	1,010	2,020
98	45.9	643	1,010
99	45.9	367	367

TABLE 5

BASIC TABLES FOR MONETARY CALCULATIONS

Allowances for Special Hospital Services—$150 Maximum—Women

	NET ANNUAL CLAIM	*COMMUTATION COLUMNS*	
AGE	*COST* $= S_x$	$H_x = \frac{1}{2}(D_x + D_{x+1})S_x$	$K_x = \sum_x^{\omega} H_x$
65	18.6	196,788	3,264,028
66	19.4	194,757	3,067,240
67	20.2	192,001	2,872,483
68	21.0	188,517	2,680,482
69	21.9	185,143	2,491,965
70	22.8	180,941	2,306,822
71	23.7	175,925	2,125,881
72	24.6	170,109	1,949,956
73	25.6	164,198	1,779,847
74	26.6	157,499	1,615,649
75	27.7	150,660	1,458,150
76	28.8	143,078	1,307,490
77	29.9	134,819	1,164,412
78	31.1	126,422	1,029,593
79	32.3	117,507	903,171
80	33.5	108,205	785,664
81	34.7	98,652	677,459
82	36.0	89,208	578,807
83	37.3	79,785	489,599
84	40.2	73,365	409,814
85	45.9	70,686	336,449
86	45.9	58,890	265,763
87	45.9	48,379	206,873
88	45.9	39,153	158,494
89	45.9	31,166	119,341
90	45.9	24,327	88,175
91	45.9	18,635	63,848
92	45.9	14,000	45,213
93	45.9	10,282	31,213
94	45.9	7,390	20,931
95	45.9	5,187	13,541
96	45.9	3,534	8,354
97	45.9	2,341	4,820
98	45.9	1,515	2,470
99	45.9	964	964

TABLE 6

BASIC TABLES FOR MONETARY CALCULATIONS

Surgical Benefit According to a Representative Surgical Schedule—Men

AGE	*NET ANNUAL CLAIM* COST $= S_x$	*COMMUTATION COLUMNS* $H_x = \frac{1}{2}(D_x + D_{x+1})S_x$	$K_x = \sum_x^{\omega} H_x$
65	12.4	108,240	1,213,911
66	12.8	104,512	1,105,671
67	13.1	99,770	1,001,159
68	13.3	94,191	901,389
69	13.5	88,614	807,198
70	13.7	83,049	718,584
71	13.9	77,493	635,535
72	14.0	71,484	558,042
73	14.1	65,607	486,558
74	14.2	59,896	420,951
75	14.3	54,354	361,055
76	14.4	49,018	306,701
77	14.3	43,300	257,683
78	14.2	37,971	214,383
79	14.1	33,036	176,412
80	14.0	28,518	143,376
81	13.8	24,219	114,858
82	13.6	20,359	90,639
83	13.3	16,798	70,280
84	12.9	13,583	53,482
85	12.4	10,726	39,899
86	11.8	8,272	29,173
87	11.2	6,261	20,901
88	10.6	4,653	14,640
89	10.0	3,390	9,987
90	9.05	2,442	6,597
91	8.5	1,632	4,155
92	7.5	1,058	2,523
93	6.5	657	1,465
94	5.5	391	808
95	4.5	221	417
96	3.5	116	196
97	2.5	55	80
98	1.5	21	25
99	.5	4	4

TABLE 7

BASIC TABLES FOR MONETARY CALCULATIONS

Surgical Benefit According to a Representative Surgical Schedule—Women

AGE	*NET ANNUAL CLAIM COST* $= S_x$	*COMMUTATION COLUMNS* $H_x = \frac{1}{2}(D_x + D_{x+1})S_x$	$K_x = \sum_x^{99} H_x$
65	12.4	131,192	1,288,653
66	12.1	121,472	1,157,461
67	11.8	112,159	1,035,989
68	11.5	103,236	923,830
69	11.2	94,685	820,594
70	10.9	86,502	725,909
71	10.6	78,684	639,407
72	10.4	71,916	560,723
73	10.2	65,423	488,807
74	10.0	59,210	423,384
75	9.8	53,302	364,174
76	9.6	47,693	310,872
77	9.4	42,385	263,179
78	9.2	37,398	220,794
79	9.0	32,742	183,396
80	8.8	28,424	150,654
81	8.6	24,450	122,230
82	8.4	20,815	97,780
83	8.1	17,326	76,965
84	7.8	14,235	59,639
85	7.5	11,550	45,404
86	7.1	9,109	33,854
87	6.7	7,062	24,745
88	6.3	5,374	17,683
89	5.9	4,006	12,309
90	5.5	2,915	8,303
91	5.0	2,030	5,388
92	4.5	1,373	3,358
93	3.9	874	1,985
94	3.3	531	1,111
95	2.7	305	580
96	2.1	162	275
97	1.5	77	113
98	.9	30	36
99	.3	6	6

TABLE 8

BASIC TABLES FOR MONETARY CALCULATIONS

Cost of Medical Care—Physicians' Services—Charged at the Rate of $1 per Service—Men

	NET ANNUAL CLAIM	*COMMUTATION COLUMNS*	
AGE	*COST* $= S_x$	$H_x = \frac{1}{2}(D_x + D_{x+1})S_x$	$K_x = \sum_x^{\omega} H_x$
65	6.2	54,120	717,228
66	6.4	52,256	663,108
67	6.6	50,266	610,852
68	6.8	48,158	560,586
69	7.0	45,948	512,428
70	7.3	44,253	466,480
71	7.5	41,813	422,227
72	7.7	39,316	380,414
73	8.0	37,224	341,098
74	8.3	35,094	303,874
75	8.6	32,689	268,780
76	8.9	30,296	236,091
77	9.2	27,858	205,795
78	9.5	25,403	177,937
79	9.8	22,961	152,534
80	10.1	20,574	129,573
81	10.4	18,252	108,999
82	10.7	16,018	90,747
83	11.1	14,019	74,729
84	11.5	12,110	60,710
85	11.9	10,294	48,600
86	12.3	8,622	38,306
87	12.7	7,099	29,684
88	13.1	5,751	22,585
89	13.4	4,543	16,834
90	13.6	3,495	12,291
91	13.8	2,650	8,796
92	14.0	1,974	6,146
93	14.0	1,414	4,172
94	14.0	994	2,758
95	14.0	686	1,764
96	14.0	462	1,078
97	14.0	308	616
98	14.0	196	308
99	14.0	112	112

TABLE 9

BASIC TABLES FOR MONETARY CALCULATIONS

Cost of Medical Care—Physicians' Services—Charged at the Rate of $1 per Service—Women

	NET ANNUAL CLAIM	COMMUTATION COLUMNS	
AGE	*COST* $= S_x$	$H_x = \frac{1}{2}(D_x + D_{x+1})S_x$	$K_x = \sum_x^{99} H_x$
65	7.1	75,118	1,123,550
66	7.3	73,285	1,048,432
67	7.5	71,288	975,147
68	7.7	69,123	903,859
69	7.9	66,787	834,736
70	8.1	64,282	767,949
71	8.3	61,611	703,667
72	8.6	59,469	642,056
73	8.9	57,085	582,587
74	9.2	54,473	525,502
75	9.5	51,671	471,029
76	9.8	48,686	419,358
77	10.1	45,541	370,672
78	10.4	42,276	325,131
79	10.7	38,927	282,855
80	11.0	35,530	243,928
81	11.3	32,126	208,398
82	11.6	28,745	176,272
83	12.0	25,668	147,527
84	12.4	22,630	121,859
85	12.8	19,712	99,229
86	13.1	16,807	79,517
87	13.4	14,124	62,710
88	13.7	11,686	48,586
89	13.9	9,438	36,900
90	14.1	7,473	27,462
91	14.3	5,806	19,989
92	14.4	4,392	14,183
93	14.4	3,226	9,791
94	14.4	2,318	6,565
95	14.4	1,627	4,247
96	14.4	1,109	2,620
97	14.4	734	1,511
98	14.4	475	777
99	14.4	302	302

TABLE 10

CONSULTATION AND PATIENT CONSULTING RATES PER 1,000 POPULATION FOR THE PRINCIPAL DISEASES AND CONDITIONS DIAGNOSED

Disease or Condition		*Consultations*	*Patients Consulting*
ALL DISEASES AND CONDITIONS	M	5862	684
	F	6414	727
Infective and Parasitic Diseases	M	103.0	20.2
	F	87.4	17.8
Neoplasms	M	278.4	29.6
	F	227.5	24.6
Allergic, Endocrine System, Metabolic and Nutritional Diseases	M	190.2	31.6
	F	313.9	52.8
Diseases of the Blood and Blood-forming Organs	M	164.1	14.4
	F	270.1	33.1
Mental, Psychoneurotic and Personality Disorders	M	128.3	27.7
	F	323.6	62.8
Diseases of Nervous System and Sense Organs	M	620.1	150.6
	F	652.2	152.5
Diseases of the Circulatory System	M	1537.2	186.0
	F	1781.1	226.8
Diseases of the Respiratory System	M	1424.3	260.3
	F	1000.9	225.7
Diseases of the Digestive System	M	536.5	133.7
	F	515.5	119.0
Diseases of the Genito-Urinary System	M	205.6	42.8
	F	164.7	45.8
Diseases of the Skin and Cellular Tissue	M	250.7	68.1
	F	248.0	68.8
Diseases of the Bones and Organs of Movement	M	451.6	119.2
	F	716.4	165.2
Congenital Malformations	M	0.7	0.5
	F	1.2	0.4
Symptoms, Senility and Ill-Defined Conditions	M	459.2	109.7
	F	621.3	136.6
Accidents, Poisoning and Violence (Nature of Injury)	M	195.2	66.0
	F	265.1	84.9
Non-Sickness	M	15.5	11.2
	F	13.2	9.1

TOWARDS STATISTICALLY BASED FIDELITY RATES

BY

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BACKGROUND

Fidelity rates have been established in the past primarily by the use of "informed judgment," in accordance with the position of fidelity-surety underwriters that statistical ratemaking methods were not applicable to the bonding lines. During the last several years, this position has been modified somewhat as underwriters have recognized the increasing similarities between fidelity bonding and casualty insurance; the rate structure, however, has yet to reflect the shift of opinion. The replacement of individual and schedule bonds by blanket coverages, particularly in the bank and commerical fields, with the accompanying shift in underwriting attention from the principal to the obligee, is probably the fundamental cause of this change in position, but there have been other more direct pressures towards statistically sounder fidelity rates.

Foremost among these has been the increasingly critical attitude of the various state regulatory authorities towards the manual rules and rates presently used by the members and subscribers of the Surety Association of America, which completed its assumption of the duties of the Towner Rating Bureau in 1949. Although the authorities have recommended various changes in the surety lines, the bulk of their criticism has been directed at rating and ratemaking procedures in the fidelity lines. Two examples of this criticism of the Association's methods and manuals are especially noteworthy:

1. *The "Virginia rate case."*
2. *The 1951 and 1957 Convention Examinations of the Surety Association.*

Another pressure towards a sounder ratemaking basis for the fidelity lines has been the deteriorating experience of bank and commercial bonds. A member of the Association prepared an exhibit showing a 2.1% underwriting loss for the period 1951-1956 for fidelity classifications excluding official bonds; experience in the two succeeding years has not been particularly enheartening. With the current attitude of the various insurance departments, a rate increase based on "informed judgment" alone would probably be difficult to support, and many underwriters thus appear willing to examine some sort of statistical ratemaking method for the fidelity lines. Presumably, the selected method would also provide a means of testing rate adequacy or redundancy in the future.

A final pressure may be found in the forces of competition on the Association companies. Under this rather ambiguous "catch-all" may be mentioned several ills of the business, particularly in the commercial blanket bond field:

1. The premium for commercial blanket bonds is presently determined by classifying the insured's employees as "A," "B," or "C," entering the rate tables to find the premium for the number of class "A" employees, and adding a constant charge for each "B" employee. Because of the lack of rigid distinction between "A" and non-"A" employees, it is normal that no two Association companies will arrive at the same premium for a given bond, with the result that the two companies find themselves in effect "cutting" rates; in addition, it is known that "C" employees cause losses, even though no premium is collected for them. It appears impossible to accommodate any substitute for the "A-B-C" method to current manual rates because of inconsistencies in the rate tables.
2. Fidelity, especially commercial coverage, is a "salesman's" line. A relatively low commission scale combined with a low medium premium produces dollar commissions which apparently do not provide the incentive necessary for producers to "sell" the line. It should be remembered in this connection that the bulk of the fidelity business is written by Association members, all of whom are stock companies.
3. Underwriters are continually disturbed by the tendency for domestic companies to write primary areas of coverage only, with the relatively loss-free excess areas covered abroad.
4. It is apparently standard practice for independents to file rates lower than Association rates as soon as the latter are published. Since the Association rates themselves are not statistically based, it is rather difficult to attack the independent filings as inadequate.
5. Departures from average rates to recognize inherent differences in hazard between insureds are limited. The commercial classification system groups insureds as either "classified" or "unclassified"; for the former, specific class discounts or surcharges are applied to basic rates, while for the latter the basic rate table applies. Currently, about half of the total premium volume is derived from "unclassified" insureds. In addition, there is no provision in the manual rules for debit rating. As a result, underwriters find themselves unable to accept many "unclassified" risks whom they would be perfectly willing to cover at a rate higher than that provided by the basic table, and forced to cancel coverage which they would be happy to carry at an increased rate.

Although a statistically based ratemaking method obviously would not provide an immediate answer to all these problems, some underwriters feel that it might be a good beginning towards a final solution of most of them.

* * * * *

The manual rates underlying many of these difficulties are not statistically based, in the usual sense of the term; rather, they have evolved over a period of time. Commercial blanket bond rates were originally adapted from individual and schedule bond rates, and were further modified to reflect changes in coverage, particularly that from an aggregate limit of liability in collusion cases, as is now found in the Primary Commercial Blanket Bond, to an individual employee limit, as is now found in the Blanket Position Bond. The general philosophy behind the rates is apparently that the rate per unit of penalty for the same exposure properly decreases as penalty increases, and, similarly, that the rate per unit of exposure for a constant penalty should decrease as exposure increases. It is evident that these conditions relate both to a percentage expense savings as premium size increases (i.e., to premium discount) and to a diminishing pure premium for each higher increment of penalty. While it would be preferable to divorce these two conditions from each other for the purpose of testing rate level, there is nothing basically wrong with correcting rates for both simultaneously as long as the graduation for increments of the variables is logical and consistent.

In the Association's present manual, there is a fairly constant relationship between the rates for Blanket Position and Primary Commercial Blanket Bonds of the same penalty and exposure, but the graduation of rates within the various tables is not consistent. Three examples of inconsistencies in commercial rates will serve to point up the inadequacies of the rate tables:

1. For both Blanket Position and Primary Commercial Blanket Bonds, the cost of adding a sixth employee under a $100,000 bond is no greater than that for the same employee under a $25,000 bond. In fact, for bonds of $25,000 or more under either bond form, each employee from the sixth through the twenty-fifth may be added for an identical price, regardless of bond size. However, with a $100,000 Position bond, although each additional employee from the sixth through the twenty-fifth costs $17.21, each employee from the twenty-sixth through the fiftieth will cost $17.90. Similarly, under a $500,000 Primary bond, the cost is only $15.17 for coverage for each of the sixth through the twenty-fifth covered employees, while each of the twenty-sixth through the fiftieth employees costs from $25.52 to $25.96, and each of the fifty-first through the hundredth results in an additional $17.01 charge.
2. The owner of an amusement park may secure a schedule bond totaling $25,000 at a rate of $9.00 per $1000 for his non-admin-

istrative employees, or a $500,000 schedule bond for these same employees at a rate of $3.00 per $1000. If the same man should also wish similar coverage for the employees of his baseball club, he would find that he could purchase the $25,000 schedule for only $5.00 per $1000, while the $500,000 cover would carry a rate of $4.00 per $1000.

3. An industrial insurance company wishes to bond five of its agents and considers that $15,000 individual bonds would satisfy its needs. Since the total bond is $75,000, the rate will be $50 per $1000 per man, and the total premium will be $3750. After some reflection, the company decides instead to purchase individual bonds of $20,000 and learns that, since the rate has decreased to $30 per $1000 per man, the bonding company will have to provide the additional $25,000 coverage at a savings of $750 over the cost of the smaller bond.

In summary, the current tables fail to provide equal proportionate increases in premium for either an increasing penalty with a constant exposure or an increasing exposure with a constant penalty. Although a part of this lack may be accounted for by the provision for premium discount, the majority is apparently the result of continuing adjustments to rates by the use of "informed judgment." As a result, it is virtually impossible to modify the existing tables to accommodate a statistical ratemaking system or a different exposure base without producing drastic, and unsupported, premium changes for a large number of insureds.

* * * * *

It appears, then, that the climate of opinion is now favorable to the development of some sort of statistical ratemaking methods for fidelity insurance. Moreover, given the inconsistencies of the present manual rates, a thorough revamping of existing procedures seems preferable to a further modification of the current rules and rates. These conclusions rest, however, on the assumption that statistical methods can advantageously be applied to fidelity experience; when the study to be discussed in this paper was begun, it seemed that, since the validity of this assumption had apparently never been established, a first task should be to test fidelity experience for similarity to the loss patterns in those lines in which statistical ratemaking methods are used. In addition, because of the varying liability assumed under fidelity bonds of different penalty, a rating system analogous to that used in the liability lines seemed appropriate for fidelity business; a study of loss distribution by size of loss would perhaps provide a statistical foundation for concrete recommendations to that effect. Accordingly, a study of losses in one company's current closed claim file was undertaken, and the primary object of this paper is to report the findings of that study and the recommendations drawn from these findings.

THE LOSS STUDY

Because of the importance of salvage to the ultimate cost of fidelity losses, original plans provided for an analysis of the distribution by size of paid losses net as to salvage collected. An examination of the age of the available closed claims revealed that the bulk of these claims dated from the period 1954-1957, so that many, and particularly those for the larger amounts, were still in salvage; to eliminate this possible cause of distortion, the plan of the study was modified to allow for the use of gross losses. A pilot study was first made of commercial claims, and the analysis was then extended to the other fidelity sub-lines (bank, public official, and federal official) and fiduciary, which, although technically a surety sub-line, is close in coverage to fidelity. The distribution of number of losses by sub-line was as follows:

Sub-line	*Number of losses*	*Percentage of total*
Bank	1684	17.7
Commercial	7048	74.3
Official	472	5.0
Fiduciary	288	3.0
Total	9492	100.0

These claims accounted for over $15 million of loss to the insured obligees.

As the data for each claim were recorded, the penalty of the bond under which the loss was payable was checked; if it appeared that the paid loss had been limited to the bond penalty, the original claim file was examined to determine, insofar as possible, the actual loss sustained by the insured, and this latter amount was substituted in the data for the actual paid loss. Losses reported in the study thus represent an estimate of the amounts which would have been paid under open penalty bonds. Two limitations to the accuracy of these estimates should be noted:

1. Some claim files were, of course, not available, and the paid loss figures were retained for these claims.
2. In many cases, it was evident that the insured had proven his loss only up to the penalty of the bond. In some of these cases, an estimate of the actual amount in default could be formed by a review of the claim correspondence; in others, the proof of loss was accepted as the only source of loss data.

Although these inadequacies create some downward pressure on the total loss incurred, the claims to which they applied were generally under small penalty bonds ($2500 or less), and it is doubtful that they result in any considerable distortion in the size-of-loss distribution.

In the final tabulation, claim data were grouped by size of loss (excluding loss expense), using intervals selected to provide statistics readily comparable with current rate manuals. For the interested reader, the tabulated data are given in the first Appendix to this paper. It should be borne in mind when reviewing the data and the remarks on them which follow that the hazards covered under important bond forms vary by sub-line, and hence that the loss data do not result from strictly homogeneous exposures. The simplest fidelity coverage is to be found in the commercial blanket bond, which normally insures against loss arising from employee dishonesty. Bond forms for public officials and fiduciaries usually guarantee also the faithful performance of the principal in the exercise of his duties; financial blanket bonds cover non-employee, as well as employee, dishonesty and unexplainable disappearance of valuables. It is lamentable that no clear distinction is made in rating between the fundamental employee dishonesty coverage and the supplemental coverages; a desire for clarity would dictate that rates for each coverage be established independently. Since, however, rates are not so published, losses arising from all covered hazards have been included in the data, and the figures should be regarded as an indication, rather than as an accurate representation, of the overall fidelity loss pattern.

As a first step in summarizing the data, the cumulative percentage distribution of numbers of losses in the various size-of-loss brackets was calculated for each sub-line and for all sub-lines combined. These distributions appear in Table 1, from which it is evident that most gross losses were relatively small in amount; it thus appears that fidelity shares with casualty lines a preponderance of low-cost losses. Unfortunately, there was no convenient way of relating loss frequencies to exposures, and it is thus impossible to comment on the stability of loss costs in terms of exposures. Nonetheless, it seems fair to conclude that the distribution of losses by size indicates that statistical ratemaking methods may be employed in the fidelity lines with advantage.

TABLE 1.—CUMULATIVE DISTRIBUTION OF NUMBER OF FIDELITY LOSSES BY SIZE OF LOSS

Amount less than	*Bank*	*Commercial*	*Official*	*Fiduciary*	*Total*
$ 100	31%	28%	24%	8%	27%
200	53	44	35	16	44
500	70	66	53	28	65
1,000	81	79	67	51	78
2,500	89	91	83	80	90
5,000	94	96	90	93	95
10,000	96	99	96	98	98
25,000	98	100–	99	100–	99
50,000	99		99		100–
100,000	100–		100–		

A second analysis of the data involved computing, for each representative bond penalty, the amount of loss which would have been paid had all bonds been of the same penalty, and then comparing these amounts to the total open penalty loss. Because of the disturbing effect on the comparison caused by an extremely large public official loss, that loss was netted of salvage before making the final calculations. Ratios of losses for each penalty to open penalty loss, incorporating this adjustment, are shown in Table 2; the method of computation of these ratios was perfectly straightforward, and its description has been relegated to Appendix II.

TABLE 2.—RATIO OF LOSS UNDER ASSUMED FIXED PENALTY BOND TO OPEN PENALTY (UNLIMITED) LOSS

Penalty	*Bank*	*Commercial*	*Official*	*Fiduciary*	*Total*
100	2.9%	8.2%	2.6%	5.4%	5.7%
200	4.7	14.1	4.7	10.4	9.8
500	8.6	26.3	9.7	23.7	18.5
1,000	12.6	38.7	15.6	40.4	27.5
2,500	20.0	57.5	25.8	66.9	41.8
5,000	27.2	71.0	35.5	82.9	52.9
10,000	36.4	81.5	44.2	93.3	62.7
25,000	52.0	92.4	54.7	99.8	75.0
50,000	64.7	97.5	63.2	100.0	82.8
100,000	76.0	99.8	71.4		88.7
200,000	85.7	100.0	78.8		92.9
250,000	87.8		82.0		93.9
500,000	93.2		97.9		97.5
750,000	98.4		100.0		99.5
1,000,000	100.0				100.0

Lastly, the data of Table 2 were compared with relativities between manual rates for bonds of various penalties. The results of this comparison may be examined in Table 3. Because it was necessary to use indices in making these comparisons, the ratios should be considered only as indicative of a pattern, especially at penalties close to the index. Nonetheless, if we assume that, over the years, the premium fund produced by current fidelity rates has been just adequate to pay losses and expenses and leave a reasonable margin, we must conclude from Table 3 that these rates have been inadequate for small-penalty bonds, and considerably redundant for large-penalty bonds. This conclusion is based on the loss-paying portion of the rate only; if we also consider the expense portion of the rate, including both an estimated minimum expense per item written and a decreasing expense percentage as premium increases, the inadequacy for small bonds and redundancy for large bonds in current rates are further enlarged.

TABLE 3.—RATIO OF PENALTY RELATIVITY UNDERLYING PRESENT RATES* TO RELATIVITY INDICATED BY LOSS STUDY

				Official		*Fiduciary*
	Bank	*Commercial*		*Indi-*		*Indi-*
Penalty	*Blanket*	*Schedule*	*Blanket*	*vidual*	*Blanket*	*vidual*
100	—	49%	—	—	—	—
200	—	53	—	—	—	—
500	—	72	—	—	—	—
1,000	—	91	—	66%	—	74%
2,500	—	100	100%	100	100%	100
5,000	89%	162	111	145	99	125
10,000	100	259	148	233	123	191
25,000	89	518	267	471	202	402
50,000	92	—	323	817	223	773
100,000	107	—	434	1445	272	—
200,000	137	—	—	—	279	—
250,000	153	—	—	—	—	—
500,000	187	—	—	—	—	—
750,000	209	—	—	—	—	—
1,000,000	230	—	—	—	—	—

* "Basic" or "general" rates for the following exposures and forms for blanket and schedule bonds:

Bank—Form 24 for a bank with 40 employees and $10,000,000 deposits. Rates for penalties less than $25,000 were extrapolated from rates for small banks.

Commercial—Schedule and Blanket Position Bond covering 40 "A" employees.

Public Official—Honesty Blanket Position Bond covering 40 "A" employees.

A PROPOSAL

Although under present manual rules the exact method of calculating bond premiums varies by sub-line, in general premiums for blanket bonds are determined by first entering a rate table at a point dependent upon number of exposures and bond penalty and then modifying the tabular rate for classification or bond form. For individual and schedule bonds, a rate per unit of penalty, either level or "stepped" as penalty increases, is extended by the aggregate bond penalty. The data of Table 2 suggest a rating method analogous to that used in the liability lines; certainly the adoption of such a method would bring about a desirable uniformity and simplicity in calculating fidelity premiums, and it is therefore proposed that all fidelity bonds be rated as follows:

1. Rates would be published, by class of business, for a unit exposure at a basic penalty.
2. For penalties above and below the basic penalty, rate differentials to the basic penalty would be published.

3. The classification rate for the basic penalty would be extended by the appropriate penalty differential to arrive at the unit rate for a bond of given penalty in that classification.
4. This rate would then be extended by the exposures to produce the manual premium for the bond.
5. Manual premium would be modified by experience rating for risks large enough to present credible experience, and by premium discount for risks developing an annual premium large enough to warrant expense gradation. By the same reasoning, minimum premiums would incorporate both a loss and an expense constant.

This rating method simplifies consistent graduation of the rate structure for bonds of different penalties and exposures, and, since its values would be statistically based, allows checking of this graduation from time to time. In addition, the method provides a convenient vehicle for solutions to many of the problems of the business mentioned earlier.

In order to effect the proposal, however, much work remains, and at least the following problems will have to be considered and solved:

1. A fundamental task is to establish a classification system, containing preferably a small number of classes, which groups principals by the loss hazard each presents. Fidelity losses may result from contact with, or control over, either cash and securities, goods, or both; the extent of the hazard may be measured both by the amount of the tangibles exposed and, perhaps more importantly, by the ability of the dishonest principal to shield his activities through access to the general books of account and to unit records such as cash registers and vouchers. The classification system should reflect these and other like considerations, rather than merely the type of business in which the principal is engaged. In connection with the development of a classification system, it would be desirable to segregate the hazards insured against, as discussed in the second section of this paper.
2. An exposure base must be selected. Considering the standard criteria which an efficient base must meet, some form of payroll base appears the most satisfactory approximation for bank and commercial risks; bond penalty is possibly the only satisfactory base for fiduciary and public official bonds as they are presently written.
3. A basic penalty must be chosen. The loss study indicates that \$2500 or \$5000 woud be most suitable.
4. Differentials must be established for penalties higher than the basic unit. It is likely that more than one set of differentials will be required, in order to recognize differences in the high-cost hazard presented by the various classes of business. For

example, in the commercial field outside employees produce a large number of low-cost, and relatively few high-cost, cases; the basic rate for this class would be higher than average, and the increased penalty factor should correspondingly be low. Executive officers, on the other hand, produce few small claims, but present a considerable hazard to "jumbo" losses; the basic rate would accordingly be quite low, and the increased penalty factor should be high enough to produce sufficient premium dollars to cover the exposure.

5. The general method of making the loss-paying portion of the rate must be settled upon, and a statistical plan must be designed to implement the method. In the past, statistical ratemaking has come to be associated with relatively frequent rate revisions; for the fidelity lines, frequent rate revisions appear highly impractical. On the other hand, there must be a way of revising rates when prospective costs indicate that current rates are either inadequate or redundant. A possible solution would be to test observed frequency and claim costs with those underlying rates, and to revise rates only when there was a significant variation from the expected value of either factor.

   More difficult to resolve than the traditionally necessary compromise between rate stability and responsiveness will be the problem of designing an adequate treatment of salvage in determining loss costs. It will be seen in Table 4 that the portion of losses on which some salvage is collected is substantial, and that this portion varies both by loss size and by sub-line. Because salvage collection may be either made soon after loss payment or deferred as installments, it is obvious that the amount collected will be a function of time; in addition, it appears that ultimate recovery is also dependent on loss size.

TABLE 4.—RATIO OF NUMBER OF LOSSES FOR WHICH SALVAGE WAS COLLECTED TO TOTAL NUMBER OF LOSSES, BY SIZE OF GROSS LOSS.

Size of loss	*Bank*	*Commercial*	*Official*	*Fiduciary*
1– 99	10%	22%	30%	22%
100– 199	10	35	45	37
200– 499	18	46	58	60
500– 999	24	55	67	59
1,000– 2,499	43	58	71	60
2,500– 4,999	51	56	64	63
5,000– 9,999	56	55	58	62
10,000–24,999	51	34	39	60
25,000–49,999	77	14	33	—
50,000–99,999	91	14	50	—
100,000 & over	71	—	50	—
	21	41	55	55

These considerations prompt the suggestion of treating salvage in ratemaking by an average value approach, so that recent loss experience could be used in the basic data. Probably it would be best to net losses by immediate salvage, and then further discount them by the average value, for the size and kind of loss, of future expected salvage collections. Since future salvage collections will always be partly dependent upon economic conditions, great care will be required in designing the actual mechanics of an average value approach.

6. The method of providing for expenses and margin in basic rates must be determined.
7. To recognize loss characteristics of individual risks, a sound experience rating plan, closely related to the manual ratemaking procedure, must be established; similarly, to recognize expense gradation by size of risk, a premium discount plan must be selected which is in keeping with the manual provisions for expense.

* * * * *

I have attempted to indicate above, for any interested members of the Society, some of the problems which will have to be solved in placing fidelity rates on a statistical basis. Relatively little actuarial work has been concentrated on fidelity and surety rates; considering the scarcity of actuaries and the problems constantly raised in the casualty lines, a good reason for this lack of attention may be found in the fact that fidelity accounts for about 0.5%, and surety only an additional 1.0%, of direct premiums written in the industry. The present situation of fidelity rates, however, affords an excellent opportunity for the application of those techniques which are the stock-in-trade of the casualty actuary, and it is hoped that some members of the Society may be interested enough to direct a portion of their energies towards the solution of the problems mentioned in this paper. In the belief that further background material may be of help to those interested, I have appended a brief bibliography. Readers will note that most of these sources are valuable primarily as indicators of opinion from various sides, and that, with the exception of the "Linder Study," little is available which would be of use in statistical ratemaking.

