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RATE REGULATION AND THE CASUALTY ACTUARY — REVISITED

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Regulation is with us, to stay, and only a proper appreciation of its impact upon all parties, public and private, stock and non-stock, organization and independent, can produce the reconciliation of conflicting interests that will make it work effectively and for the good of all.

— Thomas O. Carlson

In the aftermath of the SEUA Case (322 U.S. 533), Public Law 15, effective March 9, 1945, gave the states until January 1, 1948 (later extended to June 30, 1948) to enact regulatory legislation so as to prevent complete application of the federal anti-trust acts to the insurance industry. The resulting casualty rating legislation, largely variations of a model bill drafted by an All-Industry Committee (AIC) in cooperation with the National Association of Insurance Commissioners, was described by Thomas O. Carlson in a paper entitled "Rate Regulation and the Casualty Actuary" and presented to this Society in 1951.[1]

Over twenty years have elapsed since the enactment of legislation in the wake of Public Law 15. During this period several administrative actions and court decisions have served to interpret many sections of the rating laws. Numerous amendments to the rating laws have been proposed and many enacted. In some states substantial revisions have occurred and today, as

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[1] Carlson, T. O., "Rate Regulation and the Casualty Actuary," *PCAS* Vol. XXXVIII, p. 9.

in the past, some advocate even more far-reaching change — federal regulation.

With the passing of sixteen eventful years, one might expect that Carlson's paper on regulation would be of little value today, but this is not the case. Therefore, the authors of this paper have sought to supplement Carlson's paper rather than to supplant it.

In addition to reviewing the proposed and enacted legislation since 1951, one can, in 1967, review the statutory language by reference to its administration by insurance commissioners and to its interpretation by the courts during the past sixteen years. The administration of the statutes has been no more uniform than their wording, which Carlson termed a "maze of legalistic meanderings and by-paths." Thus, in two states with so-called "file and use" laws, one simply acknowledges filings while the other stamps them approved for use. In two states with similar versions of the "model bill," one may routinely approve almost all submissions, while the other may have complex filing requirements promulgated by administrative order and may approve only those filings which conform to its "accepted" ratemaking formula. Even with this broad diversity, it is instructive in determining the meaning of identical (and similar) sections of the regulatory laws to see how they have been administered in the several states.

The final determination of what a law means lies with the courts. Unfortunately, there is no shortage of insurance rate cases to quote from, and the authors have attempted to be selective. Most of the quotations are from five cases, which are very briefly summarized in Appendix B. It is hoped that the summaries will help make the context of each quotation clear. The intent is to present a judicial over-view of ratemaking procedures, not a definitive list of relevant cases on the issues examined. The five most frequently quoted cases are drawn from five states and deal with automobile (3), fire (1) and compensation (1) insurance. While this diversity may appear to be a handicap, it should be noted, for example, that one automobile case[2] was quoted by a court in a compensation decision and another[3] was cited in a court decision involving a telephone company and a public utility commission. The latter auto case, drawn from a state where the commissioner has the power to fix auto rates, also was cited in a court decision

[2] *National Bureau of Casualty Underwriters* v. *Superintendent of Insurance of the State of New York*, 6 A.D. 2d 72, 174 N.Y.S. 2d 836 (1958), reversed for mootness 6 N.Y. 2d 842. (See Appendix B)

[3] *Massachusetts Bonding and Insurance Company* v. *Commissioner of Insurance*, 329 Mass. 265, 107 N.E. 2d 807 (1952). (See Appendix B)

in a state where the commissioner does not have such power. Thus, certain principles propounded by the courts are not limited in application to the jurisdiction, line of insurance, or even industry involved, but rather have broad validity. In reviewing the case summaries and commentaries, the reader is cautioned that the authors are not lawyers.

> *Each ferry ought to be under a public regulation, to wit, that it give attendance at due time, a boat in due order and take but reasonable toll.*
>
> — Lord Hale (1670)

These basic rules of regulation laid down almost three hundred years ago by Sir Matthew Hale, Lord Chief Justice to the King's Bench during the reign of James I, for an industry providing a public service are embodied, in embellished form, in the insurance codes of today. The sections of the insurance laws dealt with in this paper are designed largely to provide a means for ascertaining whether the toll be reasonable or not. Attention is focused upon the regulation of rates for casualty insurance other than compensation insurance. The statutes will be examined by paragraph in the same order as in Carlson's paper, first as they have been interpreted by the Commissioners and the courts, where administrative orders and court decisions have been made, second by reviewing the changes in the statutes which have occurred at the state level and finally in relation to proposed amendments thereof. The text of several sections of the AIC (Casualty and Surety Rate Regulatory Model) Bill is presented in Appendix A, along with detailed descriptions of the more substantive differences between the existing rating laws and the Model Casualty Bill.

(a) Base Criteria for Rates (AIC Bill § 3(a)4)

In practice, the criteria "not excessive, inadequate or unfairly discriminatory" have been broadly interpreted to mean just or reasonable. Generally, neither the legislature nor the regulatory authorities have provided precise, legal definitions of the terms. "The legislatures have specified that the authority to approve or disapprove a rate filing is vested in the Commissioner of Insurance. The question as to whether the rates specified in the filings are either inadequate or excessive is not addressed to this Court."[4]

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[4] *John S. Carroll, Hubert Safran,* and *David Hahn on behalf of all other persons similarly situated,* Plaintiffs, v. *J. Richard Barnes,* Defendant, District Court in and for the City and County of Denver and state of Colorado (1967). (See Appendix B)

In those cases where the courts have felt it necessary to provide some interpretation of the statutory criteria they have generally held that rates must be high enough to provide for the payment of losses and expenses, and to provide a margin for profit. A Minnesota court[5] in commenting on what constituted a "reasonable" rate stated: "The workmen's compensation rate must be high enough to provide the revenue necessary to cover the amount needed for the payment of workers' claims and also to cover the expenses and provide a profit to the insurance carrier." Similar language was used by the Wisconsin court[6] in a fire rate case when it stated that rates should be sufficient to cover future losses, expenses and a margin for profit.

The statutory definitions of the criteria provided by a few states should probably be taken as providing a range of reasonableness, rather than an exact test of the rates. For example, it is doubtful that it was the legislative intent in California to test the adequacy of rates *solely* by the standard that "No rate shall be held to be inadequate unless (1) such rate is unreasonably low for the insurance provided and (2) the continued use of such rate endangers the solvency of the insurer using the same. . . ."[7] Rather, the definition of inadequacy must be read with that of excessiveness in providing a range within which rates are acceptable. This may be illustrated by a Massachusetts case, in which the commissioner maintained that in order for the rates to be inadequate they must be confiscatory. In striking down the commissioner's contention, the court states: "We are of the opinion that the statute imposes upon the commissioner the duty of fixing a rate that lies somewhere between the lowest rate that is not confiscatory and the highest rate that is not excessive or extortionate."[8] In the same decision the court quoted an earlier case which held that "The mere fact that a rate is non-confiscatory does not indicate that it must be deemed to be just and reasonable."[9] Apparently Carlson's remarks concerning a "zone of reasonableness" continue to be relevant. It may be noted at this point that a mere statement by the commissioner in a disapproval order that rates are excessive, inadequate or unfairly discriminatory is insufficient to be upheld. Several courts have commented on this point. In the words of an Illinois court: "It is not sufficient for the Director [of Insurance] to say that the

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[5] *State ex. rel. Minnesota Employers' Association et. al.* v. *Faricy et. al.,* 363 Minn. 468, 53 N.W. 2d 457 (1952). (See Appendix B)

[6] *Fire Insurance Rating Bureau* v. *Rogan,* 4 Wis. 2d 558, 91 N.W. 2d 372 (1957). (See Appendix B)

[7] *California Insurance Code,* Article 2 § 1852(a). (See Appendix A, section (a))

[8] *Mass. Bonding* v. *Commissioner, op. cit.*

[9] *Banton* v. *Belt Line Railway,* 268 U.S. 413, 423, 455. Ct. 534, 537, 69 L. Ed. 1020.

rates are excessive or inadequate or unfairly discriminatory. The language of the act is that he give notice *wherein* the rates are discriminatory or excessive or inadequate."[10]

Carlson noted that unfortunately there were many who felt that it should be possible to determine from the statistics an incontrovertible or actuarially exact result. Regrettably, there remain a few quixotic accountants, legislators and regulators who seek the development of an actuarially exact formula which would eliminate judgment and end controversy over trend factors, development factors, limitations, etc. The concept has been embodied in the proposed (and never enacted) "statistical rating law,"[11] in the administrative orders of some insurance departments,[12] and in proposals from intervenors at public hearings.[13] But like Shangri-La the final, actuarially exact formula is never discovered, because, alas, it does not exist. On this issue, the courts also have upheld Carlson's view. That the work of the actuary is an art in which there will be differences of opinion was recognized in a Wisconsin fire rate case when the court stated:

> In filing proposed new rates it seems to us that the statute contemplates that the bureau is faced with the difficult problem of estimating what will happen in the future. The best guide to the future is what has happened in the past. Its calculations must be based on estimates advisedly made rather than on conjecture. . .
>
> In reviewing the proposed rates the duty of the commissioner and his staff is the same. . . . It is not surprising that the Bureau's staff and the commissioner's staff should arrive at different estimates when there is no mathematical formula or slide rule that will permit the calculation of exact percentages of earned premiums to be allocated for future expenses, losses and underwriting profits.[14]

In a workmen's compensation rate case, a Minnesota court addressed itself to the question of whether or not the State Board in setting rates must limit itself to the use of a mathematical formula:

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[10] *National Bureau of Casualty Underwriters* v. *McCarthy*, Circuit Court, Cook County, Illinois (1956).

[11] Muir, J., "Problems of Rating Organization," *PCAS* Vol. XLIX, pp. 190–191.

[12] See, for example, the administrative orders of the Kentucky Insurance Department.

[13] See, for example, the proposals of T. Grayson Maddrea in the 1966 Virginia and Maine Hearings.

[14] *Fire Bureau* v. *Rogan, op. cit.*

> [T]here is not certainty that mathematically sound adjustments would produce results more accurate than those used by the Board . . . We do not mean . . . that the Board is required to use a mathematically precise formula but to make the various adjustments. The Board, at its discretion, may consider facts and circumstances which are not incorporated in the formula for the computation of a given adjustment.[15]

It would appear from these and other cases that the courts recognize the need for flexibility and judgment in the application of the basic criteria for rates.

Since 1951 several items relating to the basic criteria of rates have appeared on the agenda of various committees of the NAIC. For example, it has been feared that unfair discrimination may have resulted from the use of (1) different profit and contingency factors, (2) non-uniform rating systems for assigned risks, (3) excessive term discounts, (4) fictitious fleets, (5) certain class systems, and (6) schedule rating and/or expense modification. Interest also has been shown in the criteria of not excessive and not inadequate. It can be argued that if a rate is unfairly discriminatory, then it is either excessive or inadequate. Discussion of one criterion is bound to raise discussion of another or all three because as Carlson pointed out it is not possible to apply the three criteria separately. The problem of application is compounded because of a lack of definition of the criteria. In 1951 the statutes in only six, ten, and seven states provided guidelines as to the meaning of excessive, inadequate and unfairly discriminatory, respectively, whereas in 1967 it appears that the statutes in nine, thirteen and ten states, respectively, have attempted definitions of the criteria.

In May, 1960 the National Association of Independent Insurers (NAII) expressed its concern over the absence of definitions of rate excessiveness and inadequacy in most state laws.[16] At the same time the NAII proposed to remedy this and other rate regulatory problems with the introduction of its "Proposed Casualty, Surety, Fire, Marine and Inland Marine Regulatory Bill." The bill adopted the California-Missouri type definition of excessive:

> No rate shall be held to be excessive unless (1) such rate is unreasonably high for the insurance provided and (2) a reasonable

[15] *State* v. *Faricy, op. cit.*

> degree of competition does not exist in the area with respect to the classification to which the rate is applicable.[16]

The bill incorporated a new definition of inadequate:

> No rate shall be held to be inadequate which upon reasonable assumptions of prospective loss and expense experience will not produce an underwriting loss.[16]

To date no state has adopted this definition; however, its basic concept appears to be embodied within the more encompassing Indiana definition:

> No rate shall be held to be inadequate unless such rate is unreasonably low for the insurance coverage provided and is insufficient to sustain projected losses and expenses, or unless such rate is unreasonably low for the insurance coverage provided and the use of such rate has, or if continued, will have, the effect of destroying competition or creating a monopoly.[16]

Although some members of the NAIC have expressed their concern over the lack of definitions for the basic criteria,[17] the NAIC's proposed consolidated fire and casualty bill provides no definitions of these terms. However, because of the continued interest in the subject of definitions for the criteria, it is likely that the NAIC may suggest definitions at some future date.

(b) Basis of Rates (AIC Bill § 3(a)1)

In reviewing this paragraph in the model bill, Carlson noted that the controversial point was probably the adjective "underwriting" which precedes the noun "profit." Subsequently, many of the other terms used in this paragraph, even the initial "due consideration" have been debated. Occasionally at rate hearings, an opponent to a rate filing has charged that the filing was inadequate in that it did not present statistics on one of the items listed in this paragraph. The Kentucky insurance department has ordered that a form accompany each filing indicating where information is to be found on each of the items listed in this paragraph; however, in general, it has been required that the filer only submit information relevant to

[16] 1960 *Proceedings of the National Association of Insurance Commissioners (PNAIC)* Vol. II, pp. 596 ff.

[17] See e.g., 1963 *PNAIC* Vol. I, p. 226 and 1967 Vol. I, p. 181.

proposed changes. This latter view was summarized by a Colorado Court in a recent auto rate case as follows:

> . . . It is claimed by plaintiffs [individuals opposing the filing approved by the commissioner] that, unless each of the items mentioned in 72-12-3(1)(b) and 72-11-3(1)(d) [the sections of the Colorado statutes giving the "basis of rates"] is included, the filing is incomplete. However, this position is contrary to the legislative provision that the filing contain such information as is appropriate in accordance with the judgment of the rating organization. It also represents a misinterpretation of the wording "due consideration." "Due consideration," properly interpreted, means not that all of the items mentioned must be a part of the filing, but that the factors specified must be given due consideration. Very obviously, due consideration can mean to include or exclude. . . . As previously stated, the statute only requires a filing to contain information as to which there is not sufficient information theretofore on file with the Commissioner of Insurance. The court finds no statutory requirement to support that which has already been approved. Since no change was requested, no support was required. . . .[18]

An equally liberal interpretation of the phrase "due consideration" was given in a different situation under a fire insurance rating statute by a Wisconsin court. The statute required the consideration of the loss and expense experience for the proceeding five years. The commissioner claimed he had considered the five years of data but that he gave more weight to the latest year.

The companies objected, claiming he was bound to use the five year average; however, the court upheld the commissioner.

> The bureau contends that the statute requires a five year average to be used. Members of the commissioner's staff testified that they gave due consideration to the figures for the five prior years but that they made certain calculations based on the trends shown thereby. The statute is not as rigid as the bureau contends. The statute provides that due consideration shall be given to the experience of the fire insurance business during a period of not less than the most

[18] *Carroll, J. S. and others* v. *Barnes, op. cit.*

recent five years for which experience is available, but nothing therein directs that an average be used.[19]

With the foregoing interpretation of "due consideration" one would expect that there could be little controversy over the phrase "past and prospective loss experience." Prior to the development of the model bill there had been several court cases, in those few states then regulating fire rates, over the merits of paid loss-written premium versus incurred loss-earned premium ratios in ratemaking.[20] In general, the model casualty bill gives the filer considerable latitude as to how he may support his filing. The appropriate loss ratio issue seldom has been significant in the post SEUA period. It has occasionally been raised, often implicitly and occasionally explicitly, but it has never been considered significant by the courts which always have held in favor of incurred-earned ratios. Similarly, to the authors' knowledge, only once in the various administrative proceedings where the issue has been raised has there ever been any serious question of the propriety of incurred-earned ratios.[21]

While it is relatively easy to determine how to measure past experience, prospective experience presents a difficult problem. Although a few rate administrators, in isolated instances, have objected on general principles to the use of trend and projection factors, most administrators and the courts have recognized their appropriateness. (See, for example, the quotation from the Wisconsin fire case given above.) The only question is how such factors are to be developed and used. The statutes provide no clear-cut guidelines. Where both the filer and the commissioner have evaluated the trends and come to different conclusions, the courts generally have held for the commissioner.[22]

In a New York auto rate case,[23] the superintendent of insurance relied upon the average experience of the past five years (rejecting the filer's use of the two most recent years) as one of his grounds for disapproving the filing. The court stated: "Our conclusion that loss experience has wors-

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19 *Fire Bureau* v. *Rogan, op. cit.*

20 See, for example, *Aetna Insurance Co.* v. *Hyde*, 315 Mo. 113, cert. dis. 485 Cit. 174; *National Fire Insurance Co.* v. *Thompson*, 281 U.S. 331; *Bullion* v. *Aetna Insurance Co.*, 151 Ark. 519.

21 In the matter of National Bureau of Casualty Underwriters proposed revision of automobile liability insurance rates for private passenger cars and miscellaneous classes for the State of Maryland, Commissioner's decision of January 7, 1966.

22 *Mass. Bonding* v. *Commissioner, op. cit.*

23 *NBCU* v. *Superintendent, op. cit.*

ened since promulgation of the current rates appears to be strongly and additionally fortified by all the evidence of trends which the record contains. . . ." The court noted the rise in average paid claim costs, accident frequency and pure premiums, concluding: "Again giving effect to the presumption that the current rates were lawfully established and, therefore, neither unreasonable nor more than adequate, we find in the record no substantial evidence supportive of the determination that those rates remain adequate. . . . We are constrained, therefore, to annual the [commissioner's] determination and necessarily under the circumstances, to remit the cases for further proceedings." However, the inadequate rates continued in effect during the entire proceedings, even though the court annulled the commissioner's determination.

It would appear that the need to make adjustments to, and projections from, the premium and loss experience has been recognized both by administrators and by the courts.

Carlson noted that there was some controversy concerning underwriting profit. The controversy continues today. An example of a court relying upon this section of the statute when considering the question of investment income is given by the Colorado case previously cited. The plaintiffs [individuals opposing the commissioner's approval of the rate increase] claimed that the commissioner erred in not considering investment income. The court replied:

> As to the second part [income from the investment of assets off setting unearned premiums] of this issue [investment income], plaintiffs admit that the judicial authority, insofar as is applicable, is split on the question. Aside from the decisions of other jurisdictions one of the factors which the Colorado statute specifies to be considered is "a reasonable margin for margins [sic] and contingencies . . ." It is noted that the figure for profits and contingencies of 5% is a relatively low figure. Undoubtedly this figure is utilized based upon the fact that there may be other income accruing to an insurance company. The statutory language specifies only a reasonable margin of underwriting profit and makes no reference to any other source of income. The statute, therefore, indicates that, for purposes of rate making, consideration be given specifically to underwriting profit and none other. . . .[24]

[24] *Carroll, J. S. and others* v. *Barnes, op. cit.*

The "judicial authority" on the underwriting profit question consists largely of contradictory fire insurance cases from the late 1920's and early 1930's. To the authors' knowledge, there have been no court cases during the post SEUA period holding that investment income should be included in ratemaking. The attitude of the courts was probably best summarized in the Massachusetts case previously cited, where the court did not discuss investment income from the theoretical, or even legalistic (as did Colorado), point of view, but pragmatically stated: "We might add that even if interest was earned [on the investment of assets offsetting reserves] in the amount suggested by the petitioner the net amount after taxes would not substantially affect the premium charges."[25] At the administrative level, this issue has frequently been raised, but investment income has been included in the ratemaking process formally in only two states.[26] In one of these states, the situation is still clouded by extensive litigation; in the other, reflection of investment income appears to contradict past cases in the state,[27] although it does have some precedent in the state. Regarding underwriting profit, per se, it should be noted that administrative and judicial precedent can be found for a number of different profit precentages.

Another portion of the "Basis of Rates" paragraph which has been subject to varying interpretations is the reference to "past and prospective expenses both countrywide and those specially applicable to this state." In practice this usually has been interpreted to permit the use of country-wide expense provisions *except* for the provision for state and local taxes, licenses and fees. The use of a state tax provision higher than the country-wide average has been contested but upheld in at least one state.[28] More than one administrator has felt that individual state expense data should be used in rate-making. One jurisdiction has provided for the incorporation of such data in rate filings.[29] However, this appears to be an exception to general practice, and the use of countrywide expense data (for items other than taxes) appears to be generally accepted. In both the New York and Massachusetts cases previously cited the issue of varying expenses by

[25] *Mass. Bonding* v. *Commissioner, op. cit.*

[26] Maryland and Virginia.

[27] *Hartford Mutual Insurance Company* v. *Commonwealth,* 201 Va. 491, 112 S.E. 2d 142 (1960); Commonwealth of Virginia at the relation of the State Corporation *Commission* v. the *Aetna Casualty and Surety Company* et. al., Case No. 17680 (1967).

[28] *American Equitable Assurance Co.* v. *Gold,* 249 N.C. 461, 106 S.E. 2d 875 (1959).

[29] Kentucky Insurance Department.

state (and territory) was raised and the court found the normal procedure of not so doing to be reasonable.[30]

It appears that very few changes have been made in this section of the insurance laws. The two changes of significance both occurred in Florida's new law, effective October 1, 1967, which specifically provides for consideration of relevant judgment factors and investment income. The inaction at the state level is also reflected in the consolidated bill proposed by the NAIC which includes no changes affecting casualty rates in the "basis of rates" section (§ 3(a) 2 of the proposed bill).[31] This situation should not be interpreted to mean that this section of the law is completely satisfactory to all interested parties. The proposed consolidated bill of the National Association of Independent Insurers is a case in point.[32] Section 3a of this bill provides:

> Rates shall be made only by insurers or rating organizations and in accordance with the following provisions:
>
> (a) To the extent applicable, consideration shall be given to the following factors:
>
> (1) As a guide to reasonable assumptions as to prospective experience:
> a. Past loss experience, if any, of the filer or other insurers or advisory or rating organizations, within or without this state;
> b. Past countrywide expense experience, if any, and those expenses, if any, especially applicable to this state, of the filer or other insurers or advisory or rating organizations;
> c. Any combination of any of the foregoing factors;
>
> (2) The judgment of the filer and its interpretation of any data relied upon;
>
> (3) A reasonable margin for underwriting profit and contingencies;
>
> (4) Dividends, savings or unabsorbed premium deposits allowed or returned by insurers to their policyholders, members or subscribers;

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30 *NBCU* v. *Superintendent, op. cit.; Mass. Bonding* v. *Commissioner, op. cit.*

31 1963 *PNAIC* Vol. I, pp. 226 ff.

32 1960 *PNAIC* Vol. II, pp. 607 ff.

(5) All other factors, including trend factors, deemed by the filer to be relevant.

(c) Expense Provisions (AIC Bill § 3(a)2)

There probably has not been much difficulty of interpretation with this provision because few expense variations are used by most filers within a line of insurance. In a recent presidential address T. E. Murrin[33] comments on the need for more refinement of expense analysis in ratemaking. Buffinton has given us an example of a needed application of this section of the statute.[34] The principle sanctioned by this paragraph of the statute has long been recognized in workmen's compensation insurance and other casualty lines.

No changes of consequence have been made at the state level in this section of the law nor have any been proposed in the major consolidated bills mentioned in this paper.

(d) Classifications and Rating Plans (AIC Bill § 3(a)3)

Although the phraseology of this section appears clear, it has led to considerable debate. Notwithstanding the fact that the all-industry phraseology appears in most states, national rating organizations and independent insurers alike have experienced difficulty in having classification and rating plans approved in a number of states. Sometimes, a state will accept a countrywide classification plan but subsequently refuse to approve any modification of the plan. This results in an individual filer having perhaps a dozen different class plans in effect in different states for a given line of insurance at the same time. While in practice the courts have accepted the principle of classification of risks, there have been a number of cases in which existing classes have been attacked as either too broad or too narrow. Since the controlling statute usually offers little in the way of guidelines as to the reasonableness of a classification system, the results of these cases do not appear to be very helpful in drawing any general conclusions. With regard to rating plans, the situation has become even more complex due to the introduction of multi-peril policies. To trace through administrative decisions and court cases the evolution of the several rating plans described by Carlson appears to be too large a task to accomplish within this

[33] Murrin, T. E., "Presidential Address," *PCAS* LII, p. 138.

[34] See Buffinton, P. G., "The Low Valued Risk — A Study of the Premium Required for Habitational Risks of Various Policy Amounts," *PCAS* XLIX, p. 119 ff.

paper. However, in general the courts have upheld the use of prospective[35] and retrospective[36] experience rating plans.

Few, if any, significant changes have been made by the states in this section of the law, nor has the NAIC proposed any changes therein. The proposed NAII bill, however, reads in this regard as follows:

> Section 3.
>
> (c) Manual, minimum, class rates; rating schedules or rating plans may be made and adopted. Risks may be grouped by classification for the establishment of rates and minimum premiums. Classification rates may be modified under rating plans to produce rates for individual risks. Classification of risks and rating plans used in modification of classification rates may be based upon any differences among risks deemed by the filer to have a probable effect upon losses or expenses.[37]

The last sentence of this section would increase considerably the latitude given the rate maker, over that provided in the AIC Bill, in individual risk rating. Connecticut has a provision which comes close to giving this much flexibility, specifically ". . . such rating plans may include application of the judgment of the insurer. . . ."[38] Another example of a flexible provision is Missouri's which allows classification rates to "be modified to produce rates for individual or special risks which are not susceptible to measurement by any established standards."[39]

(e) Rate Filings (AIC Bill § 4 Except Both the Fourth Sentence in Subsection (a) and All of Subsection (h))

In a vast majority of the states, the controlling statute clearly gives the authority (indeed the duty) to make filings to the individual insurer which may delegate the authority to a rating organization. It would seem obvious that the filer is given the initiative both in this paragraph and in others to

[35] See, for example, *Century Cab Inc.* v. *Commissioner of Insurance,* 327 Mass. 652, 100 N.E. 2d 481 (1951) and *North Little Rock Transportation Co.* v. *Casualty Reciprocal Exchange,* 85 S. Supp. 961 (1950), aff'd 181 F. 2d 174, cert. den, 340 U.S. 823, 71 S. Ct. 56.

[36] See, for example, *State Compensation Insurance Fund* v. *McConnell,* 46 Cal. 2d 330, 294 p. 440 (1956).

[37] 1960 *PNAIC* Vol. II, pp. 607 ff.

[38] § 38.187(a)3 *Connecticut Insurance Law.*

[39] § 379.470(6) *Missouri Insurance Law.*

develop a rate schedule using his experience (supplemented as desired), his formula, and his judgment. If the end product, the rates, meet the basic criteria then the commissioner should approve them. Unfortunately, this is an oversimplification.

The commissioner and his staff must use some guidelines in judging the rates. Their standards may develop into a ratemaking formula with judgments different from those adopted by the filer. If the two formulas result in widely different results, the filer's rates are disapproved and he must decide whether to adopt all or part of the commissioner's formula and try again or to appeal to the courts — a decision not lightly made. In some situations it may appear to the filer that he cannot achieve approval of a rate filing unless it is based upon a certain formula or upon certain ratemaking principles adopted by the commissioner.

There have been a number of court cases in which the filer has accused the commissioner of exceeding his authority and illegally attempting either to require a ratemaking formula or to indirectly fix rates by disapproving those that differ from the commissioner's calculations. The courts have generally agreed that such activities are illegal. However, it is often difficult to distinguish between a careful analysis of a filing coupled with a properly drawn disapproval order giving findings and reasons for disapproval and an illegal attempt to fix rates.

In the Wisconsin case previously cited, the rating bureau had charged that the commissioner was attempting to fix rates, although the commissioner denied this contention in court. The court stated:

> The bureau contends that in effect the commissioner has adopted the figures prepared by his staff and in his decision and order he is attempting to do indirectly what he could not do directly. The bureau contends that the effect of the commissioner's determination is that no rates will be approved by him that do not comply with his staff's computations. The position of the bureau is understandable when the exhibits prepared by the commissioner's staff are considered in the light of the testimony given by members of his staff. If the bureau is correct in its argument the decision of the commissioner is invalid. However, in view of his statements both in the circuit court and before this court he is precluded from so asserting in the future.[40]

[40] *Fire Bureau* v. *Rogan op. cit.*

Editorializing, the court noted that if the commissioner attempted to fix rates, his disapproval order was illegal. The court accepted his statement that he was not setting rates, but precluded him from asserting that he would not approve any filing that did not comply with his staff's calculations. In the New York case previously cited, the court noted that the Superintendent could not fix rates and that there was no statutory formula for ratemaking. It also noted that he was not bound by his own past practice and was not bound to a rigid formula of his own construction.[41] Carlson noted that for practical reasons it was (and generally it still is) customary to treat all states as though prior approval were required. In practice, many insurance departments ignore the waiting periods and there are often long delays between the date of filing and the final action on the rate filing. Today, many segments of the industry have backed a movement to modify rating laws so that not only would prior approval not be required but rates could be used when filed or be used without filing. Four states (Florida, Georgia, Indiana, and Louisiana) have substantially changed their laws in this direction. It is interesting to note that the end result desired by many of those supporting these changes is embodied in the AIC Model Bill, which does not require prior approval and which provides for the use of rates 15 days after they have been filed (i.e. rates are deemed to be approved 15 days after they are filed, unless they are actually disapproved beforehand). Perhaps, if the attitude of filers twenty years ago was that AIC states be treated as if prior approval were not required, the laws would have been administered as they were written and there would be little need for revision of the statutes.

An interesting sidelight on the application of the deemer provision is found in an Illinois case which was cited in the discusssion of statutory standards. The Director of Insurance had disapproved an auto filing on the grounds that it failed to meet the statutory standards. However, he gave no notice as to wherein the filing was deficient. The court stated:

> ". . . In fact there is abundant evidence that when the director was asked wherein they did not comply he refused to give any information. On that ground alone I think the court would be fully justified in saying that the rates became effective at the expiration of the first 15 days."[42]

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[41] *NBCU* v. *Superintendent, op. cit.*
[42] *NBCU* v. *McCarthy, op. cit.*

Thus, the court invoked the deemer provision at the conclusion of the 15 day waiting period. This action had a salutary effect because although the new rates were not allowed to be used until the court issued its decision they did not lie in abeyance until further consideration was given to them by the Insurance Director.

The major legislative changes pertaining to the subsections covered by Carlson's section (e)-1, which pertains to the filing requirements and the confidentiality of the filing, involve the addition of Florida and Georgia to those states which do not require formal rate filings. Since 1951 the number of states providing for public inspection of filings prior to their effective date has increased from 2 to 7. Tennessee's law now specifically provides for reference filings (i.e. the filer may incorporate, by reference, into his filing any part of any existing filing and supporting information in the Commissioner's possession which is open to public inspection) but requires insurers not members or subscribers of a licensed rating organization to file a satisfactory statement of their qualification to make rates (§ 6356.22(a)). Wisconsin now specifically requires the filing of short rate tables.

The Commissioner's proposed consolidated bill does not provide for any substantial changes in the subsections of the rating laws covered by Carlson's section (e)-1.

In regard to Carlson's section (e)-2, it may be noted that Indiana's code now authorizes agency filings (§ 4(g)1). An agency filing is a filing made by a bureau *solely* on behalf of the affiliate(s) requesting the filing rather than on behalf of all affiliates. The Commissioners' bill makes no changes in this section of the law which pertains to an insurer authorizing the Commissioner to accept bureau filings made on the insurer's behalf.

Section (e)-3 of Carlson's paper is captioned "review and approval" and it pertains to the so-called "waiting period" and "deemer" provisions of the AIC Bill. The recent no file laws in Florida and Georgia and modified prior approval laws in Indiana and Louisiana have eliminated the waiting period and deemer provisions in whole or in part in these four states. Of the seven other jurisdictions which appear to have changed this subsection of their insurance codes, only one shortened the waiting period. The other six lengthened the waiting period — generally to 30 days with provisions for an extension not to exceed from 15 to 60 additional days before the deemer becomes applicable.

This "review and approval" subsection of the rating law appears to have sparked the greatest amount of controversy within the industry and between major segments of the industry and the NAIC. While the NAIC and segments of the industry, including the National Association of Mutual Insurance Agents, favor retention of the AIC approach, the American Insurance Association, American Society of Insurance Management, Insurance Company of North America, National Association of Casualty and Surety Agents, National Association of Insurance Agents, National Association of Insurance Brokers, and the National Association of Independent Insurers among others favor adoption of either modified prior approval (which could be called, just as well, modified file and use), file and use, or no file legislation.[43] The subject continues to be debated by the NAIC and industry. While those expounding a more liberal approach would be gratified by formal adoption of their view by the NAIC, it is likely that whatever progress is made in this direction, in the short run at least, will be made on a state by state basis after an independent or legislative in-depth analysis of the issues such as occurred in those states taking the more flexible tack.

No changes of consequence have been made at the state level or recommended by the NAIC in the subsections covered in Carlson's sections (e)-4, captioned "filing after use," (e)-5, entitled "rate in excess of normal" and (e)-6, captioned "special filings." The premium volume affected by these subsections is relatively small, although the so-callled "consent to rate" provision has become more important because of the extremely tight market experienced in recent years, particularly in some areas for certain coverages, e.g., substandard automobile insurance in congested urban areas.

(f) Supporting Information (AIC Bill § 4(a), Next to the Last Sentence Only)

As Carlson noted, this provision has been interpreted to mean that an insurer may file simply by referring to the filing of a rating bureau. This practice is quite common today. Carlson's fear that the reference filer may in some cases represent a larger volume than the rating bureau filing is probably less true today since so many large independent companies utilize their own data in establishing rates.

The question of whether supporting information should be provided with

[43] See 1966 *PNAIC,* Vol. I, pp. 156 ff.

a filing is not an easy one to answer. If the burden to request such information is placed upon the commissioner, then the filer will face additional delays since the waiting period commences after all the requested information has been supplied. Furthermore, if the filer does not support his proposal, it is easier for the commissioner to disapprove, since he will have only requested the information he feels necesssary and the filer will not have amassed any body of evidence in the record from which to appeal. In a number of cases, issues raised by the filer, the commissioner and by intervenors have been dismissed by the courts on the grounds that there was insufficient evidence to make a determination.[44] Since the initiative to file lies with the filer, it would seem that the burden of proof also is his, and that he weakens his position by not providing sufficient supporting information to prove his case. It also may be noted, that this paragraph should be read together with the section of the "basis of rates." For example, in giving due consideration to past and prospective loss experience, the filer may include his own experience, the experience of other filers, his interpretation of the data, etc.[45]

This part of the rating laws has been subjected to very little revision — nor has the NAIC recommended any changes. The proposed consolidated bill of the NAII, however, reads in this regard as follows: "Such filing shall be accompanied by the information upon which the filer supports such filing. The filer may incorporate by reference into its filing all or part of any existing filing and supporting information and any other relevant information or material in the Commissioner's possession which is open to public inspection."[46] As previously mentioned, Tennessee's statute provides for such reference filing.

(g) Disapproval (AIC Bill § 5)

The statutes generally provide that the filer has the right of hearing if a filing is disapproved and that the commissioner shall specify in what respects he finds such a filing fails to meet the statutory requirements. (As noted in an Illinois case above, the mere recitation of the requirements is insufficient.) Furthermore, it is usually required that the commissioner give findings of facts and determinations in addition to his order.

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[44] For example, *State* v. *Faricy, op. cit., Mass. Bonding* v. *Commissioner, op. cit., NBCU* v. *Superintendent, op. cit., NBCU* v. *McCarthy, op. cit., Carroll, J. S. and others* v. *Barnes, op. cit.*

[45] See *Carroll, J. S.* v. *Barnes, op. cit.* See also the regulations of the Kentucky Insurance Department.

[46] See 1960 *PNAIC*, Vol. II pp. 607 ff.

> Such findings are necessary in aid of intelligent judicial review. . . . The difficulties inherent in the statutory scheme of regulation, whereby the superintendent may not directly fix rates but must approve or disapprove proposed rates *in toto* furnish an additional ground for requiring findings in terms of the statistical and monetary factors involved. In many cases the area of dispute might thus be narrowed and the treatment of new filings expedited, after a decision adverse in part, and without the necessity of judicial review.[47]

The frequent citation of court cases in this paper does not imply that the ratemaker can expect to win court if he cannot convince a commissioner. In general (but not without exception), a court will not disturb the action of a commissioner unless he has exceeded his powers, made a mistake of law, or acted contrary to the evidence (or without its support). This is illustrated by a Massachusetts case in which the petitioners, a group of insurance companies, had challenged the Commissioner's rates on the grounds that he had used a three year average, although there was a clear upward trend. The petitioners maintained that the latest year (1950) should have been used in setting rates (for use in 1952). The court did not disagree with the petitioners allegations, and in fact stated:

> The evidence, oral and documentary, introduced by the petitioners is impressive and tends strongly to support their estimate of the probable conditions of 1952. It is not challenged by the commissioner or contradicted by any evidence introduced by him. If the commissioner had fixed the rates on the basis of the 1950 loss data it would be difficult to say that he was wrong. But the question is not what this court would decide if it were in the position of the commissioner. It is elementary that the fixing of rates is not a proper judicial function. *New England Telephone & Telegraph Co.* v. *Department of Public Utilities,* 327 Mass. 81, 85, 97 N.E. 2d 509, 512; *American Employers' Ins. Co.* v. *Commissioner of Insurance,* 298 Mass. 161, 169, 10 N.E. 2d 76. This court does not sit as a board of review to substitute its judgment for that of the Legislature or of the commission lawfully constituted by it, as to matters within the province of either. *Boston & Albany Railroad* v. *New York Central Railroad Co.,* 256 Mass. 600, 618–619, 153 N.E. 19, 25.[48]

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[47] *NBCU* v. *Superintendent, op. cit.*

[48] *Massachusetts Bonding and Insurance Company* v. *Commissioner of Insurance,* 329 Mass. 265, 107 N.E. 2d 807 (1952). (See Appendix B)

However, the court affirmed the commissioner's action.

It is worth reemphasizing that even if the court did not affirm the commissioner's action, the practical result would be that the case would have been sent back to the commissioner for further proceedings. Thus, even when a court reverses a commissioner's decision, the case is generally sent back to the commissioner and may ultimately become a moot question.

Since Carlson did not construct a table of exceptions to AIC § 5 no attempt was made to determine the changes which may have taken place in the corresponding sections of the state laws. It is worthwhile, however, to review briefly the subsections of § 5, examine the criticism they have received, and discuss some of the changes in these subsections.

Subsection (a) provides that if the Commissioner disapproves a filing within the waiting period or an extension thereof, he must so inform the filer by written notice specifying therein how the filing fails to meet the requirements of the law. Thus, under an AIC type law, the Commissioner may disapprove a filing before it has become effective *without* holding a hearing, the filer does have a right to a hearing on the disapproval order but the disapproved rates may not be used in the interim unless the filer obtains a stay of the Commissioner's order, which is an unlikely event. The NAIC bill would continue this approach. Under the enacted and proposed "no file" and "file and use" laws, by their very nature, rates are not disapproved *prior* to filing. Under a "no file" law rates are not formally filed and with a "file and use" law and under certain conditions with a "modified prior approval" law the rates are effective when they are filed and therefore are subject to the so-called subsequent disapproval provision which, as in the AIC Bill, requires a hearing to be held before the Commissioner may issue a disapproval order. Under this provision time shifts to the side of the filer since he may continue to use the effective rates until they are disapproved. Also, it would seem that the filer might be more successful in having a disapproval order stayed because such stay would in effect preserve the status quo (i.e. continue to allow the insurer to use its existing rates) and because if the order were not stayed the filer would not have any rates in effect unless he were to file another set of rates acceptable to the Commissioner. By the same token, if the stay were denied and the Commissioner refused to approve another filing, the filer would be left without a set of effective rates. It is of interest to note that the proposed NAII bill provides that a disapproval order would not take effect for at least 90 days.

