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CONTENTS OF VOLUME LVI

CONTENTS OF VOLUME LVI (Cont.)

"We must reflect that where so much strength is spent on finding a way of telling the truth, the truth itself is bound to reach us in rather an exhausted and chaotic condition."

—Virginia Woolf

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INSURANCE INVESTMENT REGULATION

ROBERT A. BAILEY

1. Introduction and Summary

Insurers are experiencing a time of upheaval and change which involves their ownership and control, their investments, and the regulation of their investments. Many legislative changes are being proposed at the state and federal levels which affect holding companies, solvency, investments of insurers, and the measurement of the profits of insurers. To help provide a background for understanding these problems and evaluating such proposals, this paper reviews the purpose and present methods of insurance investment regulation, describes some of the shortcomings of the present methods, suggests some principles for achieving the purpose of insurance investment regulation, and presents suggested legislation designed to remedy some of the present shortcomings.

The paper concludes that solvency is the paramount objective of insurance investment regulation and that the present methods of regulation are mostly indirect. A direct approach to solvency would be, first, to provide positive protection to the public against the effects of insolvency and second, to define solvency by defining liabilities and by defining a minimum amount and quality of assets needed to assure payment of the liabilities.

Present methods in most cases fail to protect the public against the effects of the insolvencies that do occur, and they fail to provide a direct definition of solvency. Failure of state regulation to protect the public against insolvencies jeopardizes the entire system of state regulation of insurance and may lead to dual federal — state regulation. Failure to define a minimum amount of qualified assets to assure solvency has resulted in the regulation of *all* assets of insurers and has also resulted in the non-

standard method of insurance accounting which obscures the true condition and value of insurers.

The present regulatory methods, being indirect for the most part, are easy to circumvent. Holding companies have illustrated this problem. The danger is that further indirect regulation for solvency will bring state regulation of insurers into increasing conflict with federal regulation of holding companies, which may invite federal regulation of insurers.

The suggested legislation included in the paper creates an insolvency fund at the state level financed by assessments on the surviving insurers after the insolvency occurs. It also defines solvency and regulates the minimum amount of assets required by such definition. All additional assets are admitted and are not regulated. The minimum amount of required assets may not include any investments in affiliates, thereby greatly reducing the need for insurance regulators to regulate holding companies, and thereby also preventing undue concentration of economic power.

It is hoped that discussion of these proposals will contribute to solutions of some of the present problems in insurance investment regulation.

2. *Purpose of Insurance Investment Regulation*

In reviewing the maze of existing statutes which regulate the investments of insurers and in analysing the myriad proposals for change and reform, including those related to holding companies, we are always in danger of overlooking the basic purpose of such regulation.

Many of the problems that face the insurance industry today find some of their roots in legislation that is designed more to regulate investments than to achieve the underlying purpose of investment regulation. If we have the purpose of investment regulation firmly in mind, we will be better able to propose changes that will achieve that purpose without restricting sound insurance managements. Legislation that fails to achieve its purpose only leads to further legislation.

The purpose of regulation of insurance investments is clearly to assure the solvency of insurers. This is the primary concern of regulation because insurance is a business affected with the public interest. Insurance is singled out for special regulatory treatment because:

(a) Insurance is a necessity in our economic society. Lenders usually require insurance to protect the security for their loan. Insurance is there-

fore necessary to facilitate credit transactions which permit ownership of homes and businesses by individuals of limited means. Insurance encourages investment in enterprises exposed to risks such as fire, wind, theft, and accidents by exchanging the unknown and variable cost of such risks for a known quantity which can be budgeted and planned for in advance. By reducing the uncertainty of the cost of such risks, insurance reduces the cost of bearing risk and thereby helps to reduce the prices of the products of such enterprises.

Insurance is a necessity in a society that is based on private enterprise and private ownership. Insurance is a method of spreading risk which increases the capacity of individuals to own larger properties or businesses by shifting to non-owners the risks over which the owner has little or no control, leaving the owner with a greater capacity to assume those risks over which he has a large degree of control. The only way to spread risk without insurance is by spreading ownership. For example, a society where everything is owned and managed by the government has little need for insurance.

(b) Insurers hold and invest large amounts of other people's money. Insurers collect money in advance in return for a promise to pay for future losses and accidents when and if they occur. The insurers hold this money from the time they collect the premium until they pay the losses, which may vary from just a few weeks for small property losses to the span of a lifetime for weekly or monthly benefits paid to widows and orphans. During the time these funds are held by insurers they must be safeguarded in order to protect the interest of the people who are depending on the promises of the insurer to pay them for their losses.

(c) If an insurer becomes insolvent the policyholders stand to lose far more than the money they paid in to the insurer. For example, if a policyholder paid $100 for $30,000 of insurance on his home, the insolvency of the insurer could cost him his home if his home had burned down before the insolvency became known. An insolvency often leaves destitute those unfortunate few that suffered a severe loss and were depending on their insurer to pay for it.

3. *Present Methods of Regulation*

The present methods of attempting to assure the solvency of insurers are briefly:

(a) To restrict investments to high quality, marketable securities to assure the liquidity and stability of the insurer.

(b) To restrict an insurer from using its assets to form or acquire control of non-insurance enterprises, in order to assure the undivided interest of the insurer's management in the welfare of the insurer. If the assets of an insurer could be used to form or acquire non-insurance enterprises, a type of management might be attracted which would be more interested in using the insurer's assets for their own purposes rather than maintaining the assets of the insurer as security for obligations to policyholders. Such a dividend interest or conflict of interest could work to the detriment of the insurer and its policyholders.

When policyholders pay premiums to an insurer, they are not investing in the insurer, they are buying insurance. The policyholders should not be forced to bear the risks of a shareholder or investor. The assets which back up the obligations to policyholders should therefore not be invested in the insurer or its affiliates.

(c) To restrict an insurer from taking credit for assets which might not be marketable in the event of insolvency, such as prepaid expenses, supplies, furniture, equipment, unsecured loans, and balances due from unlicensed reinsurers. Such assets may be sound and marketable for a going concern but may not be marketable when the insurer has become insolvent. Solvency is safeguarded by valuing an insurer's assets on a liquidating basis under the most adverse conditions rather than on the basis of a going concern.

(d) To require minimum reserves for certain kinds of insurance benefits. Minimum reserves are prescribed by statute for life insurance policies on conservative interest and mortality assumptions, for unearned premiums on a conservative 100% pro-rata basis, and for unpaid bodily injury liability and workmen's compensation claims incurred during the most recent 3 years.

4. Present Methods Fail to Solve the Central Problem of Insolvency

The present methods are a study in indirection. None of them attack the problem of insolvency directly, except in a few states where insolvency funds have been enacted to protect selected policyholders, usually only workmen's compensation or automobile liability insurance policyholders.

A direct approach to regulation against insolvency would be: first, to

provide the insuring public with positive protection against the effects of the insolvency of an insurer; and second, to define solvency by defining liabilities and by defining the quantity and quality of assets needed to assure a safety margin sufficient to reduce the frequency and severity of insolvencies to an acceptable minimum.

The present failure of state regulation to provide positive protection against the effects of insolvency will not be permitted to endure forever. Eventually someone will provide such protection. And whoever does will necessarily define solvency and regulate insurers to prevent as many insolvencies as possible. Such regulation will include regulation of investments, reserves and annual statement accounting. It will include an examination system to check compliance. And it will include a method of taxing the insurers to pay for the cost of the insolvencies that do occur and to pay for the cost of administering the regulatory and examination system. If that someone is the federal government, we will be faced with dual regulation which will certainly be more burdensome than the present system of state regulation.

5. *Present Methods Fail to Define Solvency Directly*

In most states the present methods have also failed to provide a direct or complete definition of solvency. Instead, various indirect and incomplete attempts have been made.

A definition of solvency would first define the liabilities and would then define a minimum quantity of assets of a minimum quality to protect the liabilities. The present definitions of liabilities are adequate for unearned premiums and life insurance policy reserves but are inadequate for casualty loss reserves. The Schedule P statutes covering casualty loss reserves are inadequate because they do not cover all casualty losses and because both the premiums and losses for bodily injury liability included in Schedule P are either undefined or are subject to manipulation, and because the minimum ratio is obsolete and does not recognize variations in methods of operation from insurer to insurer.

The present investment regulations attempt indirectly to define a minimum quantity of assets of a minimum quality to cover the liabilities by "non-admitting" certain kinds of assets and by prohibiting certain other kinds of investments.

The price of the failure to define directly a minimum quantity of qualified assets has been incalculable. It has resulted in the regulation of *all* assets rather than a defined amount. An insurer with 100 million dollars in liabilities is subject to much the same regulation of investments whether it has a billion dollars in assets or only 110 million. This situation has made insurers of more value to non-insurer conglomerates than to the stockholders of the insurer because the non-insurer conglomerate can shift some of the surplus surplus from the insurer to one of the non-insurer entities in the conglomerate where it is no longer subject to insurance investment regulation. "Non-admitting" some assets has led to a non-standard accounting system which reconciles to the "admitted" assets and which distorts the true financial condition and earnings of an insurer and has depressed the market value of insurance stocks.

Is it worth it?

Is it worth the non-standard accounting system which does not properly match income against expenses and claims, which makes regulators, stockholders, policyholders, security analysts, and the internal revenue service adjust the reported statements of insurers to reflect more nearly their true condition, and which because of the confusion and mystery involved, depresses the market value of insurance stocks? Is it worth the interference and restriction on all the assets of an insurer to avoid defining the minimum amount of assets of a minimum quality?

6. *The Present Methods, Being Indirect, are Easy to Circumvent*

(a) Present restrictions on investments and on financing and acquiring on-insurance enterprises can be circumvented through a holding company that controls the insurer.

The holding company can transfer some of the surplus of the insurer to the holding company where the restrictions do not apply. It can cause the insurer to loan money to, or buy bonds of the holding company or any of the other subsidiaries of the holding company, thereby using the assets of the insurer to finance the non-insurance operations of the holding company.

Such circumvention is encouraged because the regulation of insurers' investments applies to all the assets of the insurer indiscriminately without appropriate distinction between assets corresponding to the liabilities and

minimum capital and the assets corresponding to the "surplus surplus" of the insurer.

(b) Present restrictions on taking credit for non-admitted assets can be circumvented through a holding company and through reinsurance.

A holding company can transfer the non-admitted assets of the insurer to the holding company or one of its subsidiaries in exchange for admitted assets, such as a bond issued by the holding company or one of its subsidiaries, and then lease or rent the non-admitted assets back to the insurer. The holding company can then take full credit for the value of the non-admitted assets in its own financial statement.

Such circumvention is encouraged by requiring a different standard of valuation for insurers than for all other businesses.

An insurer can take credit for prepaid expenses by reinsuring part of its business and receiving a prepaid commission from the reinsurer equal to whatever portion of its prepaid expenses it wishes to take credit for. It can even obtain credit in this way for more than its prepaid expenses if it wishes to. For example, if an insurer's prepaid expenses equal 30% of its unearned premium reserve, it may reinsure 10% of the loss potential in the unearned premium reserve in exchange for 50% of its unearned premium reserve, and receive a commission from the reinsurer equal to 35% of the unearned premium reserve. By so doing the insurer reduces its unearned premium reserve by 50%, reduces its cash by 15% of its unearned premium reserve, and increases its surplus by 35% of its unearned premium reserve. The reinsurer gets 5% of the unearned premium reserve for profit and overhead.

Such circumvention is encouraged by requiring the insurers to use an accounting system which forces the statement of profit and loss to reconcile with the non-standard method of valuing assets. The statement of assets which excludes non-admitted assets does not present a full and true statement of the insurer's condition. And the statement of profit and loss which reconciles to such a statement of assets likewise does not present a full and true statement of the profit or loss of the insurer.

(c) Present requirements for minimum reserves can be circumvented through reinsurance and through expense, claim, and premium allocations, and do not reflect the varying operating methods of different types of insurers.

The minimum reserve for unpaid bodily injury liability and workmen's compensation claims can be circumvented by adjusting the allocation of premiums, expenses, and even claims to such lines of business. The premium for a policy covering bodily injury liability and other coverages at a single premium can be allocated to suit the purposes of the insurer and to minimize the reserve requirement. Likewise a compromise settlement of a claim for bodily injury liability and other coverages can be similarly allocated. Expense allocations are even easier to manipulate. Reinsurance can be used to translate premium income into expense reductions as illustrated in (b) above, in order to reduce the minimum reserve requirements which are set as a percentage of premiums.

The minimum reserve for unpaid bodily injury liability and workmen's compensation claims, being set at the same percentage of premiums for all insurers, does not reflect the different expected loss ratios of insurers that use differing methods of operation. Some insurers operate at lower rates with lower expense ratios and corresponding higher loss ratios. A minimum reserve set at a uniform loss ratio for all insurers is ineffective for insurers with higher than average loss ratios.

Such circumvention is made possible by treating reinsurance the same as direct insurance, by requiring minimum reserves for unpaid losses for only selected kinds of insurance rather than for all kinds of insurance, and by basing the minimum reserves for unpaid losses on expected losses rather than on the combined result of losses and expenses — that is, on profits.

(d) In summary, the present methods of regulating for solvency have caused a lot of work, red tape, and restrictions and have distorted the true financial condition of insurers without accomplishing their objective of protecting the public from the effects of the more than 1,000 insolvencies that have occurred.

The present system is inefficient. It requires a lot of auditing, examining, and nervous vigilance by the regulators. It produces a lot of intervention into the affairs of insurers, their owners, and subsidiaries. It encourages circumvention.

7. *Impact of Holding Companies*

Under the existing indirect methods of solvency regulation, holding companies present two serious problems. First, they make insurance invest-

ment regulation more difficult because a holding company is able to make large and sudden changes in and withdrawals from the investments of an insurer, and it has the opportunity to use the assets of the insurer to finance the other activities of the holding company. Second, they bring state regulation of insurers into increasing conflict and overlap with federal regulation of the holding companies. The more state regulation of insurers is forced to interfere in the affairs of federally regulated non-insurers, the more logic and demand there will be for federal regulation of insurers.

Most of the current proposals to deal with the problems posed by holding companies will increase the conflict of state and federal regulation and do not come to grips with the basic problem of solvency. They are designed more for regulating holding companies than for assuring solvency and protecting the public against the effects of insolvency. Being indirect, they will bury the regulators under mountains of paper.

However, if state regulation provides positive protection for the public against insurer insolvencies, and if it defines solvency so as to exclude all investments in affiliates of the insurer, whether parents, subsidiaries or cousins, from the minimum amount of assets required to support the insurer's liabilities, then there would be no need for insurance regulators to regulate holding companies, as far as solvency is concerned. (There may still be a need for disclosure of information regarding tender offers of insurers because of the exemption of some insurers from federal securities regulation.)

The unnecessary intrusion into the affairs of non-insurer holding companies is just one more price we may have to pay to prolong the present indirect and ineffective regulation of insurer solvency. Even if we pay that price we will still face more and more legislation until the public finally has effective protection against insurer insolvencies. Holding companies are not our problem. Insurer insolvency is. Holding companies are merely the instruments that have shown the weaknesses in our present indirect regulation for solvency.

8. *Principles for Achieving the Purpose of Insurance Investment Regulation*

(a) The public should be affirmatively protected against the effects of insolvency of insurers for all kinds of insurance.

(b) The liabilities of an insurer should have meaningful statutory minimums. The one remaining area still to be so defined are reserves for unpaid losses and loss adjustment expenses for property and casualty insurance. However, in order to avoid interference with standard accounting procedures, any statutory loss reserves in excess of the insurer's own estimates should be carried as part of surplus, "below the line," and used only in determining the minimum required amount of qualified assets.

(c) The minimum amount of qualified assets should be defined. With positive insolvency protection for the public, the minimum amount of qualified assets can probably be set at the sum of the liabilities, reserves, and minimum statutory capital and surplus.

(d) The quality of the assets used to satisfy the minimum amount of qualified assets should be defined so as to assure reasonable liquidity, diversification, and unavailability for financing non-insurance activities of the insurer or its affiliates. It is essential that the minimum asset and investment requirements of an insurer should be the same regardless of the surplus of an insurer and regardless of who owns the insurer. It is pointless to prohibit an insurer to engage in non-insurance related activities if a holding company is able to use an insurer's minimum required assets to finance the holding company's non-insurance activities. Besides, investments in affiliates are often not as liquid as other investments and their value is difficult to establish.

(e) All assets in excess of the statutory minimum, the "surplus surplus," should be unregulated and should be permitted to be valued in accordance with generally accepted accounting principles. In other words, all assets should be "admitted." Any attempt to force an insurer to invest and value its surplus surplus in a more restrictive way than a non-insurer only invites circumvention and take-overs by holding companies. It makes an insurer more valuable to a non-insurer conglomerate than to the insurer's stockholders.

Diversification through holding companies and subsidiaries should be permitted and the requirements for investments and accounting should be unaffected by such diversification. There are many sound reasons for diversification and economies to be gained which should not be blocked so long as the public can be adequately protected from insolvencies and misuse of the assets of insurers.

9. Contingency Reserve for Unpaid Claims

The suggested legislation attached hereto contains a "contingency reserve" for unpaid claims which is used only to determine the minimum amount of restricted assets required for the insurer. It is not required to be shown as a liability or reserve. It would be included as part of the surplus surplus. It is not a perfect minimum claim reserve nor does it imply that any insurer without a contingency reserve has adequate claim reserves. But it is strongly biased against insurers that have inadequate reserves and it is much more effective than Schedule P in protecting against insolvency.

The contingency reserve equals the profits on the latest two calendar-accident years for all kinds of property and casualty insurance, excluding reinsurance. An insurer with redundant claim reserves will show a contingency reserve less than the total profits shown in the two most recent annual statements because the statement profits for the last two years will be the sum of the profits on the two most recent calendar-accident years (the contingency reserve) plus the profits from the release of reserves on claims more than two years old. An insurer with inadequate reserves will show a contingency reserve greater than the total profits in the two most recent annual statements because the statement profits for the last two years will be the profits on the two most recent calendar-accident years minus the reserve deficiencies emerging on reserves on claims more than two years old.

Insurers earning profits will not be penalized because the contingency reserves requires only that those profits be held in restricted assets for two years before disbursement as dividends to stockholders or investment in affiliates or other unrestricted investments. Insurers incurring a loss and reporting a loss will not be penalized because no contingency reserve will be required. Insurers incurring a loss but reporting a profit will be penalized because the profits on the two most recent accident years, where phony profits are generated by understating claim reserves, will be held in restricted assets and the losses from emerging deficiencies on old claim reserves will reduce the insurers' surplus surplus. Insurers who suffer losses but report profits are usually the ones in greatest danger of insolvency and of greatest concern to regulators.

The contingency reserve excludes reinsurance because some reinsurance claims are not reported with date of accident, and because reinsurance can be used to manipulate premiums and expenses as well as claims. It includes

all kinds of fire and casualty insurance in order to avoid the manipulation of premium, expense, and claim allocations among the various lines of business. And it uses an expected claim ratio equal to 100% of premiums less the actual expense ratio for each insurer, instead of an arbitrary, uniform expected claim ratio like the 60% and 65% of Schedule P, in order to reflect varying methods of operation and to keep the ratio up to date.

10. Suggested Legislation

Following is a copy of suggested legislation to create an insolvency fund at the state level for all forms of property and casualty insurance, financed by assessments on the surviving insurers after the insolvency occurs. A similar fund would be needed for life insurers.

Also following is a copy of suggested legislation to define solvency and to regulate investments of insurers in accordance with such definition.

Legislation similar to this has been introduced in Michigan in 1969 and represents the work and thought of many people from insurers, insurance industry associations, and state government. It is hoped that full discussion of this suggested legislation in conjunction with the many other proposals currently being made will contribute to solutions which will meet the objectives and eliminate the faults described above.

CHAPTER ..... INSOLVENCY FUND

Sec. 1. (1) To implement the provisions of this chapter, there shall be maintained within this state, by all insurers authorized to transact insurance in this state, except those authorized to transact life insurance in this state, but including the accident fund created by ....., an association of such insurers to be known as the "property and casualty guaranty association," hereafter referred to as the "association." Every such insurer shall be a member of the association, as a condition of its authority to continue to transact insurance in this state.

(2) The association shall be managed by a board of governors, composed of 5 member insurers, each of whom shall be appointed by the commissioner to serve for terms of 3 years and until their successors are appointed and qualified. Three of the governors shall be domestic insurers and two shall be foreign insurers. At least 2 governors shall be stock

insurers and at least 2 shall be non-stock insurers. The 5 governors shall be representative, as nearly as possible, of all the kinds of insurance covered by this chapter. In case of a vacancy for any reason in the office of any such governor, the commissioner shall appoint a member insurer to fill the unexpired term of such vacant office to maintain the membership of the board as required herein.

(3) The association shall adopt a plan of operation and any amendments thereof, not inconsistent with the provisions of this chapter, necessary to assure the fair, reasonable and equitable manner of administering the association, and to provide for such other matters as are necessary or advisable to implement the provisions of this chapter. The plan of operation and any amendments thereof shall be subject to prior written approval by the commissioner. All members of the association shall adhere to the plan of operation.

(4) If for any reason the association fails to adopt a suitable plan of operation within six months following the effective date of this chapter, or if at any time thereafter the association fails to adopt suitable amendments to the plan of operation, the commissioner shall adopt and promulgate such reasonable rules as are necessary or advisable to effectuate the provisions of this chapter. Such rules shall continue in force until modified by the commissioner or superseded by a plan of operation adopted by the association and approved by the commissioner.

(5) In accordance with its plan of operation the association may designate one or more of its members as servicing facilities, but a member may decline such designation. Each servicing facility shall be reimbursed by the association for any expenses it incurs and for any payments it makes on behalf of the association. Each servicing facility shall have authority to perform any functions of the association that the governors lawfully may delegate to it and to do so on behalf of and in the name of the association. The designation of servicing facilities shall be subject to the approval of the commissioner.

(6) The association shall have authority to borrow funds when necessary to effectuate the provisions of this chapter.

(7) The association, either in its own name or through servicing facilities, may be sued and may use the courts to assert or defend any rights the association may have by virtue of this chapter as reasonably necessary fully to effectuate the provisions thereof.

Sec. 2. As used in this chapter:

(1) "Member insurer" means an insurer required to be a member of the association in accordance with the provisions of section 1 (1).

(2) "Insolvent insurer" means a member insurer for which a domiciliary or ancilliary receiver has been appointed in this state after the effective date of this chapter.

(3) (a) "Covered claims" means obligations of an insolvent insurer which: (i) arise out of the insurance policy contracts of the insolvent insurer issued to residents of this state or are payable to residents of this state on behalf of insureds of the insolvent insurer, (ii) were unpaid by the insolvent insurer, (iii) are presented as a claim to the receiver in this state or the association on or before the last date fixed for the filing of claims in the domiciliary delinquency proceedings, and (iv) were incurred or existed prior to, on, or within 30 days after the date the receiver was appointed.

(b) Covered claims shall not include any obligations to refund unearned premiums, nor any obligations incurred after the expiration date of the insurance policy, or after the insurance policy has been replaced by the insured or after the insurance policy has been cancelled by the association as provided in this chapter.

(c) Covered claims shall not include any obligations to insurers, insurance pools, underwriting associations, or any person who has a net worth exceeding $1,000,000.

(d) Covered claims shall not include any claim in an amount of $200 or less, nor the first $200 of any claim in excess of $200, nor that portion of any claim which is in excess of any applicable limit provided in the insurance policy.

(e) Covered claims shall not include that portion of any claim, other than a workmen's compensation claim, which is in excess of $500,000.

Sec. 3. (1) The association shall pay and discharge covered claims. It may do so either directly by itself or through a servicing facility or through a contract for reinsurance or transfer of liabilities with any member insurer, in accordance with the plan of operation.

(2) The association shall be a party in interest in all proceedings involving a covered claim and shall have the same rights as the insolvent insurer would have had if not in receivership: (a) to appear, defend, and

appeal a claim in a court of competent jurisdiction, (b) to receive notice of, investigate, adjust, compromise, settle and pay a covered claim, and (c) to investigate, handle and deny a non-covered claim. The association shall have no cause of action against the insureds of the insolvent insurer for any sums it has paid out, except as provided by this chapter.

(3) If damages against uninsured motorists are recoverable by the claimant from his own insurer or from the Motor Vehicle Accident Claims Fund created by the motor vehicle accident claims act, or any similar fund, such damages recoverable shall be a credit against a covered claim payable under this chapter. If damages against an insured who is not a resident of this state are recoverable by a claimant who is a resident of this state, in whole or in part, from any insolvency fund or its equivalent in the state where the insured is a resident, such damages recoverable shall be a credit against a covered claim payable under this chapter. Any amount paid a claimant in excess of the amount authorized by this section may be recovered by action brought by the association.

(4) The association shall continue coverage for covered claims under all insurance policies of the insolvent insurer that were in force on the date the receiver was appointed until the insurance policy has expired in accordance with its terms, or has been replaced by the insured or has been cancelled by the association as provided in this chapter, but in no event for a period longer than 30 days after the date the receiver was appointed.

(5) The association shall have authority to cancel insurance policies of the insolvent insurer by mailing or delivering to the insured at the last known address within this state a ten days' written notice of cancellation, notwithstanding any statute or policy provision to the contrary.

Sec. 4. The association shall have authority to submit reports and make recommendations to the commissioner regarding the financial condition of any member insurer. Such reports and recommendations shall not be considered public documents. There shall be no liability on the part of, and no cause of action of any nature shall arise against, member insurers, the association or their agents or employees, the governors, or the commissioner or his authorized representatives, for any statements made by them in any reports or recommendations made hereunder.

Sec. 5. (1) Insureds entitled to the protection of this chapter shall cooperate with the association in accordance with their policies in the same

manner as they would have been required to cooperate with their insurer if it were not in receivership, and shall be deemed to have assigned to the association any right to make claim against the receiver for a refund of unearned premium for the period of coverage provided by the association beginning on the date of receivership.

(2) Any insured or claimant entitled to the benefits of this chapter shall be deemed to have assigned to the association, to the extent of any payment received, his rights against the estate of the insolvent insurer.

Sec. 6. To the extent necessary to secure funds for the association for payment of covered claims and also for payment of reasonable costs of administering the association, the association shall levy assessments upon all member insurers. The association shall allocate its claim payments and costs to the following 3 categories: workmen's compensation insurance, automobile insurance, insurance other than workmen's compensation and automobile insurance. Separate assessments shall be made for each such category. The assessment for each category shall be used to pay the claim payments and costs allocated to such category and shall be in proportion to the net direct premiums written after deducting dividends paid or credited to policyholders by each member insurer in this state for kinds of insurance included within such category, as reported in the most recent annual statement available at the time of assessment. The rate of assessment shall be a uniform percentage of such premiums for all member insurers. Such assessments shall be remitted to and administered by the association in accordance with the plan of operation. Each member insurer so assessed shall have at least 30 days advance written notice as to the date the assessment is due and payable. No member insurer shall be assessed during any calendar year for more than 1% of any of its net direct premiums written in this state during the previous calendar year. Such assessments shall be recognized in the rate-making procedures for insurance rates in the same manner that expenses and premium taxes are recognized. Any unused assessments and any reimbursements from the receiver remaining in any category in excess of covered claims and expenses allocated to such category shall be refunded by the association to the member insurers who paid the assessments for such category in proportion to their assessments paid. An insurer which ceases to be a member of the association shall have no right to a refund of any assessment previously remitted to the association. The commissioner may revoke the certificate of authority to transact business in this state of a

member insurer which fails to pay an assessment when due as provided in this chapter and after demand having been made.

Sec. 7. All proceedings in any court of law of this state to which the insolvent insurer is a party shall be stayed for a period of 60 days from the date a receiver is appointed in this state or in the state of domicile of the insurer, to permit proper defense of all pending causes of action.

Sec. 8. When a receiver is appointed in this state for any member insurer, the receiver shall promptly give notice of this appointment and a brief description of the contents of this chapter by first class mail, to: (a) all persons known or reasonably expected to have or be interested in claims against the insurer, at the last known address within this state; (b) all insureds of the insurer, at the last known address within this state; and (c) the governors of the property and casualty guaranty association. The receiver may also require that agents of the insurer give prompt written notice of the same information, by first class mail, to their insureds at the last known address within this state. The receiver shall also promptly publish such notice in a newspaper of general circulation in the county where the insurer had its principal office in this state not less than once per week, for four weeks, and by publication elsewhere in this state as the court shall direct.

Sec. 9. The association shall be exempt from all license fees, income, franchise, privilege or occupation taxes levied or assessed by this sate, any municipality, county or other political sub-division of the state, except state, county or municipal taxes upon the real or personal property of the association, which is to be assessed and taxed in the same manner as real property and personal property of other non-exempt persons.

Sec. 10. (1) The operation of the association shall at all times be subject to the regulation of the commissioner. The commissioner, or any deputy or examiner, or any person whom the commissioner shall appoint, shall have the power of visitation and examination into the affairs of the association and free access to all books, papers and documents that relate to the business of the association, may summon and qualify witnesses under oath, and may examine officers, agents or employees or any other person having knowledge of the affairs, transactions or conditions of the association.

(2) Any member insurer aggrieved by any action or decision of the association may appeal to the commisioner within 30 days from the action

or decision. Proceedings under this section are subject to the provisions of .....

CHAPTER ..... INVESTMENTS

Sec. 1. (1) Every domestic insurer authorized to transact insurance in this state, including domestic fraternal benefit societies and the accident fund created by....., shall have the power to loan or invest its funds in any investment, and shall have the power to buy, sell, hold title to, possess, occupy, hypothecate, convey, manage, protect, insure and deal with respect to its investments, property and monies to the same extent as any other person or corporation may do under the laws of this state or of the United States, and may value its assets and liabilities in accordance with generally accepted accounting principles; provided:

(A) Every such insurer or fund shall have assets in cash or as defined in this chapter in a total amount at least equal to its liabilities including its reserves as required by this code, plus an amount for contingencies as defined in section 1(5), plus an amount equal to the minimum capital and surplus required to be maintained by this code. Assets defined by sections..... (real estate) shall not be used to satisfy more than 10% of this requirement. Such liabilities and reserves may be reduced by: (i) reinsurance ceded to the extent admitted in accordance with regulations prescribed by the commissioner, (ii) policy loans secured by policies included in such liabilities and reserves but not in excess of the cash surrender value of such policies, (iii) the net amount of life insurance premiums and annuity considerations deferred and uncollected, (iv) amounts receivable from any person to the extent that they offset liabilities or amounts payable to the same person, (v) amounts receivable from an agent or agency which does not have control of more than 10% of all agents' balances of the insurer and which is not affiliated with the insurer as defined in section 1(3), on policies with an effective date not more than one month old, to the extent that such amounts are offset by unearned premium reserves on the same policies. Such assets, liabilities and reserves shall exclude assets, liabilities and reserves included in separate accounts established in accordance with section ..... The value of any income due and accrued in respect to such assets may be included in such total amount. Such assets shall not be valued at more than the actual value

as ascertained in the manner approved by the commissioner, except those assets valued in accordance with section 1(1)(B) by insurers subject to section 1(1)(B).

(B) Every such insurer authorized to transact life insurance, including fraternal benefit societies, shall have assets in cash or as defined by sections ..... (certificates of deposit, government bonds, stock in federal mortgage agencies, corporate bonds, preferred stocks, savings and loan shares, collateral loans, real estate first mortgages, amounts receivable from authorized insurers) in a total amount at least equal to 90% of the reserves established in accordance with sections ..... (reserves on life insurance policies and annuities). Assets defined by section ..... (preferred stock) shall not be used to satisfy more than 1/9 of this requirement. Such reserves may be reduced by: (i) reinsurance ceded to the extent admitted in accordance with regulations prescribed by the commissioner, (ii) policy loans secured by policies included in such reserve but not in excess of the cash surrender value of such policies, (iii) the net amount of life insurance premiums and annuity considerations deferred and uncollected, (iv) amounts receivable from any person to the extent that they offset liabilities or amounts payable to the same person. Such assets and reserves shall exclude assets and reserves included in separate accounts established in accordance with section ..... The value of any income due and accrued in respect to such assets may be included in such total amount. Assets defined by section ..... (stock in federal mortgage agencies) may be valued at the cost price thereof. Assets defined by sections ..... (government bonds, corporate bonds, collateral loans and real estate first mortgages) which have a fixed term and rate may, if amply secured and not in default as to principal and interest, be valued as follows: if purchased at par, at the par value; if purchased above or below par, on the basis of the purchased price adjusted so as to bring the value to par at maturity and so as to yield in the meantime the effective rate of interest at which the purchase was made. The purchase price shall in no case be taken at a higher figure than the actual market value at the time of purchase. The commissioner shall have full discretion in determining the method of calculating values according to the foregoing rule. Such other assets shall not be valued at more than the actual value as ascertained in the manner approved by the commissioner.

(2) The assets required by section 1(1)(A) shall not include more than 5% of such assets invested in, loaned to, secured by, leased or rented

to, or deposited with any one person, or invested in any one parcel of real estate, but this restriction shall not apply to obligations of the United States or any state of the United States, or agencies or instrumentalities thereof, principal and interest of which are fully guaranteed by the United States or by any state of the United States.

(3) The assets required by sections 1(1)(A) and 1(1)(B) shall not include any assets invested in, loaned to, secured by, leased or rented to, or deposited with any person that is, directly or indirectly, owned or controlled by the insurer, or that, directly or indirectly, owns, controls or is affiliated with the insurer. Two persons shall be deemed to be affiliated if they are both owned or controlled, directly or indirectly, by the same person or by the same group of persons. Control shall be presumed to exist if any person, directly or indirectly, owns, controls, holds with the power to vote or holds proxies, representing ten per cent (10%) or more of the voting securities of any other person.

(4) Notwithstanding the limitations in subsections (2) and (3), the assets required by sections 1(1)(A) and 1(1)(B) may include the value of a wholly owned subsidiary authorized to transact insurance in this state in an amount equal to the assets defined by sections 1(1)(A) and 1(1)(B), respectively, as limited by sub-sections (2) and (3), which are held by such subsidiary and which are in excess of the amount of such assets required for such subsidiary by sections 1(1)(A) and 1(1)(B), respectively.

(5) The amount for contingencies referred to in this section for each insurer other than an insurer authorized to transact life insurance and other than an insurer transacting only title insurance, shall equal the sum of its underwriting gain, if any, realized for each of the two most recent calendar years in respect to its entire business excluding reinsurance ceded and assumed, as calculated by subtracting from the premiums earned during each such year the sum of: the incurred policy benefits and adjustment expenses related thereto arising out of accidents or events that occurred during each such year, the other underwriting expenses (excluding federal and foreign income taxes to the extent offset by net investment gain) incurred during each such year, and dividends to policyholders incurred during each such year. The amount for contingencies referred to in this section for insurers authorized to transact life insurance and insurers transacting only title insurance shall equal zero.

Two or more insurers authorized to transact insurance in this state may

compute the amount for contingencies referred to in this section on a consolidated basis and prorate the total amount for contingencies to each such insurer in proportion to the premiums earned by each such insurer, if:

(a) they are affiliated through ownership, where each such insurer is wholly owned by or wholly owns one or more of the other insurers in such group, or,

(b) they pool substantially all their business with each other and the commissioner certifies that such computation on a consolidated basis will more accurately reflect the financial condition and affairs of such insurers.

(6) Every insurer or fund, including fraternal benefit societies, authorized to transact insurance in this state on the effective date of this section shall be allowed two years after the effective date of this section in which to comply with the requirements of this section. Any such insurer which fails to meet the requirements of this section at the end of such two years may be granted one extension of an additional two years in which to comply by the commissioner if the commissioner is satisfied such insurer is safe, reliable and entitled to public confidence and would materially suffer from a forced conversion of its assets to comply with this section.

DISCUSSION BY S. C. DuROSE

In this paper, the author proposes certain premises which are said to be the basis for insurance investment regulation and then describes and discusses some of the shortcomings of the persent approach to investment regulation. He also suggests certain principles for achieving his concept of the purposes of insurance investment regulation. Also attached to the paper are copies of legislation proposed in the state of Michigan for the creation of a post-insolvency assessment type fund and for the regulation of insurer investments. It is my opinion that the primary interest of the Society as respects this paper is the author's rationale and discussion of insurance investment regulation.

The author calls attention to the fact that, in most states, there is at present no acceptable solution to the handling of the social problem of paying claimants in event of the liquidation of an insurer. Attention is also directed to deficiencies in the present insurance accounting system and in financial reporting. The author deals with these matters in the framework

of insurance investment regulation. The paper is of value in that the author presents rather unusual and novel concepts as to the purpose of insurance investment regulation and as to present deficiencies and proposed remedies. I happen to agree with much of what the author has said but, on the other hand, I disagree with several of the premises upon which he has constructed his dissertation.

The author points out several problems involving holding companies which he quite correctly exposes to the light of day. He also identifies some of the niceties of reinsurance that are currently attracting the scrutiny of insurance regulators. However, I must confess that I do not share his conclusion that all facets of these problems can be properly resolved solely through the regulation of insurer investments. I agree with a great many of the points that the author makes but I cannot agree that the regulation of insurer investments such as is proposed would resolve the many complex problems involved with upstream and downstream holding companies, deficiencies in uniform accounting and financial statement reporting, and the methods and practices of management in the conduct of an insurance business.

The basic premise of the paper seems to be that "The purpose of regulation of insurance investments is clearly to assure the solvency of insurers." I do not believe that the regulation of insurer investments can be boiled down to that one statement of purpose nor do I believe that this actually states the purpose of investment regulation either in the past or in our current business climate. The regulation of investments cannot, by itself, "assure the solvency of insurers." It is my observation that non-life insurers generally become insolvent as a result of a failure to adequately recognize or disclose reserves for unpaid claims, unearned premiums, and other contractual liabilities. Life insurers become insolvent because of a failure to properly control expenses. Neither of these causes of insolvency can be eliminated by regulation of investments.

In 1965 the Wisconsin Legislature passed legislation setting up the Insurance Laws Revision Committee of the Wisconsin Legislative Council for the purpose of rethinking and rewriting the Wisconsin insurance laws. Spencer L. Kimball, Dean, University of Wisconsin Law School, has been staff director of this project since its inception. The various chapters of the revised Wisconsin Insurance Code typically go through a drafting sequence of a working draft, preliminary draft, first draft, second draft,

third draft, and usually a fourth draft, before final action by the Insurance Laws Revision Committee and then consideration by the Legislative Council. After favorable consideration by these committees, the draft is then prepared in bill form for introduction to the Legislature. Dean Kimball has prepared a separate chapter on the regulation of investments that is presently in the third draft stage. In this draft, he suggests that there are four general objectives for the regulation of investments of insurers. Briefly, they are:

1. To seek to prevent incompetent management from making speculative or otherwise unsuitable investments that endanger policyholder interests.
2. To seek to stabilize the financial position of insurers to prevent them from being unduly vulnerable to shifts in economic circumstances.
3. To assert a degree of control with respect to concentration of economic power.
4. To accomplish specific social objectives such as investment in public housing or in urban renewal.

I agree that many statutes are not completely clear in defining solvency or insolvency of an insurer. The regulation for solvency would seem to involve a great many facets of the insurance business other than the mere regulation of investments. It would seem to me that additional matters in the regulation of an insurer for solvency or insolvency include the efforts of the insurance regulator in the areas of uniform accounting; specifications of the format for monthly, quarterly, and annual financial reports; rate regulation; reinsurance contracts; examination of insurers; licensing; and annual review of the performance of management and their methods and practices in the conduct of an insurance business, including the maintenance of the financial solidity of the corporation. There are various tests of performance as respects solvency. When a company fails certain of these tests, or does not show a proper rating by one of these tests, then it is indicated that the company is insolvent. The problem of insolvency is to devise adequate tests to show either insolvency or a predictable trend in that direction. The regulation of investments, while building in safeguards against insolvency, would not in itself prevent insolvencies.

In a technical legal sense, it would appear that a commissioner would have difficulty in going before a court to request liquidation and receivership of an insurer on the basis that the insurer was not solvent because it

had not conformed to the requirements of an investment law. I would think that the lawyers would, in general, have to proceed on the more affirmative basis that the insurer was, in fact, insolvent and unable to meet its obligations. In this connection, it is of interest to note the definition of insolvency contained in section 645.03 (14) (b), Wisconsin Statutes, as follows:

"645.03 (14) 'Insolvency' means:

"(b) For any insurer, that it is unable to pay its debts or meet its obligations as they mature or that its assets do not exceed its liabilities plus the greater of 1.) any capital and surplus required by law to be constantly maintained, or 2.) its authorized and issued capital stock. For purposes of this subsection, 'assets' includes one-half of the maximum total assessment liability of the policyholders of the insurer; and 'liabilities' includes reserves required by law. For policies issued on the basis of unlimited assessment liability, the maximum total liability, for purposes of determining solvency only, shall be deemed to be that amount that could be obtained if there were 100% collection of an assessment at the rate of 10 mills."

Chapter 645 of the Wisconsin Statutes is the Insurers Rehabilitation and Liquidation Act which was enacted by the Wisconsin Legislature in the 1967 session and is the work of the Insurance Laws Revision Committee under the direction of Spencer Kimball. This is a comprehensive Act which gives to the Commissioner of Insurance a great number of tools or procedures for coping with the whole spectrum of complex problems in the area of delinquency in insurance companies. I will not attempt to recite the substance of this chapter but I would commend it to all members of the Society for study.

It is not possible for me to attempt a critique of the proposed investment regulation law. I am not familiar with Michigan insurance law, and without having a knowledge and understanding of the context of the law into which the proposed chapter will be inserted it is difficult to formulate valid comments. I note, for example, that the proposed legislation seems not to contain a definition of either solvency or insolvency. Presumably some other statute would contain such a definition.

In summary, I believe that the author has done a service by identifying

some significant issues in the insurance business today, and, in any event, his ideas are different and thought-provoking. I agree with the deficiencies he has noted in the accounting and regulatory system that we have. I do not agree that the author has properly identified the basic purposes of the regulation of insurance investments nor would I agree that the author has proposed appropriate solutions to achieve the purposes that he has identified. I believe that the author has oversimplified the many facets of insurer regulation for solvency and solidity and, having done this, he attempts to ascribe too great curative powers to his solution to the oversimplified problem. However, I believe that there is merit in what the author proposes when considered in the more limited context of investment regulation. Within such a framework, his points are worthy of serious consideration.

Actuaries should, on occasion, climb down from their ivory towers and mingle with the natives struggling to keep alive in the jungle down below. Papers such as this and a caustic critique and attendant discussion serve such a purpose and thereby broaden the perspective of insurance actuaries.

DISCUSSION BY CLYDE H. GRAVES

Mr. Bailey, in his paper "Insurance Investment Regulation," has undertaken a large order. He has attempted, as he stated in his introduction, (1) to review the purpose and present method of insurance investment regulation, (2) to describe some of the shortcomings of the present methods, (3) to suggest some principles for achieving the purpose of insurance regulation, and (4) to present suggested legislation designed to remedy some of the present shortcomings.

The discussion of the purpose and present method of insurance investment regulation is much too brief. Mr. Bailey states that "The purpose of regulation of insurance investments is clearly to assure the solvency of insurers." Recently, New York, Wisconsin, as well as Michigan, have restudied the question of investment regulation and in Wisconsin and Michigan bills are currently being considered, while New York has just amended its laws to deal with investment and holding companies. In a draft on "Regulation of Investments" prepared for the State of Wisconsin Legislative Council, it is stated that the laws regulating investments of insurers have a number of objectives and it goes on to mention four: (1) To prevent management from making speculations or otherwise unsuitable investments

that endanger policyholders interests, (2) to stabilize the financial position of insurers, to prevent them from being unduly vulnerable to shifts in economic circumstances, (3) to deal with the problem of the concentration of economic power, and (4) to achieve certain social objectives. An example of number (4) is found in the New York law with reference to investments in housing projects.