APPENDIX I.—BASIC LOSS DATA

BANK

Size of loss	*Number of Claims*	*Loss incurred*	*Loss expense*	*Salvage claim count*	*Salvage collected*	*Salvage expense*
1– 99	528	22,701	181	52	2,107	—
100– 199	361	43,692	1,848	35	2,789	69
200– 499	281	86,750	471	51	9,255	141
500– 999	186	120,996	2,446	44	18,282	154
1,000– 2,499	141	215,110	4,902	61	64,221	977
2,500– 4,999	77	262,564	7,000	39	84,028	443
5,000– 9,999	36	249,465	4,887	20	31,415	1,404
10,000– 14,999	21	263,616	4,332	13	63,079	1,280
15,000– 19,999	11	184,625	1,190	4	10,842	54
20,000– 24,999	7	158,276	2,697	3	20,530	674
25,000– 49,999	17	583,744	12,900	13	200,487	5,773
50,000– 74,999	8	474,302	20,463	7	43,798	—
75,000– 99,999	3	265,181	7,463	3	62,951	2,132
100,000–199,999	5	761,555	4,242	3	75,056	20
200,000–249,999	—	—	—	—	—	—
250,000–499,999	1	258,190	2,638	1	101,400	—
500,000–999,999	1	826,539	—	1	311	—
1,000,000 & over	—	—	—	—	—	—
Totals	1,684	4,777,306	77,660	350	790,551	13,121

COMMERCIAL

Size of loss	*Number of Claims*	*Loss incurred*	*Loss expense*	*Salvage claim count*	*Salvage collected*	*Salvage expense*
1– 99	1,959	95,135	2,200	425	17,773	1,251
100– 199	1,151	162,759	2,922	398	38,070	4,121
200– 499	1,527	484,474	10,549	705	127,416	10,131
500– 999	949	663,748	11,676	517	171,484	16,248
1,000– 2,499	838	1,289,469	22,596	489	267,285	19,891
2,500– 4,999	350	1,192,778	14,496	197	181,888	11,291
5,000– 9,999	169	1,096,552	13,626	93	119,542	9,068
10,000– 14,999	47	587,646	14,303	19	40,719	2,477
15,000– 19,999	21	363,013	152	4	4,607	300
20,000– 24,999	8	179,980	311	3	19,544	1,926
25,000– 49,999	21	702,810	3,323	3	25,742	75
50,000– 74,999	4	231,893	409	—	—	—
75,000– 99,999	3	242,774	395	1	10,500	1,500
100,000–199,999	1	112,000	—	—	—	—
200,000–249,999	—	—	—	—	—	—
250,000–499,999	—	—	—	—	—	—
500,000–999,999	—	—	—	—	—	—
1,000,000 & over	—	—	—	—	—	—
Totals	7,048	7,405,031	96,958	2,854	1,024,570	78,279

APPENDIX I.—BASIC LOSS DATA—*(Continued)*

OFFICIAL

Size of loss	*Number of Claims*	*Loss incurred*	*Loss expense*	*Salvage claim count*	*Salvage collected*	*Salvage expense*
1– 99	111	5,036	61	33	1,695	44
100– 199	53	7,244	255	24	2,478	131
200– 499	84	28,765	1,342	49	10,378	683
500– 999	69	49,403	1,782	46	21,943	4,490
1,000– 2,499	73	109,929	2,406	52	29,932	2,267
2,500– 4,999	36	127,744	1,841	23	30,107	3,945
5,000– 9,999	26	166,620	7,848	15	26,089	2,671
10,000– 14,999	8	97,119	1,512	3	10,303	1,179
15,000– 19,999	3	50,117	730	2	13,885	1,122
20,000– 24,999	2	42,786	505	—	—	—
25,000– 49,999	3	108,011	298	1	9,817	411
50,000– 74,999	2	129,239	3,868	1	11,083	6,509
75,000– 99,999	—	—	—	—	—	—
100,000–199,999	1	115,000	13	—	—	—
200,000–249,999	—	—	—	—	—	—
250,000–499,999	—	—	—	—	—	—
500,000–999,999	—	—	—	—	—	—
1,000,000 & over	1	1,571,364	509	1	1,039,167	1,399
Totals	472	2,608,377	22,970	250	1,206,877	24,851

FIDUCIARY

Size of loss	*Number of Claims*	*Loss incurred*	*Loss expense*	*Salvage claim count*	*Salvage collected*	*Salvage expense*
1– 99	23	803	912	5	367	—
100– 199	22	3,037	498	8	896	15
200– 499	35	12,050	1,282	21	4,911	266
500– 999	68	48,407	3,510	40	15,303	1,343
1,000– 2,499	83	131,501	7,908	50	37,434	2,885
2,500– 4,999	38	128,616	5,960	24	31,116	1,296
5,000– 9,999	13	87,540	5,067	8	23,590	1,358
10,000– 14,999	3	35,380	272	2	5,204	185
15,000– 19,999	2	32,066	1,094	1	3,303	1,116
20,000– 24,999	—	—	—	—	—	—
25,000– 49,999	1	26,262	1,692	—	7,529	—
50,000– 74,999	—	—	—	—	—	—
75,000– 99,999	—	—	—	—	—	—
100,000–199,999	—	—	—	—	—	—
200,000–249,999	—	—	—	—	—	—
250,000–499,999	—	—	—	—	—	—
500,000–999,999	—	—	—	—	—	—
1,000,000 & over	—	—	—	—	—	—
Totals	288	505,662	28,195	159	129,653	8,464

APPENDIX II.—CALCULATION OF RATIO OF LOSS AT ASSUMED FIXED PENALTY TO OPEN PENALTY (UNLIMITED) LOSS

The total loss incurred under the assumption that all bonds in force were of penalty p_i equals the sum of (1) all losses for amounts less than p_i and (2) the product of p_i and the number of losses for amounts equal to or greater than p_i. Upon dividing this sum by the total open penalty loss, the desired ratio is obtained. Symbolically, the ratio

$$\frac{lp_i}{L} = \frac{\sum_{t=1}^{i-1} l_t + p_i \sum_{t=i}^{\infty} n_t}{\sum_{t=1}^{\infty} l_t}$$

where, for the i-th size-of-loss bracket,

p_i = lower boundary
n_i = number of losses
l_i = amount of loss

and the infinity symbol merely denotes that the summation is carried to the end of the data table.

As an example, the beginning of the calculation for bank bonds is shown below.

(1) p	(2) Σl	(3) Σn	(4) $p \Sigma n$	(5) $\Sigma l + p \Sigma n$	(6) $\frac{lp_i}{L}$
0	—	1,684	—	—	.000
100	22,701	1,156	115,600	138,301	.029
200	66,393	795	159,000	225,393	.047
.	.	.	.	.	.
.	.	.	.	.	.
1,000,000	4,777,306	—	—	4,777,306	1.000

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THE COMPENSATION EXPERIENCE RATING PLAN — A CURRENT REVIEW

BY

DUNBAR R. UHTHOFF

More than twenty years ago, Mr. Perryman contributed his tremendous work on "Experience Rating Plan Credibilities." (Proceedings XXIV) Shortly thereafter, Mr. Smick described the new plan, comparing it to the old and providing the various formulae used, and then in 1941 Mr. Johnson set down some oddities observed in calculating the original New York values, suggesting improvements. Subsequent to this wealth of material, our Proceedings contain nothing, evidence of a job well done and of little trouble with the plan's application.

But, like many of our rating processes, the plan contains its nuisance quota of constant values changing in significance as dollars lose theirs.

The loss discounting formula continues to assign $1,500 maximum primary to cases that now average double or triple the average costs of twenty years ago, and certain credibility values have become upset as they are allied to loss discounting. As discounting may be restored to some semblance of the originally intended level, the credibility values will need examination for possibile revision.

If the plan is to be adjusted materially, the event might also serve as the occasion for simplification towards facilitating mechanical ratings. Some considerable success in that direction already has been achieved despite the relatively cumbersome tabular requirements, but improvement appears quite possible and highly desirable.

Analytical study surrounding these questions has provided a subcommittee of the National Council Actuarial Committee with many happy hours and this work continues. Undoubtedly, considering an almost twenty-year omission in our Proceedings, the subject must be of interest to many Society members, and by writing now, discussion provided by our forum may contribute to final action or at least to understanding of solutions finally adopted.

The writer, therefore, intends this approach:

(a) A conception of the logic and development of what amounts to a dual modification formula;

(b) Brief developments of the important underlying formulae, as these are convenient here for discussion of departures, with the suggestion that Mr. Perryman's paper is a "must" for completely general analyses and thorough foundation;

(c) Some critical inspections of how the credibility structure has been operating, with particular emphasis upon those values appearing most susceptible to simplification; and

(d) Suggestions for changes appearing most logical, and though these include benefit of committee discussion, it should be understood they are not necessarily the committee's intended adoption.

1. *Some Basic Concepts—A Dual Credibility System*

Most people readily understand manual classification rates as average measures of loss exposure per $100 of payroll for classified portions of individual risks, and since the classification system is as fine as can be reasonably expected, such rates logically could be applied without further ado if there were no means of measuring the extent to which individual risks do not fit the average contemplated by the class rates. Thus the usual explanation of risk experience rating modification includes the term, "better or worse than the average." We need not disturb this comfortable familiarity, but for our present purpose it seems best to tuck it away as over-simplification and proceed more analytically.

The manual rate includes a gross expense factor, this addition to the pure loss rate being intended to provide the expenses necessary for handling risks with premiums under the $1,000 size, above which premium discounts operate to reduce the expense loadings for larger risks. Removing the gross expense portion leaves the rate for losses —the "pure premium"— and after minor adjustments for differences in cost levels between current period and the older rating period, this is the basis of the "expected losses" which will be used in determining risk modifications. Thus the manual rates serve to establish the point of reference for actual risk losses, a self-correcting feature: redundancy in rates promotes credit modifications of those rates, inadequacies promote debits; to the risk large enough to receive 100 per cent credibility, when E = S, the "self-rating" point, manual rates are substantially unimportant.

A general expression for the simplest form of rating formula is

$$M = \frac{AZ + E\ (1 - Z)}{E} \text{ where}$$

A = Actual Losses
E = Expected Losses
Z = Credibility Factor, less than or equal to 100%.

In such simple form, using total actual losses which may suffer extreme variation if no restrictions are imposed, the criteria by which the system of Z or credibility values are set up must recognize the practical undesirability of substantial variations caused by chance severe losses, or their absence, and rating effectiveness is less than it could be if loss experiences might be used under a system of recognizing that an incurred loss involves two sets of influences: Those bringing about its occurrence, and those determining its amount.

Relatively high credibilities might be assigned to occurrences as measured against an average frequency reference, and lesser credibilities might be used in evaluating severity, this logic possibly leading to a conclusion that two modifications be established and somehow combined through an equitable weighing process. Exploration of what these weights might be leads to understanding of the split type of loss treatment, the splitting of actual case losses between "primary," the early loss dollars, and "excess," the losses accumulating from continued payments related to severity—and the parallel splitting of expected losses to primary and excess references. The coincidence with a pure occurrence type of modification can be seen by letting the primary loss definition be the first dollar only of each case, which would actually amount to a one-for-one case count.

But using only the first dollar of each loss would make no distinction at all between cases. Conceivably this might be overcome by setting up several loss categories, perhaps by type such as medical only, temporaries, etc., or by size, but we must always remember the need for an expected average point of reference paralleling the treatment of actual cases, and complicated treatments have to be avoided.

By placing equal value upon all loss dollars up to a specific amount per case, and lesser value or weight upon successive loss dollars over such amount, it is seen that recognition is given to both the frequency or occurrence element and to the distinction between types of cases as gauged by case amounts. In the original design, \$500 (\$300 or \$400 in some lower-cost states) was taken as the specific point below which loss dollars would be treated equally. To the next \$500 of each case, a weight of two-thirds, instead of one, represents decreased emphasis upon these dollars as frequency indicators, while the remaining one-third of each dollar is placed to the excess side, as distinguished from primary, to be used for severity indications as risk size permits. Of the next \$500, two-thirds squared, or four-ninths, are assigned to primary and so on, all part of the operation of the complete formula for splitting any loss over \$500 in amount to the primary and excess portions:

$$\text{Primary, } A_p = \text{Initial } 500 + \frac{2}{3}(500) + \left(\frac{2}{3}\right)^2 (500) + \left(\frac{2}{3}\right)^3 (500) + \ldots\ldots + \left(\frac{2}{3}\right)^{n-1} (500) + \left(\frac{2}{3}\right)^n (R) \ldots\ldots\ldots (1)$$

where R is the remainder after (n — 1) intervals of \$500 beyond the initial \$500.

Selection of the \$500 point must originally have been assigned to judgment, as well as the practical consideration that only 10 per cent of cases at that time would be above \$500 and need discounting. The previous plan used a split of \$1,000 for indemnity and \$100 for medical, so the principle and experience with it was not entirely new, and the 1940 plan could be termed a refinement in using multiple splits and applying these to indemnity and medical combined. And as the treatment of actual losses must be reflected in like treatment of expected losses, the discounting method may be selected with some degree of freedom, limited by judgment upon the answers to essentially two questions:

First, will the amount of losses included within the initial value, and within the additional primary portions of successive increments, comprise a sufficiently large portion of total losses for the application of a separate primary credibility system, such that frequency indications given by the primary portion will provide reasonable but not extreme effects upon risk modifications, and

Second, will the discounting formula provide a reasonable limit to the amount of primary loss added to the rating by a single case, bearing in mind that the complement of low primary definition must be larger excess loss and lower excess credibilities.

These questions are somewhat allied, of course, and really boil down to the one of proportions deemed most reasonable and practical for application of a dual modification formula. We may write the modification formula as follows, wherein the dual modification system and the weighting by primary and excess is clear:

$$M = \left(Z_p \times \frac{A_p}{E_p} + 1 - Z_p\right)\frac{E_p}{E} + \left(Z_e \times \frac{A_e}{E_e} + 1 - Z_e\right)\frac{E_e}{E} \quad \ldots (2)$$

in which the subscripts p and e designate primary and excess portions of actual and expected losses, and Z_p and Z_e designate primary and excess credibilities, derived as equivalent to credits for clear experience;

$$Z_p = \frac{E}{E_p + WE_e + B} \quad \ldots (3)$$

$$Z_e = WZ_p \quad \ldots (4)$$

W and B will be defined below, but for the moment we may note that by substituting the credibility expressions (3) and (4) for Z_p and Z_e in equation (2), the formula used directly in the rating form may be obtained:

$$M = \frac{A_p + WA_e + B}{E_p + WE_e + B} \quad \ldots (5)$$

II. *Derivation of K_e, K, and Q*

The expected loss size at which, or below which, excess losses are not included is termed the Q point. At this point and below $W = O$ so the modification becomes

$$M = \frac{A_p + B}{E_p + B} \text{ or}$$

since $B = K$ when $E < Q$,

$$M = \frac{A_p + K}{E_p + K}$$

Inclusion of excess losses begins above this Q point according to the values of

$$W = \frac{E - Q}{S - Q}$$

Wherein S = the self-rating expected loss size at which, of course, $W = 1$.

For $E > Q$, as excess losses are included, the K value must be gradually eliminated so that self-rating may be accomplished, and the modification formula then could be

$$M = \frac{A_p + WA_e + K(1 - W)}{E_p + WE_e + K(1 - W)} \quad \ldots\ldots (6)$$

so $M = \dfrac{A}{E}$ when $E = S$, $W = 1$

However, Z_p may be greater than unity in

$$Z_p = \frac{E}{E_p + WE_e + K(1 - W)}$$

if $K < E_e$. Above the Q point, therefore, a value K_e is substituted for K, and to ensure that $K_e > E_e$ at any risk size, values of K_e are obtained from the linear function proceeding from the point $K_e = K$, $E = Q$, to the point $K_e = gS$, $E = S$, wherein g is a maximum anticipated excess ratio $E_e \div E$. If g is indeed the maximum excess ratio for any E, it follows that at any point below S, $K_e > E_e$.

Deriving the function for K_e by equating slopes

$$\frac{K_e - K}{E - Q} = \frac{gS - K}{S - Q} \quad \ldots\ldots (7)$$

$$K_e = K + \frac{(E - Q)\ (gS - K)}{(S - Q)}$$

$$K_e = K + W\ (gS - K), \text{ since } W = \frac{E - Q}{S - Q}$$

$$K_e = K\ (1 - W) + WgS \quad \ldots\ldots (8)$$

Substituting K_e for K in (6), and letting $B = K_e(1 - W)$, yields the familiar form (5).

The K value used without alteration when $E \leq Q$, and which is part of K_e when $E > Q$, is based upon a judgment decision that a minimum ratable risk be debited a maximum 25 per cent for a maximum loss. The maximum ratable loss is twice the "Average Death and Permanent Total Value", which at the minimum risk size can be used only at the primary maximum of \$1,500. An expression for minimum 3-year expected losses is 3PL, in which P = annual minimum subject premium, now \$500, and L = the permissible loss ratio. Since only expected primary, E_p, will be used in the modification, 3PL is multiplied by the statewide ratio, D, of primary to total losses, to construct an approximate modification for the minimum risk,

$$M = \frac{A_p + K}{E_p + K} = \frac{A_p + K}{3PLD + K} \quad \text{(9)}$$

Letting A_p take on a \$1,500 addition:

$$M + \triangle M = \frac{A_p + 1500 + K}{3\,PLD + K}$$

$$\triangle M = \frac{1500}{3\,PLD + K} = .25, \text{ the maximum intended debit}$$

Solving,

$$K = 4 \times 1500 - 3PLD \quad \text{(10)}$$

For example, if L and D each are approximately .60, and P = 500, then K = 5,460, rounded to \$5,500, a K value common to most states, since variations in L and D by state have small effect.

The derivation of expression (8) for K_e would not be valid if K itself did not meet the requirement $K > Qg$. Thus we have a condition which should be met by a selection of Q, otherwise not restricted in theory, that $Q < \frac{K}{g}$. In practice, Q has been set at $Q = \frac{K}{D}$, and since D, the average statewide primary ratio, is still well over .40, Q values are well below those required by $Q < \frac{K}{g}$, as g is allowed to retain its original 1939 value of .40. But we may note for the moment that a g of .40 is now much too low for many risks, and Q values now do not fit the true requirement

$$Q < K \div \frac{E_e}{E}$$

so that the many risks with excess ratios $E_e \div E$ higher than D are receiving primary credibilities greater than 100 per cent.

As Z_p may exceed unity at $E = Q$ for certain risks, the same illogical result carries over into areas involving K_e, when $E > Q$.

This difficulty with g as a fixed value is of course referred to by Mr. Perryman, and later pointed to by Mr. Johnson shortly after the plan's New York introduction as needing revision as D ratios decline with inflated loss costs. If complete assurance is demanded that Z_p never exceed unity, g should now be practically double .40 in many states. A further discussion of g will follow.

III. *Alternative Discounting Formulae*

Summing formula (1) to infinity, the maximum primary loss is \$1,500. Probably this limit, and the rapidity with which it is approached, has operated most strongly to accelerate the decrease in D ratios as case costs increased, and also has been the source of most of the discomfiture felt by practical underwriters as they observe the small use of today's high cost cases in a majority of ratings.

A few average death and permanent total values used in 1940 were \$1,930 in Georgia, \$3,800 in Massachusetts, \$3,830 in Michigan, \$6,800 in New York. In the atmosphere of those cost levels, \$1,500 maximum primary must have appeared quite adequate. The \$500 as initial value and subsequent split points is somewhat less disturbing, although increase to at least \$750 would appear to be a minimum step in this connection. However, as there is an increase in the splitting points \$750, \$1,500, \$2,250, etc., at each of which a new discounting ratio must apply, there is an instinctive concern over the discontinuity of this type of function. There seems to be no serious reason why the successive split points be determined as multiples of the initial value. Ideally, the successive additions to primary, for successive equal increments of cost, should be continuously decreasing for increments chosen as small as we please. Suppose then the expression for a primary equivalent of any given loss size, over the initial value I, were

$$A_p = I + a_1r_1 + a_2r_2 + \ldots \qquad (11)$$

in which the increments $a \rightarrow o$, and $r_2 < r_1$, etc.

This may be written $A_p = I + (A - I)\, r \ldots\ldots (12)$ where A = Actual case cost, and r is a function of A and is the average discounting ratio as successively decreasing discount ratios have been applied to the small increments a, i.e., $r = \dfrac{a_1r_1 + a_2r_2 + \ldots}{A - I}$.

Equation (12), although expressing an ideal type of discounting function, does not appear useful in practice. But the precise nature of the relations between successive ratios r_n need not concern us if we can determine an expression for the average r compatible with a selected practical expression for A_p, so long as the selected expression approaches the limit of the maximum desired primary for an infinitely large loss, A, and also if $A_p = A$ when $A = I$. These restrictions are observed in the quite simple and usable

$$A_p = \frac{A}{A + C} \times \text{Maximum Primary} \quad \ldots\ldots\ldots\ldots \quad (13)$$

Substituting I for A_p and A, in (13),

$$I = \frac{I}{I + C} \times \text{Maximum Primary}$$

so Maximum Primary $= C + I$, and (13) becomes

$$A_p = \frac{A}{A + C} \times (C + I)$$

Equating to (12)

$$I + (A - I)r = \frac{A}{A + C} \times (C + I)$$

$$(A - I)r = \frac{A(C + I) - I(A + C)}{A + C}$$

$$r = \frac{AC - IC}{(A + C)(A - I)}$$

$$r = \frac{C}{A + C} \quad \ldots\ldots\ldots\ldots \quad (14)$$

Substituting this expression for r in equation (12) yields, of course, equation (13).

It may be noted that formula (13), although demonstrated above to be a refinement of the present multi-split discounting system, has a logic of its own, as it expresses application of a credibility factor, $\frac{A}{A + C}$, to a maximum primary.

The desirability of a formula of this type in the light of mechanical application is obvious, not only in individual risk rating but also in the mass treatment of losses necessary for periodic revisions of classification D ratios. In addition, facility is gained for occasionally adjusting the formula for new initial values and maximum primaries. Probably a reasonable shift at the moment, without incurring too much risk disturbance, would be to a \$750 initial and a maximum of \$3,750, so that the constant C could be the nicely round figure of 3,000.

$$A_p = \frac{A}{A + 3000} \times 3750 \quad \ldots\ldots\ldots\ldots \quad (15)$$

Thus a $750 loss would be $750 primary. A future increase in initial value is easily accommodated by an increase in maximum primary, or conceivably a decrease in the constant C, so that Maximum Primary $-\mathrm{C} = \mathrm{I}$. Hence the discounting emphasis may be shifted easily without any concern over split-type ratios of the two-thirds variety. If greater primary for smaller cases becomes desirable, the initial value increase may be accommodated by a corresponding decrease in C; or if higher primary for large cases is wanted, the maximum primary and the constant C are increased by the same amount. Adjustment to current cost conditions in such an important part of risk rating is highly desirable, and the suggested formula enables corresponding adjustment in class D ratios quite easily.

Test discounting of losses for several states under formula (15) reveals very close to a 10-point addition to discounting ratios obtained from the present formula. There happens to be so little variation, in fact, between states and between classes that the considerable problem of switching during a transitionary period, as it must involve all states, could be substantially reduced by addition of 10 points to all current D ratios.

IV. *Effect of New Discounting Upon the Constant K*

The K value derivation has been shown to depend upon maximum primary and a judgment decision as to maximum debit for a single large case. Adoption of a formula such as (15) — and for purposes of discussion formula (15) will be used from here on — means a substantial increase from the present $1,500, and this increase will vary according to each state's Accident Limitation equal to twice the average cost of death and permanent total cases. If the initial and present 25 per cent debit criteria is to be continued, K values will become quite high, seriously decreasing the complementary credit available to the smaller risks, as credibility will be reduced.

Deriving some K values through formula (10);

State Accident Limitation	*Equivalent Primary*	*Approximate New K* (4M-800)	*Present K*
20,000	3261	12,200	5500
30,000	3409	12,800	"
40,000	3488	13,200	"
50,000	3538	13,400	"
60,000	3571	13,500	"

It becomes questionable that the old 25% criteria should be retained, as it requires a variation in K hardly consistent with practical considerations: (1) The State Accident Limitation, dependent upon benefits for relatively rare cases, is only occasionally a guide to benefits for most cases; (2) a criteria set according to the very special case of a minimum rating, though providing a convenient statement, is not highly germane to the determination of credibility values having important application through the whole range of risk sizes; (3) credits now provided to no-loss small risks, substantial in number, would be seriously reduced, a transition problem.

The following table of primary values, present and proposed formulae, for a few case sizes, shows the change in primary dollars, through the range of predominately probable cases, is quite a different matter from the increase over present $1500 primary occasioned by the larger cases.

Case Cost	*Primary Values Present*	*Primary Values Proposed*	*Case Cost*	*Primary Values Present*	*Primary Values Proposed*
750	680	750	7,500	1,500	2,679
1,000	830	938	10,000	1,500	2,885
2,000	1,200	1,500	20,000	1,500	3,261
3,000	1,370	1,875	30,000	1,500	3,409
4,000	1,440	2,143	40,000	1,500	3,488
5,000	1,470	2,344	50,000	1,500	3,538

Consideration of these and other factors suggests judgment be applied to the end result rather than to only extreme conditions. We might, therefore, contemplate the modification effect, with several suggested K values, for occurrence of several case sizes; and because an increase in minimum ratable size could be a logical possibility and nothing is gained here by tossing that question around, whether it should be $750, $1,000 or higher, examination at a $1,000 subject premium size is convenient:

Using (9), $M = \frac{A_p + K}{3PLD + K}$, approximately $= \frac{A_p + K}{1{,}080 + K}$,

and $\Delta M = \frac{\Delta A_p}{1{,}080 + K}$:

(1) Case Size	*(2)* Present Primary	*(3)* Present ΔM, $K = 5{,}500$	*(4)* New Primary	*(5)* New ΔM, for Several K Values: $K = 7{,}500$ $\Delta A_p \div 8{,}580$	*(6)* $K = 10{,}000$ $\Delta A_p \div 11{,}080$	*(7)* $K = 12{,}500$ $\Delta A_p \div 13{,}580$
750	680	10%	750	9%	7%	6%
1,000	830	13	938	11	8	7
2,000	1,200	18	1,500	17	14	11
3,000	1,370	21	1,875	22	17	14
4,000	1,440	22	2,143	25	19	16
5,000	1,470	22	2,344	27	21	17
10,000	1,500	23	2,885	34	26	21
20,000	1,500	23	3,261	38	29	24
50,000	1,500	23	3,538	41	32	26

Comparing column (3) to (5), (6) and (7) provides a broad view of what might happen debit-wise. Confining this view to the range of case sizes up to \$5,000 which will predominate, a new K value of \$7,500 appears most fitting to present concepts. Also, an important consideration must be the credit available for no losses, a common circumstance for the \$1,000 subject premium risks:

Using $1 - \dfrac{K}{1080 + K}$, this is 16% presently, and the new credits would be 13% for $K = 7{,}500$, 9% for $K = 10{,}000$ or 8% if K were 12,500. Again, $K = 7{,}500$ provides the closest approach.

V. *Effect Upon Q Point*

Q has been shown to have only a maximum restriction $\dfrac{K}{g}$, g being selected as the maximum possible ratio $\dfrac{E_e}{E}$ for any risk. Using a K of 7,500 and assuming g at .75 which corresponds to D ratios of .25 for some classes in some states, the maximum $Q = 10{,}000$. It is interesting to see what happens to Z_p when total expected losses $= Q$, and the primary and excess portions are designated as Q_p and Q_e:

$$Z_p = \frac{Q}{Q_p + K} = \frac{Q}{Q_p + Qg} \quad \text{when } Q = \frac{K}{g}:$$

For a risk with $\dfrac{Q_e}{Q} = g$, $Z_p = 1$, and Z_p becomes less as $\dfrac{Q_e}{Q}$ decreases, which means that Z_p decreases as Q_p increases, apparently illogical. But expressing the modification as

$$M = Z_p\left(\frac{A_p - Q_p}{Q}\right) + 1$$

and letting $A_p = 0$ and $Z_p = \dfrac{Q}{Q_p + Qg}$

$$M = \frac{Qg}{Q_p + Qg} = \frac{Qg}{Qg - Q_e + Q},$$

which becomes $\dfrac{Qg}{Q}$ when $Q_e = Qg$, so the selection of g is important in amount of credit, $1 - \dfrac{Qg}{Q}$, when $Q_e = Qg$, as well as being important to keep $Z_p < 1$.

As Q_e becomes less than Qg, if we use $\triangle Qg = Qg - Q_e$, $\triangle M = -M\left(\frac{\triangle Qg}{Q + \triangle Qg}\right)$ so that as the ratio $\frac{Q_e}{Q}$ become less than g, i.e., as $\frac{Q_p}{Q}$ increases, the credit for no losses increases, a logical end result despite the apparently illogical decrease in Z_p as the primary portion increases.

This demonstration has two purposes: to show the importance of g in determining credibility level, and to point up that although Z_p does move contrarily to the primary portion of a given E, the weighting effect of $\frac{E_p}{E}$ on the primary modification makes this less disturbing.

VI. *Avoiding Use of Maximum Excess Ratio g*

A selection of g is necessary to the tabular credibility values of B corresponding to values of $W = \frac{E - Q}{S - Q.}$. We have seen how important this value is in determining the credibility level, and some reflections upon this may be summarized as follows:

1. g must be kept up to date as the maximum, or Z_p will exceed unity.

2. If only one g is used for all states, this single selection is dependent then upon the highest cost state, and primary credibilities in lower cost states for equivalent expected loss sizes are less than if g were selected for each state, yet the maximum Q point must be much the same.

3. Depressed primary credibility in low-cost states, which also have lower self-rating points, results in a more rapid traverse of the distance from Q to self-rating.

4. Most important, the use of tabular B and W values, and the consequent need for g, results in its rigidity in substantial departure from the proper use of $\frac{E_e}{E}$ for each risk, and is required only because of the impracticability of constructing tabular values contemplating all possible variations of $\frac{E_e}{E}$.

In short, the rating plan is seriously encumbered by the conception of tabular B and W values. It is more complicated than it need be, a vital consideration as we should gear more and more of our procedures to mechanical processes. It becomes pertinent, therefore, to examine possibilities for individual risk determination of credibility values, so no tables are needed which are cumbersome to produce mechanically, and so no g selection would be required. But unless we can simplify our rating formula, individual risk calculations will remain less desirable than construction of tabular values.