Subsection (b) pertains to disapproval of special surety or guaranty filings. The NAIC bill contains no changes in this section while the NAII bill would treat *all* disapprovals in the same manner.

Subsection (c) contains the "subsequent disapproval" provision of the AIC Model Bill which provides for not less than 10 days' written notice of a hearing, specification of the filings' deficiencies, a reasonable period after the hearing before the filing becomes invalid, and immunity to policies made or issued before the expiration of the effective filing. The NAIC Bill makes no change in this provision.

Subsection (d) contains the infamous "aggrieved party" provision. All of the major proposed bills discussed in this paper include revision of this provision. The NAIC Bill requires an aggrieved party to have "a specific economic interest affected by the filing" and states that "no rating or advisory organization shall have any status under this Act to make application for a hearing on any filing made by an insurer . . ." The NAIC Bill makes no substantive changes in the other provisions of this subsection.

The final subsection of § 5 reinforces the validity of classification plans and individual risk rating provided for in § 3(a)3. No change of substance has been suggested for this subsection in any of the previously discussed bills.

(h) Rating Organizations (AIC Bill § 6)

Prior to the advent of the SEUA decision, rating organizations insisted upon countrywide adherence to their manual rates and rules by member insurers. The rating organization interpreted the statistics, set the rates and enforced their use. With the model bill, many of these functions were transferred to the states, which became the enforcers of the filed rates and the final interpreter of the statistics. The transition from the pre SEUA concept of a rating bureau to today's concept has been dramatic indeed. This is illustrated by comparing countrywide adherence rules to the filing procedure adopted by the newly formed Insurance Rating Board.

> IRB will make *general filings* on behalf of all members and subscribers. However, for individual companies these means will be available to depart from such general filings: Companies may *deviate* from IRB actions when permitted to do so according to the deviation statutes of the various states. The facilities of IRB and the expertise of its staff will be available for consultation and assistance in the preparation of *agency filings*. The Executive Com-

> mittee is authorized to establish appropriate *special procedures* to handle situations that cannot be resolved satisfactorily through normal filing procedures, statutory deviations or agency filings.[49]

The rating bureau is being transformed from a fixer and regulator of prices in the industry to largely an information service. The transition is not complete, and has not been painless, as indicated by the many court cases concerning the right of partial subscribership, deviation, etc.

Carlson did not include a table of exceptions to the rating organizations section of the AIC Bill; however, an examination of the appropriate section of the state laws indicates that most read as does the AIC Bill. One would conclude, therefore, that few changes have occurred in the intervening years at the state level. The four subsections of this section primarily deal with (a) licensing, (b) right of full or partial subscribership, (c) prohibition against bureau rule regulating dividends, and (d) authorizing cooperation among rating bureaus and insurers. The consolidated bill proposed by the NAIC makes no changes in these subsections but adds the following subsections from the AIC Model Fire Bill:

> (e) *Any rating organization may provide for the examination* of policies, daily reports, binders, renewal certificates, endorsements or other evidences of insurance, or the cancellation thereof, and may make reasonable rules governing their submission. *Such rules shall contain* a provision that in the event any insurer does not within sixty days furnish satisfactory evidence to the rating organization of the correction of any error or omissison previously called to its attention by the rating organization, it shall be the duty of the rating organization *to notify the [commissioner] thereof.* All information so submitted for examination shall be confidential.
>
> (f) Any rating organization may subscribe for or purchase actuarial, technical or other services, and such services shall be available to all members and subscribers without discrimination.

The bill proposed by the NAII includes editorial changes and defines a bureau member as insurer entitled to participate in the management of the bureau.

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[49] "The New Insurance Rating Board" (Insurance Information Institute, N.Y. August, 1967), emphasis added.

(i) Deviations (AIC Bill § 7)

The varying administration of virtually identical rate regulatory code provisions is illustrated by Regulation No. 12 of the Alabama Insurance Department under date of September 1, 1961 relating to property and liability rate deviations. The regulation specified that both Alabama and countrywide earned premiums, incurred losses and underwriting gain or loss along with acquisition expenses, general expenses, and taxes incurred (related to written and to earned premiums) be submitted for the most recent five-year period for fire and allied lines and for the most recent three years, at least, for casualty and inland marine coverages. The implication apparently is that no deviation would be approved until the insurer had written business at bureau rates in Alabama for five and three years, respectively.

The regulation also stated that no action would be taken on a deviation filing until the insurance department was notified by the concerned rating bureau of its position on the deviation and whether it desired a hearing, whereas Section 28–399 of the Code appeared to require the department to set a time and place for a hearing when it notified the bureau of the deviation filing. While neither the Alabama statute nor the AIC deviation provision specified any time limit on calling a hearing, Regulation No. 12 was even more deficient in this regard because apparently it would enable the bureau to delay the deviation indefinitely simply by not taking action to notify the department.

Neither the Alabama code nor the AIC bill required that deviations commence and expire on particular dates each year yet Regulation No. 12 required all deviations to become effective on May 1 of each year and expire the following April 30. Furthermore, the regulation advised that retroactive approval of deviations (apparently of those filed after May 1) was prohibited by a 1947 decision of the Alabama attorney general.

It seems obvious that Regulation No. 12 could seriously handicap insurers who wished to deviate, first because of the delaying opportunity afforded the bureau on the deviation hearing and second because of tying deviations to a single date while allowing bureau filings to be made at any time of the year.

Widespread dissatisfaction with administrative and statutory roadblocks to competitive opportunity has led to a liberalization of the deviation section of several state laws. In states having "no file" or "file and use" laws the need for a deviation section in the code may be eliminated entirely. Since Carlson's paper was written at least six jurisdictions with AIC deviation provisions have eliminated the restriction on deviations to uniform percentage decreases or increases. At least ten jurisdictions have eliminated the one year limitation on the duration of deviations. This action is in accord with the following model bill provision recommended by the NAIC Subcommittee to Review Fire and Casualty Rating Laws and Regulations:[50]

Sec. 7 — DEVIATIONS Marked to show additions *to* (underlined) and deletions *from* (in brackets [ ]), the AIC Casualty Bill.

Every member of or subscriber to a rating organization shall adhere to the filings made on its behalf by such organization except that any such insurer may make written application to the Commissioner [for permission to file a uniform percentage decrease or increase to be applied to the premiums produced by the rating system so filed for a kind of insurance, or for a class of insurance which is found by the Commissioner to be a proper rating unit for the application of such uniform percentage decrease or increase, or for a subdivision of a kind of insurance (1) comprised of a group of manual classifications which is treated as a separate unit for rate making purposes, or (2) for which separate expense provisions are included in the filings of the rating organization.] to file a deviation from the class rates, schedules, rating plans or rules respecting any kind of insurance, or class of risk within a kind of insurance, or combination thereof. Such application shall specify the basis for the modification and [shall be accompanied by the data on which the applicant relies.] a copy [of the application and data] shall also be sent simultaneously to such rating organization. [The Commissioner shall set a time and place for a hearing at which the insurer and such rating organization may be heard and shall give them not less than ten days' written notice thereof. In the event the Commissioner is advised by the rating organization that it does not desire a hearing he may, upon the consent of the applicant, waive such hearing.] In considering the application [for permission] to file such deviation, the Commissioner shall give consideration to the available statistics and the principles for rate making as

50 1963 *PNAIC* Vol. I, pp. 226 ff.

> provided in Section 3 (Making of Rates) of this Act. The Commissioner shall issue an order permitting the [modification] deviation for such insurer to be filed if he finds it to be justified and it shall thereupon become effective. He shall issue an order denying such application if he finds that [the modification is not justified or that the resulting premiums would be excessive, inadequate or unfairly discriminatory.] the deviation applied for does not meet the requirements of this Act.
>
> Each deviation permitted to be filed shall [be effective] remain in effect for a period of not less than one year from the effective date [of such permission] unless [terminated] sooner withdrawn by the insurer with the approval of the Commissioner or until terminated in accordance with the provisions of Section 5 (Disapproval of Filings).

Section 5, Disapproval of Filings, of the Model Bill received scant attention in Carlson's item (g) because according to Carlson the section was of interest primarily from the legal angle. The section, however, has been the focus of considerable criticism especially as it pertains to the "rights" of a rating organization in hearings on deviation and independent filings. An NAIC subcommittee which studied the problem recommended amendment of the "aggrieved party" subsection so that no rating organization would have "aggrieved party" status with regard to any filing in effect or being considered by the insurance department.[51] As previously mentioned, this amendment has been incorporated into the bill proposed by the NAIC.

(j) Advisory Organizations [AIC Bill § 10]

Four of the seven states which according to Carlson had no provision in their law regarding advisory organizations have since enacted such a provision. Of the three remaining states only Massachusetts and New Hampshire, for automobile liability, make no reference to advisory organizations. A 1961 report of the U.S. Senate Committee on the Judiciary was especially critical of the laxity of regulation of advisory organizations in the way of license requirements and periodic examination.[52] The proposed consolidated bills of the NAIC and the NAII have the same provisions as

[51] See 1962 *PNAIC* Vol. II, pp. 504–505.

[52] *The Insurance Industry*, Report No. 831, 87th Congress 1st Session, August 29, 1961, Committee on the Judiciary United States Senate.

Section 10 of the AIC Bill. In regard to the examination of advisory organizations, which is provided for in Section 12 of the AIC Bill, the NAIC Bill makes no changes while the NAII, though substantially equivalent, adds language detailing the purpose of such examinations and the types of information that may be examined.

(k) Exchange of Information [AIC Bill § 13(b)(c)]

Only Vermont of the seven states in which the provisions of Carlson's section (k) were not applicable has amended its law to include these provisions. No other changes of substance appear to have been made in the appropriate sections of the state laws. The NAIC Bill proposes no changes in these subsections while the NAII Bill broadens the language of paragraph (b) of Section 13 of the AIC Bill to include within its scope advisory organizations and statistical agencies within and outside the state.

(l) Recording and Reporting of Loss and Expense Experience (AIC § 13(a))

A cursory reading of this paragraph of the model bill would lead one to expect that each insurance commissioner would be issuing his own statistical plan and collecting data. As Carlson noted, in most of the states the promulgation of the various statistical plans was by a letter addressed to all carriers listing approved plans and statistical agencies. And there ended most of the controversy outlined by Carlson. Currently the plans are modified almost annually, and a few states do ask for the inclusion of special codes. Du Rose has presented a detailed discussion of this section of the statute, and of an alternative means of gathering statistics which would more closely correspond to the wording of the statute.[53]

Only minor changes appear to have been made in this section of the state laws. No change is proposed in the NAIC Bill and the NAII bill generally follows the AIC Bill approach.

SUMMARY

Although there have been numerous minor changes in rate regulatory laws since 1951, only four states adopted major revisions in their codes.

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[53] DuRose, S. C., "A Uniform Statistical Plan and Integrated Rate Filing Procedure for Private Passenger Automobile Insurance." *PCAS* Vol. XLV, p. 41.

These revisions and those suggested by the AIA and the NAII have been directed toward placing greater reliance upon competition as a regulator of rates and thus permitting the flexibility in ratemaking procedure which Carlson believed to be so essential. His conclusions that rate regulation has resulted in a thorough and on-going review of rate making procedure and that it has led to greater consistency and uniformity in practice remain valid. As he further noted, regulation unfortunately has sometimes resulted in undue formularization of judgment, delays and provincialism. Despite the trend toward greater flexibility widened by the changes in regulatory laws, it appears that price regulation is with us to stay.

APPENDIX A

EXCEPTIONS TO MODEL BILL PHRASEOLOGY

It should be noted that these summaries have been prepared from an actuarial, rather than a legal, viewpoint.

(a) Basic Criteria for Rates

"Rates shall not be excessive, inadequate or unfairly discriminatory."

State	Basic Exception	Definition of		
		Excessive	Inadequate	Unfairly Discriminatory
Alabama	1			
Alaska*				
Arizona*		18	19	
Arkansas*				
California*		8	3	
Delaware*				5
District of Columbia				2
Florida*		20	21	
Georgia		8	22	
Idaho*			3	
Indiana*		8	23	
Iowa*				
Kansas	4			
Louisiana*				
Maine				5
Maryland*				
Massachusetts	6[a]			5
Minnesota			7	
Mississippi	4			
Missouri		8	3	
Montana*	24[b]	24	24	24
Nebraska			9	
Nevada*				
New Hampshire*	10[a]			5
New Jersey*	1			
New York*	25, 26, 27, 28			
North Carolina	11			
Oklahoma		12	3	2
Oregon*	13			
Puerto Rico*	26[b]			
Rhode Island			14	15
South Carolina*	29[b]	30		
South Dakota*				
Tennessee	16			
Texas	17			
Utah*				
Vermont*	31			
Virginia*				
Washington*	32			33
West Virginia*				

* Combined Rate Law (at least in part) for Fire and Casualty Insurance

a — Motor Vehicle (Liability) Only
b — In Addition To AIC Model Bill Phraseology

(a) Basic Criteria for Rates

Explanations of Exceptions to Model Bill Phraseology
(Numbers in Parentheses Refer to Carlson's Original References)

1. (1) ". . . rates that are not unreasonably high or inadequate for the safety and soundness of the insurer, and which do not unfairly discriminate between risks in this state" (Ala. § 292), (N. J. § 17; 29 A-4 continuing: "involving the same hazards and expense elements").
2. (24) "Nothing in this section shall be taken to prohibit as unfairly discriminatory the establishment of classifications or modifications of classifications of risks based upon the size, expense, management, individual experience, location or dispersion of hazard, or any other reasonable considerations attributable to such risks provided such classifications and modifications apply to all risks under the same or substantially similar circumstances or conditions" (D.C. § 35-1503(c)), (Okla. § 902 D.).
3. (19) "No rate shall be held to be inadequate unless (1) such rate is unreasonably low for the insurance provided and (2) the continued use of such rate endangers the solvency of the insurer using the same, or unless (3) such rate is unreasonably low for the insurance provided and the use of such rate by the insurer using same has, or if continued will have, the effect of destroying competition or creating a monopoly" (Idaho § 348 (4)), (Mo. § 379.470 (3)), (Okla. § 902 A), (Calif. Art. 2 § 1852 (a)).
4. (2) "Rates shall be reasonable, adequate and not unfairly discriminatory" (Kans. § 40-1112 (4)), (Miss. § 5834-02 (a)).
5. (25) Same as 2 except: Add "unreasonable or" before "unfairly discriminatory," delete "the" before "size," add "purpose of insurance" after "individual experience" and delete "attributable to such risks" after "considerations" (Me. § 2763.3), (Mass. § 5.4(c) (not for compulsory auto), (Del. § 2303 (5)(d) Also change "of classifications of risks" to "of classifications or risks"), (N.H. Ch. 329-B § 3(f)).
6. (3) For compulsory motor vehicle liability *only* ". . . to fix and establish or secure and maintain fair and reasonable classifications of risks and adequate, just, reasonable and non-discriminatory premium charges . . ." (Mass. § 113 B).
7. (20) "No rate shall be held to be inadequate if the information furnished by the insurer in support of the filing shows that the business being written at the rate proposed in the filing is being written by the insurer at a profit" (Minn. § 70.36 (4)).
8. (16) "No rate shall be held to be excessive unless such rate is unreasonably high for the insurance provided and a reasonable degree of competition does not exist in the area with respect to the classification to which such rate is applicable" (Mo. § 379.470 (2)), (Calif. Art. 2 § 1852 (a)), (Ga. 56-507 (a)), (Ind. Sec. 3a. (4)).
9. (21) "No rate shall be held to be inadequate for use in this state if its use will not endanger the solvency of the insurer charging such rate and if it bears a reasonable relation to the loss and expense ratios of such insurer in all states in which it is licensed for the same class of risk" (Nebr. § 44-1403 (4)).
10. (5) Motor Vehicle Liability Only: "Rates . . . shall be adequate, reasonable, and nondiscriminatory as against citizens or classes of citizens of this state . . ." (N.H. § 412:15).
11. (8) Casualty Other Than Automobile Liability: "The Commissioner shall not approve any rate, rate manual, classification of risks, rating plan, rating schedule or other rating rule which is excessive, inadequate, unreasonable or unfairly discriminatory" (N.C. § 58-131.13). "Whenever the Commissioner finds, . . ., that . . . [the] application of an approved classification, rating

schedule or other rating rule is unwarranted, unreasonable, improper or unfairly discriminatory, he shall order the Bureau or insurer to revise or alter the application [etc.] . . ." (N.C. § 58–131.16).

Automobile Liability Only: "Whenever the Commissioner, . . ., shall determine, . . ., that the rates charged or filed on any class of risks are excessive, inadequate, unreasonable, unfairly discriminatory, or otherwise not in the public interest, or that a classification or classification assignment is unwarranted, unreasonable, improper or unfairly discriminatory he shall . . . [have them] altered" (N.C. § 58–248.1).

12. (16) Same as note 8 except: add "(1)" after unless; replace "provided and a" with "provided; or (2) a"; and add "and such rate is unreasonably high for the insurance provided" after "applicable" (Okla. § 902 A).

13. (9) "Rates shall be just, reasonable and not unfairly discriminatory" (Ore. § 737.110 (5)).

14. (22) "And if the insurer using the rate or premium shall show to the satisfaction of the Commissioner that it is writing such kind or class of insurance at a profit, . . ., the rate or premium used is not inadequate (R.I. § 27–9–20).

15. (26) "If the insurer making or issuing a contract or policy at a rate or premium less than that provided by any filing shall, . . ., show to the satisfaction of the Commissioner that the rate or premium was used in good faith to meet an equally low or lower net cost to the insured of a competitor, . . ., the rate or premium is not unfairly discriminatory" (R.I. § 27–9–20).

16. (11) "Rates shall be fair, reasonable, adequate and not unfairly discriminatory" (Tenn. § 6356.21.4).

17. (12) *Motor Vehicle:* "Just, reasonable, and adequate for the risks to which they respectively apply, and not confiscatory as to any class of insurance carriers authorized by law to write such insurance" (Tex. Art. 5.03). *Casualty Insurance and Fidelity, Guaranty and Surety Bonds:* "Rates shall be reasonable, adequate, not unfairly discriminatory, and non-confiscatory as to any class of insurer" (Tex. Art. 5.14).

18. (15) "No rate shall be held to be excessive if the director finds that free competition exists in the area and in the classification covered by such rate" (Ariz. § 17.(a)).

19. (18) "No rate shall be held to be inadequate unless the director finds that the loss experience of the insurer in the classification covered by such rate has been adverse for a continuous period of not less than two years immediately preceding the date of such finding" (Ariz. § 17.(a)).

20. Same as note 8 except conditions are numbered and "area" is replaced with "Florida" (Fla. § 627.062 (2)(a)).

21. Same as note 3 except change "such" to "the" throughout. In Point 3 add "the" before "same," and add "of" before "creating" (Fla. § 627–062 (2)(b)).

22. (Basically same as note 3) "No rate shall be held inadequate unless (1) it is unreasonably low for the insurance provided, and (2) continued use of it would endanger solvency of the insurer, or unless (3) the use of such rate by the insurer using same has, or will, if continued, tend to destroy competition or create a monopoly" (Ga. § 56–507(a)).

23. (Basically same as note 3) "No rate shall be held to be inadequate unless such rate is unreasonably low for the insurance coverage provided and is insufficient to sustain projected losses and expenses; or unless such rate is unreasonably low for the insurance coverage provided and the use of such rate has, or if continued, will have, the effect of destroying competition or creating a monopoly" (Ind. § 3a.(4)).

24. (4) In addition to AIC phraseology: "No insurer . . . shall fix . . . any rate for insurance upon property in this state which discriminates unfairly between risks in the application of like charges and credits or which discriminates unfairly

between risks of essentially the same hazard and having substantially the same degree of protection, [shall be charged], nor shall any rate be such as to endanger the solvency of such insurer" (Mont. § 40-3612). "No rate shall be held to be excessive, inadequate or unfairly discriminatory if the Commissioner finds that free competition exists in the area and classification covered by such rate. No rate shall be held to be inadequate unless the Commissioner finds that the continued use of such rate shall endanger the solvency of the insurer charging such rate" (Mont. § 40-3613).

25. (6) "Rates shall be reasonable and adequate for the class of risks to which they apply" (N.Y. § 183.(b)).

26. (6) "No rate shall discriminate unfairly between risks involving essentially the same hazards and expense elements or between risks in the application of like charges and credits" (N.Y. § 183(1)(c)), (P.R. § 1204(1)(c)).

21. "Whenever the Superintendent finds, . . . , that unfair discrimination exists in . . . rates made or used . . . he may order . . . remov[al] [of] such discrimination, but the same shall not be removed by increasing the rate on any risk affected by the order unless such increase is approved by the Superintendent as reasonable" (N.Y. § 186.1).

28. (7) "Whenever the Superintendent shall determine, . . . , that the rates charged or filed, . . . , are excessive, unfairly discriminatory, inadequate or unreasonable, he shall order that such rates be appropriately adjusted" (N.Y. § 186.2).

29 "If [the Commissioner] shall conclude, . . . , that there is unfair discrimination, he shall order the discrimination removed and require . . . [the] promulgat[ion of] a rate which is not unfairly discriminatory" (S.C. § 37-707). In addition to AIC phraseology.

30. (17) "If . . . rates . . . are excessive or unreasonable in that the results of the business of such companies in this State during the five years next preceding the year in which the investigation is made, as indicated by the official annual statements of the insurance companies . . . , show an aggregate underwriting profit in excess of a reasonable amount'" (S.C. § 37-708).

31. (13) "Rates shall be just, reasonable and adequate, taking into consideration all factors reasonably attributable to the classes of risks involved" (Vt. § 4655(b)).

32. (14) "Premium rates shall not be excessive, inadequate, or unfairly discriminatory. This section does not apply to casualty insurance" (Wash. § 45.19.02).

33. "No insurer shall . . . permit any unfair discrimination between insureds or subjects of insurance having substantially like insuring, risk, and exposure factors, and expense elements. . . ." (Wash. § 45.18.48).

(Carlson numbers not used: 7, 10, 23)

(b) Basis of Rates

The following division of the phraseology into six parts has been added for convenience in reference.

"Due consideration shall be given

1) to past and prospective loss experience within and outside this state,
2) to catastrophe hazards, if any,
3) to a reasonable margin for underwriting profit and contingencies,
4) to dividends, savings or unabsorbed premium deposits allowed or returned by insurers to their policyholders, members or subscribers,
5) to past and prospective expenses both countrywide and those specially applicable to this state, and
6) to all other relevant factors within and outside this state."

State	Exceptions						
	(b)-1	(b)-2	(b)-3	(b)-4	(b)-5	(b)-6	Other
Alabama	1	NR	2	3	NR	4	
Alaska		5	NR			NR	
Arkansas						NR	
California	7	5, 7	7	7, 9	7	7, 8	
Colorado			10				
Delaware		5				NR	
District of Columbia	11				11	11	12, 13, 14, 15
Florida	7	5, 7	7	7	7	7, 8	16
Georgia	7	5, 7	7, 17	7, 9	7	7	
Hawaii	18				18	18	
Illinois							14
Indiana		5		19		NR	
Iowa		5					
Kansas	20	20	20, 10	20, 36	NR	20	
Massachusetts	NR[a] 21	NR[a]	NR[a]	NR[a]	NR[a] 21	NR[a] 21	
Michigan							14
Mississippi			10		22	23	
Missouri	24	20	20	20	20	20, 25	20, 12
Nevada		5					
New Hampshire	NR[a]	NR[a] 5	NR[a]	NR[a]	NR[a]	NR[a]	
New Jersey		5	2	3	NR	4	
New York		5	2	26		4	
North Carolina	NR	NR	NR	NR	NR	NR	
Ohio							27, 12
Oklahoma							12, 13, 14, 15
Oregon	28						
Pennsylvania	21				21	21	12, 13, 14
Puerto Rico	29	5	2	3	NR	30	
South Carolina		5					
SouthDakota		5					
Tennessee			10	3	NR		
Texas	35[a]	NR[a]	NR[a] 10	NR[a] NR	35[a] 31	NR[a]	
Vermont		5		26			
Virginia		5					32[a]
Washington		5			NR		33
West Virginia							34
Wyoming				26		NR	

NR — No Reference
a — Motor Vehicle (liability) only

(b) Basis of Rates

Explanations of Exceptions to Model Bill Phraseology
(Numbers in Parentheses Refer to Carlson's Original References)

1. (1) "To past experience within the state and without the state when necessary, and due consideration may be given prospective loss experience within the the state and without the state when necessary over such period of years as appears to be fairly representative of the frequency of the occurrence of the particular risk" (Ala. § 392).
2. (8, 10) "To a reasonable profit for the insurer" (Ala. § 392), (N.J. § 17:29A-4(c)), (N.Y. § 183(d) with "for the insurer" deleted), (P.R. § 1204(1)(d) as N.Y. but add "underwriting").
3. (11) "In the case of participating insurers, to policyholders' dividends" (Ala. § 392), (N.J. § 17:29A-4(c)), (P.R. § 1204(1)(d)), (Tenn. § 6356.21(2) with phrase reversed, i.e. "to policyholders' dividends, in the case of participating insurers"), (Kans. § 40-1112(1) same as Tenn. in addition to AIC phraseology.).
4. (16) "To all factors reasonably related to the kind of insurance involved" (Ala. § 392), (N.J. § 17:29 A-4(c)).
5. "To the conflagration and castastrophe hazards." All of these jurisdictions have combined fire and casualty rate laws (at least in part) and that is why "conflagration" is included.
6. Same as 3, Tennessee version, but in addition to standard phraseology (Kans. § 40-1112(1)).
7. (2) "Consideration shall be given, to the extent applicable, to . . ." (Calif. § 1852(b)), (Fla. § 627.072(1)), (Ga. § 56-507(b)).
8. (17) "Including judgment factors, deemed relevant . . ." (Calif. § 1852(b)), (Fla. § 627-072(1) excluding "deemed relevant").
9. (12) "Consideration may also be given in the making and use of rates to dividends . . ." etc. (Calif. § 1852(b)), (Ga. 56-507(b)).
10. (9) "Underwriting" excluded before "profit" (Kans. § 40-1112(1)), (Miss. § 5834-02(b)), (Tenn. § 6356.21(2)), (Tex. Art. 5.14.1).
11. "District" in place of "state" (D.C. § 35-1503(b)).
12. (20) "To physical hazards" (D.C. § 35-1503(b)), (Mo. § 379.470(4)), (Ohio, § 3937-02(4)), (Okla. § 902.B), (Pa. § 1183(a)).
13. (21) "To safety and loss prevention factors" (D.C. § 35-1503(b)), (Okla. § 902.B), (Pa. § 1183(a)).
14. (22) "To underwriting practice and judgment" (D.C. § 35-1503(b)), (Ill. 1065.3 § 456(1)(a)), (Mich. § 500.2403(1)(a), (Okla. § 902.B), (Pa. § 1183a) which adds "to the extent appropriate").
15. (23) "To whether classification rates exist generally for the risks under consideration: to the rarity or peculiar characteristics of the risks"; (D.C. § 35-1503(b)), (Okla. § 902.B.).
16. "To investment income or [*sic*] unearned premium reserves and loss reserves" (Fla. § 627.072(1)).
17. "To a reasonable margin for underwriting ["profit" appropriately omitted by error] and contingencies" (Ga. § 56-507(b)).
18. "Territory" in place of "state" (Hawaii § 181-693.(a)(1)).
19. "Unabsorbed premium deposits" and "subscribers" deleted (Ind. § 3a (1)).
20. (7) "May" instead of "shall" (Kans. § 40-1112(1)), (Mo. § 379.470(4)).
21. "Commonwealth" in place of "state" (Mass. § 5(a)1), (Pa. § 1183 (a)).
22. (14) "and country-wide expense experience" (Miss. § 5834-02(b)).

23. (18) "To all factors reasonably attributable to the class of risks" (Miss. § 5834-02.(b)), (N.Y. § 183(d)), (P.R. § 1204(1)(d)).
24. (5) "Due consideration shall be given to past and prospective loss experience within this state and consideration may also be given to past and prospective loss experience outside this state to the extent appropriate" (Mo. § 379.470(4)).
25. (19) "Which the insurer or rating organization deems relevant to the making of rates" (Mo. § 379.470(4)).
26. "In the case of participating insurers to policyholders' . . ." etc. (N.Y. § 183(d)), (Vt. § 4655), (Wyo. § 52-1503(a)(1)).
27. (24, 25) "The experience or judgment, or both, of the insurer or rating organization making the rate": (Ohio § 3937.02(2)). "The experience of other insurers or rating organizations"; (Ohio § 3937.02(3)). Also note 16 in section (d).
28. "Retrospective" instead of "past" (Ore. § 737.110(2)).
29. "Puerto Rico" instead of "State" (P.R. § 1204(1)(d)).
30. ". . . including trend factors" (Ind. § 3a(1)).
31. (15) "To expenses of operation" (Tex. Art. 5.14.1.).
32. "In the case of motor vehicle insurance as defined in section 38.1-21, consideration shall be given to all sums distributed by the State Corporation Commission from the Uninsured Motorist Fund in accordance with the provisions of sections 12-65 and 12-66 to the companies writing motor vehicle bodily injury liability and property damage liability insurance on motor vehicles registered in the State"; (Va. Art. 4 § 38-252(3)).
33. (26) "In addition to other factors required by this section, rates filed by an insurer on its own behalf may also be related to the insurer's plan of operation and plan of risk classification" (Wash. § 45.19.03(4)).
34. (27) "To such factors as expense, management, individual experience, underwriting judgment, degree or nature of hazard or any other reasonable considerations, provided such factors apply to all risks under the same or substantially the same circumstances or conditions" (W. Va. § 3.(3)).
35. (6) "To insure the adequacy and reasonableness of rates the Board may take into consideration past and prospective experience, within and outside the State, gathered from a territory sufficiently broad to include the varying conditions of the risks involved and the hazards and liabilities assumed, and over a period sufficiently long to insure that the rates determined therefrom shall be just, reasonable and adequate, and to that end the Board may consult any rate making organization or association that may now or hereafter exist" (Tex. Art. 5.04).

(Carlson numbers not used: 3, 4, 13)

(c) Expense Provisions

"The systems of expense provisions included in the rates for use by any insurer or group of insurers may differ from those of other insurers or groups of insurers to reflect the requirements of the operating methods of any such insurer or group with respect to any kind of insurance, or with respect to any subdivision or combination thereof for which subdivision or combination separate expense provisions are applicable."

(d) Classifications and Rating Plans

"Risks may be grouped by classifications for the establishment of rates and minimum premiums. Classification rates may be modified to produce rates for individual risks in accordance with rating plans which establish standards for measuring variations in hazards or expense provisions, or both. Such standards may measure any differences among risks that can be demonstrated to have a probable effect upon losses or expenses."

State	(c) Expense Provisions (Model Bill § 3.2)	(d) Classifications and Rating Plans (Model Bill § 3.3)	
		Omissions	Different Phraseology
Alabama			1
California	1		2
Colorado	2		
Connecticut			3
Delaware	3		8
District of Columbia	NR		4
Florida			22
Georgia	1		2
Hawaii	4		
Illinois	5		6
Indiana			23
Kansas	6	5	
Louisiana			7
Maine			8
Massachusetts	NR[a]–		9, 8
Michigan			6
Mississippi		5	10
Missouri			11, 12
New Hampshire	NR[a]	NR[a]	8
New Jersey	NR, 7		13
New York	8		
North Carolina	NR		14[a], 15[a] 15
Ohio	9		16
Oklahoma	10		4
Pennsylvania			17
Puerto Rico	11		
Rhode Island		18	19
Tennessee	12	5	
Texas	NR	5	20[a], 21
Vermont	NR	NR	
Wyoming	13		

NR — No Reference
a — Motor Vehicle (Liability) Only

(c) Expense Provisions

1. Omits the final clause "for which . . . . applicable" (Calif. § 1852(c)), (Ga. 56-507(c)).
2. Omits "with respect to any kind of insurance or" (Colo. § 72-12-3(1)(c)).
3. Substitute "insurance company(s)" for "insurer(s)" throughout (Del. § 2303(4)).
4. Substitute "class" for "kind" in "kind of insurance" (Hawaii § 181-693(2)).
5. Substitute "company(s)" for "insurer(s)" throughout (Ill. 1065.3 § 456(1)(b)).
6. Add after the second "combination": "The commissioner of insurance, . . ., approves the application of separate expense provisions; but this subdivision shall not be construed to require uniformity among all insurers with respect to the application of other subdivisions of this section" (Kans. § 40-1112(2)).
7. No reference — see note 1 in section (a) for only reference to expenses.
8. Substitute "one or more kinds of insurance or subdivisions of kinds of insurance, or classes of risks, or any part or combination of the foregoing, for which . . ." for "To any kind . . . combination . . . combination" (N.Y. § 183(f)3.).
9. Last "subdivision or combination" omitted (Ohio § 3937.02(B)).
10. Last "with respect to" omitted (Okla. § 902 C.).
11. Add "filed by any casualty insurance rating organization" (P.R. § 1204(2)).
12. "The systems of expense provisions included in the rates for use by any group, such as participating and nonparticipating groups of insurers, may differ from those of other groups of insurers to reflect the requirements of the operating methods of any such group with respect to any kind of insurance, or any subdivision or combination thereof, for which the commissioner approves the application of separate provisions" (Tenn. § 6356.21.2).
13. Substitute "of insurances" for "thereof" (Wyo. § 52-1053(a)2.).

(d) Classifications and Rating Plans

Explanations of Exceptions to Model Bill Phraseology
(Numbers in Parentheses Refer to Carlson's Original References)

1. (4, 5) "Every rating organization, and every insurer which makes its own rates, shall make rates that are not unreasonably high or inadequate for the safety and soundness of the insurer, and which do not unfairly discriminate between risks in this state, and shall, in rate-making, and in making rating plans (a) adopt basis classifications, which shall be used as the basis of all manual, class, schedule or experience rates" (Ala. § 392).
2. (6) In addition: "Classifications or modifications of classifications of risks may be established based upon size, expense, management, individual experience, location or dispersion of hazard, or any other reasonable conditions. Such classifications and modifications shall apply to all risks under the same or substantially the same circumstances or conditions (Calif. § 1852(d), (Ga. § 56-507(d)).
3. Substitute "provide for recognition of variations in hazards or in expense requirements, or both; such rating plans may include application of the judgment of the insurer and may . . ." for "establish standards for measuring variations in hazards or expense provisions, or both. Such standards" (Conn. § 38.187(a)(3)).
4. (7) See note 2 (24) in section (a).
5. (1) Omit third sentence (Kans. § 40-1112(3)), (Miss. § 5834.02(d)), (Tenn. § 6356.21.3), (Tex. Art. 5.14.2.).
6. In second and third sentences after ". . . plans which . . ." substitute "measure variation in hazards or expense provisions, or both. Such plans may

measure any differences among risks that have a probable effect upon losses or expenses. . . ." (Ill. 1065.3 § 456(1)), (Mich. § 500.2403(c)).

7. (10) In addition (after first sentence): "Rates may be established on the basis of any classifications submitted by any insurer or group of insurers, provided such classifications are found to be reasonable . . ." (La. § 1404.3(b)).

8. (9) See note 5 (25) in section (a) in addition to AIC phraseology.

9. (11) For Compulsory Motor Vehicle Liability Only: Provision is included for "fair and reasonable classifications of risks" (Mass. § 113B). Also see note 6 (3) in section (a).

10. (12) Second sentence adds "or in experience" after "hazards" (Miss. § 5834-02(d)).

11. Omit "rating plans which establish" in second sentence (Mo. § 379.470(6)).

12. (13) In addition: "Classifications or modifications of classification or any portion or any division thereof, of risks may be predicated upon size, expense, management, individual experience, purpose of insurance, location or dispersion of hazard, or any other reasonable considerations, provided such classifications and modifications shall be applicable to the fullest practicable extent to all risks under the same or substantially the same circumstances or conditions. Classification rates may also be modified to produce rates for individual or special risks which are not susceptible to measurement by any established standards;" (Mo. § 379.470(6)).

13. (14) Same as note 1 through "state" continuing "involving essentially the same hazards and expense elements, and shall, in rate making, and in making rating systems (a) adopt basic classifications, which shall be used as the basis of all manual, minimum, class, schedule, experience or merit rates; (b) adopt reasonable standards for construction, for protective facilities, and for other conditions that materially affect the hazard or peril, which shall be applied in the determination or fixing of rates (N.J. § 17:29A-4).

14. (15) "The Compensation Rating and Inspection Bureau of North Carolina . . . [has among its] functions . . . to maintain rules and regulations and fix rates for automobile bodily injury and property damage insurance and equitably adjust the same as far as practicable in accordance with the hazard of the different classes of risks as established by said bureau (N.C. § 58-246(1)).

15. (16) See note 11 (8) in section (a).

16. (17) In addition same as note 13, except substitute "apply" for "shall be applicable to the fullest practicable extent" (Ohio § 3937.02(C)). "Special filings may be made at any time with respect to any individual or special risks whose size, classification, degree of exposure to loss, previous loss experience, or other relevant factors call for the exercise of sound underwriting judgment in the promulgation of rates appropriate to such individual or special risks" (Ohio § 3937.03(D)).

17. (18) See note 58 in section (e).

18. (2) Omit second and third sentences (R.I. § 27-9-4.3).

19. (19) See note 62 in section (e).

20. "The Commissioner is hereby authorized and empowered to require sworn statements from any insurer affected by this Act, showing its experience on any classification or classifications of risks and such other information which may be necessary or helpful in determining power classification and rates or other duties or authority imposed by law. The Commissioner shall prescribe the necessary forms for such statements and reports, having due regard to the rules, methods and forms in use in other states for similar purposes in order that uniformity of statistics may not be disturbed" (Tex. Art. 5.05(d) motor vehicle).

21. (21) Second sentence: substitute "in such risks on the basis of any or all of the factors mentioned in the preceding paragraph" (Tex. Art. 5.14.2). The words "preceding paragraph" refer to basis of rates section (b).
22. In addition: "Such classifications and modifications shall apply to all risks under the same or substantially the same circumstances or conditions (Fla. § 627.072(3)).
23. "Risks may be grouped by classifications, by rating schedules or by any other reasonable methods, . . . etc." (Ind. § 3a(2)).

(Carlson numbers not used: 3, 8, 20.)

(e) Rate Filings

1. "Every insurer shall file with the Commissioner every manual of classifications, rules and rates, every rating plan and every modification of any of the foregoing which it proposes to use. Every such filing shall state the proposed effective date thereof, and shall indicate the character and extent of the coverage contemplated. When a filing is not accompanied by the information upon which the insurer supports such filing, and the (Commissioner) does not have sufficient information to determine whether such filing meets the requirements of the Act, he shall require such insurer to furnish the information upon which it supports such filing and in such event the waiting period shall commence as of the date such information is furnished. . . . A filing and any supporting information shall be open to public inspection after the filing becomes effective."
2. Filings may be made by a rating organization on behalf of a member or a subscriber.
3. "The commissioner shall review filings as soon as reasonably possible after they have been made in order to determine whether they meet the requirements of this Act." Subject to the exception specified in (e)-6 below, the commissioner has a waiting period of 15 days in which to consider the filing, which period may be extended by him for an additional period not to exceed 15 days upon proper notice to the filer. A filing is deemed approved unless disapproved by the commissioner within the waiting period or any extension thereof. This is the so-called "deemer" provision.
4. ". . . the commissioner may, by written order, suspend or modify the requirement of filing as to any kind of insurance, subdivision or combination thereof, or as to classes of risks, the rates for which cannot practicably be filed before they are used."
5. "Upon the written application of the insured, stating his reasons therefore, filed with and approved by the commissioner, a rate in excess of that provided by a filing otherwise applicable may be used on any specific risk."
6. "Any special filing with respect to a surety or guaranty bond required by law or by court or executive order or by order, rule or regulation of a public body, not covered by a previous filing, shall become effective when filed. . . ."