There are other discussions of the purposes of insurance investment regulation to be found in the "Report of the Special Committee on Insurance Holding Companies" published by the New York Insurance Department in February, 1968 and in the Proceedings of the National Association of Insurance Commissioners. For example, in the Report of the Industry Advisory Committee to the D1 Subcommittee of the NAIC on Holding Company Legislation, presented at the December, 1968, NAIC meeting, it is stated, "The thrust of insurance department regulations should be directed primarily to the maintenance of solvency of the insurer, to the protection and fair treatment of policyholders and to the prevention of activity that might adversely affect competition within the insurance business." My point here is that there is needed a much more in-depth discussion of the purpose of investment regulation than is presented in Mr. Bailey's paper. This is needed in order to evaluate the charge Mr. Bailey makes that state regulation has failed to protect the public against insolvencies and has forced on the industry a "non-standard method of insurance accounting which obscures the true condition and value of insurers."

I do not accept as proven the charge that state regulation of investments is a failure, and I do not agree that the valuation of assets and liabilities in accordance with "generally accepted accounting principles" is necessarily better for the insurance industry and the public than "statutory insurance accounting." For discussion of this later point see the report of the Committee on Annual Statement published in the 1965 CAS *Proceedings* when it is stated that "withholding full recognition of earnings and surplus while material uncertainties remain" is a controlling principle.

Mr. Bailey's solution to all the problems of insurance accounting, reserves, Schedule P, valuation of assets and liabilities, regulation of investments, holding companies, and insolvencies appears quite simple. It is to define a minimum amount of "restricted assets" required for an insurer, to regulate the investment of these restricted assets, to permit insurers to invest any asset in excess of restricted assets as they please, and to create an insolvency fund to take care of all the insolvencies which will then occur.

The solution is too simple.

There is a need to modernize the laws regulating investments and to liberalize the investments of "surplus surplus." However, I think there should be more study given to defining surplus surplus. To say that it is surplus in excess of that which "may reasonably be required to assure solvency, effective functioning, and necessary growth," as stated in the New York Report, or that which is excess to the "surplus needed to support the insurance operation," as is expressed in the Wisconsin study, is not defining the term. How much surplus is needed to support the insurance operation? What is needed to assure solvency? How much is needed for necessary growth? Should there be a relationship between the amount of surplus and premium writings, surplus and underwriting profit? Should there be a security valuation reserve? How much surplus is needed to cover large underwriting loss, a sharp drop in the stock market, and an increased volume of business?

Mr. Bailey's definition of surplus surplus is the difference between surplus defined in accordance with generally accepted accounting principles and "restricted assets" where restricted assets is defined as an amount equal to a company's liabilities including reserves, plus an amount for contingencies, plus an amount equal to the minimum capital and surplus required by the state insurance code. The amount for contingencies is the company's underwriting gain, if any, realized for each of the two most recent accident years. Note that if a company has underwriting losses, it would have fewer restricted assets than if the company had an underwriting gain.

The value of this formula for measuring surplus surplus, if such surplus is to be completely unrestricted, requires considerable study before adoption by any state.

With reference to the insolvency fund bill attached as an exhibit to Mr. Bailey's paper, I would like to make the following comments as to its characteristics:

1) It is a *state* fund, not a federal fund.
2) It is a *post* assessment fund not requiring contributions until after an insolvency has taken place.
3) It covers all property and casualty coverages, not just workmen's compensation or automobile liability.

4) It provides for separate assessments, for workmen's compensation, automobile insurance, and "all other."
5) It provides that the assessments shall be recognized in the rate-making process.
6) It provides for a maximum assessment in any one year of one percent of net direct premiums written.
7) It provides for unpaid claims against the insolvent company, and does not cover refunds of unearned premiums.
8) It provides for a $200 deductible.
9) It provides for a Board of Governors composed of insurance companies.

Possibly the most controversial part of the insolvency bill is its extension of coverages to other than workmen's compensation and automobile liability. There will, of course, be quite a debate as to whether each state should establish an insolvency fund or whether one should be set up by the federal government. I understand a bill has just been introduced in Congress to create a Federal Insurance Guaranty Corporation — the bill being much more restrictive on industry than Dodd's bill of a few years ago.

Mr. Bailey concludes his paper by stating, "It is hoped that full discussion of this suggested legislation in conjunction with the many other proposals currently being made will contribute to solutions which will meet the objectives and eliminate the faults . . . . . [of insurance investment regulations]." To this I agree.

DISCUSSION BY ROBERT G. ESPIE

Mr. Bailey's paper presents an interesting and comparatively novel approach to the perennial problem of assuring that insurance companies will in fact be able to carry out the promises they make to their policyholders. In fact, I would suggest that perhaps the real title of his paper should not be "Insurance Investment Regulation" but rather "Insurance Company Solvency Regulation."

The main framework of his approach may be thought of as one in which companies are allowed to prepare balance sheets according to generally accepted accounting principles with a separately-calculated test as to whether their financial position is such as to allow them to continue in business. Such an arrangement would simplify greatly the problem of pre-

paring financial statements which will be useful to investors without destroying the ability of regulators to protect the citizenry from insolvency.

Mr. Bailey has perhaps used an unfortunate phrase in the section in which he states that "insurers hold and invest large amounts of other people's money." Although the problem may be merely one of semantics, the objective of simplifying and clarifying the necessarily esoteric art of insurance accounting is not served by stating that insurance companies "hold other people's money." Although the knowledgeable reader will not fall into error, the casual reader should not be misled as to the real facts, which are that insurance company assets are owned by the insurance company and that the policyholder has a very valuable conditional promise to pay.

Mr. Bailey's direct approach to regulation against insolvency starts with the objective of providing the insurance public with positive protection against the effects of the insolvency of an insurer. Surely, the first step in such a program should be to prevent the occurrence of an insolvency which would endanger policyholders' interests.

Mr. Bailey's device of sequestering the profits of the two most recent calendar years is ingenuous, and it follows what appears to have been the original philosophy of Schedule P. It has, however, the shortcoming that while it provides an added cushion to the policyholders of a company which is operating profitably, it notably fails to provide any cushion for a company which is operating unprofitably. If one looks at this concept as being in effect a requirement of additional surplus over and above the minimum statutory requirement, it does seem odd that no such requirement should exist for a company running an underwriting loss.

There is also a question as to whether the "profits" on the latest two calendar years represent statutory underwriting profits, or statutory underwriting profits plus investment income, or profits as determined by generally accepted accounting principles. If the company's basic financial statement is prepared according to generally accepted accounting principles, there may be no calculation of the classical statutory underwriting profit. And it does not seem appropriate to define profits for Mr. Bailey's purposes as being the change in the surplus position when the surplus is determined from his proposed solvency test.

It would appear that the proposed legislation would allow a life insurance operation to value its bond holdings on an amortized basis but would

not so allow a casualty and property company. The question of using amortized values vs. market values for the bond holdings of a casualty and property company is much too important to be settled in favor of market valuation without a thorough airing.

IS "PROBABLE MAXIMUM LOSS" (PML) A USEFUL CONCEPT?

JOHN S. McGUINNESS

Purpose of this Paper. The term "PML" or "probable maximum loss" is one of the most widely used terms in property insurance underwriting. But it represents one of the least clear concepts in all insurance. This fact is reflected by the results of a four-year study that involved collecting the personal and company definitions of PML from over one hundred underwriters and underwriting executives. No two of their definitions fully agree.

In the absence of a clear and specific meaning, the term can be a true invitation to disaster, because it thus provides a foundation of sand for the quantitative part of risk selection. The Lake Charles, Louisiana, oil refinery and McCormick Place, Chicago, fires of the 1960's dramatically demonstrated this fact to several insurers. On the other hand, if buttressed by a clear and specific definition and if based on properly collected and analyzed facts, the term can be an extremely useful and valuable tool. The purpose of this paper is to show how it can be made such a tool by suggesting (1) a precise definition, (2) how accuracy of PML estimates is related to the stability of a portfolio of risks, and (3) methods of measurable accuracy for determining the PML of a risk.

DEFINITION

The following definitions are suggested:

> The probable maximum loss *for a property* is that proportion of the total value of the property which will equal or exceed, in a stated proportion of all cases, the amount of loss from a specified peril or group of perils.
>
> The probable maximum loss *under a given insurance contract* is that proportion of the limit of liability which will equal or exceed, in a stated proportion of all cases, the amount of any loss covered by the contract.

In more familiar statistical language, that is more clearly related to credibility criteria for example, the insurance definition may be restated:

> The probable maximum loss under a given insurance contract is that proportion [100(m+k)%] of the limit of liability which with probability P is greater than or equal to any loss covered by the contract,

where m is the mean or "expected" proportion of loss.

The first of these two definitions is pertinent to the insured and his risk manager, while the second definition is of course more directly pertinent to the underwriter, since it is tied directly to his underwriting results. The first definition requires four pieces of information and the second calls for three pieces. These merit a closer look.

The first datum required for the property definition is the value of the property. The second required datum is a proportion of that value. These are definite, measurable quantities. The first can be expressed as a monetary amount, and the second either as a monetary amount or as a percentage of value. The fourth required datum is the peril or group of perils that is being considered. Since there are apt to be considerably different PML's for the different major perils, it is usually wise to determine these PML's separately and then to select the largest for use. For the insurance definition, the amount of insurance is needed instead of the value of the property, and the second needed datum differs correspondingly. The fourth datum is not needed explicitly for insurance.

The third datum is the major essential which is missing from existing definitions of PML. Unless we state in specific numerical terms the degree of probability which we desire, PML cannot have a clear or precise meaning. This probability must be factually based and should be measured as accurately as possible, not just pulled from the air or based on unaided judgment. The probability should also be selected on the basis of factual criteria that suitably link it to the objective underlying its selection: a definite degree of stability in underwriting results.

Benckert and Sternberg have secured evidence that the distribution by size *(monetary amount)* of fire losses to dwellings follows a Paretoan curve.[1] Mandelbrot has given a theoretical justification why all fire losses should be so distributed.[2] It is reasonable to assume therefore that the distribution of

[1] Benckert, L-G. and Sternberg, I., "An Attempt to Find an Expression for the Distribution of Fire Damage Amount," *Transactions XVth International Congress of Actuaries* Vol. II, p. 288, New York, 1957.

[2] Madelbrot, B., "Random Walks, Fire Damage Amount and Other Paretoan Risk Phenomena," *Operations Research*, Vol. XII, p. 582, 1964.

losses by *proportion of value* from any peril for a group of similar risks — or over a very long period of time for the same risk — also follows the Paretoan distribution, as indicated in Figure 1. The use of the variance and similar statistics related to such a curve, especially in determining probabilities or setting confidence intervals, accordingly requires some discretion.

It is easier to develop a confidence interval by transforming the relative frequency distribution into a cumulative or ogive form, which coincides with the "greater than or equal to" form of our definition of PML. This has been done in Figure 2.

It is also worth noting that the probability pertinent to PML involves only one tail — the upper end — of the relative frequency distribution of claims, as shown in Figure 2. With respect to PML we are only interested in adverse fluctuations, those *above* the PML value. This differs from most ratemaking situations, in which both upward and downward fluctuations about the mean or some other statistic must be considered.

PML AND THE STABILITY OF A PORTFOLIO

PML is used in at least two types of situations. Its primary uses is in the quantitative part of underwriting or risk selection. Here it is used as the basis for attempting to secure an adequate spread of risk, by limiting the amount of an insurer's liability to loss from a single occurrence. It is used primarily in connection with the fire peril, and to a lesser extent in connection with other perils giving rise to localized losses, for example sprinkler leakage, water damage, and explosion. It is still less used in connection with windstorm, earthquake, and similar loss to individual properties. It is used very little and with extreme imprecision in connection with catastrophic exposures that give rise to losses to several insured properties at the same time. With respect to the financial soundness of insurers, however, a precise use in connection with the catastrophic exposure is its potentially most important type of employment.

The term is also used in connection with engineering inspection of existing properties, and engineering analysis for safety and loss prevention of proposed building designs. Its present use in these connections, however, is just as imprecise as in connection with underwriting.

The immediate purpose of determining the PML for any specific property or risk is to provide a basis for selecting the maximum amount of

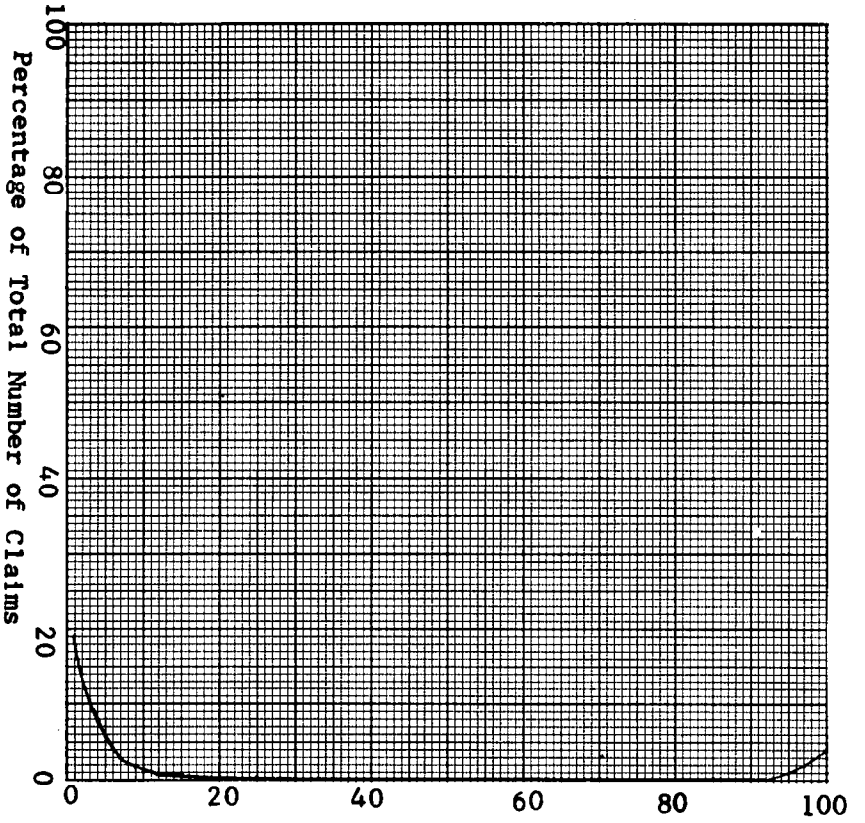

Figure 1.- Shape of a Relative Frequency Distribution of Property Claim Amounts as Percentages of Insured Amounts

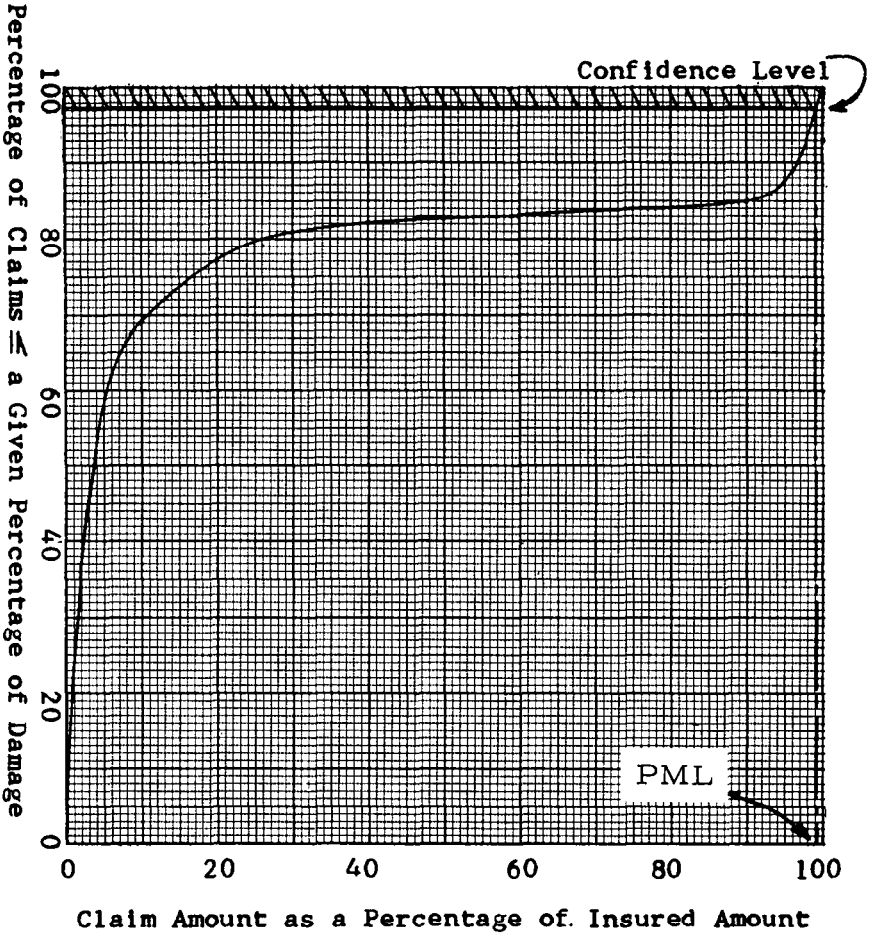

Figure 2.- Shape of a Cumulative Relative Frequency Distribution of Property Claim Amounts as Percentages of Insured Amounts

insurance that an insurer should retain on the risk for its own account. This amount is commonly called the insurer's "net retention." PML is a tool to be used in achieving a particular result — the retention — not an end in itself. Parallel to determining the company's own retention or exposure to loss on a particular risk, the maximum amount to which an insurer wishes to expose its treaty reinsurers on the same risk is also based on the underwriter's assessment of the PML.

In turn, the purpose of setting underwriting retentions is to stabilize an insurer's experience so that one or more large individual losses will not adversely affect its over-all underwriting result by more than a specified amount during any one year.

The ultimate objective for determining the PML of an individual risk is therefore to help stabilize the over-all claim results of a portfolio or group of risks during each year or other accounting period. Most insurers set a goal each year of a specific monetary amount of claims. This may be done explicitly, or it may be done implicitly by stating a target premium volume and a target loss ratio.

The stability objective is, then, to experience an *actual* total amount of claims, C_a, no greater than the target ("expected") amount, C_e, plus k, a constant. $C_a - C_e = k$ can be equated either with the accumulated amount of unexpended catastrophe loadings to all premiums received since a certain starting date, or with a certain proportion of surplus designated as a catastrophe reserve.

Realistically, some chance fluctuation (as well as fluctuation from other causes) above or below the targeted amount of claims must be expected. Any favorable fluctuation below the target is welcome and requires no defense. But any adverse fluctuation, above the target, must be limited in accordance with the financial resources available to the insurer to absorb it. The size of an insurer's surplus, and the relative size of its surplus and the targeted amount of claims, determine how much of an adverse fluctuation the insurer can safely absorb and how high a probability it requires that a selected maximum allowable adverse fluctuation will not be exceeded.

Even if the PML's on all of an insurer's risks are determined with great accuracy, however, adequate stability of results will not be achieved unless the insurer's retentions on the different classes of risks are appropriately graded. How to achieve these appropriate gradings lies outside the scope

of this paper, even though closely related to its subject. It needs emphasis, however, that unstable underwriting results can not properly be attributed to inaccurate determination of PML's unless the influence of an insurer's retention schedule (line sheet) and other pertinent factors is first examined and found to be favorable.

METHODS OF MEASURING PML

Methods now in use for determining PML's are necessarily based on sketchily informed judgment, since the degree of accuracy to which PML can be measured depends largely on the quality and quantity of pertinent statistical information that is available. It is not possible, for example, to determine the probabilities previously described without having facts on which to base them, and such facts are not presently being collected, except for dwellings, in the manner required.

It is therefore appropriate to examine what facts are needed to measure PML and then to investigate how and if these facts can economically be obtained. There are also different methods by which PML can be measured. These all deserve examination so that, even if at present only the simplest and least accurate is feasible to use, it can be seen whether at a later time more accurate methods can be substituted.

The simplest approach to measuring PML is to obtain the amount of claim and the amount of insurance on each risk that has sustained a loss during a given year, and to classify these paired figures by major statistical class (occupancy, construction, protection, and peril or coverage). Separation by major individual peril is to be preferred. The pairs of figures can be translated into loss percentages, a frequency distribution of these percentages made for each of the sub-classes described, and the maximum percentage of loss involved in 90, 95, 99, or some higher percentage of all the claims in each category determined. The use of data for more than one year would increase the spread and probably the stability of these results.

An adjustment to reflect the different proportions of insurance to value would materially improve accuracy. This could take the form of a further subdivision of data by type of average or coinsurance clause. It would be a four-way or five-way split (none, 80%, 90%, and 100%, or all these plus 70%) that would further fragment the data. It might alternatively be simplified into a two-way split (i.e., with or without an average clause) by

multiplying the loss percentage of each risk insured with an average clause by the percentage of that clause. This would approximately put all the results from these latter risks on a 100 per cent average-clause basis, as Table I illustrates. It is clear from the table how the average clause achieves equity by holding claim payments to exactly the same percentage of the amount of insurance, whether or not the insured honors his commitment to purchase the specified amount of insurance. At the same time it avoids distortions in ratemaking from under-insurance.

(1) Average Clause Percentage (Insured's Commitment)	(2) Value of Property	(3) Amount of Insurance	(4) Amount of Loss	(5) Percentage of Insurance to Average Clause Commitment	(6) Amount of Claim	(7) Percentage of Claim	(8) Percentage of Claim × Average Clause Percentage
80	10,000	8,000	5,000	100.0	5,000	62.5	50.0
90	10,000	9,000	5,000	100.0	5,000	55.6	50.0
100	10,000	10,000	5,000	100.0	5,000	50.0	50.0
80	10,000	6,000	5,000	75.0	3,750	62.5	50.0
90	10,000	6,000	5,000	66.7	3,333	55.6	50.0
100	10,000	6,000	5,000	60.0	3,000	50.0	50.0
80	10,000	4,000	5,000	50.0	2,500	62.5	50.0
90	10,000	4,500	5,000	50.0	2,500	55.6	50.0
100	10,000	5,000	5,000	50.0	2,500	50.0	50.0

Table 1. Adjustment of Average-Clause Results to a Full-Insurance Basis

A further step towards increased accuracy would be to analyze the total results of all six sub-classes at one time by multiple correlation. The effects of differences between the different years during which data were collected, between states and other geographical subdivisions, and effects of other variables included in the statistical collecting plan should be included in the correlation model. This step could also be taken with currently collected statistics if corresponding claim amounts and insurance amounts were kept together.

A third stage would be to include in a correlation model all of the variables included in the schedules and other rating plans. This would involve making available to a central statistical agency the schedule-rating makeups for individual risks that are now kept at the state level by the individual rating and inspection bureaus.

At present probably only the first stage is possible. While this would probably produce PML estimates with a wide variance, they would still be a major improvement because they would be fact-based and because the variance would be known. Nothing required for measuring PML's on a class basis is not already required for accurate ratemaking. Indeed, establishment of such fact-based PML's could be a step in improving ratemaking accuracy. Once the third stage described above is reached, a suitable multiple-correlation model would be made available to insurers for transfer from underwriters to a computer the determining of PML's for individual risks of any degree of complexity. Such a model would also permit the complex retention guides or line sheets of property insurers to be based directly and precisely on factual data.

Judging Underwriters' Performance in Estimating PML. Only if there is feedback to underwriters that shows them which estimates are good and which are poor can they and their superiors hope for improvement in PML estimates. Also, the superiors cannot soundly judge this aspect of job performance without such information. For these two internal purposes it is therefore useful for an insurer to secure regularly from its statistical records a summary of PML performance for each underwriter, yearly or perhaps more often.

This can be accomplished by recording the insurance PML percentage for each risk estimated by an underwriter, by similarly recording the actual percentage of loss to insured amount for each claim on such risks during a unit time period, by calculating the error of estimate (actual percentage minus estimated percentage) for each claim, and by calculating the mean and variance of the whole group of these errors of estimate for each time period.

It might be desirable to weight the errors of estimate by the amounts of insurance involved, since a small percentage error on a large risk could affect an insurer's results as much as large percentage errors on several small risks. Although errors in both directions are to be avoided (too conservative PML's lead to wastefully high reinsurance purchases and excessive reinsurance processing costs, while too liberal PML's lead to an excessive number of unstabilizing large claims) any error would preferably be in a conservative direction. It is therefore important to consider the sign of the mean error as well as its size.

For each time period, the mean error and variance of each underwriter could be compared with the over-all company mean and variance, or with the over-all mean and variance of underwriters handling the same types of risks. Separate consideration of results with family risks and with business risks would be the minimum split needed if underwriters are specialized on that basis in the company. A review and analysis of the largest percentage errors from each underwriter's results could lay the foundation for better results in succeeding periods. A comparison of the mean errors and variances over time, both for individuals and for the company as a whole, could keep management abreast of whether the desirable downward trend was present in each case and of which underwriters needed help in improving their results.

DISCUSSION BY ROBERT L. HURLEY

There is much that the reader may find remarkable in the paper, "Is Probable Maximum Loss (PML) a Useful Concept?" The term, itself, is believed one of those esoteric symbols of the underwriting fraternity whose members must, in turn, sometimes find certain actuarial arcana a bit mystifying. It is not possible that PML can convey to the actuary the associations (not necessarily all pleasant) that these letters can suggest to the experienced fire underwriter. Presented with the McGuinness warnings on large fire losses, an underwriter may well reflect that there have been fire catastrophies before McCormick place, which he, incidentally, might not regard as likely destined to be the last of such disasters. Nevertheless, a lifelong schooling not to hazard, needlessly, an undue portion of his company's assets in a single occurrence would typically dissuade the underwriter from placing any significant reliance upon a purely fatalist approach to risk evaluation. Moreover, he could not help being at least a bit curious about any such approach as Dr. McGuinness's which might be construed as showing the underwriter how much he could safely write on the risks offered to him. The actuary, too, would have more than a passing interest in any such demonstration, although, understandably, the underwriter would be the most immediate beneficiary of any such mathematical solution to the age old problem of determining PML.

But before attempting to evaluate the McGuinness proposal, it may be helpful to identify his mathematical sources since they stem more from the economics and sociological than from the actuarial literature. About the

turn of the present century Vilfredo Pareto, who had recently assumed the Chair of Economics at Lausanne previously graced by the distinguished economist Leon Walras, published a two-volume tone on economic theory buttressed, if not somewhat laden, with mathematics. Probably the feature which, at the time, caught the fancy, not only of the professional economist, but also of the reading public, was the Pareto law which claimed that with an ascent in the income scale, while the number of recipients thereof declined sharply, the relative percentage of the total income absorbed by the dwindling number did not decline at the same rate. Pareto expressed his law as $N = k\,x^{-a}$ where N is the number receiving incomes of x greater than k, a threshold value. Not satisfied with his slightly meteoric thrust into notoriety, Pareto pushed along into the wider fields of sociology and philosophy.

Time has relegated Pareto's economic law to a respectable, but maybe nonetheless deserved, neglect. To cite just one teacher who has long been in the vanguard of economic theory, Paul Samuelson noted:

> "According to the Pareto law, there is an inevitable tendency for income to be distributed according to a logarithmic curve whereon the upper tail of the income data of many different countries and many different times fell along straight lines of almost the same slopes. He came to believe this as a fundamental law, regardless of social and political institutions, and regardless of taxation. In the past 50 years, more careful studies have refuted the universality of Pareto's law as well as its inevitability."

Pareto's sociological writings won for him only the opprobrium (and this probably not at all deserved) as one of the philosophical fathers of 20th century fascism. Moreover, the earlier disciples of his mathematical theories may have escaped only a somewhat lesser disenchantment faced with the charge that Pareto's work was solely a trivial extension of the somewhat "outdated" system of densities introduced by Karl Pearson in 1894. And even in the current revival of Pareto mathematics, some may believe the contributions to be of more heuristic than corroborative value.

However, this reviewer believes that the CAS is not responsible for the partialities with which the accolades may be distributed in other learned disciplines, and is concerned only with the possible significance of the findings in the allied professions to actuarial problems. And; in this regard, we are indebted to Dr. McGuinness for directing our attention to the research cur-

rently being conducted by European actuaries on the Pareto curve. To the McGuinness list of references one might add the paper in the 16th International Congress at Brussels in 1960 by Benktander and Segerdahl pointing out "the Pareto distribution is essentially the most 'dangerous' analytical expression that can be used to describe a claim distribution, notwithstanding the values of the parameters involved."

While not unappreciative of the almost disingenuous shifts to which even scholars may sometimes resort who are moved by an uncritical reverence for an author, it is believed still incumbent on us not to dismiss summarily the use being made of the Pareto curves in Europe, but to research, such as Dr. McGuinness has suggested, possible applications to U. S. insurance problems. Solely as an addendum to this commentary on the McGuinness proposals, there are offered some fire (excl. dwellings) loss distributions related to the actual value of the properties, taken from the public records of various fire rating bureau large deductible filings in the middle 1960's. It is suggested that these might be viewed as not unrelated to the Pareto equation with some modifications therein.

Now the McGuinness paper proposes three objectives in order to show how PML can be made a useful and valuable tool, by suggesting:

(1) a precise definition of PML,

(2) how the accuracy of PML estimates is related to the stability of a portfolio of risks,

(3) methods of measurable accuracy for determining PML of a risk.

1. The definition of PML

Dr. McGuinness noted that a four-year investigation among company underwriting executives revealed a singular lack of unanimity on the meaning of Probable Maximum Loss. One of my former underwriting associates had a favorite jingle pointing up the shades of meaning which underwriters attach to PML. He was, however, once somewhat taken aback when an underwriting trainee who, on being questioned as to the PML on a particular acceptance, responded that since the policy authorized $100,000 which was the full value of the risk, he judged that the PML should not likely be more than that figure.

Actually, McGuinness offered two definitions of PML and seemed to favor the following modification of the second:

Fire (Ex. Dwellings) - Ratio of First $1000 of Loss to Total Loss – Correlated to Insurable Value of Risk

Value of Risk (Mean of Range) (x)	Losses Paid* Total	Losses Paid* Segment Under $1000	% Loss Under $1000 (y)	Log y (z)	(Log x)	Log Log x (w)	(w^2)	(wz)
$ 7500	8439	3523	41.7%	1.62014	3.87506	0.58827	0.34606	0.95308
17,500	19 068	3718	19.5%	1.29003	4.24304	0.62768	0.39398	0.80913
37,500	25,083	2819	11.2%	1.04922	4.57403	0.66036	0.43608	0.69286
75,000	29,180	2213	7.6%	0.88081	4.87506	0.68802	0.47337	0.60601
175,000	30,466	1849	6.1%	0.78533	5.24304	0.71958	0.51780	0.56511
375,000	17,664	805	4.6%	0.66276	5.57403	0.74617	0.55677	0.49453
Sub total	129,900"	14,927"		6.28829"		4.03008"	2.72406"	4.12132"
Open End	33,519	1793						
Total	163,419"	16,720"						

$\Sigma z = na + b \Sigma w$ $\quad 6.28829 = 6a + 4.03008\,b$

$\Sigma wz = a \Sigma w + b \Sigma w^2$ $\quad 4.12132 = 4.03008\,a + 2.72406\,b \times \left(\frac{6}{4.03008}\right) = 6.13584 = 6a + 4.05555\,b$

$0.15245 = (-)\ 0.02551\,b$

$b = (-)\ 5.9761$

$a = +\ 5.0621$

Least Squares Equation $z = 5.0621 - 5.9761\,w$

$\log y = 5.0621 - 5.9761 \log \log x$

$y = 10^{5.0621}(\log x)^{-5.9761}$

$y = \frac{10^{5.0621}}{(\log x)^{5.9761}} = \frac{a}{t^b}$ or $y = a \cdot t^{-b}$ where $t = \log x$

This is a common form of the Pareto Distribution

* In $1000

PML

"The probable maximum loss under a given insurance contract is that portion of *100 (m + k) %* of the limit of liability which, with probability '*p*,' is greater than, or equal to, any loss covered by the contract."

I am reasonably convinced that my former underwriting associate would not be at all inclined to take exception to this definition, as being much less meaningful than the others with which he was familiar, once the terms had been explained to him. It is likely, however, that he would have a number of searching questions as to the basis of the m and k and particularly the p values. It is not likely that he would be much impressed by a 5% or 1% confidence limit, in the feeling that he could not afford to accept, albeit, such a small probability, in view of the even smaller probability of any large fire loss.

However, this reviewer is inclined to regard the McGuinness definition as being more compact and certainly more mathematically precise, once the parameters of his test have been set. Nevertheless, there is still the lurking suspicion that there may be no substantial gain in understanding, via any such mathematical definition, if the probabilites to be assocated with it cannot be handled with the statistical assurances required.

2. *How accuracy of PML estimates is related to the stability of a portfolio of risks*

It is difficult within a given framework to disagree with the McGuinness proposition that the immediate purpose of PML is to select the maximum amount of insurance that an underwriter should retain on the risk for his own account — at least, to the extent that this observation may be tautological. Nor can one easily take exception to the McGuinness formula $Ca - Ce = k$ where Ca is the total, Ce the expected claims, and k is a constant.

It is noted, however, that an underwriter might arrange his risk selections so that his annual loss ratio variation would be minimal by writing relatively small lines on acceptable risks. Conversely, it is possible for the same underwriter, while allowing for a greater variation in his annual loss ratio expectancy, to increase his company's long-term profit by writing large lines on super-choice risks.

3. *Methods for measuring PML*

It is believed that Dr. McGuinness is correct that the statistics needed to determine PML, as defined, are not now collected (except possibly for

dwelling risks) on any formal industry program. The McGuinness proposal is believed to involve the collection of losses related to insurable value on initially a simple class basis. He would then determine the maximum percentage of loss involved in, for instance, 90% of all claims in each category.

This procedure is seemingly the reverse of the typical deductible analysis. It is believed that one will readily appreciate the considerably more difficult task of making reliable estimates of the appropriate charge in risk rates for losses in excess of, say, 90% of insurable value than determining the expected savings under a 1% valued deductible. Incidentally, the percent deductible savings is a function of risk size which, also, would not likely prove a negligible factor in the McGuinness proposal.

It is possible that some companies are now collecting, for their own use, data on the percent loss to insurable value, and such statistics may well be helpful in setting company line sheets and underwriting risk gradings. It is thought that many underwriters are not unaware of the danger involved in projecting top line loss experience in view of the relatively small likelihood of loss in these upper regions, and are guided accordingly in the PML evaluations.

In summary, this reviewer believes that Dr. McGuinness is to be commended for an interesting and thought provoking article of particular value to the CAS membership as a reminder of the work by European actuaries on the Pareto curves.

DISCUSSION BY EDWARD B. BLACK*

The author's treatment of the Probable Maximum Loss concept is both interesting and thought-provoking from an underwriter's viewpoint. It is a subject of great importance because a clear understanding of PML and its application can spell the difference between profit or loss, success or disaster, in the property insurance line. Mr. McGuinness aptly establishes this fact in his reference to the large losses at the oil refinery in Louisiana and the exhibition building in Chicago, Illinois. No one can debate the serious outcome of the reported deficiencies in the PML factors in such instances and I suggest these two examples could be multiplied many times in any year

* Mr. Black was a guest reviewer of this paper. He is Secretary-Underwriting at the Insurance Company of North America and is in charge of that company's commercial fire and allied lines underwriting.

although, fortunately, to a considerably less extent. Nevertheless, while I agree with the author's approach to achieve the purpose of the paper, i.e., showing how PML can be made a useful and valuable tool, I find myself dissenting with or questioning the validity of a number of statements.

For example, Mr. McGuinness states that the concept of PML is "one of the least clear concepts in all insurance." It is true that the definitions may vary between underwriters when put down in words, but I feel strongly that there is a universal meaning as to the end result which all underwriters expect PML to accomplish. It seems to me that the situation is analagous to the familiar quotation, "A rose by any other name would smell as sweet," i.e., PML, no matter how you define it, is simply *Probable Maximum Loss.* It is neither *foreseeable* nor *possible* loss — rather, it is the maximum loss which *probably* will happen when, and if, the peril insured against actually occurs. My observation is based upon numerous discussions of the subject with underwriters in this country, from both stock and mutual companies, and with underwriters from abroad. The words they use may be somewhat different, but they all translate to the same final meaning.

In view of the above, I do not feel that a new or standard definition will change results and emphatically disagree with the suggestion that there should be two precise definitions, one suited to the insured and his risk manager and another suited to the insurer. It seems highly improper to me that the insured should consider anything more than the total value of his property exposed to *any* peril, i.e., the amount subject to possible total loss. The only safe and proper course for the buyer is to purchase enough insurance to protect this maximum exposure. To encourage him to do otherwise through consideration of *any* Probable Maximum Loss concept is to tread on thin ice and could lead to improperly exposing his financial interests.

The same reasoning does not (or should not) apply to the insurer. As Mr. McGuinness so aptly states under the heading "PML and the Stability of a Portfolio," "the purpose of setting underwriting retentions is to stabilize an insurer's experience so that one or more individual losses will not adversely affect its over-all underwriting result by more than a specified amount during any one year." The PML concept is invaluable here for it is the device that enables the underwriter to accept maximum lines (amounts) on individual risks, thus obtaining maximum share of the total premium while theoretically holding his expected or probable loss exposure within acceptable limits. It is for this reason that the underwriter

cannot afford to enjoy the caution and conservatism of selecting the maximum *possible* PML in every instance. Almost invariably, the windstorm or tornado PML will be greater than that of fire and to select the largest peril — PML would result in a tremendous reduction in desirable premium via more limited capacity geared to retentions.

There are several statements under "Methods of Measuring PML" which appear controversial. First, the author states that facts relating to probabilities are not presently being collected. This is not entirely correct because this long-existing industry deficiency is currently being rectified with the National Insurance and Actuarial Statistical Association's recent statistical plans. In concert with Mr. McGuinness' purpose, underwriters eagerly anticipate the time when sufficient facts have been accumulated from the industry to support precise PMLs. Nevertheless, some individual companies have in the past collected, and continue to collect, experience data from their own loss records and other public sources. (Example: inspection or rating bureau reports and analysis of individual loss occurrences.) It is the continual review and study of such instances that develop the skill and aid the judgment of the experienced property underwriter.

Second, and most important, I take issue with the author's statement that "the simplest approach to measuring PML is to obtain the amount of claim and the amount of insurance on each risk that has sustained a loss during a given year, and to classify these paired figures by major statistical class." My point of issue is not with the approach which is meaningful as respects homogeneous units of the same, or approximately same, value. What I question is the value of this approach from a practical viewpoint when one is considering the concept of PML. It seems to me that companies fall into two categories when underwriting risks of small value such as lend themselves to the table technique used in the paper. Companies with high retention levels are not concerned with PML on such risks — rather, it is a simple matter of rate adequacy or inadequacy. They will either want all of the risk, or none of it. Alternatively, companies with small retentions will shy away from the practice of using a PML on such risks even though the PML results developed through the suggested study will be valid. Admittedly, such a study could result in the small company raising its retentions on a class of risks (again, presupposing adequate rates), but I suggest they will *in practice* continue to consider these small risks as 100% PML and rely upon reinsurance treaties to protect them above their retention(s).

From a truly practical standpoint, I suggest the concept of PML would gain much greater reliability if individual losses of $25,000 or more on properties valued at $100,000 or more would be studied and results recorded without giving weight to the coinsurance or average clause (if any) in the policy. The author's Table rightfully points out that there is no relation between the average clause and the amount of insurance purchased, but the figures shown under amount of claim would infer that losses are commonly and correctly adjusted within the framework of the average clause requirement. It is unrealistic to make this assumption due to the many variables in an actual adjustment, e.g., the *true* actual cash value or replacement cost of the property; proper consideration of inflationary factors; carelessness on the part of the adjuster.

I believe a study on the basis described above (dollar loss incurred vs. value), related to the factors mentioned — occupancy, construction, protection, peril, coverage plus exposure — over a reasonable period of time, would be the best method of producing guidelines for reasonable, efficient determination of individual risk PML. This suggestion's practicality is indirectly recognized by the author in his statements relative to "Judging Underwriters' Performance in Estimating PML." An on-going, continuously updated, study of this type would improve the results desired from use of the PML concept, but would never, in my opinion, entirely replace the subjective evaluation of each risk by the seasoned underwriter.

DISCUSSIONS OF PAPERS PUBLISHED IN VOLUME LV

THE CAPITAL INVESTMENT MARKET AND THE INSURANCE INDUSTRY

R. J. BALCAREK

VOLUME LV, PAGE 186

DISCUSSION BY J. ROBERT FERRARI

The primary purpose of the Balcarek paper is to determine a critical combined loss and expense ratio (which he calculates to be 101.4) above which it becomes more profitable to abandon insurance operations and become solely an investment fund. The methodology employed is a comparative analysis between a hypothetical insurer with annual operating results equal to an average of the 1964-66 experience of stock insurers licensed in New York and a hypothetical investment fund that the insurer ostensibly could become if it so desired.

Balcarek contends that the conversion from insurance operations to investment fund operations will be accompanied by a reduction of nearly 50 percent of invested assets, or, more specifically, his Table 3 shows an assumed reduction of about 44 percent from $22,277,398,000 to $12,558,496,000. The reader has no way of testing this assumption, however, because sufficient details of the hypothetical liquidation are not presented. Some interesting questions about the liquidation process that might have been considered are: How will bond sales affect the market and at what level of bond prices are the insurer's bonds relinquished? Doesn't liquidation force the insurer to realize capital losses on bonds that would not be realized if the bonds were held to maturity? How sensitive is the critical combined loss and expense ratio to interest rate changes and their effect on market prices of bonds? What portion of the equity in the unearned premium reserve will be returned upon policy cancellations?

Consider, for example, an alternative assumption that assets dropped exactly 50 percent as a result of liquidating the insurance operation. Such a development would leave only $10,839,218,000 available for common stock in the investment fund and with this assumption the critical ratio is raised to about 103. This example demonstrates the sensitivity of the critical ratio to the liquidation value assumption.

Balcarek suggests another variable that will affect the critical ratio when he contends that by assuming the investment fund takes riskier and hence more profitable (expected profits?) investments the critical ratio will be *lowered*. But, if this is true, then it follows that the insurer also can *raise* the critical ratio by taking riskier investments[1] with higher expected returns. In fact, by varying the risk-return assumptions for the insurer, the fund, or both, it is possible to generate a set of critical ratios that will be a function of risk (or expected return) and no one ratio is relevant unless it is possible to specify the desired risk/expected-return balance for either the fund or the insurer. As a matter of fact, Balcarek's analysis can easily be reversed by specifying an expected adjusted underwriting profit or loss and then calculating a critical investment return. This might be a more sensible approach but Balcarek does not discuss this alternative nor the advantages of one over the other.

The critical ratio also is a function of the rate of return that is assumed for common stock. His critical ratio of 101.4 is based on an assumed total rate of return (dividends plus appreciation) of about 12.16 percent on common stock. If an assumption of 10 percent is used,[2] the critical ratio works out to 101.8 and at 8 percent the critical ratio is approximately 102.2. While an assumed expected return of 8 percent would appear low in today's investment environment, the choice of a conservative figure is one way of recognizing that liquidation is not a costless or riskless matter because by so doing an insurer will be giving up the market position, consumer and agent loyalties, and corporate organization it took years to build. In economics these considerations are called entry and exit problems and invariably the analysis forces a distinction between short-run and long-run conditions before a decision to enter or exit an industry can be made. Balcarek places primary emphasis on the short-run. In any event, the critical ratio appears to be relatively insensitive to changes in the expected return assumption relative to changes in other assumptions. (See Table 1)

Balcarek's model would have been much more revealing had he applied it to individual companies rather than aggregate operating results of stock companies licensed in New York. The critical ratio of 101.4 may not be appropriate for any one company even if one accepts his set of assumptions.