Since Q may be as small as we please, the effect of low selection being only a reduction in primary credibility and an earlier use of excess losses, we may examine the result of eliminating Q entirely, with the reservation for the moment that we will later examine the possibility of setting some point E below which excess loss rating work will be avoided.

Instead of $W = \frac{E - Q}{S - Q}$, $W = \frac{E}{S}$, and g will be replaced by $\frac{E_e}{E}$.

From (8), $K_e = K\,(1 - W) + WgS$

$$K_e = K\left(\frac{S - E}{S}\right) + \frac{E}{S}\frac{E_e}{E}S$$

$$K_e = K\left(\frac{S - E}{S}\right) + E_e \qquad (16)$$

This is eminently practical, and K_e is, of course, always greater than E_e, as previously shown to be required to insure $Z_p < 1$.

Now using $B = K_e\,(1 - W)$,

$$B = K\left(\frac{S - E}{S}\right)^2 + E_e\left(\frac{S - E}{S}\right) \qquad (17)$$

but we may question the necessity, bearing in mind the search for a simpler form, of squaring the less than unity coefficient of K. If we could set

$$B = K\left(\frac{S - E}{S}\right) + E_e\left(\frac{S - E}{S}\right), \qquad (18)$$

we would have a usable

$$B = (K + E_e)\left(\frac{S - E}{S}\right) \qquad (19)$$

and such adjustment appears permissible:

1. K_e would equal $K + E_e$, and this, of course, satisfies the condition that $K_e > E_e$.

2. When $E = S$, $W = 1.00$, and the requirement is satisfied that B be entirely removed at the self-rating point, so that $M = \frac{A}{E}$.

3. The modification formula becomes the same as one originally derived by Mr. Perryman as one of the possibilities (his formula (14), based upon $Z_p = \dfrac{E}{E+K}$) and apparently preferred by him at that time:

$$M = \frac{A_p + W\ (A_e - E_e) + E_e + K\ (1-W)}{E + K\ (1-W)} \quad \ldots\ldots\ldots (20)$$

Since $B = (K + E_e)\ (1 - W)$, this becomes

$$M = \frac{A_p + WA_e + B}{E_p + WE_e + B}$$

identical in form to the present, but differing in B to the result that B may be calculated readily for each risk and no table look-up would be necessary.

In arriving at (20) however, $W = \dfrac{E}{S}$, and a note was made that although this provided for no Q point, we might nevertheless adopt one as a judgment point below which excess losses would not be rated and some work thus would be avoided on the considerable number of risks for which excess indications could amount to very little.

We might accomplish much the same saving in work were we to decide upon a value of E below which the W value would not be used, as it would be of negligible size, but this creates smoothing problems and appears clumsy. It would seem better to continue the familiar concept of Q, so that $W = \dfrac{E-Q}{S-Q}$, and although this Q might be varied between states, as a practical matter since no substantial theory is involved and no substantial modification effects are involved either, a common point such as 10,000 might better be used. It is easy to see that not much is involved here. At the Q point the modification for clear experience is

$$M_1 = \frac{K + E_e}{K + E}, \text{ since } W = O$$

and if W had been continued as $\dfrac{E}{S}$, (no Q point),

$$M_2 = \frac{K + E_e\ (1-W)}{K\ (1-W) + E}$$

Since the W involved in both numerator and denominator of M_2 must be quite small at a reasonable Q such as 10,000, ($W = .05$ when $S = 200{,}000$, or .025 when $S = 400{,}000$), the modification M_2 will tend to be quite close to M_1, the variations being plus or minus, depending upon the relative values of K, E and E_e. Thus the Q point may be selected entirely upon consideration of what size of risk distribution indicates may be the rating work involved, and selection of an all-state point has much in its favor for interstate ratings.

* * * *

It is hard to say precisely when an accumulation of changing forces demands adapting action. Difficulties anticipated—risk disturbances, re-education, interstate rating complications as two plans temporarily may be in effect—make it a step not lightly undertaken. There is a good question that these difficulties may be lessened by proceeding gradually, confining the first step to a change in discounting formula, a corresponding upward adjustment in D ratios and K values and in the g value necessary to retention of the tabular system of B and W values. This step would be relatively easy, would restore validity to the plan's originally sound foundations, and is easily understandable as a counterpart of long-term inflation. Actually, this is something which should have been accomplished steadily over the years, and a worthy intent now may be to keep pace in future, as well as to eventually adopt formulae which will automatically help in this purpose and also contribute to reduction of rating work.

DISCUSSION OF PAPERS READ AT THE MAY 1958 MEETING

AUTO B.I. LIABILITY RATES — USE OF 10/20 EXPERIENCE IN THE ESTABLISHMENT OF TERRITORIAL RELATIVITIES

BY
MARTIN BONDY

VOLUME XLV — PAGE 1

DISCUSSION BY R. L. BORNHUETTER

We are now experiencing an era of automobile liability ratemaking in which it is an absolute necessity that adequate territorial rates be established and maintained. In developing rates by territory the question of what experience is to be used is definitely a major factor. The author's discussion on the use of 10/20 bodily injury experience for territorial relativity in New York is certainly an able contribution to this problem of developing territory liability rates. As more and more states increase their financial responsibility limits above the 5/10 basic limits, the problem dealt with in this paper becomes more relevant in areas outside of New York.

Several phases, such as the appropriate credibility procedure to be applied to the incurred losses between 5/10 and 10/20, have been discussed by Mr. Simon in his review of this paper or will be presented in a separate paper which has been recently submitted to the Society by Mr. Roberts.

The main point this writer would like to make in this area of ratemaking is the problem of developing a true picture in some of the smaller territories as respects the relative level of settling claims for these areas when compared to others.

At the present time, the National Bureau of Casualty Underwriters utilizes the latest three calendar-accident years of experience in most states for the purpose of developing private passenger car territory rates. In smaller territories the true characteristics as respects varying levels of claim settlement probably cannot be adequately reflected when only three years of experience are used for territory review.

Offhand then, this problem presents another area for possible research, namely, the review of territorial experience for a much longer period than three years with an attempt to establish any significant differences in the claim characteristics which would lead to higher claim settlements or more frequent excess losses. By grouping territories according to their characteristics, favorable or unfavorable, the problem of reflecting the claim settlement level in these territories could be recognized by the use of separate increased limits tables.

These tables would recognize and reflect the basic differences in territory characteristics under discussion. Certainly it is intended that there should be only two or three tables per major classification type (e.g., private passenger cars). By periodic review every three or four years these assignment groupings could be kept current. Actually, this is not a new thought; however, it seems to be a field which could be investigated especially in this day of high claim settlement costs. Granted, there are many problems in this type of rating procedure and some may render the method completely impractical.

In summary, it is the writer's opinion that the use of 10/20 experience for territory rate development is certainly a step in the right direction but it is not the complete answer to the problem of establishing overall adequate rates for individual territories.

DISCUSSION OF PAPERS READ AT THE NOVEMBER 1958 MEETING

THE ADVANTAGES OF CALENDAR-ACCIDENT YEAR EXPERIENCE AND THE NEED FOR APPROPRIATE TREND AND PROJECTION FACTORS IN THE DETERMINATION OF AUTOMOBILE LIABILITY RATES

BY

PAUL BENBROOK

VOLUME XLV, PAGE 20

DISCUSSION BY R. LINO

At a time when adverse underwriting results for automobile liability insurance, particularly for private passenger cars, are a subject of great concern to the insurance industry, Mr. Paul Benbrook's paper, "The Advantages of Calendar-Accident Year Experience and the Need for Appropriate Trend and Projection Factors in the Determination of Automobile Liability Rates" is indeed a welcome and timely addition to the *Proceedings* of the Casualty Actuarial Society.

Mr. Benbrook's diversified experience substantiates his qualifications to discuss this subject. His paper, which outlines the advantages to be realized by the use of calendar-accident year experience in lieu of policy-year experience, and which discusses the reasons why trend and projection factors are essential if rate levels are to be realistic for the period in which they are to apply, should be of particular interest

(1) to the technicians of both insurance companies and ratemaking organizations who have the responsibility of developing ratemaking systems for the establishment of adequate insurance rates;

(2) to the technicians on the state supervisory level who have the responsibility of passing on rate proposals submitted to them by the industry; and finally

(3) to the students who are preparing themselves for the examinations of the Society.

The first section of Mr. Benbrook's paper contrasts the calendar-accident year and the policy-year methods of compiling automobile liability experience as regards their use in rate level determination and enumerates and analyzes the advantages of the accident-year method. The transition from a policy-year to a calendar-accident year basis has been made after careful and detailed studies by the National Bureau and the Mutual Insurance Rating Bureau. The superiority of accident-year experience has also been recognized by State Supervisory officials throughout the country in their acceptance of rate proposals developed on this basis.

Although accident-year statistics materially reduce the time lag between the experience period and the effective date of the rates, Mr. Benbrook notes that no system of gathering past experience can produce a realistic rate level unless it is adjusted to reflect current costs and to provide for a reasonable prediction of the losses that may be anticipated for the period during which the rates will apply. In the second section of his paper he illustrates this need by citing as an example, the Texas revision of private passenger car rates which became effective on August 1, 1958.

To the casual reader this example may appear to be somewhat involved in that a combination of accident-year experience through the first six months of 1957 for National and Mutual Bureau companies, and policy-year experience through 1956 for those companies reporting to the National Association of Independent Insurers was utilized in this rate level determination. This method was used because of the fact that the N.A.I.I. statistical plan was revised only recently to provide for the compilation of private passenger car experience on a calendar-accident year basis. For this reason it was necessary to develop separate trend and projection factors to apply to the accident-year and policy-year experience respectively to reflect:

(1) the change in calendar-year paid claim frequencies through the year ended December 31, 1957; and

(2) the change in the calendar-year average paid claim costs to August 1, 1958, the effective date of the revised rates.

To aid the reader, Mr. Benbrook has incorporated many detailed exhibits, clearly identified, which show the development of their trend and projection factors.

I do not believe that it is the reviewer's function to discuss the weaknesses, if any, in the ratemaking system employed in the Texas revision nor to refer to other alternate methods utilizing trend and projection factors in rate level determination. These points may serve as a basis for future papers to the *Proceedings* of the Society. It is sufficient to say that the rate regulatory authorities in Texas have made an honest attempt to establish adequate rate levels in the state by taking cognizance of trends in costs and in frequencies.

It may be of interest to the reader, however, if the reviewer briefly outlines the most recent ratemaking procedure adopted by the National Bureau and utilized in the revisions of rates for private passenger cars that became effective late in 1958 and early in 1959. The objective was to develop a rate revision program based on a review of the most recent available experience through accident-year 1957 that would produce an adequate level of basic limits rates for those policies effective during 1959 and in the early part of 1960. For the large premium volume states, in establishing statewide rate levels, full weight was given to the indications for the latest accident-year 1957; for those states having medium premium volume an 85% weight was assigned to accident-year 1957 and a 15% weight to accident-year 1956; for those states having more limited premium volume a 70% weight was assigned to accident-year 1957 and a 30% weight to accident-year 1956.

To meet the objective that rates be adequate for the period in which they are to apply, it was essential that recognition be given to the general upward trend in claim costs since the experience period under review. The average date of coverage represented by accident-year 1957 experience used for rate level in the large premium volume states was approximately July 1, 1957. The accident-year 1957 incurred losses were adjusted to reflect the eighteen months of subsequent change in the calendar year average paid claim costs or to approximately the effective date of the revised rates. These trend factors contemplated that the average rate of increase in average paid claim costs indicated by the line of best fit through the average paid claim cost data for each of the four latest available twelve-month periods, would prevail in the eighteen months subsequent to the experience used in the determination of the statewide rate level. The following table outlines the derivation of the trend factors used in the review of private passenger car rates in Pennsylvania that became effective in 1959 (See table on following page).

In the medium and small premium volume states where the rate level was based upon weighted averages of calendar years 1956 and 1957 loss ratios, the average date of coverage was approximately May 1957 and March 1957 respectively. The difference in the average date of coverage is due to the different weighting bases utilized. To adjust the weighted accident-year experience to approximately the effective date of the revised rates, 21 and 24 month trend factors were applied to the medium and small volume states respectively.

In conclusion, this reviewer would like to congratulate Mr. Benbrook for his excellent contribution to the *Proceedings* of our Society.

PENNSYLVANIA
AUTOMOBILE LIABILITY — PRIVATE PASSENGER CARS

Development of Factors to Adjust Accident Year 1957 for Subsequent Trend in Claim Costs (Based on Calendar Year Average Paid Claim Cost Data)

National Bureau Members & Subscribers

(1) Year Ended	(2) Paid Losses*	(3) Number of Paid Claims	Average Paid Claim Cost (4) Actual (2)÷(3)	Average Paid Claim Cost (5) Line of Best Fit
		Bodily Injury (Basic Limits)		
6/30/55	$6,550,990	12,815	$511	$513.90
6/30/56	7,457,224	13,445	555	544.30
6/30/57	8,377,499	14,914	562	574.70
6/30/58	9,431,142	15,466	610	605.10
		Property Damage (Total Limits)		
6/30/55	5,332,773	57,753	92	91.40
6/30/56	6,109,563	62,259	98	99.30
6/30/57	6,831,839	63,020	108	107.20
6/30/58	7,817,873	67,859	115	115.10

	Bodily Injury	Property Damage
(6) Average Annual Dollar Change in Paid Claim Costs Based Upon Line of Best Fit	$+30.40	$+ 7.90
(7) Average Dollar Change in Paid Claim Costs in 18-Month Period (Line 6 times 1.50)	$+45.60	$+11.85
(8) Average Change in Paid Claim Costs in 18-Month Period Expressed as Percent [(7) ÷ Col. (5) for 6/30/58]	+ 7.5%	+10.3%
(9) Proposed Factor to Adjust Accident-Year 1957 Losses to Reflect 18 Months of Subsequent Change in Average Paid Claim Costs: 1.0 + (8)	1.075	1.103

* Excluding all loss adjustment expenses.

A UNIFORM STATISTICAL PLAN AND INTEGRATED RATE FILING PROCEDURE FOR PRIVATE PASSENGER AUTOMOBILE INSURANCE

BY

STANLEY C. DuROSE, JR.

VOLUME XLV, PAGE 41

DISCUSSION BY C. H. GRAVES

Mr. DuRose has published a very interesting paper illustrating the dilemma confronting a rate analyst when reviewing automobile liability rate filings made with an insurance department. Using Wisconsin as an example, Mr. DuRose pointed out that in 1957 two hundred and five companies either filed automobile liability rate revisions, had such filings made on their behalf by rating bureaus, or continued to write under filings made prior to 1957. If each company had made only one filing in 1957 or had a filing made on its behalf by a rating bureau, the Department Rate Analyst would have had to review ninety-eight* separate and distinct filings of automobile liability rates for private passenger cars and would have had to determine if such filings met the requirements of the rating law that rates "not be excessive, inadequate or unfairly discriminatory."

It will be readily realized that this would represent a tremendous assignment. From the viewpoint of an insurance department rate analyst, the volume of work to be handled is reduced in almost direct proportion to the increase in number of companies becoming affiliated with rating organizations. Fortunately for the rate analyst, the requirement of the Wisconsin rating law that each company file its rates also permits companies to fulfill that requirement by joining rating bureaus which make one filing on behalf of all its affiliated companies.

Although Mr. DuRose stated that "the Mutual Insurance Rating Bureau, in filing rate revisions, usually depends on the combined statistics of M.I.R.B. and N.B.C.U.", he failed to mention that the Mutual Bureau filings are based on the experience of all companies reporting to the Mutual Bureau and National Bureau which, it should be noted, would include the experience of a large number of independent companies. Considering only private passenger experience, the following table presents a distribution of the number of private passenger cars by groups of companies**:

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* In 1957, ninety companies were affiliated with the National Bureau for services in Wisconsin and nineteen with the Mutual Bureau for such services.

** 1956 P.D. exposure as reported to Wisconsin by the statistical agencies.

	No. of Cars	*Percent*
National Bureau Members and Subscribers	106,929	11.5
Other Companies Reporting to the National Bureau	88,841	9.6
Mutual Bureau Members and Subscribers	50,153	5.4
Other Companies Reporting to the Mutual Bureau	48,102	5.2
Companies Reporting to the Midwestern Independent Statistical Service	631,895	68.3
Total	925,920	100.0

It is not without significance that a private passenger car rate revision made by the Mutual Bureau which utilizes the experience of all companies reporting to the National Bureau and Mutual Bureau, would be based on 31.7 per cent of the total number of private passenger cars and not on the 5.4 per cent written by its members and subscribers.

It is possible for the Mutual Bureau to make a rate filing based on the combined experience of all companies reporting to the Mutual Bureau and National Bureau because of the fact that all such companies follow the same automobile liability statistical plan. Companies reporting to the Midwestern Independent Statistical Service do so in accordance with the automobile statistical plan published by the National Association of Independent Insurers, and it should be noted that Wisconsin experience is reported in a form not easily combinable with the experience reported to the Mutual Bureau and National Bureau. Such experience is reported by territory with all classes combined and statewide by classification and not by class for each territory.

According to Mr. DuRose's plan, Phase 1 would include the promulgation of a uniform statistical plan containing uniform territory definitions and classifications. The problem of obtaining tabulations of automobile liability experience of all companies has been met in a number of states. Although in a number of states the N.A.I.I. automobile statistical plan as well as the automobile liability statistical plan of the National Bureau and Mutual Bureau has been adopted, some states require the reporting of experience by class by territory. Such experience when reported in this manner can be combined. In four states, Texas, Louisiana, North Carolina and Virginia, automobile liability rates are made on the basis of the combined experience of all companies writing in those states. Likewise, experience reported to the N.A.I.I. for New Jersey and New York is reported by class for each territory and could be combined with experience reported to rating organizations. In this connection, it may be noted that the New York Insurance Department has promulgated a statistical plan for automobile insurance presenting minimum requirements.

A copy of this plan is included in the "Examination of Insurance Companies" Volume 5, Chapter 10, published by the New York Department in 1955. One cannot seriously object, I believe, to an insurance department requirement for a minimum plan similar to that promulgated by the New York Department, because such a minimum plan would provide the department with data which could be utilized for rate review purposes.

In addition, the Ohio Insurance Department has promulgated uniform statistical definitions for use of all companies in reporting automobile liability and physical damage experience. These uniform definitions were developed after consultations with representatives of the various statistical agencies and with representatives of independent companies.

It should also be noted that with respect to fire and allied lines, the Wisconsin Insurance Department, as has practically all the other states, promulgated a uniform statistical plan which is followed by all companies in reporting fire and allied lines experience to the three statistical agencies, namely, National Association of Independent Insurers, National Board of Fire Underwriters and Mutual Insurance Advisory Association.

As reflected by the title of his paper, Mr. DuRose would establish, in addition to a uniform statistical plan, an "Integrated Rate Filing Procedure". Quoting from his paper, "I submit that it is not possible to obtain the stated objectives of the rate regulatory laws without . . . the establishment of an integrated rate filing procedure based on certain factors developed from the analysis of the consolidated underwriting experience of all companies".

It is this idea which would receive opposition from both independent companies and rating bureaus. As outlined in the paper, under this integrated rate filing procedure:

(1) It would be necessary that all rate filings reflect the territorial and classification relativities that are indicated from the consolidated experience. (In this connection, it may be pointed out that in filings made by the National Bureau and Mutual Bureau, classification relativities for private passenger cars are based on countrywide data.)

(2) All rate filings would have as a foundation the pure premium indications of the Uniform Statistical Plan. (This "pure premium" approach to rate making was discussed by Donald P. McHugh, Counsel for the U.S. Senate Antitrust and Monopoly Subcommittee, in his address at the N.A.I.C. Zone 2 meeting in April, 1959.)

(3) The pure premium would be established by the Insurance Commissioner.

(4) The establishment of pure premiums and relativities would be effective on the same specific date each year.

(5) The Insurance Commissioner would establish a rate or premium for each classification in each territory, reflecting the pure premiums determined under the Uniform Statistical Plan, the over-all average stock company expenses and an acceptable allowance for profit and contingencies.

Under this procedure, "a company or rating bureau, rather than filing rates, would file a series of factors representing percentages of the established base". In other words, under this plan the Commissioner would determine the rates, and a company or group of companies could deviate uniformly from such rates if such deviations could be supported.

The plan as outlined in Mr. DuRose's paper is essentially the Texas method for determining rates, and it should be pointed out that the Texas regulatory law provides for the determination of rates by the Texas Board of Insurance. Under the All-Industry regulatory law, adopted in most states, the making of rates is a function of the companies. The power of the Commissioner is one of review—not one of rate making.

It would appear that Mr. DuRose's plan was motivated by the problem of dealing with rate filings made by the large number of independent companies operating in Wisconsin. It is admitted that this is a problem, but I do not believe that insurance companies are in favor of state-made rates as the solution to this problem.

ESTIMATING ULTIMATE INCURRED LOSSES IN AUTO LIABILITY INSURANCE

BY

FRANK HARWAYNE

Volume XLV, Page 63

DISCUSSION BY J. M. CAHILL

The elaborate formulae treatment of Mr. Harwayne is dealt with by Lewis H. Roberts in an Appendix to this written discussion.

I intend to direct attention to the practical rather than to the theoretical aspects of Mr. Harwayne's treatment of this subject. It will quickly be inferred that I see little merit in embarking on the use of complicated formulae in ratemaking to ascertain what is disclosed by other available statistics that are both relevant and up-to-date.

Mr. Harwayne's whole analysis is based on that part of the New York Supplemental Insurance Expense Exhibit which shows the development of New York automobile bodily injury experience by policy year. This Exhibit carries the experience of each policy year from its initial valuation as of 12 months on through the successive annual revaluations to 84 months of development.

While this Exhibit may have some value in that it portrays the overall character of the automobile bodily injury liability experience in New York, it would not be practicable to use this type of experience data in ratemaking for the following reasons:

1. It is for all types of cars: private passenger, commercial, long haul truckmen, buses, taxicabs, hired cars, etc. in combination.
2. It is for all sizes of limits written, including for example 500/1,000 as well as the 10/20 limits required under the New York Compulsory Insurance Law.
3. It includes medical payments, uninsured motorists, death and disability coverages, etc.
4. Note that no similar information is available for automobile property damage liability insurance. But more important, for no other state is similar information on the development of the aggregate automobile liability experience (bodily injury or property damage) by policy year available through a Supplemental Insurance Expense Exhibit or otherwise. The insurance companies would probably object were these supplemental reports imposed by states generally because it truly would be for no useful purpose and would involve considerable additional expense of preparation.

   May I add the gratuitous comment that this portion of the New York Supplemental Insurance Expense Exhibit is an anachronism that does not seem to serve any useful purpose.

In striving for a means of getting an up-to-date, accurate indication of the experience picture, Mr. Harwayne makes only slight reference to the vastly superior type of data now available in the form of the accident year experience compiled from the statistics reported under the Automobile Bodily Injury and Property Damage Liability Statistical Plan. While accident year data presently are compiled only for private passenger cars, the Statistical Plans were amended as of January 1, 1958 to produce this type of experience in due course for the commercial and other categories of vehicles. The accident year data can be compiled not only for the year ended December 31 but also for the year ended June 30, which for practical purposes means that it can be kept right up-to-date for use in ratemaking.

To give an indication of how superior the accident year data are to policy year data for ratemaking purposes, I merely have to cite that as of the first report (15 months after the beginning of the accident year period) the ratio of paid to incurred losses for some states is more than 55% for bodily injury and 85% for property damage. In New York where cases are settled somewhat more slowly for reasons with which you are familiar, the percentages are nearer to 30% and 70% respectively. But even these are vastly higher than the policy year relationship of the paid losses as of the first report to the ultimate incurred losses which would be only 7% for bodily injury and 21% for property damage in New York.

Mr. Harwayne has disregarded the fact that under the Statistical Plan the losses reported are inclusive of allocated loss adjustment and that in ratemaking the necessary further provision for unallocated loss adjustment is included with the provision for losses through the use of current factors of 1.10 for bodily injury and 1.16 for property damage which are supported by a review of the countrywide experience and expense costs reported in the Insurance Expense Exhibit.

At the earlier stages of development by policy year, the losses reported in the New York Supplemental Insurance Expense Exhibit contain substantial bulk reserves established by the companies for "Incurred But Not Reported", "Future Adverse Development," etc. These reserves are determined by formulas and methods that vary by company, and may be moved forward annually with little change. If a company tended to establish an excessive reserve for future development beyond 36 months, for example, the credit runoff would be repeated policy year after policy year although there was no substantial change in the number of dollars in the bulk reserve. It is important to note that such bulk reserves cannot be included in the losses reported for ratemaking purposes under the Statistical Plan.

While the New York Supplemental Insurance Expense Exhibit contemplates that the automobile bodily injury liability losses reported by policy year will be exclusive of all loss adjustment, for most companies the individual case reserves are set up inclusive of allocated loss adjustment. In practice, almost without exception the companies do not establish separate case reserves for the indemnity and the allocated loss adjustment portions. When a company sets up a loss reserve of say $5,000, it is intended to cover whatever loss payment may eventually be made and also whatever allocated loss adjustment expense may be incurred. From the standpoint of solvency, it makes no difference whether the amount is used to settle a just claim, whether it is used in defense of an unjust claim, or whether it is eventually paid partly as indemnity and partly as allocated loss adjustment expense.

A few companies do establish individual case reserves separately for indemnity and for allocated loss adjustment. But even for these companies there seems to be a tendency to understate the allocated loss adjustment reserve and to rely on the indemnity reserve to provide an adequate reserve in the aggregate. Many more companies use a formula relationship to adjust the outstanding losses to reflect the elimination of allocated loss adjustment in preparing the New York Supplemental Insurance Expense Exhibit.

Nevertheless, it is probable that, through the mechanics of insurance accounting under the Annual Statement, amounts subsequently paid as allocated loss adjustment expense are transferred to the loss adjustment expense account with the end result that an overstated credit development with respect to the incurred losses is indicated in the New York Supplemental Insurance Expense Exhibit. The credit development of outstanding losses to the extent of 12% and 14%, which is demonstrated in Mr. Harwayne's paper to have occurred in connection with the development of the New York automobile bodily injury loss experience by policy year as reported in the New York Supplemental Insurance Expense Exhibit, is largely a fictitious credit development for the reasons explained above, and does not occur in any such magnitude in the data used for ratemaking which are reported under the Statistical Plan to be inclusive of both losses and allocated loss adjustment.

For identical reasons, the same sort of development occurs in the countrywide Schedule "P". By a simple calculation combining the annual statement loss adjustment account with the incurred loss account in Schedule "P" by policy year, a measure can be obtained as to whether in the aggregate the company estimates of incurred losses for bodily injury including all loss adjustment are accurate. For the member companies writing more than 90% of the volume of the National Bureau, the development of the loss and of the loss adjustment experience for policy years 1950 through 1954 from 36 months is shown in the following table:

	Development From 36 Mos. of Policy Year				
Item	*1950 to 72 Mos.*	*1951 to 72 Mos.*	*1952 to 72 Mos.*	*1953 to 60 Mos.**	*1954 to 48 Mos.**
Incurred Auto B.I. Losses	−3.2%	−3.4%	−3.4%	−2.9%	−1.5%
Incurred Auto B.I. Loss Adj.	+7.3	+8.0	+11.9	+12.1	+10.2
Combined	−1.7	−1.8	−1.3	−0.9	+0.1

* Latest available as of Dec. 31, 1957

Note how the incurred loss adjustment account moves up as the incurred losses go down. In combination there is comparatively little development from 36 months on. Any development that occurs is reflected in the ratemaking process where the development of the losses including allocated loss adjustment as reported under the Statistical Plan is carried out to 60 months for bodily injury and to 36 months for property damage in the case of private passenger cars.

For automobile bodily injury, the ratio of allocated loss adjustment to premium was 4.7% countrywide for National Bureau member companies; for automobile property damage it was 2.1%. In terms of incurred losses, these ratios would be approximately 6.5% B.I. and 3.5% P.D.; these ratios would be far higher, of course, in terms of the outstanding losses at the various stages of development. Therefore, this potential transfer item to which Mr. Harwayne has referred only in a footnote is not negligible by any means.

While I feel that there is no need to base the ratemaking process on the type of data reported in the New York Supplemental Insurance Expense Exhibit or upon elaborate and complicated formulae which inherently would fail to recognize the effect of such changes as the raising of the limits required by Financial Responsibility laws, nevertheless it is encouraging to note the recognition given in Mr. Harwayne's paper to the need to measure trend and to reflect the indications of the latest available experience. Within the past year and a half the National and Mutual Bureaus had to request a hearing and then successfully appeal to the Appellate Court on a disapproval by a former New York Superintendent of Insurance based largely on the premise that two years of policy year experience was too short a period to use for ratemaking purposes and that preferably the experience period should be of five years duration. A quick glance at the New York loss ratios by policy year shown in the various tables in Mr. Harwayne's paper shows the worsening trend of the experience and the clear need for substantial rate increases. In Table F -X, for example, the steady increase in the incurred loss ratios (excluding all loss adjustment) shown from 51.8% in policy year 1953 to 73.0% in 1957 depicts the serious deterioration of the New York automobile bodily injury liability experience. The corresponding expected loss ratio excluding all loss adjustment was only approximately 51%. The last rate revision effective during this period was in 1956, which makes it self-evident that the rates were seriously inadequate in 1957 when the National and Mutual Bureaus proposed rate increases which were disapproved in November, 1957 and which became the subject of hearings and court action.

Thus, while I do not favor the introduction of the elaborate formulae outlined by Mr. Harwayne, I do welcome his paper which supports the recognition of trends as implied in the aggregate loss ratios shown in such reports as the New York Supplemental Insurance Expense Exhibit. But better tools for this purpose are now available, and in due course even better methods of measuring and predicting trends will be evolved.

APPENDIX

LEWIS H. ROBERTS

It is always gratifying to see mathematics applied to the varied and complex problems of casualty insurance. As such methods of analysis are brought to bear more often, reduction of the nebulous areas of intuitive estimate not only places our science on more certain ground, but frees the mind to concentrate on the key decisions which are the proper province of judgment.

Such papers as Mr. Harwayne's, which boldly attack important problems in spite of their mathematical difficulty, are therefore received with pleasure by this reviewer even when he takes exception to the author's methods and conclusions.

Mr. Harwayne approaches the problem of estimating ultimate incurred losses in two independent ways. The first way is to discount outstanding losses reported for ratemaking purposes by a factor which essentially represents allocated loss adjustment included in loss reserves on the Insurance Expense Exhibit. Since the fallacy of this procedure has been already shown in detail by Mr. Cahill it will not be discussed further here.

The author's second approach is to discard reported information on outstanding losses, and to estimate ultimate incurred losses solely from paid losses as of a given date. It is difficult to believe that any mathematical procedure which discards information can be expected to yield better rates than a time tested method that uses all reported information.