The more substantive departures from the Model Bill provisions are noted below:

State	(e)-1 Filing Required And Confidential Until Effective	(e)-2 Filings by Rating Bureau	(e)-3 Review and Approval: Waiting Period	(e)-4 Filing After Use	(e)-5 Rate in Excess of Normal	(e)-6 Special Filings
Alabama	1, 2		3	NR	NR	NR
Alaska	4		5			
Arizona	6		7, 8			
Arkansas	6, 9					
California	10	NR	NR	NR	NR	NR
Colorado	11, 76		8, 12	NR		
Connecticut			13			
Delaware	4, 6		8, 14			
Dist. of Col.	2, 15		8, 16	NR	NR	NR
Florida	10	NR	NR	NR	17	NR
Georgia	10, 18		NR	NR	NR	NR
Idaho	19	19	19	19	19	19
Illinois	20		21			22
Indiana	23	24	25			NR
Kansas	2, 26		3	NR		
Kentucky			13			
Louisiana	4, 27		28, 29			NR
Maine	9		8, 30			NR
Maryland	31					
Massachusetts	32[a]	32[a]	32[a]	32[a]	32[a]	32[a]
	9	—	8, 30			NR
Michigan	11, 77		33, 78		61	
Minnesota			34			
Mississippi	27, 35		3	36	37	
Missouri	38	38	38	38	38	38
Montana	39					
Nevada	4					
New Hampshire	2[a], 41[a]		30[a], 42[a]	NR[a]	NR[a]	NR[a]
	2		30, 40			
New Jersey	2, 43		44	NR	45	NR
New York	46		47		48	
North Carolina	49[a]	50[a]	30[a], 42[a]	NR[a]	51[a]	NR[a]
	2, 52	—	30, 42	NR	51	NR
Ohio	6, 9		8, 53			
Oklahoma	15, 27, 54		8, 34	55	56	
Oregon			8			
Pennsylvania	6, 9		8, 13		57	58
Puerto Rico	59		60		61	
Rhode Island	6, 62					
South Carolina			13			
South Dakota	4		13			
Tennessee	4, 68, 71		3	NR	NR	64
Texas	65[a]	65[a]	65[a]	65[a]	65[a]	65[a]
	2, 27, 35		13	NR	NR	67
Utah	68, 73		8, 69			NR
Vermont	2, 27, 70		3	NR	NR	NR
Virginia	4, 68, 71		30, 42		61	
Washington	2	72	3			
West Virginia	73		34			
Wisconsin	74		75			
Wyoming	27		8, 30			NR

NR — No reference
a — Motor vehicle (liability) only

(e) Rate Filings (Model Bill § 4)

Explanations of Exceptions to Model Bill Phraseology
(Numbers in Parentheses Refer to Carlson's Original References)

1. ". . . File . . . a copy of the rating plan upon which such rate is based, or by which such rate is fixed or determined" (Ala. § 394).
2. (1) No provision as respects public inspection (Ala. § 394), (D.C. § 35.1504(a)), (Kans. § 40-1113(a)), (N.H. motor vehicle liability § 412:14), (N.J. § 17:29A-6), (N.C. § 58-131.13), (Tenn. § 6356.22(a)), (Tex. Art. 5.15(a)), (Vt. § 4655), (Wash. § 48.19.440).
3. (9) No waiting period, 30 day deemer (Ala. § 395), (Kans. § 40-1113(c)), (Miss. § 5834-03(c)), (Tenn. § 6356.22(c)), (Vt. § 4654), Wash. § 48.19.440).
4. "Every insurer shall file . . . every manual, minimum, class rate, rating schedule or rating plan and every other rating rule, and each modification of any of them which it proposes to use" (Alaska § 21.39.040(a)), (Del. § 2304(a), (La. § 1407.A (1)), (Nev. § 694.070.1), (S.D. § 4 (1)), (Va. § 38-241).
5. In section (d) of Model Bill ". . . or any extension thereof" omitted in last two sentences (Alaska § 21.39.040(d)).
6. Omits: ". . . and in such event the waiting period shall commence as of the date such information is furnished" (Ariz. § 18(a)), (Ark. § 241(3)), (Del. § 2304(a)), (Ohio § 3937.03(A)), (Pa. § 1184(a)), (R.I. § 27-9-7).
7. (10) 15 day waiting period, with no extension, *no deemer* (Ariz. § 18(c)).
8. (11) Disapproval only after hearing (Ariz. § 19), (Colo. § 72-12-5(3)), (Del. § 2304(c)), (D.C. § 1504(c)), (Me. § 2765), (Mass. § 7), (Ohio § 3937.04), (Ore. § 737.135(1)), (Pa. § 1185(a)), (Utah § 31-18-4), (Wyo. § 52-1505), (Okla. § 9036).
9. Omits "its interpretation of any statistical data it relies upon" (Ark. § 241 (3)), (Me. § 2764), (Mass. § 6(a)), (Ohio § 3937.03(A)), (Pa. § 1184(a)).
10. (2) Normal rate filings not required, however, see note 3 in section (1) for requirement regarding maintenance of records.
11. Supporting information to determine whether filing meets requirements, if needed, must be requested by the Commissioner within 15 days after date of filing (Colo. § 72-12-4(2)(a)), (Mich. § 500.2406(1) (within 10 days)).
12. 15 day waiting period, no extension unless for hearing, deemer equivalent (Colo. § 72-12-5(3)).
13. (21) 30 day waiting period, 30 day extension, deemer (Conn. § 38-188(e)), (Ky. § 304.621(4)), (Pa. § 1184(d)), (S.C. 37-694), (S.D. § 4(4)), (Tex. 5.15(e)).
14. (13) No waiting period specified. However, Commissioner is to "review filings as soon as reasonably possible. . . ." Filing deemed approved unless disapproved (Del. § 2304(c)).
15. "Every company shall file . . . all rates and rating plans, rules and classifications which it uses or proposes to use . . . " (D.C. § 35-1504), (Okla. § 903A — omit "rules").
16. (14) "Rates may become effective immediately upon filing or at such future time as the company or rating organization making them may specify. They shall remain in effect unless and until changed by the company or rating organization making them, or adjusted by order of the Superintendent in accordance with the provisions of this chapter" (D.C. § 35-1503(f)).
17. "With written consent of the insured filed with the insurer . . ." Approval by the Commissioner not necessary (Fla. § 627.181).

18. "Every insurer shall maintain with the commissioner copies of the rates, rating plans, rating systems, underwriting rules, policy or bond forms used by it" (Ga. § 56–522.1).

19. (3) Filing is required only if the commissioner upon biennial review and hearing shall determine that reasonable competition does not exist with respect to certain classes of insurance, whereupon provisions analagous to those in the model bill become applicable (Ida. § 347, § 346, § 350).

20. Second sentence adds ". . . he shall, within fifteen days of such filing, give written notice to such company stating wherein such filing appears not to meet the requirements of . . ." this Article and before "request . . . company to furnish information . . ." (Ill. 1065.4 § 457(1)).

21. In addition: "Any waiting period may be further extended upon request of any such company or rating organization" (Ill. 1065.4 § 457(4)).

22. In addition: "Any filing, other than a special filing with respect to a surety or guaranty bond, the proposed effective date of which is less than fifteen days from the date it is filed, shall become effective on the proposed effective date unless disapproved prior thereto, and shall not be subject to the waiting period. . . ." (Ill. 1065.4 § 457(5)).

23. Omit: "Shall state the proposed effective date thereof, . . ." in the second sentence, and the entire third sentence. Substitute, in place of the third and last sentence, "The commissioner shall have the right to request any additional relevant information. A filing and any supporting information shall be open to public inspection as soon as stamped 'filed' within a reasonable time after receipt by the commissioner, and copies may be obtained by any person on request and upon payment of a reasonable charge therefor" (Ind. § 4b, c).

24. In addition: "That any subscriber may withdraw or terminate such authorization, either generally or for individual filings, by written notice to the commissioner and to the rating organization and may then make its own independent filings for any kinds of insurance, or subdivisions, or classes of risks, or parts or combinations of any of the foregoing, . . . , or may request the rating organization, within its discretion, to make any such filing on an agency basis solely on behalf of the requesting subscriber" (Ind. § 4g(1)).

25. "Filing shall become effective upon the date of filing by delivery or upon the date of mailing by registered mail to the commissioner, or on a later date specified in the filing" (Ind. § 4d). See also note 15 in Section (i).

26. Second sentence reads: "Every such filing shall indicate the character and extent of the coverage contemplated and shall be accompanied by the information upon which the insurer supports the filing."
Remainder of the subsection omitted (Kansas § 40–1113(a)).

27. Omit third and fourth sentence (La. § 1407.A(1)), (Miss. § 5834–03(a)), (Okla. § 903A and second sentence), (Tenn. § 6356.22(a)), (Tex. Art. 5.15(a)), (Wyo. § 52–1504(a)), (Vt. § 4655 and second sentence).

28. Omits Model Bill Section (c) which begins: "The [Commissioner] shall review filings. . . ."

29. In addition: "When a filing of adjustments of rates for existing classifications of risks (1) does not involve a change in the relationship between such rates and the expense portion thereof, and (2) does not involve a change in rate relativities among such classifications on any basis other than loss experience, such filing shall be effective upon the date or dates specified in the filing and shall be deemed to meet the requirements of this part" (La. § 1407F.).

30. (15) No waiting period. No deemer (Me. § 2764), (Mass. § 6), (N.H. § 4), (N.H.M.V.L. Ch. 412), (N.C. auto liability § 58-248), (N.C. § 58-131.13), (Va. § 38-253), (Wyo. § 52-1504).

31. Last sentence reads: "The Commissioner may, on the date a filing is received, place the filing on file in his office for public inspection" (Md. § 243(c)(1)).

32. (4) "The commissioner shall, annually on or before September fifteenth, after due hearing and investigation fix and establish . . . premium charges to be used . . . for the ensuing year . . ." (Mass. compulsory Motor Vehicle Liability § 113B.).

33. In addition to AIC phraseology: ". . . where a filing is not accompanied by supporting information and such information is required by the commissioner . . . such filing shall be deemed to meet the requirements . . . unless disapproved by a commissioner within 15 days after such information is furnished" (Mich. § 500.2408(2)).

34. 30 day waiting period, 15 day extension with deemer (Minn. § 70.38(4)). (Okla. § 902G), (W. Va. § 4(2)(e)).

35. In addition to second sentence AIC phraseology: ". . . and shall be accompanied by the information upon which the insurer supports the filing" (Miss. § 5834-03(a)), (Tenn. § 6356.22(a)), (Tex. Art. J. 15(a) also "by the policies and endorsement forms proposed to be used").

36. (24) "If the commission in its discretion shall determine that a filing is impractical or unnecessary as to a kind, class, subdivision or combination of insurance, it may by written order suspend the requirement of filing as to kind, class, subdivision or combination until otherwise ordered by it" (Miss. § 5834-03(e)).

37. (27) "A rate in excess of that provided by approved filings may be used on specific risk with the written consent of the commission and the insured" (Miss. § 5834-03(f)).

38. (2) No filing required, but "Such agreements [to adhere to rates, etc. by two or more insurers] shall be submitted in written form to the superintendent for his consideration together with such information as he may require to determine whether they are consistent with (the act) . . . and otherwise in the public interest" (Mo. § 379.465(4))

39. (5) "Every rating bureau shall file . . ." (Mont. § 40-3604(1)).

40. (17) Commissioner may suspend filing for 30 days pending investigation as to whether it meets requirements of the Act (N.H. § 5(a)).

41. Reads in toto: "Every insurance company authorized to transact business in this state which insures against loss by reason of the liability to pay damages to others for damage to property or bodily injury including death arising from the operation, maintenance, or use of motor vehicles within this state, shall file with the insurance commissioner individually or in collaboration with others, in such forms as he may prescribe, its classification of risks and premium rates applicable thereto, together with a schedule or rating to be in use and such other statistical information as the commissioner may require" (N.H. motor vehicle liability § 412:14).

42. (16) Prior approval necessary (N.H. motor vehicle liability § 412:15), (N.C. auto liability § 58-248 within 90 days), (N.C. § 58-131.13), (Va. § 38-253).

43. ". . . every insurer shall, before using or applying any rate to any kind of insurance, file with the commissioner a copy of the rating-system upon which such rate is based, or by which such rate is fixed or determined (N.J. § 17L29A-6).

44. (18) No waiting period specified in the law; however, 90 day deemer provision is included (N.J. § 17:29A–7).

45. "Upon written application of an insurance company, broker or agent, which application shall include the signed consent of the applicant for insurance. . . ." etc. (N.J. § 17:29A–7.1).

46. "Every rating organization and every authorized insurer shall file . . . every rate manual, schedule of rates, classification of risks, rating plan, and every other rating rule and every modification of any of the foregoing which it proposes to use" (N.Y. § 184.1).

47. (19) Prior approval necessary for motor vehicle insurance required by section 17 of the vehicle and traffic law and fore surety bonds given in lieu of such required motor vehicle insurance (N.Y. § 184.7). New York Insurance Department, however, construes this to apply to all automobile liability insurance.

48. "Agreements may be made among insurers with respect to the equitable apportionment among them of insurance which may be afforded applicants who are in good faith entitled to but unable to procure such insurance through ordinary methods and such insurers may agree among themselves on the use of reasonable rate modifications for such insurance, . . . subject to the approval of the superintendent" (N.Y. § 184.10).

49. (6) Rates are made and filed by statutory administrative bureau (N.C. auto liability § 58–248).

50. "Before the commissioner of insurance shall grant permission to any . . . insurance company or any other insurance organization to write automobile bodily injury and property damage insurance in this State, it shall be a requisite that they shall subscribe to and become members of the North Carolina Automobile Rate Administrative Office" (N.C. § 58–247(a)).

51. "A rate in excess of that promulgated by the rating bureau may be charged on any specific risk provided such higher rate is charged with the knowledge and written consent of both the insured and the Commissioner" (N.C. auto liability § 58–248.2), (N.C. § 58–131.18).

52. Reads in toto: ". . . Every rating bureau or insurer which makes its own rates shall file . . . every rate manual, classification of risks, rating plan, rating schedule, and every other rating rule which is made or used by it, and upon . . . request, all other information concerning the application and calculation of rates made or used by it" (N.C. § 58–131.13).

53. (20) Rates effective immediately upon filing (Ohio § 3937.03(C)).

54. (7) "All schedules and insurance rates . . . shall be open to inspection to the public after such filings are made" (Okla. § 904.A).

55. (26) "Rates or risks which are not by general custom of the business or because of rarity or peculiar characteristics written according to normal classification or rating procedure and which cannot be practicably filed before they are used may be used without being filed. The board may make such examination as it may deem advisable to ascertain whether any such rates meet the requirements of this article (Okla. § 902G).

56. (28) Approval not necessary (Okla. § 902 H.).

57. "Upon the written consent of the insured stating his reasons, therefor . . ." etc. (Pa. § 1184(g)).

58. (30) In addition: "Any filing with respect to a contract or a policy covering any risk or kind or insurance or subdivision thereof for which classification rates do not generally exist in the industry, or which by reason of rarity or peculiar characteristics does not lend itself to normal classification or rating procedure, shall become effective when filed and shall be deemed to meet the requirements of this Act (Pa. § 1184(e)).

59. "Every rating organization and every authorized insurer shall file . . . every rate manual, schedule of rates, classification of risk, rating plan, and every other rating which is made or used by it, and all other information concerning the application and calculation of rates made or used by it, and every modification of any of the foregoing which it contemplates to use" (P.R. § 1205(1)).

60. 30 day waiting period, with up to 60 day extension with deemer (P.R. § 206(1)(a)).

61. "Upon written application of the insurer, stating the reasons therefor . . ." etc. (P.R. § 1209), (Mich. § 500.2414), (Va. § 38-262 ". . . accompanied by the written consent of the insured or prospective insured . . ."). In Michigan, the word "insurer" is a typographical error in the law.

62. (8) In addition: ". . . provided, however, that classification rates may be modified without additional filing to produce rates for individual risks which are lower than those filed and which evaluate variations in physical or moral hazards, individual risk experience or expense provisions and which are not inadequate or unfairly discriminatory" (R.I. § 27-9-7).

63. In addition: "The insurer may incorporate by reference into its filing all or part of any existing filing and supporting information in the commissioner's possession which is open to public inspection. However, any insurer not a member or subscriber of a licensed rating organization shall file with the commissioner a satisfactory statement of its qualification to make rates" (Tenn. § 6356.22(a)).

64. (31) "Any such filing with respect to a fidelity, surety or guaranty bond shall be deemed approved from the date of filing to the date of such formal approval or disapproval" (Tenn. § 6356.22(d)).

65. (4) "The Board [of Insurance Commissioners] shall have the sole and exclusive power and authority to determine, fix, prescribe, and promulgate . . . rates of premiums to be charged and collected by all insurers writing any form of insurance on motor vehicles in this state . . ." (Tex. Motor Vehicle Art. 5.01).

66. No waiting period specified; however, a 30 day deemer provision with possible 30 day further postponement is included. (Tex. Art. s.15(c)).

67. (32) "Any filing for which there is no approved rate shall be deemed approved from the date of filing to the date of such formal approval or disapproval" (Tex. Art. 5.15(d)).

68. In third sentence substitute "may" for "shall" (Utah § 31-18-3 (2)), (Va. § 38-241).

69. (10) 15 day waiting period with extension until additional supporting information is furnished. No deemer provision specified in the law (Utah § 31-18-3(2)).

70. "Every insurance company and rating organization . . . shall file . . . any schedule of rates, rules, regulations or forms and such other information concerning the same as shall be suggested, approved or made by any such company or organization" (Vt. § 4654).

71. (7) "A filing and any supporting information shall be deemed to be a public record" (Va. § 38-241).

72. "Every insurer as to casualty insurance shall file with the Commissioner its rates and rating schedules, or it may adopt advisory rules and rates of rating organizations" (Wash. § 48.19.440).

73. (7) A filing and any supporting information shall be open to public inspection as soon as the filing is made (Utah § 31-18-3(2)),(W.Va. § 4(2)(b)).

74. Add: "including short rate tables" to first sentence. Add "such short rate tables shall specify the percentages of the premium to be charged or retained by the insurer, and shall cover all policies of insurance the term of which is less than the term prescribed for such insurance by the rate and rating schedules as filed by such insurer or by a rating bureau or organization in behalf of such insurer" (Wis. § 204.40(1)).

75. (23) Add: "A filing made by an insurer for a kind of insurance or subdivision thereof as to which such insurer is not a member of or subscriber to a rating organization shall be deemed to meet the requirements of this act unless disapproved by the Commissioner after notice and hearing and findings made in accordance with the requirements of The Section on Disapproval of Filings" (Wisc. § 240.40(5)).

76. "Within fifteen days after the date of the filing, together with any additional information, if any, in support of the filing . . . the Commissioner shall place the filing . . . on file in his office for public inspection . . ." Col. § 72-12-5(2)).

77. "In lieu of the filing requirements . . . as an alternative method . . . any insurer or rating organization may file . . . Every such filing . . . shall state the effective date thereof, shall take effect on said date, shall not be subject to any waiting period . . . and shall be deemed to meet the requirements . . . A filing and any supporting information shall be open to public inspection, if the filing is not disapproved" (Mich. § 500.2430(1)).

78. For the "alternative filing" method in Note 77. Within 15 days after such filing the Commissioner may give written notice to the filer specifying how he contends filing fails to comply with requirements and fix a date for a hearing with at least 10 days notice. The Commissioner, after hearing, may disapprove the filing but such order must be entered within 30 days of the date of the filing and it may require an adjustment of premium up or down, "if the amount is substantial and equals or exceeds the cost of making the adjustment." Disapproval orders not based upon a hearing whose notice is given within 15 days of the filing may not order premium adjustment (Mich. § 500.2430(2) and (3)).

(Carlson numbers not used: 12, 22, 25, 29)

(i) Deviations (Model Bill § 7)

Any member of or subscriber to a rating organization "may make written application to the (Commissioner) for permission to file a uniform percentage decrease or increase to be applied to the premiums produced by the rating system so filed for a kind of insurance, or for a class of insurance which is found by the Commissioner to be a proper rating unit for the application of such uniform percentage decrease or increase, or for a subdivision of a kind of insurance (1) comprised of a group of manual classifications which is treated as a separate unit for rate making purposes, or (2) for which separate expense provisions are included in the filings of the rating organization." There is no waiting period except for that introduced by a 10-day notice of hearing to the rating organization, which may waive the hearing. Prior approval is required. Deviation filings are to be judged in general by same criteria as other filings (see (a) above). Deviations are effective for a period of one year unless terminated sooner with the approval of the (Commissioner).

	Exceptions				
State	Scope	Hearing	Approval	Waiting Period	Duration
Alabama	1	2			
Alaska	3	4			5
Arizona		4	6	7	
California	NR				
Colorado	8				
Delaware	3		9		
District of Columbia	10	2, 11			12
Florida	NR				
Georgia	NR				
Hawaii	13				
Indiana	14, 15	4, 15	6, 15		12, 16
Indiana	14, 15	4, 15	6, 15		12 16
Iowa	3	4			5
Kansas	17	4			12
Massachusetts	NR[a]				
Michigan	3	4	18		5
Minnesota					12
Mississippi	19				
Missouri	NR				
Nevada	3	4			5
New Hampshire	NR[a]				
New Jersey	20	2			12
New York	21	4			5
North Carolina	NR[a]				
	22	2			12
Ohio		4, 24	6, 23, 24		12
Oklahoma	25	4	6	7	12
Pennsylvania		4	6	26	5
Puerto Rico		4			12
Rhode Island		4	6	27	5
South Dakota	3	4			5
Tennessee	1				5
Texas	NR				
Utah	3	4			5
Vermont	25	2			12
Washington		6		26	12
West Virginia		2			
Wisconsin		6, 23	28		

NR - No Reference a - Motor Vehicle (Liability) Only

(i) Deviations

Explanation of Exceptions to Model Bill Phraseology
(Numbers in Parentheses Refer to Carlson's Original References)

1. (1) "For a kind of insurance or for a subdivision or combination thereof, for which . . . the (supervisor) has approved the application of separate expense provisions" (Ala. § 399), (Tenn. § 6356–24). In these two states the foregoing is the only basis for a deviation.
2. (10) No time limit on notice of hearing (Ala. § 399), (D.C. § 35–1506(f) "reasonable time"), (N.J. § 17:29A–10), (N.C. § 58–131.15), (Vt. § 4655), (W. Va. § 7(b)).
3. (3) "To file a deviation from the class rates, schedules, rating plans or rules respecting any kind of insurance, or class or risk within a kind of insurance, or combination thereof" (Mich. § 500.2450(1)), (Alaska § 21.39.070(a) "Uniform percentage deviation"), (Del. § 2307), (Iowa § 7), (Nev. § 694.280), (S.C. § 37–730), (S.D. § 7), (Utah § 31–18–6(1)).
4. (11) No provision for a hearing (Kans. § 40–1115). Except for provision for appeal by minority (Kans. § 40–1116) same as model bill § 8 (Mich. § 500.2456), (Alaska § 21.39.080), (Ind. § 11a), (Iowa § 8), (Nev. § 694.290), (N.Y. § 184.11 within 30 days), (Ohio § 3937.07), (Okla. see § 903), (Pa. § 1187), (R.I. § 27–9–19 or if disapproved § 27–9–18), (S.D. § 8), (Utah § 31–18–7), (P.R. § 1230), (Ariz. § 27), (La. § 1411).
5. (22) "For a period of not less than 1 year . . ." etc. (Mich. § 500.2452(2)), (Alaska § 21.39.070(b)), (Iowa § 7), (Nev. § 694.280), (N.Y. § 185.4), (Pa. § 1187), (R.I. 27–9–26), (S.D. § 7), (Tenn. § 6356.24), (Utah § 31–8–6(2)).
6. (13) No approval required (Ariz. § 20(b), (Ind. § 9C.a "effective upon date of filing"), (Ohio § 3937.06), (Okla. § 906.F), (Pa. § 1187), (R.I. § 27–9–26), (Wis. § 204.43), (Wash. § 48.19.440).
7. (17) 15 days (Ariz. § 20(b)), (Okla. § 906.F).
8. Substitute "rates made," "make," "are applicable," "made" for "filings made," "file," "are included in the filings of the rating organization," and "filed" respectively throughout the paragraph with "so filed" omitted (Colo. § 72–12–8).
9. (14) In addition: "All term policies issued pursuant to such deviations may remain in force until their expiring dates" (Del. § 2307).
10. (4) ". . . may deviate such filings . . ." "The Superintendent shall approve any such deviation unless he finds that . . . [it] would be inconsistent with the provisions of this chapter" (D.C. § 35–1506(f)).
11. (12) "Unless he approves the deviation within thirty days he shall . . . grant a hearing" (D.C. § 35–1506(f)).
12. (21) No time limit on duration of deviation (D.C. § 35.1506(f)), (Kans. § 40–1115), (Ind. § gc.), (Minn. § 70.41), (N.J. § 17:29A–10), (N.C. § 58.131.15), (Ohio § 3937.06), (Okla. § 906.F.), (P.R. § 1214), (Vt. § 4655 (c)), (Wash. § 44.19.440).
13. "For a class of insurance, or for a class of insurance . . ." (Hawaii § 181–697).
14. ". . . may file with commissioner a deviation from the rates, rating schedules, rating plans, rating systems or rules respecting any kind of insurance, division, subdivision classification, or any part or combination of any part of the foregoing" (Ind. § 9a).
15. "When a filing or deviation involving a rate adjustment depends upon a change in the relationship between the proposed rates and the anticipated

production expense portion thereof from the relationship anticipated under any rates previously filed and currently in effect for the company or rating organization involved . . ." (Ind. Sec. 7a.) ". . . on file for a waiting period of twenty (20) days before it becomes effective . . . such filing or deviation shall be deemed to meet the requirements of this act unless disapproved (1) within such waiting period, or, (2) if a hearing has been called and written notice thereof given by the commissioner during such waiting period, then within ten (10) days after the commencement of such hearing . . . the commissioner may at any time within the waiting period call a hearing upon not less than ten (10) nor more than fifteen (15) days' written notice . . ." (Ind. § 7b).

16. In addition: "A change in the rates, rating schedules, rating plans, rating systems or rules to which the deviation applied shall not terminate the deviation without the consent of the insurer to which the deviation applies" (Ind. § 9c).

17. (6) "For a kind of insurance, or for a subdivision or combination thereof" (Kans. § 40-1115).

18. (15) As an alternative a deviation "shall become effective immediately as of the date filed . . . any . . . disapproval . . . must be entered within 30 days of application . . . If such deviation shall be disapproved, the insuring provisions of any contract or policy issued prior to the time the order becomes effective shall not be affected" (Mich. § 500.2452(1)).

19. (1) ". . . for a kind, class or classes of insurance, or for a subdivision or combination thereof for which . . . the commission has approved the application of separate expense provisions by such rating organization" (Miss. § 5834-06).

20. (7) ". . . to a particular kind or kinds of insurance" (N.J. § 17:29A-10).

21. ". . . may make written application . . . for permission to deviate from the rates, schedules, rating plans or rules filed on its behalf by such rating organization" (N.Y. § 185.4).

22. (9) ". . . request . . . for approval of a deviation from a filing approved by him and made by a rating organization of which it is a member or subscriber" (N.C. § 58-131.15).

23. (14) ". . . shall not affect any contract or policy made or issued prior to the expiration of the period set forth in said order" (Ohio § 3937.04), (Wis. § 204.41.4(b)).

24. (16) Disapproval only ". . . after a hearing upon not less than twenty days written notice . . ." (Ohio § 3937.04).

25. (4)(8) Deviation must be uniform in its application and not inconsistent with the provisions of the article (Okla. § 906.F.), (Vt. § 4655(c) continues "in its application to all risks in the state of the class to which such deviation is to apply").

26. (18) 30 days, but the commissioner may authorize earlier (Pa. § 1187), (Wash. § 48.19.440).

27. (19) 30 days (R.I. § 27-9-26).

28. (20) 15 days with possible 15 day extension (Wis. § 204.43).

(Carlson numbers not used: 2, 5)

(k) Exchange of Information
(Model Bill § 13(b), (c))

1. Interchange of Rating Plan Data. "Reasonable rules and plans may be promulgated by the Commissioner for the interchange of data necessary for the application of rating plans."
2. Consultation with Other States. "In order to further uniform administration of rate regulatory laws, the Commissioner and every insurer and rating organization may exchange information and experience data with insurance supervisory officials, insurers and rating organizations in other states and may consult with them with respect to rate making and the application of rating systems."

	Exceptions	
State	(k)–1	(k)–2
Alabama	1	1
California	NR	3
District of Columbia	NR	NR
Florida	NR	3
Georgia	NR	4
Indiana	NR	5
Massachusetts	NR[a]	NR[a] 2
Mississippi	NR	NR
Missouri	NR	6
New Hampshire	NR[a]	NR[a]
New Jersey	NR	NR
North Carolina	NR	NR
Oklahoma	NR	NR
Oregon		2
Puerto Rico		2
Rhode Island		2
Tennessee		2
Texas	7[a] 7	2[a], 8[a] 2
Washington		6

NR — No Reference
a — Motor Vehicle (Liability) Only

(k) Exchange of Information (Model Bill § 13(b), (c))

Explanations of Exceptions to Model Bill Phraseology

(Numbers in Parentheses Refer to Carlson's Original References)

1. (1) Substitute "loss experience" for "data" (Ala. § 393).
2. (4) "May consult and cooperate" (Ala. § 393), (Mass. § 15(c)), (Ore. § 737.525 (2)), (P.R. § 1217), (R.I. § 29-9-40), (Tenn. § 6356.27(c)), (Tex. Art. 5.05 (c) Motor vehicle, (Tex. Art. 5.19(e)).
3. (5) "Licensed rating organizations and admitted insurers are authorized to exchange information and experience data with rating organizations and insurers in this and other states and may consult with them with respect to rate-making and the application of rate systems" (Calif. § 1853.7), (Fla. § 627.314(4)).
4. "Exchange of Information or Experience Data: Consultation with Rating Organizations and Insurers.
   Cooperation among rating organizations or among rating organizations and insurers in rate making or in other matters within the scope of this Act is hereby authorized." Continues as in Model Bill § 11(b).(Ga. 56-511 only provision in Ga.). In the other states it is in addition to AIC phraseology (Colo. § 72-12-7(3)), (Ill. 1065.6 § 459(4)), (Ind. § 8 f.), (Kans. § 40-1114 (e)), (Mont. § 40-3629.(3), etc.
5. Add: "Advisory organization or statistical agency" to groups allowed to exchange information, etc. (Ind. § 16a.b.).
6. (5) "Every rating organization and insurer may exchange information and experience data with insurers and rating organizations in this and other states and may consult with them with respect to rate making and the application of rating systems" (Mo. § 379.465.1), (Wash. § 45.19.38).
7. ". . . requiring the interchange of loss experience . . ." in lieu of "data" (Tex. Art. 5.05(b) motor vehicle), (Tex. Art. 5.19(b)).
8. See note 35 in section (b) for consultation with "any rate making organization or association."

(Carlson numbers not used: 2, 3)

(l) Recording and Reporting of Loss and Expense Experience

For convenience in reference the five sentences in the Model Bill phraseology have been noted here separately.

1. "The commissioner shall promulgate reasonable rules and statistical plans, reasonably adopted to each of the rating systems on file with him, which may be modified from time to time and which shall be used thereafter by each insurer in the recording and reporting of its loss and countrywide expense experience, in order that the experience of all insurers may be made available at least annually in such form and detail as may be necessary to aid him in determining whether rating systems comply with the standards set forth in Section ——."
2. "Such rules and plans may also provide for the recording and reporting of expense experience items which are specially applicable to this state and are not susceptible of determination by a prorating of countrywide expense experience."
3. "In promulgating such rules and plans, the commissioner shall give due consideration to the rating systems on file with him and, in order that such rules and plans may be as uniform as is practicable among the several states, to the rules and to the form of the plans used for such rating systems in other states."

4. "No insurer shall be required to record or report its loss experience on a classification basis that is inconsistent with the rating system filed by it."
5. "The commissioner may designate one or more rating organizations or other agencies to assist him in gathering such experience and making compilations thereof, and such compilations shall be made available, subject to reasonable rules promulgated by the commissioner, to insurers and rating organizations."

(1) Recording and Reporting of Loss and Expense Experience

	Exceptions					
State	(1)–1	(1)–2	(1)–3	(1)–4	(1)–5	Other
Alabama	NR	NR	NR	NR	NR	1
Arizona					2	
California	NR	NR	NR	NR	NR	3
Colorado	4				5	
Delaware					6	
District of Columbia	NR	NR	NR	NR		
Florida	7		7	7	3	
Georgia	NR	NR	NR	NR	NR	3
Illinois				8	9, 10	
Indiana		11		12		
Kansas					13	
Kentucky					14	
Massachusetts	NR[a]	NR[a]	NR[a]	NR[a]	NR[a]	15[a]
	4	—	—	—	—	—
Michigan				16	16	
Minnesota					5	
Mississippi	17	NR			18	
Missouri	NR	NR	NR	NR	NR	
Montana	NR	NR	NR	NR	NR	
Nebraska					5	
New Hampshire	NR[a]	NR[a]	NR[a]	NR[a]	NR[a]	19[a]
	—	—	—	—	—	—
New Jersey	NR	NR	NR	NR	NR	20
New York	21					22
North Carolina	NR[a]	NR[a]	NR[a]	NR[a]	NR[a]	23[a]
	NR	NR	NR	NR	NR	24
Ohio	25, 26	NR	NR	27		
Oklahoma	NR	NR	NR	NR	NR	
Oregon	17				28	
Pennsylvania					29	30
Puerto Rico	21	31			NR	32
South Dakota	37				37	
Texas	17[a], 25[a], 33[a]	NR[a]		NR[a]	34[a]	35[a]
	17, 25, 33	NR		NR[a]	34	—
Utah					5	
Vermont	4, 36				5	
Virginia				38		
West Virginia	39					

(I) Recording and Reporting of Loss and Expense Experience (Model Bill § 13(a))

Explanations of Exceptions to Model Bill Phraseology
(Numbers in Parentheses Refer to Carlson's Original References)

1. (15) "Every insurer shall file annually on or before July 1 with the rating organization of which it is a member or subscriber or with such other common agency representing a group of insurers as the Bureau may approve, and with the Bureau, a statistical report showing its premiums and its losses on all kinds of insurance to which this article is applicable, together with such other information as the Bureau may deem necessary for the proper determination of the reasonableness and adequacy of rates. Such statistical report filed with the rating organization may be consolidated and filed by such common agency. Such data shall be kept and reports made in such manner and on such forms as may be prescribed by the Bureau. All such annual filings . . . shall be kept under lock and key . . ." (Ala. § 393).
2. (11) In addition: "But no insurer shall be required to file its experience with an organization of which it is not a member or subscriber" (Ariz. § 32(a)).
3. (16) "Every insurer, rating organization or advisory organization and every group, association or other organization of insurers which engages in joint underwriting or joint reinsurance shall maintain reasonable records, of the type and kind reasonably adapted to its method of operation, of its experience or the experience of its members and of the data, statistics or information collected or used by it in connection with the rates, rating plans, rating systems, underwriting rules, policy or bond forms, surveys, or inspections made or used by it so that such records will be available at all reasonable times to enable the Commissioner to determine whether such organization, insurer, group or association, and in the case of an insurer or rating organization, every rate, rating plan and rating system made or used by it, complies with the provisions of this chapter applicable to it. . . . Such records shall be maintained in an office within this state or shall be made available for examination or inspection within this state by the Commissioner at any time upon reasonable notice" (Calif. § 1857), (Fla. § 627.318(1)), (Ga. 56–522).
4. (2) "The Commissioner may promulgate . . ." (Col. § 72–12–14), (N.H. § 7), (Vt. § 4655(d)).
5. (11) In addition: "No insurer shall be required to record or report its experience to a rating organization or agency unless it is a member of such organization or agency" (Colo. § 72–12–14), (Minn. § 70.47), (Nebr. § 44–1432 add "or subscriber"), (Utah § 31–18–12(1)).
6. In addition: "Each company shall report its loss or expense experience to the lawful rating organization or agency of which it is a member or subscriber. Any company not reporting such experience to a rating organization or other agency may be required to report such experience to the Commissioner. Any report of such experience of any company filed with the Commissioner shall be deemed confidential and shall not be revealed by the Commissioner to any other company or other person, but the Commissioner may make compilations including such experience" (Del. § 2312(a)).
7. Substitute "Rating systems in use" (1–1) and "Rating systems in use in this state" (1–3) for "Rating systems on file with him" and "used" for "filed" (1–4)(Fla. 627–331).
8. (10) In addition: "No company shall be required to record or report any experience on an experience classification which it does not use in the making of its rates or to record or report its experience on any basis or statistical plan that differs from that which is regularly employed and used in the usual course of such company's business . . ." (Ill. 1065.13 § 466(1)).

9. (11) In addition: "Nor shall it be required to report such experience to any rating organization of which it is not a member or subscriber, or to an agency operated by or subject to the control of such a rating organization" (Ill. 1065.13 § 466(1)).

10. (12) In addition: "Any company not reporting such experience to a rating organization or other agency designated by the Director, shall report such experience to the Director . . . The experience of any company filed with the Director shall be deemed confidential and shall not be revealed by the Director to any other company or other person, provided, however that the Director may make compilations of all experience, including the experience of any such company, or of such experience and the compilation made by the designated rating organization or other agency" (Ill. 1065.13 § 466(1)).

11. In the first phrase substitute "approve" for "promulgate" and omit last phrase after "annually" (Ind. § 16a).

12. Substitute "approving" for "promulgating" (Ind. § 16a).

13. (11) In addition: "Provided that nothing in this Act shall be construed to require, nor shall the commissioner adopt any rule to require, any insurer to record or report its loss or expense experience on any basis or statistical plan not consistent with the rating system filed by it" (Kans. § 40–1118(a)).

14. (11, 13) "No insurer shall be required to report such experience to any licensed rating or qualified advisory organization of which it is not a member or subscriber. The experience of individual insurers thus reported to the commissioner shall not be revealed by him, except by court order, but the commissioner shall make a compilation of all such experience to the extent he may deem practicable and he shall, to the extent he may deem practicable, make a consolidation of all compilations filed with him and those made by him. All such compilations and consolidations shall be available to licensed insurers and licensed rating and qualified advisory organizations and shall also be open to public inspection, subject to reasonable rules promulgated by the commissioner" (Ky. § 304.641(1)).

15. (17) "The commissioner . . . may at any time require any company to file with him such data, statistics, schedules or information as he may deem proper or necessary to enable him to fix and establish or secure and maintain fair and reasonable classifications of risks and adequate, just, reasonable, and nondiscriminatory premium charges for such policies or bonds . . ." (Mass. § 113 B Compulsory Motor Vehicle Liability).

16. (10, 11) In addition: ". . . No insurer shall be required to record or report its loss or expense experience on any basis or statistical plan that differs from that which is regularly employed and maintained in the usual course of such insurer's business, or to any rating organization or agency of which it is not a member or subscriber" (Mich. § 500.2472(1)).