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[1] The exact nature of the riskier investments Balcarek has in mind is not described in his paper.

[2] That is, a 10 percent return is assumed on the common stock held either by the insurance company or the investment fund shown in Table 3 of the Balcarek paper.

However, he concludes from his analysis that, since the average aggregate underwriting loss for insurers in New York State exceeds the critical ratio, a *majority* of insurers have exceeded the critical ratio. Presumably, he refers to the fact that the aggregate combined ratio of the New York companies from 1964-1966 is $101.45 \left(1 + \frac{156{,}405}{10{,}804{,}797}\right)$ according to the data in his Table 3. But, since the 101.45 is, in effect, a weighted average of individual company results, it does not follow that a *majority* of insurers had a ratio greater than 101.40 until we are told something about the dispersion of individual companies by profitability and size around the average.

In addition to Balcarek's failure to show the effect of varying the assumptions concerning liquidated value and return on common stock, he also fails to test any possibilities other than remaining in the insurance business and operating as in the past, or liquidating and becoming an investment fund. It is likely, however, that an insurer that has exceeded Balcarek's critical ratio will not be so anxious to dissolve that it will not first look for ways of improving its operations as an insurance company. One that is suggested immediately by Balcarek's model is to increase an insurer's holding in common stock since this should raise its critical ratio. Balcarek's investment fund, on which his ratio of 101.4 is based, is created by the insurer's original holding of common stock and by disposing of $2,000,481,000 of bonds yielding 3.55 percent and placing these proceeds in common stock returning 12.16 percent. If we assume that the insurer, without liquidating, could dispose of these bonds and invest the proceeds in common stocks,[3] the calculations show a critical ratio of 103.

Taking just the three variables discussed in this review, it is possible to construct a set of critical ratios based on varied assumptions. For example, consider the following set of assumptions (in each case Balcarek's assumption is first):

Liquidation Value	1. $12,558,496,000 ($12,259,015,000 in common stock fund)
(Value of Investment Fund)	2. $11,138,699,000 ($10,839,218,000 in common stock fund)

[3] Regulatory and internal constraints may prevent this action but it would make sense to exert pressure to change regulatory and internal restrictions if the only other alternate was liquidation.

Insurers Investment in Common Stock	1. $10,258,534,000 2. $12,259,015,000
Expected Return on Common Stock (dividends plus appreciation)	1. 12.16% 2. 10.00% 3. 8.00%

The critical ratios on the basis of these assumptions are shown in Table 1 of this review. Neither the variables nor the assumed values for them are exhaustive but the results in Table 1 range from 101.4 to 105.0 indicating that there is no one critical ratio for the industry or a company but a set of ratios based on underlying assumptions and not necessarily restricted to those employed in this review. Balcarek did not explore this form of sensitivity analysis which would have greatly improved his paper and discouraged possible misinterpretation of his results.

TABLE 1

Critical Ratios of Adjusted Underwriting Results to Earned Premiums

	Insurers' Investment in Common Stock[a]					
	$10,258,534			$12,259,015		
	Expected Return			Expected Return		
Liquidation Value[a]	12.16%	10%	8%	12.16%	10%	8%
$12,558,496	101.4[b]	101.8	102.2	103.3	103.3	103.3
$11,138,699	103.2	103.4	103.7	105.0	104.7	104.4

[a] 000 omitted.
[b] Balcarek's critical ratio.

DISCUSSION BY W. J. MACGINNITIE

Mr. Balcarek has made another contribution to the growing literature on the relationship between investment income and underwriting results. There are many ways of looking at this relationship, and Balcarek's may prove useful to some actuaries in analyzing the profitability of a company or companies over time.

There are some difficulties with the method, however, and it should be applied with care. First of these is the omission of federal income taxes. While tax rates may vary from company to company and from time to time, they are an important consideration in investment strategy and should be included in any comparison of alternative returns.

In Balcarek's example, for instance, application of the tax rates in the situation of a typical stock agency company would render the insurance business more profitable than the investment trust.[1] Another place where federal income taxes should be recognized is in the conversion of equity in the unearned premium reserve into surplus. Taxes will be assessed at the ordinary income rate at the time of that conversion. (The assessment could take the form of reducing an otherwise available tax loss carryforward.)

A second difficulty with the method is that it is really only applicable to certain steady-state situations. Rate of change in the size of an insurer's liabilities can result in misleading conclusions from a method that uses calendar period data. If an insurer is growing at a very rapid rate, for instance, the investment income earned in the current calendar year may be much less than the discounted future value of investment income on reserves generated by the current year's underwriting activities. Balcarek's static model may then show that he is unprofitable when in fact he has only chosen to forego current income in order to receive future income that has a greater present value.

Balcarek uses his approach to show the current lack of profitability in the insurance business. Unfortunately, he has chosen a data source (the New York Statistical Tables) that leaves much to be desired. Data for companies licensed in New York is biased, in that it excludes a significant number of companies and/or subsidiaries that have chosen to stay out of New York. More seriously, however, the totals include both parent and subsidiary in the capital and surplus account, and they include intra-corporate dividends in the investment account. This results in a significant over-

[1] Assuming an effective tax rate of:
a. 20% on bond interest, due to a high proportion of tax-exempts,
b. 7½% on dividends,
c. 50% on other investment income,
d. 20% (25%, discounted from the future date of realization) on capital gains,
e. 50% on underwriting profits.
and that the investment trust pays taxes as an ordinary business corporation, not as an investment company under the 1940 act.

statement of stockholders' equity[2] and a lesser overstatement of investment income.[3] An alternative data source is hard to find however, and it may be that someone will have to assemble a large pile of convention blanks and annual reports to shareholders and start turning out truly consolidated statements.

Another point to be noted about the New York Statistical Tables is that they include the stock subsidiaries of certain mutual companies, which Balcarek tried to exclude.

Balcarek's method correctly matches assets to liabilities, particularly common stocks with surplus. Some recent papers have used an average return on the total portfolio, which is just not in accord with the real world, either regulatory or management. The fact is that most insurers keep their surplus in common stocks and their liabilities in bonds, cash, and receivables.

Having pointed out the significant distortions in Balcarek's data base, one must say that his conclusions about the profitability of insurance remain unproven. Better data might prove him right; it might not. But the fact is that significant structural changes are taking place in the industry, apparently in part because some people *believe* that the business is not profitable. Three observations seem pertinent:

1. Casualty actuaries have not yet done an adequate job of exploring the technical aspects of the relationship between investment income and underwriting. Balcarek's paper is another contribution to our evolving knowledge.

2. Return on equity increases if equity is decreased relative to premium volume, assuming that underwriting income plus associated investment income is positive. Perhaps one of the causes of the industry's problem is that many companies are overcapitalized.

3. Balcarek did not investigate the dispersion of returns by company, but it could be observed that some carriers are earning rather handsome returns. Perhaps we are witnessing another chapter in the shift of market share to the more efficient competitors.

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[2] A rough check indicated to this reviewer that the stockholders' equity was overstated by at least 10%, and possibly considerably more.

[3] This resulted in a big increase in 1966 dividends on common stock when one fleet paid large intercorporate dividends.

Finally, it should be noted that some writers in the field of capital budgeting have moved away from internal rates of return, and started to explore external ones. For a stock company, the external return is the one that a stockholder receives, which is normally his dividend plus the appreciation in the value of the stock. So as if there aren't enough problems with the internal return, actuaries may soon have to turn their attention to the ticker tape.

AUTHOR'S REVIEW OF DISCUSSIONS

I greatly appreciate the detailed reviews of my paper. They produced a number of interesting questions, some of which may merit additional discussion.

Professor Ferrari points out that during the liquidation of the insurer's assets, the book values of bond portfolios and equities in unearned premiums may not be realized. This, according to him, would reduce the assets of the investments fund and raise the critical ratio. I am not fully in accord with his reasoning. Granted that the book value of bonds is not a market value as they consist of largely fictional values depending on the purchase price of the bond, its due date, and its face value. It is very likely that these values are overstated due to the fact that bond prices have been falling for some years. It follows that the insurers' surplus is overstated and what is much more important, their actual earnings have been overstated. The exact figures are not available. However, if we consider the average drop in bond prices as shown by the various indices and apply it to the bond portfolios, then it would be apparent that this would make the comparison worse for the insurers.

One can also speculate that the equity in unearned premium reserve is overstated. This will happen in the following circumstances:

(1) If the insurer abandons his insurance operations by means of policy cancellations. Professor Ferrari seems to assume that this will be the actual course of action. In reality, there are some more rational alternatives available.

(2) If the book of business is of such a poor quality that the prospective loss ratios would wipe out at least a part of the equity. This alternative means that in our comparison we again overstated the earnings of the insurers.

Another important point arises when Ferrari discusses the possibility of variation in risk-return for the insurer, the fund, or both, as he confuses the risk to the investment portfolio and the risk to owners' capital. In case of the investment fund, these two risks are nearly equal, as, except for cash, the investment portfolio is equal to owners' capital. In the case of insurer, the risk to owners' capital is much greater due to the fact that the same capital supports a much larger investment portfolio and a volatile, largely unprofitable insurance operation. To obtain a valid comparison, it is the risk to owners' capital which is important and this is why the fund may undertake riskier investment with higher expected returns before it reaches the insurer's level of risk to owners' capital. Ferrari asserts that the insurer can raise the critical loss ratio by making riskier investments. However, this would only happen if we arbitrarily forced the fund to make much safer investments than the insurer, e.g., we may easily come to a *conclusion* that the critical loss and expense ratio is 150% if we assume that the assets of the insurer are invested in foreign mining stocks and warrants, while the fund is forced to invest in the bluest of blue chips.

It should be realized that in most comparisons of this nature there are always some factors and imponderables which it is impossible to evaluate with precision. Therefore, the final result should be regarded as an estimate and, as such, it is subject to a margin of error. Various people will have to make up their own minds whether my estimate is optimistic or pessimistic. My impression is that the reviewers searched diligently for factors which would make my estimate pessimistic. Mr. MacGinnitie even assumed that the investment fund would be organized in a manner which would maximize its income tax liability. On the other hand, they were unable to find a single factor which would operate in a different direction. Some of these factors are as follows:

(a) The assumption that the investment fund performs in line with the broad stock market averages is very conservative.

(b) The insurers were given credit for the unrealized capital gains on common stocks but were not penalized for the unrealized capital losses on their bond portfolios.

(c) The stockholders' equity in the investment fund operation is exposed to a smaller risk than under the insurance operation. Hence, the investment fund would be justified to increase its earnings by making riskier investments.

(d) I examined the profitability of the conversion from an insurer to an

investment fund because it was the easiest and the most obvious choice. This does not mean that this was the most profitable choice. Some of the new entrepreneurs moving into the insurance industry are blessed with a tremendous amount of imagination and set for themselves high profitability standards. They are unlikely to be impressed with my earnings of projection of 11.9% (before federal taxes) for the investment fund.

In view of these considerations, it would appear that MacGinnitie may have been a little too eager to pronounce as not proved the proposition that the profits in the casualty and property insurance industry are inadequate. While sympathizing with his position, I would like to point out that it does not really matter whether we in the insurance industry accept or reject such a proposition. What really matters is whether we can prove, beyond all reasonable doubt, to the investment market that the insurance industry is earning a satisfactory rate of profit.

THE RELATIONSHIP OF UNDERWRITING, INVESTMENT, LEVERAGE, AND EXPOSURE TO TOTAL RETURN ON OWNERS' EQUITY

J. ROBERT FERRARI

VOLUME LV, PAGE 295

DISCUSSION BY R. J. BALCAREK

It is only very recently that the insurance industry began to acquaint itself with the concept of the return on owners' equity and its implications. Professor Ferrari's important and interesting paper presents a solid foundation for further exploration and analysis.

The reviewer found the formulas illuminating and beautiful in their simplicity. However, simplicity is not always an unqualified blessing. It may be useful to warn that the utilization of Ferrari's formulas requires a great deal of caution. As a case in point, one could easily argue on the basis of formula (3) that, provided the underwriting results do not fall below a certain standard, the premium volume should be expanded as much as possible. No doubt, such expansion would increase the total return on owners' equity but the equity would be exposed to a considerably higher risk. Therefore, it would seem that the maximization of the return should be subject to the condition that there is no appreciable increase in the degree of risk to which the owners' equity is exposed.

Secondly, the formulas lend themselves best to describe a static state. They could be used to illustrate the current or past relationships of a single insurer, a group of insurers, or the industry as a whole. Once we adopt a dynamic approach we would find that most of these relationships start interacting with each other. We cannot say: "Let us increase the premium writings in relation to surplus, assume all other relationships constant, and thus determine the effect of the increase in premium volume on the rate of return." The problem is that the other relationships will not stay constant and they will change directly as a result of the change in premium volume. Professor Ferrari anticipated this to some degree when he mentioned the

possibility of the additional business being of a poorer quality, i.e., using his symbols, if P/S increases then U/P may decrease. Obviously this is a possibility, but it would appear that the majority of the companies could avoid it provided they imposed adequate controls over the process of expansion. However, there will be other, perhaps more powerful, relationships, assuming the need to keep the risk to owners' equity unchanged:

(1) When the premium to surplus ratio P/S increases, then the investment gain on assets I/A will tend to decrease because (a) the proportion of uninvested assets originating from the insurance operations, such as cash and agents' balances, will tend to rise, and (b) with a higher P/S the element of risk to owners' equity becomes greater and this would have to be compensated for by a more conservative investment policy.

(2) An insurer can safely write a larger premium volume with the same surplus if his underwriting results are more favorable. In other words, the ratio of premium volumes to surplus P/S will move in the same direction as rate of underwriting profit U/P.

(3) An examination of the relationship between the rate of underwriting profit U/P and the investment return on assets I/A leads to the conclusion that they would tend to move in the same direction. This means that if underwriting results are good the insurer could indulge in a more aggressive investment policy.

No doubt, there are more such inter-relationships and no formula or mathematical model could possibly take them all into account. However, the reviewer feels that Ferrari's formula would benefit greatly if two or three such relationships were incorporated into it. It has to be realized that a study of each of these relationships would be fairly involved, providing ample material for a separate paper. The reviewer is convinced that it is possible to determine, at least partially, the parameters involved in these relationships. Once this is done (easier said than done), then, using linear programming or a similar technique, Ferrari's formula could be used to determine an optimal solution from the stockholders' viewpoint.

The reviewer's recent paper entitled "The Capital Investment Market and the Insurance Industry"* presents a special case of the relationship

* *PCAS*, Vol. LV, p. 186 (1968).

between U/P and P/S. It describes the case when the rate of underwriting return U/P is so low that the desirable written premium to surplus ratio P/S is equal to zero.

DISCUSSION BY ROBERT A. BAILEY

Mr. Ferrari has illuminated the relationships among return on equity, return on assets, and return on sales with simple formulas. These simple relationships provide valuable insight and should be helpful to anyone who must make meaningful decisions as to the future course of an insurer, in underwriting commitments, investments, and prices.

Mr. Ferrari's formulas illustrate the effect of leverage — the relationship of premiums and liabilities to shareholders' equity — and have thereby enabled him to pose the important problem of the optimum capital structure for an insurer.

His formulas lead to two significant conclusions:

(1) Capacity depends on profits. If the net result from underwriting plus the investment gain from the investable portion of the insurance reserves is a profit, capacity will increase. If it is a loss, capacity will decrease. (Of course, profits may also be dependent on capacity — too much capacity leading to reduced profits in a competitive market.) The correct measurement of investment returns from funds attributable to the underwriting operation is therefore of critical importance to the management of an insurer.

(2) The optimum capital structure, assuming a profitable result from underwriting and the underwriting portion of investment income, is a minimum of capital and a maximum of leverage. In fact, if it is possible, the optimum capital is less than zero. Mr. Ferrari suggests that variability of earnings introduces an opposing tendency to maximize capital in order to stabilize earnings, because stable earnings are capitalized at a higher rate than variable earnings. According to this theory the optimum capital structure is attained at some mid-point between the opposing tendencies to maximize leverage and to maximize stability of earnings. However, this restraint on attaining maximum leverage applies only if the insurer is an independent entity. This restraint is largely eliminated if the insurer is owned by a holding company that holds other enterprises in addition to insurance.

A holding company can treat its insurance operation like a separate

account, separate from its other operations. This separate account would contain only enough assets to equal the insurance liabilities. The profits on those assets would be included in the total result of the insurance operation. If the total result is a profit, the profit would be paid out of the insurance account into the holding company's funds. A net loss would require a payment into the insurance account from the holding company's funds.

Stripping away all the corporate structures and looking at the holding company as it is in reality, we would see several operations, one of them insurance, plus perhaps an air line, a television station, a leasing operation, a manufacturing operation, and so on. Each one would be operated as a separate account, with the cash flow from one account used to finance the cash needs of another, and with temporary losses in any account being covered by profits from others. The shareholders' equity required for such a holding company as a whole would be less than the sum of the shareholders' equities required if each account were operated independently.

The holding company could build an insurance operation without any additional shareholders' equity by using the already existing equities in the other accounts as security for the insurance operation. Putting the corporate structure back into the picture, the financial statement of the insurance subsidiary would show assets in excess of liabilities, but all of that excess, and perhaps more, would be represented by notes, bonds, and stocks issued by affiliates, plus real estate and equipment leased to affiliates, and deposits in affiliated banks.

The higher the marginal cost of debt financing by the holding company, the greater the financial advantage of using the insurer's assets to finance the cash needs of the holding company, the greater the investment return to the holding company on the insurer's assets, and the larger the underwriting loss that would be considered a break-even point for the insurer by the holding company. In other words, as the leverage of the holding company increases, the tendency is for the insurer's investments to become more speculative, and the underwriting policy to become more aggressive.

The only restraints on the amount of the insurer's assets used to finance the other operations of the holding company are the insurance investment regulations of the states, which vary considerably from state to state, and in some cases do not provide adequate restraints against misuse of an insurer's assets by a holding company.

A holding company would measure the riskiness of the insurance portfolio not in relation to the capital and surplus of the insurer but rather in relation to the earning stream and resources of all the operations included in the holding company.

With a large diversified holding company in the picture the actuarial problem of the expectation of ruin for the insurer, and the related restraints on investment policy and underwriting policy, become less significant, and the proper allocation of investment profits to the insurance account assumes major significance for the decision makers. And the optimum leverage becomes more than an actuarial problem. It becomes a question of social policy.

Mr. Ferrari is to be complimented on expressing complex relationships in simple mathematical terms and for an original contribution of great significance in analysing insurance profits and capital structure.

ON THE CREDIBILITY OF THE PURE PREMIUM

ALLEN L. MAYERSON, DONALD A. JONES,
NEWTON L. BOWERS, JR.

VOLUME LV, PAGE 175

DISCUSSION BY JEFFREY T. LANGE

"It is the purpose of art to give a clearer picture of reality."
— Piet Mondrian

One of the purposes of constructing a model or theoretical abstract of an actual situation is to be able to see it more clearly. Many ratemakers have recognized practical deficiencies in credibility tables. Rates for low volume lines of insurance (and for low volume territories of major lines) are sometimes increased one year only to be reduced in the next year. They have also noted that the formal credibility standards are insensitive to the line of insurance, in that the same credibility factors are assigned in spite of differences in the distribution of number of claims and claim amounts. In their theoretical paper, Messrs. Mayerson, Jones, and Bowers have provided the ratemakers with a clear picture of the weaknesses of existing procedures and a practical tool for recomputing credibility standards.

It would be hard to disagree with the authors' conclusion that the existing credibility standards for automobile and general liability lines are too low. Assuming a Poisson distribution for the number of claims and using the 1963 size of claim data published by the National Bureau of Casualty Underwriters and the Mutual Insurance Rating Bureau, the reviewer obtained a 100% credibility criterion of 3,434 for automobile (private passenger) property damage liability data with a probability of 90% that actual losses will be within 5% of expected losses. This solution compares with the authors' 4713 and the current 1084. Calculations for general liability coverages also confirmed the authors' conclusion.

The authors' second and third conclusions appear equally valid. The impact of recognizing the positive skewness of the claim amount distribution and the use of the negative binomial in place of the Poisson would further raise the credibility criteria. However, as noted by the authors and by Mr. Nelson, in his discussion of this paper, the numerical significance of

these two refinements is much less than that of reflecting the size of claim distribution.

The fourth conclusion that credibility criteria vary by coverage can be illustrated with the following credibility criteria computed from the 1963 automobile data cited above and from 1967 general liability data published by the Insurance Rating Board and the Mutual Bureau.[1] (In the following paragraphs, full credibility is defined as being within 5% of the expected pure premium with a probability of .90.) While a credibility standard of 3434 claims was indicated for private passenger property damage liability coverage (total limits), the bodily injury coverage would require 3931 claims when losses are limited to $5000 and 5098 claims when losses are limited to $10,000. A later sample of claims produced a 6241 claim standard for unlimited (or total limits) bodily injury private passenger. Thus, within the private passenger subline, there was a substantial difference between the bodily injury and property damage coverages (6241 versus 3434) and the limitation of losses to $10,000 and $5000 resulted in substantially reduced credibility requirements.[2]

The use of private passenger data for New York only gave credibility standards about 20% below countrywide. Countrywide commercial car data (as opposed to private passenger) yielded bodily injury results almost identical to the private passenger while the property damage requirement was 4462 versus 3434.

For the general liability coverages, even greater variation was observed. For owners, landlords and tenants insurance, 100% credibility points of 4583 and 11,881 were obtained for bodily injury and property damage respectively, while for manufacturers and contractors bodily injury coverage, a 3672 criterion was obtained.

It should be noted that the sample sizes used in these calculations are substantial. For example, for private passenger cars over 300,000 claims were used while the O.L.&T. bodily injury sample was more than 75,000. The substantial differences coupled with the ease of making the calculations suggest that, in the future, credibility standards, being more or less tailor-made to the situation, might be subject to much more variation by line and state.

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[1] The author wishes to acknowledge the assistance of J. Robert Hunter in the preparation of this section.

[2] A similar conclusion was reached by L. H. Roberts in "Credibility of 10/20 Experience as Compared with 5/10 Experience," *PCAS* Volume XLVI, p. 235.

"On the Credibility of the Pure Premium" leaves unresolved several points concerning credibility. First, what rule should be used for partial credibility? Mayerson[3] rejected $Z = (n/N_{1.00})^{1/2}$ (the square root rule) in favor of $Z = \frac{n}{n+k}$, but this latter formula is inconsistent with having a 100% credibility point as derived in this paper. Such formulas for partial credibility were rejected by Maguire[4] in his 1969 paper on credibility. Second, is the authors' approach to credibility, based on Perryman, the proper one? Would other approaches — Maguire, Buhlmann,[5] or Braverman[6] — yield a "better" result? Third, if one accepts the authors' approach, how does one select the values of P and k. In the case of the model leading to 1084 claims, whether one selects P at .90, .95 or .99 (all reasonable) and k at .01, .05 or .10 (also reasonable) leads to a variation of 100% credibility criteria from 271 to 10,623. This range is more significant than the difference between the negative binomial and Poisson distributions or even between the old credibility standards and the indicated. Thus, the authors have not given (and did not claim to give) a formula which yields a unique 100% credibility point suitable for all calculations.

As far as the classical theory has been developed, given a particular loss distribution (for a line and state) one may obtain a unique criterion for 100% credibility once an arbitrary P and k are selected. In some practical situations one does not seek a unique criterion. For example, in a rate filing, it would be desirable to use two or more criteria. For determination of territory relativities, the disutility of giving too little belief to the latest indication may mean the loss of the opportunity to write additional business, or the loss of existing business, in certain territories (i.e. the loss of the opportunity of a profit on certain units). Since the relativity procedure is balanced, giving too little credibility does not result in a loss in premium revenue on all units but rather charges that are too high for some units and too low for others.

In the calculation of statewide rate level, on the other hand, the indication is credibility weighted with no change, and any reduction in credibility results in a reduction in premium revenue on all units, since in an inflation-

[3] Mayerson, A. L., "A Bayesian View of Credibility," *PCAS* Volume LI, p. 85.
[4] Maguire, R. D., "An Empirical Approach to the Determination of Credibility Factors," presented at the Spring, 1969 Meeting of the Society of Actuaries.
[5] An explanation of Buhlmann's approach to credibility is given in C. C. Hewitt's discussion of this paper.
[6] Braverman, J. D., "A Critique of Credibility Tables," *Journal of Risk and Insurance* Volume 34, p. 409.

ary economy increases are more common than decreases. The disutility of too little credibility is much greater in the case of statewide rate level than in the case of territory relativity calculations, since the former can lead to a dollar loss on all units while the latter results only in the lost opportunity for profit on some units. In other words, the mathematical and statistical tools cannot be separated from the decision procedure — the business situation — itself. If one accepts this premise, then the selection of P and k becomes an exercise in statistical decision theory once the disutilities of the various outcomes are postulated. This latter step is, of course, a subjective one and can be performed only if one accepts the subjective, or Bayesian, view of probability. Apparently, the classical Neyman-Pearson solution of credibility problems is only of use to Bayesian statisticians.

DISCUSSION BY JOHN S. McGUINNESS

This is a fundamental paper of great significance. Besides the concrete advance it explicitly reports, it also has several substantial implicit qualities. These are easy to miss but they are worthy of specific recognition for the valuable instruction they provide.

Primarily, the paper provides a sound and distribution-free theoretical basis that permits the development of a specific criterion (a precise number of claims) for ascribing full credibility to data that reflect both relative claim frequency and average claim cost for a single-parameter class of risks. It appears to provide an objective basis for overcoming two present and contrasting deficiencies in ratemaking practice. The first deficiency is the current neglect of the average claim cost element (and its variability) in determining a class credibility, and the second is the present common neglect of the relative frequency element (and its variability) in making time-series adjustments.

The author's approach, in using the total amount of claims (T) as the major variable of which the variation is measured, is a less easily visible quality. It is a clever and rewarding change in viewpoint. By focusing their attention on this aggregate or collective figure, rather than on the much smaller pure premium, they have for their analysis a statistically much more manageable datum and one for which it is much easier to determine a mean and an objective measure of variability. This difference in approach appears to parallel precisely the difference between approaching

single-auto merit rating as (a) measuring and basing rates on the experience of an individual automobile or (b) measuring and basing individual auto rates on the experience of aggregates or classes of risks, where the claim experience of each class has defined characteristics that differ from those of other classes.

This difference in approach has made unit-risk merit rating demonstrably sound actuarially, and it has made development of a fully representative (of both frequency and mean severity) credibility criterion by the authors demonstrably feasible actuarially. It is the mental equivalent of a military outflanking movement, permitting attack from the side or the rea when frontal attack fails. The potential of this tool — shifting one's view point or perspective to find a solution to a problem — as an aid in making similar major strides in future actuarial progress deserves explicit recognition which it does not appear generally to have received.

The paper is important not only for what it accomplishes but also for what it seems to promise. The full credibility criterion it sets forth is not linked in the paper to any criteria for partial credibility. But one such link and set of criteria which suggest themselves involve a slight change, a change linked to the "asymptotic" approach of Prof. Mayerson's previous paper.[1] Once the maximum permitted percentage deviation of the observed pure premium from the expected pure premium (Perryman's k) is set, the probability P that the observed pure premium will differ no more than $100\,k\,\%$ from the expected pure premium can be used as the credibility. An infinite sample size N would be needed to give full credibility under this approach, but the credibility of large samples measured by this criterion would approach so close to 100 per cent that it would be feasible to treat any sample with a P exceeding a set threshold as having full credibility. The threshold could be set at 99%, 95%, or the 90% used by the authors.

It will be clear to the reader that this "threshold" can with equal reason and logic be considered

(1) the Perryman and the present authors' criterion or critical point for full credibility, it being also the logical point of departure for an (in the paper) undefined but potentially multi-valued set of criteria for degrees of partial credibility; also

[1] Allen L. Mayerson, "A Bayesian View of Credibility," *PCAS* Vol. LI, p. 85.

(2) the confidence level for a classical two-valued Neyman-Pearson decision concerning a hypothesis in which the only two permitted credibility values are zero (rejection) and 100 (acceptance); and further

(3) a full-credibility threshold for a precisely defined, multivalued, set of objective criteria for all degrees of credibility (in which the credibility or $z = P$).

The paper, with its collective approach, also has important underwriting and reinsurance, as well as ratemaking, implications. The quantitative objective of an underwriter is, in conjunction with maximization of total profit, to keep adverse fluctuations in the total amount of actual claims within a given maximum percentage of the expected total, to a given degree of probability, P. The present authors' statement of the Perryman full credibility criterion says exactly the same thing, but in ratemaking rather than in underwriting terms.

Because of this parallel, the criterion presented in the paper can immediately be extended beyond its single class, single time period limits. Rosenthal[2] has shown how, in types of insurance giving rise only to total losses, such a criterion can be determined for a combination of classes of risks with different mean sizes of loss (in his scheme, amounts of insurance) and different relative claim frequencies. His work has been extended[3] to embrace as well all the types of insurance that give rise to partial losses, to different rating territories and time periods, and to all other types of differences in the characteristics of various classes of risks; and also to handle the contagion or catastrophe (interdependence of risks) problem.

These two papers had also gone beyond another of Perryman's limitations. They removed the need to assume equality between mean and variance. Their common approach permits a skewed (for example, a positive or negative binomial as well as Poisson) or unskewed (normal curve as a limiting form of the binomial) type of distribution. The present paper, however, appears to provide for a much more general set of possible types of distribution. This is another very important contribution.

[2] Irving Rosenthal, "Limits of Retention for Ordinary Life Insurance," *Record* of the Institute of Actuaries, May 1947, pp. 8-22.

[3] John S. McGuinness, "Controlling the Effects of Catastrophes in Insurance Against Floods and Other Elemental Perils," *Transactions XV International Congress of Actuaries* Vol. IV, p. 190.

One may take but minor exceptions to the present paper. One exception is to eliminate the N from assumption "(b) that the random variables $N, X_1, X_2, \ldots$ are independent . . . ," since once that X_N is chosen, N is determined. Secondly, it would be clearer if it were stated whether the automobile property damage data were for total limits or were truncated to a standard limit. It would also be useful to mention the need, due to inflationary and other temperal changes, of frequently recalculating the size of N for each type of insurance and for at least some breakdowns or subclasses thereof. This might have to be done as often as yearly in order to produce an actual variance as small as that postulated from prior data.

The minor nature of these points simply tends to confirm an opinion that recognizes these authors' paper as a scholarly, clearly presented, and very important contribution.

DISCUSSION BY KENNETH L. McINTOSH

Assuming that necessary data could be made available, the only argument against recognition of claim cost variation in credibility calculations seems to be one advanced by Mr. Perryman himself. He noted that the resulting "great increases in credibility requirements could not very well be made in practice under present day conditions for they would greatly limit the employment of local data."[1] Mr. Perryman's "present day conditions" of 1932 are not, however, the "present day conditions" of 1969. Messrs. Mayerson, Jones, and Bowers have refocused attention upon the question, and perhaps the argument will bear re-examination. The data problem should not prove insoluble if it once is decided that the hidden cost of deficient credibility standards exceeds the out-of-pocket incident to data collection and processing.

When full credibility is defined by $P = 90\%$, $k = 0.05$, it is doubtful that retention of the 3rd and higher claim cost moments results in any significant increase in accuracy, except possibly in extreme cases. Assuming $\lambda_3 = \lambda_2 = \lambda$, then Eq. (E) of the paper becomes:

$$\lambda = \frac{Z_e^2}{k_1^2}\left[1 + \frac{\mu_2}{\mu^2}\right] \tag{1}$$

[1] Perryman, F. S., "Some Notes on Credibility," *PCAS* Vol. XIX (1932), p. 73.

and solving Eq. (F) of the paper for k as a function of λ, we have:

$$k_2 = \frac{Z_c}{\lambda^{1/2}}\left[1+\frac{\mu_2}{\mu^2}\right]^{1/2} + \frac{Z_c^2-1}{6\lambda}\cdot\frac{1+3\frac{\mu_2}{\mu^2}+\frac{\mu_3}{\mu^3}}{1+\frac{\mu_2}{\mu^2}} \tag{2}$$

Substituting into Eq. (2) the value of λ from Eq. (1), after simplification the result is:

$$k_2 = k_1 + \frac{k_1^2(Z_c^2-1)}{6Z_c^2}\cdot\frac{1+3\frac{\mu_2}{\mu^2}+\frac{\mu_3}{\mu^3}}{\left[1+\frac{\mu_2}{\mu^2}\right]^2} \tag{3}$$

Setting $k_1 = \pm 0.05$ and $Z_c = \pm 1.645$, Eq. (3) becomes:

$$k_2 = \pm 0.05 + 0.000263\,\frac{1+3\frac{\mu_2}{\mu^2}+\frac{\mu_3}{\mu^3}}{\left[1+\frac{\mu_2}{\mu^2}\right]^2} \tag{3.a}$$

whence if:

$$\frac{1+3\frac{\mu_2}{\mu^2}+\frac{\mu_3}{\mu^3}}{\left[1+\frac{\mu_2}{\mu^2}\right]^2} \leqslant 3.80$$

then by Eqs. (3) and (3.a) we have $k_2 - k_1 \leqslant 0.001$. It will be found that actually we have $k_2 - k_1 = 0.0007$ for the automobile data given in the paper, and for either set of workmen's compensation data we have $k_2 - k_1 = 0.0005$. It also should be noted that neglect of the third moment does not change the width of the confidence interval, but merely displaces it by a very small amount.

Considering the uncertainty in the observed values of the higher moments and remembering that truncation error will result in any case from chopping the expansion at a given number of terms,[2] errors of the magni-

[2] It would have been helpful had the paper included some indication of error bounds to be associated with the Cornish-Fisher expansion.

tude of those calculated above seem negligible for all practical purposes. Comparable results might be expected, on the basis of the Central Limit theorem, when the assumption that $\lambda_3 = \lambda_2 = \lambda$ is abandoned, although the calculations have not been made.

Partial credibilities present a different picture when the expected number of claims drops below about *100*. Noting that $Z_{.5} = 0$, and that from the definition of t_c it follows that $T_c = E(T) \longrightarrow t_c = 0$, using only the first two terms of the expansion, we find, after some algebra, that:

$$\frac{T_{.5}}{E(T)} = 1 - \frac{\mu_3\lambda + 3\mu_2\mu\lambda_2 + \mu^3\lambda_3}{6\mu\lambda(\mu_2\lambda + \mu^2\lambda_2)} \tag{4}$$

and that if Z_a is the solution of:

$$Z + \frac{\mu_3\lambda + 3\mu_2\mu\lambda_2 + \mu^3\lambda_3}{6(\mu_2\lambda + \mu^2\lambda_2)^{3/2}}(Z^2 - 1) = 0 \tag{5}$$

then:

$$Pr\{T < E(T)\} = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{Z_a} e^{-1/2 Z^2} dZ \tag{6}$$

Using the automobile claim cost data from the paper and assuming $\lambda_3 = \lambda_2 = \lambda$, values of $T_{.5}/E(T)$ and of $Pr\{T < E(T)\}$ were calculated for several values of λ selected to have arithmetically convenient square roots. Some of the results are listed in the following table:

λ	$\frac{T_{.5}}{E(T)}$	Z_a	$Pr\{T < E(T)\}$
$\geqslant 400$	$\geqslant 0.995$	$\leqslant 0.049$	$\leqslant 0.520$
225	0.991	0.065	0.526
100	0.980	0.096	0.538
64	0.969	0.119	0.548
36	0.945	0.157	0.562
16	0.876	0.229	0.591
9	0.780	0.294	0.616

$$\frac{T_{.5}}{E(T)} = 1 - 1.984\lambda^{-1} \qquad Z_a = (0.2688\lambda + 1)^{1/3} - 0.5184\lambda^{1/2}$$

In all probability the sampling mean, as an unbiased estimator, will have zeroed in upon true expectation by the end of all eternity, but classification rates normally rest upon at most only five or six years of experience. When at most only five or six observations are to be used in a given rate calculation, a probability of 0.55 or more that a single observation will fall below expectation, and a probability of 0.5 that it will fall below 95% of expectation, would seem significant even though credibility will be low in such cases. Where the rating formula ultimately rests upon truncated distribution,[3] the effects of skewness will be minimized, and perhaps may be reduced to negligible proportions. Nevertheless, the matter seems worth investigation.

Entirely apart from the present application specifically to the credibility problem, the Cornish-Fisher expansion seems to offer a simple technique whereby empirical distributions of loss may be developed readily, either when a theoretical distribution cannot be fitted, or when a theoretical distribution, if fitted, is too complex for routine practical calculation. Although the estimation of annuity costs as such may be of little interest to most casualty actuaries, as an example of techniques readily applicable to casualty problems, Mr. Bowers' paper[4] cited by the present authors will repay study by anyone interested in actuarial methods.

It is to be hoped that Messrs. Mayerson, Jones, and Bowers will not rest with their present significant contribution, and that additional data will become available to permit practical application of their results.

DISCUSSION BY DALE NELSON

In their paper, the authors present a distribution-free approach to the problem of evaluating the full credibility standard for a specific block of business, after having briefly reviewed the customary approach. Their motivation stems from two principal concerns:

(i) the usual derivation is based on the distribution of the number of claims and, generally, ignores the distribution of claim amounts

[3] E.g., when, as in private passenger automobile, basic limits experience, rather than total limits experience, is used.

[4] Bowers, Newton L., Jr., "An Approximation to the Distribution of Annuity Costs," *TSA* Vol. XIX (1967), p. 295.

even though the results are applied to such loss statistics as pure premiums and loss ratios, in addition to claim frequencies; and

(ii) the third and higher moments of these distributions are usually glossed over and simply accounted for by means of a normal approximation.

The results derived in the paper reaffirm the fact that the effect of (i) is very substantial, and establish that the importance of (ii) is relatively minor.

Most of my comments are technical in nature, but I would like to remark first on a curious situation. Despite the fact that the factor $A = 1 + \frac{S^2}{M^2}$ needed to compensate for (i) has been known for over 35 years, that it is fairly easy to rationalize, and that it is rather large in size (most calculations yield values ranging from 2 to 5), the actuarial community has been almost united in their indifference to its use. Part of the reason for this undoubtedly lies in the difficulty encountered in evaluating S, given the form of most insurance data. But estimates have been made for most lines, at one time or another, and in view of the conservative nature of most actuarial techniques it is surprising that some convenient, arbitrary value of S (say $2M$), has not been used in place of the implicit value $S = 0$.

The following are a few technical notes pertaining to the authors' paper which may be of interest.

(1) The authors have used the first two terms of the Cornish-Fisher expansion to approximate the $100e$ percentile, t_e, of the distribution of $\frac{T - E(T)}{\sigma_T}$ in terms of the corresponding percentile, Z_e, for the standard normal distribution:

$$t_e \sim Z_e + \frac{1}{6}(Z_e^2 - 1).\ \frac{E[T - E(T)]^3}{\sigma_T^3}$$

They have not commented on the accuracy of this expansion; but about all that can be said, in general, of this particular two term approximation is that the error term goes to zero with n^{-1}, where n is the number of exposure units.

In checking this approximation formula against known distributions a fair degree of accuracy was found to exist, particularly in the tails of these

distributions. With the Gamma distribution, for example, the relative error was less than 5% for the cases tested.

(2) By using this approximation and the usual definition of full credibility, the authors derive the full credibility standard, Λ, by setting

$$\frac{kE(T)}{\sigma_T} = t_e, \text{ with } e = \frac{1+P}{2}$$

This, as the authors admit, produces a somewhat conservative standard. A more correct formulation would have been to determine e and e' such that:

$$t_e = \frac{kE(T)}{\sigma_T} = -t_{e'}$$

$$\text{and } Pr\,[Z_{e'} \leq Z \leq Z_e] = P$$

Although the arithmetic can get rather burdensome, it is possible to determine Λ in this fashion. For instance, in the authors' first example, this procedure yields $\Lambda = 4{,}573$ (compared to the authors' *4,713*).

This raises a couple of interesting questions since the authors derived a slightly higher standard, $\Lambda = 4{,}577$, by ignoring the third moment. Specifically,

(a) Does the presence of positive skewness in the distributions yield a lower standard of credibility than the symmetric case? or

(b) Is this phenomenon spurious and only a reflection of the error in the Cornish-Fisher approximation?

It should be noted that similar results are also obtained for the other examples. Intuitively, it doesn't seem that (a) should be true. This would lead one to conclude, then, that perhaps the third moment effect is of the same order of magnitude as the error term in the formula used to measure it and that the usual normal approximation is entirely satisfactory for most purposes.

(3) The authors' approach, and other published results, take the normal approximation as their point of departure. This produces, in effect, an increasing sequence of lower bounds to the full credibility standard as the conditions on the higher moments are relaxed. It is intellectually, if not practically, interesting to approach the problem from the other side — i.e. to devise upper bounds to the standard.

Thus, Chebyshev's theorem states that:

$$Pr\left[\,|t| \leq \frac{kE(T)}{\sigma_T}\,\right] \geq 1 - \frac{\sigma_T^2}{k^2E(T)^2}$$

regardless of the form of the distributions. Resolving this yields the following standard for full credibility:

$$\Lambda = \frac{A}{k^2(1-P)}$$

This estimate is much more conservative; for example, in comparison to the usual standard of 1,084 claims, the same parameters produce the value $\Lambda = 4{,}000$ for claim frequency and $4{,}000A$ for the pure premium. There are more elaborate Chebyshev-type relations, involving higher moments, which could be used to reduce this upper bound. From a practical standpoint, however, these are not useful since the required moments are not available.

DISCUSSION BY LEROY J. SIMON

This fine paper is providing a new stimulus to the thinking of actuaries on the important subject of credibility. A primary purpose of this review is to place additional information before the Society relating to another line of business, namely fire.

The Actuarial Bureau of the National Board of Fire Underwriters and, more recently, the National Insurance Actuarial and Statistical Association have assembled, under the direction of Dr. J. H. Finnegan, statistical data on fire losses in the United States. The latest compiled information was for 1964 and the results are shown in the accompanying table. The data were derived from "Adjusters' Loss Reports" which are forms completed by adjusters upon the settlement of each claim. The reports reflect the payment made to all involved companies as a combined total. Thus, if a claim were split among ten companies the entry would be made as one entry for the full amount and not as ten separate reports for shares of the amount. For our purposes, the method of compilation in the accompanying table is much better than the usual compilation of data in the fire field where split losses would be reported separately and never pulled together into a single combined total.

In many instances an adjuster's report represents the total damage sustained in a fire, but if the insured had one group of policies on his building

and a second set of policies on contents, two separate adjustments would be made and two separate adjuster's loss reports would be submitted. Hence, it is proper to think of adjuster's loss reports as being on a claim basis, but not always representing the total loss from a single fire. The data are also deficient in that not all losses are reported with 100% completeness and in that all companies in the industry do not participate in preparing adjuster's loss reports.

The table is a composite of adjuster's loss reports for all states for amounts $250 and over. Reports for amounts from the first dollar up were available only for Oregon and the Oregon data were used to approximate the countrywide figures for claims under $250. Hence, the distribution is an approximation but an examination of the data indicates that this approximation is probably of much less importance than the effect that sampling fluctuation would be expected to have upon the various moments of this highly skewed distribution.

Having thus obtained a distribution of fire losses for combined buildings and contents losses and combined dwelling and commercial properties, we proceeded to calculate the various moments of the distribution. The moments were as follows:

$$\mu = 2191.56$$
$$\mu_2 = 208{,}557{,}000$$
$$\mu_3 = 224{,}875{,}000{,}000{,}000$$

If we assume the number of claims has a Poisson distribution, formula (F) (in the Mayerson paper) using $k = .05$ produces $\lambda = 53{,}435$. If, instead, we solve equation (E) which only involves two moments, we obtain $\lambda = 48{,}075$. The use of the third moment of the claim amount distribution increases the number of claims needed for full credibility by 11%.