A possible ground for doubting the value of outstanding losses as reported may have been the mistaken conclusion reached in the first approach, referred to above. Apart from that, no evidence has been adduced by the author to justify discarding reported amounts of outstanding losses as worthless. Furthermore, even if those reported amounts were worthless the claim count on outstanding claims is incontestable, and used in conjunction with a reasonable estimate of average claim cost at date of settlement should provide a far sounder evaluation of outstanding losses than an estimate based on paid claims alone. This should be evident, not only from considerations of credibility (paid claims as of 12 months, for example, represent according to the author's figures only 7% of ultimate incurred losses) but from the effect of trend of average paid claim costs during the run-off period on the percentage of ultimate incurred losses paid at a given stage of maturity.

In estimating average cost at date of settlement of outstanding claims, the element of trend enters in such a way as to be susceptible to separate treatment. But if we estimate ultimate incurred losses on the basis of a past observed ratio of paid to ultimate incurred losses, the effect of trend is so intimately involved in this ratio that the task of adjusting the ratio to allow for changes in trend is greatly complicated. Although the author did not discuss the trend problem it is inseparable from this approach, and neglect of such adjustment is equivalent to the assumption that the future trend of average claim cost will follow the same pattern as obtained during the development of the experience from which the ratio of paid to ultimate incurred losses was derived.

Because of this reviewer's objection to the use of paid losses alone to estimate ultimate incurred losses, the mathematical techniques that were used to develop this approach are in his opinion immaterial although generally sound and ingenious. There are, however, a number of technical defects that could be remedied.

Equation (4) in Part IV of the first paper was obtained by trial and error by altering the coefficient developed in Eq. vii of Appendix A, the reason for the adjustment being the unbalanced fit provided by the latter equation. Inspection of the differences from observed values for Eq. (4) compared with those for Eq. vii suggests that this adjustment has, if anything, increased the unbalance since the positive differences for higher values of t have been reduced only slightly at the expense of introducing negative differences for lower values of t. These difficulties could have been avoided by changing the signs of Eqs. i, ii and iii (Appendix A) and taking logarithms, thus yielding linear equations in the unknown parameters a, b and c. Solution for these values by least squares (with appropriate weighting) would have permitted use of as many observed values as available rather than just the first three, thus avoiding the unbalance inherent in the author's method.

It is also worth remarking that the differences between values calculated from Eq. (4) and observed values can not be regarded as random. Where an equation is derived from a set of data having only one observed value for each value of the independent variable (time in this case), and particularly when the fit is made to selected points, there is always question as to whether the differences are not due to bias in the fit, so that future data would show differences from the fitted function in the same direction as the observed data. Use of several years' experience with the least squares method would eliminate these doubts if the function chosen is really suitable for the data to be fitted.

Use of function for periods of less than a year does not appear to be justified, according to the table in Part IV.

With respect to the rate level adjustment factor (Part V), parentheses are required around the expression $\frac{L_A . 1}{P_A \; r_A}$ to avoid ambiguity.

Expression (7) in Part V is actually a hybrid policy year. In this writer's opinion more information is to be obtained from the data by showing the incomplete policy years separately and averaging them, if appropriate in consideration of volume and other relevant factors, after adjustment for trend.

With calendar-year-accident-year data soon to become available on a fiscal year basis for all types of cars, however, there seems to be little need for elaboration of methods of analyzing policy year experience.

Equation IV of the second paper was derived without regard for the boundary conditions implied by its use as a periodic function (i.e., as descriptive any year) which require that the accident frequency and its first derivative should be the same at the last instant of the year as at the first instant. This omission impairs subsequent calculations for periods of time such as one, two, ten or eleven months, or for periods exceeding a whole number of years by these numbers of months.

The author's derivation of the functions F(t) and G(t) is otherwise a commendable example of mathematical construction which this reviewer greatly appreciated reading. Mr. Harwayne's papers are therefore a welcome addition to our literature, notwithstanding the before mentioned objections to certain of his methods and conclusions.

DISCUSSION BY F. J. HOPE

In the introduction of his paper, Mr. Harwayne cites the serious need for insurance premiums which will be adequate in the face of an inflationary economy. He suggests that this need can be met, in part at least, by taking steps to bridge the time-gap between the cut-off date of basic ratemaking data and the effective date of rate revision. Certainly there can be little quarrel with either the need for adequate rates or the desirability of achieving them through use of the most recent factual information available.

In general design, his proposal to narrow the time-gap is patterned after the rate level adjustment factor widely used in Workmen's Compensation ratemaking. In this approach, the detailed elements which constitute the basic ratemaking data are adjusted by a single factor derived from more recent data available in "bulk" only. In Workmen's Compensation, the "bulk" data are calendar year earned premiums and incurred losses reported by state at six months' intervals. Mr. Harwayne proposes the use of premiums written and losses paid. He suggests the use of the latest policy year of such data, since that is readily available in the New York Supplemental Insurance Expense Exhibit, but points out the possibilities of adapting his proposal to other types of compilations, such as calendar-accident year.

Although the paper is divided into five parts, it can be summarized as being based on these two fundamental premises:

1. That policy year incurred loss ratio data evaluated as of 36 months or later can be projected to "ultimate" by a simple adjustment of outstanding losses, and
2. There is a consistent and measurable relation between policy year paid losses as of 12 months and "ultimate" incurred losses.

The first premise is familiar to most of us under the name of loss development. It is generally assumed that reserves on outstanding losses include what might be termed a "margin of safety". Mr. Harwayne terms this the "conservative practices required by prudent company operations". When a body of ratemaking data includes a number of reserves on open claims, it has been common practice to adjust the data to reflect future developments. The traditional approach has been to develop factors based on the ratio of incurred losses at a later date to the same losses as of an earlier date, and to apply these factors to more recent data. The theory appears to be that, in the aggregate, reserving practices demonstrated in the older years have continued with respect to later years. The factors are usually, but not always, less than unity, as might be expected. Mr. Harwayne adopts a somewhat different approach, suggesting that since the savings derive from reserves on outstanding claims, the loss development factor should be one applicable to outstanding claims only. On the basis of several years of experience, he demonstrates in Exhibit II that for stock and mutual companies in New York, a "discount" factor of 12% would be appropriate for Automobile Bodily Injury. The obvious step, then, is to discount outstanding losses by the appropriate factor, leaving paid losses unmodified.

Both approaches to loss development depend upon an overall consistency in reserving practices, not only as to intent, but as to accomplishment as well. Claims men, collectively, may feel that their reserves at a given point in time have a "margin of safety", but if they have erred in their judgment, then the data evaluated as of that time upsets the required continuity in reserving practices. This is one of the hard facts of life in ratemaking, with no apparent answer other than the basic tenet that if we apply our procedures with reasonable consistency (and stay in business long enough) aberrations from average conditions will be balanced out.

As compared to the more traditional loss development method, Mr. Harwayne's approach seems to have some advantage in the event of a general change in rate of settlement. If, for purposes of discussion, we assume that claims men collectively did reserve with a 12% margin of safety, but changed the rate at which claims were settled, it would take several years for the traditional method to catch up with the change. Since Mr. Harwayne's method modifies outstanding losses only, adjustment to the change in rate of settlement would be immediate. There remains the very important and debatable question of whether a change in rate of settlement would affect the size of the settlements, thereby upsetting results under either method. That possibility could be the subject of separate study.

In Exhibit II, the ratios of Savings to Outstanding are consistent enough to warrant considerable respect for Mr. Harwayne's conclusions. He readily acknowledges and demonstrates that one could expect considerable variation among different types of carriers, and for various combinations of carriers. The writer of this review can add that, from his own company's countrywide data for eight consecutive policy years, he found no such consistency in savings percentages from year to year, nor from one evaluation date to the next, except that developments between 36 and 48 months seemed to be quite consistent in all except two years.

In Table B of Part I, Mr. Harwayne has adjusted actual loss ratios to a discounted basis, using 12% of outstanding losses, for several policy years at consecutive evaluation dates. The fact that they are very consistent when so adjusted is called "dramatically revealing", but to this writer it seems only the logical consequence of Exhibits I and II. The actual loss ratios are identical with the Incurred Losses in Exhibit I, except for number of digits. Exhibit II demonstrates that there was quite consistent development in those Incurred Losses from one evaluation date to the next. Also, the proportion of Outstanding to Incurred as of the various evaluation dates was quite consistent among the several policy years studied, so that application of a discount factor to Outstanding approximated the application of a different factor to Incurred. It seems only natural, therefore, that when adjusted to reflect consistent development, the results themselves are consistent. This seems to be a test of conclusions on the same data from which they were drawn, perhaps for want of any other data to test.

With respect to the first of Mr. Harwayne's two premises, it is this writer's opinion that his approach warrants continued study, perhaps on a countrywide basis, and in such a way that tests could be applied to other than the source data of the study. For the purposes of this paper, development of losses to "ultimate" appears to be an intermediate step, and whether it be accomplished by his method or another is somewhat of a separate issue, although a very important issue in itself. If rigorous tests demonstrate that Mr. Harwayne's method is wanting, the more traditional method could be used. Therefore, with complete reservation as to whether the 12% "discount" is a truly valid figure, and recognizing the limitation on any type of loss development procedure, it will be assumed that losses developed to an "ultimate" basis by Mr. Harwayne are sufficiently accurate for the purpose they serve in his paper.

Mr. Harwayne's second and more novel premise is that policy year paid losses as of 12 months or 24 months bear such consistent relationship to ultimate incurred losses that the former can be used to establish an acceptable estimate of the latter. Since written premiums as of 12 months represent ultimate earned to a substantial degree, the way is open to put a recent but incomplete bulk of policy year data on an incurred to earned loss ratio basis in a method quite different from the recently abandoned "earned factor" approach.

In brief, Mr. Harwayne suggests that policy year paid losses as of 12 months or 24 months could be adjusted to ultimate incurred through dividing by 6.99% or 42.37% respectively. It is unfortunate that he had only three policy years from which to develop his ratio, but those three do show a remarkable consistency. Again referring to countrywide data for his own company, this writer was able to develop similar ratios, on the basis of losses paid as of 12 months to losses paid as of 60 months. For seven consecutive policy years the ratios, while different from the above ratios, remained within 1.0 points on each side of the arithmetic average. Similar percentages for losses as of 24 months ranged within 5.0 points around the average.

The concept of projecting a full policy year of incurred losses on the basis of what might be termed an "advance sample" seems a little bold on first examination, yet the facts thus far seem to warrant its serious consideration.

In a further refinement, Mr. Harwayne has used his observed values to fit a curve and develop a formula by which the percentage of paid to ultimate incurred can be developed for any evaluation time "t". Since he has supplemented this section with further notes, comment on this section will be made separately.

In conclusion, Mr. Harwayne puts forth a suggestion for a rate level adjustment factor to be based on the latest Policy Year Paid/Written Loss Ratio, to be used in conjunction with Calendar/Accident Year ratemaking data. The exact form of the factor is quite similar to the Compensation factor, except that it includes a neutral zone of plus or minus .025. If actually put into practice, the use of the latest incomplete policy year could take any one of several forms. Initially it might be given only a moderate weight in the overall rate level, until such time as its reliability has been demonstrated in actual usage.

Certain practical but not insurmountable difficulties would present themselves in a procedure of this type. As Mr. Harwayne points out, the data as now reported in New York is for all types of automobile, with no breakdown by private passenger, commercial, etc. At present there is no requirement for this type of data in many other states. However, once the concept had been adopted in principle, the details of how to get the data could undoubtedly be worked out.

For universal use, as always, there would be the problem of credibility in the smaller states, especially in a procedure requiring that a small amount of paid losses be "inflated" by the use of factors such as a divisor of .0699. It might be that such factors would have to be based in large part on countrywide data. Even in the larger states, it is probable that, initially, less than 50% weight would be given to a factor of this type in the overall rate level.

Mr. Harwayne has put forth a fresh approach towards solving a problem of the first magnitude, with interesting statistical data to demonstrate the validity of his arguments. The Society is indebted to Mr. Harwayne for this paper, and the subject deserves not only further discussion, but active study and analysis of similar type data wherever available.

AUTHOR'S REVIEW OF DISCUSSION

In his discussion of my paper Mr. Cahill begins by relegating the theoretical aspects to others, and directs his attention solely to the practical aspects. He sees "little merit in embarking on the use of complicated formulae in ratemaking to ascertain what is disclosed by other available statistics that are both relevant and up-to-date".

The author investigated the time situation as respects the availability of summaries within the New York State Insurance Department. It was found that the experience covering transactions during 1957 had been summarized by June 1958. It was also found that the National and Mutual Bureaus had submitted their statistical data on October 27, 1958, and had furnished the summaries used for filing on the same day. In addition, transactions during the year 1958 were summarized by the New York Insurance Department in final form by

June 1959. To date (October 1959) no summaries of classified rate-making data have been submitted to the New York Insurance Department.

What is the significance of this? Mr. Carlson put his finger on it at the last meeting of our Society when, in conducting the seminar on the use of small scale computers, he pointed out that for the most recent automobile liability rate revision the time saving could be translated into a monetary saving exceeding $1 million dollars per week and almost $5 million dollars per month. Based upon this example, the four to five month lag between the time that Supplemental Insurance Expense Exhibit data is available and the summarization of classified statistical experience represents a cost of approximately $20 million dollars. Elements of such magnitude are worthy of practical consideration.

In response to Mr. Cahill's specific criticisms:

1. The paper notes reservations arising out of the fact that all types of autos are included. It was suggested that the matter might be covered by a simultaneous rate revision for private passenger, commercial and all other cars; or private passenger might be considered alone if agreement could be reached on this point. It should be observed that the private passenger experience far over-shadows the experience for all other types of automobiles. Mr. Hope in his criticism says on the matter of breakdown by type of data, "once the concept had been adopted in principle, the details of how to get the data could undoubtedly be worked out".
2. As a possible criticism the paper noted that the data included all sizes of limits on a very large volume of business in New York State. Rather than being a criticism, there may be an advantage to be gained by affording recognition through the rating process, to elements which are seldom given experience recognition.
3. Although not specifically mentioned in the paper, the same advantage might apply to medical payments coverage, etc.
4. The paper deals solely with auto liability (bodily injury). The lack of similar information for property damage in New York State and for both coverages in other states was assumed to be self-evident to insurance actuaries, statisticians and accountants. If insurance executives become aware that the companies could benefit to the extent of $20 million in New York State and more than that countrywide, it seems highly speculative to conclude as Mr. Cahill does that "insurance companies would properly object were these supplemental reports imposed by states generally because it truly would be for no useful purpose."

There is no doubt, of course, that accident year data by class and territory detail are vastly superior to calendar year experience in the liability field; however, such superiority must be weighed against the time element and the millions of dollars which could be lost by a time-lag in utilizing up-to-date insurance data.

Mr. Cahill's main criticism concerns loss development. The downward development of losses is not contested; however, he says that the downward development of losses is offset by the upward movement of allocated claims expense. His proof consists of:

1. asserting that companies cannot and do not follow uniform accounting instructions that expenses be segregated from losses and
2. compiling Schedule P figures for allocated claims expense and *unallocated* claims expense combined.

If his criticism of uniform accounting instructions is valid, question is raised as to why the insurance industry does not press for amendment which would allow the inclusion of allocated claims expenses with losses. Unless there is specific proof to the contrary one should assume that companies are following instructions in filling out the Insurance Expense Exhibit.

On the second item above, Schedule P figures are net figures in comparison with the New York Supplement which is on a direct basis. More importantly, however, Mr. Cahill fails to demonstrate that allocated loss adjustment expense development offsets pure loss development. It is quite likely that the partial development offset which he does show is due principally to the development of *unallocated* loss adjustment expense (which is 60% of total loss adjustment expense) and which in ratemaking already includes developments during the calendar year. Unfortunately the figures which he uses are expressed in terms of incurred losses rather than outstanding losses. His figures have been translated below to show the amount of development of loss expenses as a percentage of the pure loss development:

Automobile Liability Insurance

Development of Losses & Loss Expenses from 36 mos.

Source: Annual Statements, Schedule P comprising over 90% of National Bureau Member Companies' Volume

Policy Year	*Development Period*	*Development Amount (In Thousands)* *Pure Loss*	*Total Loss Expense*	*Development of Loss & Total Loss Expense as Ratio to Development of Pure Loss*
1950	36-72	—$7,924	$3,038	61.7%
1951	36-72	—10,148	3,787	62.7%
1952	36-72	—11,048	6,138	44.4%
1953	36-60	— 9,983	6,554	34.3%
1954	36-48	— 5,527	6,022	9.0%

If the development of total loss expense stems from unallocated claims expense it is already included in the ratemaking process; *if* the development of total loss expense stems from allocated claims expense, the figures from Mr. Cahill's summary still leave as much as 62.7% of the amount of pure loss development from 36 to 72 months to be considered.

Mr. Cahill's contention that there is comparatively little development from 36 months on is not entirely borne out by the foregoing or by the actual development factors indicated in rate filings. In fact the ratemaking process currently includes such factors because of the supporting information disclosed by the Supplemental Insurance Expense Exhibit some years ago.

On Mr. Cahill's polemic discussion, the auto rate case has been forcefully and ably considered by the courts in New York State. It would be well for our members to read the judicial decision in this case.

The comments by Mr. Roberts are opinions which are worth consideration. It is possible, however, that the errors produced in estimating unpaid costs via judgment applied to individual case reserves exceed those produced by estimating unpaid costs via observation of the development of paid costs. Some of the companies which have been most successful in the auto liability field place great emphasis on the evolution of paid losses as a basis for estimating outstanding losses.

The technical defects pointed out by Mr. Roberts, while of negligible magnitude, are appreciated. The author noted that a discontinuity occurs in Equation IV but chose not to clutter up the main point by using a more complicated periodic function. I believe that whatever impairment there might be in the subsequent calculations is of relatively minor importance.

Mr. Hope in his review recognizes the need to bridge the time gap between the cut-off date of the basic ratemaking data and the effective date of rate revision.

In time we expect that more policy year paid losses as of 12 months or 24 months will become available to test the validity of utilizing paid losses as a measure of ultimate incurred losses.

One of the reasons for utilizing a neutral zone of plus or minus 2.5% is related to the problem of credibility, particularly in the smaller states which Mr. Hope notes as a problem.

Running through each of the criticisms, the most important things to note are:

1. that the insurance industry looks for improvement.
2. that the members of our society recognize that mathematics still plays a significant part in the development of actuarial analysis.

As between the various comments made it is refreshing to realize that Hope is with us.

METHODS OF COST LIMITATION UNDER PRIVATE UNEMPLOYMENT BENEFIT PLANS

MURRAY W. LATIMER

Volume XLV, Page 88

DISCUSSION BY P. A. WILLIAMS

For several years labor unions have been fighting for some sort of guaranteed annual wage. Although they are not guaranteed wages, as such, the plans discussed in Mr. Latimer's paper are an outgrowth of the demand for them.

The author was obviously confronted with a monumental task in collecting the data which makes up this paper but he has given a comprehensive and detailed account of the history, development, provisions and problems connected with Supplementary Unemployment Benefit plans. Since this subject is new to the *Proceedings of the Casualty Actuarial Society,* he even seemed to foresee the limitations the reviewer might have and wrote his own critique in Chapter VI, "Conclusions as to Effectiveness of Cost Limitations."

While I was studying this paper, I found it very hard to keep my mind on the technical problems being discussed and off of the nature of the plan itself, that is, the concept of not working—and getting paid for it. Finally, I realized that the two were the same for the most part and that the hardest problems involved spring out of the social nature of the plans.

Very little was said in the paper about the enforced savings plan used in the glass industry. The problems encountered are few since the employee pays his own way by collecting only what has been put away in his behalf. But in the plans of the other industries discussed, workers who qualify receive a supplement to their state unemployment pay which brings their total benefit up to 65 percent (or 60 percent) of after-tax wages. This brings about many inequities.

In many cases the benefits along with remuneration for part-time work are as great as the regular after-tax wages received for being on the job, especially when it is taken into consideration that certain expenses are eliminated when a worker is laid off, such as the costs of transportation to and from work, lunch money, work clothes, etc. This tends to remove any incentive the employee might have had for seeking new employment. On the other hand, the fact that after-tax wages are computed on the basis of the federal income tax withholding bracket or percentage penalizes the more stable employee with a family and home who finds it advantageous to itemize his expenses. His benefit might be based on an amount well under his actual after-tax wages.

It is my understanding that an employee receiving workmen's compensation would be refused unemployment compensation on the grounds that he was not "able to work and available for work." Another inequity develops from this situation. At a comparatively low wage level the unemployment benefit overtakes the maximum workmen's compensation benefit. Thereafter, the injured worker receives less than the laid-off worker. The percentage used to calculate benefits under the SUB plans appears to be too high.

It was brought out in the paper that no insurance is available to cover the hazard of unemployment. This is understandable. What insurance company would be willing to underwrite a line in which practically every loss would be catastrophic in nature? The pooling of risks, as this article suggests, would do little to alleviate the problem. The hazard exists principally in the mass production industries whose fortunes run on pretty much the same economic cycle. Throwing several companies in one industry or several industries together for insurance purposes would create an exposure comparable to the conflagration hazard to which a fire underwriter would be exposed if he insured every building in the slum area of a large city. There is no doubt in my mind that unemployment is uninsurable. The framers of these SUB plans seemed to admit this when they built in a method of reducing either the benefit or its duration if the fund dropped too low with an extra safety measure which cut off benefits altogether as the fund approached rock bottom. Insurance companies would be happy to sell coverage which ceased as soon as the dollars set aside to pay losses were expended—but who would be willing to buy it?

The funds mentioned above are maintained by making contributions based on hours worked. The difficulties of having these donations to the fund based on benefits or credit units were discussed by Mr. Latimer. The reserve represented by the fund does not seem to reflect the actual liability of the plan. After more experience has developed some attempt should be made to relate both the contributions and the level of the fund itself to the benefits.

If no sound relation can be found, then a slightly different approach might be taken with respect to maintaining the fund. The problem of continued high contributions to the fund after sizeable lay-offs have occurred would be alleviated if a buffer zone were established. Rather than having just a maximum level below which contributions are made, a maximum and a minimum level should be established. Payments would be made into the fund until the maximum was reached, then no payments would be made until the level of the fund dropped to the minimum at which time they would be resumed. Using this method would give employers the advantage of not having to "pay in" during early stages of lay-offs and would produce the natural effect of having the fund build up during good years and fall off during bad years.

Mr. Latimer's description of the plans was clear, his analysis, realistic. My remarks are intended to be additions to his own conclusions rather than a criticism of the paper's content or the manner of presentation. As suggested by the author, the impact of the recent recession on the SUB plans should prove interesting and would be a worth while subject for a follow-up paper for the *Proceedings*.

RATEMAKING FOR FIRE INSURANCE

JOSEPH J. MAGRATH

Volume XLV, Page 176

DISCUSSION BY N. J. BENNETT

I can think of few more conflicting emotions of a professional sort than the feelings of an actuary with an essentially casualty training on first being introduced to the rituals of fire ratemaking. His whole background, built on an often complicated and yet reasonably systematized base, has left him inadequately prepared for the deceptive simplicity of the design for fire rates laid before him. Probably he will be, as was this reviewer not too long ago, quite unable to decide whether he is viewing the record of a successful old professional which it might pay him to emulate, or whether what he sees is an anachronism which has thrived on luck and lack of vigorous opposition.

This paper must be read carefully and in conjunction with the several earlier papers on fire statistical procedures. It is extremely gratifying to note the increasing variety and complexity of papers on fire insurance and to find that the descriptive and definitive papers which were pure necessity a few years ago are giving way to more critical discussions which can draw on earlier writers for fundamentals. Those who are still strangers to the 1921 Standard Profit Formula or who have failed to become intimate with major perils, occupancies, coinsurance, conflagrations, balance point loss ratios, and all the idiom of this field will come to find authors on fire subjects increasingly difficult to follow. This is as it should be, and Mr. Magrath was able to present a broad survey of current practices by relying on our good sense to discover, if we have not already done so, that Messrs. Graves and Finnegan have relieved him of any obligation save passing reference to the complexities of statistical collection and preparation.

This paper serves an admirable purpose as a logical step forward in the series of introductory and elementary papers on fire insurance which followed this Society's broadened scope of activities. It sets out accurately a venerable method of ratemaking which brooks no neutral attitudes. Fire ratemaking produces either the iconoclast eager to tear down and rebuild or the equally fervent disciple of the status quo, usually in a position to make the decisions, who counters with, "Leave it alone, it works." Although there is no logical necessity for preferring grey when confronted with black or white, this paper shows that while there is much that is confusing or unreasonable in fire ratemaking there is, all the same, a great deal that is comfortably familiar and basically sound. The happy medium in our desire for improvement thus would seem to offer a more appropriate and attainable goal for our immediate efforts than a wholesale indictment of a method which has only just begun to show its Achilles' heel.

Mr. Magrath comments particularly on two typical problems which illustrate quite well the irritations many technical people encounter in trying to understand fire rates. In describing the formula treatment of loss adjustment expense, he discovers, as did the New York Insurance Department, that the only common sense method is to treat it as a function of loss. This seems, unhappily, not to be the method of Inter-Regional. One of the first steps of an analyst in testing a method or formula is to find its extreme or limiting values. Such a simple test here at the advisory organization level would have displayed the dangers in boldly shifting items between loss and expense provisions. The second comment again concerns loss adjustment expense, but now the problem is one of semantics. The words "allocated loss adjustment expense" as described by Inter-Regional must be interpreted in some non-familiar fashion to become meaningful. This is a wasteful and confusing situation which could be eliminated without a second thought. It is possible for terms to be defined consistently for the entire fire and casualty industry without yielding principle.

Two memorable sentences appear in this paper. The first occurs in discussing the 1958 New York revision. "An *adverse* experience trend was apparent, so it seemed desirable to use the latest possible experience and use a weighting factor emphasizing the more recent years." Although the reference is to a particular case, it is not clear that the modifier of "experience trend" is a variable to which should be assigned prevailing values whatever they are. The statement as it stands has unfortunate implications. The second sentence is a gem which is reminiscent of the Bible for succinctness and clarity. Describing a minor adjustment in formula made, somewhat reluctantly, at the behest of the New York Insurance Department, the author says simply, "The change was accepted for purposes of harmony."

Perhaps the most striking feeling one gets in reading this paper is a suspicion that the title might better have been "Ratelevel Making for Fire Insurance." Class adjustments receive but a cursory glance. This imbalance, it should be added, shows no improper emphasis by the author but only reflects the almost exclusive concern throughout most of the country with over-all adequacy. Mr. Magrath, after displaying the venerable New York Credibility Table, which must hold some sort of record for durability, does outline a proposal for determining credibility and making class adjustments which was once discussed by committees of the EUA. That someone has been thinking of this problem is evident—and particularly welcome news. That this particular scheme has serious shortcomings, however, the author demonstrates at once by simply testing an extreme case. The desire of the actuary, moreover, to proceed further along these lines becomes somewhat less than overwhelming when he considers the problems involved in recasting the awesome distribution of the range into a malleable and practical form.

When once the fundamentals put down in this paper are assimilated and the casualty ear becomes attuned to the atonality of the fire ratemaker's scale, a certain very broad question arises. Exactly what is the 1921 Standard Profit Formula and what is its relationship to fire rates? The caustic reply that the answer should be obvious is exasperating because the answer is anything but obvious. Anyone who has made even a casual effort at reconciling the "formula" to current rating methods finds variance and opposition between the two, or complete silence on the part of the formula at a critical stage. This bewildering complication is the consequence of an unfortunate historic identification of accounting results with the production of rates for a future period. Rating methods capable of meeting the complementary demands of the industry and regulation need far more flexibility and imaginative treatment than can be given under a strict analysis of financial results.

The current method of measuring a company's financial progress and strength is well suited to the particular nature of the insurance transaction. This method which is obviously as applicable to Workmen's Compensation or Automobile Liability as it is to Fire Insurance is restated as part of the Standard Profit Formula. Yet, whereas the former two lines see no embarrassment in seeking entirely different statistical and mathematical techniques for ratemaking, once the contributions to surplus have been measured, fire insurance has felt some constraint toward loosening the tie between the accountant and the actuary. With an observable shifting of fire business among types of carriers and away from classic patterns into multiple line policies, there seems to be little doubt of the need for the broadest possible approach to fire rates. Such an approach will almost certainly be recorded and debated in our *Proceedings* as has been Workmen's Compensation ratemaking for many years.

The addition of papers such as this to our *Proceedings* needs no justification. The precursor of this modern series of educational endeavors by members of the Society was undoubtedly Mr. Marshall's well-known paper on Workmen's Compensation Ratemaking. Despite the coexistence of more esoteric papers on Compensation for the well-informed actuary, Mr. Marshall found a wide audience among actuaries as well as many others. Those whose work does not permit them the luxury of playing a part in the development of particular methods in the ever-changing insurance world, or who haven't access to the necessary sources of information find these fundamental statements invaluable. Mr. Magrath is to be thanked for accurately recording much of the current theory and practice of fire insurance ratemaking and for providing a solid base upon which to build.

RATE REVISION ADJUSTMENT FACTORS

LEROY J. SIMON

Volume XLV, Page 196

DISCUSSION BY R. L. HURLEY

The paper "Rate Revision Adjustment Factors" by LeRoy J. Simon is essentially an analysis of the mathematics underlying the adjustment of current rates to reflect loss ratios experienced under the premium rate structure formerly in effect. Early in the article, the author points out that the rate revision factor will, most frequently, be of significance with coverages for which the pure premium method is not applicable because the official Stat plans do not provide an exposure base. Probably, fire and allied lines would constitute a most typical environment within which the techniques discussed in this paper might be applied—although there are probably instances when they would be equally pertinent to casualty lines.

At the outset, the "Rate Revision Adjustment Factor" is defined as a number which, when multiplied by a set of collected premiums, will revise or correct these premiums to reflect a new or current set of rates. Under Case A, the paper establishes this number "F" mathematically in its simplest form divested of any of the ramifications encountered in the normal work-a-day situations of rate making. Then a comparison is made between this precise expression and the equivalent equation which would result if common practices were turned into mathematical language.

In subsequent sections, the author relaxes the various restrictions which were initially imposed on his mathematical development in order to present the underlying concepts with a minimum of algebraic distractions. In Case B, the paper analyzes the play of Installment Payment Plans which have, at least in fire insurance, assumed commanding importance. Certainly no mathematical treatment of fire loss ratios could be considered adequate without a careful investigation of this influence. As a consequence of this investigation, the author introduces in "Case C" a mathematical equivalent whereby the effect of rate revisions on 5 year Installment Plans is expressed or "telescoped" into the initial year of the policy.