17. (6) Substitute "biennially" for "annually" (Miss. § 5834–07(a)), (Ore. § 737.520 (1)), (Tex. Art. 5.05(a) motor vehicle), (Tex. Art. 5.19(a)).

18. "The commission may designate and empower any association, organization or other facility representing casualty insurance companies which transact business in this state . . ." etc. (Miss. § 5834–07(a)).

19. (18) "Every insurance company . . . shall file with the insurance commissioner, individually or in collaboration with others, in such form as he may prescribe, its classification or risks and premium rates applicable thereto, together with a schedule or rating to be in use and such other statistical information as the commissioner may require (N.H. § 412:14 Motor Vehicle Ins.).

20. (19) "Every insurer shall file annually with the rating organization of which it is a member or subscriber, or with such other agency as the commissioner may approve at the request of such rating organization, or with the commissioner, if such insurer is not a member or a subscriber of a rating organization, a

statistical report showing a classification schedule of its premiums and its losses on all kinds of insurance to which this act is applicable, together with such other information as the commissioner may deem necessary for the proper determination of the reasonableness and adequacy of rates" (N.J. § 17:29A–5).

21. (7) "Every authorized insurer shall annually file with the rating organization of which it is a member or subscriber, or with such other agency as the (Commissioner, Superintendent) may approve, a statistical report showing a classification schedule of its premiums and losses on all kinds or types of insurance business to which this section is applicable, and such other information as the (Commissioner, Superintendent) may deem necessary or expedient for the administration of the provisions of this (chapter article) the (Commissioner, Superintendent) from time to time may prescribe the form of such report including statistical data conforming to established classifications. Such statistical reports shall be consolidated in accordance with regulations prescribed by the (Commissioner, Superintendent)" (N.Y. § 183.5) (P.R. § 1215).
"Statistical plans and rules shall be promulgated for the recording and reporting of expense experience on a countrywide basis" (N.Y. § 183.6), (Also see note 31 for P.R.).

22. (20) In addition: "The superintendent shall have power, in his discretion to prescribe by regulation, uniform classifications of accounts to be observed, and statistics to be reported by insurers and other organizations which are subject to the provisions of this article. He may also in his discretion prescribe by regulation, forms of reporting such data by insurers and such other organizations. Such classifications of accounts, and statistics to be reported and forms of reporting shall be reasonable and may vary with the kind or type of insurer or organization. No such regulation or amendment thereto shall be promulgated by the superintendent except upon notice and after hearing to all insurers and organizations affected thereby. Any regulation or amendment thereto shall be promulgated by the superintendent at least six months before the beginning of the calendar year in which the same shall take effect. Any regulation or order of the superintendent made under this section shall be subject to judicial review by any insurer or organization aggrieved thereby" (N.Y. § 189).

23. (21) ". . . the Commissioner of insurance is hereby authorized to compel the production of all books, data, papers and records and any other data necessary to compile statistics for the purpose of determining the pure cost and expense loading of automobile bodily injury and property damage insurance in North Carolina" (N.C. § 58–248 automobile liability).

24. (22) "Every insurer shall annually on or before October 1, file with the rating bureau of which it is a member or subscriber, or with such other agency as the commissioner of insurance may approve or designate, a statistical report showing a classification schedule of its premiums and losses on all classes of insurance to which this article is applicable, and such other information as the Commissioner may deem necessary or expedient for the administration of the provisions of this article" (N.C. § 58–131.14).

25. (4) "Reasonably adapted to each of the rating systems on file with him" omitted (Ohio § 3937.12 also "statistical plans"), (Tex. Art. 5.05(a) motor vehicle), (Tex. Art. 5.19(a)).

26. (5) "Which may be modified from time to time and which shall be used thereafter"; "in the recording" and "countrywide expense" omitted (Ohio § 3937.12).

27. (10) "No insurer shall be required to record or report its loss experience in a manner that differs from that which is regularly employed and maintained in the usual course of such insurer's business" (Ohio § 3937.12).

28. ". . . subject to reasonable procedures and allocation of costs thereof . . ." (Ore. § 737.520(2)).

29. (11) In addition: "Nor shall any insurer be required to report its experience to any agency of which it is not a member or subscriber" (Pa. § 1193(a)).

30. (23) In addition: "Such rules and plans shall not place an unreasonable burden of expense on any insurer" (Pa. § 1193(a)).

31. (9) "Statistical plans and rules may be promulgated for the recording and reporting of expense experience as to items which are specifically applicable to Puerto Rico and are not susceptible of determination by a prorating of expense experience elsewhere" (P.R. § 1215(2)).

32. "The commissioner may, in his discretion, prescribe by regulation, uniform classifications of accounts to be observed, and statistics to be reported by insurers and other organizations which are subject to the provisions of this chapter. He may also in his discretion prescribe by regulation, forms of reporting such data by such insurers and organizations. Such classifications of accounts, and statistics to be reported and form of reporting shall be reasonable and vary with the kind or type of insurer or organization . . ." (P.R. § 1216).

33. (8) In addition: ". . . after due consideration . . ."; substitute "rates" (Motor Vehicle) or "rating plans" (other Casualty) for "rating systems" and "loss experience and such other data as may be required, in order that the total loss and expense experience of all insurers" for "loss . . . experience, . . . insurers" (Tex. Art. 5.05(a) motor vehicle), (Tex. Art. 5.19(a)).

34. (14) "The Board may designate one or more rating organizations or other agencies to gather and compile such experience" (Tex. Art. 5.05(a) motor vehicle), (Tex. Art. 5.19(a)).

35. (24) "The Commissioner is hereby authorized and empowered to require sworn statements from any insurer affected by this Act, showing its experience on any classification or classifications of risks and such other information which may be necessary or helpful in determining proper classification and rates or other duties or authority imposed by law. The Commissioner shall prescribe the necessary forms for such statements and reports, having due regard to the rules, methods and forms in use in other states for similar purposes in order that uniformity of statistics may not be disturbed" (Tex. Art. 5.05(a) motor vehicle).

36. Add: ". . . unless exempted in writing by the commissioner" before "in the recording . . . of its loss . . ." (Vt. § 4655(d)).

37. "reasonable" omitted (S.D. § 4655(d) 13).

38. "or on its own behalf" in addition (Va. § 38-261).

39. ". . . loss and expense experience . . . countrywide experience, . . ." (W. Va. § 13).

(Carlson numbers not used: 1, 3)

APPENDIX B

National Bureau of Casualty Underwriters vs. Superintendent of Insurance of the State of New York
Mutual Insurance Rating Bureau vs. Superintendent of Insurance of the State of New York

Appellate Division, Supreme Court, New York, June 17, 1958

The petitioners, the National Bureau of Casualty Underwriters and the Mutual Insurance Rating Bureau, had filed a rate increase for automobile liability insurance with the Superintendent of Insurance and had based their proposal upon policy years 1955–1956. The Superintendent disapproved the filing, stating (1) that the two year base was unreliable and that a five year base, policy years 1952 through 1956, was more realistic, and (2) that the percentage loading for general administration expense, based upon countrywide data, was unsound. After a review of the trends in costs and frequencies, the court found that the evidence did not support (1) and annuled the Superintendent's determination, remitting it for further proceedings not inconsistent with its opinion. With regard to (2) the court noted that the filer's method was consistent with the requirements of the Superintendent for the compilation of expense data. The case was appealed by the Superintendent, who accepted a refiling of the increase before his appeal was heard, thus rendering it moot. The case was cited, although not as the basis for the decision, by the court in *Matter of the New York Compensation Board v. Superintendent of Insurance,* 8 A.D. 2d 455 (the citation appears on p. 456), affirmed 8 N.Y. 2d 803.

Massachusetts Bonding and Insurance Company v. Commissioner of Insurance, Massachusetts, 1952

Massachusetts Bonding and Insurance Company along with forty-nine other stock and thirteen mutual insurers objected to the auto rates fixed by the Massachusetts Commissioner for 1952. Their case was joined to another case, brought by an automobile owner who alleged that the Commissioner had erred in fixing rates by failing to consider certain relevant points. (Expenses by territory, traffic hazards peculiar to the territory, interest on loss reserves.) The commissioner defended himself by stating that in order to prove him wrong the companies must show the rates to be confiscatory. The court dismissed the commissioner's defense, dismissed the alleged errors in the second case (largely for lack of evidence), and although it agreed with the logic of the insurers' complaint in the first case it refused to substitute its judgment for the commissioner's and dismissed their complaint, thus upholding the commissioner. This case was subsequently cited in *New England Tel. & Tel. Co. v. Department of Public Utilities,* 121 N.E. 2d 896, and in several insurance cases, including *Travelers Indemnity Co.* v. *Williams,* 190 So. 2d 27 (Florida, 1966).

John S. Carrol, Hurbert Safran and David Hahn on behalf of all other persons similarly situated, Plaintiffs, v. J. Richard Barnes, Defendant

District Court, Denver, Colorado, April 21, 1967

The plaintiffs objected to automobile rate filings made by the National Bureau of Casualty Underwriters and the National Automobile Underwriters Association which had been approved by Insurance Commissioner Barnes. The plaintiffs objected to the use of incurred loss-earned premium ratios, the failure to use investment income, the use of basic limits experience rather than total experience, the failure to include in the filing all items included in the "basis of rates" section of the statute, and the failure of the Commissioner to audit all data. The court examined the issues point by point, finding in each case against the plaintiffs and in favor of the Commissioner, noting that incurred loss-earned premium ratios were the accepted way of analyzing insurance data, that the statute required the consideration of underwriting (not investment) income, that the filer need only supply data to support changes and that the Commissioner's duties with regard to examination had been carried out as required by statute. The compaint was dismissed and the Commissioner's order affirmed. At this writing, the case has been appealed.

Fire Insurance Rating Bureau, an unincorporated association, Appellant, v. Paul J. Rogan, Commissioner of Insurance of the State of Wisconsin, Respondent

Supreme Court of Wisconsin, June 26, 1958

The Insurance Commissioner had disapproved rate filings for fire and extended coverage insurance and approved rate filings for separately written windstorm insurance. The rating bureau appealed, a circuit court upheld the commissioner, and this appeal was taken to the Wisconsin Supreme Court. The rating bureau contended that the commissioner erred both in not using the five year average loss ratio (but instead giving greater weight to the latest year in reviewing rates) and in not permitting a sufficient margin for profit and contingencies. Further, it argued that the commissioner exceeded his authority in that he was attempting to fix rates. The Court held that the commissioner's review had "considered" the five years of experience and that *undue emphasis was given by both parties to the profit question. With regard to the question of fixing rates, the Court stated that the commissioner had recognized (in his statements to the Court) that he could not fix rates and was precluded from doing so. The Court affirmed the commissioner's action.

State ex. Rel. Minnesota Employer's Association et. al. v. Faricy et. al.

Supreme Court of Minnesota, May 6, 1952

The Minnesota Employers' Association and others challenged the compensation rates set by a three man board headed by Insurance Commissioner Faricy. A district court upheld the board and appeal was taken to the Supreme Court. The case was complex in that a number of technical points in the ratemaking calculations were challenged. The court found that the board had not presented evidence to substantiate the modification of certain factors in the formula and further found that although there had been almost annual rate adjustments the actual loss ratio had remained substantially below the expected loss ratio. The court reversed both the district court and the board and ordered further proceedings.

DISCUSSION BY HARRY T. BYRNE

Messrs. Hartman and Lange accomplished a formidable task when they brought up to date the analysis of rate regulatory laws which was contained in the paper which Mr. Carlson presented to this society in 1951.

While Mr. Carlson's paper was primarily an analysis of rate regulation and its impact on actuarial thought, he also discussed in depth such topics as statistical reporting, manual ratemaking procedures, individual risk rating plans and credibility. The authors stated at the outset that they did not seek to supplant Mr. Carlson's paper, and their paper is essentially historical, but this fact does not detract from its value as a record of the important developments in the field of rate regulation since 1951. The fact that much of the paper is historical tends to disarm a discussant, and this reviewer, perhaps somewhat selfishly, concluded that the authors' paper could well have contained more in the way of expressions of opinion, and conjecture as to the future.

Their paper satisfies an obvious need. The entry of the casualty actuary into fire and allied lines ratemaking, "file and use" regulatory legislation, and the current controversy over recognition of investment income in ratemaking are only three examples of the kinds of developments since 1951 which generated the need for this paper.

The authors have examined each section of the statutes, provided the reader with examples to illustrate how the laws have been interpreted, cited changes which have been made in the statutes and outlined revisions which have been proposed. It becomes obvious to the reader that the sections of the law called the Basic Criteria for Rates and the Basis of Rates are the foundations of rate regulation as we have known it.

The basic criteria for rates: "not excessive," "not inadequate," and "not unfairly discriminatory" remain today, as they were in 1951, not susceptible to precise definition; and, as the authors point out, in those states where statutory definitions have been provided they should be taken as providing a range of reasonableness, rather than an exact test.

Likewise, the Basis of Rates section continues to provide only a general guide to reasonableness for the rate filer. The determination of trend and projection factors as respects "prospective loss experience" and "prospective expenses" continue to be areas where the regulator's judgment as to what is reasonable all too frequently differs from that of the rate filer.

With virtually all statutes, then, focusing as they must on the concept of "reasonableness," it is not surprising that the administration of a rating law is the key to the degree of difficulty experienced by the rate filer.

As we examine the difficulties being experienced by the rate filer today, there are many who conclude that the insurance industry's inability to obtain needed rate increases and thus achieve reasonable profit levels is largely the result of politically motivated pressures to reduce rates, and that changes in the regulatory laws must be made so as to permit competition to play a more dominant role in the control of rates. Thus, the all-industry type statute, existing in more than 40 states, has been labeled by some as a failure. A "no filing" regulatory law of the California type is increasingly offered as a reasonable alternative which would have the advantage of removing price regulation from its present political spotlight of publicity. While "file and use" or "no file" statutes can by no means guarantee an end to the difficulties of the ratemaker, under such laws the climate is such that much of the political pressure on the regulator is removed. The result is a flexibility of pricing and the rate filer is in a position to respond quickly to the needs of the market place. With competition playing a more important part in price regulation, the supervisory authorities may be increasingly concerned with unfair discrimination, financial stability and monopoly.

It remains to be seen how long the authors' paper will continue to provide a representative picture of rate regulation. For example, it is easy to list several current developments which suggest changes in rate regulation.

— The alleged failure of the all-industry type statute has already been mentioned.

— The mass marketing of personal lines has underlined certain questions and inconsistencies existing under today's regulation.

— The present trend toward holding companies and diversification is already having an impact upon regulation.

— The feeling of some regulators that it is their responsibility to see that the insurance industry responds to what they view as the needs of society. There is a danger that this concept of the social responsibility of insurance regulation could result in over-regulation.

— The increasing use of policyholder dividend programs by stock companies is a development which suggests that rate regulation has not kept pace with the needs of the marketplace.

State regulation is currently undergoing one of its most severe tests and today's climate is one of change. The feeling that changes are needed exists, at least to some extent, among company personnel, agents and rate regulatory authorities. The authors have provided a valuable reference point in the history of rate regulation from which future changes in the statutes may readily be gauged.

We are indebted to the authors for providing us with a paper which is informative to the student as well as useful to the ratemaker.

ECONOMIC FACTORS IN LIABILITY AND PROPERTY INSURANCE CLAIMS COSTS 1935–1967

NORTON E. MASTERSON

INTRODUCTION

"One cannot steer a ship by looking only at the wake."

Economic costs have become an increasing factor in the growing cost of liability and property insurance claims. In this paper, I shall analyze claims costs as they are affected by economic factors. An underlying purpose is to supplement our standard practice of analyzing past experience with a look at current and near future economic trends.

Multiple line insurance companies have not prospered as have most other well managed enterprises in the post World War II period nor during the prosperous nineteen sixties. The need for liability and property insurance is recognized but the costs and reasons for rising costs have not gained the acceptance accorded to less needed goods and services desired by personal and commercial policyholders. A major reason is one of language, particularly in relating our insurance terminology to more understandable economic and general business terms.

My presidential address in May, 1956, was entitled "Insurance Language Problems" (*PCAS* Vol. XLIII). At that time I said (in part):

"As another approach to creating a better understanding of our costs and prices, and in further consideration of a common language, we might try to explain our costs in more common *economic* terms.

"To supplement our insurance and actuarial terminology of losses and loss adjustment expenses, we could exhibit fire and casualty insurance companies as huge purchasers of the following goods and services: automobiles, including tires, repair parts and body rebuilding; roofs, lumber and other building materials; doctors' fees and other medical expense, hospital care and rehabilitation; loss of time wages; high court verdicts and damages; plate and safety glass; personal effects; loss prevention; lawyers' fees, legal and court costs. . . .

"Thus our disbursements for losses and expenses become more understandable as affected by external economic conditions, particularly price levels and wage or salary levels."

CLAIMS MARKET PLACE

"The buyer needs a hundred eyes, the seller not one." George Herbert

In this paper I compare significant segments of our insurance loss costs with related external economic factors through many special series of index numbers. There are many inherent peculiarities in our claims costs (our economic cost of production). Our major costs are not determined by supply and demand in dealing with suppliers in a market place.

Our claim costs differ widely from manufacturing costs of production. For example, in the paper manufacturing industry, there is a continuity with a New York order followed by a California order followed by a foreign order. But each insurance claim is a personal or separate transaction. This cost of production in insurance is related to: Acts of God, failures of men, chance happenings, weather, adversity, greed, dishonesty.

We are obliged to procure claims services under controversial, severe, hasty and often emergency conditions. The furnishing of claims service is not a normal market place transaction between supplier and buyer. Claims settlement transactions can take place in court rooms, lawyers' offices, repair garages, hospitals. The legalistic atmosphere is often one of friction and excessive demand rather than that of normal commercial esprit de corps.

The procurement of claims services for liability and property lines requires dealing with high costs (excessive retail) furnishers of services: doctors, clinics, hospitals, lawyers, repair garages, TV repair men, jewelers, furriers, building trades. Except for certain concentrated claims services in large cities (insurance company service garages, company clinics, etc.) each item of claims costs is a separate (often emergency) transaction at "retail," i.e., individualized prices.

The predominance of legal services and medical care in claims costs is a principal cause of high personal injury settlement costs. Doctors and lawyers are high-cost furnishers of professional service. They are a most affluent segment of our professions both as to educational preparation and the non-competitive nature of their charges for services. Obviously, every member of the medical profession has a doctor's degree while every lawyer has a master's degree or higher.

ECONOMIC DEFINITIONS OF CLAIMS

"I have always admired the mystical way of Pythagoras,
and the secret magic of numbers." Sir Thomas Browne

In the previous discussion of the concept of purchasing goods and services to settle liability and property claims, the claims function is defined as a very unique system of procurement of goods and services in the economic market place. For the settlement of liability and property claims, our claims function is to provide indemnification for losses or injuries in two broad groups:

1. Persons — Loss and Loss Adjustment Costs
   a. Physicians' fees
   b. Hospital services
   c. Drugs and prescriptions
   d. Loss of earnings
   e. Legal services
   f. Pain and suffering
   g. Funeral expenses
   h. Court costs
   i. Rehabilitation

2. Property — Loss and Loss Adjustment Costs
   a. Automobiles
   b. Residences
   c. Commercial structures and property
   d. Personal effects and property

In 1967 the approximate incurred loss costs for claims and claims adjustment expenses were as follows for the liability and property lines in the United States:[1]

[1] For the purposes of this paper liability and property claims data include the lines of insurance listed in the 1967 multiple line annual statement, except ocean marine, accident and health, fidelity and surety, earthquake, growing crops and aircraft damage.

1967 Losses and Claims Adjustment Expenses	Millions
Auto bodily injury	$ 3,660
Auto property damage	1,500
Auto phyiscal damage	2,300
Workmen's compensation	1,850
Other bodily injury	710
Other property damage	190
Fire	1,140
Extended coverage	340
Allied lines	160
Homeowners	1,255
Commercial multiple peril	410
Inland marine	370
Glass	26
Burglary and theft	78
Boiler and machinery	51
TOTAL	$14,040

But for the purposes of this economic study, we can exhibit these same figures as follows:

1967 Loss and Claims Adjustment Expenses by Economic Categories	Millions
Persons	$ 6,415
Property	
Automobiles	3,725
Dwellings	1,380
Buildings and structures (other)	1,730
Miscellaneous	790
TOTAL	$14,040

This conversion is obvious for major items. Based upon approximate 1967 distributions of claims by kind of loss the "Persons" category was assigned to bodily injury and workmen's compensation, and the personal liability portions of homeowners and commercial multiple peril costs. Fire, extended coverage, and allied lines losses were divided into dwelling and commercial and a minor transfer was made from automobile property damage for non-automobile damage.

CLAIMS COST INDEXES

To make an objective appraisal of economic costs in the claims function, I used existing official and accepted commercial economic indexes and avoided completely the use of figures generated by our own industry except to determine certain weights for a composite index.

Special purpose claims costs indexes required the construction of sub-indexes for each of the component parts of the main index for each line of insurance for each year.

In my research and studies for this paper I considered over one hundred indexes in addition to the components I selected finally. These are set forth in Exhibits II and III. By *category* the various indexes used were:

I. *Persons*

1. Automobile and other bodily injury, medical and indemnity, including personal liability in homeowners and commercial multiple peril coverages
    a. CPI hospital charges
    b. CPI physicians' fees
    c. OBE per capita personal income (for lost time indemnity)
    d. Specials, based on a, b, c above
    e. Pain and suffering, extras, etc. at 2 to 3 times "specials"

2. Workmen's compensation
    a. CPI hospital charges
    b. CPI physicians' fees
    c. BLS average weekly gross earnings for manufacturing, contracting and "all other" (based on wholesale, retail and miscellaneous enterprises)
    d. National Council on Compensation Insurance law amendments rate level changes

II. *Automobiles*

1. Auto physical damage
   a. CPI auto repairs and maintenance
   b. OBE average annual earnings per full-time employe — automobile repair, services and garages
   c. Average annual income per person engaged in automobile repair, services and garages (derived from OBE NIP national income and number of persons engaged in production by industry)
   d. BLS average weekly gross earnings — motor vehicle dealers, retail
   e. OBE average annual earnings per full time employe — motor vehicles and motor vehicle equipment
2. Auto property damage liability
   a. Same as auto physical damage indexes for automobile damage
   b. Auto bodily injury loss index as a "loading" to reflect influences of companion bodily injury in third party auto property damage claims

III. *Dwellings*

1. Fire, extended coverage, allied lines
   a. CPI home — maintenance and repairs
   b. Boeckh construction cost index — residences
2. Homeowners
   a. Same as 1 a and 1 b above
   b. Other bodily injury loss index as a measure of personal liability coverage

IV. *Buildings and Structures*

1. Fire, extended coverage, allied lines
   a. American Appraisal Company construction cost index
   b. Dept. of Commerce composite construction cost index
   c. Engineering News–Record construction index
2. Commercial multiple peril
   a. Same as 1 a, 1 b and 1 c above for property loss
   b. Other bodily injury loss index as a measure of personal injury liability coverage

V. *Miscellaneous Property*

1. Inland marine
   a. CPI apparel
   b. CPI recreation goods
   c. CPI commodities, less food
   d. WPI construction equipment
   e. WPI agricultural equipment
   f. WPI furniture and other household durables
   g. OBE average personal disposable income
   h. OBE average personal consumption — durable goods
   i. OBE average annual earnings per full-time employe — manufacturing
   j. OBE average annual earnings per full-time employe — wholesale and retail

2. Other property damage
   a. Commercial building property loss index (same as fire and extended coverage)
   b. WPI machinery and motive products (1935–1957), machinery and equipment (1958–1967)
   c. OBE personal consumption expenditures — durable goods
   d. OBE implicit GNP price deflators — producers' durable equipment
   e. Other bodily injury loss index as a "loading" to reflect influence of companion personal injury in third party property damage

3. Glass
   a. WPI flat glass
   b. BLS average weekly gross earnings — flat glass
   c. BLS average weekly gross earnings — contract construction, general building contractors

4. Burglary
   a. CPI apparel
   b. CPI recreation goods
   c. CPI commodities, less food
   d. OBE average per capita disposable personal income
   e. Average per capita personal consumption for durable goods

5. Boiler and machinery
   a. BLS average weekly gross earnings — machinery

b. OBE average annual earnings per full-time employe — machinery, excluding electrical
c. OBE average annual earnings per full-time employe — electrical machinery
d. WPI metal working machinery and equipment
e. WPI general purpose machinery and equipment
f. BLS average gross earnings — electrical equipment
g. BLS average gross earnings — engines and turbines

VI. *Loss Adjustment Expenses*

1. Legal services — average annual income per person engaged in legal services (derived from OBE NIP national income and number of persons engaged in legal services)

2. BLS average weekly gross earnings — fire, marine and casualty insurance carriers (1958–1967); index for all insurance carriers used (1947–1957); extrapolation (1946–1935)

The index for legal services, defined above (VI-1), measures allocated loss adjustment expense and services and the level of unallocated legal salaries and services.

The index defined in VI-2 above is a measure of the level of non-legal or general office unallocated loss adjustment expense and services.

The proportions of the two indexes defined above have been established by lines of insurance and by years in accordance with actual and estimated distributions of legal and non-legal loss adjustment expenses in the national experience of all major carriers.

VII. *Composite Index*

The composite index for each year 1935–1967 was compiled by applying to each line index in each year the relative proportion of the average incurred loss and loss expense dollars for the two previous years.

LIABILITY-PROPERTY INSURANCE INDEX

Exhibit I shows for each of the liability and property coverages an economic cost of claims index for each of the 33 years in this 1935–1967 study.

Certain features and limitations of this type of index must be observed in studying and using it.

1. This LPI index measures those economic factors affecting claims settlement costs. These economic costs operate *after* the claim has been incurred.
2. The LPI index does *not* measure numerous economic and other factors which might increase or decrease the number of claims — such as increases in traffic density, and frequency.
3. Each individual year's index is related to the base period 1957–1959 as are the two leading groups of price or cost indexes — consumer price indexes and wholesale price indexes.
4. Certain component indexes, particularly consumer price indexes and wholesale price indexes, are compiled and published on a 1957–1959 base. Other forms of data, averages, and indexes were converted to a common 1957–1959 base for this study and the LPI index.
5. The numerical value of each 1967 index is, for example, a measure of the percentage trend in claim costs since the 1957–1959 average. Thus, the 1967 index is a measure of the 1960's to date.
6. This LPI index differs from our standard consumer price indexes in one important aspect. The standard consumer price index is a quantitative one and does not reflect quality changes but measures the change in price that would have occurred if there had been no change in the quality or characteristics of goods and services.

However, in this new LPI index to measure changes in economic costs of claims, all phases, including quality, which influence claims settlement bargaining and costs, must be considered. For example, the consumer price index for new cars was 97.2 in 1966 or 2.8% less than in the 1957–1959 base period. But an LPI index for auto physical damage and property damage liability must include components to measure the higher quality and other replacement cost or repair factors.

CONSTRUCTION OF INDEX

The index number method has been used in this paper for three reasons:

1. It is a practical way of making quantitative measurements of differing economic factors for dissimilar multiple line coverages on a chronological basis.

2. Available and acceptable official economic indexes published by Federal government agencies can be utilized.
3. The indexes so produced for liability and property insurance coverages can be related to general U.S. business indexes so that multiple line insurance can be compared with general business economic trends.

The basic index construction is the application of percentage weights to selected economic indexes. (Appendix B details for each line of business the selected indexes and the weights used to construct the respective Composite Indexes in Exhibit I.)

Construction of the auto bodily injury index (143.8) for the year 1966 illustrates the method used for each of the 15 coverages for each of the 33 years. As stated above, three basic indexes are used for automobile and other bodily injury: (a) CPI hospital daily charges; (b) CPI physicians' fees; and (c) OBE per capita personal income (for salary and wage loss). For 1966 these indexes were 168.0, 128.5 and 141.5 respectively. The first two are published by the U.S. Bureau of Labor Statistics. The third is the Office of Business Economics published average of $2,966 or 141.5 on the 1957–1959 average of $2,097. A medical index of 145.5 was calculated by using a weight of .57 for physicians' fees and .43 for hospital daily charges.

These weights were derived from statistics of expenditures for health and medical care published by the Department of Health, Education and Welfare, Social Security Administration. Supplementing this source were interviews by the author with insurance company claims personnel. These proportions of physicians' fees and hospital charges vary from .63/.37 in 1935 down to .57/.43 used for 1967. An index for "specials" (a claims department term for actual expenses incurred by the claimant) of 143.9 was calculated by applying a weight of .60 to the medical index, 145.5, and .40 to the per capita personal income index, 141.5. The ABI loss index is the combination of the above three components in these proportions for 1966: .15 for medical, .15 for personal income, and .70 for "specials." This is equivalent to basing the ABI loss index on the medical and average income indexes plus 2⅓ times the "specials" for pain and suffering, extras, etc. The calculated ABI loss index thus determined is 143.8 (excluding loss adjustment).

The loss adjustment index for ABI 1966 is based on a .72/.28 proportion of a legal services index of 147.8 and the fire, marine, and casualty insurance average weekly earnings figure (published by the U.S. Bureau of Labor Statistics), of $101.68, or the 132.9 index on the 1957–1959 base. The .72 weight represents not only the allocated loss expense but a portion of unallocated loss expense involving technical and legal personnel. The .28 weight represents the general claims office unallocated expense. The respective proportions of the two indexes were derived by the author from actual insurance expense exhibit statistics and a separate study of insurance company unallocated loss expense splits between legal services oriented expenses and general office expense.

The final 1966 ABI index is derived from the loss index of 143.8 and the loss adjustment index of 143.6. The weights for loss and loss adjustment are .817 and .183 respectively — derived from insurance expense exhibit countrywide figures for 1966 for companies entered in New York State. Applying these weights to 143.6 and 143.8, respectively, produces the final ABI index of 143.8 for 1966.

CURRENT TRENDS

1966–1967

In the following exhibit each line is shown for 1966 and 1967 preliminary on the standard 1957–1959 base to measure the 1960's and current 1967 relative to 1966. In adidtion, each LPI index has also been converted to a 1947–1949 base to give a measure of the trend in claim costs in the post World War II years.

Claims Costs Indexes

	Current Period 1957–59 = 100		Post World War II 1947–49 = 100	
	1966	1967**	1966	1967**
Auto bodily injury	143.8	156.5	220.6	240.0
Auto property damage	140.6	146.8	218.0	227.6
Auto physical damage	137.2	140.9	214.0	219.8
Workmen's compensation	150.7	163.2	277.5	300.6
Other bodily injury	144.5	157.5	222.7	242.7
Other property damage	135.9	141.7	206.8	215.7
Glass	126.2	130.7	196.9	203.9
Burglary and theft	132.3	137.8	180.7	188.3
Boiler and machinery	130.5	133.1	212.9	217.1
Fire	126.1	132.4	179.6	188.6
Extended coverage	127.0	133.1	182.2	191.0
Other allied lines	126.1	132.4	179.6	188.6
Homeowners	123.6	131.6	*179.1	*190.7
Commercial multiple peril	131.5	138.6	*190.6	*200.9
Inland marine	131.1	136.1	191.9	199.3
COMPOSITE	138.3	147.3	212.9	227.7

* Extrapolated to base 1947–49
** Preliminary

COMMENTS ON 1967

Composite — The national average LPI index of 138.3 in 1966 increased to a preliminary 1967 index of 147.3. The composite index for 1967 on a 1947–1949 base has more than doubled to 227.7.

Bodily Injury — The automobile bodily injury coverage index increased to 156.5% over the 1957–1959 base period and to 240.0 on the 1947–1949 base period. Sharply rising medical costs, especially hospital daily rate charges, have caused these index increases. As a component of medical care in the consumers price index, the index for hospital daily service charges had the greatest increase of all components — rising to 211.4 in the fourth quarter of 1967 for an annual average of 200.1. This annual average for 1967 (on the 1957–1959 base) represents a very drastic increase of 10% each year since 1958.

Other Liability — The same rising costs which are described above for auto bodily injury caused similar increases — the other liability index — 157.5% on the 1957–1959 base and 242.7% on the 1947–1949 base.

Automobile Damage — Damage to automobiles and property damage caused by automobiles (principally other automobiles) now constitute the major category in liability and property insurance in annual dollars of incurred losses and adjustment expenses. The 1967 auto property damage and the auto physical damage indexes are now at 146.8 and 140.9 on the 1957–1959 base. It should be emphasized that these indexes measure economic cost factors only and do not measure an insurance carrier's average claims costs because of two factors peculiar to these lines. Many small property damage claims are closed without payment. The deductible auto collision coverages distort direct comparison of gross repair costs compared with an insurance carrier's claim payment.

Workmen's Compensation — This line shows the sharpest increase in its claims costs index of any of the coverages included in this study. The 1967 indexes are 163.2 and 300.6 on the current period and postwar bases, respectively. All three components in the workmen's compensation index show sharp rises — average weekly earnings for manufacturing, contracting, and all other; compensation insurance law amendments; and medical costs.

Property Lines — The two-party property damage or loss lines indexes reflect the increases in replacement costs of insured property. These lines show smaller increases over the base periods. They are, of course, not subject to the high costs related to medical care for injured persons.

CONCLUSION

> "Then you ought to have put my money on deposit, and on my return I should have got it back with interest." Saint Matthew 25:27 (New English)

As do our general price or cost indexes these indexes exhibit general national claims cost trends only. I should like to think that this study of liability and property claims costs will create an interest by top managements, regulating officials, politicians, and the public to the end that there will be greater understanding and appreciation of the problems of insuring and indemnifying for personal injury and property losses in our private enterprise economic system.

This LPI index does not measure *every* cause or reason for changes in our claims costs. It is intended to measure trends in those *economic* factors which operate during the claims settlement procedure, i.e. *after* the claim has been incurred. Because it is a new index with a 33-year historical post-study, I have included Exhibit IV for comparison and orientation with other economic factors. A selection of U.S. Statistics, Indexes and Averages has been converted to the official government base period, 1957–1959, to provide direct translation to the LPI index which is also on the official 1957–1959 basis.