The 1921 standard profit formula for fire insurance provided that only the first million dollars of loss would be chargeable to the state in which it originated. In 1949 the formula was modified to allow more to be charged to the state up to 10% of the annual fire insurance premium volume of the state. If the amounts in the table were limited to one million dollars the moments would be as follows:

$$\mu = 2169.75$$
$$\mu_2 = 139{,}970{,}000$$
$$\mu_3 = 55{,}928{,}400{,}000{,}000$$

FIRE LOSSES BY SIZE

Countrywide, 1964

Size of Payment		No. of Claims	Losses Paid
0	249	160,986	10,887,863
250	499	63,619	22,235,666
500	999	42,568	29,852,177
1,000	1,999	31,601	43,662,219
2,000	4,999	35,866	111,977,907
5,000	9,999	19,112	127,622,989
10,000	14,999	6,372	75,875,011
15,000	19,999	2,611	44,268,678
20,000	24,999	1,588	34,880,190
25,000	49,999	2,665	90,884,964
50,000	74,999	784	47,161,040
75,000	99,999	363	31,210,793
100,000	149,999	280	33,776,642
150,000	199,999	141	24,086,211
200,000	249,999	57	12,738,263
250,000	299,999	40	11,030,300
300,000	349,999	24	7,668,749
350,000	399,999	24	8,968,778
400,000	449,999	11	4,667,100
450,000	499,999	8	3,815,203
500,000	549,999	8	4,256,955
550,000	599,999	5	2,913,404
600,000	649,999	4	2,490,542
650,000	699,999	2	1,323,443
700,000	749,999	1	701,898
750,000	799,999	2	1,523,046
800,000	849,999	1	802,729
850,000	899,999	1	855,722
950,000	999,999	1	959,781
1,000,000	and over	7	15,042,833
Total		368,752	808,141,096

Substituting these values in equations (F) and (E) we obtain $\lambda = 35{,}287$ and 33,258 respectively. The introduction of the third moment here increases the credibility requirement by 6%.

The number of claims required for full credibility under the assumptions above is strikingly reduced by the introduction of the million dollar limitation. The values of λ in fire lines certainly contrast sharply with those in automobile and workmen's compensation found in the original paper. In closing, let me emphasize that the fire loss distribution data found herein is an approximation and should not be considered a precise nor final answer on this subject.

DISCUSSION BY CHARLES C. HEWITT, JR.

This review will have two principal parts:

(1) A focusing of attention upon the recent general definition of credibility by Buhlmann (1), and
(2) A commentary upon the true meaning of "full credibility" in view of the insight that Buhlmann's generalization provides.

(1) Partial Credibility — the Buhlmann Definition

Buhlmann restates the familiar

$$z = \frac{n}{n+K}$$

when n is the number of observations, but goes on to prove that

$$K = \frac{\textit{Expected value of the process variance}}{\textit{Variance of the hypothetical means}}^{*}$$

* This conclusion was reached with respect to both the Gamma-Poisson process and the Beta-Binomial process in Mayerson's earlier work (2) on a Bayesian treatment of credibility, but was not recognized in this most general form by either Mayerson or the author of this current review in his earlier review of Mayerson's Bayesian approach (3). In the latter review this author even went to the trouble of pointing out Albert W. Whitney's fifty-year-old statement (4) of this formulation for the (essentially) Beta-Binomial situation without achieving the insight contained in Buhlmann's analysis. (In failing to recognize K in the Buhlmann format, this reviewer was fooled by his own constant dependence on the Gamma-Poisson process and the coincidence that the mean and variance in the Poisson process are identical.) Finally (for those who prefer numerical values attached to ideas) the Appendix includes an application of the Buhlmann definition to Canadian private passenger auto statistics.

If it is assumed that the *variance of the results of prior observations* is admissible as an estimator for the *expected value of the process variance,* then Buhlmann's work may be generalized far beyond actuarial, mathematical, or even mensural limitations:

$$\text{Credibility} = \frac{(n)\ \text{Number of observations}}{(n)\ \text{No. of observations} + (K)\ \dfrac{\text{Variation in results}}{\text{Variation of hypotheses}}}$$

Take the simple statement of faith, "There is but one God." This permits no variation in hypothesis; therefore the denominator of *"K"* is zero, *"K"* is infinite, and credibility is zero. Thus no observation, no matter how often repeated, can shake the faith of the persons who make this assertion.

There are, then, three variables which can affect credibility:

(i) number of observations,
(ii) variation in results (estimator for process variance), and
(iii) variation of hypotheses (variance of hypothetical means).

Credibility will increase from zero towards unity as:

(i) the number of observations increases, or
(ii) the variance of the results of prior observations decreases, or
(iii) the variance of the hypothetical means increases.

These statements will be illustrated with examples, each slightly more complex and unfamiliar than the preceding. Full credibility occurs —

(i) *When the number of observations increases without limit.*
This is the most easily understood situation — by laymen and mathematicians alike. The classic example is the coin toss in which the proportion of heads or tails becomes more believable the more often the observation is repeated.

(ii) *When there is reason to expect that repeated trials will produce the same result.*
This is the situation in which the immediate observation produces essentially the same result as prior observations. The best known examples are in the physical sciences — the time of rising and setting of the sun and moon, the position in the skies of the planets and stars, the time of high and low tides, the temperature at which water boils or freezes — and so on.

(iii) *When the possible hypotheses are not finite, and one hypothesis is substantially as likely as another.**

This is the situation in which there is no a priori knowledge and no clue as to any favored prediction(s). Because we live in an advanced civilization it is difficult to conjure a good illustration. However, let us use our imaginations to suppose that we are the first sentient beings placed upon Earth, and that awareness occurs for the first time during the night. Imagine our awe when the first sunrise (that we have ever been conscious of) occurs; we do not know whether it is a ball of fire that will be snuffed out in an instant, or on the other hand whether it will remain in the sky forever. Finally, the sun does set on our first observed daytime, but we still don't know whether or not we'll ever see the sun shine again. However, if it does come up again we now think we know how long daylight will last.

(2) Full Credibility — the Classicist's Definition

We have just seen that, lacking (i) an infinite sample, (ii) absolute invariance of results, or (iii) infinite variance of hypotheses, there is no such thing as full credibility. There is a certain percentage of human beings, including a substantial number of mathematicians and actuaries, which finds this thought intolerable.

The classical statistician (Neymann-Pearson School) does not trust a priori judgments, because he says they are "biased" — a word apparently more horrid than "spit." The classicist has achieved a definition of full credibility by a contrived device that runs something like this, "Full credibility exists when an-observation-should-be-within-100k%-of-the-expectation-with-probability, P." But in dodging a priori judgments the classical statistician creates two new parameters k and P, both of which may be varied to suit the judgment or practical necessity of the statistician using them. The sterility of this concept becomes evident when one tries to assign partial credibility, having decided upon full credibility without any real understanding of the meaning of credibility itself. A number of approaches have been

* The essence of these three statements appeared in the *Proceedings* of this Society as long ago as 1950 (5) in a discussion by the late A. L. Bailey. This reviewer was strongly tempted to credit (A. L.) Bailey rather than Bühlmann with the general definition of partial credibility. If this review has erred in giving credit to Buhlmann, it is because the Buhlmann definition is not obscured by the often confusing symbols which the pioneer American actuary unfortunately selected for expressing his (otherwise) lucid thoughts.

tried; one such is the square root of the number of claims (presumably because the variance of the mean increases in proportion to the expected number of claims).

Fortunately the authors of the paper being reviewed here make no claim that their effort is productive of an approach to partial credibility. In fact, early in the paper they point toward the Buhlmann definition. Thus, within the self-imposed restrictions, the Mayerson-Jones-Bowers paper is a worthy attempt to come to grips with the often perplexing problem of assigning full credibility to pure premiums by contemplating both the frequency and severity of claims, and the distributions of frequency and severity. If one "buys" the classical standard for full credibility, referred to in the preceding paragraph, then the authors have achieved their goal of establishing a distribution-free approximation of a standard for full credibility, which utilizes the *relationship* between the higher moments and the mean of the distributions of the number and size of claims. (So we have Mayerson the Bayesian (2) and Mayerson the classicist, and an unregenerate Bayesian may only ask, "Will the real Allen Mayerson please stand up?")

At this point in the discussion it becomes necessary to point to a practical weakness in the solution offered by Mayerson-Jones-Bowers. If one reads this paper carefully he notes that, although the authors emphasize the distribution-free nature of their standard, the three examples which illustrate the standard *all assume specific distributions for the number of claims.* This is *not* merely for convenience, as the authors seem to imply, but a necessary substitute for the fact that one cannot obtain higher moments (than the first) of the distribution of the number of claims without retreating into some specific assumption concerning exposures. Even partitioning the number of claims for a particular risk, or group of risks, on a year-by-year basis (a possible device for estimating higher moments of the number of claims) implies the use of one "risk-year," or "class-year," as an exposure base. Those familiar with workmen's compensation insurance will recognize that even this restriction is not sufficient when the payroll (exposure base) of a risk, or group of risks, fluctuates from one year to the next.

APPENDIX

Buhlmann (1) indicates that the problem of estimating the expected value of the process variance and the variance of the hypothetical means has

not yet been attacked. But it has, although Buhlmann would have had no way of finding this out. Using data in his own 1960 paper on Canadian private passenger automobile merit rating (6), this reviewer presented the following estimators at a panel session on credibility in Boston in November, 1965. Rephrased to fit the Buhlmann definition of partial credibility, the data is again presented below:

	Canadian Private Passenger Car Experience			
Classification	Expected Value of Process Variance	Variance of Hypothetical Means	K	z
	(1)	(2)	(3)	(4)
	(Exposure basis—one car year)		(1)/(2)	$\frac{1 \text{ (car year)}}{1 + (3)}$
1 — Adult — pleasure use	.087	.00288	30.2	.032
2 — Young driver — limited use	.120	.00337	35.6	.027
3 — Business use	.142	.00487	29.2	.033
4 — Unmarried young owner (or principal operator)	.162	.00599	27.0	.036
5 — Married young owner (or principal operator)	.110	.00263	41.8	.023

The process is Gamma-Poisson as described in detail in (6).

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ELEMENTS OF TIME-SERIES ANALYSIS IN LIABILITY AND PROPERTY INSURANCE RATEMAKING

JOHN S. McGUINNESS

VOLUME LV, PAGE 202

DISCUSSION BY LEWIS H. ROBERTS

Time series, particularly in their cyclic behavior, possess an almost occult fascination. Recognition of their importance can be traced back millennia to priesthoods founded upon ability to predict seasonal events such as the annual flooding of the Nile and the Euphrates. In our time economists and laymen alike seek to read the future movement of prices and indices from trends and cycles perceived in records of the past. McGuinness points out that our *Proceedings* contain very little on the subject, which is perhaps surprising for a profession dedicated to prediction, and his paper is very welcome.

Clarification of one statement by the author may be in order before getting into discussions of theory. He states that "The available data are all in yearly form." While this is true of most statistics collected by rating and statistical organizations, monthly, quarterly, and semi-annual data are used by actuaries. An important example is provided by the average claim cost data used by the Insurance Rating Board, which is compiled on a quarterly basis. Since the author later alludes to these data, we infer that by "available" he means available to him at the time of writing the paper.

The author recognizes four major types of movements in time series, to wit:

"(1) basic or long-time trend,
(2) cycles (irregular periodic variations), i.e. wavelike changes over periods of somewhat irregular length,
(3) seasonal (regular periodic) variations, i.e. wavelike changes over periods of fixed length,
(4) irregular, random, or erratic fluctuations."

In connection with measurement of trend, McGuinness says, "Since

trend is a long-term movement, measuring it with reasonable accuracy requires data for a relatively large number of years. Ideally, the term covered by the data should extend over the periods of at least two or three of the longest cycles. This is clearly necessary to avoid mistaking some cyclical movements for trend movements. *As a practical matter it is not usually possible at the outset to secure a consistent and long enough series of precisely pertinent data.* Ten years' data are mandatory as a minimum for reasonably reliable results, and in many cases will not suffice." (Reviewer's italics.)

Random effects and other unexplained irregularities,* unfortunately, create major obstacles to the interpretation of these movements.

Figure 1 shows 100 observations from a series that appears to satisfy the requirement of covering at least two or three of the longest cycles. An unmistakable upward trend seems to justify projection of future values with better than usual assurance. Figure 2 presents the data of a related series. They, too, seem to satisfy the requirement as to number of longest cycles but exhibit a downward trend over the last 60 data points. What is a reasonable projection for the next 10, 20 or more observations? Figure 3 sets forth the next 200 observations from the same series. Due to rescaling, the amplitude of vertical movements is one half that of Figure 2, but even when allowance has been made for this the cyclical characteristics previously apparent seem to have almost vanished. The earlier downward trend has leveled out for a full 100 observations followed by a small rise for 10 observations, a downward trend for 40 observations, level values for another 35 and a slight downward trend for the last 15. Whatever might be predicted from Figure 3, it hardly supports the expectations suggested by Figure 2.

Before any calculations are invested in a more sophisticated analysis of these data it is only fair to identify them. They are a pseudo-random sequence generated by the General Electric Mark I time-sharing computer in New York City. Because of their seemingly peculiar behavior for numbers simulating a true random series, we present Figure 4, reproduced by permission from *An Introduction to Probability Theory and Its Applications* by William Feller (John Wiley & Sons, New York). These results are said in that book to be based upon the frequency of even digits in a 10,000-digit section of *A Million Random Digits with 100,000 Normal Deviates* by

* It might be argued that, by the definition of randomness, there are no other unexplained irregularities. Yet what is "random" to one observer is explainable to another.

Figure 1

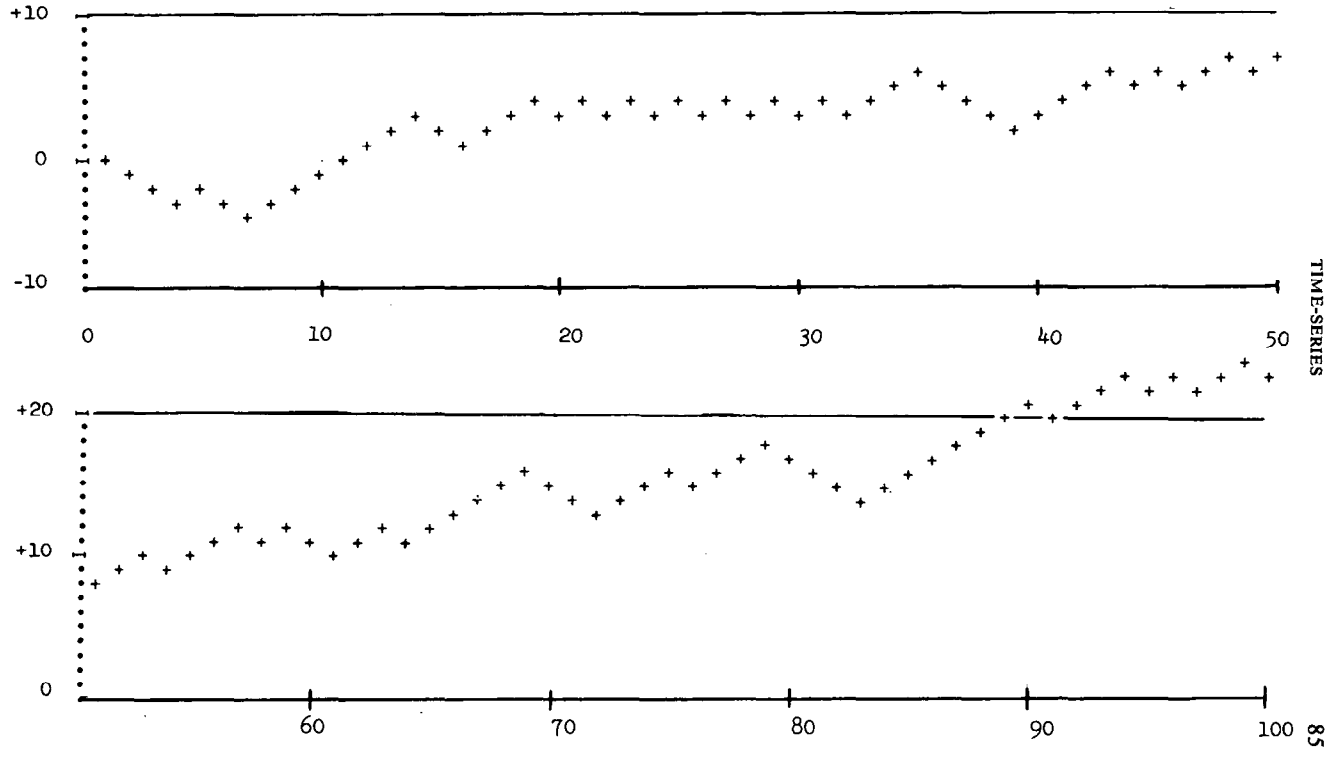


Figure 2

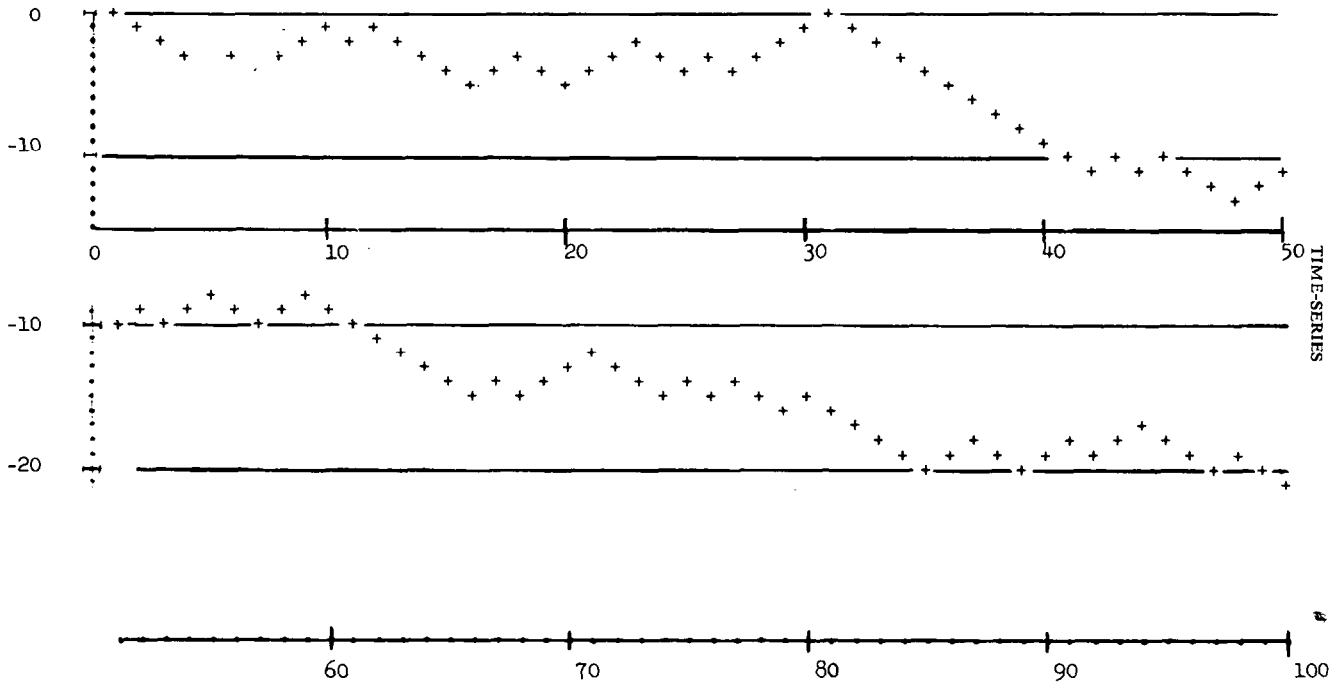
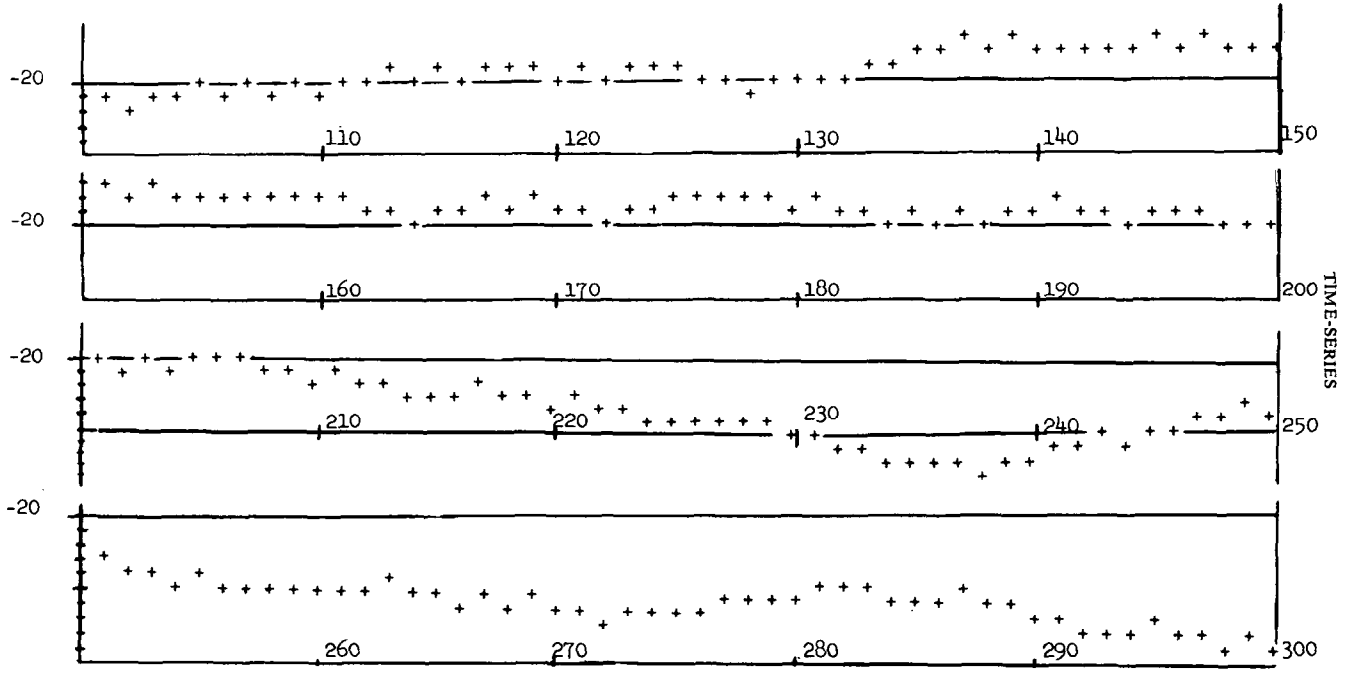


Figure 3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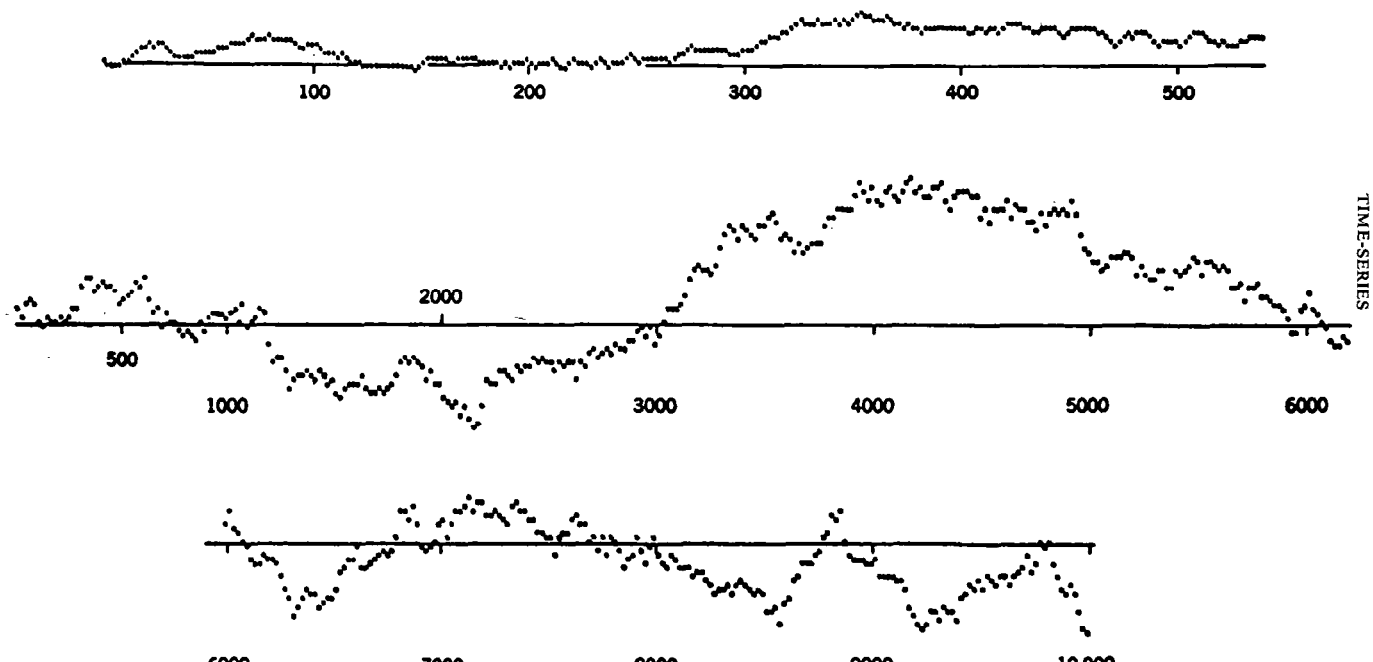
290
300
TIME-SERIES

Figure 4


100
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the Rand Corporation (Free Press, Glenese, Ill.) Without ourselves having actually tested any of these series of randomness, we note that Professor Feller's comments on this series, which looks at least as peculiar as our own, support its acceptance as a random simulation.

We offer these figures as evidence of the practical difficulty, if not the virtual impossibility, of distinguishing real trends and cycles from random effects through study of the data alone. Unless the mechanism responsible for a trend (for example, inflation) is known a priori, inference of its continuance beyond the last observation can be dangerous. Where analysis can measure a significant degree of auto-correlation, the danger is reduced for short-term projections, but uncertainty increases rapidly as the period of projection is extended.

The author correctly points out the difficulty of establishing correct values for cyclic parameters and recognizes that periodic variations tend to be irregular. How are we to distinguish irregular true cyclic variations from irregular random cyclic variations? Suppose we have 10 data points. In removing linear trend we use two degrees of freedom. Suppose we approximate a cyclic effect with a sine curve. This will require one parameter for phase, one for amplitude and one for period, leaving us with five degrees of freedom. Goodness of fit must now be estimated by dividing the sum of squared residuals by five and the result may or may not be less than that obtained by dividing the residuals after the first step (trend removal) by eight. It may not even be less than the adjusted mean square deviation of the observations from their average. (That is, using a nine as the divisor since there are nine degrees of freedom relative to the average.)

It may be, of course, that the sine curve actually does give the best fit among the three alternatives named. Suppose, however, that some other five-parameter function, say a fourth degree polynomial, gives an even better fit. Does that make it a better predictive function? Hardly. To predict intelligently we must bring some a priori knowledge to the problem because we can always fish out something from the mathematician's bag of tricks to fit the data in a particular case. (It is easy enough, for example, to vary the parameters of the sine curve as a function of time or to approximate any data as closely as we please with a Fourier series.) In the absence of an understanding of the mechanism generating the data and responsible for such features as cycles, we may infer such knowledge from supposedly

similar other cases. We cannot, however, legitimately test our hypotheses upon the data which suggested them.

An elementary dictum in the use of mathematical formulas for interpolation and extrapolation is that while the former is safe enough, at least for "well-behaved" functions, we commit the latter only at our peril. This is merely one aspect of the general principle contrasting the deductive process with the inductive, another being the application of natural laws to familiar cases in contrast to their extension beyond the range of prior observation. Predictions in which the independent variable is time necessarily belong to the latter type of operation, hence can never escape the uncertainties inherent in extrapolation. It is possible, however, to make reliable predictions of future events without extrapolation if we can find the proper non-temporal variables. A simple example is provided by the calculation of celestial motions and this returns us full cycle to the need for understanding of underlying mechanisms.

There is one type of case, at least, where extrapolations on the time variable can yield good results statistically. This is where a sufficient number of prior observations have been made to establish that the event being predicted is a regular sequel to recognizable repeating patterns. An example is provided by predictive functions developed in World War II for control of anti-aircraft fire. These functions were derived through testing various predictors against simulations of evasive tactics employed by aircraft pilots. Unfortunately, no comparable simulation comes readily to mind for use in our problem.

The author states that "It seems unlikely that averaging state time-series with concurrent countrywide results is ever appropriate." A possible explanation might observe that for it to be appropriate, a reduction in the mean square error should result through cutting the variance to a degree greater than the bias is increased through the introduction of data extraneous to the state. The same comment would apply, of course, to the averaging of results for several states. At present, however, such biases and variances are not computed, hence the decision to average different bodies of data is made on an essentially intuitive basis and this reviewer is unable to say to what extent they are justified except to comment that they look reasonable in the instances he has seen. The author's recommendation that components be analyzed separately is sound.

Of especial relevance in automobile insurance, the author states that

". . . use only of one of the two components introduces distortions that partly defeat the purpose of the analysis." The components, of course, are frequency and severity. It is difficult to argue against this view beyond noting that the mechanism of trend in severity is at least partly understood as inflation. Some would add popular psychology as a factor in jury verdicts, but this seems a little nebulous as a "mechanism." With respect to frequency, however, there seem to be various mechanisms operating in different ways. On the one hand, more and more cars come onto the roads, thereby increasing the number of cars with which any one car might collide. This should tend to increase frequency. On the other hand, more and better roads are built to counter this effect. Is the density of cars per square mile of paved surface increasing or decreasing? Should we look for some physical measure analogous to heat, in which both vehicle density and average velocity are taken into account? How do we quantify the safety of roads independently of the events we seek to predict? Perhaps some system of grading could be devised which, together with traffic density and "temperature" would prove useful. We have not yet even mentioned trends in law enforcement and safety promotion.

The author rightly notes that changes in distribution of exposures by class of driver and use of vehicle contributes spurious directions to trend data. This, at least, is a mechanism we understand and can adjust for. Its mention here serves only to emphasize the need for caution in reading trends. If not merely random, apparent trends may be very real — and wholly misleading. Ratemakers, of course, are fully alert to this factor.

The author recognizes, but might perhaps better have more strongly emphasized, that stability and lag cannot be wholly separated. If new experience is not to exercise its full impact immediately, which would be inconsistent with stability, it follows that at least part of the effect must lag. It also follows that a stable program must prove costly to carriers when an upturn is not followed by a downturn. Unfortunately for them, this has been more common in recent decades than the reverse.

In general, as a matter of pricing strategy, it would seem preferable to employ a system of short-term prediction that would track as closely as possible with varying costs rather than a long-range system, even if one could be confident of its ultimate accuracy. With only long-range accuracy, years not characterized by underwriting losses would see erosion of business to carriers with lower and currently more accurate rates, a devastating combination of results.

The author's numerous figures and statistics provide a valuable source for others who may study the problems of time series. We are indebted to him for reminding us of their importance and more or less forcing us to think about a difficult subject that is perhaps more comfortable, but most unwise, to neglect.

DISCUSSION BY MICHAEL A. WALTERS

This treatise by John McGuinness represents an entire approach to the problem of reflecting trend in insurance ratemaking. Following a methodical definition of terms and statement of the difficulties involved, he develops his thesis as to where the solution lies and provides valuable procedures for the practical implementation of that solution. In short, if his thesis proves acceptable, he has given us a rather complete answer to the question of trend.

His thesis basically is as follows. The importance of trend requires the establishment of a method that is actuarially precise, uses a maximum amount of information, is applicable to all lines, and reflects cyclical movements to some extent while at the same time providing stability and removing arbitrary judgment. The current method of reflecting trend apparently is unsatisfactory according to these criteria; and so he has established a method that does qualify, using several techniques of statisticians such as the theory of runs, statistical control charts, and unbiased index numbers.

He defines "trend" as long-term movement, thereby requiring a large number of years to measure it accurately. Hence, the current shorter term method seems doomed at the outset, although the author later recognizes the need to reflect cyclical movements and major irregular fluctuations. Fundamentally, however, his concern is for the long-range growth of pure premiums, excluding the cycles and waves that temporarily mask the ultimate trend.

His "proof" of the stability of long-term estimates consists of projecting the short-term estimates for more years than they are meant to be projected and comparing them with the long-term projection of long-term data. This seems to beg the question as to which method more accurately predicts the insurance results of the immediate future, given the experience of the immediate past coupled with some knowledge of the patterns of movement.

On the other hand, if stability is to be stressed ahead of accuracy, then one should ponder the competitive and financial edge of a company whose rates are accurate *every* year versus a company whose rates are adequate only when averaged over a ten year period and are substantially off the mark in the interim. It should also be pointed out that rate changes which fluctuate to reflect the non-stable movements of inflation and insurance perils are invariably a matter of size of increase rather than a question of increase versus decrease.

Regarding the fitting of polynomials to past data, it should be kept in mind that the "goodness of fit" of a curve to the observed experience is significant only if the pattern is expected to repeat itself in the future. Mr. McGuinness realizes this by his adoption of a straight line as the practical solution to selecting a trend curve; but the longer the trend line, the more one should realize that the true growth of insurance costs is *probably* exponential, much like the growth of interest, i.e. $(1 + i)^n$.

One further point of contention for this reviewer in Mr. McGuinness's discussion of theory was his reference to the overall pure premium as being independent of the distributions and correlations of the various underlying rating criteria. He states that "any changes in the distributions by rating criteria that are not handled in another manner automatically are taken into account in fitting the trend line." However, one need only consider the possibility that pure premiums could be decreasing owing to shifts in distribution to lower-rated criteria; and yet within those criteria, there could be definite upward trends in pure premiums. All of this can be taking place with no change in relativity by rating criteria.

Ratemakers are aware of this phenomenon although it has not occurred to any extent thus far, to this reviewer's knowledge. As a matter of information, one large state was recently analyzed for automobile insurance distributional changes over a three year period; a certain amount of shift from urban to rural territories was noted along with an increase in the number of multi-car policies. These shifts were offset, however, by an increase in the number of youthful operators, all the changes producing little net effect on average rates. The point is that the dynamics of population change warrants constant surveillance for its possible effects on underlying data used for trend purposes.

Despite the above comments, this reviewer found the paper to contain many valuable contributions to the subject of trend. The author's depth of

research and inclusion of definitions are noteworthy, as are his comments on the nature and quality of trend data and on the length of projection. Especially enlightening are the sections on property coverages, where the use of Fisher's Ideal Index Number is shown to produce meaningful results by combining several diverse groups of catastrophe-laden data.

With regard to the techniques involved in compiling the statistical control charts, the calculation of index numbers is rather lengthy but could be done by computer, as could the formulation of the equation of the trend line. If the guide lines are selected to be a "standard error" perpendicular distance from the trend line so as to contain a certain percentage of the data points, then the method of cyclical adjustment will have to be revised because of the disparity between the vertical and the perpendicular distance from the guide lines to the trend line.

There is also a possibility that changes and improvements in data could render ten years an impractical length of time for maintaining uniform data. These changes can be relatively indepedent of the control of the ratemaker, such as revisions in financial responsibility limits, changes in coverage, and refinements of the experience period to accident half-years, or even accident quarters.

The several areas Mr. McGuinness suggests for further inquiry are potentially rewarding, but as priority over these one might pursue ways of improving the present trend technique, such as: seasonal adjustments, employment of more recent data by means of more refined computer techniques, reflection of claim frequency trend to supplement average claim cost trend, and possible use of external data to support the judgment of the ratemaker if sufficient correlation can be shown in the past between the insurance data and the external data.

Mr. McGuinness has written an educational and thought-provoking paper. His technique of analyzing long-term trends in liability and property insurance is basically sound and can give the ratemaker a broad perspective of what has occurred in the past. Perhaps some version of his methodology that is versatile enough to fully and promptly recognize the costly and sometimes not-so-short-lived cycles in insurance will be the most effective solution to the problem of trend.

AUTHOR'S REVIEW OF DISCUSSIONS

The perceptive reviews by Messrs. Roberts and Walters take two somewhat dissimilar approaches. It accordingly may be helpful in replying to contrast the two. The reviews also point up the fact that the paper could have been a clearer communicative tool.

Mr. Roberts interjects some very interesting data, accompanied by cogent comments, although with respect to actual ratemaking Mr. Walters' comment about the difficulty of securing long series of consistent data (even series much shorter than Mr. Roberts') is pertinent. Mr. Roberts' random sequences, although they reflect potential difficulties in determining *causes,* can provide excellent evidence of the adaptability of the described methods of analysis. If one takes any complete series of the random data (or any smaller number down to ten) and applies the described methods to them, it appears that the resulting predictions will be quite satisfactory.

One point that should not be missed in this connection is that the methods described, excepting only the combination of the control chart with the other techniques, have been developed and applied by economic statisticians to a very diverse group of non-insurance time series for close to half a century. They therefore reflect both a great deal of theoretical development and a great deal of practical wisdom gained from practical application.

Mr. Roberts' cautions about the high desirability of knowing something about the underlying mechanism, and about the difficulty of establishing cyclic parameters, are well taken. We could well supplement them by citing the cautions against "nonsense correlation" that appear in most text books about economic statistics. It is one of the fruits of the long development and practical experience reflected in the methods described that in using them we do not have to concern ourselves with precise determination of the cyclic parameters or whether the waves we see are true cycles or some type of irregular or random fluctuation. The simple analytical rule given in the paper is specifically designed to avoid the difficulty of estimating complex cyclic parameters.

It is true that better knowledge of the underlying mechanisms and causes of changes in time series can aid us in selecting curves of appropriate shapes,

but the paper demonstrates there is much that can be done, with very scanty knowledge of these parameters, that will still permit us to make accurate and stable predictions and without the introduction of arbitrary judgment. The examples in the paper also show how the methods objectively dampen the wide fluctuations in single-state data that underly the use of multi-state or countrywide data in ratemaking. This dampening has in all cases known to the author been sufficient to make the use of extraneous (out-of-state) data unnecessary.

Both reviewers rightly emphasize the importance of the conflicting needs for stability and accuracy of response. The competitive effect of the interplay between these two factors that is reflected by any one company's or bureau's rates will depend most, however, on when they file new rates in relation to competitors. If they file first, they can always be second guessed. Perhaps most important is to maintain a premium level (and the analysis here is aimed at premium level, not at individual rates) that is profitable. The competition will not for very long try to use rates that are unprofitable. The problem of adequacy has during the past two decades been a much more important one than the problem of being at a competitive disadvantage by not reducing rates quickly enough in line with statistical indications. The examples show that the methods described take well into account *both* the long-term and short-term indications of experience, and react at turning points (which are most critical) faster than the methods now in common use.

An over-all or systems approach was used to achieve the methodological balance between the conflicting needs for both accuracy and stability. One thing which the data in the paper make crystal clear is that, despite the continued presence of inflationary tendencies, there are very definite downward movements that legitimately call for rate decreases from time to time. The actual filings of the rating bureaus have demonstrated the very opposite of the statement that ". . . rate changes which fluctuate to reflect the nonstable movements of inflation and insurance perils are invariably a matter of size of increase rather than a question of increase versus decrease." Any system of time-series analysis must not reflect any such bias — it must be able to reflect such decreases as well as increases — if it is to be truly suitable for ratemaking purposes.

Mr. Roberts clearly recognizes that the paper discusses the whole problem of time-series analysis, not just the one type of time-series movement

called "trend." Failure to grasp this key distinction, covered by the third of the five stated objectives of the paper, creates some difficulties for Mr. Walters. To overcome this communicative failure in the paper we can contrast his interpretation with what the paper should have more clearly implied.

> The reviewer says that the thesis of the paper is that
> "The importance of trend requires the establishment of a method that is actuarially precise, uses a maximum amount of information, is applicable to all lines, and reflects cyclical movements to some extent while at the same time providing stability and removing arbitrary judgment . . .
> "He defines 'trend' as long-term movement, thereby requiring a large number of years to measure it accurately. Hence, the current shorter term method seems doomed at the outset, although the author later recognizes the need to reflect cyclical movements and major irregular fluctuations. Fundamentally, however, his concern is for the long-range growth of pure premiums, excluding the cycles and waves that temporarily mask the ultimate trend."

Had the paper been clear enough for the reviewer correctly to infer what the paper was meant to imply, however, he would probably have written along these lines:

> The importance of all four generally accepted types of movements in time series requires the establishment of a method that is actuarially precise, uses a maximum proportion of the pertinent information available, is applicable to all lines, and reflects trend and cyclical and irregular and (when appropriate) seasonal movements as far as they can practicably be measured while at the same time providing stability and removing arbitrary judgment.
> He states and uses the generally accepted definition of "trend," thereby requiring a large number of years to measure it accurately. Hence the current shorter-term method seems doomed at the outset since it is not designed to reflect, as the author recognizes from the outset is necessary, cyclical movements and major irregular fluctuations. Fundamentally, his concern is for a system that handles equally well all four major types of movements in time series and that masks neither the longer-term nor the shorter-term movements.

The reviewer accurately points up a major disadvantage of the com-

mon substitution of short-term averages by ratemakers in place of the economic statisticians' long-term trend when he says that the author's ". . . 'proof' of the stability of long-term estimates consists of projecting the short-term estimates for more years than they are meant to be projected and comparing them with the long-term projection of long-term data." The short-term trended average gives no perspective of the direction or shape of the long-term movement. The 16th footnote to the paper is in point here.

It would be most informative to compare the forecasts or indicated rate-level adjustments, given by the methods shown in the paper and by the short-term trended-average method now so widely used, with the actual results that were experienced. This could be done for each of a series of years for several of the sets of data presented in the paper (or any other comparable sets). Comparisons of accuracy (via the standard error of estimate or some similar measure) could well be made (1) for several years within each series and (2) for individual years among the group of series.

One can easily agree with Mr. Walters' belief that the true growth of insurance costs is probably exponential, or a modified exponential or logistic shape that eventually tends to flatten. To determine this, however, we need much longer series than any of those available for the paper.

It is apparently lack of clarity in the paper rather than disagreement which underlies Mr. Walters' seventh and eighth paragraphs. The paper does state that the over-all pure premium is independent of the distributions and correlations of the various underlying rating criteria in data *for any one year*. It then goes on to state that these distributions and correlations *could* have an effect on the relationships among over-all average pure premiums for a series of years. The conclusion that these have not so far been of material size in liability insurance is shared by Mr. Walters.

In using the over-all pure premium we are dealing with an average. An average often masks certain details. So far the details here masked have been unimportant. As a means of insuring that, at any time these details do become important, they are properly handled in the rating process, the paper points out that it would be highly desirable to use a pure premium index that reflects in a controlled manner the changing internal mix. This would be an exact parallel to controlling the changing mix among collision deductibles — a change which is definitely of material size — that is illustrated in the paper. Had the needed data been available, an example of

how this index number control could be used for liability insurance premium levels would have been given in the paper.

In short, we agree that there is a potential problem, we agree that the problem has not so far been material in liability insurance, and we agree that it bears watching. An automatic method of doing this watching and at the same time making any necessary adjustments has been proposed. Even without this automatic control mechanism the suggested analytical methods do automatically adjust the rate level for any changes in the distribution by rating criteria. Only if separate time-series analyses are made for two or more individual components of any of the three current major groups (private passenger, commercial, and garage) will there be difficulties. If the suggested index numbers are used, these difficulties will be eliminated.