The previous sections were designed independent of growth, or if you prefer, on the assumption of zero growth. In Cases "D" and "E" a growth factor is superimposed on respectively the Prepaid Policy (i.e., Case "A") and the Installment Policy (i.e., Case "B") including in the latter case the effect of telescoping rate revisions back into the initial year of the Installment Policy. And finally, the author presents a corollary wherein he analyzes methods by which a company with a set of rates differing from those of another carrier or bureau may obtain a composite comparison of the different rate levels between the two organizations.

No mathematical effort ever escapes the logical necessity of making assumptions. By common tests, we customarily demand that the assumptions not outrage our experience of things as we know them. For more theoretical investigations it should suffice that the postulate system be free of any substantive inner contradiction.

It is thought that the author's simplifications of insurance experience are quite straightforwardly presented. He works on written premiums only, although experience for rate making purposes is reviewed on an earned premium basis. He assumes that exposures are distributed evenly over the year whereas there may be reason to suspect a seasonal variation underlying random chance gyrations. Annual installments are treated as constant in respect to the amounts of insurance over the life of the policy and the premiums are considered as paid in equal installments. Neither these nor the other assumptions that serve as the framework on which the mathematics are woven into a multi-phased design rub painfully against the reviewer's appreciation of insurance realities as he understands them.

We should like to consider the paper's conclusions, expressed and implied, under the dual aspects of "factual" and "logical". It may be that other readers will regard such a distinction as tenuous at best; and hold that if any such differentiation is to be made, the reviewer has seemingly reversed the accepted meaning of the terms. Under the connotation of "factual," we do not disagree, but are not distressed, with the author's conclusion that the intuitive approach in adjusting collected premiums for rate changes introduces a constant bias of a maximum order of 1¼% inadequacy under a 20% rate reduction. We also noted that the commonly used arithmetic mean gives a less accurate answer than the harmonic mean in summarizing the effect of class rate changes on different mixes of business, but a pencil test of a few examples suggest that the variations may not be too wide under typical circumstances.

We begin to become disturbed at the author's demonstration that a significant disparity is introduced by ignoring the effect of five year installment business (cf. equation 34)—but this disquiet may possibly stem chiefly from theoretical considerations. While accepting these factual conclusions, we reflect that one should not be displeased if in its first statistical attempts, fire insurance rate equities attain a rough, frontier-type of justice. Over the years, the schedule approach has proved its value in the fire insurance field, and the future should afford even greater improvements, but it may be a little while before fire rates can be made to a fine degree of statistical precision. Possibly this observation may be extended to certain other coverages for which the rates are influenced by the loss ratio indications.

The reviewer thought that the major contribution of this paper may ultimately prove to be the logical consequences of its mathematical demonstrations. While the substance of the article is within the mathematical requirements of our Society, it demands a careful reading—with a pencil never far from hand. The fundamental ideas are succinctly presented. As the argument unfolds, more difficult concepts are introduced and the algebra becomes somewhat rigorous. The reviewer spent a goodly number of hours on the simplifications in the area of equations (26) through (33) before arriving at the indicated formulas. In general, the notation possesses an inner consistency and a degree of elegance that make the mathematical reasoning a delight for the reader.

In any pursuit founded, as insurance, on statistical science, the more frequently elements significantly deficient in respect to mathematical precision are introduced into the rating procedures the more obscure the logical inter-relationships and the less defensible the procedures—on purely statistical grounds. Few actuaries, we trust, would force this observation to mean that insurance rates are always reducible to set equations. Most practitioners in our profession soon learn that there are seldom mathematical transforms which will automatically turn the specific rating problem into a trim statistical equation. Our theoretical investigations must be counted as successful if they quicken our insight into the noumenal of the insurance transaction. We are fortunate that with Mr. Simon's paper, our *Proceedings* will contain a scholarly research into the inter-relationships underlying the loss ratio method of adjusting rates.

AUTHOR'S REVIEW OF DISCUSSION

LEROY J. SIMON

I appreciate having Mr. Hurley review the paper because I know it represents a thorough and unbiased consideration. While he and I both use the fire insurance business as the principal source of our examples, I know we both agree that the formulas presented in the paper are quite general and may be used in any line of insurance. Wherever rate revision adjustment factors are used, there is no reason to use anything other than the proper formula. To do otherwise is to voluntarily introduce an element of inadequacy into the rate structure.

The factors developed in the paper relate to written premiums only. The preferable way to adjust experience to current rates is to apply these factors to the written premium first and then convert the adjusted premiums to an earned basis. In the fire insurance line, a striking example of the error of reversing the order of this process is given in this volume of the *Proceedings* in Note 7 of the paper "Notes on Some Actuarial Problems of Property Insurance" by L. H. Longley-Cook.

The only difference in Mr. Hurley's conclusions and mine appears to be a matter of degree. He states that he is "not distressed" with the element of inadequacy that is introduced by using the incorrect formula; he is not displeased with the fact that fire insurance rate equities "attain a rough, frontier-type of justice"; and he observes that it may be a little while before fire insurance rates can be made "to a fine degree of statisical precision". As we encounter increasing rate competition in each of the insurance lines and as we find tighter and tighter rate regulation, we are being forced to eliminate any loose techniques wherever we find them. When we speak of a 1¼% inadequacy in an overall rate structure, I feel that we must be gravely concerned because this represents a full one-fourth of a 5% theoretical profit loading in the rate. If we look back at the actual profit realized over the past few years, any unnecessary bias that produces a consistent inadequacy takes on an even greater importance. Even in the fire insurance industry where rate making methods are perhaps in their most elementary stage, such an improvement is one of a number of steps forward that must be made. Remember, we might be dealing with the overall rate level in a given state and slight errors might result in many thousands of dollars in their effect. Perhaps, through making simple refinements like this we can further improve the accuracy of our rate making in many lines and accelerate the introduction of better actuarial methods into such lines as fire insurance.

In the six-month interval from the time the paper was originally presented I have had a few additional thoughts which may be of help to those who have had the interest and perseverance to read through the paper, the review, and now the reply. On page 199 in the original paper, some interpretations are made of the values found in Appendix B. Rather than stating that the error is equal to $(1 - C)$, it would be better to calculate the amount of error to be equal to $(1 - 1/C)$. In this way we could then say that the true amount multiplied by 1 plus this error factor will produce the incorrect answer. This is the more usual interpretation we place upon the concept of a percentage of error.

To overcome the distortions referred to in the footnote on page 200, there are three methods available. The first of these is to use the full term reporting method under which term business paid on an installment plan is recorded on the company books as a single entry at the inception of the policy. This is the method advocated by the writer of the article referred to in the footnote. The second method uses the annual reporting system where installments are recorded each year as they fall due, but the amount of "surcharge" in the first installment is entered for the full term of the policy. This method is explained by Dudley M. Pruitt in a paper entitled "Unearned Premium Reserve on Fire Installment Premium Policies", which appeared in The Interpreter (the monthly publication of the Insurance Accounting and Statistical Association) for August 1951. Another method also based on the annual reporting system is covered by Paul Otteson in the Proceedings of the Insurance Accounting and Statistical Association for 1951, page 352. This method does not require the use of a full term premium tabulating card entry for the "surcharge" but it does require more coded information to determine which installment payment of the series is being considered. When the first of these three methods is used, equation (6) is appropriate in dealing with rate revision adjustment factors (under the assumption of a level premium volume). However, when either Mr. Pruitt's or Mr. Otteson's formula is used, the more complex equation (14) would be the starting point for installment business.

Equation (37), which sets forth a formula for comparing rate levels between two different organizations, can also be used to good advantage to determine the value of "d" itself, which is used extensively throughout the earlier equations in the paper. In the denominator of equation (37) there is a ratio of the Bureau rate divided by the company rate. If this ratio is replaced by the old rate divided by the new rate, we then have a formula for determining the average rate level change. Notice that the weights used in this equation are based upon premium volume and not upon exposure units. (Remember that if exposure units are available, one would simply extend the exposures at old rates and then extend them at new rates and make the comparison in this fashion, thus avoiding the computational complexity of equation (37)).

THE CANADIAN MERIT RATING PLAN FOR INDIVIDUAL AUTOMOBILE RISKS

HERBERT E. WITTICK

VOLUME XLV, PAGE 214

DISCUSSION BY A. D. PINNEY

Automobile insurance rates have been a matter of great concern to both the Insurance Industry and the insuring public during the past few years. Many solutions have been proposed, but the one put forth most often is Merit Rating. Mr. Wittick's paper on "The Canadian Merit Rating Plan For Individual Automobile Risks" is, therefore, very timely and of keen interest to most of us.

He has presented to the Society a clear and concise description of what the present Canadian plan is and how it evolved over a number of years. In addition, Mr. Wittick has exhibited data which clearly substantiates the theory that risks which have produced claims are more likely to have losses in the following year than those which are claim free.

In his conclusions, Mr. Wittick makes the following statement in reference to the advantages of this merit rating plan:

> "It permits a low rate for the select risk, and that is what the insuring public demands."

What this plan actually provides is a discount, not a low rate. It will be recalled that the base rate is applied in full for a risk having an accident during the past year, and discounts of 10%, 20%, and 35%, if accident free for one, two or three years. The off-balance that results from the current distribution of risks is so great as to require a base rate for liability over 40% higher than what would be required if no merit rating plan were used. The net result is that the 35% discount is in reality only an 8% discount, and the 20% and 10% discounts are actually surcharges of 13% and 28%. It can further be shown that for a driver to obtain a long term advantage under the Canadian Merit Rating Plan as it now exists, he should not average more than one loss every 13 years. Obviously, there are no large financial savings, and the insured who is getting a 10% or 20% discount is actually a poorer risk than average, not a preferred risk.

DISTRIBUTION OF CARS INSURED

Merit Rating	*Class 1*	*Class 2*	*Class 3*	*Class 4*	*Class 5*	*All Classes Combined*
A	82.7%	75.7%	76.1%	62.3%	79.6%	80.5%
X	3.7	4.1	4.8	6.6	4.4	4.0
Y	4.9	5.9	6.5	8.7	5.6	5.3
B	8.7	14.3	12.6	22.7	10.4	10.2
Combined	100.0	100.0	100.0	100.0	100.0	100.0

OFF-BALANCE PRODUCED BY DISCOUNTS ON THIS DISTRIBUTION

Merit Rating	*Distribution of Cars Insured*	*Percent of Base Rate*	*Cols. (2)x(3)*
A	80.5%	65	.523
X	4.0	80	.032
Y	5.3	90	.048
B	10.2	100	.102
			.705

% Increase in Rate Level to Correct for Off-Balance:

$$\frac{100}{70.5} - 100 = 41.8$$

Effective Rate Level:

Merit Rating	*Adjusted Base Rate Level*	*Percent of Base Rate*	*Effective Rate Level (2)x(3)*
A	141.8	65	92.2
X	141.8	80	113.4
Y	141.8	90	127.6
B	141.8	100	141.8

Comparative Costs of Insurance to a risk with a claim incurred during the 9th year. (Assuming a constant rate of $50 per year when no merit rating is involved.)

Year	*Cumulative Cost Merit Rating*	*Cumulative Cost No Merit Rating*
9	$414.90	$450.00
10	485.80	500.00
11	549.60	550.00
12	606.30	600.00
13	652.40	650.00
14	698.50	700.00
15	744.60	750.00

Now this hasn't been shown in an attempt to discredit the plan where it is now used, but to show why it is extremely doubtful that it could be initiated in the United States in its present form. The required change in manual rates would be prohibitive.

It is significant, however, that by means of the Canadian Plan, the Automobile Insurance Industry is able, for the first time, to meet the demand for a rating plan that will produce a lower rate for the careful driver than that produced for the careless driver. It is hoped that the plans that have been or are about to be introduced in the United States will be as successful.

DISCUSSION OF PAPERS READ AT THE MAY 1959 MEETING

COMPULSORY AUTOMOBILE INSURANCE IN EUROPE

FRANK ASTILL

VOLUME XLVI, PAGE 1

DISCUSSION BY F. S. PERRYMAN

Mr. Astill's paper gives a useful summary of compulsory automobile insurance in Europe. The paper is factual and descriptive of the situation as it existed in April when Mr. Astill presented the paper, but as is usual, particularly in connection with legislative activities, there are continual changes, and, as of October 1959 there have been a number of additional developments as follows:

1) In Great Britain the Assurance Companies Acts 1909/46 have now been consolidated by the Insurance Companies Act 1958. This made no substantive changes in the provisions of the earlier legislation.
2) Following a very recent Court of Appeal decision, insurers liability to pay hospital charges now extends to all third parties and not merely to those defined in the 1930 Road Traffic Act.
3) A new law became effective July 1, 1959 in Denmark providing mainly for changes in maximum liability amounts. These now became Kr.150,000 ($21,750) but with a maximum of Kr.60,000 per accident year. For material damage the limit becomes Kr.60,000 ($8,700).
4) As of January 1, 1960 a completely new law becomes effective in Finland, which provides for considerable fundamental changes. The new law establishes that the use of a motor vehicle will carry with it liability for injuries or damage caused to others and that this liability must be covered by insurance. Claims may be made against the insurer direct. Under the hitherto existing law the owner or driver of the vehicle was freed from liability only if it could be proved that the injury or damage had not been due to a defect in the vehicle or fault of the driver. This will no longer apply but the reversed onus remains.

   Insurance cover will be unlimited but the new law no longer limits maximum amounts for certain types of injury or damage, except that for material damage the limit has become M.25,000,-000. In the case of death, not only the widow and orphans may claim indemnification but also any other persons whom the deceased had to support. Claims for pain and suffering will also be admissible.

5) Although the Saar territory had its own compulsory insurance laws, it is likely that, following the integration of the territory with Germany, changes will take place.

6) Poland now participates in the Green Card Scheme. The law regarding visiting motorists requires cover up to limits of ZL.150,000/450,000 for bodily injury and ZL.75,000 for property damage liability. There is no compulsory insurance requirement for Polish Nationals at present but it is expected that this will be introduced in 1960.

In view of the automobile situation in this country, casualty carriers here would like to have seen the paper include some comments upon automobile premium rates and results, particularly comparing the costs of uninsured motorists schemes as compared with the general rate level. However, this would open up a very large subject, not actually within the scope of this paper, which perhaps could be the basis of a later paper.

In connection with the observation that a deposit is limited to £15,000 whereas insurance is unlimited, it is probable that this provision is rarely used. How many Britons could mobilize £15,000 of capital, and of those who could, how many would sterilize its earning power? Only a portion of the interest income of such capital would be required to pay insurance premiums. It is implied that cash is required for deposit although perhaps securities could be used. It may also be observed that a bond is limited to £5,000 instead of being £15,000 as the deposit is, or unlimited as is the insurance. It is obvious that the deposit cannot be unlimited, and the reasons for these alternative provisions which exist also in the U.S.A. Compulsory Legislation, including Workmen's Compensation Acts, is that it is Financial Responsibility which is sought and insurance is only one means, although the most practical one, and therefore the main one, of providing this.

Reference is made to the fact that claims have not exceeded £20,000 but this should not be taken to mean that the unlimited liability provisions are of no value. Multiple claim accidents and property damage claims very quickly can amount to substantial sums, and this is easily illustrated by the case of an automobile which was driven on to an airport runway and caused the wreck of a landing airplane.

Mr. Astill attributes the success of compulsory insurance in the United Kingdom to prosperity, full employment, and social security which have combined to keep losses from getting out of control. It is curious that with the same conditions obtaining in this country, automobile insurance has been a most severe problem for us and not as free from difficulties as it apparently has been in England. Additionally, conditions of inflation since World War II existed both in the U.K. and in the U.S.A. We have been caught between rising loss costs and claim frequencies, and inflexible rate regulation. In observing that U.S.A. results parallel those in Germany and in France rather than those in the U.K., could we not attribute this to reasons which are not economic but social? Is it not due ultimately to the different mores of our respective citizenry?

It is interesting to note the arrangements which have been made whereby tourists can easily comply with the various compulsory acts using the Green Card system. Similar arrangements are available to American tourists in Europe for there are many American insurers who could make such arrangements for their policyholders, either by direct or indirect participation in such a scheme or through another carrier.

We owe Mr. Astill our thanks for having given us this thorough and very carefully prepared paper. It brings home to us, most of whom are engaged in domestic insurance practice, the fact that insurance is a world-wide mechanism, whose problems and practices transcend national borders.

LIABILITY INSURANCE FOR THE NUCLEAR ENERGY HAZARD

RICHARD H. BUTLER

VOLUME XLVI, PAGE 23

DISCUSSION BY J. P. GIBSON, JR.

Since liability insurance for the nuclear energy hazard is still in the research and development stage, Dick Butler's paper on this subject is a masterpiece in painting the picture as it currently exists.

Mr. Butler was one of the pioneers chosen to blueprint the necessary innovations required to arrive at our present method of handling liability insurance for the nuclear energy hazard. He demonstrates in this paper a thorough grasp of the subject. Only a master of the situation could possibly condense into a short paper the historical background and explanation of progress in this newest of insurance ventures.

The paper only hints at the magnificent job of public relations achieved by the nuclear pools to work out an insurance program that would mesh with the government indemnity, to secure agreement by the insurance industry of uniform reinsurance exclusion clauses and acceptance by the public of concurrent exclusion clauses. The fact that these exclusions accomplished a transfer of liability from one piece of paper to another does not detract from the splendid salesmanship required.

Consider for a moment some of the innovations now in actual practice. The Nuclear Energy Liability Policy continues in effect indefinitely until terminated. The limit of liability expressed in the policy applies to the entire period that the policy is in effect. Loss adjustment expense is included within this limit of liability. The omnibus definition of assured sweeps into coverage even the *tort-feasor*. With respect to off site property owned by the assured, such property is covered on a third party basis.

At least one innovation will surely be tested in our courts when a suitable occasion arises. This is the clause in the policies that provides for a limitation of liability with respect to multiple policies applicable to the same loss. The insurance industry fervently hopes that this clause will be affirmed by the courts.

Since this type of insurance is still in the research stage, rather precise and yet complicated phraseology was required. In several instances, it was necessary to use the indirect approach. For example, Mr. Butler says in his paper "don't look for this employers' liability coverage in the insuring agreements of the facility policy because it turns up as an exception to an exclusion and as a proviso clause in the 'other insurance' condition." Again the coverage of isotopes is left in the normal liability policies because it falls down between the chairs of other exclusions.

Rate making was a real problem. The buyers of the coverage wanted rates based on probable losses. The insurance industry believed that rates should be made on the basis of possible losses. This difference of opinion was finally resolved by the Industry Credit Rating Plan. While this plan is explained at the end of his paper, Mr. Butler displays consummate diplomacy by giving credit for its creation to the actuaries. To the best of my knowledge, the Industry Credit Rating Plan has not at this date been reduced to an endorsement that could be attached to the outstanding liability insurance policies on the nuclear energy hazard.

For the record, one small comment may be in order. Mr. Butler states "the constitutions of the liability pools were adopted in the Spring of 1956." This is true of the stock pool but not of the mutual pool. The mutual pool has no constitutions, no bylaws, no officers nor in fact, any corporate existence. The mutual pool is purely a reinsurance pool and is one of six administered by the American Mutual Reinsurance Company. In the interest of simplicity and economy, an association of six mutual casualty companies was created known as Mutual Atomic Energy Liability Underwriters. On the mutual side, all liability policies are issued by MAELU and immediately reinsured 100%. Since all six companies are licensed in all of the states and are thus qualified to issue all policies, its operation is simple indeed.

It is my understanding that there is an additional reason for the innovation of the coverage on a third party basis of an assured's off site property. Since no catastrophe reinsurance is available for the companies writing the physical damage coverage on the nuclear energy hazard, such companies were sensitive to the prospect of catastrophe losses. Capacity to insure an individual reactor site appeared to be available, but widespread property damage losses flowing from one nuclear incident might approach catastrophic limits with no catastrophe reinsurance. Therefore, the transfer of coverage of such off site property to the liability policies, thus bringing them in for protection under the Government Indemnity Bill, solved this problem for the insurers of the physical damage coverage.

Mr. Butler's paper will serve as an invaluable reference work on the complex, intriguing and highly important subject of liability insurance on the nuclear energy risk.

SOME FURTHER NOTES ON ESTIMATING ULTIMATE INCURRED LOSSES IN AUTO LIABILITY INSURANCE

FRANK HARWAYNE

VOLUME XLVI, PAGE 59

DISCUSSION BY F. J. HOPE

Mr. Harwayne has presented this paper as a supplement to his previous paper "Estimating Ultimate Incurred Losses in Auto Liability Insurance" (Volume XLV, 1958 *Proceedings* of C.A.S.). He here elaborates on the derivation of and the factors underlying a formula incorporated in his preceding paper; namely,

$$\log_{10} y = 2.0674 t^{-.80599}\ 10^{-.24841t}$$

In the formula, a value for y expresses losses paid as of any evaluation date t as a percentage of total losses eventually to be incurred on a policy year of automobile insurance exposures.

In this elaboration, Mr. Harwayne examines the various forces that go into the accumulation of losses paid with the passage of time. On the first page, he draws upon Mr. Tapley's earlier paper to suggest two conclusions; namely, that (1) "easier claims are settled first", with which there can hardly be any quarrel, and (2) "that the number of claims paid during a particular time interval is functionally related to the number of claims outstanding at the beginning of that time interval." It would seem that this latter needs some elaboration with respect to relative number of car exposures immediately prior to the period, since that would affect the number of claims outstanding at the beginning of the period.

On Page 60, with respect to the distribution of number of claims paid (as % of total) according to average age of accident, there follows a statement to the effect that the values are "satisfied by a formula for paid increments comprised of 9% of the amount (presumably number) outstanding as of the beginning of each month." There is no elaboration as to how the value of 9% was established, so one must assume that it was derived from the same data as the distribution itself.

The formula for N, the cumulative number of claims paid (as a percent of total) according to time measured from date of accident is relatively simple and fits the observed data quite well. However, it becomes extremely complex when combined with a third degree equation designed to reflect seasonal variations in number of claims created.

The reviewer made his way through a check of the algebra and calculus involved, and can only express doubts as to the practical value of this formula in the everyday business of revising rates. It could be expected that both company executives and insurance department authorities would insist upon observed data to substantiate the formula, to such degree that that formula itself would not be needed. It must be acknowledged that the comparison between calculated values and observed values for Policy Year 1956 is impressive.

With respect to Mr. Harwayne's summary, we can agree that the traditional method of developing earned premiums and earned exposures are suitable for approximating the occurrence of losses as well, subject to seasonal variations. In his summary, he also notes that, measured from time of occurrence, the average paid claim cost increases with time, and leaves it to the reader to speculate on what the result might be if a company made every effort to clear out its claims quickly. The inference seems to be that claims grow large because they are allowed to age; it is more likely in most instances that they age because they are of a serious nature and, therefore, destined to be large from the moment of occurrence. There is also an inference that the companies could reduce their losses by disposing of them more quickly; on the contrary, it is not only possible, but quite probable, that the haste to dispose of claims rather than resist them has been a major factor in the steady growth of average claim size, and thereby a disservice to both companies and the public in the long run.

It is this reviewer's conclusion that Mr. Harwayne's development of formulas to measure the various forces behind loss payments makes an excellent addition to the *Proceedings* of the Casualty Actuarial Society. For practical application, they require and should initiate more rigorous tests by substantial volumes of data.

NOTES ON SOME ACTUARIAL PROBLEMS OF PROPERTY INSURANCE

LAURENCE H. LONGLEY-COOK

VOLUME XLVI, PAGE 66

DISCUSSION BY F. W. DOREMUS

A careful review of Mr. Longley-Cook's paper must impress the reader with the extent of his research, the depth and clarity of his reasoning and the challenge of his conclusions.

He explores many facets with a precision that again draws to the attention of the Society those contributions that can be made by it to reducing the overall complexity of fire insurance rate making.

One cannot avoid the impression that the rapid changes in the property insurance field, and the dearth of underwriting profit during the past few years, need continued and combined research facilities, with the best minds, to chart a future course and evaluate past results.

There is a challenge to the actuarial side to match the practical underwriting side in the developments that lie ahead.

In my review, I am limiting my comments to those phases which, in my experience as an underwriter, call for an extension of views.

2. *GENERAL PROBLEM*

The author mentions "a fairly close parallel between schedule rating in fire insurance and the numerical system of rating used in life insurance underwriting."

It would seem to me that this parallel would be lost in the base used with the two kinds of insurance. Life insurance is based upon the mortality rate, which is fixed in the certainty of death and converted to a mortality table that has seen little change over the decades to reflect the extended longevity of our modern times.

Unlike life insurance, fire insurance is not based upon a certainty, but rather upon a probability of the loss occurrence related to factors of building construction, occupancy, protection and exposure, none of which are susceptible to precise actuarial treatment under our present methods of compiling and reporting statistical data.

The law of large numbers cannot operate in the fire insurance field as it does under the mortality table of life insurance because no homogeneous groupings can compare with the age groups and life expectancy of the millions of persons covered by life insurance.

To attempt a comparable actuarial development would, in my opinion, require creating and maintaining statistics along these general lines:

1. Number of risks in each of the 115 classes divided according to construction and protection and separated as to building value and contents value.
2. Number of those risks, so divided, which are covered for fire insurance.
3. The percentage of insurance to value on those risks covered for fire insurance.
4. The number and extent of fire insurance losses applying to each class divided as to building loss, contents loss, and separated as to those covered by insurance and those not covered.
5. The cause of the fire insurance loss and the amount of loss attributable to each cause.
6. List of factors contributing to the spread of the fire in connection with large losses applying to any class.

If such statistics were available for a sufficient period of time to develop actuarial studies of pure loss cost, it is possible that the resultant display would merely confirm today's judgment of the experienced underwriter and the competent rater as to the relativity in fire insurance rates now developed by the varied schedule treatments.

Certainly, such actuarial precision would not deter the Companies from deviating as to the base and selecting the best risks of a class for special rate concessions or broadened forms of fire insurance coverage.

Further, the rapid developments of the past ten years, particularly in the field of "package" policies now embracing commercial, manufacturing and the dwelling classes, plus ever increasing number of deviations and independent filings using current fire rates as a base, have cast a shadow upon the future validity of current fire insurance rating practices.

Added to this trend are some Companies' separate filings of broadened protection for specific groupings, such as motels, summer camps, public buildings, churches, hospitals, hotels, large housing projects, involving one or more of the following features—"Replacement Cost Coverage" for contents, Guaranteed amount of insurance as a substitute for the traditional use of the coinsurance principle, and, a form of "loss of use" insurance to apply as tuition fees, rental value or business interruption insurance depending upon the class of risk covered.

The package policy and the independent or deviating filing for specific classes involve not only the fire insurance rate but the rating of the windstorm peril under the Extended Coverage Endorsement, the burglary and comprehensive public liability rating of the Casualty insurance field, and the inland marine rating of transit coverage.

The increased sale of package policies and those under deviating or independent filings could reach the point where the rate levels for the several coverages lose validity unless the particular components are accurately separated and inserted into the statistical experience, both as to premiums and losses.

If this is not done and the package policy is treated as a class or kind of insurance, then the premiums and losses thereof, usually representing risks of a better grade, will not appear in the classified experience and the remainder, representing the less desirable groupings, will require progressively higher rates.

An example of this phenomenon has already developed in connection with the writing of specific windstorm insurance. As the premium volume of the Extended Coverage Endorsement expanded, the volume of specific windstorm coverage decreased until the loss experience on the limited remainder would require a rate level higher than that charged for the Extended Coverage Endorsement.

Accordingly, the specific windstorm rate levels recommended in the Eastern territory were set at the same figure used for the Extended Coverage Endorsement and required a minimum of 80% insurance to value under the use of a Coinsurance Clause.

It is not beyond the realm of possibility that if, for example, the

Homeowners Package Policy is treated as a class or kind of insurance and its premiums and losses for each peril are thus lost to the statistical base used for dwelling rate making, then there must be progressively increased rates upon the remainder.

3. DWELLING—Building-Contents Differential

The study cited by the author which indicated that contents rates were approximately 1.4 times the building rates merely confirms the old precept that dwelling contents under protection develops higher loss cost than the building containing the property and the "old time" raters usually indicated a 50% increase in dwelling building rate for contents coverage.

We agree with Mr. Longley-Cook that low insurance to value on contents influences the loss experience. Further, that the identical rate for building and content of dwellings outside of recognized protection was predicated upon the probability that a fire would result in a total loss. It may be that this judgment could be modified in certain areas now served by modern rural fire protection using tank trucks and spray nozzles for fighting fires.

4. DWELLING RATING PLANS

The simplicity of the plan outlined by the author wherein he divides the Protection Factor into four classes and the construction into two grades would seem workable if dwelling property could be appropriately defined and limited to one family owner-occupied dwellings of modern construction.

Such risks present no problem to the underwriter and the loss experience thereon would be better than average because of greater insurance to value induced by the insurance requirements of the mortgagees and the fact that most new dwellings are constructed under building codes designed to minimize the hazard of fire from heating and electrical installations.

However, the use of this simple plan would adversely affect the rate level for these modern owner-occupied dwellings when its statistical base included the older dwellings in the so-called blighted areas of large cities, the dwellings currently covered for an amount of insurance well below today's replacement cost less depreciation, and those risks now defined as dwellings in many rating jurisdictions which include, in some cases, four apartments or four families in a single building unit and related occupancies such as Doctor and Dentist offices, beauty parlors, barber shops, etc.

The dwelling classification in any State, from a statistical standpoint, represents the largest grouping of separate units but the rate level determined by loss experience necessarily places a penalty upon the better risks and grants more favorable treatment to the less desirable ones. This creates a competitive situation, particularly when a Company deviates from existing rates but limits its acceptances to those risks of the better grade. Unless some realistic sub-division of the dwelling loss experience is devised, there will continue to be this disparity among the rates charged for the units contributing to the base.

Currently, studies are underway to relate the various applications of protection grades to the dwelling class and to evaluate some of the present territorial treatments of chimney constructions, shingle roofs and lightning rods.

5. *ACTUARIAL ASPECTS OF SCHEDULE RATING*

Mr. Longley-Cook suggests a plan for a more accurate method of schedule rating which includes substituting a single nationwide rating bureau for the present method where one or more States are handled by a single autonomous rating bureau. There are 38 such rating bureaus serving the United States, including District of Columbia, Alaska and Hawaii.

He suggests standardizing the rate making schedules and this project had previous consideration by the Insurance Executives Association and involved extensive study and testing of two approaches to the problem prior to the dissolution of that organization.

While uniformity in schedule application may be desirable, there could be a fruitful area for actuarial exploration into the feasibility of substituting so-called "class rates" for certain smaller and less complicated mercantile risks now rated under schedules. Presently, these require the relatively expensive process of physical inspection, then the manual application of charges and credits to a schedule rating procedure, including printing and distribution of specific rate cards. A study of this project would necessarily include

(a) A decision as to where the "line would be drawn" between the risk eligible for schedule rating and the one to which "class rates" could be applied. Factors of size, floor area, height, insurable values and occupancy would influence the judgment of those charged with the decision.