APPENDIX A

Sources of Data for LPI Index

Bureau of Labor Statistics — U.S. Department of Labor	BLS
CPI Consumer Price Indexes	CPI
WPI Wholesale Price Indexes	WPI
Average Weekly Gross Earnings by Industry	
Office of Business Economics — U.S. Department of Commerce	OBE
National Income and Product Accounts	NIP
Average Per Capita Earnings by Industry	
Average Per Capita Income and Product	

National Council on Compensation Insurance
Workmen's Compensation law amendment rate level changes 1940–1967 (extrapolation 1940–1935)

The American Appraisal Company
Construction Cost Index — average for 30 cities 1913 = 100

E. H. Boeckh and Associates, Inc.
Construction Cost Index — Residences

Engineering News-Record
Construction Cost Index — Construction

U.S. Department of Commerce
Construction Cost Index — Composite

The A. M. Best Company
Aggregates & Averages — Fire and Casualty

1935 - 1967
LIABILITY and PROPERTY INSURANCE
CLAIMS COSTS INDEXES: 1957-59 = 100

EXHIBIT I

	Auto Bodily Injury	Auto Property Damage	Auto Physical Damage	Workmens Compen-sation	Other Bodily Injury	Other Property Damage	Glass	Burglary	Fire	Extended Coverage	Other Allied Lines	Home-Owners Mult.Per	Commer-cial Mult.Per	Inland Marine	Boiler and Machinery		COMPOSITE INDEX	
1935	34.0	31.8	30.1	27.0	37.3	33.2	24.4	32.2	29.9	30.2	29.9			31.4	26.2		30.9	1935
36	35.4	33.4	32.1	28.1	38.3	33.2	26.8	34.5	31.1	31.6	31.1			33.1	28.4		32.2	36
37	36.4	34.6	33.3	29.4	39.1	35.0	29.6	36.2	33.7	33.9	33.7			34.8	30.8		33.8	37
38	35.5	33.2	31.6	28.8	38.6	34.3	28.7	34.4	34.2	34.3	34.2			33.4	28.7		33.2	38
39	36.1	34.3	33.2	29.0	38.9	34.9	28.2	35.7	34.5	34.6	34.5			34.3	36.0		33.8	39
1940	36.9	35.7	35.0	29.3	39.3	35.9	29.5	37.1	35.4	35.4	35.4			35.3	37.3		34.7	1940
41	39.5	39.2	39.1	31.3	41.1	38.6	35.3	42.2	38.1	38.1	38.1			39.3	40.6		37.5	41
42	44.0	41.8	40.7	34.9	44.3	40.2	42.2	46.9	41.0	41.1	41.0			44.0	45.4		40.6	42
43	49.5	44.1	41.3	39.0	48.9	42.2	49.2	50.9	43.2	43.5	43.2			47.7	47.6		43.6	43
44	53.0	46.3	42.7	41.9	52.0	43.6	52.3	54.9	45.8	46.3	45.8			51.0	49.0		46.3	44
1945	54.8	47.6	43.8	42.3	53.8	45.5	51.1	56.9	48.4	48.9	48.4			52.9	49.0		47.8	1945
46	57.2	53.5	51.9	44.0	56.2	52.8	50.5	63.1	54.1	54.3	54.1			58.0	50.6		52.3	46
47	61.7	60.6	60.1	49.8	61.1	61.3	60.1	69.5	66.1	65.7	66.1			64.4	57.4		60.6	47
48	66.5	65.6	64.8	54.9	66.0	67.0	64.9	75.0	71.7	71.1	71.7			69.9	62.5		65.9	48
49	67.3	67.4	67.4	58.3	67.5	68.8	67.4	75.0	72.8	72.3	72.8			70.7	64.1		67.6	49
1950	70.2	72.3	73.9	61.7	69.7	73.4	70.1	79.6	76.4	75.8	76.4			74.9	67.7		71.5	1950
51	75.4	75.9	76.3	67.3	74.3	77.4	75.5	83.7	82.3	81.4	82.3			80.0	75.8		76.2	51
52	79.3	78.8	78.6	72.5	78.2	79.5	78.9	85.0	84.9	84.0	84.9			81.5	78.6		79.4	52
53	82.5	83.5	84.5	76.3	81.3	83.3	84.8	88.3	86.7	86.0	86.7			85.0	81.7		83.0	53
54	84.6	85.2	85.8	79.5	84.4	84.9	87.4	88.2	87.6	87.3	87.6			86.0	82.6		84.8	54
1955	88.8	90.9	92.4	84.5	88.6	90.7	91.9	92.8	90.2	90.1	90.2			90.4	87.0		89.5	1955
56	92.4	93.3	93.9	89.7	91.9	93.7	94.9	95.2	94.4	94.3	94.4	95.3		93.8	93.2		92.9	56
57	96.9	97.6	98.0	94.7	96.8	97.9	97.6	98.3	97.8	97.8	97.8	98.2	97.2	97.6	96.8		97.1	57
58	99.6	98.6	97.8	100.2	99.7	98.5	98.3	98.8	99.6	99.3	99.6	99.4	99.8	99.0	99.2		99.2	58
59	103.7	103.9	104.2	105.3	103.8	103.9	104.4	103.2	102.9	103.0	102.9	102.5	103.5	103.5	104.7		103.8	59
1960	107.2	106.7	106.5	111.6	107.4	105.9	104.4	104.8	105.3	105.3	105.3	104.5	106.2	105.6	106.3		107.1	1960
61	112.1	109.9	107.9	117.5	113.5	109.1	105.6	106.3	107.5	107.9	107.5	106.4	109.4	107.4	109.6		110.7	61
62	116.9	115.1	113.6	123.3	118.0	113.4	108.2	110.6	110.1	110.5	110.1	108.5	112.9	111.3	113.4		115.2	62
63	122.1	120.6	119.3	130.0	123.8	118.4	113.0	114.6	113.1	113.9	113.1	111.1	116.7	115.1	116.2		120.0	63
64	127.6	126.0	124.7	133.4	128.3	123.4	118.5	120.1	116.4	117.1	116.4	114.3	120.4	120.2	120.2		124.6	64
1965	134.6	132.8	131.3	139.7	135.9	129.6	121.8	126.3	120.4	120.9	120.4	117.9	125.0	125.5	124.2		130.6	1965
66	143.8	140.6	137.2	150.7	144.5	135.9	126.2	132.3	126.1	127.0	126.1	123.6	131.5	131.1	130.5		138.3	66
67	156.5	146.8	140.9	163.2	157.5	141.7	130.7	137.8	132.4	133.1	132.4	131.6	138.6	136.1	133.1		147.3	67

1935 - 1967
COMPONENT INDEXES IN L-P-I INDEX
1957-59 = 100

EXHIBIT II

	Consumer Price Indexes							Wholesale Price Indexes							OBE Per Capita Income			GNP	Loss Adjustment	
	Physician Fees	Hospital Charges	Home Repairs	Auto Repairs	Apparel	Recreation ~~-Goods~~	Commod-ities less food	Flat Glass	Mach. & Equip.	Metal Working Machines	Gen. Purpose Machines	Constr. Equip.	Agric. Equip.	Furn. House Durables	Pers. Income	Disposable Income	Pers.Con. Durable Goods	Implicit Price Deflator	Legal Services Av. Income	Av.Gr. Earnings Ins.Cos.
1935	53.9	23.8			46.6	53.0	50.2		40.0			41.0	50.3	48.6	22.6	24.9	17.0	38.7	34.4	32.2
36	54.2	24.0			46.9	53.0	50.8		41.0			41.0	50.5	49.3	25.5	28.1	20.9	38.5	35.3	34.2
37	54.5	24.6			49.4	53.0	53.0		42.0			41.0	50.5	54.7	27.4	29.9	23.0	41.4	36.3	36.0
38	54.4	25.2			49.1	53.0	53.0		43.0			42.0	51.3	53.4	25.1	27.3	18.7	43.0	34.7	35.6
39	54.5	25.3		51.4	48.3	54.4	52.1		43.7	43.6	45.9	41.0	50.2	53.2	26.5	29.1	21.7	42.2	35.1	35.9
1940	54.5	25.4		51.2	48.8	55.4	52.4		44.2	44.3	46.0	40.0	49.9	54.4	28.3	31.1	25.1	43.4	36.2	35.4
41	54.7	25.9		53.5	51.1	57.3	55.0		45.8	45.3	46.8	42.2	50.2	57.8	34.3	37.7	30.6	46.3	38.3	37.8
42	55.8	28.0		58.2	59.6	60.0	61.2		47.7	45.8	47.3	43.6	52.1	62.5	43.5	47.0	22.1	51.5	42.7	41.3
43	59.4	30.2		58.9	62.2	65.0	63.8		47.4	45.7	46.3	43.6	52.1	62.1	52.8	52.9	20.4	51.1	47.4	45.8
44	61.8	31.5		59.6	66.7	72.0	67.3		47.4	45.6	46.1	43.7	52.3	63.8	57.0	57.3	20.9	51.9	53.7	49.1
1945	63.3	32.5		60.1	70.1	75.0	70.0		47.8	45.6	46.1	44.0	52.5	63.9	58.3	58.2	24.3	51.7	58.6	51.0
46	66.4	37.0		62.0	76.9	77.5	74.4		53.6	50.0	49.8	47.8	56.3	67.8	60.3	61.4	47.2	57.5	56.0	55.5
47	70.7	44.1		67.2	89.2	82.5	83.9	70.1	61.8	56.9	57.6	54.2	65.2	77.8	63.3	63.8	60.4	64.6	60.1	63.4
48	73.5	51.5		71.0	95.0	86.7	90.3	73.9	67.5	61.3	62.7	61.3	73.1	82.5	68.4	69.9	66.0	70.3	66.6	66.3
49	74.8	55.7		72.8	91.3	89.9	89.0	77.5	71.2	64.2	66.2	65.3	78.1	83.8	66.3	68.5	70.2	73.6	68.8	68.1
1950	76.0	57.8		74.3	90.1	89.3	88.9	79.3	72.6	61.2	68.6	67.2	79.8	85.6	71.6	73.9	85.5	75.2	70.3	70.6
51	78.8	64.1		79.9	98.2	92.0	95.6	84.2	79.5	76.2	76.7	74.5	86.6	92.8	79.1	79.6	81.7	80.9	73.6	74.0
52	82.3	70.4		81.8	97.2	92.4	96.4	84.4	81.2	77.5	76.1	75.6	87.7	91.1	82.8	82.3	79.6	82.2	75.7	76.4
53	84.5	74.8	87.1	86.2	96.5	93.3	96.6	89.2	82.2	78.6	77.9	77.9	88.2	92.9	86.2	85.8	88.5	83.5	78.6	81.2
54	87.0	79.2	88.6	89.2	96.3	92.4	95.6	91.9	83.2	79.8	79.6	79.3	88.1	93.9	85.3	85.9	86.0	84.0	85.0	84.5
1955	90.0	83.0	90.6	91.2	95.9	92.1	94.9	94.5	85.8	84.1	83.2	82.6	88.9	94.3	89.7	90.3	102.1	85.9	92.1	88.4
56	92.7	87.5	94.4	94.8	97.8	93.4	95.9	98.5	92.1	92.0	91.7	89.5	92.0	96.9	94.5	94.5	98.3	91.8	92.8	93.5
57	96.7	94.5	98.4	98.2	99.5	96.9	98.8	100.2	99.7	97.6	97.9	96.3	96.3	99.4	97.8	97.6	101.3	97.5	98.4	97.4
58	100.0	99.9	100.0	99.8	99.8	100.8	99.9	100.0	100.1	100.0	99.4	100.1	100.3	100.2	99.0	99.2	92.8	100.0	99.0	100.0
59	103.4	105.5	101.7	101.9	100.6	102.4	101.2	99.9	102.2	102.4	102.7	103.6	103.4	100.4	103.3	103.3	106.4	102.0	102.6	103.7
1960	106.0	112.7	103.5	103.9	102.2	104.9	101.7	97.9	102.4	105.3	103.6	105.8	1-5.4	100.1	105.9	105.0	106.8	102.2	104.5	107.1
61	108.7	121.3	105.0	106.5	103.0	107.2	102.0	96.8	102.3	106.3	102.8	107.5	107.4	99.5	108.2	107.5	102.1	102.1	116.7	111.2
62	111.9	129.8	105.8	107.7	103.6	109.6	102.8	97.0	102.3	108.1	103.3	107.8	109.5	98.8	113.1	111.9	112.8	102.3	118.8	115.8
63	114.4	138.0	107.2	109.2	104.8	111.5	103.5	98.3	102.2	108.5	103.8	109.6	111.1	98.1	117.2	115.8	121.3	102.3	128.7	120.2
64	117.3	144.9	109.4	110.6	105.7	114.1	104.4	102.4	102.9	110.5	104.4	112.4	112.9	98.5	123.5	123.6	131.1	103.0	135.4	123.9
1965	121.5	153.3	111.7	112.6	106.8	115.2	105.1	100.9	103.7	113.6	105.1	115.3	115.1	98.0	131.9	131.5	144.3	104.2	142.8	128.0
66	128.5	168.0	116.4	114.7	109.6	117.1	106.5	100.7	106.0	118.8	109.7	118.9	118.5	99.1	141.5	140.1	151.9	106.2	147.8	132.9
*67	137.6	200.1	122.3	119.2	114.0	120.1	109.0	105.3	108.5	124.1	113.7	123.0	122.4	101.2	150.1	148.3	154.0	108.9	152.8	136.9

*Preliminary

1935 - 1967
COMPONENT INDEXES IN L-P-I INDEX
1957-59 = 100

EXHIBIT III

	BLS Average Weekly Gross Earnings									OBE Average Annual Earnings						Building Costs				NCC Ins.
	Manufacturing	Contract Constr.	All Other	Gen. Bldg. Constr.	Flat Glass	Machinery	Elect. Equip.	Engines Turbines	M.V.Dlrs. Retail	M.V. Mfg.	Whole.-Retail	Machinery less Electr.	Electr. Machinery	Repair Service Garage	Manufacturing	Dept. of Comm. Composite	Amer. Appraisal Co.	Boeckh Resident	Eng. New Constr.	WC Law Amend.
1935	23.6	23.5	27.4	23.5						24.4	30.0	25.2	26.1		24.4		23.7	31.8	26.0	
36	25.6	25.9	30.1	25.9						26.2	30.1	27.4	28.3		25.8		24.9	32.7	28.0	
37	28.3	28.9	32.1	28.9						27.4	31.7	29.9	30.9		27.6		29.0	34.8	31.0	
38	26.2	28.0	31.4	28.0						27.1	31.7	27.1	29.2		26.0		29.0	35.8	31.0	
39	28.1	27.3	32.2	27.3						28.9	31.9	29.7	30.6		27.3	35	29.4	36.5	31.0	
1940	29.6	28.8	33.2	28.8						31.7	32.4	32.0	32.3		28.7	36	30.0	37.6	31.8	.66
41	35.0	34.0	36.6	34.0						36.8	34.6	37.9	36.7		38.2	39	31.9	40.7	33.9	.662
42	43.6	42.3	41.7	42.3						47.2	37.7	46.5	43.8		40.6	44	35.3	43.0	36.4	.667
43	51.2	49.6	46.9	49.6						48.8	41.7	50.5	47.2		47.1	47	36.9	44.9	38.2	.668
44	54.3	52.6	50.2	52.6						50.9	45.6	52.6	49.3		50.5	46	38.2	48.8	39.3	.685
1945	52.5	50.9	50.9	50.9						48.6	49.6	51.8	49.5		50.5	48	39.7	52.3	40.5	.689
46	51.5	49.9	53.8	49.9						46.1	55.7	50.6	50.1		50.5	56	47.1	57.4	45.5	.708
47	58.4	56.5	60.1	57.1	53.0	52.4	59.2			51.5	61.7	55.0	55.1		56.0	68	63.0	69.5	54.4	.735
48	63.1	62.7	64.8	63.6	57.0	62.2	64.2			55.4	66.2	60.9	60.5	64.9	61.0	75	71.7	74.2	60.6	.755
49	64.0	64.9	67.1	65.9	59.0	62.1	65.7			59.2	68.0	61.6	62.5	65.8	62.1	73	71.7	76.1	62.8	.792
1950	69.3	66.9	70.5	67.6	64.0	69.1	69.9			65.9	71.4	66.6	64.9	68.9	66.3	77	73.2	80.3	67.1	.821
51	75.2	73.9	76.0	73.7	69.7	78.4	75.7			69.4	74.5	75.1	71.3	74.3	72.4	83	77.9	86.5	71.4	.838
52	79.8	79.6	79.7	81.5	71.2	81.9	80.0			76.0	77.3	79.3	75.7	78.1	76.9	86	81.0	88.8	74.9	.867
53	83.7	83.0	83.1	86.0	80.9	85.1	83.6			81.6	81.3	83.5	79.3	83.4	81.3	88	84.5	90.4	78.9	.881
54	83.7	85.4	85.1	87.9	83.6	83.8	83.9			83.4	84.3	84.0	81.5	85.2	82.7	88	86.7	89.7	82.6	.898
1955	89.9	87.3	89.2	88.8	94.8	90.0	88.2			89.9	88.0	87.9	85.7	87.8	87.4	90	89.0	92.4	86.8	.919
56	93.6	92.5	93.0	93.3	94.1	95.8	93.7			90.0	92.3	93.9	90.2	91.8	92.1	95	93.0	96.5	91.1	.951
57	96.9	96.3	96.6	97.4	95.1	96.9	96.3			94.2	96.3	96.4	94.3	97.2	96.0	99	97.1	98.5	95.2	.966
58	98.2	99.6	99.3	99.6	94.1	97.1	98.8	100.0	96.3	100.7	99.5	98.6	100.3	99.1	99.2	100	99.9	99.2	99.9	1.014
59	104.8	104.1	104.1	103.1	110.8	106.0	104.9	105.9	103.6	105.1	104.1	105.0	105.4	103.7	104.8	102	103.1	102.5	104.9	1.020
1960	106.6	108.5	106.6	106.6	106.9	107.7	106.8	106.1	105.8	108.1	107.8	107.5	108.6	107.4	107.4	103	105.7	104.2	108.4	1.069
61	109.7	113.4	109.6	111.8	102.8	110.6	111.2	111.1	106.5	108.8	110.6	110.4	112.9	111.3	110.5	104	108.5	104.5	111.5	1.084
62	114.7	117.6	113.8	115.6	105.5	116.4	114.7	116.0	112.0	117.1	114.7	115.2	116.4	115.5	114.4	107	110.8	106.3	114.7	1.102
63	118.3	122.1	117.6	120.6	113.2	119.4	116.7	119.7	117.3	123.4	118.9	118.2	119.8	119.7	118.8	109	114.3	108.5	118.5	1.117
64	122.3	126.8	116.2	126.1	120.7	125.3	119.7	123.2	121.3	129.1	123.3	125.0	125.0	123.9	124.3	112	117.4	111.6	123.2	1.130
1965	127.7	132.9	120.5	131.6	125.3	131.4	124.5	129.1	126.8	135.1	127.4	128.8	127.4	127.6	128.2	116	120.6	115.2	127.8	1.135
66	133.4	140.1	125.2	140.1	128.4	138.9	128.5	138.3	131.2	138.1	132.0	134.9	130.0	132.7	133.4	121	126.9	120.2	134.3	1.182
*67	136.6	149.0	130.2	148.4	128.0	139.3	131.8	139.0	134.6	142.6	136.6	140,3	132.6	137.3	138.0	126	133.1	127.4	140.7	1.221

*Preliminary

1935 - 1967
U.S. STATISTICS, INDEXES AND AVERAGES
Converted to 1957-59 = 100

EXHIBIT IV

	U.S. Population			Gross National Product	No. of Motor Vehicles	FRB Industrial Production	BLS Consumer Price Index	Stock Market				COMPOSITE INDEX	
	Total	Age 16 & Over	Employed Labor Force					NYSE Composite	Standard Poors 500	Dow Jones 40 Ind.	Fire Casualty Stocks		
1935	73.2	79.6	55.3	15.8	38.5	30.7	47.8		22.6	22.5	25.5	30.9	1935
1936	73.6	80.1	59.1	18.0	41.4	36.3	48.3		32.9	30.4	29.4	32.2	36
1937	74.1	80.6	62.7	19.8	43.6	39.7	50.0		32.8	31.2	26.3	33.8	37
1938	74.6	81.3	59.3	18.5	43.3	31.4	49.1		24.4	24.8	24.1	33.2	38
1939	75.2	81.9	62.0	19.8	45.0	38.3	48.4	26.9	25.7	26.8	25.9	33.8	39
1940	75.8	82.9	65.3	21.8	47.1	43.9	48.8	25.0	23.4	25.3	26.6	34.7	1940
1941	76.6	83.8	71.0	27.2	50.6	56.4	51.3	22.8	20.9	22.8	28.2	37.5	41
1942	77.5	84.7	76.5	34.5	47.9	69.3	56.8	20.0	18.4	20.1	26.3	40.6	42
1943	78.6	85.7	78.0	41.9	44.8	82.9	60.3	26.7	24.5	25.3	30.7	43.6	43
1944	79.5	86.4	77.3	45.9	44.2	81.7	61.3	29.0	26.5	26.9	30.9	46.3	44
1945	80.3	87.1	75.9	46.3	45.0	70.5	62.7	35.2	32.3	31.8	34.9	47.8	1945
1946	81.2	88.0	80.6	45.6	49.9	59.5	68.0	39.7	36.3	35.9	37.2	52.3	46
1947	82.7	88.8	84.4	50.6	54.9	65.7	77.8	35.1	32.3	33.3	33.5	60.6	47
1948	84.2	89.7	87.1	56.3	59.6	68.4	83.8	35.5	33.0	33.7	36.0	65.9	48
1949	85.7	90.7	85.9	56.1	64.8	64.7	83.0	34.2	32.4	33.7	40.9	67.6	49
1950	87.1	91.5	89.0	62.3	71.3	74.9	83.8	41.5	39.1	40.6	47.8	71.5	1950
1951	88.6	92.5	91.4	71.8	75.3	81.3	90.5	49.3	47.5	48.3	50.4	76.2	51
1952	90.1	93.4	92.3	75.5	77.3	84.3	92.5	52.5	52.1	50.8	58.3	79.4	52
1953	91.6	95.0	94.3	79.7	81.6	91.3	93.2	51.8	52.6	51.8	63.0	83.0	53
1954	93.2	95.9	92.6	79.8	84.9	85.8	93.6	62.1	63.2	62.6	80.6	84.8	54
1955	94.9	96.8	95.7	87.0	91.0	96.6	93.3	81.9	86.1	83.0	98.5	89.5	1955
1956	96.9	97.7	98.8	91.6	94.5	99.9	94.7	91.9	99.2	92.5	92.1	92.9	56
1957	98.4	98.8	99.8	96.4	97.4	100.7	98.0	89.3	94.4	89.2	88.2	97.1	57
1958	100.0	99.9	98.8	97.8	99.1	93.7	100.7	93.8	98.4	92.2	96.4	99.2	58
1959	101.7	101.2	101.4	105.7	103.5	105.6	101.5	116.9	122.1	118.6	115.4	103.8	59
1960	103.8	102.9	103.6	110.1	107.2	108.7	103.1	113.4	118.8	115.9	120.1	107.1	1960
1961	105.5	104.1	104.0	113.7	110.2	109.7	104.2	134.4	141.0	129.7	169.5	110.7	61
1962	107.2	105.6	106.2	122.5	114.9	118.3	105.4	125.5	132.7	120.0	163.0	115.2	62
1963	108.8	107.6	108.4	129.1	120.0	124.3	106.7	142.8	148.7	134.1	179.9	120.0	63
1964	110.3	109.3	111.3	138.3	125.2	132.3	108.1	166.3	173.1	156.4	190.8	124.6	64
1965	111.7	111.0	114.6	149.5	131.3	143.4	109.9	179.6	187.6	170.8	182.2	130.6	1965
1966	113.1	112.6	118.4	162.5	136.6	156.3	113.1	174.9	181.4	163.9	183.3	138.3	66
1967	114.2	114.4	122.0	169.1	141.4	156.6	114.2	197.5	202.0	165.0	167.4	147.3	67

AUTO BODILY INJURY | OTHER BODILY INJURY

	Medical Care Phys.Fees	Hosp.	Wts.	Med. Index	Av.Pers. Income	Total Specials	Loss Index	Loss Adj.	Wt Loss L.Adj.	A.B.I. Index	Med. Index	Av.Pers. Income	Total Specials	Loss Index	Loss Adj.	Wt Loss L.Adj.	O.B.I. Index
1935	53.9	23.8	.63 .37	42.8	22.6	34.7	34.1	33.7	.829 .171	34.0	Same as ABI		36.7	38.2	33.9	.80 .20	37.3
36	54.2	24.0		43.0	25.5	36.0	35.5	35.0	.813	35.4			37.8	39.1	35.0		38.3
37	54.5	24.6		43.4	27.4	37.0	36.5	36.2	.807	36.4			38.6	39.8	36.2		39.1
38	54.4	25.2		43.6	25.1	36.2	35.6	35.0	.794	35.5			38.1	39.5	34.9		38.6
39	54.5	25.3		43.7	26.5	36.3	35.3	35.3	.787	36.1			38.5	39.8	35.3		38.9
1940	54.5	25.4		43.7	28.3	37.5	37.1	36.0	.795	36.9			39.1	40.1	36.0		39.3
41	54.7	25.9		44.0	34.3	40.1	39.8	38.2	.816	39.5			41.1	41.8	38.2		41.1
42	55.8	28.0	.62 .38	45.2	43.5	44.5	44.5	42.3	.780	44.0			44.7	44.8	42.4		44.3
43	59.4	30.2		48.3	52.8	50.1	50.2	46.9	.790	49.5			49.7	49.4	47.0		48.9
44	61.8	31.5		50.3	57.0	53.0	53.2	52.3	.821	53.0			52.3	51.8	52.6		52.0
1945	63.3	32.5		51.6	58.3	54.3	54.5	56.3	.844	54.8			53.6	53.1	56.8		53.8
46	66.4	37.0		55.2	60.3	57.2	57.4	55.9	.851	57.2			56.7	56.3	55.9		56.2
47	70.7	44.1		60.6	63.3	61.7	61.8	61.1	.848	61.7			61.4	61.2	60.9		61.1
48	73.5	51.5		65.1	68.4	66.4	66.5	66.5	.844	66.5			66.1	65.9	66.5		66.0
49	74.8	55.7	.61 .39	67.4	66.3	67.0	67.0	68.6	.831	67.3			67.1	67.2	68.6		67.5
1950	76.0	57.8*		68.9	71.6	70.0	70.1	70.4	.815	70.2			69.7	69.5	70.4		69.7
51	78.8	64.1		73.1	79.1	75.5	75.7	73.7	.851	75.4			74.9	74.5	73.7	.80	74.3
52	82.3	70.4		77.7	82.8	79.7	79.9	75.9	.859	79.3			79.2	78.8	75.9	.78	78.2
53	84.5	74.8		80.7	86.2	82.9	83.1	79.4	.851	82.5			82.4	82.0	79.2	.77	81.3
54	87.0	79.2		84.0	85.3	84.5	84.5	84.9	.848	84.6			84.3	84.2	84.9		84.4
1955	90.0	83.0		87.3	89.7	88.3	88.4	91.0	.855	88.8			88.0	87.8	91.2		88.6
56	92.7	87.5		90.7	94.5	92.2	92.3	93.0	.858	92.4			91.8	91.5	93.0	.76	91.9
57	96.7	94.5	.60 .40	95.8	97.8	96.6	96.7	98.1	.863	96.9			96.4	96.3	98.2		96.8
58	100.0	99.9		100.0	99.0	99.6	99.6	99.3	.857	99.6			99.7	99.8	99.2	.75	99.7
59	103.4	105.5	.57 .43	104.3	103.3	103.9	103.9	102.9	.847	103.7			104.0	104.1	102.9	.74	103.8
1960	106.0	112.7		108.9	105.9	107.7	107.6	105.3	.836	107.2			108.0	108.2	105.1	.73	107.4
61	108.7	121.3		114.1	108.2	111.7	111.5	115.2	.832	112.1			112.3	112.8	115.4	.72	113.5
62	111.9	129.8	.58 .42	119.4	113.1	116.9	116.7	118.0	.828	116.9			117.5	118.0	118.1	.70	118.0
63	114.4	138.0		124.3	117.2	121.5	121.3	126.3	.833	122.1			122.2	122.7	126.4		123.8
64	117.3	144.9	.57 .43	129.2	123.5	126.9	126.7	132.2	.833	127.6			127.5	127.9	129.3		128.3
1965	121.5	153.3		135.2	131.9	133.9	133.8	138.7	.840	134.6			134.2	134.5	139.2		135.9
66	128.5	168.0		145.5	141.5	143.9	143.8	143.6	.817	143.8			144.3	144.6	144.2	.695	144.5
67	137.6	200.1	.57 .43	164.5	150.1	158.7	158.3	148.3	.820 .180	156.5			160.2	161.3	149.0	.695 .305	157.5
						Weights .6 Med. .4 Pers.I	Weights .15 Med. .15 Pers Inc. .70 Spec						Weights .7 Med. .3 Pers.I	Weights .25 Med. .75 Spec			

	AUTO PHYS. DAMAGE										AUTO PROPERTY DAMAGE					
	Auto Repair CPI	Av. Earn. Auto Repair	Av. Gr. Earn. M.V.Dlrs. Retail	Av. Pers. Dur. Gds.	Av. Earn. M.V.Mfg.	A.Phys. Dam. Loss	Loss Adj.	Wts Loss L.Adj.	A. Phys. Dam. Index		ABI Loss	A.Phys. Dam. Loss	APD Loss	APD L.Adj.	Wts Loss L.Adj.	APD Index
1935	51.5			17.0	24.4	29.6	31.1	.868 .132	30.1		34.1	29.6	31.0	33.6	.686 .314	31.8
36	51.5			20.9	26.2	31.7	34.6		32.1		35.5	31.7	32.8	34.9	.717	33.4
37	51.5			23.0	27.4	32.9	36.1		33.3		36.5	32.9	34.0	36.2	.737	34.6
38	51.5			18.7	27.1	31.1	35.2		31.6		35.6	31.1	32.5	35.1	.727	33.2
39	51.4			21.7	28.9	32.8	35.6		33.2		36.3	32.8	33.9	35.4	.766	34.3
1940	51.2			25.1	31.7	34.9	35.7		35.0		37.1	34.9	35.6	35.9	.783	35.7
41	53.5			30.6	36.8	39.3	38.0		39.1		39.8	39.3	39.5	38.1	.799	39.2
42	58.2			22.1	47.2	40.5	41.9		40.7		44.5	40.5	41.7	42.1	.774	41.8
43	58.9			20.4	48.8	40.5	46.4		41.3		50.2	40.5	43.4	46.8	.787	44.1
44	59.6			20.9	50.9	41.5	50.9		42.7		53.2	41.5	45.0	51.9	.813	46.3
1945	60.1			24.3	48.6	42.3	54.0		43.8		54.5	42.3	46.0	55.6	.833	47.6
46	62.0			47.2	46.1	51.3	55.7	.875	51.9		57.4	51.3	53.1	55.8	.834	53.5
47	67.2			60.4	51.5	59.8	62.1		60.1		61.8	59.8	60.4	61.4	.839	60.6
48	71.0	64.9		66.0	55.4	64.6	66.4		64.8		66.5	64.6	65.4	66.5	.837	65.6
49	72.8	65.8		70.2	59.2	67.2	68.4		67.4		67.0	67.2	67.1	68.5	.811	67.4
1950	74.3	68.9		85.5	65.9	74.4	70.5		73.9		70.1	74.4	72.7	70.4	.813	72.3
51	79.9	74.3		81.7	69.4	76.7	73.8		76.3		75.7	76.7	76.3	73.8	.845	75.9
52	81.8	78.1		79.6	76.0	78.9	76.1		78.6		79.9	78.9	79.3	76.0	.845	78.8
53	86.2	83.4		88.5	81.6	85.1	80.2		84.5		83.1	85.1	84.3	79.6	.835	83.5
54	89.2	85.2		86.0	83.7	85.9	84.7		85.8		84.5	85.9	85.3	84.8	.824	85.2
1955	91.2	87.8		102.1	87.9	92.8	89.9		92.4		88.4	92.8	91.0	90.6	.834	90.9
56	94.8	91.8		98.3	90.0	94.0	93.2		93.9		92.3	94.0	93.3	93.1	.847	93.3
57	98.2	97.2		101.3	94.2	98.0	97.8		98.0		96.7	98.0	97.5	98.0	.849	97.6
58	99.8	99.1	96.3	92.8	100.7	97.6	99.5		97.8		99.6	97.6	98.4	99.4	.846	98.6
59	101.9	103.7	103.6	106.4	105.1	104.3	103.3		104.2		103.9	104.3	104.1	103.0	.833	103.9
1960	103.9	107.4	105.8	106.8	108.1	106.6	106.1		106.5		107.6	106.6	107.0	105.5	.831	106.7
61	106.5	111.3	106.8	102.1	108.8	107.2	113.4	.882	107.9		111.5	107.2	108.9	114.6	.830	109.9
62	107.7	115.5	112.0	112.8	117.1	113.2	117.0		113.6		116.7	113.2	114.6	117.6	.829	115.1
63	109.2	119.7	117.3	121.3	123.4	118.7	123.6		119.3		121.3	118.7	119.7	125.4	.843	120.6
64	110.6	123.9	121.3	131.1	129.1	124.2	128.5		124.7		126.7	124.2	125.2	130.9	.851	126.0
1965	112.6	127.6	126.8	144.3	135.1	131.0	133.9		131.3		133.8	131.0	132.1	137.0	.863	132.8
66	114.7	132.7	131.2	151.9	138.1	136.9	138.9	.87	137.2		143.8	136.9	140.0	142.0	.85	140.6
67	119.2	137.3	134.6	154.0	142.6	140.5	143.3	.87 .13	140.9		158.3	140.5	146.9	146.6	.85 .15	146.8

WORKMEN'S COMPENSATION

	Mfg.	Contr.	All Other	Total	W.C. Law x Level	Indem. = Index	Indem. Wt.	Phys. Fees	Hosp. Rates	Wtd. Med.	Med. Wt	Adjust. Index	Adj. Wt	W.C. Index
1935	23.6	23.5	27.4	25.1	.660	16.6	56.3	53.9	23.8	43.4	30.6	33.7	13.1	27.0
36	25.6	25.9	30.1	27.3	.660	18.0	56.1	54.2	24.0	43.6	30.5	34.9	13.4	28.1
37	28.3	28.9	32.1	30.0	.660	19.8	55.5	54.5	24.6	44.0	30.1	36.2	14.4	29.4
38	26.2	28.0	31.4	28.8	.660	19.0	55.7	54.4	25.2	44.2	29.4	35.0	14.9	28.8
39	28.1	27.3	32.2	29.5	.660	19.5	56.5	54.5	25.3	44.3	29.0	35.4	14.5	29.0
1940	29.5	28.8	33.2	30.5	.660	20.1	57.1	54.5	25.4	44.3	28.3	35.9	14.6	29.3
41	35.0	34.0	36.6	35.3	.662	23.4	58.4	54.7	25.9	44.3	28.2	38.1	13.4	31.3
42	43.6	42.3	41.7	42.6	.667	28.4	59.9	55.8	28.0	45.8	28.0	42.2	12.1	34.9
43	51.2	49.6	46.9	49.2	.668	32.9	60.7	59.4	30.2	48.9	27.5	46.9	11.8	39.0
44	54.3	52.6	50.2	52.4	.685	35.9	61.1	61.8	31.5	50.9	26.9	52.1	12.0	[illegible]1.9
1945	52.5	50.9	50.9	51.5	.689	35.5	61.8	63.3	32.5	52.2	26.4	56.1	11.8	42.3
46	51.5	49.9	53.8	52.0	.708	36.8	61.6	66.4	37.0	55.5	25.7	55.8	12.7	44.0
47	58.4	56.5	60.1	58.6	.735	43.1	62.3	70.7	44.1	60.9	25.4	61.2	12.3	49.8
48	63.1	62.7	64.8	63.7	.755	48.1	61.5	73.5	51.5	65.4	25.9	66.5	12.6	54.9
49	64.0	64.9	67.1	65.5	.792	51.9	60.1	74.8	55.7	67.7	26.5	68.6	13.4	58.3
1950	69.3	66.9	70.5	68.4	.821	56.2	59.2	76.0	57.8	69.3	26.9	70.4	13.9	61.7
51	75.2	73.9	76.0	75.2	.838	68.0	59.4	78.8	64.1	73.4	28.0	73.7	12.6	67.3
52	79.8	79.6	79.7	79.7	.867	69.1	58.8	82.3	70.4	77.8	29.1	75.9	12.1	72.5
53	83.7	83.0	83.1	83.3	.881	73.4	58.1	84.5	74.8	80.8	28.8	79.5	13.1	76.3
54	83.7	85.4	85.1	84.7	.898	76.1	57.8	87.0	79.2	84.0	28.7	84.8	13.5	79.5
1955	89.9	87.3	89.2	88.0	.919	81.7	58.0	90.0	83.0	87.3	28.9	90.9	13.1	84.5
56	93.6	92.5	93.0	93.0	.951	88.4	58.0	92.7	87.5	90.7	29.0	93.0	13.0	89.7
57	96.9	96.3	96.6	96.6	.966	93.3	58.2	96.7	94.5	95.9	29.1	98.1	12.7	94.7
58	98.2	99.6	99.3	99.1	1.014	100.5	58.2	100.0	99.9	100.0	29.4	99.3	12.4	100.2
59	104.8	104.1	104.1	104.3	1.020	106.4	58.3	103.4	105.5	104.2	29.4	103.0	12.3	105.3
1960	106.6	108.5	106.6	107.2	1.069	114.6	57.4	106.0	112.7	108.6	29.9	105.4	12.7	111.6
61	109.7	113.4	109.6	110.7	1.084	120.0	57.8	108.7	121.3	113.6	30.0	114.9	12.2	117.5
62	114.7	117.6	113.8	115.1	1.102	126.8	57.3	111.9	129.8	118.9	30.0	117.8	12.7	123.3
63	118.3	122.1	117.6	119.0	1.117	132.0	57.4	114.4	138.0	123.6	30.2	125.9	12.4	130.0
64	122.3	126.8	116.2	120.8	1.130	136.5	57.5	117.3	144.9	128.1	30.4	131.6	12.1	133.4
1965	127.7	132.9	120.5	126.1	1.135	143.1	57.6	121.5	153.3	133.9	30.5	137.9	11.9	139.7
66	133.4	140.1	124.8	131.6	1.182	155.6	57.7	128.5	168.0	144.3	30.7	142.9	11.6	150.7
67	136.6	149.0	128.4	136.5	1.221	166.7	57.7	137.6	200.1	162.6	30.7	147.6	11.6	163.2

OTHER PROPERTY DAMAGE

	Bldg. Comm. Loss	WPI Mach.	Av.Earn. Mach.	Pers. Consum. Dur.Gds.	Pr.Defl. Dur. Equip.	OBI Loss	Loss Index	OPD Adj. Index	Wt $ Loss L.Adj.	OPD
1935	26.9 .3	40.0 .2		17.0 .2	38.7 .1	38.2 .2	31.1 1.0	33.6	.75 .25	33.2
36	28.6	41.0		20.9	38.5	39.1	32.6	34.9		33.2
37	31.7	42.0		23.0	41.4	39.8	34.6	36.2		35.0
38	31.7	43.0		18.7	43.0	39.5	34.1	35.0		34.3
39	31.6	43.7		21.7	42.2	39.8	34.7	35.4		34.9
1940	32.3	44.2		25.1	43.4	40.1	35.9	35.9		35.9
41	34.6	45.8		30.6	46.3	41.8	38.7	38.1		38.6
42	38.2	47.7		22.1	51.5	44.8	39.5	42.2		40.2
43	40.3	47.4		20.4	51.1	49.4	40.6	46.8		42.2
44	40.9	47.4		20.9	51.9	51.8	41.5	52.0	.80	43.6
1945	42.4	47.8		24.3	51.7	53.1	42.9	55.7		45.5
46	49.3 .3	53.6 .2		47.2 .2	57.5 .1	56.3 .2	52.0	55.8	.793	52.8
47	61.9 .3	61.8 .1	57.4 .1	60.4 .2	64.6 .1	61.2 .2	61.3	61.4	.777	61.3
48	68.9	67.5	62.2	66.0	70.3	65.9	67.1	66.5		67.0
49	69.0	71.2	62.1	70.2	73.6	67.2	68.9	68.5		68.8
1950	71.9	72.6	69.1	85.5	75.2	69.5	74.3	70.4		73.4
51	77.6	79.5	78.4	81.7	80.9	74.5	78.4	73.8		77.4
52	80.9	81.2	81.9	79.6	82.2	78.8	80.5	76.0		79.5
53	83.9	82.2	85.1	88.5	83.5	82.0	84.4	79.6		83.3
54	85.8	83.2	83.8	86.0	84.0	84.2	84.9	84.8		84.9
1955	88.4	85.8	90.0	102.1	85.9	87.8	90.7	90.7	.775	90.7
56	93.1	92.1	95.8	98.3	91.8	91.5	93.9	93.0		93.7
57	97.2	97.7	96.9	101.3	97.5	96.3	97.9	98.1		97.9
58	99.8	100.0	97.1	92.8	100.0	99.8	98.2	99.4		98.5
59	103.4	102.1	106.0	106.4	102.0	104.1	104.1	103.0		103.9
1960	106.0	102.9	107.7	106.8	102.2	108.2	106.1	105.4	.754	105.9
61	108.7	102.9	110.6	102.1	102.1	112.8	107.2	114.9		109.1
62	111.9	102.9	116.4	112.8	102.3	118.0	111.9	117.8		113.4
63	115.2	103.1	119.7	121.3	102.3	122.7	115.9	126.0		118.4
64	118.8	103.8	125.3	131.1	103.0	127.9	120.6	131.8		123.4
1965	123.1	105.0	131.4	144.3	104.2	134.5	126.8	138.2	.755	129.6
66	129.4	108.2	138.9	151.9	106.2	144.6	133.5	143.2		135.9
67	135.4 .3	111.5 .1	139.3 .2	154.0 .1	108.9 .2	161.3 .2	139.7	147.9	.755 .245	141.7

			GLASS										BURGLARY						
		Sic 321 Flat Glass Av.Gr.Earn	Contract Const. Gen.Bld.	WPI Flat Glass	Glass Loss	Loss Adj.	Wts Loss L.Adj.	GLASS INDEX		CPI Apparel	CPI Recreat. Gds.	A.V. Dispos. Inc.	Av. Pers. Durables	CPI Comm. less Food	Burg. Loss	Loss Adj.	Wts Loss L.Adj.	BURG. INDEX
1935			23.5		23.5	32.7	.90 .10	24.4		46.6	53.0	24.9	17.0	49.0	32.1	32.7	.85 .15	32.2
36			25.9		25.9	34.4		26.8		46.9	53.0	28.1	20.9	50.0	34.5	34.4		34.5
37			28.9		28.9	36.1		29.6		49.4	53.0	29.9	23.0	52.0	36.2	36.1		36.2
38			28.0		28.0	35.4		28.7		49.1	53.0	27.3	18.7	52.0	34.2	35.4		34.4
39			27.3		27.3	35.7	.897	28.2		48.3	54.4	29.1	21.7	52.1	35.7	35.7	.854	35.7
1940			28.8		28.8	35.5		29.5		48.8	55.4	31.1	25.1	52.4	37.4	35.5		37.1
41			34.0		34.0	37.9		35.3		57.1	57.3	37.7	30.6	55.0	42.9	37.9		42.2
42			42.3		42.3	41.5		42.2		59.6	60.0	47.0	22.1	61.2	47.8	41.5		46.9
43			49.6		49.6	46.1		49.2		62.2	65.0	52.9	20.4	63.8	51.7	46.1		50.9
44			52.6		52.6	50.0		52.3		66.7	72.0	57.3	20.9	67.3	55.7	50.0		54.9
1945			50.9		50.9	52.5	.897	51.1		70.1	75.0	58.2	24.3	70.0	57.6	52.5		56.9
46			49.9		49.9	55.6	.891	50.5		76.9	77.5	61.4	47.2	74.4	64.2	55.6	.872	63.1
47		53.0	57.1	70.1	59.8	62.7		60.1		89.2	82.5	63.8	60.4	83.9	70.5	62.7		69.5
48		57.0	63.6	73.9	64.7	66.3		64.9		95.0	86.7	69.9	66.0	90.3	76.3	66.3		75.0
49		59.0	65.9	77.5	67.3	67.9		67.4		91.3	89.9	68.5	70.2	89.0	76.0	67.9		75.0
1950		64.0	67.6	79.3	70.0	70.6		70.1		90.3	89.3	73.9	85.5	88.9	80.9	70.6		79.6
51		69.7	73.7	84.2	75.7	73.9	.881	75.5		98.2	92.0	79.6	81.7	95.6	85.2	73.9	.863	83.7
52		71.2	81.5	84.4	79.3	76.2		78.9		97.2	92.4	82.3	79.6	96.4	86.4	76.2		85.0
53		80.9	86.0	89.2	85.4	80.7		84.8		96.5	93.3	85.8	88.5	96.6	89.5	80.7		88.3
54		83.6	87.9	91.9	87.8	84.6		87.4		96.3	92.4	85.9	86.0	95.6	88.8	84.6		88.2
1955		94.8	88.8	94.5	92.3	88.8		91.9		95.9	92.1	90.3	102.1	94.9	93.4	88.8		92.8
56		94.1	93.3	98.5	95.1	93.4		94.9		97.8	93.4	94.5	98.3	95.9	95.5	93.4	.865	95.2
57		95.1	97.4	100.2	97.6	97.6		97.6		99.5	96.9	97.6	101.3	98.8	98.4	97.6		98.3
58		94.1	99.6	100.0	98.1	99.8		98.3		99.8	100.8	99.2	92.8	99.9	98.6	99.8		98.8
59		110.8	103.1	99.9	104.5	103.5		104.4		100.6	102.4	103.3	106.4	101.2	103.1	103.5		103.2
1960		106.9	106.6	97.9	104.1	106.6	.881	104.4		102.2	104.9	105.0	106.8	101.7	104.5	106.6		104.8
61		102.8	111.8	96.8	104.6	112.3	.875	105.6		103.0	107.2	107.5	102.1	102.0	105.4	112.3	.863	106.3
62		105.5	115.6	97.0	107.0	116.4		108.2		103.6	109.6	111.9	112.8	102.8	109.7	116.4		110.6
63		113.2	120.6	98.3	111.7	121.9		113.0		104.8	111.5	115.8	121.3	103.5	113.4	121.9		114.6
64		120.7	126.1	102.4	117.4	126.2		118.5		105.7	114.1	123.6	131.1	104.4	119.1	126.2		130.1
1965		125.3	131.6	100.9	120.5	131.0		121.8		106.8	115.2	131.5	144.3	105.1	125.6	131.0		126.3
66		128.4	140.1	100.7	124.8	135.9		126.2		109.6	117.1	140.1	151.9	106.5	131.8	135.9		132.3
67		128.0	148.4	105.3	129.4	140.1	.875 .125	130.7		114.0	120.1	148.3	154.0	109.0	137.4	140.1	.867 .133	137.8
	Wts.	.3	.4	.3					Wts.	.09	.10	.51	.15	.15	1.00			