Mr. Walters is correct that the distance of the guide lines from the trend line, in the figures showing data with the trend removed, should reflect the slope or *"b"* factor of the trend equation. The guide lines in these figures should be *cos arctan b* times the standard error from the trend lines. He also correctly points to one of the banes of the economic statistician's life: changes in the form and classification of the data in time series. Since it was possible to produce all of the charts in the paper, however, one can be reasonably optimistic on this score.

Mr. Walters' last paragraph has been answered above. One of the principal advantages of the system described in the paper over current methods is the fact that it adjusts for cyclical effects in a flexible and reasonably objective manner, and in a way that does not permit continued deficit operations over the long periods that have been experienced in the recent past. It is felt these deficit periods reflect the need for improvements in the present system. Both reviewers are to be complimented on raising important points and for their reasoned and considerate approaches.

Grateful acknowledgement is due personnel of National Bureau of Casualty Underwriters and National Automobile Underwriters Association (now combined as Insurance Rating Board) for help in securing the Illinois and Kentucky data and to Mr. Carl Wilcken, then Actuary of Canadian Underwriters Association, for help in securing the Canadian data, used in the paper. Such acknowledgement is also due unknown critics for pointing out several ambiguities and obscurities in the original draft.

AN ACTUARIAL NOTE ON ACTUARIAL NOTATION

JEFFREY T. LANGE

VOLUME LV, PAGE 196

DISCUSSION BY JOHN C. WOODDY

Jeffrey Lange has sketched some of the values and characteristics of a system of notation. Without mentioning it explicitly, he discusses the matter of the extent of acceptance of a particular system, pointing out that the canon of *life* actuarial notation has been fixed by an International Congress of Actuaries. It might also be noted that many symbols, as for instance the plus sign and the integral sign, enjoy even wider understanding without having been decreed by any official body.

This brings out the fact that in order for any system of notation to be practical and effective it must appeal to a sufficiently large body of practitioners. In preparing an elementary text on the mathematical theory of risk I laid out a set of symbols, drawn largely from earlier works, which would be internally self-consistent and which would provide for most of the concepts in the field. I went so far as to gather together in an appendix all the symbols and formulae developed in the text. I do not really expect, however, that this notation will be widely used; there are just not enough people doing work in the field of risk theory. Another example of an attempt to establish a system of notation for a particular purpose occurs in the article on exposed-to-risk formulae by E. W. Marshall in Volume XLVI of the *Transactions of the Actuarial Society*. The symbols he used for new entrants, survivors, deaths, withdrawals, and existing policyholders remain, but the *system* of angles, dots, brackets, subscripts, superscripts, etc., has been scrapped in favor of a *verbal* description of the specifications, such as mean age, age last birthday, etc., for each element in a given exposure formula. This scrapping of the system came after an attempt over some ten years to enshrine it by including it in the examination syllabus of the Society of Actuaries.

A good system of notation will be succinct, precise, and consistent. A given symbol will always mean the same thing. When the definitions of two

different symbols are only slightly different, the reader will realize that the concepts *must* be different because different symbols are used. A good system of notation facilitates the making of distinctions between closely related entities. For instance, in the mathematical theory of risk, the density function usually written as $p(z)$ is the distribution of the relative probabilties of the amount of one claim given that a claim occurs, but it is not the conditional distribution of the aggregate amount of claims given that exactly one claim occurs, which would be symbolized by $F(x,t|y=1)$.

A good notational system also reveals relationships which may be obscured by purely verbal descriptions or by ad hoc schemes of notation. For example, the present life actuarial notation makes it clear that an endowment insurance is the same as level term insurance plus a pure endowment. Interestingly, it does *not* readily reveal that such an insurance with its cash values (or reserves) is equivalent to a decreasing term insurance plus a savings fund.

Where, then, do we find ourselves when considering how to make computers do actuarial calculations? In the first place, any involved manipulation of notational symbols is presumably performed manually by the actuary. When he has solved his problem conceptually and is prepared to feed some numbers into the computer and get some other numbers out, verbal labels would seem to be the most flexible for the purpose. In order to permit future modification of the computer program, of course, the job record must contain reasonably complete notes of both the actuary's algebra and the programmer's formulation.

In my own observation, which I must confess is limited and incomplete, most of the jobs involving only those symbols defined in the International Notation have already been programmed: reserves, premiums, asset shares. The sorts of things actuaries are now investigating require the use of symbols defined specifically for the problem in hand.

I do think that there is a need for a sort of "Guide to the Selection of Symbols" to be used by anyone writing a mathematical work. I am thinking of something analogous to Strunk & White's "The Elements of Style," which might be described as a collection of the "hard" information needed by any writer of English. Certainly there are varying degrees of clarity in various writers' private notations. One intriguing example is Cramer's "Mathematical Methods of Statistics," which uses symbols drawn not only from the English and Greek alphabets, which most of us can make shift to

recognize and pronounce, but also from the Gothic alphabet, the names of whose letters are unknown to me and probably to most readers in this country. How can one think about a particular function which one cannot put a name to? This reinforces the proposition that every mathematics book should have a glossary which names and defines all symbols used.

To return to the specifics of Jeff Lange's paper, I should point out that the two dots used over a letter, as $\ddot{a}$, are a diaeresis, not an umlaut. (The umlaut is a substitute for the letter *e* following the letter so decorated.) Also, the distinction between a and $\ddot{a}$ is not between "permanent and temporary annuities" but between annuities with payments beginning at the end and the beginning, respectively, of the initial period.

By this time you will have noticed that I have refrained from revealing my ignorance by attempting to comment on Jeff's suggestions with respect to a standard notation for casualty and property actuarial work. Actually, my reference to a manual of style for notation is pertinent here, although such a manual should have a broader sphere of applicability than the purely actuarial. Perhaps the ideal body to develop such a manual is a well-organized group of highly qualified professionals, such as our Society, with no vested interest in an existing code, and having expertise in the general field of mathematics. Such an endeavor could be undertaken with full regard for the idiosyncrasies of computers but without imposing limitations which may inhibit all generations up to the present and yet be of no consequence to machines of the near future. Do you remember the first color television sets with the mechanical color wheel?

DISCUSSION BY R. GUSTAVE OIEN

In his note, Mr. Lange has demonstrated diligent research on the problem of standardized notation for actuarial work. He has conveyed a sense of the history of the development of the notation used by life insurance actuaries, a sense of the utility derived from the standardization of that notation, and a sense of the problems which still exist in that area. The author develops the inter-relationship of the problems of standardizing notation for working purposes with those of standardizing expressions for use in computer language systems and those of reasonable notation for printing purposes.

Very appropriately, the author ends his note with several questions relative to the position of the property and casualty actuary with respect to the current revisions taking place in the standardization of life actuarial notation and, also, the development of a notational system for property and casualty actuarial work. The balance of this review consists of a response to these questions:

1. "Should casualty actuaries, either independently or through the Society, have any role in the development of the new notation?"

Individuals, through personal interest or their particular vocational situation, might well participate in this activity. However, it is the opinion of this reviewer that the Casualty Actuarial Society, as such, should not participate in this activity. This opinion is grounded in the belief that, though the kinds of activities engaged in by both life and casualty actuaries are similar, the main core of technical problems that each deals with has marked differences. In particular, that body of functional relationships which underlies life actuarial notation is, in this reviewer's opinion, relatively marginal to the total body of property and casualty problems and relatively central to the main body of life, health, and pension problems.

2. "Is standard notation needed for casualty and property actuarial work?"

It is difficult to argue with the advantages of such standardization as listed by the author. The author goes on to indicate that these arguments have not been compelling in the past. It might be possible that a more optimistic atmosphere would result if the scope of the notational standardization for casualty-property actuarial work were limited.

3. "If developed, should the causualty-property actuarial notation be a derivative of life, health, and pension notation?"

This reviewer does not believe that the casualty and property actuarial notations should be derivative of life, health, and pension notation. Again, this opinion stems from the belief that the differences in the problems underlying the two actuarial areas are of such a magnitude that such a derivation is not reasonable. However, this may be only a quibble over the use of the term "derivative." It would certainly seem desirable in developing a property-casualty actuarial notation system to keep overlapping areas consisting with the life notation, and in developing any non-overlapping notation, to avoid any ambiguity with the life notation.

4. "If the first three questions are answered positively, how might the problem of notation be studied further?"

Whether undertaken by an individual actuary, an informal group of actuaries, or a group of actuaries organized as a research committee under the auspices of the Casualty Actuarial Society, the job of developing a standardized notational system is formidable. This reviewer has no real answer.

Mr. Lange should be thanked both for the questions he has generated and the useful information he has presented to us in his "Actuarial Note on Actuarial Notation."

A REVIEW OF NUCLEAR ENERGY INSURANCE

RICHARD D. McCLURE

VOLUME LV, PAGE 255

DISCUSSION BY BURRELL C. LAWTON*

Mr. McClure has performed a valuable service to the insurance industry with this paper. Unfortunately, the nuclear insurance program has remained a mystery to almost all but the few who have labored long and hard to make the program work. Mr. McClure is one of those few and thus can speak from personal knowledge.

In addition to the fact that the inclusion of comments on the property side of the nuclear program broadens the scope of his paper, Mr. McClure's chore was necessarily more difficult than that assumed and accomplished so well by Richard Butler back in 1959. Ten years have elapsed, and under these conditions an author feels it necessary in giving a complete picture to evaluate what has actually happened in addition to describing the theories and intent of the program. As can be expected in making qualitative judgments, Mr. McClure is expressing his personal views, and many of his evaluations and conclusions might be challenged by others participating in the program.

It does not seem fitting in this forum to quarrel with matters of judgment but I do feel that there are some factual areas in which I should express my thoughts:

1. Burglary policies issued by many insurers *do* carry a nuclear exclusion — comparable in working to that quoted for plate glass policies. Also a good part of the London ocean marine market utilizes a nuclear exclusion.

2. The item on property insurance with respect to subrogation infers that there *might* be coverage under the liability policy for some

* Mr. Lawton, a guest reviewer of Mr. McClure's paper, is Secretary of the Hartford Insurance Group, and represents the Hartford Group on all of the major committees of NELIA.

subrogation claims by the property insurers. There is no coverage under the liability policy in this area.

3. The table of deductible credits for property insurance is the writer's "estimate." There is no standard procedure for the rating of these deductibles.

4. There is great difference of opinion about the liability coverage with respect to the licensee's property not "at the site." The remarks on this subject should especially be regarded as the author's opinion. It might also be desirable to read again Mr. Butler's remarks on this point, and the comment by Mr. J. P. Gibson, Jr. (Page 336-337, *PCAS* Vol. XLVI).

5. It is indicated that the "two year discovery clause may be extended by payment of a small additional premium." This is true in only certain isolated instances and generally may be done *only* with the consent of all reinsurers. However, negotiations are presently under way with reinsurers to extend this period generally to ten years.

6. The indication that "The pools have premium schedules for package reactors, university reactors, etc." infers that there are, in effect, "manual rates" for some of the exposures. Actually, a full record of all rated risks is maintained, and when a new risk is rated, it is compared to those previously rated so that the rates may not be unfairly discriminatory. Specific rates are published by IRB and MIRB for each risk based on the hazards of that risk. Any "schedules" represent only guides, which are varied for each risk according to its exposures.

AUTHOR'S REVIEW OF DISCUSSION

I was fortunate to draw Mr. Lawton as my reviewer, and the reader may be assured that there are few people better grounded in all phases of nuclear energy insurance. His comments are well taken. In particular, his first two points are correct, and I was unaware of his fourth point dealing with the liability coverage with respect to the licensee's property not at the site.

It should be pointed out, however, that there is indeed a guide for credits for deductibles in property insurance. It has been in use for many

years, but it is now recognized that increasing values are causing reduced coinsurances, and the credits will necessarily vary. Second, the two-year discovery clause is still a fact today. Finally, the entire rating of nuclear liability insurance is (a) rated, so that technically Mr. Lawton is correct; however, there is more sophistication in rating nuclear exposures than his remark implies.

FUNDING THEORIES FOR SOCIAL INSURANCE

JAMES C. HICKMAN

VOLUME LV, PAGE 303

DISCUSSION BY PAUL E. SINGER

In restating for our benefit Henry Aaron's theorem "The Social Insurance Paradox" and in extending the same type of analysis to conditions contrary to those assumed by Aaron, James Hickman has given us in "Funding Theories for Social Insurance" a deliberately simplified and limited analysis of alternative social insurance funding systems. He has been careful to draw no conclusions not justified by his analysis and he has attempted to attribute no more validity to his assumptions than they deserve. He has, in fact, warned us very effectively against the careless acceptance of conclusions based on his own or anyone else's assumptions.

The modest goals of his paper and the simple model he employs deserve credit for their modesty and simplicity. Simple as it is, his model of a social insurance system is entirely adequate for the demonstration he has undertaken; it is, in fact, an advance over Aaron's in having introduced a survival function which, while it does not affect the conclusions of the present paper, would have significance in any quantitative determination of tax rates. There should be no objection to his assumption that some of the parameters are constant, nor to his assumption that all workers enter the labor force at the same age and retire at the same age. Reasonable variations from these assumptions would not affect the conclusions he has reached, and to this extent the model is adequate for its intended purposes.

The first part of "Funding Theories for Social Insurance" is merely a modified restatement of Aaron's paper, designed to pave the way for the alternative analysis of the second part. Naturally, it reaches the same conclusion Aaron does, one which Hickman points out would be intuitively obvious to all of us. It is evident, almost without demonstration, that if, in Robert Myers' words, "the combination of the rate of growth of population and the rate of increase in earnings will continuously and forever exceed the rate of interest," then a pay-as-you-go social insurance system can be operated successfully on the principle of a chain letter.

Hickman goes on to explore the alternative assumption and to consider the implications of differing rates of time preference and of transformation of present into future goods. It is these considerations which lead to his Table 1, in which all the possible order relationships among three key rates are listed, together with their implications for the relative values of three different social insurance approaches: pay-as-you-go, completely funded, and none at all. The conclusions expressed in Table 1 are really only three rather than six; in each instance the choice of a social insurance approach is dictated by the rate which dominates the other two in size. Thus, for example, Inequality (1) supports a pay-as-you-go system, not because, as Hickman says, "the marginal time preference rate is less than the marginal rate of transformation between present and future goods," but simply because the rate of increase in aggregate real wages is greater than either of them; the same is true for Inequality (6). In Inequalities (2) and (3) the rate of transformation dominates and a funded system is preferred. In Inequalities (4) and (5) time preference rate dominates and social insurance is rejected.

Each of these pairs provides some occasion for thought. The assumption underlying Inequalities (1) and (6) has been rejected both by Hickman and by Myers in his review of Aaron's paper for the *Transactions of the Society of Actuaries.* If the only justification for a pay-as-you-go social insurance system were the hope of operating it forever as an infinitely proliferating chain letter, the pay-as-you-go approach would have to be abandoned. Even if total population were stable rather than increasing, the size of the labor force could be decreasing as the result of later ages of entry, earlier ages of retirement, or changing patterns of mortality. Even with a growth rate of zero for the labor force, it is unlikely that the rate of increase in real wages alone could support the system; with a negative growth rate, the situation would be impossible.

Inequalities (2) and (3) seem to represent a "good investment" approach; they are dominated by a high rate of transformation of present into future goods and they invite the investment of taxes in a fully funded social insurance system. At first blush, the problems of productively managing the assets of such a system provide some cause for concern. Even in its present immature state, this country's Social Security system would have to administer huge reserve funds; its now unfunded liabilities already are of the order of magnitude of the national debt and are increasing rapidly. In a wider perspective, however, this problem may not be so formidable as

it seems; the monies which would be in reserve under a fully funded system would have been drawn from an economy whose assets are already predominantly at work, and their deployment merely would be subject to different administrative controls than at present.

In honor of the anti-hero of one of Aesop's fables, Inequalities (4) and (5) might be said to represent the "grasshopper" approach. The assumptions underlying this evaluation of social insurance in terms of individual time preference rates deserve some close scrutiny, because the results obtained — consistent though they may be with "conventional actuarial wisdom" — may seem to many readers to be in conflict with their intuitive folk wisdom. If there is indeed a contradiction here, its source may be in the attribution to time preference of certain mathematical characteristics which it does not really possess.

In the first part of his paper Hickman, Like Aaron, assumes that the marginal rate of time preference is equal to the interest rate, and he finds it convenient to represent both by the familiar symbol δ for the force of interest. The mathematical properties of the force of interest are well-known. It combines cheerfully with other algebraic quantities, according to all the laws of exponents, in a perfectly regular fashion. Its negative is called the force of discount; the process of discounting is the algebraic inverse of the process of accumulation at interest. Everything works equally well in either direction along the time scale. If two sets of payments can be shown to be equivalent at any point in time, their equivalence is guaranteed at every other point, past or future — and inequalities are just as persistent. In the second part of the paper, Hickman considers the possibility that time preference may assume other values, and he permits it to retain the symbol δ, which is not needed for its usual purpose since interest rate is not being considered. He also attributes to it all the algebraic properties usually associated with δ when it represents the force of interest, and he takes advantage of these to construct Table 1. The mathematical attributes of δ, the marginal rate of time preference, apparently acquired by prior association with δ, the force of interest, enable him to make an evaluation *at retirement age* of both the taxes paid during working life and the benefits expected during retirement.

The utilization of the time preference rate in this fashion seems to be at odds with our usual understanding of its nature, whether we consider its origins in economic theory or our observations of the world about us. In the classical theory of interest its role is comparatively limited. It represents

an instantaneous individual attitude at a moment of decision: specifically, it quantifies the choice made between a present and a future good. It operates in one direction only — prospectively — and with a fairly limited time-horizon. Its value is influenced by the choices which are available. It is not by any means a constant for any individual; in fact, even at a single point in time it varies continuously along any one of the "indifference curves" which represent all the combinations of present and future goods that the individual would consider equally acceptable. Its only tendency toward any general value is found in its statistical contribution, through the processes of supply and demand, to the determination of the market interest rate. Human behavior suggests other ways in which time preference is very unlike the force of interest. Hickman's comment on "the economic behavior of many young people" suggests one: time preference appears to be a function of attained age. Even over fairly short time-spans, few humans consider their time preferences of the past binding on them in the present; we all reserve the right to change our minds, and we all hope to find a way to "eat our cake and still have it." The grasshopper's time preferences changed significantly from summer to winter! It also appears that time preference interacts in some way with an economic utility function: the preferences we display in the investment of surplus funds differ markedly from our attitudes toward the necessities of life.

If the marginal rate of time preference is to be employed in the actuarial evaluation of social insurance proposals, it would appear that serious thought must be given to the mathematical attributes of time preference. Some of the possibilities which suggest themselves for investigation are these:

1. Time preference rate may not be constant; it may be a function of age.
2. It may be unidirectional: while it may reflect the basis of decisions for the future, it probably is not valid for re-evaluation of the past.
3. It may vary with time-span in some complex fashion. If the amount A one year from now is worth Ae^{-d} now, it may not follow that A ten years from now is worth Ae^{-10d} now.
4. Time preference and economic utility may be inter-related.

In short, the marginal rate of time preference may require a mathematical model strikingly different from that which represents the force of interest.

The significance of these comments for Hickman's Table 1 is evident. If time preference can be manipulated mathematically just as the force of interest can be, then the Table presents the correct conclusions for each of its sets of assumptions. If not, then all the conclusions are suspect until a proper mathematical model for time preference can be developed. There are indications in both economic theory and folk wisdom that the conclusions are in fact not valid. A single counterexample might be found by investigating this question: Do some of the young persons who invest in insured pension plans display in their current discretionary activities time preference rates which are higher than the guaranteed interest rates of the plans?

One significant refinement of Hickman's model could be the introduction of an economic utility function, even if nothing else were changed. The assumption that every dollar has equal value may not be appropriate in this context. The dollars paid for social insurance taxes, if they are skimmed off the top of an adequate gross wage, may have a marginal value much less than that of the dollars received for essential retirement income; the difference could well affect the conclusions.

None of these comments detracts in any way from the fact that Mr. Hickman has presented a clear and cogent analysis of the problems he set out to treat, within the framework of his assumptions. He has at least answered all the questions he raised. This review obviously has not done as much; there is a tendency for reviewers to dwell on shortcomings which they have neither the inclination nor the skill to remedy. They must also, unfortunately, take note of technical flaws, and Mr. Hickman's paper is marred by a few. In the definitions the term "rate" is used ambiguously; not until the force of interest has been introduced and the first equation written does the reader learn what kind of rates h and g are. The ages a and r are defined as "average" but they are used as absolute uniform values; so is "average annual wage rate." Some of the notation, while not incorrect, tends to distract the reader. The time variable t serves in the first equation to identify all persons living at time t; then throughout the rest of the paper it identifies persons entering the labor force at time t. The function $W(t)$ and the constant $W(0)$ are defined in such a way that $W(0)$ is not, as one might expect, the value of $W(t)$ when $t=0$. This might have been avoided; neither $W(t)$ nor the corresponding function $R(t)$ is used in the subsequent development at all. Finally, the comment that g could serve either as a rate of increase in entrants to the work force or as a rate of increase

in the survival function, with the same effect on population, could not hold good for very long without implying probabilities of survival greater than unity.

DISCUSSION BY ROBERT J. MYERS

The paper "Funding Theories for Social Insurance" presented by Mr. Hickman contains an excellent mathematical proof of some theories of insurance financing. Although I have some minor points dealing with his notation and explanation of concepts,[1] his proofs are mathematically rigorous. The same can not be said of the paper by Henry Aaron that is cited by Mr. Hickman.

The proof deals with the readily evident idea that, if income to a pension system is assumed to increase perpetually at a rate faster than interest accumulates, then it is possible to operate that system perpetually at a pay-as-you-go premium rate that is lower than the corresponding entry-age-normal premium rate. This is similar to the old perpetual motion tricks, such as the Ponzi game, that we frequently encounter and that are generally dependent on the power of increasing input into the system. We all know of the many high-risk insurance firms which, due to their low premiums, were dependent on constantly increasing underwriting volume and with which mounting claims finally caught up.

Mr. Hickman is admirably cautious about avoiding the conveyance of the wrong idea that the mathematical concept involved is a panacea to social security financing. I would have preferred that he had delved more on the impracticability of the idea, but of course, each author must be allowed to maintain his own sense of proportions.

The proposition that is presented is highly theoretical and of little practical value. It is entirely based on the assumption that income to a retirement system will perpetually increase (due to both population and average-wage increases) at a rate that is higher than the interest rate. I believe that it is possible to observe in practice, for short periods of time, this

[1] For example, he defines $W(t)$ in terms of $W(0)$, but the latter is not the former, when valued at $t = 0$, as is customary in mathematical notation. Also, the values h and g are defined as annual rates, and δ is also defined as an annual rate (force of interest); as used in the derivations, all three conform to the actuarial concept of "force."

particular differential in rates. In fact, in some developing countries this period may be prolonged due to rapidly increasing populations. However, it is inconceivable that we should assume that population will continue to increase at a high rate forever. After all, there is just so much room on our planet!

It is also inconceivable that interest rates could forever be lower than rates of increase of wages. In fact, it is entirely possible to have a situation in which wages would remain stable and prices would decrease due to better productivity. In that case, the assumptions adopted for the proposition would not be fulfilled, since interest rates would still be positive. Similarly, we can see that over the long run, interest rates will be higher than increases in wages, since in a free economy all factors tend to adjust each other toward a state of equilibrium.

I might point out that the assumptions would be valid for a temporary period in countries with inflationary problems. Under these circumstances, there is no advantage in accumulating reserves unless these are invested in inflation-safe assets. This fact has been recognized earlier (for example, see my paper "Actuarial Analysis of Pension Plans under Inflationary Conditions," *Transactions of the Sixteenth International Congress of Actuaries,* Vol. 1, June 1960).

AUTHOR'S REVIEW OF DISCUSSIONS

As the reviewers perceived, I had a modest objective in mind when I wrote this paper. The objective was to illustrate, by a detailed examination of a simple model, the profound difficulties involved in attempting to establish the superiority of any particular social insurance funding method by a chain of purely mathematical reasoning; even when this reasoning proceeds from apparently plausible assumptions. The two reviewers have contributed to the achievement of this objective in a more colorful and forceful fashion than I did.

Mr. Singer's discussion of the marginal rate of time preference contributes significantly to the establishment of the intended point. I acknowledge the relevance of the questions about time preference rates that Singer, with the help of Aesop, has proposed. The relevance of these questions further reduces the possibility that a single, time invariant, time preference rate assumption may be used to reach any meaningful decision on financing a comprehensive social insurance program.

May I also acknowledge that there are a great many verbal interpretations that may be made of the results contained in my tabular presentation. Singer has added several that I failed to state and certainly there are many others that could be proposed. I carried out my table to the extent that I did solely because there are six possible orderings among three unequal numbers and it appeared that the objectives of the paper would be advanced if each of these inequalities was exhibited.

Mr. Myers' suggests that a twin of the paper under discussion be written with the same subject but with the emphasis on the practical problems associated with various social insurance funding methods. I certainly agree with Myers on the need for such a paper. Solid scholarly investigations of the practical impact of various social insurance funding methods are scarce. The implications of the choice of a social insurance funding method may be awesome. Even Aaron, in his short theoretical note in support of current cost funding, acknowledged that his conclusion would be invalid if the current cost method would tend to reduce savings and investment and thereby reduce the growth rate of real income. A major study which would survey the actual experience of nations that have elected various funding methods for their social insurances systems would be of immense value. My only hesitancy about urging such a study is that the author and his readers should recognize that in our dynamic world where not only technology but social institutions and even habits of life are changing, the conclusions of such a practical study might remain valid for only a short period of time.

One could quite properly be accused of glibness if he did not at least acknowledge the deep difficulties involved in designing a methodology for such a study. The problem is to measure the impact of the social insurance funding method when many other influences are simultaneously operating on the economic and social indices being monitored for the purpose of recording the impact of social insurance funding.

May I suggest, however, that a North American actuary who elects to embark on such a study is rather fortunate. Within the English language actuarial literature, the discussions carried on in Canada, the United Kingdom, and the United States on social insurance funding are well recorded. The economic reasoning that motivated the recent funding decisions for the Canada Pension Plan are especially interesting. The confusing issue as to whether a current cost social insurance system retards savings and investment in a developing country or whether it constitutes investment in human welfare that in some way will pay off in economic growth is discussed in a

series of papers published in *The Role of Social Security in Economic Development,* Research Report 27, Social Security Administration, Office of Research and Statistics.

The two reviewers and I, in a certain sense, have avoided the central issue. Singer came close to it when he suggested the explicit introduction of a utility function rather than forcing individual preferences to be reflected only through a constant average marginal rate of time preferences. To the practical minded man, who has a distaste for theory, it may seem perfectly obvious that mathematical decision analysis of any sort has no application in such a complicated public issue as social insurance funding. To such a person this decision is a political one to be decided solely by the political process, either by an edict from the sovereign in a totalitarian country, or by legislative compromise in a republic. Yet, since actuarial science is concerned with making coherent economic decisions in the face of uncertainty, an actuary rather instinctively believes that analytic methods should be used to guide this decision.

The present discussion, ignited by Aaron's paper, is built on the premise that individual preferences may, in a natural way, be averaged in constructing a preferences ordering for society. Each of us, as participants in the political process, recognize the difficult problems involved in this averaging process. The two reviewers and I have pointed out technical problems in this process with respect to social insurance funding. Untouched, but just below the surface of our discussion, is a serious technical question which is only partly solved. That is, can individual preferences among uncertain prospects be averaged in some way to construct a social preference for what, in the aggregate, are relatively certain social states? The practical man would answer *no* and state that this is the business of politics. The theorist would answer with a hopeful *yes* but admit that there are many unresolved issues in building an adequate theory for this problem. Perhaps the major reference in this area is the following book:

Arrow, Kenneth J., *Social Choice and Individual Values,* John Wiley, and Sons, 1951.

On the technical issues raised by the reviewers, I must plead guilty of introducing sloppy notation in defining $W(t)$. I wish that I had used simply w as the average real wage rate at time zero but I did not and I am left only the alternative of apologizing to my readers. The second technical issue raised by the reviewers concerned the language used in introducing the annual rates g and h which, as they indicated, are analogous to the force of

interest. On this issue I can only express my sorrow that the language troubled the reviewers but I am less certain in this case about the proper remedy. The word *rate* is a very troublesome one. Students of compound interest are inflicted with the burden of learning a multiplicity of symbols and terms (annual effective interest rate, nominal annual rate, force of interest, nominal annual discount rate, annual effective discount rate) for describing the same growth of capital function. Nesbitt and Van Eenam ("Rate Functions and Their Role in Actuarial Mathematics," *RAIA* Vol. 38, 1948) wrote a paper in which they defined basic rates and rate functions and then they derived much of the mathematics of life contingencies from these definitions. In this paper the force of mortality and the force of interest are called *rates.* In many differential equations books the factor which actuaries call the *force of interest* is called a growth rate. In statistics, the force of mortality is called the *failure rate* or the *hazard rate.* Although I regret the confusion that my choice of language caused, I do not know how to straighten out the many different concepts of *rate.* It appears, however, that the use of the term *force,* when applied to rates of increment or decrement, seems to be largely confined to actuarial literature.

MINUTES OF THE 1969 SPRING MEETING

May 25-28, 1969

TAMIMENT-IN-THE-POCONOS, TAMIMENT, PENNSYLVANIA

On Sunday afternoon, May 25, prior to the formal convening of the Spring session on May 26, the Council met from 2:00 P.M. to 4:50 P.M.

Advance registration of attendees was held from 4:00 P.M. to 5:30 P.M. and was continued the following morning. Those registrations indicated attendance by the following 92 Fellows, 45 Associates and 28 guests in addition to approximately 35 wives:

FELLOWS

Alexander, L. M.
Allen, E. S.
Bailey, R. A.
Balcarek, R. J.
Barber, H. T.
Bennett, N. J.
Berquist, J. R.
Bevan, J. R.
Bornhuetter, R. L.
Boyajian, J. H.
Byrne, H. T.
Cima, A. J.
Cook, C. F.
Crowley, J. H.
Curry, A. C.
Curry, H. E.
Dorf, S. A.
Eliason, E. B.
Elliott, G. B.
Espie, R. G.
Finnegan, J. H.
Fitzgibbon, W. J., Jr.
Flaherty, D. J.
Fowler, T. W.
Gibson, J. A., III
Gillam, W. S.
Graham, C. M.
Graves, C. H.
Hachemeister, C. A.
Hart, W. Van B., Jr.
Hartman, G. R.
Harwayne, F.
Hazam, W. J.
Hewitt, C. C., Jr.
Hilhouse, J. A.
Hughey, M. S.
Hunt, F. J., Jr.
Hurley, R. L.
Johe, R. L.
Johnson, R. A.
Kallop, R. H.
Klaassen, E. J.
Kormes, M.
Lange, J. T.
Linder, J.
Lino, R.
Liscord, P. S.
MacGinnitie, W. J.
Masterson, N. E.
Matthews, A. N.
McClure, R. D.
McGuinness, J. S.
McNamara, D. J.
Menzel, H. W.
Miller, N. F., Jr.
Mills, R. J.
Morison, G. D.
Moseley, J.
Muetterties, J. H.
Murrin, T. E.
Naffziger, J. V.
Nelson, D. A.
Newman, S. H.
Niles, C. L., Jr.
Oien, R. G.
Otteson, P. M.
Pollack, R.
Potermain, N. W.
Riccardo, J. F., Jr.
Richards, H. R.
Roberts, L. H.
Rodermund, M.
Rosenberg, N.
Roth, R. J.
Ryan, K. M.
Salzmann, R. E.
Scheibl, J. A.
Schloss, H. W.
Simon, L. J.
Simoneau, P. W.
Skelding, A. Z.

FELLOWS

Smith, E. R.
Sturgis, R. W.
Tarbell, L. L., Jr.
Trist, J. A. W.
Uhthoff, D. R.
Verhage, P. A.
Walsh, A. J.
Webb, B. L.
Wieder, J. W., Jr.
Wilcken, C. L.
Wittick, H. E.

ASSOCIATES

Adler, M.
Atwood, C. R.
Bradshaw, J. G.
Brown, W. W., Jr.
Chorpita, F. M.
Comey, D. R.
Cooper, W. P.
Durkin, J. H.
DuRose, S. C., Jr.
Faber, J. A.
Feldman, M. F.
Ferrari, J. R.
Flack, P. R.
Franklin, N. M.
Gill, J. F.
Gould, D. E.
Jensen, J. P.
Jones, N. F.
Hartman, D. G.
Heer, E. L.
Honebein, C. W.
Hunter, J. R., Jr.
Levin, J. W.
Linquanti, A. J.
Mokros, B. F.
Munro, R. E.
Murray, E. R.
Murray, J. B. M.
Plunkett, J. A.
Price, E. E.
Raid, G. A.
Ratnaswamy, R.
Richardson, H. F.
Richardson, J. F.
Royer, A. F.
Scammon, L. W.
Singer, P. E.
Snader, R. H.
Trees, J. S.
Walters, M. A. (Miss.)
Walters, M. A.
Welch, J. P.
Wooddy, J. C.
Woodworth, J. H.
Young, R. G.

GUESTS

Banfield, C. J.
*Bechtolt, P. R.
Black, K., Jr.
*Blanc, R.
*Connolly, C. T.
*Eddins, J. M.
Fox, A. E.
Haase, R. D.
Hall, J. W.
Hardy, H. R.
*Hayden, R. C.
Henning, P. F., Jr.
Johansen, R. J.
*Kedrow, W. M.
Kennedy, R. M.
Marryott, F. J.
*Nagel, J. R.
*O'Shea, H. J.
*Rodgers, H. C.
Rosser, H.
Rothbart, H.
Ryan, J. J.
Scher, E.
Sohmer, H.
Spare, W. A.
Wade, R. C.
White, B. R.
Zubay, E. A.

* Invitational Program

A reception for early arrivals was held from 6:30 P.M. to 7:30 P.M.

MONDAY, MAY 26, 1969

President William J. Hazam called the meeting to order at 9:15 A.M.

Mr. Paul Henning, Actuary of the Pennsylvania Insurance Department, representing Insurance Commissioner David O. Maxwell, who was unable

to be present as scheduled, welcomed the gathering to the State of Pennsylvania. Vice President Daniel J. McNamara then assumed the chair.

The first order of business was consideration of proposed amendments to the Constitution and By-Laws which had been mailed to the members with full details under date of April 8, 1969.

Upon the question being put to a vote, the proposed amendments were adopted unanimously by the Fellows present to become effective May 26, 1969.

Next, came consideration of a recommendation by the Council that the Casualty Actuarial Society file for incorporation pursuant to the Not-For-Profit Corporation Act of the State of Illinois. This recommendation had also been mailed to all members of the Casualty Actuarial Society under date of April 8, 1969. The recommendation of the Council was approved unanimously by the Fellows present.

Attached to the "Final Notice" of the Spring Meeting was a memorandum sponsored by the "Committee On The Future Role Of The Casualty Actuarial Society," Harold W. Schloss, Chairman, presenting numerous aspects of the problem on which the Committee was soliciting comments from the members. During the discussion led by Chairman Schloss, there was a lively exchange of views from the floor and among the Committee members present. The full Committee consists of:

Charles C. Hewitt, Jr.	Harold W. Schloss, Chairman
Charles A. Hachemeister	Dunbar R. Uhthoff
W. James MacGinnitie	P. Adger Williams
Thomas E. Murrin	

There then followed two concurrent workshop seminars.

1. "Insurance Investments and Capital Markets," LeRoy J. Simon, Moderator. This seminar centered around a review and discussion of Rafal J. Balcarek's paper "The Capital Investment Market and the Insurance Industry" and J. Robert Ferrari's paper "The Relationship of Underwriting Investment, Leverage, and Exposure to Total Return on Owners' Equity." The selected participants for the discussion, in addition to off-the-cuff participants from the audience, were:

Robert A. Bailey	J. Robert Ferrari
Rafal J. Balcarek	W. James MacGinnitie

2. "Current Thoughts on Ratemaking Techniques," James R. Berquist, Moderator. This seminar centered around a review of Allen L. Mayerson's paper "On the Credibility of the Pure Premium" and of John S. McGuinness' paper Elements of Time-Series Analysis in Liability and Property Insurance Ratemaking." The selected participants, not all of whom could be present to give their comments verbally, were:

Jeffrey T. Lange	Lewis H. Roberts
John S. McGuinness	LeRoy J. Simon
Kenneth L. McIntosh	Michael A. Walters
Dale A. Nelson	

After luncheon the session was devoted to a continuation of the Council meeting which had convened on Sunday afternoon and to various committee meetings which had been called by committee chairmen.

As an extra-curricular activity there had been arranged an afternoon bus tour to a nearby Pennsylvania Dutch Farm and Museum. Also, there had been arranged for the golfers a handicap golf tournament.

TUESDAY, MAY 27, 1969

After the meeting had been called to order by President William J. Hazam at 9:05 A.M. Vice President Richard L. Johe took over the conducting of the session.

Moderators LeRoy J. Simon and James R. Berquist reported on the activities during the two concurrent workshop seminars held on Monday, May 26.

Robert A. Bailey then presented a paper, "Insurance Investment Regulation," which was reviewed separately by Stanley C. DuRose and Clyde H. Graves.

The President then presented Associate diplomas to the following four students who had successfully completed all of the requirements for Associateship status:

John G. Bradshaw, Jr.	Gerald R. Hartman
Warren P. Cooper	Joseph W. Levin

This was followed by the presentation of a Fellowship diploma to Gerald R. Hartman by President Hazam who observed that this was one of the

rare instances of a candidate successfully completing simultaneously th requirements for admission as both an Associate and Fellow.

There were then held two concurrent seminars:

(1) "Loss Reserve Problems — Financial and Ratemaking"

Moderator:	James F. Gill
Participants:	Alan C. Curry
	William S. Gillam
	Roy H. Kallop
	Dunbar R. Uhthoff

(2) "Operation of Individual State FAIR Plans"

Moderator:	Charles L. Niles, Jr.
Participants:	P. Robert Bechtolt
	Harry T. Byrne
	Richard M. Kennedy
	Kevin M. Ryan

After luncheon, from 2:00 P.M. to 5:00 P.M., there followed a panel discussion "The Automobile Problem — Views and Previews" with Charles C. Hewitt, Jr., Actuary, Allstate Insurance Company as moderator. The discussion was subdivided as follows:

A. Academic Viewpoint — Dr. John W. Hall, Professor of Insurance at Georgia State College.

B. Regulatory Viewpoint — Wisconsin Insurance Commissioner Robert D. Haase.

C. Legal Viewpoint — Franklin J. Marryott, Retired Vice President and General Counsel of Liberty Mutual Insurance Company.

D. Actuarial Viewpoint — Paul S. Liscord, Vice President and Actuary of Travelers Insurance Companies.

The presentation was followed by an extended question and answer period among the panel members and from the floor.

In the evening, from 6:30 P.M. to 7:30 P.M., there was a social hour followed by an informal dinner at which Jack Moseley presented the prizes to the multitude of "winners" at the impromptu golf tournament held on Monday afternoon.

WEDNESDAY, MAY 28, 1969

Vice President Daniel J. McNamara presided at this session which was called to order at 9:15 A.M.

The first item on the program was a discussion "What Should Be Done With Homeowners?" In the absence of Gordon M. Barker, Jack Moseley acted as Moderator, with participants:

Daniel J. Flaherty	John H. Muetterties
Howard R. Hardy	James F. Richardson

The ensuing business session consisted of:

(a) New Paper — "Is 'Probable Maximum Loss' (PML) A Useful Concept?" by John S. McGuinness.

(b) Reviews of Papers Presented at November, 1968 Meeting

(1) "An Actuarial Note on Actuarial Notation" — Jeffrey T. Lange, reviewed separately by R. Gustave Oien and John C. Wooddy.

(2) "A Review of Nuclear Energy Insurance" — Richard D. McClure, reviewed by Burrell C. Lawton and read by Dale R. Comey in Mr. Lawton's absence.

(3) "Funding Theories for Social Insurance" — James C. Hickman, reviewed separately by Robert J. Myers (whose written review was read by Michael A. Walters) and by Paul E. Singer.

President William J. Hazam then reported briefly to the membership on the following items:

(1) He had appointed, and the Council had confirmed, an Advisory Committee to Department of Transportation:

Paul S. Liscord, Chairman	M. Stanley Hughey
Robert A. Bailey	Jeffrey T. Lange
Harold E. Curry	Joseph Linder
Clyde H. Graves	Philip O. Presley
Charles C. Hewitt, Jr.	Paul W. Simoneau

(2) Some time during the month of June there would be off the press a brochure "The Essential Executive" to replace the present brochure "A Career as a Casualty Actuary." A reasonable number of copies could be obtained gratis upon request to the Secretary-Treasurer. President Hazam noted the valuable contribution toward the successful completion of this project by Neill W. Potermain, Assistant Vice President and Associate Actuary of the American Mutual Liability Insurance Company, and by Harry R. Richards, Associate Actuary of the Travelers Insurance Companies.

(3) Education and examination activities, including consideration of the possibility of preparing, perhaps on a joint basis with Georgia State College, a text book "Casualty Contingenies," dealing with the mathematics of non-life insurance.

(4) Future meeting sites as follows, some of which had been confirmed, with the remainder under consideration:

	Spring	*Fall*
1969	—	Atlanta, Georgia
1970	Hollywood, Florida	Chicago, Illinois
1971	White Sulpur Springs, W. Virginia (Greenbrier)	New Jersey or Ann Arbor, Michigan
1972	Lake Geneva, Wisconsin	Boston, Massachusetts
1973	Catskill Area, New York	

Brief reports were then made to the membership as follows:

(1) By Charles C. Hewitt, Jr.: The Astin Colloquium was scheduled for September 22-25, 1969, in Poland.

A conference on the subject of "Analysis of Decisions Under Uncertainty," sponsored jointly by the CAS Committee on Mathematical Theory of Risk and the Committee on Research of the Society of Actuaries, would be held at Harvard University on November 20-22, 1969.

(2) By Norton E. Masterson: The new Year Book of the American Academy would be off the press shortly. The Academy was preparing diplomas and certificates to be issued to the members.

The annual meeting of the Academy would be held in Boston on November 19, 1969, and would tie in with the meeting of the Society of Actuaries. The Academy Committees on Accreditation and on Professional Conduct had under consideration some items of major importance.

Following the foregoing, the Spring 1969 Meeting of the CAS adjourned at 12:30 P.M.

Respectfully submitted,

A. Z. SKELDING,
Secretary-Treasurer.

VOLUME LVI, Part II No. 106

PROCEEDINGS

NOVEMBER 16, 17, 18, 1969

FOOD FOR THOUGHT

PRESIDENTIAL ADDRESS BY WILLIAM J. HAZAM

It was our late past president, Dudley Pruitt, who wondered why presidents give addresses and who ever reads them after they are given. He made the startling discovery that they gave addresses because the Bylaws require it. He further discovered that these addresses were read avidly only by all subsequent presidents clutching for inspirational straws. I am no exception. However, I should like to forewarn my successors that though the reading of presidential addresses may be an interesting and educational experience, it should be done at a time other than in the preparation of their own addresses. For instead of finding inspirational straws, one will find (if I may be regarded as an example) complete frustration in any attempt to match the high standards of literary style, wit, and substance with which previous addresses have been so generously endowed. I could resort to the presidential "point with pride" and "view with alarm" school of speeches but I have chosen rather to preview — not with alarm, although maybe I should — the anticipated future.

May I digress at this point to emphasize that this is not my forecast of the future. Six years in the weather forecasting business, prior to my escape to the less vulnerable actuarial profession, created a certain amount of sensitivity to errant prognostications. I recall my first forecast, fresh out of meteorology school and at my first duty station. It was for a Navy anti-submarine squadron operating off the New England coast. I downed four American planes in that forecast — just think, one more and I would have been a German ace.