(b) The number of such risks within each statistical class and the approximation of premium volume to gauge the effect upon loss experience for the class. This could involve refinement to the statistical base to create two sections for each class, i.e., one for schedule rated risks and the other for class rated risks.

A review of the other four steps in the plan proposed by the author for a more accurate method leaves something for the practical rate man to ponder. For instance, the simplification of schedules by omitting minor debits and credits would raise problems in connection with the rating of a complex manufacturing risk of fire-resistive construction and protected by automatic sprinklers because of the variety of standards to be met in evaluating the fire safety of a risk as reflected in the final rate. Many times, a minor charge for a deficiency in a large value risk has a significant reflection in the final premium cost and the physical correction of the defect to remove the minor charge develops greater fire safety and a reduced possibility of loss.

The three remaining steps are non-controversial if a nationwide bureau operated with standardized rate making schedules.

6. TERM RULE AND INSTALLMENT PLANS

The comments on term rule in this section with respect to the recommended change from the old factor of 75% for each additional year in excess of one to 85% or 2.7 for three years draw attention to the fact that this change in factor with its extension of eligibility leads to an increase in anticipated premium volume from the classes presently eligible and a decrease in premium volume for those classes not previously eligible.

With respect to the author's discussion of the impact of installment plans on the statistical results, it should be noted that the Deferred Premium Payment Plan, tested in California and now recommended for countrywide use, contemplates equal annual installments, thus removing some of the variables existing in the other plans. If each installment is treated as "annual" for reserve purposes, the resulting earned premiums will be 50% of one-third of 2.7 times the annual rate for the first year and an equal percentage for the second and third.

Comparing the previous 3-year treatment of installments at full rate the first year and 78% for each of the succeeding years, there would be a decrease of ten percent the first year, a minor benefit the second year, and about 15% increase for the third and fourth years.

To explore the present movement of loss experience in relation to the prospective results based on the countrywide use of the Deferred Premium Payment Plan would be a formidable task but the actuary could be challenged by this study particularly when related to the impact of the new term rule now operating in most states.

8. RATE REVISION TECHNIQUES

The practical rate man in the fire insurance field leans heavily upon the principles established by his predecessors. He evaluates data with a "slide rule" of experienced judgment and until recently, i.e., within the past ten years, did not have a recommended pattern for rate level evaluation and revision that could be applied at the State level or in Regional territories. The pattern was consolidated by Inter-Regional Insurance Conference in the principles recommended in 1955 and quoted by Mr. Longley-Cook.

This recommendation of Inter-Regional Insurance Conference brought into focus, for the first time, a plan for fire insurance rate level treatment that could be reviewed by the trained actuary for testing as to theory and practice. It also came at a time when loss experience was worsening; the rapid developments of coverage extension were reaching a pinnacle, and at a time when deviating or independent rate filings were being made in an attempt to syphon off the better grade risks in several profitable classes. The plan also felt the impact of the term rule change and a revision in the installment premium payment plan.

In general, the challenge of the Inter-Regional Insurance Conference recommendation to the trained actuary is not, in my opinion, the validity of its separate sections but rather a study of the base from which it stems. For instance, the classified statistics might well be re-studied for application to today's conditions and a challenge given to those specific classes which do not produce a sufficient countrywide premium volume to establish credibility and are thus subject to wide fluctuations in yearly loss ratio when a single large loss distorts the statistical picture.

Likewise, a study of state by state experience would show the wide variation between classified figures in Wyoming and New York, or Vermont and California due to total fire insurance premium volume in those states being unrelated except in the realm of over-all results.

The recommended plan of Inter-Regional Insurance Conference is not static but continues under study in the light of suggested changes to improve its application during the four years of testing and this includes the study of the validity of the earned and incurred loss experience as suggested by the author in a section of his paper.

9. CREDIBILITY

This subject has always been an intriguing one for the practical rater and if a mathematical formula could be devised that would measure the beginning and end of credibility, he would be forever grateful.

Arbitrary standards within a single state or the inclusion of experience in contiguous areas using essentially the same rate base have not proved completely satisfactory. Neither have the countrywide results for certain classes developing a relatively small volume been considered relevant in an appraisal of rate movement.

Much could be done by the Society in the field of exploring facets of credibility in fire rate making and in the very interesting field of rating the Extended Coverage Endorsement with its loss frequencies dependent upon the formation of tornadoes and the movement of hurricanes.

CONCLUSION

In concluding these comments on Mr. Longley-Cook's paper, I would make the observation that the half century of building the structure of fire insurance rate making is not unlike the housing of a growing family where the original home is increased in size by constructing additional stories in height or spreading horizontally by new wings to accommodate the ever increasing brood.

In the process of evolution, accuracy may have been sacrificed in some areas and complexity created in the rating treatments, particularly in those risks where our expanding economy sparked by advances in science and technology have caused re-evaluation of previous hazards and the fire safety measures related thereto.

The actuary and this Society can be of real help by continuing the studies of the several facets of the problem on a specific basis, selecting possibly one or more of the areas treated so ably by Mr. Longley-Cook in the paper under review.

OCEAN MARINE RATE MAKING

D. DOUGLAS ROBERTSON

VOLUME XLVI, PAGE 81

DISCUSSION BY F. J. HUNT, JR.

Ocean Marine Insurance has been included in our reading list and examinations for a number of years now. However, a check of the *Proceedings* indicates that we have never before had a paper on the subject. Mr. Robertson's paper, therefore, fills a long-standing gap and should be most helpful in rounding out our coverage of the property insurance field.

Ocean Marine Insurance has not been completely ignored by the actuarial profession. Early volumes of the Journal of the Institute of Actuaries contain varied articles and reports on the subject. In Volume I of the Assurance Magazine (which later became the Journal of the Institute of Actuaries) there are an even dozen marine articles including such actuarial subjects as a study of collision statistics developing the relative probabilities of collision resulting in total loss for sailing vessels and steamers. By 1900 such articles had virtually disappeared from the Journal and an index to previous volumes published about that time notes that entries under the heading "Marine Insurance" had been omitted. This was probably partly due to an increasing preoccupation of the Institute with the life field; however, we may well conjecture that a contributing factor was a certain lack of enthusiasm on the part of the marine underwriters. With a history dating back to ancient times and policies comparable to the modern form having been written prior to 1400 A.D., the marine business had well established policy forms, underwriting procedures and rating methods. The underwriters could hardly have been expected to pay much heed to the proposals and opinions of the comparatively recent upstarts from the newer fields of insurance.

Mr. Robertson's paper is quite general in nature—a natural result of covering such a large field in a few pages. Also, rating procedures in ocean marine are fairly indefinite and rather difficult to pinpoint.

Probably in no other field does the underwriter's judgment weigh so heavily; as a matter of fact, in most instances the underwriter is the rate maker. William D. Winter in his "Marine Insurance" mentions some of the reasons for this situation:

> "Marine underwriting is not scientific in the sense that life underwriting is.
>
> "The marine underwriter is dealing with risks that are affected not only by the ordinary stable situations encountered every day but also by the rapidly changing conditions encountered on the seas. No chart or table can be devised that will show to a nicety how many days will be clear and how many stormy or that will measure the severity and direction of storms. He is dealing with problems over which the veil of the future is drawn, but he must rely on past experience and his judgment of changing conditions in order to arrive at conclusions of what will probably happen in the future. Furthermore, owing to the unusual physical hazards to which marine risks are subjected, the experience upon which the underwriter depends must extend over a considerable period of time, 10 years perhaps being the shortest period from which to draw conclusions."

A further complicating factor in ocean marine is that its worldwide nature in a very practical way precludes the use of exact formulas or procedures. This has been publicized most recently in the hearings before the United States Senate Antitrust and Monopoly Subcommittee by the testimony of Mr. Miles F. York on behalf of the American Institute of Marine Underwriters:

> "World competition and the unique characteristics of marine insurance require flexibility in individually considered premium rates. The American market could not compete in the world market if regulation robbed it of the necessary flexibility."

Even though there are no actuarial formulas in the computation or derivation of ocean marine rates, a more careful reading of Mr. Robertson's paper does reveal several areas where there are procedures or problems similar to those which we encounter in other fields. While there are no industrywide ocean marine classified experience figures, each company does keep its own figures and the success of that company may well hinge on the detail available in its statistics. "Biography of a Business", a history of the Insurance Company of North America, contains a chapter describing how the unprofitable result of their ocean marine account in the 1890's was eventually corrected on the basis of information made available through the introduction of a more complete and meaningful statistical plan.

The open cargo account can be readily compared to experience rating in the casualty field and the hull account to automobile fleet rating. While the ocean marine underwriter is more subject to the pressures of competition in arriving at the account or fleet rates, he still must consider such factors as allowance for catastrophe losses and credibility in determining how far experience should be reflected in revised rates.

The estimating of increasing costs on deferred hull repairs indicates that loss reserving can occupy a position comparable to the rest of the industry. Improvements in communication and transportation have greatly reduced the traditional delays in reporting losses, but there is still a sufficient lag, particularly on export cargo, to make important the accurate estimating of the incurred but not reported reserves.

The quotation from Winter mentioned before should have a familiar ring to the fire side of the business. The extreme difficulty of forecasting weather patterns and the need for a prolonged period of experience parallel very closely the problem in developing adequate extended coverage rates—particularly in those states subject to devastating hurricanes at irregular intervals.

With Mr. Robertson's paper finally getting ocean marine insurance into our *Proceedings* and serving as a reminder that our Society is interested in all fields of property insurance, we can hope that there will be forthcoming more detailed studies in those areas of ocean marine where actuarial techniques and experience can be of assistance.

A REVIEW OF THE EXPERIENCE OF MASSACHUSETTS WORKMEN'S COMPENSATION EXPERIENCE RATED RISKS

WALDO A. STEVENS

VOLUME XLVI, PAGE 87

DISCUSSION BY M. G. McDONALD

Mr. Stevens has followed the suggestion contained in a recent address of President Pruitt wherein it was implied that the actuary should get out of the "niche" and assist the underwriter. This paper presents comprehensive data which should provide a better market for debit rated risks in general. Of course, there are other considerations employed by the underwriter in viewing applications from debit rated risks besides loss ratio and modification. Many times an underwriter with a solid safety engineering unit behind him can convert the risk from the debit to the credit side of the ledger. In other instances competent field forces find misclassification which when brought to the attention of the supervising bureau results in a shift. In addition, the experience of other lines is viewed as possible support.

Mr. Stevens makes several comments on the Massachusetts exception in the application of the off-balance factor to experience rated risks exclusively and further suggests that the exception be eliminated. However, he offers no better solution than exists outside of Massachusetts. Approximately ninety percent of premium developed in Massachusetts in the most recent years comes from experience rated risks. The insertion of the off-balance into the manual rates, without further adjustment, merely increases the size of the off-balance factor. The current 1.03 factor applied to rated risks in Massachusetts would in all probability approach the 1.087 in Connecticut manual rates (Mr. Marshall, P.C.A.S., XLI). It is difficult to explain to trade associations and the public that such a change is desirable, necessary or in the public interest.

Back in 1938, (Vol. XXV, Part I) Mr. Thomas O. Carlson, Current Notes Editor, reported that in New Jersey, "The expected loss factor used for determining expected losses in the experience rating of risks has been increased several points above the standard permissible loss ratio. This is equivalent in effect to the introduction of a differential between experience rated risks and non-experience rated risks, and the resulting deficiency in rate level is made up by a factor included in the manual rates."

Apparently from Mr. Marshall's description of the National Council procedure, the inclusion of the correction for off-balance in the manual rate is standard practice and little or no offset is made in the expected loss factors. As Mr. Marshall points out, this method results in the reflection of almost 100% of the off-balance correction in the modified rate of the very low credibility risks while the opposite is true for the 100% credible risks, necessitating the doubling of the indicated off-balance factor.

Such an increase in Manual Rate Level in Massachusetts would be received by small risks, 80% of the total, with horror and the rate hearing would take on the aspects of the Massachusetts Auto hearings. It seems to the reviewer that Mr. Stevens has the ability and the source data to investigate the possibility of making the experience rating plan balance within itself or to materially reduce the off-balance factor so that correction, therefore, in Manual Rates would be more reasonable. A paper of this nature would make interesting reading.

REVIEWS OF PUBLICATIONS

ALLEN L. MAYERSON, BOOK REVIEW EDITOR

Paul H. Jacobson, *American Marriage and Divorce,* Rinehart & Co. Inc., New York, 1959, pp. 188

Dr. Jacobson has compiled the first collection of reliable statistics on the occurrence, duration and dissolution of marriages. His more than 100 tables, mostly based on population data compiled by federal, state and local authorities, include information valuable not only to demographers and sociologists, but also some that may be useful to the actuary. In particular, chapter 6, entitled "Chances of Marriage and Remarriage", includes tables, by age and sex, of marriage rates for single persons and remarriage rates for the widowed and divorced. In each case tables are given for 1940 and for 1948, and the substantial changes, both in the probability that a widowed or divorced woman will remarry and the age at which she will do so, should make any actuary think twice before using pre-war remarriage tables for any purpose where precision is important. The commentary accompanying the tables, though not very extensive, contains interesting comparisons of U. S. data with figures for other countries.

John E. Pierce, *Development of Comprehensive Insurance for the Household,* S. S. Huebner Foundation for Insurance Education, Philadelphia, Pa., 1958, pp. 435

This excellent book traces the evolution of fire and casualty insurance for individuals from contracts insuring a particular type of property against a specific peril to multiple peril and comprehensive contracts which contain, in one document, complete coverage on the dwelling and personal property as well as consequential loss and liability insurance. A complete history is given of the development of the Personal Property Floater, and eighty pages are devoted to the gradual evolution of both the liability and physical damage coverages of the automobile policy. Mr. Pierce sees the new Homeowners' policies as a logical outgrowth of more than fifty years of experimentation and gradual integration and broadening of policy coverage, a thesis he develops extremely well. In addition to being a source of many historical details not available elsewhere, this book is a must for any thoughtful insurance man who is concerned with how policies evolved into their present forms, or who has the responsibility for the development of new contracts.

O. D. Dickerson, *Health Insurance,* Richard D. Irwin, Inc., Homewood, Ill., 1959, pp. 500

This book contains a well-organized and interesting study of health insurance. The impact of ill health on society and the need for health insurance are well treated, and the detailed consideration of hospital insurance, surgical and medical coverage, major medical insurance and loss of time policies is always adequate and sometimes excellent. The "problems and issues" section at the end of each chapter which explores current and controversial questions, is especially noteworthy, and the comparison of Blue Cross and private insurers is excellent. The chapters on rate-making and related actuarial questions are rather weak; also, while there are numerous quotations from insuring agreements and other policy provisions, illustrative premium rates are conspicuously absent. The book is the most up-to-date reference available in its field, and should be useful as a source of statistics on health insurance, as well as for educational purposes.

Robert Riegel and Jerome S. Miller, *Insurance Principles and Practices,* Prentice-Hall, Inc., Englewood Cliffs, N. J., 1959, 4th ed., pp. 876

This old standby, revised and brought up to date, is probably the most complete book covering all lines of insurance. It devotes 115 pages to the nature of insurance, types of companies and the structure of the insurance business. Life insurance encompasses more than 200 pages, while health insurance and social security take up another 50. Fire insurance received a detailed, 200 page treatment, while fifty pages are devoted to marine insurance and 200 to casualty and surety coverages. Each line is discussed separately, the chapter subdivisions are clearly identified, and within each line of business each major policy form is analyzed in detail, including exclusions, conditions and illustrative premium rates. The chapters on fire insurance rate-making and reserves are quite complete, and rate-making in other types of insurance, while treated in somewhat less detail, is given far more emphasis than in most other insurance texts. The pages are closely packed and contain a wealth of detail. The book amply lives up to its claim to be a "one-volume library" and is probably the best general reference book available.

Frank J. Angell, *Insurance, Principles and Practices,* Ronald Press, New York, 1959, pp. 894

This book, one of the more complete and readable introductory insurance textbooks available, consists of six parts. Part I contains two chapters devoted to risk and the fundamental principles of insurance, while Part II comprises three chapters covering fundamental legal principles, common policy provisions and a brief discussion of rules, rates, underwriting reinsurance and other basic aspects of insurance. Part III devotes 125 pages to fire and marine insurance, while Part IV is a 300 page discussion of casualty and surety lines. Part V contains 110 pages devoted to life insurance and pension plans, while Part VI covers the History and regulation of insurance, types of insurers, rate-making, underwriting, and other miscellaneous topics. The book is intended as an introductory text for college students, though it contains far more material than can be covered in the usual college course. The discussion of various types of policy forms is quite detailed, which makes the book a handy reference for agents and home office employees of insurance companies. The style and quality of writing are quite good.

H. Wayne Snider, ed., *Readings in Property and Casualty Insurance*, Richard D. Irwin, Inc., Homewood, Ill., 1959, pp. 543

This unique book is a compilation of 54 articles on various aspects of insurance, reprinted from various journals and magazines. Among the publications represented are the CLU and CPCU journals, the Weekly Underwriter, Best's Insurance News, the Insurance Law Journal, the Journal of Insurance, and even one article from the Proceedings of the Casualty Actuarial Society. The authors of the 54 articles include actuaries, lawyers, company officials, teachers, and corporate insurance managers. The range of the articles is quite wide; they are grouped in nine sections whose headings indicate a rather complete textbook in property insurance. Section 1 is entitled "Risk and Insurance", Section 2 "Insurance Carriers", Section 3, "Insurance Company Operations and Problems", and so on, including Section 6, "Rating and Rate Making", which includes three members of this Society among the eight authors writing on this topic.

The various sections, however, are merely convenient headings under which from two to twelve articles can be grouped for ready reference. No section makes any attempt to furnish complete coverage. For example, Section 2, "Insurance Carriers", contains chapters on Self-Insurance, Lloyds, Reciprocal Insurance, and a chapter by Alfred M. Best entitled "Rating the Financial Structure of Insurance Companies". There is no discussion of stock and mutual companies; the editor states that the operations of these carriers are readily understood by the student of insurance. Similarly, the section on rate-making contains a delighful article by Messrs. Dudley Pruitt and Laurence Longley-Cook on the Law of Large Numbers, three articles on fire insurance rate-making, one on liability rates, one on Auto Merit Rating, one entitled "Multiple Line Underwriting: Rating Methods" and two more general discussions, but nothing on workmen's compensation insurance.

The articles are, on the whole, quite well chosen, and include many provocative titles, some of which are bound to be of interest to anyone concerned with insurance. While the diversity of authorship and the large gaps in coverage make this volume of questionable utility as a textbook, its diversity and its selection of intelligent, readable articles, many of which would otherwise be accessible only with difficulty, make it useful both to the advanced student of insurance and to the actuary, agent or other insurance man.

OBITUARY

WILLIAM JAMES CONSTABLE

1891—1959

William James Constable, a Fellow of the Society since 1934, died in Manchester, New Hampshire, on April 19, 1959 after a lingering illness. Mr. Constable was a Vice President of the Casualty Actuarial Society from 1938 through 1940, and had served as a member of the Council for the periods 1935-1945 and 1950-1952. He was a member of the Committee on Admissions from 1937 through 1951. His contributions to the Society included a paper on the making of Massachusetts Compulsory Automobile Bodily Injury Liability Insurance Rates.

Mr. Constable was born in Yonkers, New York, on March 24, 1891. After completing his high school education in Yonkers, he attended New York University.

He began his insurance career with the Commercial Union Insurance Company. He became associated with the National Council on Workmen's Compensation Insurance in 1920, which in 1922 was succeeded by the present National Council on Compensation Insurance. Mr. Constable continued with the latter organization until 1926 at which time he was an Assistant Secretary. In July of 1926 he became Secretary of the Massachusetts Automobile Rating and Accident Prevention Bureau in Boston. He became associated with the Lumbermen's Mutual Casualty Company in March of 1930 as a Resident Secretary in Boston. For many years he was the Executive representative of the Company on committees of various rating boards and bureaus. He became Manager of its New York office in 1941. In 1946 he was made Manager of the New England Department of the Company. He was made President of the Excess Insurance Company of America in July of 1948 and retired from active business in the early part of 1951. During his period of service with the Kemper Organization he was a Director of the Federal Mutual Liability Insurance Company and the National Retailers Mutual Insurance Company.

Known always as "Connie" to his friends and business associates he will long be remembered for his warm and friendly personality and for his unfailing good humor and wit. For many years he was the Toastmaster at the Spring and Fall dinners of the Society and his contributions during those sessions added much to the enjoyment of the Fellows, Associates and their guests.

He was active in the Masonic fraternity and was Worshipful Master of Victory Lodge of Watertown, Mass. in 1936. He was an ardent golfer and a well-known member of the Scarsdale Golf Club, and on its tricky fairways and greens was always a capable and strong competitor. He had a deep and abiding affection for choral music and for many years was a member of a male chorus in Yonkers. He was a member of the Park Hill Reformed

Church in Yonkers. His interests extended to charities and for a number of years he was very active in Salvation Army fund raising drives within the insurance industry.

His wife, Helen Wambach Constable, passed away in February of 1958. He is survived by a daughter, Miss Jane Helen Constable, and a son, William McMillan Constable.

OBITUARY

CHARLES WILLIAM JACKSON

1864—1959

Charles W. Jackson, a Fellow of the Society since 1916, died on September 21, 1959, (10 days before his 95th birthday) at Glenview, Illinois.

Mr. Jackson was born in Westmill, England on October 1, 1864. He received his education in the Engilsh schools and graduated from St. John's College, Cambridge, in 1886. Following his graduation, he embarked on a noteworthy career as a teacher for a period of fourteen years in several well-known private schools. This period included residence at Bruges, Belgium, to teach at a private English college.

He moved to Canada in 1900 and resumed his teaching career at Montreal. He also worked part time in the office of the London & Lancaster Life Insurance Company where he studied for the examinations of the Actuarial Society of America. He became an Associate of that Society in 1904 and a Fellow in 1909. He contributed to their Transactions several papers; outstanding among these was a paper entitled "Permanent Disability Benefits", the first paper on the subject of permanent and total disability to appear in this country.

Thereafter, Mr. Jackson worked for the consulting actuarial firm of Miles M. Dawson. From 1908 to 1912 he was Actuary of the Greensboro Life Insurance Company. In 1912 he came to New York as Actuary of the Postal Life Insurance Company; the major part of his actuarial career was spent in that position, from which he retired in 1934.

His vitality and zest for life was so great, however, that this retirement was far from marking the end of his actuarial career. He continued to contribute of his wisdom and experience to the Postal Life by serving as a member of its Board. In addition, he became associated with the consulting actuarial firm of Woodward and Fondiller and remained with that firm until his final retirement in 1944.

Mr. Jackson was one of those rare individuals whose outward appearance reflect their inner worth. He balanced technical competence with sound business acumen in a manner which was always an inspiration and a challenge to his associates.

He is survived by his wife, Mrs. Mary C. Jackson, and a daughter, Mrs. Ruth Wisely.

OBITUARY

ROSSWEL A. McIVER

1896—1959

Rosswel A. McIver, known affectionately by his many friends as "Mac", died suddenly while at his desk in the Washington National Insurance Company Home Office, Evanston, Illinois, on April 1, 1959. His death was due to a heart attack. He would have been 63 years of age on May 12.

Born in Alpena, Michigan, he graduated from the University of Michigan in 1920. During World War I he served in the United States Army and was stationed in Archangel, Russia, above the Arctic Circle.

After serving as Assistant Actuary with the National Council on Workmen's Compensation in New York City, and as Assistant Actuary for the American National Insurance Company of Galveston, Texas, he joined the Washington National Insurance Company in 1924 and served as Actuary since that time. His keen analytical mind, practical judgment, and deep understanding of human relations enabled him to contribute heavily to the success of his company. His kindness, thoughtfulness and generosity endeared him to everyone and will be long remembered.

Mr. McIver was an Associate of the Casualty Actuarial Society, a Fellow of the Life Office Management Association and a member of the Chicago Actuarial Club.

Mr. McIver was an avid and omnivorous reader and participated in the Great Books courses. He was as interested in the physical world as in the realms of literature. Fascinated by far places, he attended many series of travelogues. He and his wife were planning a vacation trip to Bermuda at the time of his death.

He is survived by his wife, Alice, two sons, John R. and Thomas, a daughter, Mrs. A. C. Tebbetts, a brother, Kenneth, and a granddaughter, Bonnie Lind Tebbetts.

OBITUARY

GEORGE D. MOORE

1883-1959

George D. Moore, Fellow of the Casualty Actuarial Society, died March 11, 1959 at the age of 76.

Born in Newark, he graduated from Barringer High School, and from Cooper Union in New York.

He entered the insurance field in the actuarial department of the Mutual Benefit Life Insurance Company in Newark, and after 10 years there he joined the New York office of the Fidelity and Casualty Company as a statistician. In 1914 he was employed by the Royal Indemnity Company of New York as a statistician. Mr. Moore became actuary, then assistant secretary of the company. When the Eagle Indemnity Company of New York was formed, he became statistician and assistant secretary there. Thereafter he was comptroller of the Standard Surety Company of New York, and in recent years had been engaged in consulting work.

Mr. Moore was an organizer of the Association of Casualty Accountants and Statisticians, and served many years as its President and as its Secretary.

Mr. Moore was a charter member of the Casualty Actuarial Society and served as its President in 1928-1929. He was one of the inner circle of actuary-statistician-accountants, in the crucial days when the casualty insurance business was in its infancy and was trying desperately to grow up. He was a colleague of such men as Rubinow of the Ocean, Flynn of the Travelers, Woodward of the New York State Fund, Ryan of the New York Insurance Department and others of the same stripe. He brought to the deliberations of these men a wonderfully practical viewpoint because he really knew how systems functioned and could offer suggestions for making things work which were invaluable.

It was a hectic period in which competitors had to be met on common ground in order to solve the problems of rate making and rating procedures. Mr. Moore always stood well with representatives of other insurers. He had their confidence, and he also had a keen sense of humor. As a result, his services in these cooperative efforts were of the greatest importance. He is remembered as a dynamo of energy with a twinkle in his eye.

He was a past Commander of the Grand Commandery, Knights Templar of New Jersey and of Jersey Commandery 19, Newark. He was a member of Roseville Lodge 143, F and AM and of the Most Puissant Grand Council of Royal and Select Masters of New Jersey, Kane Council 2. Mr. Moore was a member of the official board of the Sanford St. Methodist Church, East Orange, and of the Federated Church, Cragsmoor, N.Y.

He leaves his wife, Mrs. Marie Kindberg Moore; a son, Donald K. of Westfield; two daughters, Mrs. Muriel Thurlow of Caldwell and Mrs. Marie W. Peterson of West Orange, and eight grandchildren.

MINUTES OF THE MEETING

May 20, 21 and 22, 1959

AMBASSADOR HOTEL, ATLANTIC CITY, NEW JERSEY

The Spring 1959 Meeting of the Society was opened at 2:00 P.M. on Wednesday, May 20, with the following seminar discussions which were held simultaneously, assignments to a particular seminar having been made in advance for each member or guest in attendance:

(a) Problem of Evaluating the Benefits of Computer Installations—Chairman, Thomas O. Carlson, Actuary, National Bureau of Casualty Underwriters, New York, N.Y.

(b) Examination of Insurance Companies—Problems Encountered by both Examiners and Examinees—Chairman, Joseph J. Magrath, Secretary, Federal Insurance Company, New York, N.Y.

(c) Ratemaking in Concert and the Federal Investigation—Chairman, Franklin J. Marryott, Vice President and General Counsel, Liberty Mutual Insurance Company, Boston, Massachusetts.

(d) Cancellation Problems in Accident and Health Insurance—Chairman, Milton G. McDonald, Fire and Casualty Actuary, Department of Banking and Insurance, Boston, Massachusetts.

(e) Principles and Procedures of Fire Insurance Rating—Chairman, Kent H. Parker, Manager Western Actuarial Bureau, Chicago, Illinois.

(f) Joint Life and Casualty Operations—Chairman, Arthur S. Kuenkler, Executive Vice President, Security-Connecticut Insurance Group, New Haven, Connecticut.

Beginning at 9:30 A.M. on Thursday, May 21, the above seminars were repeated. Thus each person at the meeting had the opportunity of attending two of the six seminars.

Upon conclusion of the seminar discussions at 11:00 A.M., the gathering met in plenary session with President Dudley M. Pruitt presiding with a registration of 63 Fellows and 23 Associates in attendance, in addition to wives and invited guests:

FELLOWS

Allen, E. S.
Barber, H. T.
Bennett, N. J.
Berquist, J. R.
Bevan, J. R.
Bornhuetter, R. L.
Carleton, J. W.
Curry, H. E.
Day, E. W.
Dropkin, L. B.
Edwards, J.
Elliott, G. B.
Fairbanks, A. V.
Foster, R. B.
Graham, C. M.
Graves, C. H.
Greene, W. W.
Goddard, R. P.
Hart, W. V., Jr.
Harwayne, F.
Hazam, W. J.
Hope, F. J.
Johe, R. L.
Johnson, R. A.
Kallop, R. H.
Kuenkler, A. S.
La Croix, H. F.
Lino, R.
Liscord, P. S.
Longley-Cook, L. H.
MacKeen, H. E.
Magrath, J. J.
Makgill, S. S.
Masterson, N. E.
Maycrink, E. C.
McConnell, M. H.
Menzel, H. W.
Murrin, T. E.
Niles, C. L., Jr.
Otteson, P. M.
Perryman, F. S.
Petz, E. F.
Pinney, A. D.
Pruitt, D. M.
Resony, A. V.
Resony, J. A.
Roberts, L. H.
Rodermund, M.
Rowell, J. H.
Ruchlis, E.
Salzmann, R. E.
Schloss, H. W.
Simon, L. J.
Skelding, A. Z.
Skillings, E. S.
Smith, E. M.
Tarbell, L. L., Jr.
Thomas, J. W.
Trist, J. A. W.
Valerius, N. M.
Wieder, J. W., Jr.
Williams, P. A.
Wright, B.

ASSOCIATES

Alexander, L. M.
Andrews, E. C.
Bittel, W. H.
Blodget, H. R.
Boyle, J. I.
Butler, R. H.
Faust, J. E., Jr.
Harack, J.
Jones, N. F.
Klaassen, E. J.
McDonald, M. G.
Muir, J. M.
Phillips, H. J., Jr.
Schneiker, H. C.
Scammon, L. W.
Simoneau, P. W.
Stern, P. K.
Stoke, K.
Sykes, Z. M., Jr.
Wilcken, C. L.
Williams, D. G.
Willsey, L. W.
Woodworth, J. H.

The President then presented to the gathering two new Associates,

Richard H. Butler, Secretary
Travelers Insurance Company
Hartford, Connecticut

Waldo A. Stevens, Assistant Actuary
Massachusetts Workmen's Compensation
Rating and Inspection Bureau
Boston, Massachusetts

who, subsequent to the last meeting, had fulfilled the requirements for Associate membership as specified in Article III of the Constitution.