PROPERTY LINES

	Home Main Repairs	Boeckh Res.	Dwell. Loss	O.B.I. Loss	H. Own. Loss		Amer. Apprais.	Dept.Com. Composite	Eng.News Constr.	Spec. Trades Constr.	Comm. Loss	O.B.I. Loss	Comm. M.P.		Wts.	Dwelling Commer.	E.C. Fire
1935		31.8 1.0	31.8 1.0				23.7 .4	32 .3	26.0 .3		26.9				.58	.42	29.7 1.00
36		32.7	32.7				24.9	34	28.0		28.6						31.0
37		34.8	34.8				29.0	36	31.0		31.7						33.5
38		35.8	35.8				29.0	36	31.0		31.7						34.1
39		36.5	36.5				29.4	35	31.0		31.6						34.4
1940		37.6	37.6				30.0	36	31.8		32.3						35.4
41		40.7	40.7				31.9	39	33.9		34.6						38.1
42		43.0	43.0				35.3	44	36.4		38.2						41.0
43		44.9	44.9				36.9	47	38.2		40.3						43.0
44		48.8	48.8				38.2	46	39.3		40.9						45.5
1945		52.3	52.3				39.7	48	40.5		42.4						48.1
46		57.4	57.4				47.1	56	45.5		49.3						54.0
47		69.5	69.5				63.0 .3	68 .3	54.4 .2	58.5 .2	61.9						66.3
48		74.2	74.2				71.7	75	60.6	63.7	68.9						72.0
49		76.1	76.1				71.7	73	62.8	65.1	69.0						73.1
1950		80.3	80.3				73.2	77	67.1	67.0	71.9						76.8
51		86.5	86.5				77.9	83	71.4	75.2	77.6						82.8
52		88.8	88.8				81.0	86	74.9	79.1	80.9						85.5
53	87.1 .3	90.4 .7	89.4				84.5	88	78.9	81.6	83.9				.58		87.1
54	88.6	89.7	89.4				86.7	88	82.6	84.1	85.8				.55		87.8
1955	90.6	92.4	91.9 .93	87.8 .07	91.6 1.00		89.0	90	86.8	86.9	88.4				.52		90.2
56	94.4	96.5	95.9	91.5	95.6		93.0	95	91.1	92.3	93.1	91.5 .07	92.9 1.00		.50		94.5
57	98.4	98.5	98.5	96.3	98.3		97.1	99	95.2	96.7	97.2	96.3	97.1		.48		97.8
58	100.0	99.2	99.4	99.8	99.4		99.9	100	99.9	99.1	99.8	99.8	99.8		.45		99.6
59	101.7	102.5	102.3	104.1 .08	102.4		103.1	102	104.9	104.2	103.4	104.1 .08	103.5		.43		102.9
1960	103.5	104.2	104.0	108.2	104.3		105.7	103	108.4	108.4	106.0	108.2	106.2		.42		105.2
61	105.0	104.5	104.7	112.8 .09	105.4		108.5	104	111.5	113.2	108.7	112.8 .09	109.1		.41		107.1
62	105.8	106.3	106.2	118.0	107.3		110.8	107	114.7	117.9	111.9	118.0	112.5		.41		109.6
63	107.2	108.5	108.1	122.7	109.4		114.3	109	118.5	122.6	115.2	122.7	116.0		.40		112.4
64	109.4	111.6	110.9	127.9 .10	112.6		117.4	112	123.2	126.9	118.8	127.9 .10	119.7		.40		115.6
1965	111.7	115.2	114.2	134.5	116.2		120.6 .3	116 .3	127.8	133.4 .2	123.2	134.5	124.4		.39		119.6
66	116.4	120.1	119.0	144.6 .12	122.1		126.9	121	134.3	140.6	129.4	144.6 .12	131.1		.38		125.4
67	122.3 .3	127.4 .7	125.9 .88	161.3 .12	130.1		133.1 .3	126 .3	140.7 .2	147.6 .2	135.4	161.3 .12	138.2		.38	.62	131.8

ECONOMIC FACTORS

PROPERTY LINES

	Fire, Allied Loss	E.C. & Lines Loss Adj.	Wts Loss L.Adj.	FIRE ALLIED INDEX	Wts Loss L.Adj.	E.C. INDEX	Loss	Loss Adj.	H.O. INDEX	Loss	Loss Adj.	COMM. M.P. INDEX
1935	29.7	32.9	.94 .06	1.00 29.9	.84 .16	30.2						
36	31.0	34.5		31.1		31.6						
37	33.5	36.1		33.7		33.9						
38	34.1	35.3		34.2		34.3						
39	34.4	35.7		34.5		34.6						
1940	35.4	35.6		35.4		35.4						
41	38.1	38.0		38.1		38.1						
42	41.0	41.7		41.0		41.1						
43	43.0	46.3		43.2		43.5						
44	45.5	50.5		45.8		46.3						
1945	48.1	53.3		48.4		48.9						
46	54.0	55.7		54.1		54.3						
47	66.3	62.4		66.1		65.7						
48	72.0	66.4		71.7		71.1						
49	73.1	68.3		72.8		72.3						
1950	76.8	70.5		76.4		75.8						
51	82.8	73.9		82.3		81.4						
52	85.5	76.2		84.9		84.0						
53	87.1	80.4		86.7		86.0						
54	87.8	84.7		87.6		87.3						
1955	90.2	89.5		90.2		90.1	91.6 .89	89.9 .11	91.4 1.00	.92	.08	1.00
56	94.5	93.3	.935	94.4		94.3	95.6	93.2	95.3	92.9	93.2	92.9
57	97.8	97.7	.93	97.8		97.8	98.3 .88	97.8	98.2	97.1	97.8	97.2
58	99.6	99.7		99.6	.85	99.3	99.4	99.5	99.4	99.8	99.5	99.8
59	102.9	103.4		102.9	.865	103.0	102.4 .87	103.3	102.5	103.5	103.3	103.5
1960	105.2	106.3		105.3	.87	105.3	104.3 .88	106.1	104.5	106.2	106.1	106.2
61	107.1	112.9		107.5		107.9	105.4	113.4	106.4	109.1	113.4	109.4
62	109.6	116.7		110.1	.86	110.5	107.3	117.0	108.5	112.5	117.0	112.9
63	112.4	122.8		113.1	.875	113.9	109.4 .89	125.3	111.1	116.0	125.3	116.7
64	115.6	127.4	.935	116.4		117.1	112.6	128.5	114.3	119.7	128.5	120.4
1965	119.6	132.4	.942	120.4	.90	120.9	116.2	131.4	117.9	124.4	131.4	125.0
66	125.4	137.4		126.1		127.0	122.1	135.6	123.6	131.1	135.6	131.5
67	131.8	141.7	.94 .06	132.4	.87 .13	133.1	130.1 .89	143.3 .11	131.6	138.2	143.3	138.6

ECONOMIC FACTORS

INLAND MARINE

	C.P.I. Apparel	C.P.I. Recr.Gds	W.P.I. Cons.Eqp	W.P.I. Agric. Equip.	W.P.I. Furn. Hs.Dur.	C.P.I. Comm. less food	Av.Pers. Dispose Income	Av.Pers. Durable Goods	Av.Ann. Earn. Mfg.	Av.Ann Earn. Wh.Ret.	Inland Marine Loss	I.M. Loss Adj.	Wt Loss	L.Adj.	INLAND MARINE INDEX
1935	46.6	53.0	41.0	50.3	48.6	49.0	24.9	17.0	24.4	30.0	31.2	32.9	.90	.10	31.4
36	46.9	53.0	41.0	50.5	49.3	50.0	28.1	20.9	25.8	30.1	32.9	34.5			33.1
37	49.4	53.0	41.0	50.5	54.7	52.0	29.9	23.0	27.6	31.7	34.6	36.1			34.8
38	49.1	53.0	42.0	51.3	53.4	52.0	27.3	18.7	26.0	31.7	33.2	35.3			33.4
39	48.3	54.4	41.0	50.2	53.2	52.1	29.1	21.7	27.3	31.9	34.1	35.7			34.3
1940	48.8	55.4	40.0	49.9	54.4	52.4	31.1	25.1	28.7	32.4	35.3	35.6			35.3
41	51.1	57.3	42.2	50.2	57.8	55.0	37.7	30.6	33.2	34.6	39.4	38.0			39.3
42	59.6	60.0	43.6	52.1	62.5	61.2	47.0	22.1	40.6	37.7	44.3	41.7			44.0
43	62.2	65.0	43.6	52.1	62.1	63.8	52.9	20.4	47.1	41.7	47.9	46.3			47.7
44	66.7	72.0	43.7	52.3	63.8	67.3	57.3	20.9	50.5	45.6	51.1	50.5			51.0
1945	70.1	75.0	44.0	52.5	63.9	70.0	56.2	24.3	50.5	49.6	52.8	53.3			52.9
46	76.9	77.5	47.8	56.3	67.8	74.4	61.4	47.2	50.5	55.7	58.2	55.7			58.0
47	89.2	82.5	54.2	65.2	77.8	83.9	63.8	60.4	56.0	61.7	64.6	62.4			64.4
48	95.0	86.7	61.3	73.1	82.5	90.3	69.9	66.0	61.0	66.2	70.3	66.4			69.9
49	91.3	89.9	65.3	78.1	83.8	89.0	68.5	70.2	62.1	68.0	71.0	68.3			70.7
1950	90.1	89.3	67.2	79.8	85.6	88.9	73.9	85.5	66.3	71.4	75.4	70.5			74.9
51	98.2	92.0	74.5	86.6	92.8	95.6	79.6	81.7	72.4	74.5	80.3	73.9			80.0
52	97.2	92.4	75.6	87.7	91.1	96.4	82.3	79.6	76.9	77.3	82.1	76.2			81.5
53	96.5	93.3	77.9	88.2	92.9	96.6	85.8	88.5	81.3	81.3	85.5	80.4			85.0
54	96.3	92.4	79.3	88.1	93.9	95.6	85.9	86.0	82.7	84.3	86.1	84.7			86.0
1955	95.9	92.1	82.6	88.9	94.3	94.9	90.3	102.1	87.4	88.0	90.5	89.5			90.4
56	97.8	93.4	89.5	92.0	96.9	95.9	94.5	98.3	92.1	92.3	93.9	93.3			93.8
57	99.5	96.9	96.3	96.3	99.4	98.8	97.6	101.3	96.0	96.3	97.6	97.7			97.6
58	99.8	100.8	100.1	100.3	100.2	99.9	99.2	92.8	99.2	99.5	98.9	99.7			99.0
59	100.6	102.4	103.6	103.4	100.4	101.2	103.3	106.4	104.8	104.1	103.5	103.4			103.5
1960	102.2	104.9	105.8	105.4	100.1	101.7	105.0	106.8	107.4	107.8	105.5	106.3			105.6
61	103.0	107.2	107.5	107.4	99.5	102.0	107.0	102.1	110.5	110.6	106.9	112.9	.92	.08	107.4
62	103.6	109.6	107.8	109.5	98.8	102.8	111.9	112.8	114.4	114.7	110.8	116.7			111.3
63	104.8	111.5	109.6	111.1	98.1	103.5	115.8	121.3	118.8	118.9	114.4	122.8			115.1
64	105.7	114.1	112.4	112.9	98.5	104.4	123.6	131.1	124.3	123.3	119.6	127.4			120.2
1965	106.8	115.2	115.3	115.1	98.0	105.1	131.5	144.3	128.2	127.4	124.9	132.4			125.5
66	109.6	117.1	118.9	118.5	99.1	106.5	140.1	151.9	133.4	132.0	130.5	137.4			131.1
67	114.0	120.1	123.0	122.4	101.2	109.0	148.3	154.0	138.0	136.6	135.6	141.7	.92	.08	136.1
Weights	.07	.01	.11	.02	.03	.06	.30	.09	.14	.17	1.00				

ECONOMIC FACTORS

BOILER AND MACHINERY

	Av. Gr. Earn. Machinery	Av.Ann. Earn. Mach.	WPI Metal Working	WPI Spec.Ind. Mach.	WPI Gen.Pur. Mach.	Av. Gr. Earn. Elec.Eq.	A.G.Earn Engines Turbines	Av.Ann. Earn. Elect.M.	Loss Index	Loss Adj.	W. Loss & S.L. Adj.	B.M. Index
1935		$25.2^{.5}$						$26.1^{.5}$	$25.7^{1.0}$	32.9	.93 .07	26.2
36		27.4						28.3	27.9	34.5		28.4
37		29.9						30.9	30.4	36.1		30.8
38		27.1						29.2	28.2	35.3		28.7
39		$29.7^{.3}$	$43.6^{.2}$		$45.9^{.2}$			$30.6^{.3}$	36.0	35.7		36.0
1940		32.0	44.3		46.0			32.3	37.4	35.6		37.3
41		37.9	45.3		46.8			36.7	40.8	38.0		40.6
42		46.5	45.8		47.3			43.8	45.7	41.7		45.4
43		50.5	45.7		46.3			47.2	47.7	46.3		47.6
44		52.5	45.6		46.1			49.3	48.9	50.5		49.0
1945		51.8	45.6		46.1			49.5	48.7	53.3		49.0
46		50.6	50.0		49.8			50.1	50.2	55.7		50.6
47	$57.4^{.2}$	$55.0^{.2}$	$56.9^{.1}$		$57.6^{.2}$	$59.2^{.2}$		$55.1^{.1}$	57.0	62.4		57.4
48	62.2	60.9	61.3		62.7	64.2		60.5	62.2	66.4		62.5
49	62.1	61.6	64.2		66.2	65.7		62.5	63.8	68.3		64.1
1950	69.1	66.6	61.2		68.6	69.9		64.9	67.5	70.5		67.7
51	78.4	75.1	76.2		76.7	75.7		71.3	75.9	73.9		75.8
52	81.9	79.3	77.5		76.1	80.0		75.7	78.8	76.2		78.6
53	85.1	83.5	78.6		77.9	83.6		79.3	81.8	80.4		81.7
54	83.8	84.0	79.8		79.6	83.9		81.5	82.4	84.7		82.6
1955	90.0	87.9	84.1		83.2	88.2		85.7	86.8	89.5		87.0
56	95.8	93.9	92.0		91.7	93.7		90.2	93.2	93.3		93.2
57	96.9	96.4	97.6		97.9	96.3		94.3	96.7	97.7		96.8
58	$97.1^{.15}$	$98.6^{.10}$	$100.0^{.10}$		$99.4^{.15}$	$98.8^{.10}$	$100.0^{.30}$	$100.3^{.10}$	$99.2^{1.00}$	99.7		99.2
59	106.0	105.0	102.4		102.7	104.9	105.9	105.4	104.8	103.4		104.7
1960	107.7	107.5	105.3		103.6	106.8	106.1	108.6	106.3	106.3		106.3
61	110.6	110.4	106.3		102.8	111.2	111.1	112.9	109.4	112.9		109.6
62	116.4	115.2	108.1		103.3	114.7	116.0	116.4	113.2	116.7		113.4
63	119.4	118.5	108.5		103.8	116.7	119.7	119.8	115.7	122.8		116.2
64	125.3	125.0	110.5		104.4	119.7	123.2	125.0	119.4	127.4		120.0
1965	131.4	128.8	113.6		105.1	124.5	129.1	127.4	123.6	132.4		124.2
66	138.9	134.9	118.8		109.7	128.5	138.3	130.0	130.0	137.4		130.5
67	$139.3^{.15}$	$140.3^{.10}$	$124.1^{.40}$		$113.7^{.15}$	$131.8^{.10}$	$139.0^{.30}$	$132.6^{.10}$	$132.5^{1.00}$	141.7	.93 .07	133.1

LOSS ADJUSTMENT INDEXES BY LINES 1957-59 = 100
(Weights indicated for Legal Services)

	BASIC INDEXES Legal Services	BASIC INDEXES Ins.Co. Av.Wkly. Gr.Earn.	Auto B.I. Wts.	Auto B.I. Index	Auto P.D. Wts.	Auto P.D. Index	Auto Phys.D. Wts.	Auto Phys.D. Index	Work.Comp. Wts.	Work.Comp. Index	Other B.I. Wts.	Other B.I. Index	Other P.D. Wts.	Other P.D. Index	Glass Burg.	Fire E.C. In Mar. B&M	H.O. Comm. MP
1935	34.4 .70	32.2 .30	.70	33.7	.60	33.6	.40	31.1	.67	33.7	.76	33.9	.62	33.6	32.7	32.9	
36	35.3	34.2		35.0		34.9		34.6		34.9		35.0		34.9	34.4	34.5	
37	36.3	36.0		36.2		36.2		36.1		36.2		36.2		36.2	36.1	36.1	
38	34.7	35.6		35.0		35.1		35.2		35.0		34.9		35.0	35.4	35.3	
39	35.1	35.9		35.3		35.4		35.6		35.4		35.3		35.4	35.7	35.7	
1940	36.2	35.4		36.0		35.9		35.7		35.9		36.0		35.9	35.5	35.6	
41	38.2	37.8		38.2		38.1		38.0		38.1		38.2		38.1	37.9	38.0	
42	42.7	41.3		42.3		42.1		41.9		42.2		42.4		42.2	44.5	41.7	
43	47.4	45.8		46.9		46.8		46.4		46.9		47.0		46.8	46.1	46.3	
44	53.7	49.1		52.3		51.9		50.9		52.1		52.6		52.0	50.0	50.5	
1945	58.6	51.0		56.3		55.6		54.0		56.1		56.8		55.7	52.5	53.3	
46	56.0	55.5		55.9		55.8		55.7		55.8		55.9		55.8	55.6	55.7	
47	60.1	63.4		61.1		61.4		62.1		61.2		60.9		61.4	62.7	62.4	
48	66.6	66.3		66.5		66.5		66.4		66.5		66.5		66.5	66.3	66.4	
49	68.8	68.1		68.6		68.5		68.4		68.6		68.6		68.5	67.9	68.3	
1950	70.3	70.6		70.4		70.4		70.5		70.4		70.4		70.4	70.6	70.5	
51	73.6	74.0		73.7		73.8		73.8		73.7		73.7		73.8	73.9	73.9	
52	75.7	76.4		75.9		76.0		76.1		75.9		75.9		76.0	76.2	76.2	
53	78.6	81.2		79.4		79.6		80.2		79.5		79.2		79.6	80.7	80.4	
54	85.0	84.5		84.9		84.8		84.7		84.8		84.9		84.8	84.6	84.7	
1955	92.1 .70	88.4 .30	.70	91.0		90.6		89.9		90.9		91.2	.62	90.7	88.8	89.5	89.9
56	92.8 .71	93.5 .29	.71	93.0		93.1		93.2		93.0		93.0	.65	93.0	93.4	93.3	93.2
57	98.4 .71	97.4 .29		98.1		98.0		97.8		98.1		98.2		98.1	97.6	97.7	97.8
58	99.0 .71	100.0 .29		99.3		99.4		99.5		99.3		99.2		99.4	99.8	99.7	99.5
59	102.6 .71	103.7 .29		102.9		103.0		103.3		103.0		102.9		103.0	103.5	103.4	103.3
1960	104.5 .71	107.1 .29		105.3		105.5		106.1		105.4		105.1	.65	105.4	106.6	106.3	106.1
61	116.7 .72	111.2 .28	.72	115.2	.61	114.6		113.4		114.9		115.4	.67	114.9	112.3	112.9	113.4
62	118.8 .72	115.8 .28		118.0		117.6		117.0		117.8		118.1		117.8	116.4	116.7	117.0
63	128.7 .72	120.2 .28		126.3		125.4		123.6		125.9		126.4	.69	126.0	121.9	122.8	125.3
64	135.4 .72	123.9 .28		132.2		130.9		128.5		131.6		129.3		131.8	126.2	127.4	128.5
1965	142.8 .72	128.0 .28		138.7		137.0		133.9		137.9		139.2		138.2	131.0	132.4	131.4
66	147.8 .72	132.9 .28		143.6		142.0		138.9		142.9		144.2		143.2	135.9	137.4	135.6
67	152.8 .72	136.9 .28	.72	148.3	.61	146.6	.40	143.3	.67	147.6	.76	149.0	.69	147.9	140.1	141.7	143.3
															.20	.30	.40 Wts.

DISCUSSION BY EDWARD W. SMITH

Mr. Masterson in presenting this paper has recognized that the casualty-property insurance industry has a knowledge gap in regard to our ability to correctly assess the cost of a significant portion of our product. The presentation is an effort to shed some light on the problem and to initiate steps which may ultimately fill the void.

The reader who hopes and expects to find all the answers as to the proper amount of trend to reflect in his rates will be disappointed. However, the reader who recognizes that the paper is primarily presented as a catalyst to stimulate an interest among management, regulatory officials, and the public will find that it should serve that purpose very well and — in addition — will be likely to find that some insight is gained as to the effect of economic factors on pricing problems with which he has been dealing.

I must admit to being one who hoped for more than he got. My own area of concern involves establishing rates for private passenger automobiles. Two of the most pressing problems in this area are, first, how to determine the amount of rate level change needed because of inflationary forces and, secondly, how to convince the regulatory officials and public as to the actual necessity of including such factors in rate promulgations. Perhaps the formula outlined in the paper might be pressed directly into service. Such an approach would have several advantages.

a. Trend based upon the proposal would likely be more acceptable to the public and regulatory officials, because it is independent of individual company control.

b. Shift in the areas in which a company's business is concentrated or in company settlement practices can cause trend lines to behave strangely. Such shifts are difficult to compensate for; the use of the Liability Property index would eliminate this problem.

c. The LPI would be somewhat more current than present trend data based upon paid costs could be. Liability losses average about one year in age at time of settlement thus trends based on paid losses are somewhat out of date by the time they become available.

d. If reliable trend indexes can be established, through the LPI, it would appear possible to file a rating formula with an escalation clause, based upon the movement of the index, which would require refiling only as frequencies and severity changed.

Therefore, as an initial thought, it appeared possible that this paper might be of immediate use if the index levels made sense.

I had available to me from company sources our own trend data for automobile lines covering a considerable period. For the sake of comparison I have prepared indexes relating 1967 averages with 1959, and have shown them below with the 1966 indexes prepared by Mr. Masterson. I have used a one year offset because there is some delay in payments, particularly in automobile liability lines.

Line	LPI 1966/1958	Company Index 1967/1959
Automobile BI	143.8	129.3
Automobile PD	140.6	154.5
Comprehensive	137.2	196.0
Collision	137.2	133.1

To the degree that such a comparison could be considered a test of Mr. Masterson's LPI, I would have to judge the results as inconclusive. However, it should be noted that the use of LPI as a replacement for trend would have produced rate levels which would not have been substantially different from those developed using company data, for the average trend projection used has been about three years or less. Only Comprehensive averages have really substantial differences.

I suspect that the approach used in developing the Liability Property index for automobile physical damage is not appropriate for insurance covering these lines. Mr. Masterson notes that differing mixes of business in regard to deductibles could cause a bias. In addition, an even greater bias is introduced by changing proportions of types of loss. Our results indicate that theft and vandalism losses comprise an ever increasing portion of our Comprehensive losses. Apparently a more refined index is required in this area.

Only the preparation of the auto BI index is discussed in real detail. Those interested in disagreeing will find that several elements are subject to differences of opinion, but the overall index level changes are most realistic. Of great interest is the acceleration of the rate of change especially in the most recent year. Our own figures based on paid losses through 1967 have not yet reflected this. Judgment says that such an acceleration will occur. Perhaps the next two years will prove what a valuable tool the LPI could be.

The Liability Property indexes for lines other than automobile appeared to me to be primarily useful as tools to make the public aware of the degree of inflation present in areas allied to each line of insurance, thereby making the need for premium level changes more understandable. Direct translation into rate making procedures will require considerable refinement.

The degree to which these indexes improves on the Consumer Price index is debatable. Perhaps, as interest in developing and maintaining such indexes is created, relationships which more completely measure the change in loss costs will be developed; for the present, the LPI must be regarded only as a general index.

Mr. Masterson has made a valuable contribution to the insurance industry by presenting this paper. However, it's primary value will be as a stimulant to further advances in the measurement of the effect of economic factors on insurance premiums rather than for the specific Liability Property indexes as presented. Unless Mr. Masterson's index is adopted, and improved through study, the value of the contribution will soon be lost. The industry would be best served if the NAIC would establish a subcommittee to oversee the development of such indexes, and the dissemination of the results to the public. In this way, indexes could be established which would be of great service to the industry and which the public would be most likely to trust and understand.

DISCUSSION BY RICHARD D. McCLURE

The crunch of inflation on fire and casualty insurance companies has become more painful in recent years; the creep has become a walk. Executives are increasingly concerned with the long succession of years of underwriting loss. Ratemakers are seeking new ways of projecting loss costs further into the future, so as to achieve premium levels which will be adequate to pay the losses whose cost will continue to escalate.

At the same time, rate filers are encountering stiff opposition to rate increases, especially those based on projections of past losses into the future. In too many cases the attitude of the regulators is that the companies cannot economically justify the increases.

Mr. Masterson's paper, in this light, is most timely and helpful. Here is a series of indexes related directly to our lines of insurance, but derived from outside impartial statistics published almost entirely by the government. If we are asked to justify a rate change for a line, we can support it not only with our own statistics (company or industry) but also with a supplemental exhibit of indexes dealing directly with the goods and services that the insurance companies must buy in order to settle claims.

The paper describes what indexes were selected. These include:

(a) Consumer Price Indexes for physicians' fees, hospital charges, home repairs, auto repairs, apparel, recreation goods, and commodities less foods;

(b) Wholesale Prices Indexes for glass, machinery and equipment, metal working machines, and others;

(c) Similar statistical tables.

Each line of insurance was examined separately to determine how a meaningful cost index could be established. For example, the index for fire insurance on dwellings is built partly on the Consumer Price Index — home maintenance and repairs, and partly on Boeckh Construction Cost Index — residences.

Although the various weights used for all indexes are set forth in an appendix, the construction of only one index is fully explained. That is the one for automobile bodily injury for the 1966 year. The author uses three sources: Consumer Price Index for daily hospital charges, the same source for physicians' fees, and the Office of Business Economics index for per capita personal income. He takes the first two and makes them into a medical index, giving a weight of .57 to physicians' fees and .43 to hospital costs. These weights vary with the years, and are derived from statistics published by the Social Security Administration.

The author then computes a measure of the out-of-pocket costs, or "specials," of auto BI claimants, and comes up with 60% medical and 40% loss of wages or income. His final index is composed 15% of his medical index, 15% of the personal income index, and 70% of the index he calls "specials" but which, of course, are for the non-specials, or pain and suffering. It may be seen that some elements are common to the three parts. In fact, a little simple algebra reduces the formula for his auto BI index to 57% of his medical index and 43% of the personal income index.

Similar indexes are built up for fourteen other lines. The 1967 numbers vary from a low of 130.7 for glass to 173.2 for workmen's compensation.

With reference to the auto BI index, it is not clear why those weights were selected. The medical index is reasonable — 57% of physicians' fees and 43% of hospital costs. Then, the specials were found to consist 60% of medical costs and 40% of loss of income, which weights the author does not explain at all. But let us suppose they are reasonable. Then, the final index was made up of 15% for medical, 15% for wages, and 70% for the specials. But if the specials are 60%-40% medical and wages, why should not the first two items be 18% and 12% instead of 15% and 15%?

Incidentally, the author points out that the use of 15-15-70 gives us a factor of 2⅓ of the specials for pain and suffering.

The factor is popularly supposed to range between 2 and 3. The reviewer tested the use of 3, by assigning weights of 12½-12½-75. The final index produced was the same number, 143.8. The reason for no change here is that so many of the base indexes employed trend up in almost the same degree. Using weights of 5-5-90, which means a ratio of 9 to 1 for pain and suffering, moves the index only from 143.8 to 143.9. Using weights of 25-25-50, which means a ratio of only 1 to 1 for pain and suffering, reduces the index from 143.8 to 143.7.

Now, how do these numbers square with the actual loss history of the insurance companies?

The reviewer compared the auto BI index with the average paid auto BI claims of all companies reporting to Insurance Rating Board and Mutual Insurance Rating Bureau. A high degree of correlation was found, over .97. However, the slopes of the regression lines are quite different, being .056 for Mr. Masterson's numbers, and .031 for the actual industry experience. These numbers are for the ten-year period ending 1967. If we shorten the period, the difference becomes even larger. For auto property damage the difference is reversed. Again, the correlation is high, over .98. But the slope of the regression line on the Masterson index is .050, while that for actual industry experience is .060. Pretty close, but the 1967 values are 146.8 and 161.8, respectively, and we would like to see these numbers a lot closer together.

If the Masterson indexes are to be used as prediction tools, more work will have to be done on them so that they more closely resemble the index of actual insurance experience. The next step, it would seem, is for us here to reach some kind of agreement on the composition and base weights in the make-up of these indexes. Also, who is to produce the new numbers as another year rolls by? Perhaps this should be done by a rating bureau.

DISCUSSION BY JOHN F. O'LEARY, JR.*

While agreeing with the thrust of Mr. Masterson's paper, I have several pertinent questions concerning his comments on the claims market place, the apparent motivation for creating this type index, and calculation of the index.[1]

In an attempt to point out the peculiarities of costs in the insurance industry, the author notes: "Our costs are not determined by supply and demand in dealing with suppliers in a market place." This seems to me to be a considerable overstatement of the case, especially in that later in the paper he sets out to measure cost factors which clearly are determined by supply and demand forces. In fact, any time a price is determined there certainly are underlying demand and supply forces operating in the market. It may be that what Mr. Masterson means is that the frequency of losses may not be determined by supply and demand; but, the dollar costs associated with a loss are determined, nevertheless, by elements of demand and supply in all the sub-markets that are drawn upon in settling that claim. All the costs involved in settling that claim, labor costs, materials costs, legal services, are prices that have been determined in particular markets by supply and demand. Admittedly, the inter-relationships among the many markets that are tapped to settle a given claim may be extremely complex, but denying that supply-demand forces are operating compounds the confusion rather than clarifies the issue.

Aware that there are different costs associated with different lines of business, the author began with an attempt to isolate cost factors relevant to each particular line of business. The crux of the problem, however, is how to measure the effects of inflation on claims costs and take account of inflationary pressures on forecast losses for ratemaking and reserve purposes. Recognizing that inflation is essentially a price phenomenon, one reaches intuitively for price indexes as variables likely to reflect in summary the changes in the economy wrought by inflationary pressures. One certainly would consider including in a list of variables that affect loss some variables (adequately defined) in the nature of price indexes. What the author ap-

* Mr. O'Leary, who is Research Associate, Operations Research, in the Insurance Company of North America, was a guest reviewer of Mr. Masterson's paper.

[1] Throughout this memorandum reference is made to several indexes. The abbreviations used are: CPI — Consumer Price Index; WPI — Wholesale Price Index; IPI — Implicit Price Index; LPI — Liability-Property Insurance Index; ABILI — Auto Bodily Injury Loss Index.

pears to have done, however, is create an intermediate variable which may or may not serve as a proxy for all the price variables which might be included in an analysis of the impact of inflation on claims costs.

Because the problem (inflation and its effects) is so complicated and difficult to assess, Mr. Masterson has chosen an index number approach. The method, if used properly, has several advantages: it is conceptually and computationally simple, it is a familiar technique, and may provide as accurate a measure as is needed for many purposes. In an operational environment, these advantages may carry considerable weight. Information developed through the index number approach, providing ball-park estimates of the effects of inflation, may be satisfactory for some purposes. Such estimates, however, may not be sufficiently refined for internal management purposes. Bearing in mind the complexities of the situation we may be required to attack the problem with more complex, less familiar, techniques to derive information more suitable for the management decision process.

Regarding the calculation of the index, questions arise about the following areas:

a. The weighting system
   (1) the choice of weights
   (2) derivation of weights
   (3) actual vs intended weights
b. Use of the CPI
c. Level of aggregation
d. Value as a forecasting tool
   (1) Reliability
   (2) Degree of relationship.

A brief discussion of these problem areas will indicate the reasons why I believe the author's approach may fall short of our expectations in view of the nature of our problem.

a. Weights

The choice of weights for the Auto Bodily Injury index (ABILI) are discussed at length in the paper. Selection of weights always involves a certain element of arbitrary choice as does the choice of a base year for the index. Generally, it is necessary to provide some rationalization for the selection and an explanation of why the choice is made.

The development of ABILI is based on three basic indexes[2] which are weighted systematically leading to his statement:

> "The ABI loss index is the combination of the above three components in these proportions for 1966: .15 for medical, .15 for personal income, and .70 for 'specials.' This is equivalent to basing the ABI loss index on the medical and average income indexes plus 2⅓ times the 'specials' for pain and suffering, extra, etc. The calculated ABI loss index thus determined is 143.8 (excluding loss adjustment)."

Reference to the Appendix will show that the author is not in fact getting the weights he desires. Instead, the medical and average incomes are not weighted equally and the ABILI, because it consists of the same variables as his medical and specials, is equivalent to changing the weights of medical fees several times and income at least twice. As a result, the actual weights operating on the three basic indexes are:

.325 on physicians fees
.245 on hospital charges
.430 on personal income.

It is not clear at all that this is what was intended.

A more serious criticism of the LPI revolves around the choice of weights selected. Two points should be considered: (1) are the weights optimum weights? (2) are they consistent weights, that is, does the weighting scheme do what we think it is doing?

There is no indication that these weights are optimum weights in the sense that he wants to use the ABILI to forecast losses. There is no test of the performance of his index compared with a relationship between ABI losses and the basic indexes treated separately in an estimating procedure.

The foregoing notwithstanding, Mr. Masterson presents a time series of the ABILI for the years 1935-1967 calculated not on the basis of a consistent set of weights for physicians' fees and hospital charges, but with the relative weights changing periodically. As a result it is extremely difficult to determine exactly what the ABILI means. Trying to find some analogy in the field of price indexes, we might say he has produced not a price index but a value index, if he is changing weights each year or at intervals. It is easier to say what it is not — it is not an index that consistently reflects the

[2] These indexes are: (a) CPI hospital daily charges (HC); (b) CPI physicians' fees (PF); and (c) OBE per capita personal income (PI).

changes in auto bodily injury losses over an extended period of time. Each time he changed the weights, he changed the index basis; so the series lacks consistency.

b. Use of the CPI Components

Using components of the CPI relevant to particular lines of business may be a step in the right direction, but some attention should be given to the structure of lags between inflationary pressures and the price indexes. There is no indication that the author took into account the fact that the CPI tends to be a poor indicator of developing inflationary pressures because it tends to lag behind the general trend of inflation after it has become an accomplished fact. For forecasting purposes, we would have to have some indication of the time period involved in this lag, especially for ratemaking purposes. The WPI is, perhaps, a better indicator of incipient inflation:

> "The WPI does not provide a satisfactory measure of the general level of prices. . . . The WPI is mainly useful in connection with the timing of inflation. . . . The WPI reflects the price movements at earlier stages of the production-distribution process and hence often is a good indicator of future trends of finished goods prices at the retail level . . . . The WPI tends to be more directly responsive to economic pressures than either the IPI or CPI. The raw materials component usually is more responsive than the entire WPI and hence is especially valuable as an indication of developing trends.
>
> "The National Bureau of Economic Research has classified the price index of basic commodities as a leading index, that is, one which tends to change direction before turning points in the business cycle; the index of wholesale prices of manufactured goods is classified as a coincident type series, one that moves in the same direction as the economic cycles with similar timing of turning points. On the other hand, consumer price indexes in general have conformed poorly to business cycles."[3]

The point of our discussion is that it may not be enough to take current values of prices indexes, especially the CPI. Rather some attention must be given to the lags involved between the onslaught of inflation and the time

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[3] M. R. Gainsbrugh and Jules Bachman, *Inflation and the Price Indexes,* Studies in Business Economics, No. 94, New York: National Industrial Conference Board, Inc., 1966, p. 70.

when it is reflected in the CPI in an estimating equation and improve our forecasts.

If an index is to be used in a forecast of losses, it is going to be necessary to forecast future values of the index. The author has provided no indication that his index can be forecast any more reliably than the components of the CPI or WPI which he is aggregating into his index. It would seem some of these problems would be removed if he had attempted to measure the degree of relationship between actual losses and various index numbers standing as proxies for price pressures in the economy.

c. The Level of Aggregation

Although this point may be beyond the scope of the paper, and is not meant as a criticism of it, some thought should be given to the level of aggregation for which Mr. Masterson's index has been created. It appears his indexes apply to national data based on national average price indexes. For our purposes this may not be desirable. There may be reason to consider the possibility of regional or state differentials in the rates at which inflation affects our losses. The impact of inflation is not evenly distributed throughout the country, nor are the levels of costs the same throughout the country. Because of this phenomenon, it may be necessary for us to consider the possibility of a regional breakdown of losses, in addition to a line of business breakdown.

d. Value as a Forecasting Tool

The main difficulty with the work done is that there is no indication of the extent to which the author's indexes are reliable forecasters of losses. They may, although there is no evidence present, adequately reflect the changes in some of the basic costs associated with losses. But, Mr. Masterson has not extended his analysis to the point of trying to establish the relationship between actual losses and his indicators. There is, at this stage, no way of judging whether his method or approach has more merit than an alternate approach which might take separately the component indexes he uses to derive his formulation. I believe it is this shortcoming of the analysis which is the source of the vague feeling of dissatisfaction culminated in asking the questions — "What is it Mr. Masterson has done?" or "How do we use his indexes?"