This anticipated future, of which I speak, is persuasively outlined for us by many prominent sociologists and economists. I think we ought to take a good hard look at this picture — this future — if for no other reason than that we will be spending the rest of our lives in it. We should look at its implications to us as an industry, and to us as actuaries, in order that we may plan and assure our development and training to meet the professional needs and demands dictated by these future trends. I am talking about the year 2000. Sociologists and economists seem to differ only in the magnitude of trends rather than substance, and I will cite a few of the important statistics that should excite us to consider a more creative role by the industry than we have ever envisioned heretofore. Here is what their speculations indicate for the year 2000 — all bets being off, of course, if we are involved in a global nuclear war. They tell us

(1) that our population will grow from the current 203 million to about 330 million — some say as much as 450 million;

(2) that our gross national product will reach 3.6 trillion in 2000, about four times what it is today (in terms of today's dollar);

(3) that the labor force will almost double and industrial productivity will increase by about three times; and the work week will be shortened by some 25%;

(4) that the per capita disposable personal income — in current dollars — will be three to four times today's;

(5) that the number of households will double from the present 62 to 124 million.

The absolute size of the population can only imply greater growth of cities and metropolitan areas. The urban population, according to the Bureau of Census, will account for 71 to 78% of the total population in the year 2000. Apparently the country will contain a few megalopolises.

These are startling figures that almost defy the imagination in the problems that are attendant to such growth. How is it likely to change the industry from what we know it today? How can we as an industry begin to prepare to meet the challenges such growth imposes? And how can we as actuaries serve our industry in its efforts to contend with the vistas of the future?

Let's take a look at some of the insurance implications. On the surface,

our markets would appear unlimited, our future bright. Yet there are problems we cannot avoid considering.

It is inevitable, in my opinion, that we will see considerable expansion of social insurances. Socialized medical care will become almost universal — probably as rapidly as our hospital and medical resources can be expanded to fill the needs, beginning with low-income families and probably covering nearly all the population by the year 2000. As the government assumes more of the medical care responsibilities, we will see substantive changes in workmen's compensation insurance. Indemnity levels will increase, matching the cost of living levels, and will likely become more uniform countrywide than is the case today. If our industry does not encourage more realistic benefit levels now, we will have further encroachment by Social Security. The social consciousness we see and feel today will not demand less tomorrow.

The same influences will push for an automobile compensation system that will inevitably gain momentum in the years ahead. In view of the anticipated growth in the number of vehicles on our highways, and the threatening ravages of such growth, the role and usage of the automobile must also change, if chaos is to be avoided. The public will demand and get stricter law enforcement, better and more fully automated highways, better and more efficient rapid transit systems that will virtually eliminate intra-city use of private passenger automobile transportation.

Personal lines insurance — auto, homeowners, etc. — will trend toward group distribution, the trend probably accelerating to the point where employers provide the coverage as unions introduce this as a fringe benefit at the bargaining table. As the personal lines aspect of our industry changes, so will the independent agency system. I expect a large number of small agencies to expire and the remaining ones to consolidate, functioning more like brokers, and largely confined to business and group risks. With an ever-increasing size of risks, there will be greater tendency to self-insurance, relegating a good portion of our services to excess limits and the non-underwriting function of engineering and claims service. With a large portion of the personal lines market on a group basis, consumer price interest will decrease and, consequently, the need for control of rates and coverage will decrease. As this change in attitude toward prices develops, so will federalization of regulation; and the entrance of life insurers into what we traditionally consider casualty markets will introduce changes in the traditional pricing structures to some form of composite rating.

Such changes will obviously require vast modifications of our forms and coverages, and revisions of our underwriting philosophy. If we are to cope with the changes profitably, an even greater change will be necessary in company operating and management techniques. It seems unnecessary to recount to you the profit squeeze the industry is facing today, or the flight of capital from the business of insurance. It is sufficient to state that the problem will not diminish in the years to come. It is imperative that management be given the guidance and tools it needs to respond to the changing environment and to adjust profitably to meet the changing markets and experience. Management must be given up-to-date information so that rates can be modified when needed, not two or three years later.

I see three forces operating to intensify the profit problem. First, I can foresee a diminishing role of the rating bureaus as rate-makers vis-à-vis statistics gatherers. On one side we find open competition laws forcing individual company initiative. On the other, we find more of the traditional bureau companies taking independent rate action. All of these developments will require a greater sharpening of the actuary's ratemaking abilities.

Secondly, the squeeze on the profit provisions implicit in the rates will undoubtedly continue, regardless of the methods used to accomplish it. Competition itself will play an important role. We will find that a point in rate level, more or less, will mean a lot more to the profit picture of a company than it does today.

Finally, the changes in coverages we anticipate will in themselves result in uncertainty, at least initially, in setting appropriate rates, probably creating another profit squeeze. Those of us involved in pricing the various proposed automobile reparations systems can appreciate the problems to some extent. It is a two-pronged problem. As actuaries, we must be able to anticipate the changes and plan for them. We must be able to advise management what to expect and how best to cope with these expectations. Once the changes are realized we must be in a position to adjust, and, on a timely basis, to minimize possible inadequacies or redundancies. We must develop what the operations researchers would call adaptive control mechanisms.

These are but a few observations and thoughts, not original by any means, already expressed in many ways by many other and more astute observers than I.

I cite them to suggest that society is demanding changes and there will be no let-up in that demand until there *is* change; and a great deal of what is being demanded is directly and indirectly linked to our inability as an industry to fill successfully the insurance needs of our society in a manner that to it seems equitable, even though the causes more often lie outside the insurance mechanism.

I believe you must agree that the proliferation of changes that will accrue from the long-term projections of the American economy are indeed compelling. We, as actuaries, can have a singular role to play. We are the mathematicians of the casualty and property insurance business; ours is the discipline that will be looked upon as the most logical to project and plan change. I believe the actuarial department should be the principal source for the application of mathematical tools and aptitudes to the solution of insurance business problems. This is a much broader concept of the actuary's role than the traditional one, and would require a much broader educational process than we now include in our syllabus. I refer you to the Travelers' late president, Sterling Tooker, and his address to us of two years ago. It deserves periodic re-reading. The message is clear. We must take the initiative to equip our young men with the necessary tools to meet the challenges facing us in the decades to come or we will be superseded. But we must do more, too. We, those of us in established positions, must equip ourselves to understand and communicate with these young men who will be acquiring expertise in the "new mathematical technology." We will be the ones to direct their activities. To a great extent, our willingness to accept their innovations, or our insistence on maintaining the status quo, will determine whether or not *any* of us can grow rapidly enough to meet successfully the challenges of the future. If those of us over forty can demonstrate that *we trust* our younger compatriots, perhaps the feeling will be reciprocated and we can get on with the job that needs to be done.

Last fall, I appointed a committee under the chairmanship of past president Harold Schloss, to examine and study the functions of the Casualty Actuarial Society, not only from an internal point of view but in relation to our external environment as well, including its relationships with other organizations as they exist today or may be anticipated in the future. At this writing, the report is not ready but I understand it is imminent. Certainly the orientation of our profession will be influenced by the scope of the committee's recommendations that the membership accepts. I submit, however, that the role of the actuary is ultimately determined by the needs of

management — not necessarily by the objectives of this Society. If we fail to fulfill these needs, management will look elsewhere and the importance of the actuarial profession will decline. With his broad understanding of the insurance industry, and with his mathematical abilities, the actuary is ideally suited and situated to become a leader and a motivating force within the industry.

We must take the initiative, now, by altering our present educational and examination structure. The process of doing so should be an evolutionary one that may require more than one road to Fellowship status — perhaps recognizing the current de facto distinction between "lay" and "pure" actuaries, and developing increasing areas of specialization. The process is not firmed up in my own mind but I will cite one or two areas that I feel will need fuller and more concentrated attention if we are to realize an important role in the future:

Ratemaking

As the importance of rating bureaus as ratemaking organizations declines there will be a need for greater emphasis on ratemaking in smaller units. The probable rapid changes in our products will require new techniques and the preparation of new training materials by members of the Casualty Actuarial Society. This is always a difficult objective to accomplish but the rewards of such effort should be quite evident.

Usage and Direction of Computerization

My feelings about computerization can best be illustrated by a story. A few years back a large Boston university developed the most sophisticated computer yet; the central processing unit occupied a full city block. To challenge the full capabilities of this machine — and determine how really good it was — the university hired a group of philosophers to come up with the most challenging question they could. After ninety days — they were on per diem, of course — they made their choice. So they fed into this marvelous monster the question, "Is there a God?" Two micro seconds later they had their reply, "There is now!"

Our abilities to develop techniques of management science, as rapidly as computer-builders improve the mechanical capabilities of their equipment, will determine whether these machines become deities to be served, or devices *to serve*. Our managements are desperately seeking

help from someone in putting the computer — with its infinite capabilities and insatiable appetite — into a proper perspective in the corporate scheme of things. If we do not equip ourselves — and rapidly so — to become the management interface between insurance machines and insurance mathematics, then someone else will, and our profession will be the poorer for it. To give you some idea of how little time is left, the new generation of computers operates in pico seconds. A pico second is to a second as a second is to 33,000 years. How can mere man best utilize this incredible capability? We had better come up with an answer.

We have a vast amount of information at our disposal which can be processed to aid us in answering the most complex questions. It seems to me that this situation demands more scientific training to increase the student's abilities to develop and create the necessary models for solutions to many management problems. Such training takes many directions — corporate long range planning, operations research, management information systems, to name a few.

I'm sure you can add your thoughts to the many questions. If we do not respond, the actuary will be relegated to the function of a technician, and deservedly so. The traditional domain of the actuary, as we have known it, will not suffice if we are to meet successfully the challenges of tomorrow. Let us, this time, act rather than react.

Now that I've fulfilled my obligation to the Bylaws, I'd like to take this opportunity to thank you for the honor of serving as your president during the past year. It has been a wonderful experience. I have been in a position to see that the Society's well-being derives from the intelligent efforts and dedication of many members. The ceaseless efforts of the officers, Council members, and committees have assured and will assure the continued health and progress of this Society. At this point, one name calls for special mention. Al Skelding has made it known that he will not be a candidate for re-election to the office of Secretary-Treasurer, after ably holding that office for the past sixteen years. I know that I speak for everyone in recording our warmest thanks for his outstanding contributions.

A REVIEW OF THE LITTLE REPORT ON RATES OF RETURN IN THE PROPERTY AND LIABILITY INSURANCE INDUSTRY

ROBERT A. BAILEY

On July 30, 1969 a report by Arthur D. Little, Inc. entitled "Rates of Return in the Property and Liability Insurance Industry" was released by the National Association of Independent Insurers who had commissioned the report. This report represents an extension and widening of the profitability analysis contained in Arthur D. Little's November, 1967 report, "Prices and Profits in the Property and Liability Insurance Industry," which was commissioned by the American Insurance Association. Both reports compute the profit ratio for the insurance industry by the following formula:

$$\frac{\text{Net income}}{\text{Net worth} + \text{Reserves for unearned premiums and unpaid losses}}$$

The result, in the most recent report, is 3.6% which compares unfavorably with the average of 10.7% for 55 other industries.

The profit formula used for the other industries was:

$$\frac{\text{Net income} + \text{Fixed charges}}{\text{Net worth} + \text{Long term debt}}$$

This formula recognizes that there are two kinds of investors: owners, and lenders. The lenders receive the fixed charges as the return on their investment:

$$\frac{\text{Fixed charges}}{\text{Long term debt}}$$

The owners receive the net income for their return:

$$\frac{\text{Net income}}{\text{Net worth}}$$

The net income is what is left over from total income after paying the fixed charges. The combined return for both kinds of investors is obtained by dividing the sum of their returns by the sum of their investments:

$$\frac{\text{Net income} + \text{Fixed charges}}{\text{Net worth} + \text{Long term debt}}$$

This is a reasonable measure of the rate of return for an industry because both the owners' and the lenders' investments are usually invested in the enterprise in the form of plant, equipment, and supplies.

The insurance industry is difficult to compare with other industries because the investment in plant, equipment, and supplies is a small portion of an insurance company's total assets. The remaining assets are usually securities which represent investments in other industries but are held by the insurance company to back up its liabilities and to provide a surplus necessary to safeguard the stability and solvency of the insurance company against unforeseen calamities.

If all the insurance company's assets were obtained from owners or lenders, the rate of return could be measured by the same formula used for other industries. But usually a large portion of an insurance company's assets are derived, not from owners or lenders, but from customers who pay for services and indemnities long in advance of the actual time of delivery or payment. As a result, the typical insurance company has a large sum of liabilities which are backed up by an equal sum of assets which were derived from the policyholders.

Before we can decide what is the proper formula to measure the rate of return for the insurance industry we must first answer several questions presented to us by the unusual financial structure of the insurance industry.

The first question involves the assets derived from the policyholders and held by the insurance company: are they invested in the insurance enterprise, or not? If they are, then we must answer the next question: what return do the policyholders receive for the funds they advance to the insurance company and how should we include that return in the profit formula?

The ADL report has answered the first question: yes, the funds derived from the policyholders, represented by the reserves for unearned premiums and unpaid losses, are invested in the insurance enterprise and therefore such funds should be included in the measurement of the rate of return. The ADL report has answered the next question by putting nothing into its profit formula to represent the return to the policyholders on the funds they advanced. The ADL report uses the formula:

$$\frac{\text{Net income} + 0}{\text{Net worth} + \text{Reserves for unearned premiums and unpaid losses}}$$

In effect, then, the ADL report assumes that the policyholders receive no

return on the funds they advance. The investment returns on the assets derived from the policyholders are not received by the policyholders. They are received by the owners and are included in net income.

We will review the question later as to whether the funds derived from the policyholders are invested in the insurance enterprise. Assuming for the moment that they are, we wish to review the return to policyholders on such funds and how the return should be included in the profit formula.

The policyholders do receive a return on the funds they advance to an insurance company. They receive several returns. One return is lower rates. It is customary to give policyholders a discount if they pay premiums, for example, three years in advance instead of one year. In the case of perpetual insurance, the discount for advance payment is 100% because, instead of a premium, there is only a deposit, 100% of which is customarily returned to the policyholder when the policy is cancelled. For advancing a perpetual deposit the policyholder receives a return equal to the full cost of the insurance for the time the insurance company holds the deposit. The ADL report excluded insurance companies that specialize in perpetual insurance. It is obvious that the assumption of no return to the policyholders for the funds advanced by them would be inappropriate for perpetual insurance. But the same assumption is also inappropriate, to a smaller degree, for all insurance companies that collect premiums in advance. Although in many cases there is no specific discount for the advance payment of premiums, the price of insurance is lower than it would be if premiums were customarily paid at the end of the policy term or at the middle of the policy term.

Another return to the policyholders comes from allowing the insurance company to hold the amount of an unpaid loss from the date the loss occurs until the date it is paid. This is the time value of deferred loss payments. On some losses where specified benefits are to be paid at specified intervals, such as weekly disability payments under workmen's compensation or accident and health coverages, the claimant has a choice of receiving the full payment in the future or of receiving a discounted payment immediately. The return that the claimant receives on the funds retained by the insurance company as a reserve for his claim is the difference between the present and future values of the claim. Other types of claims where the amount of the benefit is unspecified, such as automobile bodily injury claims, also have a time value although it is not specified. Claim adjusters know that delay in settling bodily injury liability claims is costly.

The fact that rates are lower because of the investment income on reserves is acknowledged by ratemakers. An example is the following quotation by Mr. Harold E. Curry, Senior Vice President of State Farm Mutual Automobile Insurance Company, which appeared in the September 1969, issue of *The Journal of Risk and Insurance,* page 452, in the article "Investment Income in Fire and Casualty Rate Making":

> "In this planning, whether it be for a company that promulgates its own rates or a group decision among companies which act in concert in making rates, the anticipated contribution toward the total financial needs to be derived from investment income is always considered and, to the extent that investment income, regardless of its source, fulfills these total needs, the burden on the other potential sources of financing is diminished, and vice versa. Thus, it becomes unmistakably clear that investment income is considered in fire and casualty rate making."

An insured, then, receives two returns on the funds he advances to an insurance company: lower premiums for the advance payment of premiums plus the time value of claims for the time interval between occurrence and payment of claims. These two returns correspond to the reserves for unearned premiums and unpaid losses. Both of these returns are deducted from the net income of the insurance company just like fixed charges on long term debt are deducted from the net income of an industrial corporation. One return reduces premiums, the other increases losses. Together they reduce underwriting income. They are offset by the investment income from the assets that back up the reserves for unearned premiums and unpaid losses. An insurance company that is only breaking even on underwriting results may actually be earning a profit close to the standard profit allowances in the rates when the investment income is added in to offset the two returns paid to the policyholders on the funds they advance.

But if the two returns paid to the policyholders on the reserves for unearned premiums and unpaid losses are deducted from net income, then they should be added back in when calculating the total rate of return for the insurance industry. The owners of the insurance company receive a return of:

$$\frac{\text{Net income}}{\text{Net worth}}$$

The policyholders receive a return of:

$$\frac{\text{Lower premiums and increased loss payments}}{\text{Reserves for unearned premiums and unpaid losses}}$$

The combined rate of return would be:

$$\frac{\text{Net income} + \text{Lower premiums and increased loss payments}}{\text{Net worth} + \text{Reserves for unearned premiums and unpaid losses}}$$

The ADL report assumed in its calculation of the rate of return that the "lower premiums and increased loss payments" was equal to zero. Consequently, the rate of return obtained is understated. Perhaps ADL omitted it because it is difficult to measure. If we estimate the return to policyholders by assuming it equals the difference between the actual underwriting results realized over the years used in the ADL report and the expected underwriting profits built into the rates, which are typically an underwriting profit of 5%, the amount added to the profit formula would be enough to raise the average profit from ADL's 3.6% to about 7%.

If the return to policyholders on the funds they advance is impractical to measure, it is certainly not reasonable to assume it equals zero. The only realistic alternative to measuring the return to policyholders and including it in the profit formula is to exclude both the return to policyholders and the reserves for unearned premiums and unpaid losses from the calculation of the rate of return.

This brings us back to the question of whether the reserves for unearned premiums and unpaid losses should be included in the calculation of the rate of return in the first place. Are the funds advanced by policyholders invested in the insurance enterprise?

The policyholders do not intend to invest in the insurance company when they pay their premiums. They pay premiums in advance because of the savings they receive. They are trying to buy insurance in the most economical and practical way available. The fact that some policies receive dividends which are paid at the end of the policy period out of the profits earned by the insurance company does not alter the basic fact that the policyholders are trying to transfer risk to the insurance company, not assume risks from the insurance company. Dividends to policyholders are considered to be part of the pricing mechanism for insurance, not an investor's return for assuming risk. The true price for insurance can only be

estimated before the coverage is provided. After the coverage is provided, the original estimate of the price is corrected by means of the dividend. If the policyholders thought there was any risk of the solvency of the insurance company, they would buy their insurance elsewhere. An investor, by way of contrast, knowingly assumes some of the risks of the enterprise, and his rate of return is proportional to the degree of risk he assumes.

Neither does the insurance company invest the funds it derives from policyholders in the insurance enterprise. It invests them in other enterprises — in government bonds, corporate bonds, mortgages, and stocks. Such assets receive a return from the enterprises they are invested in and are included in the calculation of the rate of return for those enterprises. To require them to earn another return in the insurance enterprise overlooks the fact that they are only pledged to secure the promises and obligations of the insurer, not invested in the insurer. The same asset cannot be invested in two enterprises at the same time. Any profit formula which assumes that certain assets are invested twice and must earn a double rate of return will understate the actual rate of return.

The funds derived from policyholders are similar to deposits in a bank. Bank deposits are not considered to be invested in the bank. They are invested by the bank and the bank pays a return to the depositors either in interest on savings accounts or services on checking accounts. Deposits are omitted from the calculation of the rate of return for the banking industry. Likewise the reserves for unearned premiums and unpaid losses are not invested in the insurance company. They are invested by the insurance company and the policyholders receive a return on their funds. Since they are not invested in the insurance company but only advanced or deposited with the insurance company, they should not be included in the measurement of the rate of return on the insurance enterprise. To include them produces a result useless to everyone. It does not measure the rate of return to the policyholders, or to the owners, or the rate of return on the total assets invested in the insurance enterprise.

If we omit the funds derived from policyholders and the return paid to the policyholders, we obtain the following profit formula:

$$\frac{\text{Net income}}{\text{Net worth}}$$

Using this formula the ADL report obtained average returns of:

Stock	8.3%
Mutual	9.2%
Total industry	8.4%

The rate of return for stock insurers can be expected to increase as some of the unused or inefficiently used capital is withdrawn by holding companies. Stock insurers have an average capitalization, including the equity in the unearned premium reserve, about equal to their annual sales, whereas mutual insurers are capitalized at about ⅔ of annual sales.

What would happen to an insurance company's profit and loss statement if it operated without any funds advanced by policyholders? Suppose it collected premiums continuously as they were earned, or collected them at the middle of the policy term. It would have to raise its rates slightly in order to offset the absence of investment income realized by competing insurance companies who collect premiums in advance. Its net income would be decreased by an offsetting amount. Suppose also that the insurance company paid losses at discounted values immediately when they occurred either directly to the policyholder or to an aggregate trust fund which would receive the amount of the discounted losses, invest the amounts, and use the investment income to pay the full amount of the losses as they became payable. Again, the insurance company's net income would be unaffected, but its losses would be reduced, thereby increasing its underwriting profit, and its investment profit would be reduced by an offsetting amount. Such an insurance company would have no reserves for unearned premiums or unpaid losses. Its rate of return calculated by the formula used by the ADL report would be higher than the rate of return for a competing insurance company that collected annual premiums in advance and still higher than the rate of return for a competing insurance company that collected three-year premiums in advance.

Consequently the rate of return calculated by the ADL formula is biased against the insurer that maintains larger proportions of reserves for unearned premiums and unpaid losses in relation to its net worth. The larger the proportion of reserves, the lower the rate of return. The ADL formula is biased in such a way that it will show the highest rate of return for an insurance company that does no insurance business! It will produce the lowest rate of return for insurance companies that use their resources most

efficiently by maintaining the highest leverage of premiums and reserves to net worth.

Since part of the return on the reserves is paid out to the policyholders and since the ADL formula excludes the part that is paid to the policyholders from the calculation of the rate of return, it is virtually impossible for any insurance company to overcome the bias built into the ADL profit formula regardless of how profitable its insurance operations may be.

One way to remove this bias is to remove the reserves for unearned premiums and unpaid losses from the formula, which brings us once again to the formula:

$$\frac{\text{Net income}}{\text{Net worth}}$$

The effect of this bias is evident in the most recent ADL report in the comparison of the average rates of return for stock, mutual, and reciprocal insurers. Mutuals and reciprocals have larger proportions of reserves for unearned premiums and unpaid losses than stock insurers do. Consequently it is to be expected that the formula used by the ADL report,

$$\frac{\text{Net income}}{\text{Net worth} + \text{Reserves for unearned premiums and unpaid losses}},$$

will produce a lower rate of return for mutuals and reciprocals, which it does.

If the rates of return calculated by the ADL formula are biased so that they are not even comparable within the insurance industry, they are certainly not comparable with other industries.

The ADL report has not given proper recognition to the return to policyholders for the funds advanced by them to insurance companies. It also improperly treats the funds derived from policyholders as if they were invested in the insurance enterprise. As a result of these assumptions, the ADL report develops rates of return for insurance companies which are biased against insurance companies that do more insurance business than average, are not comparable with other industries, and are substantially understated.

DISCUSSION BY IRVING H. PLOTKIN*

I. Introduction

We are pleased to have this opportunity to reply to Mr. Bailey's well written review of Arthur D. Little, Inc.'s recent study[1] of property and liability insurance. Mr. Bailey raises several methodological questions in financial and welfare economics. We will address each of these questions in turn. While we disagree with several of the conclusions Mr. Bailey reaches with respect to economic methodolgy, we do not disagree with what is, perhaps, the primary, practical (non-theoretical) conclusion of the Bailey review. We agree that it is both interesting and useful to compare properly measured and adjusted return on net worth for stockholder owned insurance companies to the return on net worth experienced in other economic endeavors having similar risk characteristics.

Throughout the ADL research we have clearly stated that the questions we sought to answer were:

1.) Are insurance prices currently high because insurance profitability is, in any sense, excessive?

and

2.) Do present levels of insurance industry profitability offer any reasonable hope of price relief?

Performing comparative risk/return analysis based on several measures of financial return and of risk, we have concluded and plainly stated that the answers are "No." Mr. Bailey appears to feel that return on net worth is the only legitimate basis on which to answer these questions. However, in the present version of his paper he fails to address the questions and offers no answer based on his own or others' research. He does, however, misquote a rate of return ratio which ADL reported. Yet by alleging that one of the ADL measures "substantially" understated insurance return, Mr. Bailey, this

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* Mr. Plotkin, a guest reviewer of Mr. Bailey's paper, is a senior economist with Arthur D. Little, Inc., management consultants of Cambridge, Massachusetts. He was the principal author of three recent ADL reports on profitability in property-liability insurance, one of which is the target of Mr. Bailey's paper.

[1] *Rates of Return in the Property and Liability Insurance Industry: 1955-1967*, June 1969. Copies are available from the National Association of Independent Insurers, Chicago, Illinois.

reviewer feels, appears to have a position on this discussion. All those concerned with the issue would be better served if that position were directly stated, supported, and then could be reviewed. Perhaps in his response Mr. Bailey will either state his answers to these questions or state his lack of a position with respect to them.

II. Bailey on Ratemaking

Before turning to Mr. Bailey's criticisms of the ADL report, we feel it is important to note the contribution Mr. Bailey's review has made to the growing discussion of the role of investment income in ratemaking. The issue Mr. Bailey addresses involves the inclusion or exclusion of investment income in the formulation of premium rates. ADL has not taken a position as to whether rates *should* be lowered by the direct inclusions of investment income in ratemaking formulas. However, Mr. Bailey appears to take a definite stand on this critical issue. In his review of current insurance practices, Mr. Bailey demonstrates that insurance premiums are lowered by the income generated through the company's investment of unearned premiums and loss reserves. He also discusses a return due to delayed loss payments.

Mr. Bailey observes, "The policyholders do receive a return on the funds they advance to an insurance company. They receive several returns. One return is lower rates" (p. 135). He indicates these returns correspond to ". . . the investment income from the assets that back up the reserves for unearned premiums and unpaid losses" (p. 136). Mr. Bailey also notes, "Although in many cases there is no specific discount for the advance payment of premiums, the price of insurance is lower than it would be if premiums were customarily paid at the end of the policy term or at the middle of the policy term" (p. 135). Mr. Bailey clearly believes that investment income is considered in determining the appropriate level of rates *even when it is not explicitly included in the rate determining formula.*

Mr. Bailey also indicates that any attempt to lower the amount of investment income accruing to a company must be offset by an equal increase in premiums. Mr. Bailey asks, "What would happen to an insurance company's profits if it operated without any funds advanced by policyholders?" (p. 139). He answers, if a company collected premiums continuously as they were earned "it would have to raise its rates slightly in order to offset the absence of investment income realized by competing insurance companies who collect premiums in advance" (p. 139).

Mr. Bailey's viewpoint on the ratemaking issue aligns him with those

who argue that investment income is already considered in premium rate decisions, although it is not explicitly included in most formulas. He argues that reducing the investment income accruing to the company must be compensated by raising premiums. I believe this position is also held by those who contend that investment income is considered in ratemaking.[2]

Mr. Bailey's discussion of ratemaking procedures is properly the subject for review by actuaries and not by an economist. Of course, Mr. Bailey's observations with respect to ratemaking underlie the rest of his arguments and conclusions with respect to the ADL profit formula.

As an economist I would note that Mr. Bailey's position is not supported by the literature or practice of national income accounting. In economic terminology, Mr. Bailey claims that property and liability insurers pay policyholders "implicit interest." The national income economists impute interest returns for several financial intermediaries but have decided that property and liability insurers do not require any such adjustment.

Dr. John A. Gorman, Associate Chief, National Income Division (U.S. Department of Commerce), has informed me that the only industries for which imputations are made are commercial banks, mutual savings banks, savings and loan associations, credit unions, regulated investment companies, life insurance companies, and uninsured pension plans.[3] Dr. Gorman explained that no imputation is made for property and liability insurers. He agreed that from a social accounting sense measuring total income (as ADL did) as the sum of operating profits (underwriting income), interest and dividends received, realized capital gains, and unrealized capital gains captures all sources of income. Further such a measurement conforms to the general national income accounting canon that the measured output "not be affected by the ownership of the capital employed in producing the output."[4] As we mention below, the ADL research purposefully strove to

[2] The complaints about high insurance premiums will not be alleviated by elongating the payment schedule, since the rates would have to be raised. Unless Mr. Bailey is willing to argue that current *total* insurance company profits ought to be reduced, then his analysis clearly shows that the only price relief offered by investment income is in the form of higher premiums and longer payment schedules!

[3] See Gorman, J. A., "The Real Output of Financial Intermediaries," Tenth General Conference of the International Association for Research in Income and Wealth, Maynooth, Ireland, August 20-26, 1967, for a detailed discussion of this area of national income accounting.

[4] Gorman, J. A., "Alternative Measures of the Real Output and Productivity of Commercial Banks," *Production and Productivity in the Service Industries,* V. R. Fuchs, ed., New York, 1969, National Bureau of Economic Research, p. 157.

obtain answers independent of the question of the ownership of assets or incomes. Yet much of Mr. Bailey's paper seems to be concerned with just such issues.

A central argument in insurance ratemaking today concerns the proper treatment of investment income. Some maintain that the investment earnings on policyholder-supplied funds (reserves) is not considered in ratemaking and, therefore, rates are too high (see, for example, Gilbert Friedman in the September, 1969 issue of the *Atlantic*). Others, like Mr. Bailey, contend that these earnings are already fully reflected in insurance rates. Still others contend that the argument is of little consequence, for their calculations show that the investment income attributable to the policyholders is minimal. An increasing number of state legislatures and insurance departments appear to be siding with those who argue that present ratemaking has failed to consider, even indirectly, investment income. They are passing laws which now require that investment income on reserves be considered in ratemaking. In some instances proposed rate filings were lowered at the request of insurance departments to account for investment income. In summary, the question of the actual or proper role of investment income does not appear to be settled in insurance literature or practice.

III. The Question of Bias

The ADL report did not take a stand on the proper or actual role of investment income. Rather it followed the national income practice (which is clear) and did not impute any interest payments in measuring the insurance industry's returns. Nor did it impute interest payments for any other industry in the study. Rather each industry's profitability was measured by the totality of (non-imputed) income generated by the total of its investable assets. This measure included all sources of profit, including the investment income earned on the reserves. (A later study measured and compared returns to net worth.)

Mr. Bailey's claim that our calculation is biased is not supported by those who have argued that investment income is excluded from ratemaking. Further his assertion that our measurement "substantially" understates the insurer's rate of return is refuted by studies (such as the one done by the late Mr. Sammy D. Sapp, of the Texas Insurance Department) which shows the minimal value of this income item.[5]

[5] On page 137 of his review Mr. Bailey suggests that the 5% underwriting profit allowance "built into the rates" be added to the Net Income figure in the ADL calculation.

The question our economic analysis sought to answer was whether present industry profitability *could* offer price relief. Believing that part of the industry's profit already lowers prices, Mr. Bailey could view our analysis as answering the question, "Can present industry profitability offer *further* price relief?" Imputed interest would play no role in answering that question. In either case, the answer is clearly "No."

Mr. Bailey concludes his analysis of the alleged bias in the ADL formula by noting that companies which have greater ratios of writing to surplus or higher ratios of reserves to surplus (such as mutuals and reciprocals) are reported by ADL as showing lower returns than companies with lower writing and reserve ratios (stock companies). Careful analysis, however, will show that unfortunately it is not any bias inherent in the ADL formula which produces these results, but the inherent nature of the *present* insurance industry that causes companies who do more writing, and/or keep larger proportions of their assets in bonds, to earn lower rates of return. The data strongly suggest that this is due to underwriting being relatively unprofitable and bond investments yielding, in total, less than stock investments. Under such circumstances, we do not understand what Mr. Bailey means by "efficiently" when he states that insurance companies "use their resources most efficiently by maintaining the highest leverage of premiums and reserves to net worth" (p. 140). By such reasoning the buggy-whip maker who around 1910 channeled his resources into more plant and equipment rather than out of the buggy-whip industry would have been considered to be making the most efficient use of his resources. Likewise for the insurance investment manager who supplied this manufacturer with capital. As an economist I cannot agree with these propositions.

Mr. Bailey demonstrates that it is the inherent nature and structure of the insurance industry, and not any bias in the ADL formula, which places insurance returns at the bottom of all other industry returns. Mr. Bailey notes that a company which received premiums as earned, and paid losses as incurred, would have unchanged profits (its premiums, he maintains, would

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It is difficult for us to understand why Mr. Bailey chooses this rather poor proxy for the imputed return to policyholders when he demonstrates but one page later a precise method for measuring the returns on these funds. It is unclear what, if any, justification Mr. Bailey has for using the 5% figure. It appears to be but an arbitrary choice for illustrative purposes; however, the reader is left with the feeling that Mr. Bailey assigns some special, actual significance to the fact that the 5% is a "profit allowance" and is "built into" the rates. We can find no real significance in it, nor in the 7% rate of return he estimates using it.

increase and its losses be reduced by an amount equal to the investment profit it used to earn under the old system). Mr. Bailey continues, "Such an insurance company would have no reserves for unearned premiums or unpaid losses. Its rate of return calculated by the formula used by the ADL report would be higher than the rate of return for a competing insurance company that collected annual premiums in advance . . ." (p. 139). Mr. Bailey elegantly shows his reader that leaving the numerator (net income) unchanged and lowering the denominator (invested funds) increases the value of the fraction (rate of return). We agree.

Mr. Bailey's example has also shown something more revealing. It should be recalled that the ADL report stated only that the present rate of return in the insurance industry appears to be low in certain senses. We did not state how this situation ought to be corrected. We did not say, for example, that profit (the numerator) should be raised or that invested funds (the denominator) should be lowered. All we said was that the way the insurance industry is *currently* run produces an unsatisfactory rate of return; unsatisfactory, that is, from the point of view of society. Mr. Bailey's example of changing the payments pattern and his remarks (p. 139) concerning "overcapitalization" shows how a fundamental, institutional change in the operations of the insurance industry is likely to produce a marked change in its rate of return. I have urged on numerous occasions that those who are seriously concerned with the problems of the insurance industry turn their sights to the basic institutions and structure of the insurance industry for it is through changes in those areas that relief may well be forthcoming. Juggling with profit and ratemaking formulas will produce no relief for the insurance consumer.

We conclude that Mr. Bailey's allegation of bias in our formula is untrue. His claim of implicit interest is rejected in the literature and practice of national income accounting and is not a settled issue in insurance. More importantly, for the questions we sought to answer, implicit interest plays no role and, therefore, could not introduce any bias. Our formula measures the return generated by *all* funds flowing into an insurance company. It neither penalizes nor rewards companies with larger reserves or higher premium to surplus ratios. If such companies show up as being less profitable, we suggest that it might be because their investments produce less income and/or they suffer higher underwriting losses. We believe that it is the inherent structure of present insurance operations and not accounting or actuarial phenomena which produce the current unsatisfactory rates of return in the industry. As will be seen in the next section, these conclu-

sions follow from an analysis of net worth as well as from our original, overall return analysis.

IV. Return on Net Worth

While we cannot accept his justifications, we can accept and do appreciate Mr. Bailey's desire to use what he calls "the only realistic alternative," the return on net worth, as a measure of comparable earnings between insurance companies and other industries. We feel the return on net worth measure is appropriate when discussing problems of insurance capacity and problems of stockholder owned insurance companies. However, in relying exclusively on this measure, Mr. Bailey leaves unanswered questions concerning the measurement of return on mutual and other non-stock insurance enterprises, the social reasons for measuring the efficiency of all assets employed as distinct from the efficiency of the employment of equity financed assets, and the effect of comparing industries with differing capital structures. How would the return to net worth measure be useful in these cases?

Even when using return on net worth as appropriate, we must emphasize one guiding principle in its use: the return on net worth for stock insurance companies must be compared with the return on net worth for other industrial or financial enterprises and, further, such comparisons must give due consideration to alternate employments of capital within a risk/return framework.

Most practitioners of financial analysis, as well as professors of finance and economics, regard the text *Security Analysis — Principles and Techniques,* by Graham, Dodd, and Cottle, as the Bible of security analysis. The entire viewpoint of the text is parochial in nature; that is, it offers advice to investors seeking the profitable employment of *their* funds. Yet, when they discuss profitability ratios, Graham and Dodd prefer to use the total return on invested funds rather than the return to net worth. The authors note:

> "The best gauge of the success of an enterprise is the percentage earned on invested capital, i.e., on the long-term (non-current) debt and preferred stock plus the book value of the common stock. This percentage, or rate of return, is the ratio to total capital of the *final* net profit available for capital funds. Thus it reflects all recurrent items of profit and loss, including income tax, but not deducting interest on funded debt. The fundamental merit of return-on-invested-capital ratio is that it measures the *basic* or over-all performance of a

business in terms of the total funds provided by all long-term investors — rather than a single class."[6]

The editors of *Forbes Magazine,* who report the return on equity figure, clearly indicate that this statistic measures only the efficiency with which corporations employ owners' funds and tell nothing about the corporation's total efficiency. They explain the net income to net worth measures as follows: "By comparing equity capital with net earnings, we are showing how efficiently management is managing *stockholders'* property."[7]

Mr. Bailey claims that ADL calculated the return on net worth for all types of insurance companies. He quotes our figures for return on Policyholders' Surplus, and identifies them as the ADL-calculated values for return to Net Worth. It is inaccurate to say that we in any way implied that our *N4/D1* measure (Net Income/Policyholders' Surplus) was a measure of return on net worth. Adjustments must be made to these figures to cast them as return on net worth. We will discuss these adjustments below.

Before turning to that we note that one of the principal reasons ADL undertook the study reviewed by Mr. Bailey was to expand our profitability results from just the stock insurers to the total industry. We are puzzled how Mr. Bailey is able to discuss a rate of return on net worth of mutual insurance companies. While we have always maintained that return on net worth is a meaningful figure in analyzing the capital market's reaction to — and the capacity problems of — stock insurance companies, we have seen no analysis either on Mr. Bailey's or anyone else's part that this is meaningful for the mutual segment of the industry. This was one of the reasons that caused us to favor the social measure of return, total earnings over total funds employed. The only place in our report where we discuss returns to net worth we do so for *"the purpose of [an] analogy"* (p. 13, emphasis in the original) involving private investors. While we appreciate Mr. Bailey's desire to make use of rate of return on net worth, we believe he must present both the reasons and framework for using such a measure. This is especially true in the case of mutual insurance companies. In our reports and papers we have always been most careful to present such necessary information.

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[6] B. Graham, D. L. Dodd, and S. Cottle, *Security Analysis — Principles and Techniques,* McGraw-Hill Book Company, Inc., New York, 1962, Fourth Edition, pp. 233-234.

[7] *Forbes,* Jan. 1, 1969, p. 37, emphasis added.

The adjustment for the effect of the cash/accrual distortion involves adding different quantities to both numerator and denominator of the *N4/D1* measure. While it is clear that a larger quantity is added to *D1* than is added to *N4,* the relative proportions are difficult to derive from abstract reasoning.[8] Our results for the past 14 years show that the denominator is increased proportionately more than the numerator — the ratio is lower by this adjustment.

Owing to the growing interest in return on net worth of insurers and its effect on insurance capacity ADL has prepared measures of this financial statistic for stock insurers. These data were presented to Senator Hart's Antitrust and Monopoly Subcommittee on November 25, 1969.

ADL has adjusted the *N4/D1* measure for stock insurers to yield a rate of return on net worth. We parameterized our adjustment by using values of .30, .35, and .40 for F in the following formulas:

$$N6 = N4 + F \cdot (\text{change in unearned premium reserve})$$
$$D3 = D1 + F \cdot (\text{unearned premium reserve})$$

We have also adjusted *N6* to reflect a 25% allowance for taxes on its unrealized capital gains portion. Preliminary calculations place return to net worth, *N6/D3* (where both net income and net worth have been adjusted to reflect income and equity in the reserve accounts), between 6% and 7% for stock insurers for the period 1955-1968. That is, they lower the returns from those calculated for *N4/D1.*

We must now ask with what should these returns be compared. Clearly, they must be compared to returns to net worth of other enterprises. Also, we must be sure that they are compared with enterprises having similar risk characteristics, this time from the point of view not of society, but of the suppliers of equity funds. An all-industry average rate of return on net worth for the same period was about 12.5%; however, none of the industries we measured showed such extreme fluctuations in rate of return as characterized the rates of return of the insurance industry. (Our report to the National Association of Independent Insurers presents some of these data.)

[8] This adjustment is *not* analogous to the one we discussed for unrealized capital gains. (See Arthur D. Little, Inc., *Replies to Criticisms of the ADL Report "Prices and Profits in the Property and Liability Insurance Industry."*) In that case we maintained that the effect of our using unrealized capital gains over the 13-year period, was essentially to add the same quantity to both numerator and denominator of the insurance industry's rate of return formula, thus raising the reported return.

We found that the closest risk equivalent investment from a *stockholder's* point of view is investment in the stock market, either through mutual funds or direct purchases of individual securities. This investment, however, must be calculated as a margined or leveraged investment to be comparable with investing directly in an insurance company.[9] The average return for comparable types of stock market, margined investments was about 20% on net worth for the period.

V. Economic Efficiency and Financial Intermediaries

Mr. Bailey suggests that since financial intermediaries are not users of real capital such as plant and equipment and since part of their funds are supplied by the customers, the measurement of rate of return based on total investable funds does not reflect the "real" return to these institutions. In essence his argument implies that society is not concerned with the efficient employment of the economic resources of these intermediaries. He asks "are the funds advanced by policyholders invested in the insurance enterprise?" (p. 137). His conclusion that these funds are not invested enter- surance industry is predicated on the following points:

1. "Policyholders do not intend to invest in the insurance company when they pay their premiums" (p. 137).
2. Insurance companies hold securities issued by other industries.

The first point is inconsistent with his previous statements. Mr. Bailey first states, "If all the insurance companies' assets were obtained from owners or lenders, the rates of return could be measured by the same formula used for other industries" (p. 134). Later, Mr. Bailey is no longer concerned with the sources of these funds but with the nature of the assets. Mr. Bailey implies that to demand a reasonable rate of return on the insurance companies' assets is the equivalent of placing the assets in double jeopardy.

On the basis of his two points, Mr. Bailey draws an analogy between the insurance policyholders and bank depositors. He points out that bank depositors do not make conscious investment decisions and that banks hold securities issued by other industries. Mr. Bailey similarly draws an analogy between the reserves for unearned premiums and unpaid losses advanced by policyholders, and the deposit liabilities of a bank. We agree, they are analogous.

[9] By "directly" we mean, not by buying an insurance company's stock, but by putting capital into a new or on-going insurance operation.

He continues by stating flatly, "Deposits are omitted from the calculation of the rate of return for the banking industry" (p. 138). *On the basis of this assertion,* he concludes his analogy by arguing the reserves "should not be included in the measurement of the rate of return on the insurance enterprise" (p. 138).