Chairman of the Educational Committee, Laurence H. Longley-Cook, then presented the report of the Committee with respect to a revised Syllabus beginning with the 1960 Examinations. The revised Syllabus expands the mathematical sections of the then existing Syllabus, as well as providing for several changes in the content of other parts of the examinations. It was voted that the report of the Educational Committee be accepted with appreciation of the membership for a job well done.

Messrs. Marryott, McDonald and Parker then summarized for the gathering the discussions that were had in connection with seminars (c), (d) and (e), respectively.

Chairman Norton E. Masterson of the Committee on Rules and Standards of Professional Conduct then discussed briefly the recommendations of his Committee, previously approved by the Council, for the adoption by the Casualty Actuarial Society of a code of ethics or "Guides To Professional Conduct." These recommendations had been sent to the membership under date of April 16, 1959.

After considerable discussion of the recommendations, the membership voted that the report be returned to the Committee and to the Council for consideration of certain modifications which several members of the Society felt were desirable.

The May 21st session was then recessed for luncheon, to reconvene in business session at 9:30 A.M. on May 22nd. An informal dinner was held the evening of May 21st.

Following the opening of the May 22nd session, Messrs. Carlson, Magrath and Kuenkler presented a résumé of seminars (a), (b) and (f), respectively.

The following written discussions of previous papers were then presented:

(a) "The Advantages of Calendar-Accident Year Experience And The Need For Appropriate Trend and Projection Factors In The Determination Of Automobile Liability Rates" by Paul Benbrook—Reviewed by Richard Lino.

(b) "A Uniform Statistical Plan And Integrated Rate Filing Procedure For Private Passenger Automobile Insurance" by Stanley C. DuRose, Jr.—Reviewed by Clyde H. Graves.

(c) "Estimating Ultimate Incurred Losses in Auto Liability Insurance" by Frank Harwayne—Reviewed by Francis J. Hope and James M. Cahill (read by Thomas E. Murrin).

(d) "Methods Of Cost Limitation Under Private Unemployment Benefit Plans" by Murray W. Latimer—Reviewed by Phillip A. Williams.

(e) "Ratemaking For Fire Insurance" by Joseph J. Magrath—Reviewed by Norman J. Bennett.

(f) "Rate Revision Adjustment Factors" by LeRoy J. Simon—Reviewed by Robert L. Hurley, followed with comment by the author, LeRoy J. Simon.

(g) "The Canadian Merit Rating Plan For Individual Automobile Risks" by Herbert E. Wittick—Reviewed by Allen D. Pinney.

(h) "Auto B. I. Liability Rates—Use of 10/20 Experience in the Establishment of Territorial Relativities" by Martin Bondy —Reviewed by Ronald L. Bornhuetter.

There then followed presentation of the following new papers:

(a) "Compulsory Automobile Insurance In Europe" by Frank Astill, Accident Superintendent, Pearl Assurance Company, Ltd., London, England.

(b) "Liability Insurance For The Nuclear Energy Hazard" by Richard H. Butler, Secretary, The Travelers Insurance Company, Hartford, Connecticut.

(c) "Some Further Notes On Estimating Ultimate Incurred Losses In Auto Liability Insurance" by Frank Harwayne, Chief Actuary, New York State Insurance Department, New York, N.Y.

(d) "Notes On Some Actuarial Problems Of Property Insurance" by Laurence H. Longley-Cook, Actuary, Insurance Company of North America, Philadelphia, Pennsylvania.

(e) "Ocean Marine Rate Making" by D. Douglas Robertson, Vice President, Marine Managers Limited, Toronto, Canada.

(f) "A Review Of The Experience Of Massachusetts Workmen's Compensation Experience Rated Risks" by Waldo A. Stevens, Assistant Actuary, Massachusetts Workmen's Compensation Rating and Inspection Bureau, Boston, Massachusetts.

(g) "Automobile Physical Damage Rate Making" by L. L. Tarbell, Jr., Assistant Actuary, The Travelers Insurance Company, Hartford, Connecticut.

Following presentation of these papers, the meeting was declared adjourned at 12:30 P.M.

MINUTES OF THE MEETING

November 19 and 20, 1959

SHERATON TOWERS HOTEL, CHICAGO, ILLINOIS

The meeting convened at 10:00 A.M. on Thursday, November 19, 1959 with President Dudley M. Pruitt presiding. A subsequent tabulation of the registration cards indicated the following 73 Fellows and 34 Associates were in attendance:

FELLOWS

Allen, E. S.
Barber, H. T.
Barker, L. M.
Bennett, N. J.
Berquist, J. R.
Bevan, J. R.
Blodget, H. R.
Bornhuetter, R. L.
Boyajian, J. H.
Boyle, J. I.
Brindise, R. S.
Byrne, H. T.
Carleton, J. W.
Coates, C. S.
Corcoran, W. M.
Curry, H. E.
Doremus, F. W.
Eide, K. A.
Elliott, G. B.
Espie, R. G.
Fitzhugh, G. W.
Foster, R. B.
Fuller, G. V.
Goddard, R. P.
Gillam, W. S.
Harwayne, F.
Graham, C. M.
Graves, C. H.
Hazam, W. J.
Hope, F. J.
Hughey, M. S.
Hunt, F. J., Jr.
Hurley, R. L.
Johe, R. L.
Johnson, R. A.
Kallop, R. H.
Klaassen, E. J.
Kormes, M.
Leslie, W., Jr.
Linder, J.
Lino, R.
Longley-Cook, L. H.
MacKeen, H. E.
Makgill, S. S.
Masterson, N. E.
Matthews, A. N.
McConnell, M. H.
Mills, R. J.
Muetterties, J. H.
Murrin, T. E.
Otteson, P. M.
Perkins, W. J.
Petz, E. F.
Phillips, H. J., Jr.
Pollack, R.
Pruitt, D. M.
Resony, A. V.
Resony, J. A.
Roberts, L. H.
Rodermund, M.
Rowell, J. H.
Salzmann, R. E.
Schloss, H. W.
Skelding, A. Z.
Skillings, E. S.
Smick, J. J.
Smith, S. E.
Sykes, Z. M., Jr.
Thomas, J. W.
Uhthoff, D. R.
Wieder, J. W., Jr.
Williams, P. A.
Wolfrum, R. J.

ASSOCIATES

ABEL, F. E.	MOSELEY, J.
ALEXANDER, L. M.	MUIR, J. M.
BALCAREK, R. J.	NELSON, S. T.
BANNISTER, D. W.	ROYER, A. F.
BERG, R. A., JR.	SCAMMON, L. W.
COATES, W. D.	SCHNEIKER, H. C.
CRAIG, R. A.	SCHULMAN, J.
CROWLEY, J. H.	STANKUS, L. M.
DICKERSON, O. D.	STEINHAUS, H. W.
DUROSE, S. C., JR.	STERN, P. K.
FAUST, J. E., JR.	STEVENS, W. A.
GIBSON, J. P., JR.	STRUG, E. J.
HARACK, J.	VAN CLEAVE, M. E.
KIRK, C. L.	WEBER, D. C.
MCDONALD, M. G.	WILCKEN, C. L.
MCGUINNESS, J. S.	WILSON, J. C.
MCNAMARA, D. J.	WOOD, D. M., SR.

The first item of the session was a discussion, with audience participation under the leadership of Robert G. Espie, Chief Accounting Officer, Aetna Life Affiliated Companies, on the topic "Casualty, Fire and Life Operations Under One Roof". Upon completion of Mr. Espie's presentation, the following members continued the discussion from the floor:

(1) Gilbert W. Fitzhugh, Vice President, Metropolitan Life Insurance Company.
(2) Laurence H. Longley-Cook, Actuary, Insurance Company of North America.
(3) Joseph J. Magrath, Secretary, Federal Insurance Company.
(4) Paul M. Otteson, Vice President and Actuary, Federated Mutual Implement & Hardware Mutual Insurance Company.
(5) E. Shaw Skillings, Assistant Vice President and Actuary, Allstate Insurance Company.
(6) Seymour E. Smith, Vice President and Actuary, The Travelers Insurance Company.

Under date of October 28, 1959, there had been distributed to the membership proposed "Guides To Professional Conduct", unanimously recommended by the Council to the membership for adoption. This document was a revised version of the proposal first submitted to the membership under date of April 16, 1959. After some discussion of the proposal, the gathering, with no dissenting opinion

"Voted, That the proposed Guides to Professional Conduct submitted under date of October 28, 1959, be adopted."

(Editorial Note: The Guides will be found on page 29 of the 1960 Year Book.)

The gathering then received the report of the Nominating Committee, S. E. Smith (Chairman), T. O. Carlson and N. E. Masterson, for the election of the officers of the Society and three members of the Council for the coming year. There being no nominations from the floor, nominations were declared closed and the gathering then voted to elect:

President—William Leslie, Jr.
Vice President—Ernest T. Berkeley
Vice President—Laurence H. Longley-Cook
Secretary-Treasurer—Albert Z. Skelding
Member of Council—Norman J. Bennett
" " " —John R. Bevan
" " " —Richard L. Johe

The meeting then voted to confirm the action of the Council with respect to the election of the following officers for the coming year:

Editor—Russell P. Goddard (to succeed E. S. Allen)
Librarian—Richard Lino (Re-elected)
General Chairman—
Examination Committee—William J. Hazam (Re-elected)

After adjournment for lunch, the meeting reconvened at 2:00 P.M., at which time it was announced that the Secretary-Treasurer had received notice of the decease of the following members subsequent to the November 1958 Meeting:

William J. Constable	(Fellow)
Rosswel A. McIver	(Associate)
George D. Moore	(Fellow and Past President, 1928-29)

The Secretary-Treasurer informed the gathering of the activities of the Council during the past year, including adoption of the following scale of increased dues for the 1959-60 fiscal year:

Fellows	$40.00*
Associates (first five years)	20.00*
Associates (after five years)	40.00*
Dues waived for members in the Service.	——

At this time the Secretary-Treasurer presented the attached record of cash receipts and disbursements for the period October 1, 1958 through September 30, 1959 and noted, in passing

(1) Disbursements had exceeded receipts by approximately $2,200, due primarily to rapidly mounting printing costs.

(2) The increased dues voted by the Council are not sufficient to correct this situation.

(3) The Council has authorized the appointment of a Special Committee to look into the ways other Actuarial Societies have adopted for revenue purposes and to report to the Council at a meeting to be held as soon as practicable.

* $15 for other than residents of U.S. or Canada.

The President then presented diplomas to the following new Fellows:

Blodget, H. R.	Klaassen, E. J.
Boyle, J. I.	Myers, R. J.
Byrne, H. T.	Phillips, H. J., Jr.
Eide, K. A.	Pollack, R.
Hunt, F. J., Jr.	Sykes, Z. M., Jr.

and introduced the following new Associates to the gathering:

Balcarek, R. J.	Hickman, J. C.
Bannister, D. W.	Kroeker, J. W.
Berkman, J.	Leight, A. S.
Copestakes, A. D.	McNamara, D. J.
Craig, R. A.	Moseley, J.
Crowley, J. H.	Royer, A. F.
Dickerson, O. D.	Steinhaus, H. W.
Fitzgibbon, W. J., Jr.	Strug, E. J.
Gold, M. L.	Weber, D. C.

The meeting was then entertained by a reading of the Presidential Address "St. Vitus's Dance".

The following written discussions of previous papers were then presented:

(a) "Compulsory Automobile Insurance in Europe" by Frank Astill—Reviewed by Francis J. Perryman (résumé presented by Harold W. Schloss in absence of Mr. Perryman).

(b) "Liability Insurance For The Nuclear Energy Hazard" by Richard H. Butler—Reviewed by Joseph P. Gibson, Jr.

(c) "Some Further Notes On Estimating Ultimate Incurred Losses In Automobile Liability Insurance" by Frank Harwayne—Reviewed by Francis J. Hope.

(d) "Notes On Some Actuarial Problems Of Property Insurance" by Laurence H. Longley-Cook—Reviewed by Frederick W. Doremus.

(e) "Ocean Marine Rate Making" by D. Douglas Robertson —Reviewed by Frederick J. Hunt, Jr.

(f) "A Review Of The Experience Of Massachusetts Workmen's Compensation Experience Rated Risks" by Waldo A. Stevens—Reviewed by Milton G. McDonald.

(g) "Automobile Physical Damage Rate Making" by L. L. Tarbell, Jr.—Reviewed by Charles L. Niles, Jr. (Review presented by title in Mr. Niles' absence).

(h) Comments by Frank Harwayne on the reviews of his paper "Estimating Ultimate Incurred Losses In Auto Liability Insurance" which had been presented by James M. Cahill and Francis J. Hope at the May 1959 meeting.

The following new papers were then presented during the remainder of the Thursday afternoon session and the first part of the Friday morning session:

(a) "An Actuarial Note On The Credibility Of Experience Of A Single Private Passenger Car" by Robert A. Bailey, Assistant Actuary, and LeRoy J. Simon, Associate Actuary, Insurance Company of North America, Philadelphia, Pennsylvania.

(b) "Some Considerations On Automobile Rating Systems Utilizing Individual Driving Records" by Lester B. Dropkin, Associate Actuary, New York State Insurance Department, New York, N.Y.

(c) "The Actuarial Aspects Of Blue Cross Plans" by J. Edward Faust, Jr., Vice President and Actuary, Universal Automobile Insurance Company, Indianapolis, Indiana.

(d) "Merit Rating In Private Passenger Automobile Liability Insurance And The California Driver Record Study" by Frank Harwayne, Chief Actuary, New York State Insurance Department, New York, N.Y.

(e) "Multiple Peril Rating Problems—Some Statistical Considerations" by Robert L. Hurley, Actuary, Liberty Mutual Fire Insurance Company, Boston, Massachusetts.

(f) "A Comparison of Auto Liability Experience Under A Compulsory Law And Under Financial Responsibility Laws" by Milton G. McDonald, Fire and Casualty Actuary, Department of Banking and Insurance, Boston, Massachusetts.

(g) "OASDI Cost Estimates And Valuations" by Robert J. Myers, Chief Actuary, Social Security Administration, Washington, D.C.

(h) "Credibility of 10/20 Experience As Compared With 5/10 Experience" by Lewis H. Roberts, Actuary, National Fire Insurance Company, Hartford, Connecticut.

(i) "Commutation Functions For Individual Policies Providing For Hospital, Surgical And Medical Care Benefits After Retirement" by Henry W. Steinhaus, Consulting Actuary and Economist, New York, N.Y.

(j) "Towards Statistically Based Fidelity Rates" by Zenas M. Sykes, Jr., Assistant to the Actuary, United States Fidelity and Guaranty Company, Baltimore, Maryland.

(k) "The Compensation Experience Rating Plan—A Current Review" by Dunbar H. Uhthoff, Vice President and Actuary, Employers' Mutual Liability Insurance Company of Wisconsin, Wausau, Wisconsin.

The meeting was then recessed and was followed by a social hour from 6:00 P.M. to 7:00 P.M. Dinner was then had at 7:00 P.M.

Following dinner, the Society was entertained by a skit—"Of All Sad Words—A Casualty Play with Small Credibility", portraying the shenanigans at a hypothetical automobile rate hearing. The skit was the brain-child of M. Rodermund and was produced by R. E. Salzmann, W. J. Hazam and M. Rodermund, with a distinguished cast of actuary-actor stars consisting of Messrs. H. T. Barber, N. J. Bennett, F. J. Hope, R. L. Hurley, M. H. McConnell, T. E. Murrin, D. M. Pruitt, J. W. Wieder, Jr., and R. J. Wolfrum.

The session reconvened at 9:30 AM. on Friday, November 19th and enjoyed an interesting Panel Discussion "Current Developments In Private Passenger Automobile Insurance" with John W. Carleton, Vice President and Actuary, Liberty Mutual Insurance Company, as moderator, making a valiant effort to steer an untroubled course between the following panel participants who, it may be assumed, did not always see eye to eye with their fellow participants:

(1) Harold E. Curry, Vice President, State Farm Mutual Automobile Insurance Company.
(2) William Leslie, Jr., General Manager, National Bureau of Casualty Underwriters.
(3) Joseph J. Magrath, Secretary, Federal Insurance Company.
(4) Seymour E. Smith, Vice President and Actuary, The Travelers Insurance Company.

Upon conclusion of the panel discussion prior to lunch, the meeting was declared adjourned.

To complete the record, there are attached to these minutes:

(1) A list of new Associates and new Fellows.
(2) A list of those who passed the May 1959 examinations.
(3) The cash receipts and disbursements report for the period October 1, 1958 through September 30, 1959.

NEW ASSOCIATES
CASUALTY ACTUARIAL SOCIETY — 1959

RAFAL J. BALCAREK
Assistant Actuary
Standard Accident Insurance Co.
640 Temple Avenue
Detroit 32, Michigan

DAN W. BANNISTER, Ass't Tax Attorney
Allstate Insurance Company
7447 Skokie Boulevard
Skokie, Illinois

JOAN BERKMAN, Actuarial Supervisor
National Bureau of Casualty Undwrs.
125 Maiden Lane
New York 38, New York

ARTHUR D. COPESTAKES, CPCU,
Assistant Secretary
American Mutual Liability Insurance Co.
Wakefield, Massachusetts

ROBERT A. CRAIG
C. F. & M. Actuarial Department
The Travelers Insurance Co.
Hartford 15, Connecticut

JAMES H. CROWLEY
Actuarial Department
Aetna Casualty and Surety Co.
151 Farmington Avenue
Hartford 15, Connecticut

NEW ASSOCIATES CASUALTY ACTUARIAL SOCIETY—1959 (Cont'd)

O. D. DICKERSON, Ph.D., C.L.U., C.P.C.U.
Associate Professor of Insurance and Real Estate
Florida State University
Tallahassee, Florida

WALTER J. FITZGIBBON, JR.
Actuarial Department
Aetna Casualty and Surety Co.
151 Farmington Avenue
Hartford 15, Connecticut

MELVIN L. GOLD, B.S., F.S.A.,
Consulting Actuary
29 Lakeview Drive
West Orange, New Jersey

JAMES C. HICKMAN, B.A., M.S., F.S.A.,
Department of Mathematics and Astronomy
State University of Iowa
Iowa City, Iowa

JOHN W. KROEKER, Actuary
Department of Insurance
Ottawa, Ontario, Canada

ARTHUR S. LEIGHT
Research Associate
Metropolitan Life Insurance Co.
1 Madison Avenue
New York 10, New York

DANIEL J. MCNAMARA, Senior Assistant Actuary
National Bureau of Casualty Underwriters
125 Maiden Lane
New York 38, New York

JACK MOSELEY, Assistant to Actuary
United States Fidelity & Guaranty Co.
Calvert & Redwood Streets
Baltimore 3, Maryland

ALAN F. ROYER, Actuary
Insurance Department
Commonwealth of Pennsylvania
Harrisburg, Pennsylvania

HENRY W. STEINHAUS, Ph.D.
Consulting Actuary and Economist
200 East 42nd Street
New York 17, New York

EMIL J. STRUG
Electronic Equipment Research Analyst
Liberty Mutual Insurance Co.
175 Berkeley Street
Boston 17, Massachusetts

DONALD C. WEBER
Instructor of Mathematics
Wisconsin State College and Institute of Technology
Platteville, Wisconsin

NEW FELLOWS CASUALTY ACTUARIAL SOCIETY — 1959

HUGH R. BLODGET, Actuarial Assistant
The Aetna Casualty and Surety Co.
Hartford 15, Connecticut

JAMES I. BOYLE
C. F. & M. Actuarial Department
The Travelers Insurance Co.
700 Main Street
Hartford 15, Connecticut

HARRY T. BYRNE, Assistant Actuary
The Aetna Casualty and Surety Co.
Hartford 15, Connecticut

K. ARNE EIDE
Statistical Bureau
Actuarial Division
Metropolitan Life Insurance Co.
1 Madison Avenue
New York 10, New York

FREDERIC J. HUNT, JR.,
Assistant Actuary
Insurance Company of North America
1600 Arch Street
Philadelphia 1, Pennsylvania

ELDON J. KLAASSEN, Associate Actuary
Continental Casualty Co.
310 South Michigan Avenue
Chicago 4, Illinois

ROBERT J. MYERS, Chief Actuary
Department of Health, Education and Welfare
Social Security Administration
Washington 25, D.C.

HERBERT J. PHILLIPS, JR., Assistant Actuary
Employers' Liability Assurance Corporation
110 Milk Street
Boston 7, Massachusetts

ROBERT POLLACK, Assistant Actuary
American Mutual Liability Insurance Co.
Wakefield, Massachusetts

ZENAS M. SYKES, JR., Assistant to the Actuary,
United States Fidelity & Guaranty Co.
Baltimore 3, Maryland

1959 EXAMINATIONS — SUCCESSFUL CANDIDATES

Following is a list of those who passed the examination held by the Society on May 7 and 8, 1959:

ASSOCIATESHIP EXAMINATIONS

PART I (a)

Bartik, R. F.
Brannigan, J. F.
Curry, A. C.
Even, C. A., Jr.
Gould, D. E.
Hammer, S. M.
Hillhouse, J. A.
Hobbs, E. J.
Jenkins, E., Jr.
Korblick, F., Jr.
Meenaghan, J.
O'Brien, J. M.
Richards, H. R.
Riddlesworth, W. A.
Switzer, V. J.
Webb, B. L.

PART I (b)

Bannister, D. W.
Bartik, R. F.
Brannigan, J. F.
Budd, E. H.
Copestakes, A. D.
DeMelio, J. J.
Eckard, G. M.
Even, C. A., Jr.
French, J. T.
Greene, T. A.
Hammer, S. M.
Hobbs, E. J.
Jenkins, E., Jr.
Linquanti, A. J.
McClure, R. D.
McDonald, C.
McKeag, D. N.
McNamara, D. J.
Meenaghan, J.
O'Brien, J. M.
Reilly, F. V.
Richards, H. R.
Riddlesworth, W. A.
Scheibl, J. A.
Strug, E. J.
Switzer, V. J.
Thompson, P.
Young, R. G.
Zory, P. B.

PART II (a)

Batista, S.
Berkman, J.
Bird, L. O.
Copestakes, A. D.
Crowley, J. H., Jr.
Curry, A. C.
DeMelio, J. J.
Dickerson, O. D.
Dvorak, W. L.
Ehlert, D. W.
Even, C. A., Jr.
Ferden, S.
Greene, T. A.
Hammer, S. M.
Herman, F. L.
Hillhouse, J. A.
Hobbs, E. J.
Hockenberg, D.
Jenkins, E., Jr.
Klein, O. R., Jr.
Korblick, F., Jr.
Leister, H. M., Jr.
Levy, G. A.
Lorman, W. E.
McClure, R. D.
McKeag, D. N.
McNamara, D. J.
Meenaghan, J.
Meilahn, J.
Millholland, P. M.
Nelson, L.
O'Brien, J. M.
Oien, R. G.
Parlin, R. W.
Parry, A. E.
Piersol, D. E.
Ratnaswamy, R.
Reilly, F. V.
Reinbolt, J. B.
Richards, H. R.
Riddlesworth, W. A.
Ross, J. B., Jr.
Scheibl, J. A.
Stapley, K.
Thompson, P.
Webb, B. L.
Young, R. G.

PART II (b)	Corcoran, J. C.	Holmberg, R. K.	Ripandelli, J. S.
	Crowley, J. H., Jr.	Jenkins, E., Jr.	Ross, J. B., Jr.
	Galson, S. P.	Parlin, R. W.	Schultz, D. A.
	Henegan, P. M.	Ratnaswamy, R.	Webb, B. L.
	Hobbs, E. J.	Riddlesworth, W. A.	Young, R. G.
PART III	Balcarek, R. J.	Gold, M. L.	Peel, J. P.
	Bell, H.	Jenkins, E., Jr.	Riccardo, J. F., Jr.
	Budd, E. H.	Linden, J. R.	Rogers, D. J.
	Corcoran, J. C.	McBirney, B. H.	Ross, J. B., Jr.
	DeMelio, J. J.	Miller, N. F., Jr.	Strug, E. J.
	Fitzgibbon, W. J.	Mohnblatt, A. S.	Webb, B. L.
PART IV	Balcarek, R. J.	Hickman, J. C.	Leight, A. S.
	Craig, R. A.	Hobbs, E. J.	Moseley, J.
	Fitzgibbon, W. J.	Holmberg, R. K.	Royer, A. F.
	Gillespie, J. E.	Kroeker, J. W.	Webb, B. L.
	Gold, M. L.		Weber, D. C.

FELLOWSHIP EXAMINATIONS

PART I	Dickerson, O. D.	Schlenz, J. W.	Sykes, Z. M.
	Linden, J. R.		Van Cleave, M. E.
PART II	Blodget, H. R.	Klaassen, E. J.	Pollack, R.
	Boyle, J. I.	McGuinness, J. S.	Simoneau, P. W.
	Byrne, H. T.		Sykes, Z. M.
	Hunt, F. J., Jr.		Willsey, L. W.
PART III	Blumenfeld, M. E.	Eide, K. A.	Hunt, F. J., Jr.
			Pollack, R.
PART IV	Blodget, H. R.	Pollack, R.	Simoneau, P. W.
	DeMelio, J. J.		Wilcken, C. L.
	Phillips, H. J., Jr.		Willsey, L. W.

NEW ASSOCIATES

The following 17 candidates, having been successful in completing the examinations, will be admitted as Associates of the Society as of the date of the Annual Meeting in November 1959:

Balcarek, R. J.	Dickerson, O. D.	Leight, A. S.
Bannister, D. W.	Fitzgibbon, W. J., Jr.	McNamara, D. J.
Berkman, J.	Gold, M. L.	Moseley, J.
Copestakes, A. D.	Hickman, J. C.	Royer, A. F.
Craig, R. A.	Kroeker, J. W.	Strug, E. J.
Crowley, J. H., Jr.		Weber, D. C.

NEW FELLOWS

The following 8 Associates, having been successful in completing the examinations, will be admitted as Fellows of the Society as of the date of the Annual Meeting in November 1959:

Blodget, H. R.	Eide, K. A.	Klaassen, E. J.
Boyle, J. I.	Hunt, F. J., Jr.	Phillips, H. J., Jr.
Byrne, H. T.		Pollack, R.

CASUALTY ACTUARIAL SOCIETY
Cash Receipts and Disbursements
from October 1, 1958 to September 30, 1959

Income			*Disbursements*	
On deposit in Chase Manhattan, October 1, 1958		$ 7,880.66		
Members Dues	$7,635.00		Printing & Stationery	$12,542.54
Sale of Proceedings	1,993.32		Postage & Telegraph	3.34
Examination Fees	1,472.50		Secretarial Work	825.00
Luncheons & Dinners	4,382.00		Examination Expense	1,491.04
Interest on Bonds	125.00		Luncheons & Dinners	3,472.48
Sale of Reprints	37.50		Library Fund	111.82
Michelbacher Fund	1,111.12		Insurance	29.14
Foreign Exchange	2.46		Refunds	312.50
Miscellaneous	—	16,758.90	Miscellaneous	179.00
Total		$24,639.56		$18,966.86
			On deposit 9-30-59 in Chase Manhattan	5,672.70
			Total	$24,639.56

Assets			*Liabilities*	
Cash in Bank 9-30-59	$5,672.70		Michelbacher Fund	$10,534.21
U. S. Savings Bonds	5,000.00		Other Surplus	138.49
		$10,672.70	Total Liab. & Surplus	$10,672.70

* * * * *

One 12 Yr. U. S. Savings Bond 2½% Series G No. M6,756,060G due for $1,000 on November 1, 1960.

Four 12 Yr. U. S. Savings Bonds 2½% Series G Nos. M7,228,102G-103G-104G-105G due for $4,000 on October 1, 1961.

Employers' Fire Insurance Company Policy No. 31F169622 for $5,000 on Proceedings stored at 200 East 42nd Street, New York, N.Y. and $2,000 on Books kept in New York Insurance Society Library. Expires September 14, 1962.

Surety Bond for $10,000 in the Royal Indemnity Company.

* * * * *

This is to certify that we have audited the accounts, examined all vouchers and investments shown above and find same to be correct.

H. G. CRANE
Chairman, Auditing Committee

October 20, 1959

EXAMINATION FOR ENROLLMENT AS ASSOCIATE

PART I SECTION (a)

1. (a) Prove that the mean of the means of sets of data of unequal size is the mean of all the data.

   (b) Using the identity $x^3 - (x-1)^3 = 3x^2 - 3x + 1$,

   prove that: $\sum_{1}^{n} x^2 = \frac{n(n+1)(2n+1)}{6}$

2. A simple random sample of 100 parts is selected from a production line. The mean and standard deviation of the sample are 60 inches and 2 inches respectively. Calculate the 95% confidence intervals for the mean and for the standard deviation of the population.

3. Given the following normal curve areas:

$t =$	1.69	1.88	1.96	2.00
area $=$	.4545	.4699	.4750	.4772

   (a) A manufacturer knows that, on the average, 4% of his product is defective. What is the approximate probability that in a lot of 1000 pieces, there will be less than 30 defective pieces?

   (b) It has been claimed that at most 50% of all people have exactly two colds per year. If we decide to reject this claim and if among 500 people we know 270 or more say they had two colds in the previous year, what is our level of significance?

4. Determine the coefficient of correlation between the scores, x, on a verbal aptitude test and the scores, y, on a quantitative aptitude test if the scores were as follows:

$y \backslash x$	1–20	21–40	41–60	61–80	81–100
1–20	1	1			
21–40		3	2	1	
41–60		2	3	6	
61–80			5	8	2
81–100				1	4

PART I Section (b)

1. (a) What is the probability that a leap year selected at random will contain:

   (i) 53 Sundays?

   (ii) only 52 Wednesdays?

   (iii) 53 Sundays but only 52 Wednesdays?

   (b) Jones and Smith play a game with two dice. Jones is to roll a pair of dice twice. He wins if he throws a 6 or an 8 on either roll, otherwise Smith wins. If Jones offers to bet $1 he will win, what should Smith bet if the bets are fair?

2. (a) Three horses A, B, C are entered in a race and the betting on them indicates that their respective chances of winning are 2/11, 4/11, 5/11. An inside tip leads us to feel that A's chance of winning has been underestimated and that it should be 1/2. What are the probabilities now in favor of B and of C?

   (b) Four dice are thrown. What is the probability that the sum of the numbers appearing will be 10?

3. The World Series is won by winning four out of seven games. Find the expected number of games in the series if one team is stronger than the other and has a probability of 2/3 of winning each game, independent of the outcome of any other game. Round your answer to the nearest tenth of a game.

4. Cards are drawn one at a time from a deck, each card being replaced and the deck shuffled before the next card is drawn. A wins if two spades are drawn in succession, B wins if two cards are drawn in succession neither of which is a spade. What is A's chance of winning?