It may be that Mr. Masterson recognizes this weakness and would pursue the matter further with the same diligence demonstrated by him in his paper. The summary judgment is, however, that he has stopped short of the problem, given that the problem is to forecast losses.

We are still left with the problem of trying to determine whether it will be easier to forecast future values for his index compared with the several components of the price indexes he uses. Beyond that lies the main question of whether a strong measurable relationship exists between his index and losses; are the variables he selected the most desirable for forecasting losses?

APPENDIX

This appendix refers to the calculation of the Auto Bodily Injury Loss index (ABILI), excluding loss adjustment expenses, performed by Mr. Masterson. As indicated in his paper, three basic indexes are used: (a) CPI hospital daily charges (*HC*); (b) CPI physicians' fees (*PF*); and OBE per capita personal income (*PI*). As shown below in Steps 1 through 3, he creates first a medical index (*MI*) by weighting *PF* and *HC*. Next, he developes an index for "specials" (*S*) which consists of *MI* and *PI*. The last stage (3) is the ABILI consisting of the *MI, S,* and *PI* components. By the time he gets to the ABILI he has changed considerably the weights applying to each of the basic components, raising questions about whether this is what he intended. The actual (equivalent) weights applying to those components appear in (4) below.

(1) $MI = .57\,(PF) + .43\;(HC)$

(2) $S\;\; = .60\,(MI) + .40\;(PI)$

(3) $\text{ABILI} = .15\,(MI) + .15\,(PI) + .70\,(S)$

Multiplying and collecting terms

(4) $\text{ABILI} = .3249\,(PF) + .2451\,(HC) + .43\,(PI)$

DISCUSSION BY JEFFREY T. LANGE

The standard ratemaking techniques for most lines of insurance incorporate some recognition of the increasing cost of settling claims. It is generally recognized that the current cost level has changed and that the future cost level will be different from that at the time of occurrence of the claims included in the detailed statistical data underlying the calculation of the rates. For most lines the adjustment to compensate for such change is based upon an analysis of insurance data.

In his paper, N. E. Masterson explains that claim payments are made to reimburse the claimant for the procurement of goods and services purchased outside the insurance system. Claim costs are affected by external economic conditions, particularly price and wage levels. Using various well known economic series, Masterson constructs for each line of insurance a series of indices which measure the pressure economic factors exert on claim costs. These indices are helpful in explaining how insurance costs increase in response to price and wage changes in our economy. In addition, they can be of use in making more sophisticated projections of future claim costs.

In 1957, J. E. Faust (*PCAS* XLIV) presented a paper in which he projected automobile claim costs with a formula which related changes in claim costs to the changes in the consumer price index. His method worked fairly well for his purposes at that time, but more recently automobile insurance claim costs have moved upward at a rate which is significantly different from the consumer price index. The indices presented by Masterson provide a means of refining Faust's work by including an economic series more closely related to insurance claim costs than were those available to Faust.

An econometric model may be defined as an equation (or set of equations) which relates an endogenous variable (an economic series) to one or more other endogenous and/or exogenous variables. These other variables may simply be related economic series or may be exogenous variables which in some sense influence the variable of interest and are external to the model. For example, automobile property damage claim costs are influenced by the wage level paid to repairmen, the cost of parts, and the price level for used cars (as a measure of replacement costs). The values of these latter variables are determined outside the insurance system and are independent of it. In addition, wage levels are determined by contracts spanning several years and price changes are frequently announced in advance. Thus information about these exogenous variables may be available before corresponding claim cost data. Furthermore, since the economic variables are influenced by long term contracts and government policy, they can sometimes be forecast more accurately than can the trends in claim costs, which are the result of the interaction of these economic factors. Hence, more accurate projections of future claim costs might be made by first estimating such independent economic variables and then estimating claim costs from these variables using an econometric model.

Masterson has constructed a series of indices for each insurance line in which appropriate economic indices were weighted to produce an average which represents the economic pressure on claim costs. Historical values of his series and the insurance claim costs can be used to obtain the structural equations of a model into which later values of his series (and values based on projected economic series) could be substituted in order to forecast insurance claim costs. For example, in 1968 insurance data would be available for 1967; however, 1968 wage and price levels would be known. In addition, wage contracts would probably be in effect dictating increases for 1969 and price levels for 1969 could probably be forecasted with some degree of accuracy. In an econometric model, this data about 1968 and 1969 wage and price levels can be used to forecast 1968 and 1969 claim costs. During periods of economic change, the forecasting of claim costs using economic data may be much more accurate than the traditional approach of relying only on past insurance data to forecast costs since the traditional method implicitly assumes a continuation of current rates of wage-price changes. If the rate of wage-price change itself accelerates (as it did in 1965-1966), then traditional approaches will underestimate claim cost trends until the insurance data fully reflects the new level of wage-price increases. Unfortunately, this could be several years after the initial change in the trend. Properly applied, econometric methods can be much more sensitive to such a change in trend rate.

In order to illustrate the possible use of Masterson's series in projecting claim costs, two familiar claim cost series have been selected: automobile bodily injury liability average paid claim costs (limited to $5,000 per claim) and automobile property damage liability average paid claim costs for all companies reporting statistics to the Insurance Rating Board. These series were selected since they are often used to project auto insurance loss costs and appear in auto rate filings in most states. Since these series exclude loss adjustment expense, Masterson's corresponding auto bodily injury and property damage loss indices were used. (The claim cost indices in Masterson's Exhibit I are the weighted average of his loss index and his loss adjustment index for each line.) Twelve years of annual data — the maximum available for the claim cost series — have been used to derive linear equations in which claim costs are first expressed as a function of time, which corresponds to current projection procedures, and then are also expressed as a function of Masterson's indices. (See Tables.)

For bodily injury coverage, the average difference between the observed claim costs and those computed as a function of time is about two percent while the difference between the observed value and that computed as a function of Masterson's loss index is approximately one percent. The respective average differences for property damage were four percent and two percent. Thus, the use of Masterson's indices gives a better fit (in an intuitive sense) than simply fitting a straight line to the data. Using slightly more sophisticated methods, it was observed that higher indices of determination and tighter confidence limits were obtained for the models incorporating the loss indices than for the line.

In order to use Masterson's indices in making a projection it would be necessary to forecast each of the underlying variables. It would be very desirable to refine the indices to a quarterly, rather than an annual basis. Some attention should be given to the form of the structural equations themselves and to the number of data points to be included. Such refinements would contribute to greater accuracy, but are beyond the scope of a discussion of a paper. The preliminary calculations in the Table do indicate that Masterson's work provides a valuable tool in predicting insurance loss costs and that there is room for additional research in this area.

Masterson constructed the indices by the application of percentage weights to selected economic indices. While this standard way of producing index numbers produces logical results in this case, it is also possible to combine the component economic series in other ways. For example, the claim costs might be directly regressed on the component series, thus empirically determining the weights of the indices. The components of Masterson's auto bodily injury loss index are Office of Business Economics' per capita personal income, and Consumer Price Index hospital charges and physicians' fees. When auto bodily injury claim costs are regressed on these component series, the resulting estimated claim costs are closer to the actual costs than were the estimates discussed in previous paragraphs and the implicit weights developed in the regression equation are different from

Masterson's weights in that he gives much greater relative weight to personal income than is given in the regression procedure. However, the significance of the regression analysis was reduced by the limited number of available data points and by the interrelationship of the variables (multicollinearity). In addition neither the regression analysis nor Masterson's indices consider the possibility that price changes may have a delayed effect on claim costs (lagged variables) or that the time series problem (auto correlation) may distort the results.

Inflation has been one of the factors contributing to the generally unsatisfactory casualty underwriting results in recent years. In his paper Mr. Masterson has given the practicing actuary a valuable tool for measuring the impact of inflation and for forecasting insurance loss costs. For the research actuary, he has opened a profitable area of inquiry which includes many challenging problems. His paper is a statistically significant contribution to the *Proceedings*.

Private Passenger Automobile Liability Insurance
Bodily Injury Average Paid Claim Costs
(Limited $5000 per Claim)

Year Ended December 31	Observed Claim Cost	Claim Cost Computed as a Function of: Time	Claim Cost Computed as a Function of: Masterson's Auto B.I. Loss Index
(1)	(2)	(3)	(4)
1956	699	694	707
1957	726	712	722
1958	742	731	732
1959	750	749	747
1960	769	767	760
1961	783	786	774
1962	797	804	792
1963	791	823	808
1964	807	841	826
1965	835	859	851
1966	887	878	886
1967	954	896	936
Index of determination		.88	.97

Column (3): Claim Cost = 675.227 + 18.4266 (Year − 1955)
Column (4): Claim Cost = 385.832 + .347686 (Masterson's Loss Index)

Property Damage Liability Average Paid Claim Costs

		Claim Cost Computed as a Function of	
Year Ended December 31	Observed Claim Cost	Time	Masterson's Auto P.D. Loss Index
(1)	(2)	(3)	(4)
1956	113	109	115
1957	124	117	122
1958	129	124	123
1959	134	132	132
1960	138	139	137
1961	140	147	140
1962	146	155	149
1963	152	162	158
1964	161	170	166
1965	175	177	178
1966	192	185	190
1967	208	193	202
Index of determination		.92	.98

Column (3): Claim Cost = 101.864 + 7.55944 (Year − 1955)

Column (4): Claim Cost = −35.9218 + .161639 (Masterson's Loss Index)

AUTHOR'S REVIEW OF DISCUSSIONS

The author is gratified and encouraged by the comments on his paper. The critical analyses re-emphasize the importance of the subject even though it is apparent that I have made a limited contribution.

As a generalization, the four reviewers point out the need for, and urge, further work beyond the scope of my work to make it more useful and meaningful, particularly in ratemaking, forecasting of losses, and for loss reserve purposes.

It has become apparent to me now — after reading these four written reviews plus about a dozen comments made to me in person or by letter from interested readers outside our Society — that there is a need for other indexes or similar numerical measurements of external economic conditions affecting liability and property insurance loss costs. I look upon my endeavor as accomplishing only two things: (1) an historical recording of external economic indexes and data and (2) the invention of a "business index." I would have to agree with Mr. McClure and with Mr. O'Leary that an index to serve in direct support of present trend factors in rate-making would need to be more precise and technical in nature — with agreement in concert as to external indexes used, weights, testing against actual experience, recognition of state and area differences, as well as the methods of preparation. As Mr. O'Leary says: "If an index is to be used in a forecast of losses, it is going to be necessary to forecast future values of the index."

These four reviews are recommended as important additional reading on the subject because, in addition to being commentaries on my paper, they furnish much new material beyond the scope of my research.

While it would be most desirable for the LPI indexes calculated by the author to have been tested against actual loss experience, there is not available any loss experience data generated solely by economic factors. Average claims cost data available embrace more than just economic factors. As stated in my paper: "This LPI Index does not measure every cause or reason for changes in our claims costs. It is intended to measure trends in those ecnomic factors which operate during the claims settlement procedure." Available claims cost data reflect other factors such as changes in deductibles, changes in acceptance or rejection of small border-line claim notices, medical payments, and low liability limits during inflationary periods, and the lack of uniformity in recording small and no-payment claims notices. Also, in a study by the author of medical care and car repair costs, he observed a sharper rise during inflation years when these costs are insurance claims than when they are not insurance "accidents." Influences other than "economic" are affecting average claims costs. Greater efficiency in claims handling and tighter settlements could offset some increase in economic factors.

Mr. O'Leary points out an inconsistency in my comments on "supply and demand" in the market-place. A more accurate statement should have been made: "Our *insurance prices* are not determined by supply and demand in dealing with suppliers in a commercial-type market-place."

Three reviewers question the weighting method employed to measure the factor of "pain and suffering." The rough rule that pain and suffering be appraised at 2 to 3 times specials, when subjected to my index arithmetic, gives an unrealistic weighting. Since the same questionable method was used in the 1957-59 base years the final index would not be changed too much by a more feasible weighting system. The author will clarify this in future index calculation and revision.

"What is it Mr. Masterson has done?" or "How do we use his indexes?" My answers to these questions posed by Mr. O'Leary are in these comments: These are business indexes and should be used in the same way we use other national business indexes or economic measurements such as the Consumer or Wholesale Price Indexes, the several stock market indexes and averages, Gross National Product and other national growth figures.

There are several reasons for relating our insurance costs to external economic factors. Inflation has a direct impact on our financial results; we are a service business in the United States, which is now the first nation in history in which more than half of the employed population is not involved in the production of food, clothing, houses, automobiles, or other tangible goods. Our premium prices reflect the spiraling increases in the skilled professions of medicine and law as well as in other executive and skilled white collar employment.

At the recent meetings of our Society our guest speakers have stressed directly the importance of the study of economic factors to supplement our internal data. At the luncheon address at our 1967 annual meeting Travelers President Sterling T. Tooker observed that the casualty-property actuary "*reacts,* often ignoring the *trends* being indicated by historical evidence, and ignoring, equally, what is going on around him *right now*" (*PCAS,* LIV, p. 230). At the 1968 spring meeting New York Insurance Commissioner Richard E. Stewart referred to general inflation, degree of future inflation, inside and outside factors, and changing external factors. At the same meeting Dr. Irving H. Plotkin on the panel discussion of "Investment Income in Insurance Rates" stated: "Even the Supreme Court can't long ignore economic factors."

Where do I go from here? I plan to continue research on the index constructions in the direction of making more use of government data published monthly and quarterly in lieu of my present use of certain data which, while official, is now available on an annual basis only. I should like to be able to come up with comparable interim indexes — at least quarterly.

Mr. Smith suggests that "The industry would be best served if the NAIC would establish a subcommittee to oversee the development of such indexes, and the dissemination of the results to the public." The NAIC staff has already made some use of the author's paper and indexes. The establishment of an economics staff member in the NAIC office would make him a desirable control person for the development of data, updating of indexes, and the dissemination of the results at frequent intervals to the state regulatory authorities and the public.

Any member interested in research to develop a technical index or other measurement of economic data for direct use in ratemaking will have available in this paper a launching pad for expanding the scope of the subject of economics in our business.

TOTAL EARNINGS FROM INSURANCE OPERATIONS — THE INVESTOR'S VIEWPOINT

RUSSELL P. GODDARD

Although investments normally contribute the major portion of the total earnings of a fire and casualty insurance company, in our *Proceedings* there have been only two papers on investments submitted by members, the first by B. D. Flynn[1] in 1927 and the second by R. A. Bailey[2] forty years later. Each of these papers dealt with that part of investment earnings which is derived from premiums; in other words these papers looked at investment earnings from the buyer's viewpoint. A guest paper in 1965 by S. Davidson Herron, Jr.[3] discussed investments from the viewpoint of the investment officer of an insurance company.

This paper breaks new ground, therefore, to the extent that it is the first one in the *Proceedings* to discuss the entire earnings of an insurance company and the interrelationship of the various sources of income, but it should not be considered in any sense original. It represents, rather, a synthesis of ideas which have been extant for a number of years, but which, to our knowledge, have never been assembled in quite the same way before. In particular, we shall draw heavily from the 1947 study made by Roy C. McCullough[4] when he was connected with the New York Insurance Department. Here again, Mr. McCullough's study was directed primarily at investment earnings derived from premiums, but an important contribution of his work was the implied formula which he developed showing the relationship of underwriting and investment results to the total earnings.

The three principal sources of income of a fire and casualty company, as they appear in the annual statement, are:

1. Interest, dividends, and rents earned, less all investment expenses.
2. Profit or loss on sale, plus gain or loss from change in difference between book and market values.

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[1] B. D. Flynn, "Interest Earnings as a Factor in Casualty Insurance Rate Making," *PCAS* Vol. XIV, p. 285.

[2] R. A. Bailey, "Underwriting Profit from Investments," *PCAS* Vol. LIV, p. 1.

[3] S. Davidson Herron, Jr., "Insurance Company Investments," *PCAS* Vol. LII, p, 238.

[4] Roy C. McCullough, "Report of Special Sub-Committee on Underwriting Profit," *Proceedings of the N.A.I.C.*, Seventy-Ninth Session 1948, pp. 74–157.

3. Underwriting gain or loss, i.e., difference between earned premiums and sum of incurred losses and incurred expenses.

The rate of return on the investment in a company is usually expressed as:

$$\frac{\text{Total gain from investments and underwriting}}{\text{Capital and surplus}} \tag{1}$$

This ratio somewhat overstates the rate of return because the amount actually contributed by investors is always somewhat greater than the nominal capital and surplus shown in the balance sheet, except when the company is brand new. As soon as the first policies are written, the surplus is reduced by the initial operating expenses (primarily commissions) which cannot be deducted from premiums since the entire amount of each premium written must initially be set aside as an unearned premium reserve. This amount is usually called the "equity in the unearned premium reserve," but Mr. McCullough preferred the more general term "prepaid expenses," which is probably less likely to be misunderstood. The word "prepaid" is not completely descriptive, since only certain expenses are paid before the policies are written, while others are paid at the time the policies are written. The exact terminology is not important as long as the nature of the transaction is understood. The rate of return can therefore be expressed as:

$$\frac{\text{Total gain from investments and underwriting}}{\text{Sum of capital, surplus, and prepaid expenses}} \tag{2}$$

For a relatively new company, the denominator in the above represents the actual amount invested in the company. For an older company, it represents the amount put in originally plus the accumulated profits left in. In the case of a mutual company, it represents the investment of policyholders in their capacity as owners of the company.

The investments of a fire and casualty company are derived either from the amounts contributed by the stockholders (i.e., capital and surplus) or from premiums which are available for investment while in the possession of the company, and before being paid out as losses, expenses, or dividends. Since the entire amount of premiums is never available for investment at any one time, one device for representing this fact in a formula is to assume that the premiums are invested at a lower rate of interest than capital and surplus. Such a formula might take the following form:

$$\text{Investor's rate} = \frac{Ci + Pj + PU}{C + pe} \tag{3}$$

Where C = Capital and surplus
P = Premiums
pe = Prepaid expenses
i = Full interest rate on capital and surplus
j = Reduced interest rate on premiums
U = Underwriting profit

A formula such as the above could be derived from tables XXI to XXIII prepared by Mr. McCullough, with slight changes in terminology. He used rates of interest from 2.75% to 3.5% for i and from 2.0% to 4.0% for j. He allowed P to range from 40% to 65% of $(C + pe)$, based on actual company operations through 1945, but indicated that this ratio could go much higher.

The use of a lower interest rate as applicable to premiums is an unsatisfactory device because it does not represent the true nature of the transaction, which is that the entire amount of premiums for a given line of insurance is not available for investment at any one time, although, once invested, it may remain invested for longer than one year.

The phrase in most common use to designate the relationship between one year's premium and the total time it is available for investment is Equivalent Period. This may be represented in a formula by the symbol Q (rather than EP, which might look like Earned Premiums) and may be so defined that $Qi = j$. This enables us to rewrite formula (3) in a more flexible form as

$$\text{Investor's rate} = \frac{Ci + PQi + PU}{C + pe} \tag{4}$$

Where: Q = Equivalent Period

and other symbols are as in formula (3)

A variation of the above formula might substitute i' for the second i, if it is assumed that capital and surplus may be invested more speculatively than the assets derived from premiums. Such a substitution may be necessary, in order to handle the sometimes troublesome item of capital gains.

With a formula similar to (4) established, it is possible to discuss the various items individually.

The investment possibilities for a fire and casualty company are essentially the same as those for a mutual fund, and somewhat greater than those for a life insurance company. The Institute of Life Insurance annually publishes what it calls the "Interest Rate" earned by life insurance companies. No comparable single figure is regularly available for fire and casualty companies, although the result may be approximated from the data in Best's Aggregates and Averages. In spite of the differences in accounting methods, and in the range of investment possibilities, the results for the two types of companies are set forth below to satisfy a natural curiosity as to their relative success in the investment market.

Calendar Year	Life Companies (a)	Stock Fire and Casualty Companies (b)
1956	3.63%	3.8%
1957	3.75	− 1.1
1958	3.85	12.1
1959	3.96	5.5
1960	4.11	3.4
1961	4.22	11.6
1962	4.34	− 1.1
1963	4.45	8.5
1964	4.53	7.1
1965	4.61	5.5
1966	4.73	− 2.1
Average	4.20%	4.8%

(a) Ratio of net investment gain to mean invested assets (including cash) less half the investment gain. The average for the 11 year period is the arithmetic average of the Individual years.

Source — Institute of Life Insurance

(b) Ratio of net investment gain to 85% of total assets.

Source — Basic data from Best's Aggregate and Averages.

For the ten year period ending in 1966, fire and casualty companies earned 4.9% on their invested assets, and for the ten years ending with 1965, the rate was 5.7%.

Fire and casualty companies normally receive a greater return on their investments than life companies, in spite of the occasional losses, which are part of the risk which anybody takes by investing in common stocks. It is interesting to compare the distribution of assets for the two types of companies.

	Life Companies (a)	Fire and Casualty Cos. (b)
Total bonds	43.1%	46.0%
Total stocks	5.2	38.0
Mortgages	38.7	0.2
Real estate	2.9	1.4
Policy loans and premium notes	5.5	0
Uncollected premiums	*	7.5
Cash	0.9	3.1
All other	3.7	3.8
Grand Total	100.0%	100.0%

(a) Best's Life Insurance Reports, as of Dec. 31, 1966

(b) Best's Aggregates and Averages as of Dec. 31, 1966
* Not listed separately

Although fire and casualty companies earn more on their investments than life companies, the latter make a more detailed analysis of their return by type of investment. For a typical well-established company, the following rates of earnings are shown:

Bonds		4.30%
Stocks		3.57
Mortgages —	Gross	5.55
	Net	5.22
Real Estate —	Gross	14.27
	Net	5.48

The relatively high yield on mortgages, and their popularity with life insurance companies, leads to a natural question as to the reluctance of fire and casualty companies to invest in them. Only one group of 28 accident and health companies was found with more than 5% of their total assets in mortgages.

In any event, it appears that the average return from investments which may be expected by fire and casualty companies is approximately 5.0%. This includes capital gains, since it is evident that the heavy investment by these companies in common stocks has been made in anticipation of capital gains. Even if this were not true, it would still be necesssary to include capital gains in this calculation, since we are here concerned with the total return to the insurance investor.

Equivalent Period.

The "equivalent period" for the purposes of this study may be defined as the proportion of premium available for investment times the period it remains invested. Although he did not use the term, Mr. Flynn gave a simple illustration of the meaning of equivalent period in his calculation of the interest earned on the premium for automobile collision insurance by assuming that the premium would be fully paid, less commissions, two months after inception of the policy, and that losses and other expenses, actually paid throughout the life of the policy, could be assumed to be paid in one lump sum six months after inception. Since Mr. Flynn arrived at interest earnings for this line of insurance of 1.0% based on an interest rate of 3.5%, it is assumed that the complete details of the calculation would be:

Proportion Available For Investment	Period (Fraction of Year)	Interest Rate	Interest Earned on Total Premium
.85	.333	3.5%	1.0%

In this case, the equivalent period would be the product of the first two items, or .28.

For other lines, such as workmen's compensation or automobile liability, where the payment of claims and claim expenses may extend over a period of many years, the principles are the same, but the actual calculations are much more tedious.

For a typical company the proportions of the total losses and loss expenses paid in each year after policy inception are shown below for these two lines:

	Workmen's Compensation		Auto Liability	
Year	Per Cent Paid in Year	Period Held	Per Cent Paid in Year	Period Held
1	41.1	0.5	28.7	0.5
2	22.9	1.5	22.8	1.5
3	14.9	2.5	18.2	2.5
4	6.4	3.5	11.2	3.5
5	3.6	4.5	6.9	4.5
6	2.4	5.5	5.0	5.5
7	1.5	6.5	3.2	6.5
8	1.5	7.5	2.5	7.5
9	1.4	8.5	1.4	8.5
10	1.3	9.5	0.1	9.5
11	1.2	10.5		
12	1.0	11.5		
13	0.8	12.5		
Total	100.0	(2.25)	100.0	(2.44)

This distribution of payments applies only to losses and loss expenses which, for this company, amount to roughly 72% of the premium. The remaining 28% of the premium will be paid out in expenses during a period of 13 or 14 months after policy inception and may be assumed to be available for investment for approximately half a year. The composite product ($.28 \times 0.5 + .72 \times 2.25$) gives an equivalent period for workmen's compensation of 1.75 years and a similar calculation produces an equivalent period for automobile liability of 1.90 years.

These calculations assume that all premium is paid in full at the inception of the policy. This assumption does not apply universally to workmen's compensation where the larger policies are subject to periodic audit, and the additional load incorporated in the deposit premiums may or may not offset the underestimates of advance premiums or the delays in audits.

It should be stressed that the estimates of equivalent periods given here are supplied only as evidence of technique and not as models or countrywide averages. For workmen's compensation particularly, the equivalent period will obviously vary from state to state, depending on the proportion of long-term cases, and from company to company, depending, among other things, on the proportion of business subject to periodic audit. Some companies estimate the equivalent period for their workmen's compensation portfolio at approximately two years.

The method outlined above of determining equivalent period has the advantage of being unaffected by changes in premium volume. The average equivalent period for all lines of business written by a company can also be approximated from the annual statement, by deducting capital and surplus from total invested assets, and dividing the remainder by earned premiums. The figure so obtained is almost meaningless in itself, being a conglomerate average of all lines, and not recognizing that investments derived from premiums have been built up over a period of years when the premium was probably lower than it now is. It is a useful device, however, in that it enables us to avoid the fiction that investments derived from premiums must necessarily earn a different rate of interest from other assets.

In the eleven year period 1956–1966 the average equivalent period for all stock fire and casualty companies listed in Best's Aggregates and Averages has ranged from .94 years to .99 years, as shown in Exhibit II. The consistency of this average during a period of rapid growth is surprising. In the more stable period 1936–1945 the values ranged from .67 to .98 with an average of .83, as shown in Tables VIII, X, and II of Mr. McCullough's study, which covered all lines written by fire insurance companies entered in New York, exclusive of U.S. Branches. During that period the invested assets other than capital and surplus increased fairly steadly from year to year, but the growth in earned premiums was far from consistent.

Prepaid Expenses.

As previously explained, the inclusion of prepaid expenses with capital and surplus as the base to which gross earnings should be related is in recognition of the fact that the nominal capital and surplus does not represent the full investment of stockholders. How much this excess investment actually is must be a matter of approximation, and we have followed the lead of Mr. McCullough in applying the ratio of commissions and taxes to unearned premiums to obtain a reasonably satisfactory answer. During the period under review, commissions and taxes dropped from 23.6% to 21.1% while other expenses decreased from 13.1% to 10.8%.

Gain from Operations: 1957–1966

During the ten-year period ending with 1966, investors in stock fire and casualty companies earned an average return of 7.7%. This return can be analyzed in accordance with formula (4) as:

Numerator	C	=	107,330,624
(000 omitted)	P	=	110,798,181
	i	=	.049
	Q	=	.99
	U	=	−.010
Combined			9,447,673
Denominator	C	=	107,330,624
(000 omitted)	pe	=	14,925,000
			122,255,624

The result may also be written as follows:

$$\frac{\overset{Ci}{5{,}246{,}284} + \overset{PQi}{5{,}374{,}820} - \overset{PU}{1{,}173{,}431}}{\underset{C + pe}{122{,}255{,}624}} = 7.7\%$$

This particular decade was an unfavorable one from an investment viewpoint, since it includes three of the four years since 1945 when the decrease in market values was great enough to offset interest earnings and produce a net loss from investments. For the ten year period ending with 1965, which included only two years with a net investment loss, the total earnings ratio was 8.9%.

In order to provide a historical background, the raw data from Mr. McCullough's report for the years 1936–1945 were extracted and placed on a basis comparable to that used here. Mr. McCullough made a different use of the data, since he did not include capital gains as part of investment income, and modified the stautory underwriting profit.

Total Gain from Operations (000 Omitted)

	1936–45* All Lines	1936–45* Fire Only	1956–65** All Lines	1957–66** All Lines
Total investment income	$ 1,109,102	$ 668,373	$ 11,753,504	$ 10,621,105
Statutory underwriting profit	109,012	120,780	−1,411,699	−1,173,431
Total gain from operations	$ 1,218,114	$ 789,153	$ 10,341,805	$ 9,447,673
C&S plus prepaid expense	$15,272,940	$8,745,054	$116,692,675	$122,255,624
Ratio %	8.0%	9.0%	8.9%	7.7%
Earned premiums	7,729,941	4,187,188	103,971,456	110,798,181
Underwriting profit ratio	1.4%	2.8%	−1.4%	−1.0%

*All fire insurance companies licensed in New York, exclusive of U.S. Branches. Data from McCullough report.

**Best's Aggregates and Averages.

In the years 1936–1945, the fire insurance companies restricted their writings to about half of their policyholders' surplus, and therefore had less money to invest. Even with favorable underwriting results, their total gain from operations was no greater than that made by all companies, fire and casualty, twenty years later. It was after 1945 that premiums started their upward climb and in the process the traditional two-for-one relation between surplus and premium has been forgotten. The industry as a whole has now reached a one-for-one point, with many individual companies allowing their writings to reach two or three times their policyholders' surplus. The mutual companies as a group now have an annual premium volume almost exactly twice their policyholders' surplus.

The present situation was anticipated, if not actually predicted, by Mr. McCullough in 1947 when he said (page 114), "Should the time come in the fire insurance business when a dollar of capital might be expected to generate a dollar of earned premium (that is, the ratio of annual earned premiums to risk capital should be 1/1) and should interest rates rise to 3.5%, it would be sufficient if the profit allowance in the rate structure were 1.75% to return 8% on capital." (For those who wish to check the arithmetic, it seems evident that a ratio of 2.75% was assumed on invested premiums, since $3.5 + 2.75 + 1.75 = 8.00$.)

Twenty years later, Mr. Mayerson, in his review of Mr. Bailey's paper,[5] mentioned the possibility that premiums might be two or three times the capital and surplus, in which case the profit from premiums alone (i.e., excluding earnings on the stockholder equity itself) would be either 14% or 21% of the stockholder equity. These returns were predicated on an underwriting profit of 5%, embodied in the rates and actually earned, and 2% on invested premiums. While the total returns of 14% or 21% seem entirely within the realm of reason, it seems more realistic to assume that the earnings ratios would be reversed, and that there would be as much as 5% interest earned on invested premiums, with a maximum of 2% of statutory underwriting profit, regardless of how much was incorporated in the rates.

It is doubtful if any group of insurance commissioners could force the insurance companies as a whole to earn the full profit allowance included in the rates, especially in view of the possibility of lower federal income taxes on investment income, as explained in Mr. Herron's paper. Any effort to maximize the net return to investors would have to take into account the varying impact of federal income taxes.

Measurements of Financial Health.

The fire and casualty industry, with total premium income of $22 billion from all types of carriers, is about 10% larger than the life insurance business in point of premium volume. Through the medium of automobile and homeowners policies, it probably reaches a larger number of people than life insurance, which derives a certain proportion of its premium from large policyholders who buy life insurance as an investment. It accounts for 3.0% of the gross national product, up from a low of 1.5% in 1945. With these indicators in the background, it must be confusing to investors to read

[5] Allen L. Mayerson, discussion of Bailey, *op. cit., PCAS* Vol. LIV, p. 20.

that the industry as a whole is a "distressed area in the American economic scene," or that it is "underearning."

The plight of the insurance investor was neatly phrased by Mr. Herron when he said, "For the insurance security analyst, there are often two separate companies under one corporate roof — the insurance company and the investment company. (The stockholder cannot enjoy this sophistication. For him there is only one.)" Investors need some means of distinguishing between reputable companies with different philosophies of management. Company A, for example, earns 4% on its investments and 2% on its underwriting, and confines its premium volume to one-half of its policyholders' surplus. Company B, on the other hand, earns 5% on its investments and loses 1% from underwriting, but has a premium volume twice as large as its surplus. Assuming an equivalent period of one year in each case, and disregarding the effect of prepaid expenses, Company A would be earning 7% for its investors and Company B 13% as measured by formula (4). Under another method of analysis, that of relating total earnings from underwriting and investments to total investable funds, Company A would earn 4.6% and Company B 4.3%.* Which method do actuaries prefer?

In conclusion, it is confidently expected that the trend toward more open competition in pricing will encourage actuaries to delve further into this fascinating subject. As Mr. Flynn said 40 years ago, "Throughout the discussions there has been a considerable amount of vagueness and confusion." When the time comes to translate the present vague knowledge into concrete figures which will create the maximum profit from the total operations of a company, the actuaries will have a field day.

* Company A: .07/(1 + .5); Company B: .13/(1 + 2).

STOCK FIRE AND CASUALTY COMPANIES
DATA FROM
BEST'S AGGREGATES AND AVERAGES
BASED ON ALL ANNUAL STATEMENTS AVAILABLE
(000 omitted)

Exhibit I

Calendar Year	No. of Companies	Premiums Earned	Interest Dividends and Rents	Profit From Sales and Appreciation	Total Investment Gain (3) + (4)	Statutory Underwriting Profit	Gain From Operations (5) + (6)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1957	752	8,336,278	460,999	-627,341	-166,342	-361,289	-527,631
1958	733	8,840,975	488,897	1,585,265	2,074,163	- 92,731	1,981,432
1959	748	9,527,075	534,478	486,167	1,020,646	+ 70,865	1,091,511
1960	767	10,266,166	592,392	63,019	655,412	+ 65,614	721,026
1961	791	10,709,883	620,612	1,895,093	2,515,706	+ 29,773	2,545,479
1962	809	11,277,728	673,401	-903,834	-230,432	+ 2,500	-227,932
1963	808	11,595,124	720,635	1,296,497	2,017,133	-218,657	1,798,476
1964	804	12,355,846	782,167	1,038,791	1,820,959	-347,516	1,473,443
1965	805	13,306,931	852,040	614,317	1,466,357	-424,506	1,041,851
1966	792	14,582,172	895,859	-1,448,358	-552,499	+102,517	-449,982
1957-66		110,798,181	6,621,484	3,999,620	10,621,105	-1,173,431	9,447,673

Calendar Year	Policyholders' Surplus	Estimated Prepaid Expenses	Capital and Surplus Plus Prepaid Expenses	Mean of Column (10)	Gain from Operations Ratio to Capital * (7) ÷ (11)
	(8)	(9)	(10)	(11)	(12)
1956	7,800,262	1,279,000	9,079,262		
1957	7,073,013	1,340,000	8,413,013	8,746,138	-6.0%
1958	8,619,370	1,377,000	9,996,370	9,204,692	21.5%
1959	9,381,140	1,459,000	10,840,140	10,418,255	10.5%
1960	9,494,889	1,499,000	10,993,889	10,917,015	6.6%
1961	11,719,406	1,496,000	13,215,406	12,104,648	21.0%
1962	11,146,292	1,467,000	12,613,292	12,914,349	-1.8%
1963	12,642,213	1,510,000	14,152,213	13,382,753	13.4%
1964	13,690,544	1,560,000	15,250,544	14,701,379	10.0%
1965	13,659,762	1,696,000	15,355,762	15,303,153	6.8%
1966	12,006,722	1,764,000	13,770,722	14,563,242	-3.1%
1957-66				122,255,624	7.7%

* Mean Capital and Surplus Plus Prepaid Expenses

Exhibit II

INVESTED ASSETS DERIVED FROM PREMIUMS

Stock Fire and Casualty Companies
Data from Best's Aggregates and Averages
(Millions of Dollars)

	85% of Total Assets (a) (1)	Capital and Surplus (2)	Invested Assets Other than Capital and Surplus (3)	Earned Premiums (4)	Ratio (3)÷(4) (5)
1956	$15,139	$ 7,800	$ 7,339	$ 7,755	.95
1957	15,205	7,073	8,132	8,336	.98
1958	17,097	8,619	8,478	8,840	.96
1959	18,530	9,381	9,149	9,527	.96
1960	19,360	9,494	9,866	10,266	.96
1961	21,747	11,719	10,028	10,710	.94
1962	21,912	11,146	10,766	11,277	.95
1963	23,791	12,642	11,149	11,595	.96
1964	25,565	13,690	11,875	12,355	.96
1965	26,604	13,659	12,945	13,306	.97
1966	26,380	12,007	14,373	14,582	.99

(a) 85% of total assets is used as an approximation to total invested assets.

DISCUSSION BY JAMES J. MEENAGHAN

The subject of overall earnings of property-casualty companies and the attendant question of investment income attributable to underwriting operations is one of the most controversial topics in the industry today. For the benefit of those who have not closely studied this issue, it might be well to review some of the past history leading up to the current controversy.

The formal inclusion in rate formulas of an underwriting profit and contingencies margin stated as a specified percentage of property insurance premiums was clearly affirmed by the National Association of Insurance Commissioners in its so-called 1921 Standard Profit Formula, which excluded investment income as a contributor in any way to underwriting profit. This ratemaking philosophy was not seriously challenged until 1947, when Mr. McCullough of the New York Insurance Department denied the 1921 formula definition of underwriting profits and argued that investment income should be considered with underwriting profits or losses in the formula determination of rates. While Mr. McCullough's report did not result in any substantial departures from previous methods of calculating rates, the subject of investment income as it relates to underwriting operations has continued to be a topic of discussion during the past twenty years. Examples of private passenger car liability rate filings in recent years which have precipitated sharp debate on this subject were those in Colorado, Ohio, and Vermont — in which the non-inclusion of investment income in ratemaking was upheld — and in Maryland and more recently New Jersey — in which rate approvals were denied partly because some portion of investment income was not reflected; the latter two cases received perhaps the most widespread publicity.

In the midst of this continuing controversy, only two studies which have presented the subject in an objective fashion come to mind. At the May 1967 meeting of the Casualty Actuarial Society, Mr. Robert Bailey presented, in this reviewer's opinion, an excellent introduction to the question which recognized the fact of life that premiums paid by policyholders do, in fact, produce some portion of the total investment income earned by a company in any given year. Company actuaries are being increasingly called upon by their managements to analyze how much investment income is generated by overall insurance operations and, more specifically, by line of insurance. Mr. Bailey outlined a basic approach for such studies, but avoided the question as to whether or not investment income should be reflected directly in rate formula calculations by state, by line of insurance. In November 1967 Arthur D. Little, Inc. released its study *Prices and Profits in the Property and Liability Insurance Industry.** While not addressing itself to the specific question of whether investment earnings should be reflected directly in price structures, the study concluded, after comparisons with other industries, that "no revision of the pricing mechanism which would reduce industry's profits below their present level can be justified on the grounds that the present level of profits is excessive."

While Mr. Goddard quite frankly admits at the outset that his paper "should not be considered in any sense original," the fact is the subject matter has not been covered extensively in the *Proceedings* previously. Mr. Goddard is to be complimented for having selected a topic which he must have known to have many controversial connotations. The reviewer offers the following comments as respects the author's analysis:

1. Mr. Goddard assumes that the rate of return from the investment of premiums is the same as the rate which has been earned as interest, dividends, and realized or unrealized capital gains from the investment of capital and surplus. In the real world, unearned premium and loss reserve funds are generally held in bonds and cash deposits and it is improper to attribute to these funds a rate of return which reflects the realized and unrealized capital gains on common stocks. Mr. Goddard's "equivalent period" concept purports to give recognition to this fact but directly recognizes only the fact that premium funds may be held for investment purposes for different periods of time than capital and surplus funds.

2. In addition, in his numeric calculations developing an overall 7.7 percent rate of return for the period 1957–1966, Mr. Goddard fails to include the equity in the unearned premium reserve with capital and surplus as being attributable to stockholders and, for this reason, understates the amount of investment income attributable to stockholders' funds and correspondingly overstates the amount of investment return attributable to premium funds.