We feel Mr. Bailey's analogy between the insurance and banking industries is appropriate. We used a similar analogy between these two financial intermediaries when concentrating on this problem of capital investment. Our analogy is presented in a paper in the *Journal of Risk and Insurance.* We stated:

> "On the contrary, insurance policies are examples of conditional promises to pay (debts) and demand deposits are examples of unconditional promises to repay persons who in essence provide debt capital. The capital they provide contributes to the long-term, permanently investable funds in the operations of these financial intermediaries. *From society's point of view, there is an opportunity cost for the monies being channeled into the insurance industry through the purchase of insurance policies, as there is an opportunity cost for the monies channeled into the banking and other non-bank financial intermediaries. An evaluation of the overall efficiency of capital employment requires viewing the total permanently invested assets in any of the industries compared.* It is for these reasons that the two major reserve accounts are included as sources of permanently invested funds in the insurance enterprise.
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> "By analogizing them with debt money suppliers, it is not meant to imply that the policyholders or depositors of a bank are making conscious investments in those operations. Rather, it is suggested that, in effect, their purchasing of the insurance product or the banking product channels investable funds into the respective industries. Clearly it would be inappropriate to compare the rates of return on merely the equity portion of the insurance or banking industry with the rates of return of the total capitalization of other industries."[10]

Mr. Bailey apparently does not appreciate the important role financial intermediaries perform in the efficient allocation of economic resources. He

[10] Irving H. Plotkin, "Rate of Return in the Property and Liability Insurance Industry: A Comparative Analysis," *Journal of Risk and Insurance,* June 1969, Vol. 36, p. 184, emphasis added.

intimates that the rate of return earned by an insurance company when investing its policyholders' or stockholders' funds is of no consequence. Mr. Bailey creates a paradox with this argument. Earlier he states that the reduced premiums enjoyed by policyholders "are offset by the investment income from the assets that back up the reserves for unearned premiums and unpaid losses" (p. 136). Mr. Bailey demonstrates that if insurance companies earned less on their reserves, policyholders would be forced to pay higher premiums and/or receive lower loss settlements. Clearly, Mr. Bailey must believe that the return on reserves is of consequence at least to policyholders.

Mr. Bailey's concern about the nature of insurance company assets may stem from his remembering some of the principles generally taught in basic economics courses. These principles concern the fact that in measuring national income, gross national product, or other measures of wealth and production, one distinguishes between real, tangible assets, and nominal or financial assets. These principles are true enough. However, some teachers and students of ecnnomics have been too quick to generalize the concepts of our highly arbitrary system of national income accounting into their discussions of more general, social-economic problems. As Professors John Gurley and Edward Shaw point out in their seminal work, *Money in a Theory of Finance,* economists have been guilty of such carelessness:

> "Preoccupation with national income and product accounts, which largely ignore financial transactions, may have led too many economists to consolidate financial accounts out of economics, relegating financial analysis to its own lonely and sometimes not very fruitful course of development. Because part or all of finance is commonly aggregated or netted out of economic analysis, economists may inadvertently have given too little weight to the bearing of finance on economic activity."[11]

Gurley and Shaw then present a 350-page description of the critical role played by financial intermediaries in the overall economic development and capital allocation processes of both advanced and developing economies. Their work is now a part of the ever-expanding economic literature discussing the critical role bank and non-bank financial intermediaries play in all aspects of "real" economics. The literature presents many theoretical formulations, institutional analyses, and econometric results, all demonstrating this

[11] John G. Gurley and Edward S. Shaw, *Money in a Theory of Finance,* Brookings Institution, Washington, D.C., 1960, p. 20.

important role. So, while Mr. Bailey's concern is perfectly understandable, especially in light of the early errors made by some members of the economics profession, his conclusions with respect to the importance of efficiently operated financial intermediaries, and the possible double jeopardy in which their funds are placed, are not substantiated either by economic theory or practice.

Let us, however, address Mr. Bailey's specific unsupported and unreferenced statement, "Deposits are omitted from the calculation of the rate of return for the banking industry" (p. 138). We must ask, by whom are they omitted? Our research shows that apparently they are omitted only by Mr. Bailey. His assertion (critical for his conclusion about insurance returns) concerning the rate of return measurements of the banking industry flies in the face of the current body of economic and regulatory literature.

The measurements of the economic efficiency of the banking industry include ratios of the rate of return to total assets. Total assets are, of course, equivalent to the sum of net worth plus deposits.

Working on behalf of the Federal Reserve Bank of Kansas City, the noted financial economist, Dr. Lyle E. Gramley, studied the economic efficiency of Tenth District member banks in the period 1956-1959. The purpose of his study was to guide banking regulators in making decisions in the public interest. In his landmark work, Gramley assesses the efficiency of the Tenth District member banks measuring "the effect of size on ratios of net current earnings to assets."[12] Clearly, Dr. Gramley believes that from a social-economic standpoint the efficiency of the banking industry must be measured by the yardstick of rate of return to total assets. In other words, he feels that a meaningful measurement of return must be based not only on net worth, but also on bank deposits.

Each year the Federal Deposit Insurance Corporation (FDIC) publishes, in a statistical supplement to its annual report, the rates of return of the banking industry on total assets as well as on net worth. We may infer from the inclusion of both statistics that neither is sufficient and that both are important, at least to the agency established by Congress to insure the efficient and safe operation of the American banking system.

The fact that these statistics are collected and published by the FDIC and are employed by both scholars and regulators demonstrates the impor-

[12] Lyle E. Gramley, *Scale Economies in Banking,* Federal Reserve Bank of Kansas City, 1962, p. 37.

tance of rates of return based on total assets. We conclude that deposits are *not* omitted from the calculation of rate of return for the banking industry as Mr. Bailey would lead us to believe, because they are important measures of economic efficiency. Likewise, reserves ought not be excluded from other than parochial calculations of returns for the insurance industry.

VI. Concluding Remarks

Mr. Bailey concludes his review by stating that one of the ADL measures "substantially" understates the rates of return for the insurance industry. While he does not say to what extent they are understated, we wonder what Mr. Bailey's position is with respect to the issue of the level of industry profitability. We conducted our studies in order to address that very issue. Our studies found that no matter how measured, the insurance industry returns very poor levels of profitability. On several occasions we have noted that our study was not an academic exercise but an attempt to obtain explanations of real world phenomena.

The formation of more than 350 holding companies by insurance companies, the diversification into mutual funds, purchases of credit card companies, etc., are some of the signs of capital unrest in the insurance industry. In addition, some large corporations and holding companies have bought up insurance company stocks for the *announced* purpose of gaining control and then withdrawing large amounts of funds from the insurance industry. Mr. Bailey cites such actions on page 139 of his paper. In its October *Review*, the A. M. Best Company notes that the effect of three recent financial moves was to withdraw about one billion dollars from the industry's underwriting capacity.[13] If the insurance industry is profitably employing funds, why have funds been channeled out of the industry by these investors?

I submit that all analyses and models concerning real problems are subject to the ultimate test of validity and value — their ability to predict and explain real world phenomena. We feel that the ADL report passes this test. We have pointed out above the technical deficiencies in Mr. Bailey's criticisms. The principal finding of the ADL study was that current insurance operations yield unsatisfactory returns on their funds. Nothing in Mr. Bailey's review contradicts that conclusion. In fact, Mr. Bailey himself presents real world evidence of dissatisfaction with insurance returns when he discusses the withdrawals of capital undertaken by holding companies.

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[13] *Best's Review*, Property Liability Edition, October 1969, p. 5.

It is time, I believe, that we stopped trying to define the ultimate, academic measure of insurance profitability and concentrate instead on finding solutions for the industry's basic problems. For example, the simultaneous effect of capital levels on capacity, return, and solvency is an important and uninvestigated area. I sincerely hope that the Fellows of the Casualty Actuarial Society will be in the forefront of those who offer constructive and realistic solutions to this country's nettlesome insurance problems.

AUTHOR'S REPLY TO DISCUSSION

Definition of the Problem

In a review of the Arthur D. Little Report on Rates of Return in the Property and Liability Insurance Industry which was presented to the Casualty Actuarial Society November 16, 1969 at Atlanta, Georgia, I showed that the ADL formula omitted a substantial part of the total return for the insurance industry and that the rate of return, 3.6%, produced by the formula was therefore substantially understated.

In a lengthy reply, which was twice as long as my review, Dr. Irving H. Plotkin of Arthur D. Little, Inc., only skirted the fundamental issue raised by my paper and did not answer it. Dr. Plotkin raised various issues such as whether insurance rates should be reduced by the direct inclusion of investment income in ratemaking formulas used to justify rate filings, the question of ownership of assets and incomes of insurers, the problems of comparisons of returns on net worth, and the withdrawal of assets from insurers by holding companies. He concludes with the sweeping statement, "It is time, I believe, that we stopped trying to define the ultimate, academic measure of insurance profitability and concentrate instead on finding solutions for the industry's basic problems."

The ADL reports were presented as among the most comprehensive, scholarly attempts ever undertaken to define and measure insurance profitability. ADL restricted itself entirely to the measurement and analysis of the facts and refrained from proposing how the situation ought to be corrected. But now that there is some doubt about the validity of ADL's methodology and formulas, Dr. Plotkin wants to get away from the nitty gritty of defining the problem and instead wants to assume that we all know what the problem is. However, ADL continues to publicize its 3.6% figure.

Defining a problem is half of its solution. A faulty definition only makes

the problem more serious. With the credibility gap that already exists in the public's view of insurance accounting, an incomplete measure of insurance profits which is widely publicized by a segment of the industry in an effort to gain short term benefits in certain political disputes may have long range detrimental effects on both the insurance industry and its regulators.

Insurance Accounting Methods

The fact that ADL had to devise its own original profit formula and had to make various adjustments to the net income and the net worth for the insurance industry reveals a fundamental deficiency in the statutory accounting methods used by the insurance industry. No one uses the results reported in the NAIC convention annual statement for insurers, except the state insurance regulators. Others "adjust" the results: IRS, ADL, Best's, the stock market analysts, and even the insurers themselves when they report to stockholders.

The unfortunate consequence of a generally unaccepted accounting method is that results are adjusted in different ways. The diversity in methods of adjustment reduces the credibility of the results. The lack of agreement on accounting methods for insurance companies casts a cloud of doubt over all the methods.

So when ADL devises a new method that shows the insurance industry is "underearning," those who want to believe such a conclusion do, and everyone else is skeptical. Likewise, when some other analyst uses a different method that shows the insurance industry is "overearning," those who want to believe such a conclusion do, and everyone else is skeptical. That both conclusions have been drawn at the same time for the insurance industry points most forcefully to the need for a generally accepted accounting method for the insurance industry.

It is certainly premature for Dr. Plotkin to assume that we all know and agree what the problem is. Furthermore, the ADL reports have not helped us define the problem because they used a profit formula that substantially understates the rate of return for the insurance industry.

Comparisons of Financial and Industrial Industries

The ADL reports compare the property and liability insurance industry with many other industries, both industrial and financial. Industrial industries obtain virtually all their investable assets from owners and lenders. Some

financial industries, like life insurers, property and liability insurers, banks, and other savings institutions, are different from industrial industries because they obtain large amounts of investable assets from customers who are neither owners nor lenders. Policyholders pay premiums in advance of the time of receipt of benefits for life insurance and property and liability insurance. Banks and other savings institutions receive deposits from depositors.

All the financial industries that obtain investable assets from their customers are alike in that they pay a return to their customers for the funds advanced by the customers. A bank provides checking and other services at no charge or at charges that are lower than the cost of the services in recognition of the investment income on the deposits.

A life insurer sells life insurance at a net price, after dividends to policyholders, that recognizes the investment income on the reserves. Similarly a property and liability insurer sells insurance at a net price, after dividends to policyholders, that recognizes the investment income on the reserves. The precise amount of return to the customer of a bank, a life insurer, or a property and liability insurer is difficult to measure because it is not specified in the contract with the customer. It is an inseparable part of a package deal and can therefore only be estimated.

The ADL reports devised a special profit formula for property and liability insurers to recognize the investable assets obtained from policyholders. The ADL formula added the assets obtained from policyholders to the denominator of the profit formula but did not add anything to the numerator. It failed to recognize the return that the policyholders receive on the funds they provide, and it thereby understated the total return on total investable assets.

Dr. Plotkin contends that the policyholders of property and liability insurers do not receive any return on the investable funds which the insurers obtain from the policyholders. This is contradicted by the rate plans in use in every state which allow discounts for the prepayment of premiums. It is contradicted by the practice of insurance managements, both stock and mutual, which is to reflect, in their pricing decisions, investment income on the reserves. This practice is indicated in the statement by Mr. Harold E. Curry, Senior Vice President of State Farm Mutual Automobile Insurance Company, which appeared in the September 1969 issue of *The Journal of Risk and Insurance,* page 452, in the article "Investment Income in Fire and Casualty Rate Making":

> "In this planning, whether it be for a company that promulgates its own rates or a group decision among companies which act in concert in making rates, the anticipated contribution toward the total financial needs to be derived from investment income is always considered and, to the extent that investment income, regardless of its source, fulfills these total needs, the burden on the other potential sources of financing is diminished, and vice versa. Thus, it becomes unmistakably clear that investment income is considered in fire and casualty rate making."

Dr. Plotkin's position is contradicted by the ADL reports themselves which contend that insurance prices should be influenced by the total return of the insurer including the investment return on the reserves. Of course, in this case, ADL urges that insurance prices should not be further reduced because the total return including investment income on the reserves is already too low.

A property and liability insurer pays a return to its policyholders on the investable assets obtained from the policyholders just as certainly as a life insurer does and just as certainly as a bank pays its depositors a return on demand deposits. The only difference is a difference of degree because life insurers and banks have more assets obtained from customers in proportion to net worth than property and liability insurers.

Dr. Plotkin contends that the ADL formula measures each industry's profitability by the "totality of non-imputed income generated by the total of its investable assets." It is true that the customers of every industry receive a benefit from the products they buy from the industry. Such benefits, or return, are properly excluded from the profit formula for each industry. The customers of the insurance industry receive very substantial benefits from the insurance they purchase. And they will receive those benefits whether they pay for their insurance in advance or otherwise. Such benefits should not be included in the profit formula for the insurance industry or any other industry. But when the customers also become suppliers of investable assets and when those investable assets are included in the profit formula, then the additional financial return which the suppliers of funds receive for supplying those funds should also be included. It is this financial return to the policyholders, which they receive, not for buying insurance, but for paying for it in advance, that the ADL formula has improperly omitted.

Comparisons with Banks and Life Insurers

Dr. Plotkin in his reply agrees that bank deposits should be treated the same as policyholder reserves in measuring profits. However, the ADL reports did not include deposits in measuring the return for banks. All comparisons of property and liability insurers with banks were made by ADL on the basis of return on net worth, excluding unrealized capital gains, which makes insurers appear less profitable than banks because insurers, unlike banks, have substantial amounts of unrealized capital gains. In all comparisons where investable assets obtained from customers were included in the formula, banks were always omitted from the comparison. In fact, whenever ADL uses a profit formula which includes investable assets obtained from customers, it compares property and liability insurance, a financial industry that obtains more than half its investable assets from customers, only with industries that do not obtain any investable assets from customers. It has never applied its formula, which includes investable assets obtained from customers, to compare the results for the property and liability insurance industry with the other financial industries that are the most comparable in that they also obtain investable assets from customers. If such a comparison were made, it would show a lower return for banking and life insurance than for property and liability insurance because banks and life insurers obtain a higher proportion, about 90%, of their investable assets from customers, compared to about 50% for property and liability insurers.

In the table on page 160, the return for property and liability insurers is compared to the returns for banks and life insurers. All the returns are calculated by the formula ADL advocated for property and liability insurers. The numerator is net income after taxes plus all capital gains (except unrealized capital gains for banks, which are relatively insignificant and are not available) plus all interest paid to lenders, depositors, and policyholders. The denominator is net worth plus long-term debt plus investable assets obtained from customers. For property and liability insurers investable assets obtained from customers are reserves for unearned premiums, unpaid losses, and unpaid loss adjustment expenses. For banks they are total deposits. For life insurers they are policy reserves and policy dividend accumulations.

Source of Data

The data for property and liability insurers were developed by Arthur D. Little, Inc., from Best's Aggregates and Averages and include insurers of

Average Rates of Return (Percent) Using ADL Formula

Year	Property and Liability Insurers	Banks	Life Insurers
1955	5.586	.932	1.188
1956	−1.610	1.002	.668
1957	2.764	1.218	.550
1958	4.303	1.387	1.352
1959	5.273	1.355	.962
1960	− .750	1.614	.694
1961	9.359	1.680	1.507
1962	2.983	1.847	.471
1963	4.495	1.985	1.201
1964	9.032	2.067	1.076
1965	−2.513	2.257	1.114
1966	1.951	2.491	.334
1967	6.803	2.685	1.224
1968		2.854	1.161
1955-1965	4.015	1.577	.980
1955-1967	3.634	1.732	.949
1955-1968		1.812	.964

all types except perpetual fire insurers, encompassing 1,197 insurers in 1967. The data for banks were obtained from the Federal Reserve Bulletin and represent the totals for all insured commercial banks, encompassing 13,488 banks in 1968. The data for life insurers were obtained from the Institute of Life Insurance, and include 1,775 U.S. life insurance companies in 1968.

Inferences Drawn from Statistical Findings

The ADL report commented that the return of 3.6% for property and liability insurers was less than the interest rate paid by most savings banks during the same period. Applying to banks the same "all inclusive definition of income" formula advocated by ADL reveals that banks themselves earned less on total investable assets than the interest rate paid by most of the same banks on savings accounts during the same period. For life insurers it reveals that "total return" on total investable assets, about 1%, is much less than the investment return on invested assets which has averaged about

4% for the life insurance industry over the interval 1955-1968. These results are an indication that the ADL formula omits a substantial part of the total return from all three of these financial industries.

If we assume that the ADL formula does indeed include the total return on the total investable assets for financial industries then we are forced into some startling conclusions.

The property and liability insurance industry is doing twice as well as the banking industry and four times as well as the life insurance industry, or alternatively, the life insurance industry is doing only one quarter as well as the property and liability insurance industry, and the banking industry is doing only half as well.

The property and liability insurers, with regulated prices, have earned four times as much as life insurers have earned with unregulated prices. Has price regulation protected the property and liability insurers from ruinous competition? If so, perhaps the way to raise the rate of return for all insurers is to increase price regulation, even for life insurers, and to further eliminate price competition!

These results for the life insurance industry indicate that resources are being over-applied to life insurance, and that society would be better off if assets were taken away from the life insurance industry and applied to other economic endeavors. If the $200,000,000,000 of assets invested in the life insurance industry were all invested in other industries earning an average of 10.7% instead of only 1.0% in the life insurance industry, society would gain by about $20,000,000,000 each year. Such an amount would have a substantial impact on our national economy. If we wanted to, we could find validation of this theoretical implication in the present occurrences in the life insurance industry. Although it is hard to point to direct capital outflow, for the industry still is growing, there are occurrences we could construe as strong signs of capital unrest. The formation of over 350 holding companies on the part of insurance companies, the spreading out into mutual funds, and the purchasing of credit card companies by certain insurance companies could all be construed as signs of dissatisfaction with the present return allowed by the economics and competitive price structure of the life insurance industry. If ADL can draw such an inference for the property and liability insurance industry based on a return of 3.6%, how much stronger the inference must be for an industry earning only 1%!

The net return for the life insurance industry, 1%, is much less than the investment return on invested assets, which has averaged about 4% for the life insurance industry over the interval 1955-1968. This shows that life insurers are losing money on insurance and making it up on investments. Life insurers are using investment income to subsidize their underwriting operations. The same, of course, is true for property and liability insurers, although to a lesser degree. It is clear that life insurers are not and never have earned a 5% underwriting profit. Instead they have been forced by the fiercely competitive market for life insurance to anticipate the investment income they expect to earn on policyholder reserves and to reduce their prices to levels that produce underwriting losses that dip deeply into their investment income. If investment income were excluded, life insurers would show an underwriting loss of about 20% of premiums. If an underwriting profit of 5% is reasonable for the property and liability insurance industry, it should be just as reasonable for the life insurance industry. The fact that the total rate of return on investable assets in the life insurance industry is only 1.0% is ample evidence that the life insurance industry is underearning and that the price of life insurance should be increased enough to raise the rate of return to a level comparable to other industries, namely, 10.7%. To achieve this, life insurers would have to earn an underwriting profit of more than 5%, after taxes, in addition to their entire investment income.

Does it all sound ridiculous? Certainly it does. The error in the ADL formula becomes obvious when it is applied to an industry like banking or life insurance where the amount of investable assets obtained from customers is about 10 times net worth. It is not quite so obvious when it is applied to the property and liability insurance industry where the investable assets obtained from customers is only 1 or 1½ times net worth.

Conclusion

I think it is clear that the profit formula used by the ADL reports for the insurance industry has a serious flaw in it. It excludes a substantial element of return from the total return. Consequently it produces rates of return which are substantially understated, which are not comparable with other industries, and which are not even comparable from one insurer to another.

THE INTERPRETATION OF LIABILITY INCREASED LIMITS STATISTICS

JEFFREY T. LANGE

Several papers in the *Proceedings* deal with established ratemaking procedures for various lines of insurance and two such papers discuss in detail the methodology for liability insurance lines. In both papers attention is restricted to ratemaking techniques for basic limits coverage. The papers mention that statistics are collected for coverage above the basic limits, but they do not describe analysis of these statistics.[1] This limitation of the papers is understandable since their objective is to describe established ratemaking techniques and since there are no widely accepted methods in the increased limits area. Almost without exception both individual companies and rating bureaus express the premium for increased limits coverage as a function of the premium for basic limits coverage. Usually, the rates for increased limits of coverage are obtained simply by applying a factor to the appropriate basic limits rate.

Increased limits of liability are widely sold and the premiums involved can be substantial. Approximately two-thirds of automobile insureds purchase some increased limits coverage, and for some general liability sublines (e.g. professional malpractice) almost all insureds carry increased limits coverage. For automobile bodily injury liability, the charge for limits of $100,000 per person and $300,000 per accident is 41% of the basic limits charge, while comparable charges in the general liability line are as high as 159% of basic limits premium. In total, the premiums for increased limits of liability for automobile and general liability lines exceed the premiums for many other lines of insurance.

The actuary is faced not only with the problem of setting the increased limits charges, but also that of setting marketing strategy. Increased limits coverage is not only voluntary, but also evanescent. To a great extent it is sold, not bought. This is especially true with regard to the precise limit

[1] Stern, P. K., "Ratemaking Procedures for Automobile Liability Insurance," *PCAS* Vol. LII, p. 155.
Lange, J. T., "General Liability Insurance Ratemaking," *PCAS* Vol. LIV, p. 30.

selected. Even if the insured recognizes the need for increased limits coverage, it is difficult for him to decide objectively how much coverage to purchase. Should the insurer encourage him to buy high limits? While it would seem that profitability would be easily ascertainable, it can be an evasive question. Large liability losses may not be settled for many years. Inflationary trends have a substantially different impact in the increased limits area and, additionally, influence outstanding cases. Increased limits losses are in the tail of the distribution of losses by size and there is considerable statistical variation. Increased limits premiums are generally lumped in with basic limits premiums along with other unrelated charges. The situation is further complicated by reinsurance treaties and the fact that beyond some limit the insurer's expected losses are zero and it is charging only for bearing the potential risk. This paper discusses the analysis of increased limits statistics, indicating several major problem areas, in the hope that other actuaries will offer suggestions as to how research in this area might be carried forward.

Loss Ratios or Pure Premiums

In ratemaking, either a loss ratio or a pure premium approach is usually used; however, neither is well suited to the increased limits area. For the loss ratio approach to yield satisfactory results it is necessary that premiums be known with some degree of accuracy. Increased limits premium charges are determined by applying a factor to basic limits rates and are included with basic limits premiums and other charges (e.g. medical payments) in one lump sum premium. To reconstruct separate increased limits premiums would require that estimates concerning increased limits and other charges be made so that the total premium can be subdivided into components. Even if this were done and loss ratios were constructed, their utility would not be great. Since increased limits charges are a function of basic limits rates, the isolated fact that increased limits experience is good or bad does not tell the ratemaker whether or not the relationship between increased limits and basic limits rates is correct.

The use of pure premiums presents a slightly different problem. Increased limits losses are influenced by many of the same factors that influence basic limits losses. For example, one would logically expect that increased limits charges should depend on rating territory and classification in addition to limit purchased. This would involve subdividing the data into a great many categories. But since increased limits data is of lesser volume than basic limits and is subject to much greater statistical variation,

it would appear that the resulting pure premiums for each category would have little credibility. Finally, the pure premium approach is not particularly convenient for testing the present rating procedure in which increased limits charges are expressed as a function of basic limits rates.

Losses to Losses

While it would be possible to adapt either the pure premium or loss ratio approach for use in increased limits ratemaking, there is another ratio which might be employed. In rating increased limits coverage, the increased limits premium charge is expressed as a ratio of the basic limits premium, which in turn is a function of basic limits losses. This suggests relating increased limits losses for a particular policy limit to the corresponding basic limits losses for that same policy limit. The resulting ratio expresses the increased limits losses as a proportion of basic limits losses. If both sets of losses are estimates of expected losses (reflecting loss adjustment expense, loss development, adjustments for changes in cost and frequency), then the ratio of increased limits premiums to basic limits premium for that policy limit should be the same as the ratio of losses to losses in order to produce comparable results. In other words, the ratio of increased limits losses to basic limits losses corresponds to an increased limits factor.

For policies carrying limits of m/n where m/n is greater than basic limits

$$r_{m/n} = \frac{\text{increased limits losses}}{\text{basic limits losses}}$$

where increased limits losses equal total losses less basic limits losses, and basic limits losses reflect the application of the basic limits of liability to each loss.

$f_{m/n}$ = increased limits factor = $1.00 + r_{m/n}$

$p_{m/n}$ = premium for limits of $m/n = f_{m/n} \times$ (basic limits rate)

One disadvantage of the approach, as stated, is that in reviewing the charge for 15/30 limits one would be restricted to the use of the experience of 15/30 policies. To avoid this limitation, one could use the experience of all policies having at least 15/30 limits (e.g. 15/30, 20/20, 25/50, etc.) and limit the increased limits losses for all such policies to 15/30.

To carry out this approach in general, losses must be subdivided in two ways: first by policy limit purchased and then by layer of loss (less than

10/20, from 10/20 to 15/30, from 15/30 to 25/50, etc.). In the latter subdivision, a $30,000 loss would have $10,000 assigned to the first layer, $5,000 to the second, $10,000 to the third and $5,000 to the fourth, assuming 10/20 basic limits. Following this procedure, the data could be arranged in an array where L denotes the losses in the cell, the first subscript denotes the upper limit of the layer of loss and the second subscript denotes the policy limit purchased by the insured. For example, $L_{15,25}$ denotes the amount of losses in the layer between limits of 10/20 and 15/30 (e.g. $5000 for a $15,000 or more claim) for policies with a 25/50 limit.

Layer of Loss	Policy Limit Purchased				
	10/20	*15/30*	*20/40*	*25/50*	. . .
Portion of losses less than 10/20	$L_{10,10}$	$L_{10,15}$	$L_{10,20}$	$L_{10,25}$	
Loss amounts between 10/20 and 15/30		$L_{15,15}$	$L_{15,20}$	$L_{15,25}$	
Loss amounts between 15/30 and 25/50			$L_{25,20}$	$L_{25,25}$	

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To evaluate the 15/30 limit, increased and basic limits losses for all policies with at least 15/30 limits would be compared

$$r_{15/30} = \frac{L_{15,15} + L_{15,20} + L_{15,25} + \ldots}{L_{10,15} + L_{10,20} + L_{10,25} + \ldots}$$

$$r_{15/30} = \sum_{i \geqslant 15} L_{15,i} \Big/ \sum_{i \geqslant 15} L_{10,i}$$

Similarly, to evaluate the 25/50 limit one would compute

$$r_{25/50} = \left[\sum_{i \geqslant 25} L_{25,i} \Big/ \sum_{i \geqslant 25} L_{10,i} \right] + r_{15/30}$$

It is probably not possible to have a layer of losses corresponding to every limit purchased, since the construction of the layers requires the subdivision of each excess loss. In the above example, the treatment of a policy limit not corresponding to a layer of losses is illustrated with the 20/40 limit. The limit factor for this limit could be set by interpolation. For limits cor-

responding to layers of loss, the following general formula is appropriate.

$$r_{m/n} = \left[\sum_{i \geq m} L_{m,i} \Big/ \sum_{i \geq m} L_{10,i} \right] + r_{m'/n'}$$

where $r_{m'/n'}$ denotes the r for next lowest layer of losses.

This formula assumes a \$10,000/\$20,000 basic limit and also assumes the application of the appropriate accident limit to the individual losses in each case.

Loss Development

In accident year ratemaking, it is generally necessary to measure subsequent "loss development" as reserves translated into paid claims with the passage of time. The customary techniques for the determination of loss development factors[2] can be applied in the increased limits area. Increased limits losses are, by definition, large liability cases and generally take a long time to be settled. Their magnitude cannot always be adequately estimated since there are few large cases and since these cases are frequently of an exceptional nature. As a result, it is necessary to measure loss development over a long period of time; significant changes in accident year losses may occur even at 60 and 72 months evaluations. A further consequence is that the factors to be applied to the first and second reportings of the losses are quite substantial. In the former case, the factors may exceed two. This implies that, even after giving careful attention to loss development factors, the actuary can give little credence to the latest year of experience alone and several years of data must be used in any analysis. If the results of the analysis must be explained to non-actuaries who might be disturbed by the magnitude of the factors, it might be well to recast the study on a calendar year basis, which although less accurate, avoids the use of loss development factors.

If loss development factors for increased limits are greater than basic limits, one might expect this same phenomenon might be observed if layers of increased limits coverage are compared. Studies have shown that increased limits loss development factors do increase for each successively higher layer of coverage. If this fact is neglected, it will distort any analysis of the factors for the higher limits (e.g. 50/100, 100/300).

[2] Stern, *op. cit.*, p. 162.

Loss Trends

In basic limits ratemaking, it is common practice to adjust the reported loss experience for prospective changes in claim cost and, for auto liability, in frequency. As basic limits rate levels are set using the latest available years of experience, and as basic limits rates are frequently revised, these adjustments are often of a routine nature. For increased limits of liability, the situation is quite different: a number of years of experience are used in ratemaking; increased limits tables are not frequently changed; increased limits trends are substantially greater than basic limits trends.

In a period of rising claim costs, the cost for excess or deductible insurance will rise more rapidly. One can grasp the general idea by considering two claims, one of \$1,500, one of \$15,000. If the \$1,500 claim increases 10 percent, its basic limits portion increases 10 percent, while if the \$15,000 claim increases 10 percent, its basic portion is unchanged at \$10,000 while its excess portion increases 30 percent from \$5,000 to \$6,500, assuming \$10,000 basic limits. Thus, if claim costs are increasing slightly each year due to inflationary pressures, the impact of this increase will be much greater on increased limits experience than on basic limits experience.

Increased limits cost trends increase more rapidly than basic limits for two reasons. First, the whole effect of the trend is in the excess portion of the increased limits claim while the effect on the basic limits portion is zero. Second, although uniform frequency trends affect equally basic and increased limits, a rising cost trend causes a rise in increased limits claim frequency since additional claims (previously only basic limits losses) break through the lower boundary of the increased limits layer of losses becoming new excess claims. If x represents the dollar amount of a loss, N the total number of claims, and $p(x)$ equals the probability that the value of a loss is x, then losses above basic limits of k, the increased limits losses, are:

$$N\left[\int_k^\infty x\,p(x)\,dx - k\int_k^\infty p(x)\,dx\right]$$

If losses increase by "a" percent, not only is the first term multiplied by $(1+a)$ with no increase in the negative second term, but basic limits losses in the range $k/(1+a)$ to k now become increased limits losses contributing the following amount to the total increased limits losses:

$$N\left[(1+a)\int_{\frac{k}{1+a}}^{k} x\,p(x)\,dx - k\int_{\frac{k}{1+a}}^{k} p(x)\,dx\right]$$

Combining this expression with the previous one yields the increased limits losses after the application of the trend. Dividing the new increased limits losses by the old gives the increased limits trend factor, which is equal to the basic limits trend factor plus a quantity which is always strictly greater than zero.

Thus it can be established mathematically that increased limits loss trends are greater than basic limits trends. How much greater? One can estimate the magnitude either directly from claim cost data or by the application of the above equations to a distribution. The lognormal distribution is a plausible model[3] for the distribution of claims by size and is relatively easy to work with. The parameters of the distribution may be estimated[4] from a sample of claims and the theoretical distribution of claims may be adjusted by a uniform trend factor. (The model may be further refined by injecting assumptions concerning the policy limits purchased because some claims are not increased fully by the trend factor since they would then exceed the insured's limit.)

In addition to obtaining basic and increased limits trend factors, the data may be grouped by layer of loss so that separate trend factors by increment of coverage may be calculated. Generally, this action will result in a basic limits trend factor less than the total limits trend factor, and in increasing trend factors for each layer of loss with the highest trend factor obtaining for the highest layer of loss. This last trend factor may be as much as twice the total limit factor. This result parallels that discussed for loss development. If these two points are neglected, one could easily be misled in an analysis of data for the higher limits of liability.

An alternative approach, which unfortunately does not lead to a gradation of trend factors by layer of loss, is separately to fit total limits and basic limits claim costs (from the same population) to a line.[5] One may subtract the basic limits average cost from the total limits average cost and also subtract the basic limits average annual change (from the fitted line) from the corresponding total limits figure. The resulting average cost over

[3] Bailey, R. A., "Experience Rating Reassessed," *PCAS* Vol. XLVIII, p. 60.
Benchert, L. G., "The Lognormal Model for the Distribution of One Claim," *ASTIN Bulletin* Vol. II, p. 9.

[4] Aitchison, J. and Brown, J., *The Lognormal Distribution* (Cambridge University Press, Cambridge, 1957), p. 39.
Gjeddeback, N. F., "Contributions to the Study of Grouped Observations," *Skandinavisk Aktuarietidskrift* Vol. 32, p. 135 ff.

[5] Stern, *op. cit.*, p. 172.

basic limits and average annual change over basic limits may be used to compute the increased limits loss trend corresponding to the basic and total limits trends. (It should be noted that both of the average dollar amounts over basic limits are expressed as in terms of all claims — both basic and excess — and thus this trend factor reflects the added frequency discussed above.) This may be illustrated with the following example:

	Average Claim Cost	Average Annual Change in Claim Cost From Fitted Line
Total limits	$1100	$100
Basic limits	1000	80
Difference	$ 100	$ 20

Total limits trend: $\frac{100}{1100} = 9\%$

Basic limits trend: $\frac{80}{1000} = 8\%$

Increased limits trend: $\frac{20}{100} = 20\%$

While this approach is not perfect it can be easily applied to readily available data, is relatively simple to explain, and does demonstrate the magnitude of the problem.

Credibility

It is well known that a way of increasing the relative credibility of a body of data is to exclude or limit the larger losses.[6] It follows that these large losses by themselves have much less credibility than do the basic losses. The amount of variation (the standard deviation or coefficient of variation) in each increased limits increment (or layer of loss) may be compared to the amount of variation in basic limits data in order to determine the degree of increased variation. This approach leads to the conclusion that increased limits experience requires higher credibility factors, but such approach does

[6] Roberts, L. H., "Credibility of 10/20 Experience as Compared with 5/10 Experience," *PCAS* Vol. XLVI, p. 235.

not lead to a determination of exact factors. Perhaps the Mayerson-Jones-Bowers formula[7] could be adapted to deal with a portion of the loss distribution and thus yield a credibility standard.

Reinsurance Costs

When increased limits coverage is written two insurance carriers are often involved: the primary (direct) insurer and the reinsurer. Some allowance must be made for the fact that both of these carriers incur administrative (operating) expenses. The basic limits rates include a provision only for the expenses of the direct or primary insurer. Increased limits premiums are determined from basic limits premiums; unless some provision is made in the analysis for the expenses of the reinsurer, the increased limits charges would be inadequate in that they would fail to contain the necessary allowance for the expenses incurred by the reinsurer and paid by the primary insurer. It is recognized that this increased expense to the primary insurer results in lower risk; therefore, the element of reinsurance expense might be combined with that of risk. However, reinsurance is an important consideration in determining profitability and the adequacy of increased limits charges.

Risk

While it is obvious that the risk assumed in insuring increased limits coverage is greater than the risk assumed in insuring basic limits coverage, it is difficult to measure this difference in assumed risk quantitatively.

Letting x denote the losses of a policy, p its expected losses, and $f(x)$ the probability that losses for an individual policy do not exceed x, risk has traditionally been defined by actuaries as follows:[8]

$$\text{Risk} = \left[\int_0^\infty (x-p)^2 \, df(x) \right]^{1/2}$$

$$\text{where } p = \int_0^\infty x \, df(x)$$

[7] Mayerson, A., Jones, D., and Bowers, N., "The Credibility of the Pure Premium," *PCAS* Vol. LV, p. 175.

[8] Borch, K., "The Theory of Risk," *Journal of the Royal Statistical Society, Series B*, Vol. 29, p. 432, attributes this definition to Hansdorf, F., "Das Risico bei Zufallsspielin," *Leipziger Berichte* Vol. 49 (1897), p. 497.

Plotkin has employed the variance in his calculation of risk, while Houston has suggested that the standard error of mean pure premium be used as measure of the risk assumed by the insurer.[9] He argues that the insurer's risk includes not only the variation inherent in the pure premium distribution, which would be measured by the standard deviation and variance, but also includes the expected variation of the average pure premium. All of these suggested measures illustrate that risk is essentially a variance, not a mean, concept.

In actuarial literature, the usual way of meeting risk is through the use of a safety loading (proportional to the risk) in the premium.[10] This is not inconsistent with economic theory which links level of profit to degree of uncertainty. Each insurer is of finite capacity and need not assume every possible risk. If the profit were the same on a 10,000/20,000 policy as on a 1,000,000/2,000,000 policy, why should a prudent insurer assume the added risk of a 1,000,000/2,000,000 or even a 100,000/200,000 policy. The argument of reinsurance does not blunt this point since the insurer must pay a greater reinsurance premium if he writes 1,000,000/2,000,000 policies than if he limited himself to 10,000/20,000. Some element in the formula, either a safety loading, a larger profit margin, or an increment for reinsurance expense, would seem necessary in the analysis of increased limits statistics.

It would seem that this element should increase as the risk increases at higher limits. For limits above $100,000 (e.g. $1,000,000), risk is more important than the pure premium, since the frequency of $1,000,000 liability claims is miniscule. While the element for risk is obviously necessary, and easily justified intuitively, it is difficult to calculate analytically. If a pure premium distribution could be obtained, the measures described in previous paragraphs might be applied.

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[9] Conrad, G. and Plotkin, I., "Risk/Return: U.S. Industry Pattern," *Harvard Business Review,* March-April 1968, p.. 90, and *Prices and Profits in the Property and Liability Insurance Industry* (American Insurance Association, New York, 1967).
Houston, D. B., "Risk, Insurance and Sampling," *Journal of Risk and Insurance* Vol. XXI, p. 511.

[10] Borch, K., *op. cit.*
Cahill, J. M., "Deductible and Excess Coverages, Liability and Property Damage Lines Other Than Automobile," *PCAS* Vol. XXIII, p. 18.
Cramér, H., "Collective Risk Theory, a Survey from the Point of View of the Theory of Stochastic Processes," *Skandia Jubilee Volume,* Stockholm.
Lange, J. T., "Application of a Mathematical Concept of Risk to Property-Liability Insurance Ratemaking," *Journal of Risk and Insurance,* Vol. XXXVI, p. 383.

Conclusion

The subjects discussed in the paper could (and have been) brought together into a complete analysis of a set of increased limits statistics. Such an analysis has not been presented in the paper since it would imply both a level of development and a degree of acceptance of the idea which is not warranted. Numerical exhibits might detract from the philosophical discussion which is necessary at this stage in the development of ratemaking procedures for increased limits coverage. On the other hand, it is interesting to note that the application of the procedures outlined in this paper to actual numerical data has led to conclusions contrary to those based simply upon overall, approximate increased limits loss ratios.

Increased limits coverage has usually been thought of as profitable to insurers and one may question whether refined calculations are necessary. Yet a paradox appears if one reviews the experience of the reinsurers, many of whom write on a "manual excess basis" receiving the manual increased limits premium (less direct expenses) as their premium. Despite their freedom from regulation, the reinsurers have not found this area profitable in recent years. Perhaps our conventional wisdom about increased limits profitability is more faith than fact and is based upon a superficial analysis which neglects the long term nature of these claims, the additional expense of reinsurance, the large risks assumed by the company, and the greatly magnified impact of trend and development on higher limits of liability.

ECONOMIC FACTORS IN LIABILITY AND PROPERTY INSURANCE CLAIMS COSTS

NORTON E. MASTERSON

SUPPLEMENT TO PAPER IN
VOLUME LV, PAGE 61

Inflation continued to be a serious problem for the liability and property insurance companies in 1968 through mid-1969. In my original paper the LPI indexes covered the period 1935–1967. This supplement is an updating of that paper.

The composite LPI index which measures the effect of economic factors which are affecting claims settlement costs rose from 138.4 to 161.4 (1957–59 = 100) in the two-year period from 1966 through 1968. In incurred claims costs dollars this rise in settlement costs amounts to over $5.7 billion in ten years, of which $2.1 billion came in 1967 and 1968.

The following tables give the 1968 data comparable to the 1967 figures on page 64 of the 1968 *Proceedings*.

1968 Losses and Claims Adjustment Expenses	Millions
Auto bodily injury	$ 3,800
Auto property damage	1,660
Auto physical damage	2,700
Workmen's compensation	2,000
Other bodily injury	800
Other property damage	205
Fire and allied lines	1,390
Extended coverage	320
Homeowners	1,400
Commercial multiple peril	510
Inland marine	400
Glass	28
Burglary and theft	82
Boiler and machinery	40
TOTAL	$15,335

The above 1968 claims costs can be classified as follows:

Economic Category	Millions
Persons	$ 6,820
Property	
Automobiles	4,275
Dwellings	1,525
Buildings and structures (other)	1,875
Miscellaneous	840
TOTAL	$15,335

The 1968 total loss and claims adjustment incurred costs of $15,335 million compares with $14,040 million in 1967 and $12,440 million in 1966. Of the $2,895 million two year increase in 1968 over 1966, $2,100 million was caused by inflationary factors as measured by the LPI indexes for the several lines.

It should be emphasized here that these figures measure only incurred loss and claims adjustment costs and exclude the effects of inflation on underwriting expenses.

The construction method for the auto bodily injury LPI index has been modified as the result of comments by three reviewers of my published paper. A revised weighting method to recognize "pain and suffering" corrects the unrealistic result of the former method. For the most recent years the .57/.43 proportion for (physicians' fees)/(daily hospital charges) has been retained to calculate the medical cost index; but, in the revision, the index for "specials" is a .7/.3 proportion for the medical cost and the personal income indexes, respectively. The loss index proportions have been changed to: .21 for medical cost, .09 for personal income and .70 for "specials." (This revision makes the 3⅓ factor a uniform multiplier but this step is retained in the index for future revision consideration should the indemnity system be modified significantly in the direction of "no-fault" compensation.)