PART II SECTION (a)

1. (a) In a certain metropolitan area the census data for ages 20 to 22 is as follows:

Age	20	21	22
Population	100,000	90,000	80,000
Number of Deaths	240	234	216

Construct a mortality table from age 20 to 22 for this data with $l_x = 100,000$ as the radix.

(b) Prove the identity:
$$D_x + 2D_{x+1} = S_x - S_{x+3} - 3N_{x+2}$$

2. (a) Given the following commutation values:

X	N_x	M_x
25	12,992,619.10	189,700.8750
35	8,510,443.06	174,423.8442
45	5,161,996.00	154,736.6133
50	3,849,487.59	142,035.0956

Find the ultimate net premium for a \$1000 whole life insurance policy issued at age 45 if the premium for the first five years is half of the ultimate premium.

(b) Express in terms of commutation symbols the tenth terminal reserve for a twenty-year term insurance policy issued at age 35.

3. A life insurance policy issued at age 25 provides for 10 annual premiums. The death benefit is $1000 for the first 20 years and $2000 thereafter. Find the net annual premium using the commutation values in 2.(a) above.

4. Given the following New York State annuity values per $100 annual wage:

I.	Widow where there are no children	(age 34)	$635.72
	A. Reduction on account of youngest child	(age 6)	82.06
		(age 7)	77.62
	B. Reduction on account of second youngest child	(age 8)	1.60
		(age 9)	1.36
II.	Youngest child	(age 6)	217.48
		(age 7)	201.65
III.	Second youngest child	(age 8)	163.19
		(age 9)	147.98

Find the present value, as of the date of death of an employee covered by the Workmen's Compensation Law of New York State, of the benefit to a widow and two children. The employee, who received an annual wage of $2500, was killed 4–15–59. His widow was born 3–18–25 and his two children were born 11–12–50 and 5–30–52.

PART II SECTION (b)

1. (a) Distinguish between the following:

   (i) Agent —

   (ii) Broker —

   (iii) Agent — Broker

   What major limitation applies only to the Agent-Broker?

   (b) Life insurance companies, as bond buyers, usually advocate a policy of investing for the "long-pull." What are the reasons for this point of view?

2. (a) What are the common characteristics of public utility enterprises?

   (b) What outstanding feature makes high grade public utility securities attractive to insurance companies and why do they possess this feature?

3. (a) It has been said that one of the essential requirements of insurance is that "the cost of insurance not be prohibitive." Explain how this axiom applies to the insurer and his operation.

   (b) Willett says, "It might be impracticable, but it would not be economically unjustifiable, to require small companies to carry higher reserves in proportion to the amount insured than large companies are compelled to carry." Explain.

4. (a) Distinguish between self-insurance and no insurance.

(b) (i) Give reasons why it should be more desirable for a large concern to purchase regular insurance than to self-insure.

(ii) When might self-insurance be cheaper than regular insurance?

5. In a given economic situation the Federal Reserve wishes to lessen the supply of funds that member banks have available for lending purposes.

(a) Describe briefly how the three major monetary controls, available to the Federal Reserve, could be utilized in this situation.

(b) (i) Indicate which of the above methods is generally more preferable; substantiate your selection.

(ii) Indicate two other possible important monetary factors affecting member bank balances which would have to be offset by the monetary controls suggested above.

PART III

SECTION (a)

1. (a) In certain cases involving the insurance transaction, the insurer makes the offer and the insured accepts. In other cases the reverse is true. Which is the more common situation? Give an example of the less common situation.

(b) What is the difference between Retaliatory tax laws and Special Privilege taxes? Identify both concepts with sufficient precision to indicate the relationship, if any, between them.

2. (a) Briefly explain the following cases:
   (i) Prudential Insurance Company vs. Benjamin
   (ii) Robertson vs. California

   What relationship, if any, do these cases have with the SEUA decision of the Supreme Court and the McCarran Act?

   (b) Name seven regulatory powers of an insurance commissioner.

3. Distinguish between "Basic Criteria for Rates" and "Basis of Rates" as provided in the All-Industry Bills. Comment on the observation that insurance rates should not be tested for "actuarial exactness" but should be investigated as to whether they have been computed in accordance with a method which may be approved as "actuarially proper."

4. Comment briefly on the following:

   (a) Do Premium Discount Plans violate the "Unfairly Discriminatory" provisions of most rating laws?

   (b) In Retrospective Rating Contracts two insureds of the same size and type can pay different premiums. Does this not constitute unfair discrimination?

5. Discuss the problem of the determination of a fair margin for underwriting profit particularly with respect to the base against which an insurance company's profits should be measured. Should investment income be considered in the establishment of such a profit provision?

SECTION (b)

6. (a) Name and describe four of the principal causes of unemployment.

(b) Is it socially desirable to superimpose experience rating on Unemployment Insurance? Present arguments, if any, against — as well as in defense of — your thesis.

7. (a) What are "Impoundment Statutes"? Discuss their effect as an incentive for the automobile owner to provide financial protection for persons injured through his negligent operation of his automobile.

(b) Briefly describe the Saskatchewan and the Massachusetts Compulsory plans for bodily injury liabilities resulting from automobile accidents.

8. The Compulsory Automobile Insurance Law enacted in New York State left certain loopholes in coverage. In 1958 the legislature took steps to correct this situation.

Name five of the areas which were left uncovered by the Compulsory Law and describe the solution put into effect in New York.

9. (a) Comment briefly on the plan for financing benefits under the Federal Government's program for Old Age and Survivorship Insurance.

(b) There are three principal systems in use for determining the amount of old age benefits payable to recipients. Discuss the advantages and disadvantages of each.

10. The question of compulsory health insurance has been receiving ever greater consideration. In your opinion, should a national compulsory prepayment medical care system be established in the United States? Discuss.

PART IV

Section (a)

Answer any *nine* of the questions numbered 1 through 12, inclusive.

1. A workmen's compensation risk decides to cancel his policy after 70 days and his premium is therefore determined on a short rate cancellation basis. Given the following information, determine his premium.

Audited payroll	$7,000.00
Rate	1.00
Loss and Expense Constant	$ 28.00
Minimum Premium	$ 38.00
Short rate percentage corresponding to 70 days in force	30%

2. In New York Workmen's Compensation Insurance, only a small proportion of insureds pay a premium which is calculated simply as the manual rate times audited payroll. Most insureds pay premiums which are different in one way or another. Describe the ways in which the premium determination formula varies.

3. Mr. Jones carries an automobile liability policy including medical payments coverage of $500 in company A. He is injured while a passenger in Mr. Smith's vehicle. Smith's auto liability policy is carried by company B. Smith likewise has $500 medical payments coverage.

   Suppose that Jones' medical bills are $500. Can he collect $500 from each carrier? What provision of the policy determines your answer?

   If Jones' medical bills were $800, how much would he collect and from whom?

4. The following questions relate to coverage under the Products division of the Owners', Landlords' and Tenants' and Manufacturers' and Contractors' Policies. Give brief statements explaining your answers.

   (a) A vegetable canner released to his outlets an entire lot of his product before discovering that it was contaminated. As a result of this contamination, numerous claims for Bodily Injury were presented before the product could be withdrawn from the market. The canner had insurance under the Products division of the M&C policy, with limits of $5,000 each person; $10,000 each accident, subject to an aggregate limit of $25,000. The claims presented although not exceeding $5,000 for any one person, totalled $24,000. Does the canner have full coverage for his legal liability in this case?

(b) Upon the request of a ladies' afternoon Bridge Club, a mortician rented folding chairs for a card party at the home of one of the Bridge Club members. During the party one of the chairs collapsed and a member of the Bridge Club was injured. The mortician has an OL&T liability policy with coverage under the Products Division. Would his legal liability for this accident be covered under this division?

5. For Mercantile Open Stock Burglary insurance a certain store classification has a coinsurance percentage of 40% and a coinsurance limit of $10,000. Given the following facts determine the payment for which the insurer is liable:

(a)	Total merchandise value	50,000
	Amount of insurance	8,000
	Amount of loss	5,000
(b)	Total merchandise value	20,000
	Amount of insurance	7,000
	Amount of loss	6,000
(c)	Total merchandise value	15,000
	Amount of insurance	7,000
	Amount of loss	8,500

6. Name and briefly describe the function of three types of Plaintiff's Bonds.

7. In determining premiums for Automobile Comprehensive Fire and Theft coverage and Automobile Collision coverage certain factors are considered. Which factors are common to the two coverages? Which are not?

8. Give the meaning of the following terms and identify which, if any, of these terms are defined in the appropriate insurance policies or endorsements thereto:

(i) fire
(ii) smoke damage (under EC)
(iii) burglary
(iv) theft
(v) robbery

9. According to what general principle can "insurable interest" be determined for a fire insurance policy and give reasons why there must be such an interest. Give examples of five different classifications of "insurable interest."

10. Explain the coverage afforded and the exposures used to determine the policyholders premium under a Bailee's Policy.

11. Give the background and purpose of the "Nation-wide Definition" and outline the scope of Inland Marine insurance.

12. Discuss briefly the essential difference in philosophy towards "Multiple Peril" coverage as exemplified by the Homeowners Policy and the Comprehensive Dwelling Policy.

SECTION (b)

Answer *all* of the questions numbered 13 through 17, inclusive.

13. (a) In his article in "Law and Contemporary Problems — Regulation of Insurance 1950," C. A. Kulp specified two basic criteria

and one concomitant essential in his evaluation of the nature and function of the insurance rate.

Identify these 3 factors and discuss their relative importance.

(b) In PCAS XIX "Some Notes on Credibility," F. S. Perryman developed a credibility formula on the basis of "Accident Frequency" and subsequently discussed possible adjustments for a second criterion. Identify this second criterion and indicate (not necessarily detailing the mathematics) the probable effect of this consideration on the standards for 100% credibility. What method is suggested to resolve the dilemma which arises?

14. (a) The credibility criterion used for classification relativity in Workmen's Compensation by the National Council on Compensation Insurance is different from that used in Auto Liability for territorial relativities by the National Bureau of Casualty Underwriters. Compare the two.

(b) In a certain state the Workmen's Compensation law provided that in case of temporary total disability, the waiting period for benefit payments would be 7 days with a retroactive feature applicable after 28 days. On July 1, 1958 the law was changed to provide a waiting period of 3 days with a retroactive period of 21 days. Describe how you would calculate the effect of this law change.

15. Of the various bases for reviewing rates (i.e. policy year, accident year, etc.) which is typically used in reviewing fire insurance rates? Present reasons "for" or "against" changing this basis.

16. (a) In a certain state auto liability rate levels have in the past been determined by taking the unweighted arithmetic mean indication of the latest two policy years. The statistical plan has now been changed to provide for the reporting of experience on a calendar-accident year basis. If two years of calendar-accident year experience are to be used for rate level, determine what weights should be given to each year in order that the loss experience should be, on the average, exactly as recent as that provided by a 50-50 weighting of policy year.

(b) If the weights determined above produce the same average loss age, should calendar-accident year experience with these weights be preferred to the equivalent (50-50) policy year experience? Discuss.

17. Describe the "Statewide Fire Insurance Rate Level Procedure" based on the set of principles outlined in 1957 by the Inter-Regional Insurance Conference.

EXAMINATION FOR ENROLLMENT AS FELLOW

PART I

SECTION (a)

1. (a) It is stated that the reserve for Incurred But Not Reported claims might be based on:
   (i) The volume of business in force.
   (ii) A function of the reserve for known cases.
   (iii) The reserve for incurred but not reported claims for the previous year modified to reflect current conditions.

   Under what conditions should each method produce satisfactory results?

   (b) Develop a formula for determining the year-end Incurred But Not Reported loss reserve for the major casualty lines; i.e., for Automobile Bodily Injury Liability, Workmen's Compensation, and Other Liability. Show which current factors affecting past experience are reflected explicitly or implicitly in this formula.

   (c) Modify the formula given in answer (b) above so that it may be used for the monthly reserve during the following year in order that any necessary change from one year-end to the next may be reflected gradually rather than abruptly.

   (d) Give the statutory requirement with regard to the Incurred But Not Reported loss reserve for fidelity; for surety.

2. (a) Section 74 of the New York Insurance Law covers the statutory requirements pertaining to the liability for unearned premium. Briefly describe three bases of computation that the superintendent may prescribe to provide adequate reserves.

(b) The formula to compute the gross premiums in force at the end of any reserve period includes the following two steps:

To the gross premiums in force at the beginning of the period,

Add: (a) Excess of original premiums over amounts received for reinsurance.

Deduct: (b) Excess of original premiums over return premiums on cancellations.

Explain the reason for each of these steps.

(c) If you were to compare the relative sizes of the unearned premium reserves of a fire company and a casualty company having identical premium writings, what would you expect to find? Why?

(d) Your company which had been issuing only one year policies during 1957 and 1958 decided to issue only six month policies effective January 1, 1959. During 1957 and 1958 your company had an even distribution of premium writings by month. Assume no new business and 100% renewals during 1959 and 1960. What percentage effect will this decision have on:

(i) Premiums Written during 1959? during 1960?

(ii) Premiums Earned during 1959? during 1960?

(iii) Unearned Premium Reserve as of 12/31/59? as of 12/31/60?

(e) With regard to (d) above, what would be the effect on surplus in 1959? in 1960? Discuss fully.

3. (a) Give an illustration of the need for a remarriage table to set up a proper reserve in the casualty field.

(b) You are on a committee to revise the American Remarriage Table by making use of later statistical data. Your committee decides to issue a special call to the carriers to obtain remarriage statistics. What pertinent information would you request in this call in order to calculate remarriage rates?

(c) Give the formulae for determining minimum reserves in Schedule P. Discuss the criticisms that have been leveled at this method of establishing minimum reserves.

(d) Outline three methods for testing reserves prospectively.

4. (a) What is the major objection to the formula now prescribed in Schedule P for distributing automobile bodily injury liability calendar year unallocated loss expense payments by policy year?

(b) Company X writes a very large volume of workmen's compensation premiums, widely diversified as to industry, risk-size and jurisdiction. It has been suggested that, in the determination of its case-basis reserves, every compensation claim against the Company which is indeterminate after more than 26 weeks have elapsed since date of accident, should be valued in accordance with a single two-column table giving E, the expected total compensation loss per dollar of weekly compensation, as a function of T, the length of time from date of accident to date of valuation, such table to be constructed on the basis of the Company's total experience (of five to ten recent policy years) in the ultimate settlement of claims which were indeterminate. You have been asked by the managers of Company X to set forth briefly your comments concerning this suggestion. Write a draft of the memorandum you would address to them in response to their request.

SECTION (b)

In order to save time, use the number of each item rather than its description in question 5 below:

5. The following were taken from Assets and Liabilities, Surplus and Other Funds of the annual statement of Company A as of December 31, 1958:

(1)	Dividends declared and unpaid	$350,000
(2)	Borrowed money	0
(3)	Bills receivable, taken for premiums	300,000
(4)	Interest, dividends and real estate income due and accrued	250,000
(5)	Reinsurance recoverable on loss payments	167,000
(6)	Funds held by or deposited with ceding reinsurers	0
(7)	Unearned premiums	41,829,000
(8)	Collateral loans	0
(9)	Capital paid up	7,000,000
(10)	Net adjustments in assets and liabilities due to foreign exchange rates	0
(11)	Bonds	35,835,000
(12)	Total liabilities	?
(13)	Funds held by company under reinsurance treaties	433,000
(14)	Reinsurance on paid losses and on unpaid losses due from unauthorized companies	149,000
(15)	Interest on borrowed money	0
(16)	Real estate	4,554,000
(17)	Federal and foreign income taxes	0
(18)	Stocks	57,771,000
(19)	Agents' balances or uncollected premiums	6,378,000
(20)	Voluntary contingency and security reserves	10,000,000
(21)	Amounts withheld or retained by company for account of others	5,000
(22)	Losses	10,994,000

(23)	Loss adjustment expenses	994,000
(24)	Other expenses (excl. taxes, licenses & fees)	62,000
(25)	Contingent commissions and other similar charges	140,000
(26)	Taxes, licenses & fees (excl. Federal and foreign income taxes)	1,155,000
(27)	Unearned premiums on reinsurance in unauthorized companies	319,000
(28)	Excess of bodily injury liability and compensation statutory and voluntary reserves over case basis and loss expense reserves	0
(29)	Less funds held or retained by company for account of such unauthorized companies as per Schedule F, Part 2	158,000
(30)	Unassigned funds (surplus)	?
(31)	Total assets	?
(32)	Surplus as regards policyholders	?
(33)	Cash and bank deposits	3,467,000
(34)	Mortgage loans on real estate	0

Prepare page 2, "Assets," and page 3, "Liabilities, Surplus and Other Funds," of the annual statement.

What are the total assets of this company (item 31)? The total liabilities (item 12)? The unassigned funds (surplus) (item 30)? The surplus as regards policyholders (item 32)?

6. (a) Name five Operating Expense Classifications of the Insurance Expense Exhibit.

(b) Name the Expense Groups of the (i) Annual Statement; (ii) The Insurance Expense Exhibit.

(c) You have available a summary of experience for companies which have submitted Insurance Expense Exhibits data.

In your expense analysis you are interested in knowing the approximate total amount of payroll audit expenses incurred for a particular line of insurance. How would you calculate this item from the summary of data contained in Part II of the Insurance Expense Exhibit?

(d) You are given the following information with regard to Workmen's Compensation from the Insurance Expense Exhibit for the Blank Insurance Company:

Part III	1.	Total — Net Earned Premiums — Standard Basis on Regular Business plus War Projects	$1,000,000
	2.	Net Earned Premiums—War Projects	100,000
	3.	Adjustments for Premium Discounts and Retrospective Rating	200,000
Part IV	1.	Other Reconciliation Items — Earned Premiums	50,000
	2.	Reinsurance Assumed — Earned Premiums	75,000
	3.	Reinsurance Ceded — Earned Premiums	30,000

What figure should be shown under "Net Earned Premiums" for Workmen's Compensation in Part II?

What figure should be shown under Total Direct Business — — Earned Premium in Part IV?

7. All policies of a monoline company which began writing business January 1, 1957 are written for a one year term and are payable in advance. During 1957, losses of $30,000 were incurred and the company reported

on December 31, 1957 a statutory underwriting loss of 30%. Premium writings were increased during 1958 by an amount X over the previous year, and losses of $51,750 were incurred in 1958. On December 31, 1958, the company was able to report an adjusted (trade basis) underwriting gain of 10%. For each policy or renewal, the rates developed by the company provide 25% for acquisition and taxes payable on inception, 20% for general administrative expenses, and contemplate a 5% profit factor. Assuming premium income to be evenly distributed throughout each year and administrative expenses to be incurred as anticipated, find X.

8. (a) Written premiums do not as a rule directly affect or enter into cash transactions. Explain.

(b) Define:

(1) Ledger Assets

(2) Non Ledger Assets

(3) Assets not Admitted

(c) List six non-admitted assets.

(d) You are called upon to analyze the results of an expense constant study to determine what expense allowances should underlie revised workmen's compensation manual rates. Prior to this study the $10 expense constant was expected to yield 4.6% of total premium which permitted a reduction of the total expense loading from 35.0% to 32.0%. The expense study revealed that the amount of expense constant dollars currently being collected represents only 3.0% of total premium. Calculate the expense provisions for revised compensation rates if the normal loading is as follows:

Items	*Values at Normal Loading*
Acquisition	10.0%
Taxes	5.0
Profit and Contingencies	5.0
Claim Adjustment	7.0
Inspection & Bureau	3.0
Administration & Audit	5.0
	35.0%

PART II

Section (a)

Note: Answer any four of the questions numbered 1 through 6.

1. (a) Derive the following expression:

Entry to Table M for the charge $= \frac{A - B}{C\ D}$

Where A = Maximum Premium Ratio ex Tax
B = Basic Premium Ratio
C = Loss Conversion Factor
D = Permissible Loss Ratio

(b) Express the relationship among the charge, the savings, and the entry ratio of Table M.

(c) In applying the Workmen's Compensation Experience Rating Plan what two steps are required to convert payroll into expected loss data? Explain.

(d) A risk whose estimated compensation standard earned premium is $25,000 selects Retrospective Plan A.

(i) Discuss the merits of providing coverage whereby losses will be limited to $25,000 per accident in the retrospective formula.

(ii) A loss limitation of $10,000 is selected. What is the estimated excess loss premium? (See Table below.)

Table

Maximum Premium Ratio $= A$
Minimum Premium Ratio $= B$
Basic Premium Ratio $= C$
Excess Loss Premium Factor $10,000 Limitation $= D$
Loss Conversion Factor $= E$
Tax Multiplier $= F$
Net Insurance Charge $= G$
Expense in Basic $= H$

2. With respect to the National Automobile Underwriters Association Collision Fleet Rating Formula:

(a) What requirements must be met in order to be eligible for special Collision Rating?

(b) How are small utility trailers treated?

(c) What is the basic experience period to be used in determining the experience modification?

(d) If less than the basic experience period is obtainable, how is the indicated debit or credit applied?

(e) What is considered a catastrophe loss?

(f) What two factors are used in entering the table of Collision Fleet Experience Adjustments?

3. (a) You are asked to compute the adjusted bodily injury rate for a New York risk developing \$30,000 or more of basic limits premium subject to experience rating under the General Liability Experience Rating Plan of the National Bureau of Casualty Underwriters on a full coverage basis. Calculate the total rate multiplier if the rating produced a 15% credit for basic limits and a 25% credit for the increased limits factor. Increased limits factor for 10/25 limits = 1.38.

(b) The indicated discount for a \$250 deductible is .450. Given the following data, determine the portion of total losses eliminated by the imposition of the \$250 deductible.

(i)	Expected loss factor (including allocated claim expense).	.50
(ii)	Allowance for other items:	
	Acquisition	20%
	Taxes	5%
	Unallocated claim expense, administration, and inspection.	.20
	Profit and contingencies	5%
(iii)	Allocated claim expense is 11% of losses	

4. (a) With respect to the Multiple Location Rating Plan:

(i) Upon what basis is credibility established to develop a credit or debit to the basic average fire rate?

(ii) What effect does an extremely large loss have on the final average rate?

(iii) What is the account loss ratio if, with a credibility factor of 20%, (1) the percent credit is 4%? (2) the percent debit is 4%?

(b) Describe and explain the need for the Deficiency of Insurance Endorsement with certain Multiple Location risks.

5. One writer (Pinney) in discussing the construction of a table of excess pure premium ratios made this statement: "The table was then extended to higher premium sizes by extending the differencing process with due regard to the necessary minimum values of the excess pure premium ratios. For example, the excess pure premium ratio for a 45% loss ratio cannot be less than 25% for, otherwise, the average loss ratio on risks having a loss ratio of 45% or less would be in excess of 45%, an obvious impossibility."
Define an excess pure premium ratio and show algebraically why the above statement about minimum values holds. Assume that the risk loss ratios employed in your basic data have been adjusted to the basis of a permissible loss ratio of 60%.

6. (a) The Standard Schedule for Grading Cities and Towns considers various features. List these features and assign them in their relative order of importance to the final classification of the city or town. Describe two conditions, not listed specifically above, which could cause a further deficiency in the rating.

(b) What are the differences between the Universal system and the Analytic system with regard to: (1) basis rate, (2) system of charges and credits, (3) occupancy charges, (4) exposure?

SECTION (b)

NOTE: Answer any four of the questions numbered 7 through 12.

7. What would be the effect of deflated values and falling prices on the loss ratios for the following forms of insurance? Explain.

(a) Accident and Health Insurance
(b) Auto B. I. Liability Insurance
(c) Auto P. D. Liability Insurance
(d) Auto Collision
(e) Liability Other than Auto
(f) Compensation
(g) Fidelity
(h) Surety
(i) Plate Glass
(j) Burglary
(k) Boiler and Machinery
(l) The expense ratio for casualty insurance companies

8. Give the arguments for and against a state fund for workmen's compensation insurance.

9. What role do you feel credibility evaluated by mathematical formulae might play in rating or policy underwriting decisions in fire insurance? Briefly discuss the possibility of using the Binomial distribution to establish fire credibility.

10. (a) Reinsurance appears principally in the following forms:

(i) Facultative reinsurance
(ii) Portfolio reinsurance
(iii) Excess of loss reinsurance
(iv) Retrocession reinsurance
(v) Quota reinsurance
(vi) Fixed Treaty reinsurance
(vii) Open and Optional Treaty reinsurance

Briefly define each form.

(b) Define and discuss the pros and cons of Spread Loss Covers.

11. Recently studies have been made of the problems which arise in connection with Accident and Health policies in which confinement to the house is required for some of the benefits thereunder. Briefly discuss these problems and your recommendations or conclusions.

12. Outline your approach to the problem of setting proper fire lines for a new small multiple line company.

PART III

Section (a)

1. (a) What is meant by "the logic" of an electronic computor?

   (b) With which of the five basic parts of a computor is the "logic" facility generally associated?

   (c) Give an example of the use of the "logic" facilities of a computor.

   (d) After all the copying, coding, punching, sorting, summarizing and tabulating is done, there is the problem of the data with impossible codes and other obvious errors. How would you eliminate this problem?

2. In discussions and comparisons of the relative cost of punch card systems as opposed to clerical systems, it has been pointed out that no system of either variety can be designed to be completely efficient for all companies. Each company must consider a problem as it arises, and try to mesh it with other problems to accomplish the greatest savings. Certain considerations must be made before switch-

ing from one system to another, and the following five questions have been proposed as specimen considerations.

(a) Do the procedures generally prescribe the use of punch-card equipment for routine determinations of the total of amounts carried in existing punch cards?

(b) Do the procedures generally prescribe summary-punching of tabulation and listing totals in all cases where expression of the totals, as such, in punch-card form, may be advantageously used?

(c) Do the procedures avoid multiple original-writings of transactions in effecting start-to-finish handling?

(d) Are the procedures designed to permit the punch-card machines to relieve clerical personnel of all but minor need for "bookkeeping know-how"?

(e) Are the procedures, both manual and machine, fully and clearly expressed in "Standard Practice Instruction" or in similar formal, written form?

Discuss each question as to its pertinence and worth in evaluating a system about to be converted to electronic machinery.

3. Discuss the practical considerations involved in deciding which one of various electronic data processing systems a company should use, including a discussion of servicing, performance, obsolescence, dependence on one machine, compatibility with other internal punched card systems, overall procedures, etc.

4. Outline what your approach would be to the preparation of Part I of the Insurance Expense Exhibit on punch card equipment.

Section (b)

Note: Answer any four of the questions numbered 5 through 10.

5. To answer each of the following questions, tell what information you would need and where you would get it.

   (a) In selecting the name for a new casualty insurance company you have prepared a list of possible names. You want to make sure that none of these possibilities has already been used for another company.

   (b) Your company writes a substantial amount of glass insurance and you want to find what rank you hold for glass insurance in your home state and whether your rank has changed in recent years.

   (c) You want to know how your incurred loss and expense ratios compare with other companies for general liability bodily injury insurance.

   (d) You want the names and addresses of insurance adjusters in Utah.

   (e) You want to see if a particular company is making large reinsurance transactions to bolster its surplus to policyholders.

   (f) Your company is extending its A&H activities from your home state to several other states. You want to know whether your hospital insurance costs will be about the same in these new states.

   (g) You want to compare your new auto liability business with the increase in automobile registrations for each state.

(h) You want to find out how the business of a group of insurance companies operating under a common management is spread among the various companies.

6. The National Board of Fire Underwriters collects statistics in accordance with the Statistical Plan for Earned Premiums and Incurred Losses.

(a) What information does this plan require the companies to report?

(b) How are Written Premiums converted to an Earned basis?

(c) How can Policy Year Earned/Incurred experience be obtained from this plan?

7. (a) What is needed in order to compile insurance statistics according to the following methods?

(i) Policy year

(ii) Fiscal policy year

(iii) Calendar accident year

(iv) Fiscal accident year

(v) Calendar year

(vi) Fiscal year

(b) State which of the methods listed in 7 (a) is used to compile statistics for each of the lines of fire and casualty insurance. Tell why each line is compiled the way it is.

8. Outline the contents of each of the following publications and state the source document(s) from which the various publishers obtain the information.

(a) Spectator — Insurance by States

(b) Best's Fire and Casualty Aggregates and Averages

(c) Argus Chart

(d) Spectator Handy Chart

9. For many years, Workmen's Compensation policies have been issued showing the experience adjusted rate for each individual classification. The National Council on Compensation Insurance recently announced a new system for issuing Workmen's Compensation policies under which manual rates would be shown for each applicable classification and any applicable experience modification would be applied to the total manual premium with no adjustment of the rates or premiums for individual classifications.

   (a) This new program will obviously require changes in the Unit Reporting form presently used by the National Council. Describe one such change and explain why the change will be required.

   (b) Certain premium items are either completely or partially not subject to Experience Rating. How should the Unit Reporting form be modified to accommodate such items and still provide the data contained in your answer to (a) above?

10. Best's Insurance Reports (Fire & Casualty) is published annually.

   (a) Outline the information contained in the publication.

   (b) Explain the rating system used.

   (c) Explain the basis used for "Liquidating Value" per share or "Adjusted Book Value."

PART IV

SECTION (a)

NOTE: Answer any four of the questions numbered 1 through 6.

1. Experience for OL&T PD lacks full credibility in many classes even on a countrywide basis because of the limited hazard and correspondingly small rates. As a result the PD rates often are uniform for the entire country excluding New York State, whereas the BI rates vary widely from state to state and by territory within each state. What do you think is the best way to vary the PD rates by state and territory to reflect variations in the PD hazard which undoubtedly exist?

2. It is sometimes suggested that the profit formula for Fire Insurance rates should be modified to reflect investment income.

   (a) Outline the points covered by the present form of the "so-called" 1921 Standard Profit Formula.

   (b) Give the arguments for and against the inclusion of investment income in the profit formula.

3. How would you determine the variations, if any, in costs by geographical area for an insurance company writing group hospitalization insurance? How could such variations be reflected in the rating structure?

4. Discuss the following items as they apply to fire insurance rates, with particular emphasis on how fire insurance rate-making can be improved in these areas:

(a) The term rule.

(b) Credibility.

(c) Expense loading.

(d) Classification rates.

5. Should the credibility standards be the same or different for rate making and experience rating? Support your answer fully.

6. You have been asked to develop a satisfactory method for reflecting "trend" in the adjustment of rate levels for Fire Insurance. List the basic considerations which should form the framework for an appropriate and satisfactory method for reflecting "trend" and describe such a method together with your reasons.

SECTION (b)

Outline and write an essay on any one of the following topics:

1. Individual Risk Merit Rating for Automobile Liability Insurance.
2. The new Homeowners' Policies — Advantages and Deficiencies.
3. The NAIC M-1 subcommittee report on the question of jurisdiction over multiple line policies.
4. The taxation of fire and casualty insurance companies.
5. A single limit policy for Automobile Liability insurance.

Show your outline of the topic clearly.

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