The following table shows the LPI indexes for the period 1966–1968 comparable with the 1966 and 1967 indexes (1957–59 = 100) on page 72 in the 1968 *Proceedings*. The 1966 index for auto bodily injury and the composite for 1966 are on the above revised basis for index construction. The 1967 indexes reflect 1968 revisions in several government indexes for

1967. The last column has been added to show the percentage increases for 1968 over 1966.

Claims Costs Indexes

	1966	1967	1968	1968/1966 %
Auto bodily injury	144.2	159.3	172.9	19.9
Auto property damage	140.6	149.5	162.5	15.6
Auto physical damage	137.2	142.3	154.8	12.8
Workmen's compensation	150.7	164.2	179.8	19.3
Other bodily injury	144.5	159.5	172.6	19.4
Other property damage	135.9	143.4	153.6	13.0
Fire and allied lines	126.1	132.4	140.8	11.7
Extended coverage	127.0	132.2	141.6	11.5
Homeowners	123.6	132.0	141.2	14.2
Commercial multiple peril	131.5	139.0	147.9	12.5
Inland marine	131.1	136.8	145.8	11.2
Glass	126.2	131.2	137.9	9.3
Burglary and theft	132.3	138.5	148.0	11.9
Boiler and machinery	130.5	133.5	140.4	7.6
COMPOSITE	138.4	148.9	161.4	16.6

Inflationary factors have increased claims costs for insurance companies during the past two years to a degree far in excess of the economic forces affecting tangible goods. The significant cause is the larger increase in the cost of *services* as compared with price increases in commodities. The procurement of claims services requires dealing with high cost (direct or retail) furnishers of services: doctors, clinics, hospitals, lawyers, repair garages, building trades, and other service enterprises. The two-year increases shown in the table above for auto and other bodily injury and workmen's compensation are large because physician, hospital, and legal services, all important in settlement of claims involving persons, have been affected by abnormal inflationary factors in the nineteen-sixties and particularly since 1966.

Damage to automobiles and property damage caused by automobiles (principally other automobiles), as measured by the LPI indexes for auto property damage and physical damage have been the subject of special

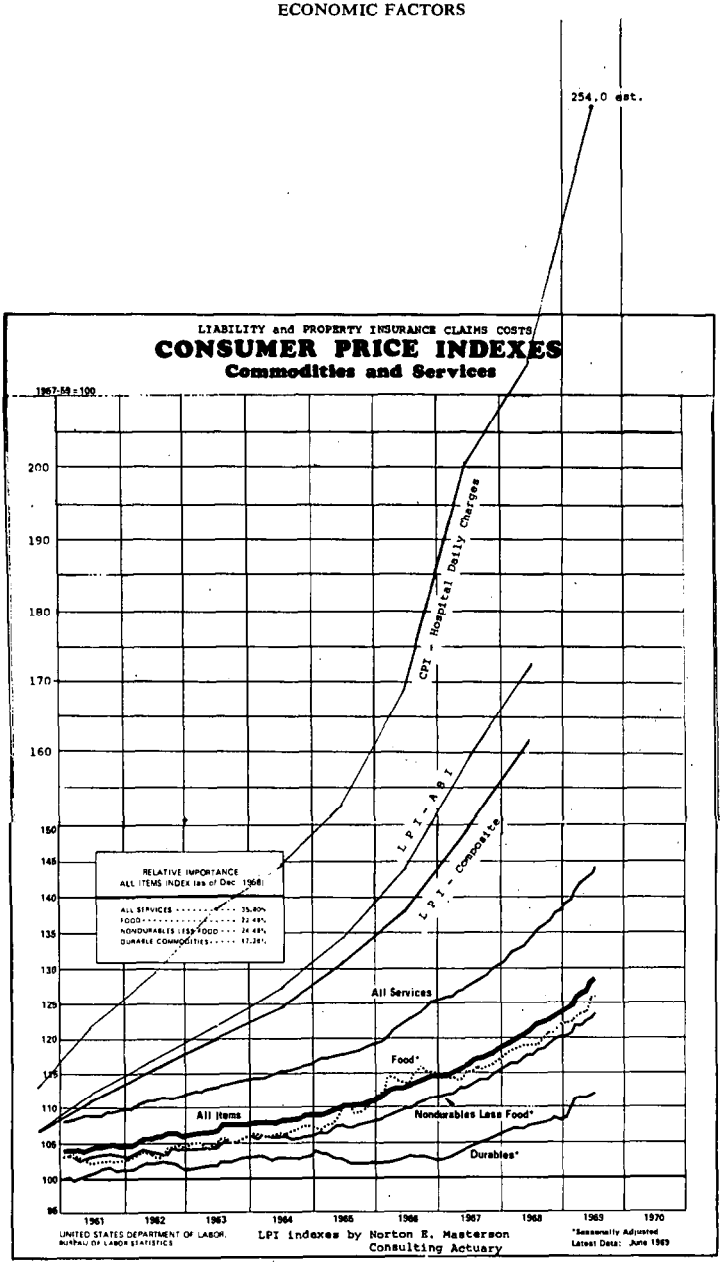
research by the author because of other factors which are pushing claims costs related to automobile replacement or repair beyond the percentage indications of these two indexes. As noted in my published paper (page 73) these two indexes measure economic cost factors only and do not measure an insurance carrier's total average claims costs because of the closure of small property damage claims without payment and the effects of changing auto collision deductibles. A third factor which appears to be accelerating auto repair costs in addition to economic trends measured by the two indexes, is the widening gap between average auto repair services including insured damage, and insured damage repair costs *only*.

The chart on the next page shows the monthly Consumer Price Indexes published the Bureau of Labor Statistics for: All Items, All Services, Food, Nondurables Less Food, and Durables. On the author's extension of this BLS chart are the following indexes, also on the 1957–59 base:

C P I — Hospital daily charges index of BLS

L P I — Composite and auto bodily injury indexes

This expanded chart now depicts two significant facts: (1) the widening spread between the BLS indexes for services, especially hospital daily charges, and the combined C P I and its important commodity elements; and (2) the widening gap between the Composite L P I and auto bodily injury indexes and the various BLS indexes.


254.0 est.
LIABILITY and PROPERTY INSURANCE CLAIMS COSTS
CONSUMER PRICE INDEXES
Commodities and Services
1967-68 = 100
200
190
180
170
160
150
145
140
135
130
125
120
115
110
105
100
95
CPI - Hospital Daily Charges
L P I - A & I
L P I - Composite
RELATIVE IMPORTANCE
ALL ITEMS INDEX (as of Dec. 1968)
ALL SERVICES 35.80%
FOOD 32.48%
NONDURABLES (less FOOD) 24.48%
DURABLE COMMODITIES 17.26%
All Services
Food*
All Items
Nondurables Less Food*
Durables*
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
UNITED STATES DEPARTMENT OF LABOR
BUREAU OF LABOR STATISTICS
LPI Indexes by Norton E. Masterson
Consulting Actuary
*Seasonally Adjusted
Latest Data: June 1969

MINUTES OF THE 1969 ANNUAL MEETING

November 16-18, 1969

REGENCY HYATT HOUSE, ATLANTA, GEORGIA

Sunday, November 16, 1969

Prior to the formal convening of the Annual Meeting on the following day, the Council met at the Regency Hyatt House from 2:00 p.m. to 5:00 p.m.

In the evening, the Council sponsored an extra-curricular "get acquainted" reception hour for the new Fellows (and their wives) who, later during the Annual Meeting, would be presented with Fellowship diplomas.

Monday, November 17, 1969

The 1969 Annual Meeting was formally convened at 9:00 a.m. by President William J. Hazam who welcomed the gathering and then introduced the Honorable James L. Bentley, Insurance Commissioner, State of Georgia.

Commissioner Bentley welcomed the gathering to the city and presented at some length his views on various problems affecting the insurance industry.

President Hazam then presented diplomas to the following new Associates and new Fellows:

ASSOCIATES

Cadorine, Arthur R.	Pilon, Andre	Wade, Roger C.
Fresch, Glenn W.	Sawyer, Joshua S., III	White, Hugh G.
	Stewart, Charles W.	

FELLOWS

Adler, Martin	Farnam, Walter E.	Lowe, Robert F.
Bickerstaff, David R.	Gowdy, Robert C.	Perreault, Stephen L.
Brown, William W., Jr.	Heer, E. LeRoy	Quinlan, John A.
Faber, James A.	Honebein, Carlton W.	Scheid, James E.

President Hazam then delivered his presidential address, which appears in the present *Proceedings* of the CAS.

The Woodward-Fondiller prize was announced by President Hazam as having been awarded to J. Robert Ferrari, Associate Professor of Insurance, University of Pennsylvania, for his paper, "The Relationship of Underwriting, Investments, Leverage, and Exposure to Total Return on Owners' Equity."

The next order of business was the election of the President, two Vice Presidents, Secretary-Treasurer, and three Members of the Council, with the following being elected:

President	Daniel J. McNamara
Vice President	Richard L. Johe
Vice President	LeRoy J. Simon
Secretary-Treasurer	Ronald L. Bornhuetter
Members of the Council	Norman J. Bennett
	Allen L. Mayerson
	Henry W. Menzel

The membership, acting under the provisions of Article V of the Constitution, voted to ratify the following elections made by the Council:

Editor	Matthew Rodermund
Librarian	Richard Lino
General Chairman, Education and Examination Committee	M. Stanley Hughey

Secretary-Treasurer Skelding then presented the minutes of the last Society meeting as well as the report of the Council on business transacted by it since the last meeting of the Society, including a complete financial report. Such reports were approved by the membership.

Vice President McNamara assumed the chair and introduced Albert J. Walsh, Vice President, Reliance Insurance Company, who moderated a panel entitled "Holding Companies, Conglomerates, and Congenerics on the Insurance Scene." Mr. Walsh introduced the following panelists:

W. James MacGinnitie, Vice President, CNA Financial Corporation
Ruth E. Salzmann, Vice President and Actuary, Sentry Insurance Group
Stuart Schwarzchild, Professor of Insurance, Georgia State University

During the luncheon President Hazam introduced a special panel of members of the faculty of Georgia State University to discuss "Urban Problems and their Relationship to the Insurance Industry." Speakers included the following:

Kenneth Black, Jr., Dean, School of Business Administration
John W. Hall, Chairman, Department of Insurance
Alex B. Lacy, Jr., Dean, School of General Studies

The meeting was reconvened at 2:30 p.m. with Vice President McNamara presiding.

The business session was continued with the reading of the following new papers and reviews:

New Papers

(1) "A Review of the Little Report on Rates of Return in the Property and Liability Insurance Industry," by Robert A. Bailey, Director, Insurance and Actuarial Section, Michigan Insurance Bureau.
A guest review of Mr. Bailey's paper by Dr. Irving H. Plotkin, A.D. Little, Inc., was read by Mr. Warren Cooper. This review was followed by an oral rebuttal by the author.

(2) "The Interpretation of Liability Increased Limits Statistics," by Jeffrey T. Lange, Secretary, Insurance Rating Board. A summary was read by J. Robert Hunter, Jr.

(3) "Economic Factors in Liability and Property Insurance Claims Costs (Supplement)," by Norton E. Masterson, Consulting Actuary.

Reviews

Separate reviews of the paper by John S. McGuinness, President, John S. McGuinness Associates, "Is Probable Maximum Loss (PML) a Useful Concept?" were presented by Robert L. Hurley, Actuary, Fire Insurance Research and Actuarial Association; and Edward B. Black, Secretary-Underwriting, Insurance Company of North America. Mr. Black's review was read by Fred Hunt.

Following the reading and discussion of papers two concurrent seminars were held:

"Trends in Actuarial Education and their Impact on Our Profession":

Seminar Leader — Laurence H. Longley-Cook
Research Consultant
Georgia State University

Panelists: Charles J. Hachemeister
Associate Actuary
Insurance Company of North America

Charles C. Hewitt, Jr.
Actuary
Allstate Insurance Company

"Group Selling and Group Automobile Insurance — The Present and Prospective State of the Art":

Seminar Leader — Bernard L. Webb
Georgia State University

Panelists: John W. Gibson
Marketing Research Director
American Mutual Liability Insurance Company

James J. Meenaghan
Assistant Vice President
Fireman's Fund American Insurance Companies

After the seminars were concluded various committee meetings were held.

A reception and banquet honoring Mr. and Mrs. Albert Z. Skelding was held during the evening. Various remarks were presented during the dinner pertaining to Mr. Skelding's significant contributions to the Society through the years. President Hazam then presented Mr. Skelding with an engraved silver tray commemorating his years of service as Secretary-Treasurer, as well as an enbossed scroll.

After the banquet the membership was favored with a surprise musical presentation, "An Assumed Risk Anthology," written and produced by Matthew Rodermund. In view of the success of this endeavor it is deemed desirable that the names of the participants be recorded in these minutes:

Robert Foster	Paul Liscord	Robert Hunter
Barry Jorve	Luther Tarbell	Virginia Hunter
		Matthew Rodermund

Tuesday, November 18, 1969

The meeting reconvened at 9:00 a.m. with Vice President Johe presiding.

The seminar leaders, Laurence J. Longley-Cook and Bernard L. Webb, presented summary reports of the panel discussions held the previous afternoon.

Oral reports to the membership pertaining to various CAS activities were presented by the following:

American Academy of Actuaries	— Harold W. Schloss
Liason Committee — DOT	— Paul S. Liscord
Education and Examination Committee	— Norman J. Bennett
ASTIN	— Charles C. Hewitt, Jr.

Following the business session Vice President Johe introduced Mr. P. Adger Williams, Vice President, Travelers Insurance Companies, who moderated a panel, "Operations Research in the Insurance Industry." Mr. Williams introduced his panelists, as follows:

Edward Y. Kung
Director of Operations Research
Insurance Company of North America

Thomas Malone
Senior Vice President
Travelers Insurance Companies

Eli A. Zubay
Professor of Actuarial Science
Georgia State University

Following the panel discussion President Hazam assumed the chair and expressed the thanks of the entire membership to Mr. Bernard L. Webb and Mr. Russell P. Goddard, who were the local arrangements committee. President Hazam then adjourned the Annual Meeting at 12:30 p.m.

It is noted that registration cards completed by the attendees and filed at the registration desk indicate, in addition to about 37 wives, attendance by 101 Fellows, 51 Associates, and 21 invited guests, as follows:

FELLOWS

Adler, M.
Allen, E. S.
Bailey, R. A.
Balcarek, R. J.
Barber, H. T.
Barker, L. M.
Bennett, N. J.
Ben-Zvi, P. N.
Berquist, J. R.
Bevan, J. R.
Bickerstaff, D. R.
Bornhuetter, R. L.
Boyajian, J. H.
Brannigan, J. F.
Brown, W. W., Jr.
Budd, E. H.
Byrne, H. T.
Carleton, J. W.
Cook, C. F.
Crandall, W. H.
Curry, A. C.
Curry, H. E.
Dahme, O. E.
DeMelio, J. J.
Drobisch, M. R.
Dropkin, L. B.
Ehlert, D. W.
Elliott, G. B.
Faber, J. A.
Fairbanks, A. V.
Farnam, W. E.
Faust, J. E.
Forker, D. C.
Foster, R. B.
Gibson, J. A., III
Gillespie, J. E.
Goddard, R. P.
Gowdy, R. C.
Graham, C. M.
Hachemeister, C. A.
Hartman, G. R.
Harwayne, F.
Hazam, W. J.
Heer, E. L.
Hewitt, C. C., Jr.
Honebein, C. W.
Hunt, F. J., Jr.
Hurley, R. L.
Johe, R. L.
Johnson, R. A.
Kallop, R. H.
Kates, P. B.
Klaassen, E. J.
Linder, J.
Lino, R.
Liscord, P. S.
Longley-Cook, L. H.
Lowe, R. F.
MacGinnitie, W. J.
Makgill, S. S.
Masterson, N. E.
McClure, R. D.
McGuinness, J. S.
McLean, G. E.
McNamara, D. J.
Meenaghan, J. J.
Menzel, H. W.
Mohnblatt, A. S.
Morison, G. D.
Moseley, J.
Muetterties, J. H.
Murrin, T. E.
Newman, S. H.
Oien, R. G.
Otteson, P. M.
Perkins, W. J.
Perreault, S. L.
Petz, E. F.
Pollack, R.
Portermain, N. W.
Presley, P. O.
Richards, H. R.
Rodermund, M.
Ruchlis, E.
Ryan, K. M.
Salzmann, R. E.
Scheibl, J. A.
Scheid, J. E.
Schloss, H. W.
Simon, L. J.
Skelding, A. Z.
Smith, E. R.
Smith, S. E.
Switzer, V. J.
Tarbell, L. L., Jr.
Verhage, P. A.
Walsh, A. J.
Webb, B. L.
Williams, D. G.
Williams, P. A.
Wilson, J. C.

ASSOCIATES

Atwood, C. R.
Bell, A. A.
Bergen, R. D.
Bradshaw, J. G., Jr.
Cadorine, A. R.
Carter, E. J.
Chorpita, F. M.
Coates, W. D.
Comey, D. R.
Cooper, W. P.
Copestakes, A. D.
Crawford, W. H.
Durkin, J. H.
Ferguson, R. E.
Fossa, E. F.
Franklin, N. M.
French, J. T.
Fresch, G. W.
Gill, J. F.
Hartman, D. G.
Holt, W. T.
Hunter, J. R., Jr.
Jacobs, T. S.
Jensen, J. P.
Jorve, B. M.
Khury, C. K.
Kilbourne, F. W.

ASSOCIATES

Levin, J. W.
Lyon, L. C.
Margolis, D. R.
Moore, J. E.
Munro, R. E.
Nelson, J. K.
Pilon, A.
Plunkett, J. A.
Raid, G. A.
Richardson, J. F.
Royer, A. F.
Sawyer, J. S., III
Scammon, L. W.
Scheel, P. J.
Schneiker, H. C.
Singer, P. E.
Snader, R. H.
Stewart, C. W.
Trees, J. S.
Wade, R. C.
White, H. G.
White, W. D.
Young, R. G.
Zory, P. B.

GUESTS

*Babb, J. A.
*Banfield, C. J.
*Battaglin, B. H.
Black, K., Jr.
Chamberlain, R. H.
*Eddins, J. M.
Gibson, J. W.
Hall, J. W.
*Hayden, R. C.
*Hewey, H. V.
*Kedrow, W. M.
Kung, E. Y.
Lacy, A. B., Jr.
Lipscomb, E.
Malone, T.
*McClenahan, C. L.
*Nagel, J. R.
Schwarzschild, S.
Stiglitz, A. M.
Williams, D. R.
Zubay, E. A.

* Invitational Program

Respectfully submitted,

R. L. BORNHUETTER,
Secretary-Treasurer

REPORT OF THE SECRETARY-TREASURER

During the past year the Council met four times. The following summarizes the principal actions taken:

Meeting of March 3, 1969

Voted to recommend to the membership that the Casualty Actuarial Society apply for incorporation as a Not For Profit Corporation under the applicable statutes of the State of Illinois. The membership subsequently approved that recommendation and the incorporation of the Casualty Actuarial Society has been effectuated.

Voted to recommend to the membership specific amendments to the Constitution and Bylaws. Those amendments were approved by the membership to become effective May 26, 1969.

Voted that the officers of the Society be empowered to determine the amount of the registration fee for attendance at each of the future meetings of the Society.

Voted to proceed with the printing of a brochure, *The Essential Executive.*

Meeting of May 25-26, 1969

Voted to cooperate with Georgia State University in the preparation of a textbook, tentatively identified as *Casualty Contingencies,* dealing with the mathematics of non-life insurance.

Meeting of September 8, 1969

Subject to ratification by the Fellows at the 1969 Annual Meeting, the Council made the following appointments:

Editor	Matthew Rodermund
Librarian	Richard Lino
General Chairman, Education and Examination Committee	M. Stanley Hughey

Adopted the recommendation of Chairman Lester B. Dropkin that the Committee on Mathematical Theory of Risk be discharged with the

thought that, if future developments indicated the desirability of a study on some phase of the theory of risk, it would be in order to appoint a committee for that specific purpose.

Voted that the Committee on Automobile Research be discharged.

Voted that the Committee on Annual Statement be instructed to render periodic reports on items of interest, including activities of the NAIC committees on matters relating to the annual statement.

Meeting of November 16, 1969

Adopted a resolution that, in the future, either the President or Secretary-Treasurer be empowered to withdraw funds on behalf of the CAS from the checking and savings accounts and have access to the safe deposit box.

Ratified various committee appointments made by President Hazam in accordance with the procedure set forth in Article VI of the Constitution.

Adopted the reports made by various committee chairmen. It is noted that the adopted report of the Finance Committee recommends, among other items:

(1) The Council consider the possibility of expanding the activities of the Society to provide for
   (a) Establishing scholarships;
   (b) Establishing awards for outstanding papers;
   (c) Financing desirable special research projects which, because of their magnitude, preclude the possibility of members of the Society and its committees being able to devote the required amount of time thereon;
   (d) Becoming increasingly self-supporting in carrying on the routine activities of the Society.

(2) To prepare for items (c) and (d) above, the per annum dues be established at

Associates	$25.00
Fellows	$50.00
Foreign (except Canada) and members in armed forces	$20.00

(3) The annual subscription to the Invitational Program be $50.00, with the further change that the present waiver of the registration fee for attendance at CAS meetings by a representative of a subscriber to the program be discontinued.

Voted that there be printed in the Year Book an outline setting forth in some detail the functions and duties of the various CAS committees.

Copies of the Financial Report of the Secretary-Treasurer for the 12 months ending September 30, 1969 were available at the registration desk for the 1969 Annual Meeting. The Financial Report is printed in these *Proceedings* following this Report.

It is noted that, due to a number of fortunate circumstances, presumably non-recurring, the Society enjoyed an unusually successful year financially; income exceeded disbursements by $20,726.00, so that assets now stand at a total of $52,539.93, made up of

Checking account balance	$ 5,461.06
Savings account balance	17,060.09
U.S. Government securities	30,018.78
Total	$52,539.93

It is also noted that, subsequent to the date of the Financial Report, additional funds were withdrawn from the checking and savings accounts and invested in U.S. Government securities.

A. Z. SKELDING,
Secretary-Treasurer

FINANCIAL REPORT

Income and Disbursements

(from October 1, 1968 through September 30, 1969)

Income		Disbursements	
Members dues	$13,155.00	Printing and stationery	$15,704.79
Examination fees	6,495.73	Secretary's office	2,400.00
Meetings	3,518.74	Examination expense	2,468.49
Registration fees	3,768.45	Meeting expense	5,067.02
Bond and Treasury Bill interest	1,018.17	Library	359.43
Savings account interest	456.83	Insurance	146.00
Sale of *Proceedings*	6,663.16	Investment expense	115.00
Sale of Readings	164.50	International Actuarial Association	25.00
Invitational program	1,740.00	Miscellaneous	81.43
Michelbacher Fund	662.58		
Dorweiler legacy	7,200.00		
Contributions	2,250.00		
Total	$47,093.16	Total	$26,367.16

Assets

As of 10-1-68		As of 10-1-69		GAIN
Checking account	$ 8,418.10	Checking account	$ 5,461.06	$—2,957.04
Bowery Savings	4,403.26	Bowery Savings	17,060.09	12,656.83
Investments	18,992,57	Investments	30,018.78	11,026.21
Total	$31,813.93	Total	$52,539.93	$ 20,726.00

(Accumulation of Michelbacher Fund: $19,242.12 + $662.58 = $19,904.70)

Investments

All investments are carried at cost except the two $1,000.00 U. S. Treasury Bonds due November 15, 1974 which are carried at the maturity value of $2,000.00.

Two U. S. Treasury Bonds 3⅞% Nos. 1673-4 due 11-15-74 for $1,000 each,	$ 2,000.00
$5,000 U. S. Treasury Bond 5¾% No. 299 due 2-15-75,	4,981.25
$5,000 U. S. Treasury Bond 4% No. 5263 due 2-15-80,	4,325.00
$5,000 U. S. Treasury Bill No. 995, 840A due 4-30-70,	4,710.25
Five $1,000 U. S. Treasury Bills Nos. 2953768A-69A-70A-71A-72A due 8-31-70,	4,645.48
$5,000 U. S. Treasury Bill No. 1060972A due 5-31-70,	4,676.17
Five $1,000 U. S. Treasury Bills Nos. 1345603A-04A-05A-06A-07A due 12-31-69,	4,680.63
Total carried at	$30,018.78

Insurance

Employers' Fire Insurance Company Policy No. F16-1099-81 for $5,000 on books and book cases stored at 200 East 42nd Street, New York City, and $2,000 on books stored in library of Insurance Society of New York. Expires 9-14-70.

Fidelity Bond No. 044571 for $25,000 in Royal Indemnity Company.

Workmen's Compensation Policy No. 7624-69-85 with Coverage B Employers' Liability endorsement for $25,000 in Federal Insurance Company. Expires 5-10-70.

Owners', Landlords' and Tenants' Liability Policy No. 7750-99-57 in Federal Insurance Company for 100,000/300,000/5,000. Expires 4-23-70.

This is to certify that we have audited the accounts and the assets shown above and find same to be correct.

Finance Committee
HENRY W. MENZEL, Chairman
JOHN H. BOYAJIAN
THOMAS W. FOWLER

October 24, 1969

1969 EXAMINATIONS — SUCCESSFUL CANDIDATES

Examinations for Parts 3 through 9 of the Casualty Actuarial Society syllabus were held May 20, 21, and 22, 1969, and examinations for Parts 4, 6, and 8 were held November 5, 1969. Parts 1 and 2 were jointly sponsored by the Casualty Actuarial Society and the Society of Actuaries, and were given May 14, 1969 and November 12, 1969. Those who passed Parts 1 and 2 were listed in the joint releases of the two Societies dated July 2, 1969 and December 31, 1969.

The following candidates, having successfully completed the requirements for Associateship during 1968, were admitted as Associates at the May 1969 meeting:

John G. Bradshaw, Jr.
Warren P. Cooper
Gerald R. Hartman
Joseph W. Levin

Since Gerald R. Hartman had also completed the requirements for Fellowship, he was awarded his diploma as Fellow at the same meeting.

MAY 1969 EXAMINATIONS

Following is the list of successful candidates in the examinations held in May, 1969:

ASSOCIATESHIP EXAMINATIONS

Part 3

Anker, Robert A.
Bass, Frederick B.
Battaglin, Bernard H.
Butler, Robert J.
Coddington, Alan W.
Crow, Sandra B.
Dempster, Howard V., Jr.
Hoffman, Dennis E.
Miller, Philip D.
Petertil, Jeffrey P.
Rais, Arnold M.
Sandler, Robert M.
Skurnick, David
Song, Young B.
Swaziek, Raymond R.
Tatge, Robert L.
Vojtik, Peter C.
Walton, Robert E.

Part 4 (a)

Hannes, Louis N.
Wade, Roger C.

Part 4 (b)

Balko, Karen H.
Cadorine, Arthur R.
Fresch, Glenn W.
Guidali, Lynn L.
Hearn, Vincent W.
Lloyd, Neil G.
McDonald, Michael P.
Quirk, William J.
Rosser, Harwood
Sawyer, Joshua S., III
Simons, Martin M.
Stewart, Charles W.
Vogel, Jerome F.
White, Hugh G.
Williams, David R.
Young, Edward W.

Part 4

DeChant, Robert D.
Drennan, John P.
Hawkins, Raymond W.
Lindquist, Robert J.
Pilon, Andre
Tatge, Robert L.
Wilson, Oliver T.

Part 5

Balko, Karen H.
Bill, Richard A.
Cadorine, Arthur R.
Fresch, Glenn W.
Head, Thomas F.
Napierski, John D.
Peterson, Nils A.
Pilon, Andre
Sandler, Robert M.
Sawyer, Joshua S., III
Skurnick, David
Stephenson, Elton A.
Stewart, Charles W.
White, Hugh G.

FELLOWSHIP EXAMINATIONS

Part 6

Bickerstaff, David R.
Lowe, Robert F.
Quinlan, John A.
Spitzer, Charles R.
Walters, Michael A.

Part 7

Atwood, Clarence R.
Banfield, Carole J.
Beckman, Raymond W., III
Bergen, Robert D.
Comey, Dale R.
Cooper, Warren P.
Ferguson, Ronald E.
Flynn, David P.
Fresch, Glenn W.
Grady, David J.
Hartman, David G.
Klingman, George C.
McDonald, Charles
Munro, Richard E.
Olsen, Dennis W.
Perreault, Stephen L.
Richardson, James F.
Ward, Michael R.
White, William D.

Part 8

Adler, Martin
Amlie, William P.
Bickerstaff, David R.
Brian, Robert A.
Farnam, Walter E.
Gowdy, Robert C.
Heer, E. LeRoy
Perreault, Stephen L.
Scheid, James E.

Part 9

Adler, Martin
Banfield, Carole J.
Beckman, Raymond W., III
Bergen, Robert D.
Brown, William W.
Faber, James A.
Farnam, Walter E.
Gowdy, Robert C.
Honebein, Carlton W.
Hunter, J. Robert, Jr.
Jacobs, Terry S.
Kilbourne, Frederick W.
Lowe, Robert F.
Scheel, Paul J.
Snader, Richard H.
White, William D.
Zory, Peter B.

As a result of the above examinations seven new Associates and twelve new Fellows were admitted at the Annual Meeting November 17, 1969:

NEW ASSOCIATES

Cadorine, Arthur R.
Fresch, Glenn W.
Pilon, Andre
Sawyer, Joshua S., III
Stewart, Charles W.
Wade, Roger C.
White, Hugh G.

NEW FELLOWS

Adler, Martin
Bickerstaff, David R.
Brown, William W., Jr.
Faber, James A.
Farnam, Walter E.
Gowdy, Robert C.
Heer, E. LeRoy
Honebein, Carlton W.
Lowe, Robert F.
Perreault, Stephen L.
Quinlan, John A.
Scheid, James E.

NOVEMBER 1969 EXAMINATIONS

The successful candidates in the November 1969 examinations were:

ASSOCIATESHIP EXAMINATIONS

Part 4 (a)

Tyrcha, Donald J.

Part 4 (b)

Bacher, William C.
Bradford, John A.
Crescio, Joseph P.
Crow, Sandra B.
Grippa, Anthony J.
Mark, Thomas
Napierski, John D.
Potvin, Robert
Sullivan, Jerry J.

Part 4

Anker, Robert A.
Battaglin, Bernard H.
Bill, Richard A.
Coddington, Alan W.
Connors, John B.
Graves, George G.
Hannum, David W.
Head, Thomas F.
Jersey, Joseph R.
Krause, Gustave A.
Miller, Michael J.
Moore, Phillip S.
Ori, Kenneth R.
Powell, David S.
Ross, James P.
Sandler, Robert M.
Schaeffer, Bernard G.
Skurnick, David
Song, Young B.
Spooner, F. Allen
Stephenson, Elton A.
Swaziek, Raymond R.
Young, Danny M.
Zarella, Edward G.

FELLOWSHIP EXAMINATIONS

Part 6

Beckman, Raymond W., III
Bell, Allan A.
Chorpita, Fred M.
Fresch, Glenn W.
Grippa, Anthony J.
Jacobs, Terry S.
Jones, Alan G.
Khury, Costandy K.
Levin, Joseph W.
Nelson, John K.
Plunkett, Joseph A.
Quirk, William J.
Richardson, James F.
Sawyer, J. Stewart
White, Hugh G.

Part 8

Atwood, Clarence R.
Beckman, Raymond W., III
Chorpita, Fred M.
Comey, Dale R.
Dickson, Carol D.
Ferguson, Ronald E.
Flynn, David P.
Grady, David J.
Hartman, David G.
Holt, William T.
Jacobs, Terry S.
Jones, Del R.
Kilbourne, Frederick W.
Klingman, George C.
Munro, Richard E.
Murray, Edward R.
Scheel, Paul J.
Snader, Richard H.
White, Hugh G.
White, William D.

Six candidates for Associateship and six candidates for Fellowship completed their requirements in the above examinations and will be admitted at the Spring Meeting in May 1970. They are:

NEW ASSOCIATES

Bill, Richard A.
Head, Thomas F.
Napierski, John D.
Sandler, Robert M.
Skurnick, David
Stephenson, Elton A.

NEW FELLOWS

Beckman, Raymond W., III
Jacobs, Terry S.
Kilbourne, Frederick W.
Munro, Richard E.
Scheel, Paul J.
White, William D.

OBITUARIES

AUSTIN F. ALLEN
1892 — 1969

Austin F. Allen, a pioneer in the Dallas insurance industry, died October 8, 1969 at the age of 77. The retired Chairman of the Board of Employers Insurance of Texas had been associated with the insurance industry since the age of 18. He had been an associate of the Casualty Actuarial Society since 1928.

Austin F. Allen was born in Avoyelles Parish, Louisiana, on February 22, 1892, and came to Texas in 1897. He first entered the insurance business in a Beaumont agency in 1910, and came to Dallas in 1912 with Trezevant & Cochran, general agents, where he remained until the Texas Employers' Insurance Association was organized in 1914. He joined the newly-created insurance organization, and grew along with it. In 1920 Employers Casualty Company was organized as a companion firm of TEIA, and in 1926 Allen was named secretary of both companies. The following year he became vice president and sales manager, and in 1928 he was elected executive vice president. For ten years he served in that capacity until he was elected to the presidency in 1938. In October, 1956, he was elected Chairman of the Board of Texas Employers' Insurance Association, Employers Casualty Company, and the recently-created Employers National Insurance Company, another companion firm.

He remained board chairman until his retirement in March, 1962, but stayed on as a member of the boards of directors and executive committees of these companies, as well as of Employers National Life Insurance Company, which was chartered in 1961.

In the insurance industry Mr. Allen won recognition for Dallas and Texas throughout the nation. During his long career he served as president of the National Association of Mutual Casualty Companies, a member of the board of trustees and executive committee of the American Institute for Property and Liability Underwriters, Inc., and a director of the American Mutual Insurance Alliance.

He was a director of the Republic National Bank of Dallas and the Children's Medical Center; a member of the executive board of the Circle Ten Council, Boy Scouts of America (Silver Beaver, 1952); president of the Circle Ten Boy Scouts Foundation; member of the executive committee of Region Nine, Boy Scouts of America (Silver Antelope, 1960), and chairman of the Region Nine Trust Foundation, Boy Scouts of America. In addition, he was a member of the board of trustees of the Texas Research Foundation and executive committee member of the Texas Good Roads Association.

Mr. Allen served as director and vice president of the Dallas Chamber of Commerce (1947-48-49) and a director (1952-53-54), campaign member of the Dallas County War Chest (1945), a chairman of the advisory board of the Salvation Army (1949), member of the boards of directors of the Y.M.C.A., National Safety Council, and Dallas Citizens Council.

He was a Senior Active Member of the Rotary Club of Dallas, and a member of the Masonic Order and the Central Congregational Church.

Mr. Allen is survived by his wife, the former Sadie Stephens; two daughters, Mrs. Logan U. Mewhinney and Mrs. Joe G. Roach, Jr., both of Dallas; five grandchildren; one greatgranddaughter; a brother, Lloyd J. Allen, Beaumont; and a sister, Mrs. Oscar Ebner, Houston.

ERNEST T. BERKELEY

1906 — 1969

Ernest T. Berkeley, past vice president of the Casualty Actuarial Society, died suddenly at his home December 26, 1969. He was 63 years old

and had just recently retired as actuary of the Employers-Commercial Union Companies after forty years of active service.

Mr. Berkeley, although born in Massachusetts, spent most of his boyhood in Maine and developed a great interest in fishing. He graduated from Harvard College in 1927 with an A.B. in mathematics and immediately entered the teaching profession. In 1929 a family friend, who was an actuary in Worcester, interested him in actuarial work and he joined the Employers as a clerk in the actuarial and statistical department. By 1934 Mr. Berkeley had become a Fellow of the Casualty Actuarial Society, and he was appointed superintendent of the actuarial and statistical department and finally actuary of the company.

During his forty years in the actuarial field Mr. Berkeley contributed much to the insurance industry. He served actively on several key national actuarial committees including the New York Compensation Insurance Rating Board, Massachusetts Automobile Rating Bureau, Inter-Regional Insurance Conference, and Workmen's Compensation Reinsurance Bureau. In addition he was active in other professional organizations, including the American Academy of Actuaries, the International Congress of Actuaries, and the Actuaries Club of Boston.

Mr. Berkeley's interests outside the insurance business were equally impressive. He gave freely of his time to community and church affairs, in particular the Boy Scouts and community fund drives. He was very active in his church and sang with the church choir for a number of years and served on the music committee.

He leaves his wife, Grace; two sons, Ernest and Stephen; and a daughter, Mrs. Patricia Wescott.

ELDEN W. DAY

1898 — 1969

Elden W. Day, who retired in 1963 as resident secretary of Lumbermens Mutual Casualty Company and American Motorists Insurance Company, died suddenly June 9, 1969, at Fairhope, Alabama, at the age of 71. He had been a Fellow of the Casualty Actuarial Society since 1956.

A native of Davenport, Iowa, Mr. Day attended Brown's Business College and Columbian Correspondence College. He joined Lumbermens Mutual Casualty Company, principal carrier of the Kemper Insurance Group,

in 1929, as auto underwriter. In 1942 he was appointed the company's Bureau representative in New York City, and the remainder of his career was in Bureau work.

At the Mutual Insurance Rating Bureau, Mr. Day served on the Governing Committee and on both the Automobile and the Liability Rating Committees. He also was a member of the Governing Committees of the Automobile Bureaus of Massachusetts, North Carolina, and Virginia. In addition, he represented the Kemper companies on the Governing, Rates, and Regional Committees of the National Council on Compensation Insurance, and alternated as chairman of the Coal Mine Pools.

However, it was in the area of the automobile assigned risk plans that "Dutch" Day became best known for his unique talents. He was the Mutual Bureau representative on the Governing Committee of the New York Automobile Assigned Risk Plan and the other eastern plans commonly administered. More important, he was a charter member of the National Advisory Committee on Automobile Assigned Risk Plans (now known as National Industry Committee) since its inception in 1946. One of the original architects of the uniform assigned risk plan, he eventually became known as "Mr. Assigned Risk Plan." His paper, "A History of the Uniform Automobile Assigned Risk Plan," in the 1956 *Proceedings,* is still recommended reading for those studying for the examinations of the Casualty Actuarial Society.

Mr. Day was equally active in community affairs. He was a member of the Advisory Council, Order of De Molay, Yonkers Chapter, and was chairman of the Troop Committee of the Hastings Boy Scouts of America. He was a member of the Consistory of New York of Ancient and Accepted Scottish Rites, and of the Mecca Temple of the Shriners. He also served on the vestry of Grace Church, White Plains.

He is survived by his wife, Leona, and his son, Reverend Dennis L. Day.

CARL HILDING FREDRICKSON

1897 — 1969

C. H. Fredrickson, a Fellow of the Casualty Actuarial Society since 1927, died in his retirement home on Galiano Island, British Columbia, on January 12, 1969. He had returned to the sea he held so dear after spending his Canadian lifetime in Ontario.

Mr. Fredrickson was respected as the dominant force in Canadian auto-

mobile actuarial work from the time of the Royal Commission of 1929 which laid the foundation for all-industry compulsory statistical reporting. But since 1924 statistics had been reported to the Canadian Underwriters' Statistical Agency, managed by Mr. Fredrickson. The Canadian automobile insurance industry is indebted to Mr. Fredrickson for the statistcal exhibit format and interpretive techniques which he founded, developed, and expanded.

The industry and his associates will remember him as a most unusual man. He was born in Sweden and went to sea at the age of 16. He had his Masters papers for square riggers when he was 21 and was captain of one of the Swedish ships patrolling the U-boat zones of the North Atlantic during the first World War. Due to an accident aboard ship which impaired his vision, he left the sea and entered university in Sweden soon after the war. He was attracted to the casualty actuarial profession and immigrated to the United States to begin his career as an actuarial student in New York City.

In 1924 he and his wife moved north to Toronto, where he assisted in workmen's compensation legislation. In a short time he was employed by the Canadian Automobile Underwriters' Association and was setting up a statistical staff and requirements for automobile experience.

All during his lifetime he was an avid fly-fisherman, hunter, canoeist, naturalist, and storyteller. His warmth and charm were boundless. He was thoroughly enjoyed by his Canadian friends and many American fellow actuaries whom he met as often as he could at Casualty Actuarial Society meetings.

On retirement in 1962 he moved from Ontario back to the sea in British Columbia and built a home on Galiano Island, one of the Gulf Islands off British Columbia's Vancouver Island. As always his boundless energy and intellect enabled him to become a fairly competent master carpenter. With the help of his youngest son, Sammy, he built his own home on this beautiful mountainous island in the Pacific, fulfilling a lifelong desire to leave in his wake a piece of land improved by his own hand. He leaves his wife Ragna and three other children, sons John and Torgne and daughter Britta.

S. TYLER NELSON

1908 — 1969

S. Tyler Nelson, who became a Fellow of the Casualty Actuarial Society in 1963, died at his home in Frankfort, Kentucky on August 9, 1969.

At the time of his death he was actuary of the Kentucky Insurance Department.

Ty Nelson was born in the State of Washington. At the age of 17 he spent a year alone on the Prince of Wales Island off the coast of Alaska, tending salmon traps. The interesting tales he was able to tell of that experience were the source of considerable enjoyment to his colleagues in later years.

Following that stint he went east and, after graduating from college, joined the Utica Mutual Insurance Company in 1930. He spent eighteen years at the Utica, becoming actuary and assistant to the president. He became an Associate of the Society in 1935.

From 1948 to 1953 Mr. Nelson served as casualty actuary of the Illinois Insurance Department, and from 1953 to 1955 he was vice president of the Exchange Insurance Association in Chicago. From there he went to the American Agricultural Insurance Company, serving until 1966 as that company's casualty manager and actuary of its reinsurance operations. In 1966 he went into consulting work and in 1967 joined the Kentucky Department.

In 1965 he became one of the charter members of the American Academy of Actuaries.

Mr. Nelson is survived by his wife, Luella; three sons, S. Tyler Jr., of Kansas City, Kansas; Jesse, of Wheaton, Illinois; and Robert, of Frankfort; a daughter, Mrs. Lynn Cores, of Glen Ellyn, Illinois; a sister, Miss Ardes Nelson, of California; three grandsons, and a granddaughter born shortly after his death.

ALAN W. WAITE

1890 — 1969

Alan W. Waite, retired Secretary of the Aetna Casualty and Surety Company, died August 17, 1969, at his home in Bloomfield, Connecticut. He was 79 years old and had retired in 1958.

He was born in Hockanum, Connecticut, April 19, 1890, and was educated at Hartford Public High School and at Yale University, in the class of 1912, where he was elected to Phi Beta Kappa. He spent his working life in the service of the Aetna Life & Casualty companies at Hartford.

Alan W. Waite became an Associate member of the Casualty Actuarial and Statistical Society of America (the Society's name until 1921, it will be recalled) by passing the 1916 examinations, making him one of the second group of Associates by examination. In 1917, he passed the first half of the examination for Fellowship. But at least half of the eight 1916 Associates, including Waite, entered the service of the United States in World War I, and it was not until 1920 that he became a Fellow, after his army service as a lieutenant in France. He was immediately appointed to the Committee on Program and served the Society in that way and then on the Examination Committee for some years.

He was committed to his work and became an eminent compensation and liability underwriter, so that he was regularly a member of various governing and rating committees of the business. Some Society members knew A. W. Waite best from their associations with him in these groups. Since he was not actively an actuary, his participation in the Society's work was limited to an occasional visit or discussion except for the early period mentioned.

He was a man of high principles and incisive views, a gentleman and a genial friend, also. He was a good tennis player and kept up his game until a fractured hip prevented in the last period of his life. At one time, he was the Aetna's tennis champion. A life-long membership in the Appalachian Mountain Club likewise attests his active, vigorous personality. None attempted twice to accompany his striding morning walk of some miles from his West Hartford home to his office.

A. W. Waite was a Mason and a member of the American Legion. Mrs. Waite had predeceased him. He left a son, Alan W. Waite, Jr.; a daughter, Mrs. Ruth W. Jordan; his brother, Roger T. Waite; and three grandchildren. His brother is also known to a number of Society members for his work in insurance aspects of nuclear energy.

INDEX TO VOLUME LVI

INDEX TO VOLUME LVI (Cont.)

INDEX TO VOLUME LVI (Cont.)

INDEX TO VOLUME LVI (Cont.)