3. The orthodox approach to determining the percentage of total invested assets which can be attributable to policyholders is to subtract from total invested assets the sum of capital, surplus, and equity in the unearned premium reserve. To the casual reader it might appear that Mr. Goddard's

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* *Editor's Note:* The summary of the full study was released to the general public in January 1968 and the full study was made available in June 1968.

equivalent period concept avoids this subtractive approach and provides a method for directly calculating the investment return on premiums, but such is not the case. A close examination of the equivalent period concept will reveal that Mr. Goddard has, in fact, defined Q (equivalent period) in such a fashion that the investment return from premium funds is in fact arrived at by a subtraction method.

4. It is possible to question whether or not unrealized capital gains should be included in the determination of overal rate of return. From the investor's standpoint, the inclusion may be proper but Mr. Goddard's figures indicating that the annual overall rate of return has varied from -6.0% in 1956 to $+21.0\%$ in 1961 make it clear that any investor's evaluation of the earnings situation will depend in large measure on the period of time he chooses to study. Property-casualty companies have been a risky investment by Mr. Goddard's measurement criteria and, for this reason, basic laws of economics would dictate the need for a fairly substantial rate of return on both investment and underwriting operations.

5. Mr. Goddard gives no recognition to federal income taxes and makes no allowance for the capital gains tax ultimately payable on unrealized capital gains.

In summary, Mr. Goddard leaves unresolved the basic question as to the amount of investment funds developed from premiums while in the possession of property-casualty companies, and, in the reviewer's opinion, has added little to the recent studies of Robert Bailey and the A. D. Little Report. Quite frankly, in resurrecting the 1947 "net worth approach" of Mr. McCullough, Mr. Goddard comes perilously close to becoming enmeshed in the current controversy as to what extent, if any, investment income should be included directly in rate formulas.

The *Proceedings* of the Casualty Actuarial Society are, in the reviewer's opinion, sorely lacking as to possible methodology for company actuaries realistically to measure, by line of insurance or by state, the extent to which investment income is generated by current insurance operations. I would hope, however, that future studies in this area will recognize, as did Mr. Bailey's contribution, that this subject is fraught with implications as respects existing and future price structures.

When one strips away all the verbiage and actuarial concepts involved, it becomes apparent that those currently advocating the inclusion of investment income directly in ratemaking formulas without any offset are, in the final analysis, arguing for a lowering of existing price levels.

The continued underwriting losses of most companies on private passenger automobile insurance, which is the focal point of the current controversy, would seem to make this proposition academic to the objective ratemaker. In addition, the accelerating trend toward California-type rate regulation, in which competition and not a formula calculation is the predominant factor as respects price structure, would seem to push the investment income question even further into the twilight zone of actuarial intramurals. Nevertheless, discussion continues.

A basic economic fact of life that all actuaries must face at the moment is that the ownership of a number of large companies is passing into the hands of individuals who are not accustomed to business losses. Regardless of company ownership, if underwriting losses continue to have an adverse effect on company earnings and if the prospect of lower rate levels as a result of inclusion of investment earnings is threatened, any reasonable person can anticipate further restriction of premium writings in such losing lines as private passenger automobile and Homeowners. Stated another way, current property-casualty insurance company assets can be expected to be increasingly invested in non-insurance ventures, not in the expansion of insurance capacity, unless an overall rate of return commensurate with the risk involved can be achieved.

I would hope that future actuarial studies into the subject of investment income will not be unmindful of this probability.

DISCUSSION BY FRANK HARWAYNE

Mr. Goddard has performed a very useful service in drawing attention to some of the previous writings dealing with earnings of insurance companies. It would have been more complete had he included the well distributed Prices and Profits report of Arthur D. Little, Inc. for the American Insurance Association, which concluded that the total rate of return for insurance companies in recent years has been significantly below those achieved on investments in other sectors of the American economy. It reached this conclusion mainly from an examination of almost the same time period that Mr. Goddard used and cited rates of return ranging from 2.0% to 9.0% of varying measurement criteria. The results most comparable to Mr. Goddard's are an average return of 9.0% for net income including unrealized gains after current taxes, all related to policyholders' surplus. Mr. Goddard's figure for underwriting profit plus investment income including unrealized gains for the years 1956 through 1965 was 8.9 per cent of capital and surplus plus prepaid expense.

Also, Mr. Goddard might have included this reviewer's paper on Insurance, Investment and Profit which appeared in the *Annals* of the CPCU, March, 1967 and in the June, 1966 *Proceedings* of the National Association of Insurance Commissioners.

In his formula (1) Mr. Goddard begins with the usual accounting concept of measuring rate of return on capital and surplus at risk. Next, in formula (2), he includes prepaid expenses as part of the sums at risk in the business, but nowhere does he indicate that prepaid expenses also result in reduced statutory underwriting profit. In other words, if insurers prorated the prepaid expenses over the life of the insurance policy their profit would be greater than shown under the statutory formula. The prepaid expenses which should increase income for the years in question are measured by the change in prepaid expenses between the beginning of the period and the end of the period. As to the amount of prepaid expenses, Mr. Goddard tends to understate this when he identifies only the commissions and taxes as being prepaid. It would make more sense to include at least some part of other acquisition and general expense since underwriting, policy issuance, etc. occur at the beginning of the policy term. Other literature such as the NAIC Subcommittee on Cost and Profit Factory Study of 1952 utilized amounts equal to 27 per cent of unearned premium reserves. It may be that in today's climate of improved expense efficiency the appropriate value may be 2 or 3 percentage points less than 27% but Mr. Goddard's figures do seem to be low.

Some of Mr. Goddard's definitions and their usage could be made clearer. In his formula (3), U should be *rate* of underwriting profit rather than underwriting profit. He does not define P to indicate that his usage is based on earned premiums and not on written premiums. Also there does not appear to be an explanation of the different bases for footnotes (a) and (b) in his Table indicating relative success in the investment market for life companies vs. stock fire and casualty companies; however, his estimate that 85% of total assets of fire and casualty companies are invested, while reasonable, appears to be on the low side. At some places in the text I was not quite sure when he meant interest income solely or when he included capital gains. It was only by verifying his source figures that I realized his figure of 5.0 per cent return is intended to include capital gains.

Yields in the stock market on stocks and bonds during the 1957-1966 period averaged 4.6% on corporate bonds and 3.5% on common stocks. In addition, the averages of stock values increased 83% or approximately 6.2% annually for the 10 year period, which is equal to a combined rate on common stocks equivalent to 9.7%. For the 10 years ended 1965 and 1967, comparable values are 11.6% and 10.9% respectively as shown in the following table:

Table of Ten Year Average Yields and Annual Growth Rates

Ten Years Ended	Yields* Corporate Bonds	Yields* Common Stocks	Average Annual Growth of Common Stock Prices**	Combined Return on Common Stocks (3) + (4)
(1)	(2)	(3)	(4)	(5)
1965	4.4%	3.5%	8.1%	11.6%
1966	4.6	3.5	6.2	9.7
1967	4.8	3.4	7.5	10.9

* Based on data of Moody's Investor's Service published in Statistical Abstract of the U.S.

** Based on data of Standard and Poor's indexes for 500 common stocks published in Statistical Abstract of the U.S.

Of course, for comparison with invested assets in insurance, the combined return on common stocks should be diluted with bond yields; nevertheless, Mr. Goddard's figures still appear to be a bit on the low side. Whether the difference is attributable to computational methods, to the inherent conservatism of the insurance business, or to the possibility that the investment departments of insurance companies have not performed as well as could be expected, or to some other reason, is not known.

Mr. Goddard's method of arriving at a time period equivalent to the period when insurers hold customers' dollars paid to cover loss amounts is analogous to an approach taken by myself in a recent report to the Pennsylvania Insurance Department and other internal reports used in the New York Insurance Department.

This reviewer attempted to apply Mr. Goddard's technique to published insurance figures of New York workmen's compensation and automobile bodily injury liability policy year losses paid according to calendar period. My figures for workmen's compensation produced an equivalent time of 3.24 years compared to Mr. Goddard's of 2.25. For auto liability my figure was 2.82 compared to Mr. Goddard's of 2.44. The composite product (following Mr. Goddard's procedure and using a .30-.70 split of expenses and losses) gives an equivalent period for workmen's compensation of 2.42 years and for auto liability of 2.12 years. All of these values including Mr. Goddard's are quite different from the figure of .99 which he develops in Exhibit II and applies in his formula (4).

A careful review of formula (4) shows it is equivalent to the sum[1] of investment and underwriting related to policyholders surplus (adjusted); it could produce better insight into what Mr. Goddard is attempting if the first term of his numerator (Ci) were identified as the yield on capital utilized in the insurance business while the remaining terms represent the return associated with the premium generated by the insurance business itself. It should also be observed that in accordance with the previous discussion of prepaid expenses and formula (2), formula (4) should be modified in the numerator to include the difference between pe at the end of the period and pe at the beginning of the period and this adds approximately .4% to the total return.

I question whether Mr. Goddard's .99 really is an equivalent time period. It is substantially less than the time period which would be produced from a straight development of the type he outlined in connection with workmen's compensation and auto liability insurance. Part of the reason this is so is that he utilizes the element which he calls invested assets other than capital and surplus. Perhaps a better term would be that portion of liabilities assumed to be invested. I find myself in minor disagreement with his figure of invested assets equal to 85 per cent of total assets and would be more inclined to take this figure at something like 87 to 88 per cent. Moreover, it should be pointed out that liabilities other than liabilities for unearned premium and loss and loss adjustment make up about 10 to 12 per cent of all liabilities. These include liabilities for Federal income tax and other items which are not necessarily related to premiums or to the insurance transaction. Thus, if these elements were taken into account it would be seen that the .99 ratio is too low. The alternative of following through on the direct approach which uses the period when funds are held would appear to be more productive.

In connection with workmen's compensation it is pertinent to observe

[1] If we call invested assets $\overline{A}$ and investment income I, then his $Q=\frac{\overline{A}-C}{P}$ and $i=\frac{I}{\overline{A}}$; formula (4) becomes $\frac{I+PU}{C+pe}=\frac{investment+underwriting}{policyholders' \ surplus \ (adjusted)}$, or his formula (2).

that underwriting and investment cannot be entirely divorced from each other; this is so because investment amounts at assumed interest rates are ultimately carried into claim amounts used for long term cases via the standard definition of incurred loss (paid amounts plus present value of reserves *as of a given reporting date*); this also is of some importance in maintaining accurate loss development procedures in ratemaking.

Mr. Goddard says it is doubtful if any group of insurance commissioners could force the insurance companies as a whole to earn the full profit allowance included in the rates; during my years in this business, such has never seemed to be the problem; perhaps Mr. Goddard means that competition probably would not permit insurance companies to earn the full allowance built into the rates for any protracted period of time. On such levels the total return could become exorbitant and the alternative of investment income taxed at lower rates may be more palatable. Or perhaps Mr. Goddard means that realization of the full allowance, on a *statutory basis,* implies such a large real return that other problems of customer relations and exorbitance might be created.

It is gratifying to live during a time when investment is no longer considered taboo for people concerned with insurance underwriting. For those who might wish to pursue the enigma of investment return, reference is made to this reviewer's communication in the March, 1968 *Annals* of the CPCU pointing out that automobile bodily injury liability premiums can be expected to generate interest income equivalent to 2.96 per cent of such premiums; whether or not one should include some part of the long term appreciation of assets could likewise be weighed. Also, referring to my study of "Insurance, Investment and Profit" in the March, 1967 CPCU *Annals,* the bases on which that study proceeded could be contrasted with Mr. Goddard's in a number of features. Whereas Mr. Goddard used a combined equivalent interest and capital gains rate of .049 my paper used a rate of .035 for each, applied to invested funds. With respect to the underwriting profit values, Mr. Goddard used the actual statutory figure of −.010 whereas my paper utilized a theoretical provision of +.035 for casualty insurance and +.060 for fire insurance. His income figure might have been augmented by the prepaid expense, just as his base also included prepaid expense. His definition of prepaid expense leaves some room for debate; he includes no part of the policy-writing and other general expenses which are paid mostly at the beginning of, rather than during, the policy term. As a result of this omission his prepaid expense averages to 22.1% of unearned premiums; had he used a figure only 15% higher (25.4%) and reflected the change in prepaid expense as part of income, then his 7.7% figure would have increased to 8.0%, and his 8.9% figure for 1956–1965 would also have increased. Mr. Goddard used the actual reported capital and surplus without reflection of stock company interownerships and he also used actual earned premiums. My study utilized a ratio of the two which was intended to reflect both the elimination of the inflated capital and surplus resulting from stock company interownerships and a reasonably efficient use of capital in the insurance business. (This latter has become recognized as a vexing problem to the insurance industry in that there are a number of deliberate movements currently in process which would divest the "surplus" surplus from the insurance business through the creation of holding companies.) In addition, my study utilized written premiums, which represents a 2 to 5 per cent difference from the lower earned premiums used by Mr. Goddard.

It is interesting to note the effect of stock company subsidiaries and interownerships and the achievements of some traditional companies. In general, the elimination of inter-company ownerships to consolidate the investment results of groups of insurers will not dramatically affect those results, since the reduction in total return caused by eliminating duplicated earnings of parent and subsidiary companies is generally more than offset by a corresponding reduction in the total policyholders' surplus of the group. The relationship of underwriting results to policyholders' surplus, however, will be greatly affected by consolidation, since total underwriting profit or loss remains unchanged by consolidation, while consolidation decreases policyholders' surplus and therefore increases the ratio of profit or loss to that surplus. For example, the Hartford Fire Insurance Group, on an unconsolidated basis, had total earnings for the year 1965 of 9.4 per cent; on a consolidated basis it was 9.1%, which reflects the underwriting loss sustained by the group in 1965. For comparative purposes, the Hartford Fire Insurance Company for the ten years ended December 31, 1966 had average annual total earnings of 8.7%.[2]

An approximate way of recognizing the inflated effect of insurance company subsidiaries and interownerships would be to reduce surplus totals in Best's figures by the market value of insurance company stocks

[2] Investment gains of $482,070,000, underwriting losses of $45,052,000, and change in prepaid expenses of $12,632,000 (25% of the change in unearned premium reserve) related to mean surplus of $4,785,111,000 and prepaid expenses of $404,-320,000 (25% of the unearned premium reserve).

held as assets; when this is done,[3] Mr. Goddard's formula (4) average annual earnings becomes $\frac{\$5{,}246{,}284 + \$5{,}374{,}820 - \$1{,}173{,}431}{122{,}255{,}624 - 22{,}292{,}198}$ or 9.5% for the ten years ended December 31, 1966. With credit for prepaid expense included, the actual figure would be 9.8% or almost 10%.

If each of the elements in my own paper were to be modified to reflect Mr. Goddard's values then my theoretical fire insurance results would have been quite close to his, namely 7.5 per cent compared with his 7.7 per cent. Conversely, if his figures were adjusted to reflect the theoretical rates of return in my paper the total return on Mr. Goddard's formula (adjusted) would have been 18.3 per cent before taxes in comparison with my values of 19.6 per cent of stockholders' funds before taxes (16.4 per cent of stockholders' funds after taxes) for fire insurance. The differences result from elements such as his invested assets figure at 85% of assets compared to my 90%, his premium to stockholders' equity working out to a ratio of .906 compared to my .92, and his relationship of assets to premium working out to 2.236 compared to my 2.439.

In summary, Mr. Goddard's paper is one actual illustration of the mathematical model described in the June 1966 *Proceedings* of the NAIC. It is an excellent recommencement of Casualty Actuarial Society interest in the interaction of inflation, underwriting, and investment in the insurance business. We should have many more objective analyses of these problems fundamental to the insurance business.

AUTHOR'S REVIEW OF DISCUSSIONS

Both Mr. Meenaghan and Mr. Harwayne refer to the Little* report, so some explanation should be given for my failure to mention it by name in my paper. The fact is that the paper was started long before the Little report appeared, as an outgrowth of a consideration of Mr. Bailey's paper (*PCAS* LIV, p. 1). I found that it was difficult to review his paper without

[3] Some argument could be made for removing some income amounts contributed during the ten year period by insurance company holdings, but this probably is relatively small and would involve an examination of Schedule D of every annual statement, a task which is impracticable.

* *Prices and Profits in the Property and Liability Insurance Industry* by Arthur D. Little, Inc.

establishing a completely different basis for discussion. To use a common metaphor, it seemed easier to attempt to weigh the whole elephant rather than his trunk, or his tusks, or his tail. In the process I came up with an earning ratio of 8.9% for the ten year period 1956–1965. At about this time the Little report appeared with its figure of 4.4% for the eleven year period 1955–1965. (The Little report bears the date November, 1967, but it was copyrighted in 1968 and was given nationwide publicity at a press conference on January 29, 1968.)

The Little study appears in two versions, the Summary Report of 37 pages and the complete report about four times as long. The figure 4.4% first appears on page 19, as "the average rate of return for the 43 property and liability stock companies studied for the 1955–1965 period." At this point there is no statement as to whether the rate of return is on net worth, policyholders' surplus, "policyholders' equity," or "total investable funds." Later in the report, however, on page 24 of the Summary Report, appears Table 3 based on Best's Aggregates and Averages covering the years 1955–1965, and showing rates of return for the period of 9.0% on policyholders' surplus and 4.2% on "Total Investable Funds." This basis, which is called denominator D_2, is explained by a footnote as follows: "This measure of return is the one which evaluates *overall* economic earnings on *total* economic resources employed. The other measures reported depart from this concept in varying degrees" (emphasis in original).

The same Table 3 appears as Table 4 on page 39 of the full report with a longer explanation on page 40, part of which is quoted below.

> "This study does not present a framework for making a risk/return comparison for returns on net worth. However, because the value of $N_4/D_1(=9.0\%)$ may appear 'reasonable' on the surface, some comments are in order. It should be recalled that N_4 includes realized and unrealized capital gains as well as operating income. In fact, well over half of this income (N_4) comes from stock market capital gains. This rate of return, then, must be compared to stock market portfolios, which, on average, have earned 11-12% after taxes during 1955–1966 period. That was on *unlevered* portfolios. The common stock owner of a property and liability insurance company holds, in actuality, a 50% levered portfolio. Accordingly, the average rate of return he should expect is 22-24%. His return of 9% is a disadvantaged one when viewed against the alternative of direct market investment."

From my point of view, this was an explanation which did not explain. I could not see why a return of 9%, even though a "disadvantaged one" should be taken at 4.2%. A letter to Mr. Irving H. Plotkin, one of the members of the Little team, asking for further explanation received no reply.

The essential difference, therefore, between the 8.9% return to investors shown in my paper and the 4.4% or 4.2% return selected by the Little organization is in the choice of the denominator. I use policyholders' surplus whereas they used "total investable funds," a figure about twice as large, producing a return about half as great. However correct their method may be as a matter of arithmetic, their index does not seem to be a particularly useful device, since it is hardly distinguishable from the rate of interest earned on invested assets. It does not measure the rate of return to present investors in insurance stocks, nor indicate the capacity of the insurance industry to attract new capital.

In referring to the Little report, Mr. Meenaghan says, "While not addressing itself to the specific question of whether investment earnings should be reflected directly in price structures, the study concluded, etc." The first few pages of the report gave me the opposite idea. Of several sentences on the first two pages that might be quoted, the following is selected: "The aim of the present study is to determine *to what extent* such a proposed treatment of investment income [i.e. inclusion in ratemaking] can be justified in property and liability insurance" (emphasis supplied). The underlined words gave me the impression that the study would provide some quantitative evaluation of investment income derived from premiums and its relationship to the total, or in other words that it "would address itself to the specific question, etc." The fact that it did not follow through on its original aim may have served to confuse Mr. Meenaghan, as well as others.

In one sense, however, it did follow through on its original aim, or at least some of the fifteen people who worked on the report found means to express views in the back pages of the full report which did not appear in the shorter Summary Report. On page 53 of the full report, after a discussion of the possible effects of lessened regulation, these comments appear: "If this were done, the investment income question would melt into the general pricing system. Investment income, like any other resource, would enter the rational, self-interested calculations of any firm seeking an advantage against its rivals."

If there is sufficient actuarial interest in the findings of the Little organization, it might be desirable to invite some member of the organization to present a formal paper for our *Proceedings*. Hopefully, such a paper could present an economist's viewpoint of certain aspects of investment income not covered in the present report, such as:

1. A comparison with life insurance with respect to:
   (a) Interest earned on invested assets,
   (b) Use of investment income in ratemaking.
2. Relationship of investment earnings to total earnings for fire and casualty insurance.
3. Total earnings rates for years prior to 1955.

There may be no satisfactory way of measuring the impact on the financial world of the Little report, which had stated that the property and liability insurance industry was underearning and would have difficulty in attracting capital. Possibly one measure would be Best's Index of Property-Liability Insurance Stocks, published weekly by A. M. Best Company. This index has a base of 10 for the years 1941-1943. It reached a high of 63 in 1966 and 1967 and stood at 54 when the Little report was publicized at the end of January, 1968. It sank to 47 in April 1968 and then climbed to 92 in December. During 1968 there was considerable interest in insurance stocks by outside capital, as evidenced by Leasco's purchase of Reliance, and ITT's purchase of an important part of Hartford stock. The significance of these activities is not entirely clear, but it appears that actuaries and other insurance men would do well not to ignore them.

Mr. Meenaghan makes the point in his introductory remarks that the subject under discussion is one of the most controversial in the industry today. I had reached the same conclusion independently, and had resolved before writing on the subject to avoid such hackle-raising words or phrases as "should," or "ought to" or "belongs to" or "attributable to" or even "held in trust for." In particular, I avoided any advocacy of the inclusion of investment income in ratemaking, although Mr. Meenaghan says that I came "perilously close" to doing so.

Mr. Meenaghan has five numbered criticisms to which I should reply:

1. Same interest rate on premiums as on capital. Not so. I made provision for two rates of interest, i and i' in the paragraph immediately following formula (4) and for the very reason Mr. Meenaghan mentioned, "in order to handle the sometimes troublesome items of capital gains."

   Different rates were not used in the arithmetical demonstration because data were not available to determine them. Mr. Bailey also used a single interest rate to apply to all invested assets within each company.

2. Equity in unearned premium reserve not included. It was included in the denominator under the name "prepaid expenses." It was not included with capital in the numerator because it is not invested in interest-bearing securities.
3. It is rather surprising that there should be any confusion about the two ways of determining the equivalent time period, since all actuaries are familiar with the relationship between calendar year and policy year statistics. I used the calendar year approach, just as Mr. Bailey did, in the arithmetical demonstration since it was based on annual statement data. For theoretical work the policy-year approach used by Mr. Flynn* would be preferable, but for lines other than workmen's compensation and auto liability, the results would have to be relatively uneducated guesses. The policy-year method is referred to as the "discounted cash flow analysis" by Mr. MacGinnitie (*PCAS LIV*) in his review of Mr. Bailey's paper.
4. Inclusion of unrealized capital gains. If the subject is total earnings, it seems to me that all capital gains and losses must be fitted into the box somewhere. At this point I appear to agree with the Little report which says (page 22 of the Summary Report) that "Such gain is one of their [the investment companies] principal goals (as it is with fire and casualty companies)." In a short period of time (and ten years may be too short) unrealized gains and losses may distort the result.
5. No recognition to federal income taxes. The paper did mention the different rates of federal income tax, as applied to underwriting investment income. It was impossible to bring this point out in the arithmetical demonstration, since such taxes are reported as one figure in annual statements. The total effect of federal income taxes can be gauged from a comparison of such taxes with earned premiums, as shown in Best's Aggregates and Averages for three recent years (amounts in millions).

Calendar Year	Earned Premiums	Federal Income Taxes	Ratio
1965	13,307	49	0.4%
1966	14,582	135	0.9%
1967	15,775	145	0.9%

* Flynn, B. D., *op. cit.*

Following his fifth numbered criticism, Mr. Meenaghan goes on to say that I leave "unresolved the basic question as to the amount of investment funds developed from premiums." I had thought that the formula provided a do-it-yourself kit for this as well as for other purposes. For example, in the ten-year period ending with 1966, the amount was slightly larger than the amount available from capital and surplus, if an equivalent period of .99 years is accepted.

Mr. Meenaghan expresses a number of opinions with respect to studies made by others on the earnings question, but he makes no choice as to the base to which such earnings should be related. Should it be net worth, giving a total earnings rate of roughly 9%, or "total investable funds," giving, at the present time, a rate about half as much?

Mr. Harwayne, on the other hand, in referring to the Little report, has no hesitation in selecting their 9.0% rather than 4.4%, and all of his figures, including his amendations of mine, are in the 9.0% ball park rather than the 4.4% one.

He has several minor criticisms of my arithmetical results and one major one, which will be discussed first. He correctly points out that Best's figures do not allow for the pyramiding effect of company interownership, but in his arithmetical correction of my formula *(4)* he changes only the denominator, whereas it would appear that the first element in the numerator should also be reduced. Some of the investment income of a subsidiary company must become part of the investment income of the parent, even though premiums and underwriting profit would not be affected. My guess is that his change of my 7.7% to 9.5% for the ten years ending with 1966 is an overstatement, but it would be a very tedious job to produce an absolutely correct result.

With respect to the ratio of invested assets to total assets, there would have been no need for an assumption if I had had access to Best's Aggregates and Averages for every year. For those years which are now available, the ratios are as follows:

1955	86.0%
1965	86.4%
1966	85.6%
1967	85.8%

If 86% of total assets had been taken as invested instead of 85% in the calculation of Q, the value of Q would have been 1.00 instead of .99

(The value of i would have decreased and total investment income would not have changed). In a period of rising premium volume, the value determined in this way will always appear low compared to the weighted average of the various *Q's* for individual lines calculated by the direct approach.

Using the direct approach (which I refer to as the policy-year method) his figure of 3.24 years for New York workmen's compensation does not conflict with my figure of 2.25 for a company doing a countrywide business. As I pointed out in the paper, the equivalent periods for this line would be expected to vary from one state to another.

Mr. Harwayne's exposition of an 11% return on common stocks is an interesting one. It is still surprising that fire and casualty companies, with their heavy involvement in stocks, have not done substantially better in the investment field than life companies. At the present time, the investment departments in fire and casualty companies do not have readily available the same records of performance, by type of investment, that are available to their counterparts in the life companies. In particular, the difference in attitude toward mortgages by the two types of companies is quite striking.

Mr. Harwayne asks for an explanation of the footnotes to the table of relative success in the investment market for life companies and fire and casualty companies. The life figures were taken from the *Life Insurance Fact Book,* an annual publication of the Institute of Life Insurance; the other figures result from dividing total investment gain [column (5) of my Exhibit 1] by 85% of total assets [column (1) of my Exhibit II]. If 86% of total assets had been taken as invested instead of 85%, the earnings rate would have been lower.

Mr. Harwayne does not comment on what appears to me to be the most exciting development of the last twenty years: the gradual but decided increase in the ratio of premiums to surplus. There never has been, and probably never will be, any scientific method of determining how large a company's surplus should be, but it seems evident that the yardstick of the future will not be any fixed ratio of total dollar amounts. The hazards to which a surplus is exposed, other than the internal hazards of security depreciation or inadequate loss reserves, might be set forth as follows:

1. Catastrophes, such as Texas City, affecting a few large risks.
2. Windstorms, or possibly floods and earthquakes, affecting many risks in a limited geographical area.

3. Court decisions producing a change in interpretation of the law.

4. Administrative decisions, such as denial of rate increases.

The list might be extended but it should be obvious that a company which wrote primarily private passenger automobile in 51 states would put a lower strain on its surplus per dollar of premium, than a company writing primarily, say, public liability insurance on highway bridges within a comparatively few states. It is probable that many companies today could increase their premium volume without endangering surplus if they were not held back by the traditional two-for-one relationship.

With respect to the question of whether the insurance commissioners could force the insurance companies *as a whole* to earn the full profit allowance in the rates, my feeling was that competition, as expressed in voluntary discounts and deviations, would tend to keep rates down; even in the pre-S.E.U.A. days the fire insurance companies did not earn the full profit allowance consistently.

Mr. Harwayne is correct, of course, in his statements about prepaid expense, both that the amounts should be higher than the bare commissions and taxes and that they should be used to increase the statutory underwriting profit, or, in this case, to reduce the underwriting loss. According to my calculations, these two changes would increase the rate of return for the 1957–1966 period from 7.7% to 8.2%.

In summary, I am grateful for Mr. Harwayne's thorough review, which illustrates quite forcefully that one of the chief values of our Society lies in the opportunity for open discussion. Mr. McCullough's* study has been discussed many times in the twenty-one years since it was written but always, in my opinion, inadequately and never by members of our profession. Even now, we have been concerned professionally with only the most elementary aspects of problems on which important decisions are being made, with or without our help. Let us hope that future papers will recognize that the way the insurance industry makes money is a question for serious actuarial consideration.

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* McCullough, Roy C., *op. cit.*

DISCUSSIONS OF PAPERS PUBLISHED IN VOLUME LIV

THE MINIMUM ABSOLUTE DEVIATION TREND LINE

CHARLES F. COOK

VOLUME LIV, PAGE 200

DISCUSSION BY DAVID P. FLYNN

Most ratemaking procedures may be described as simply the processes through which loss experience at least one year old is projected to estimate the loss experience of the same risks one or two years in the future. This time lag is the inevitable result of the constraint that the rates be reviewed on the basis of the total loss experience of the line. Even with high speed computers, it is physically impossible to record, gather, sort, and caress the enormous amounts of data involved in any reasonable length of time. It follows from this built-in lag that recognition must be given to the possible differences in claim cost levels between the two periods if we are to achieve adequate rates.

Many years ago it was justifiable to assume that the cost levels of the experience period under review would continue with little change throughout the period for which the new rates would be in effect. However, during the period following the Second World War, it became increasingly obvious that the combined inflationary effects of continuing federal deficits, the expanding money supply, and increased labor costs would make it necessary to include a factor in the formulas that would compensate for the marked increases in claim costs. It was for this purpose that the least squares trending procedure was introduced. The criterion underlying the least squares line is that this is the line for which the sum of the squares of the differences between it and the points to be fitted is as small as possible.

Up until the present time little has been done to modify the conditions which cause inflation. It is now widely held by government economists that a rate of inflation of 2% to 3% per year is necessary and desirable in an expanding economy. It is evident that as long as this attitude continues, some type of trend factor will be inevitable. In fact, we should not be too surprised to see the size of the current trend factors increase. In 1966, the last full year for which statistics are available, the cost of the average automobile bodily injury claim increased 6% compared with a previous yearly increase of about 3%. Automobile property damage claim costs are now increasing at a rate of nearly 10% per year. If the current three-year lag between the experience period and the time at which the losses are paid continues, we will need minimum trend factors of over 15% for bodily injury and over 25% for property damage.

Mr. Cook's paper has now given us an alternative method to compute trend lines that is based upon the criterion that the sum of the absolute values of the differences should be a minimum, rather than the sum of the squares of the differences. The author states that the present least squares procedure has two major drawbacks. The first, that of the excessive influence of an odd point, arises out of the basic least squares criterion. For example, a point that is four units from the line would be given a weight of sixteen, and to offset the effects of this single point would take sixteen more points one unit from the line. This is a general criticism in that it applies to any curve that is fitted using the least squares criterion.

The second criticism is that excessive weight is given to the extreme points. This unequal weighting arises out of the formula for the slope of the line which is given by $\sum x_i y_i / \sum x_i^2$. To appreciate this objection it is necessary to recall that the points have been centered about the origin and when the multiplication in the numerator is performed, the outer points count more toward the sum than the inner points. This criticism applies only to the least squares method of fitting a line and it should not be applied to the general least squares curve-fitting procedure.

The criticisms that Mr. Cook outlines are valid. The first may be met only by throwing out the odd point. The second is highly theoretical in that the author has ignored the influence of the other element in the product and it is impossible to say beforehand how the slope will change unless we know the value of these elements.

It may be interesting to note that when the least squares trend line is used to fit points that represent year-ending averages, a secondary weighting procedure is involved that to a certain extent offsets the second criticism. For instance, the automobile trend line consists of a time series of twelve paid claim cost amounts over a three-year period where each point represents the cost for a year ending in a calendar quarter. If we itemize the number of times each quarter is counted, the results are that the first, second, and third quarters of the time series are counted one, two, and three times respectively. The succeeding quarters up to the last three are each counted four times while the remaining three quarters receive counts of three, two, and one. Thus the earliest and latest quarters receive smaller counts than those in the middle and tend to offset any reverse weighting of the formula.

The minimum absolute deviation method of fitting a line will eliminate the deficiencies of the least squares method and, in addition, is many times easier to use. However, the absolute deviation procedure itself has a very serious drawback that was recognized by the author in his paper. This deficiency is not always present but only comes into effect when $Z_{k^*} = MX$. In this instance the slope of the fitted line is not unique and any slope within a given range will satisfy the basic criterion of minimizing the sum of the absolute values of the differences. Mr. Cook suggests that in this case we use the average value in the range. While this suggestion is reasonable, the deficiency in the method still remains in that we are forced to enter a judgment factor into what ideally should be a completely objective method. It should be noted that the condition $Z_{k^*} = MX$ is not highly unlikely since it occurs in fitting the latest countrywide automobile trend line both for bodily injury and for property damage.

The author describes the method that he has developed as an "algorithm of the operations analysis type" which perhaps could be stated as a method based upon a constructive proof. However, no matter what you call it, it is not an easy proof to read. In an effort to be concise, the author has left many gaps in the proof for the reader to fill in for himself, making it difficult for the casual reader to follow. Those with the spare time will find the exercise rewarding.

Mr. Cook has again demonstrated his unique talent for mathematics and we hope that he will come forward soon with more work in this area.

DISCUSSION BY KENNETH L. McINTOSH

This paper most certainly demonstrates, should such demonstration be necessary, that "an algorithm of the operations analysis type" need not involve complex and interminable arithmetical detail.* A word of arithmetical caution may be in order, however. Since $a_i = (y_i - \bar{y})/x_i;\ x_i \neq 0;$

* The distinction between traditional "mathematics" and "Operations Analysis" may be a matter more of semantics than of substance. *Cf., e.g.:* Newton's algorithm to obtain the roots of polynomials; also the Gauss, Gauss-Jordan, and Crout algorithms for solving simultaneous linear equations. Linear Programming is directly related to Combinatorial Analysis, and Dynamic Programming seems to have an impact upon the theory of the Calculus of Variation. Where is the line to be drawn?

the difference $y_i - \overline{y}$ must contain at least as many significant digits as are desired in a_i. In many cases this will require retention in the original data of more decimal places than necessary to obtain equal precision in the results of the least squares calculation.

The application of the algorithm is not so restricted as the author states it to be. "Equal intervals between measurements" are *not* required; it is required only that $\overline{x} = 0$, and even that constraint may be by-passed. Nowhere does the proof of the method rest upon the value of any individual x_i, nor upon the value of any interval $x_{i+1} - x_i$. It follows that the algorithm is valid for arbitrary spacing of the measurements. The necessity for the constraint $\overline{x} = 0$ is not apparent from the analysis presented in the paper, but becomes apparent upon further analysis of certain mathematical detail which is totally unnecessary to Mr. Cook's rigorous and beautifully concise proof. To avoid the constraint, suppose that $X \neq 0$; where $\overline{X}$ is the mean of the original abscissae. Let $x_i = X_i - \overline{X}$, and minimize $\sum^n{}_i \mid ax_i + \overline{y} - y_i \mid$ by the algorithm. If the solution is $a = a^*$, then the desired line on the original X_i's will be:

$$y = a^* + X + b^*; \quad (b^* = \overline{y} - a^*\overline{X})$$

On the necessary assumption that some simple linear model (as opposed to a curvilinear model) will be an acceptable approximation of the true but unknown trend function, projection of the least squares line to a future time point, x_{n+p}, yields an unbiased estimate of y_{n+p}, even where a normal distribution cannot be hypothecated. If $\overline{x} = 0$, of course $\overline{y}$ will be an unbiased estimate of the y-intercept no matter how the line may be fitted. An unbiased estimate of the y-intercept is not of itself sufficient, however, to guarantee that the projection of the minimum absolute deviation line to x_{n+p} will yield an unbiased estimate of y_{n+p}. This matter requires further investigation.

Mathematically, Mr. Cook has neatly sliced a Gordian knot, but the mathematical structure of the algorithm becomes apparent only when the knot is untied in laborious fashion. The difficulty of minimizing $E(a) = \sum^n{}_i \mid ax_i + \overline{y} - y_i \mid$ stems, of course, from the fact that the derivative, $E'(a) = dE(a)/da$, is not continuous on the entire line $-\infty < a < \infty$. However, on any open interval, $a_i < a^* < {}_{i+1}$, the derivative $E'(a^*)$ can be shown to exist, and on that interval $E'(a^*) \equiv$ constant. Further, the one-sided derivatives exist at the end points of the interval, and:

$$E'(a_i + 0) = E'(a^*) = E'(a_{i+1} - 0)\ ; i = 1, 2, \ldots, n - 1$$

It follows that there will exist some unique interval, say $a_\mu < a^* < a_{\mu+1}$, such that:

$$E'(a_\mu - 0) < 0; \; and: \; E'(a_{\mu+1} + 0) > 0$$

and either:

$$E'(_\mu + 0) = E'(a^*) = E'\ (a_{\mu+1} - 0) < 0 \qquad \text{CASE I.}$$

or else:

$$E'(a_\mu + 0) = E'(a^x) = E'\ (a_{\mu+1} - 0) \equiv 0 \qquad \text{CASE II.}$$

In Case I it follows that $E(a_{\mu+1}) = Min\ E(a)$. In Case II, $E(a)$ is minimized by any a^* in the closed interval, $a_\mu \leqq a^* \leqq a_{\mu+1}$. The algorithm is neither more nor less than a simple, by no means obvious, and, to say the least, ingenious technique which immediately locates the interval $a_\mu < a^* < a_{\mu+1}$ among the n–1 intervals $a_i < a < a_{i+1}$, and which in the process discriminates between Case I and Case II without need to calculate the derivatives in either case. Once the algorithm is given, it is not too difficult to prove its validity by direct reference to the intervals and derivatives noted above, though the development is longer and more involved than the proof given in the paper. Developing the algorithm in the first place is a very different matter indeed.

Mr. Cook has broken a trail into very interesting territory. Though not yet persuaded that minimum absolute deviation should supplant least squares in the trend calculation, I suggest that the matter is well worth further study.

A DISCIPLINE FOR THE AVOIDANCE OF UNNECESSARY ASSUMPTIONS

LEWIS H. ROBERTS

VOLUME LIV, PAGE 205

DISCUSSION BY ROBERT L. HURLEY

Lewis H. Roberts' paper, "A Discipline for the Avoidance of Unnecessary Assumptions," published in the CAS *Proceedings* Volume LIV (1967) was initially prepared for the seminar presented by the Committee on Mathematical Theory of Risk at the Society's meetings in Detroit, Michigan, November 1966. While the presentations of this colloquium have been made available to the membership in a separate booklet, it is a happy stroke that the Roberts' paper will appear in the official *Proceedings* as readily accessible research material for present and future students of the insurance business.

In his introductory section, Roberts was quick to eschew any thought of venturing into a philosophical treatise on "Ockham's razor." This reference was offered solely as a citation of some pertinency to color a fairly recent mathematical development of likely promise to the actuarial profession. In essence, the paper advances the idea that E. T. Jaynes' Formalism, developed from the Shannon treatment of "Entropy" or "Uncertainty," may possibly be applied to certain situations not uncommonly encountered in actuarial work.

For example, the actuary on occasions has only various averages culled from the data rather than complete information on the frequency distributions of the losses and/or premiums and/or exposures to work with. Naturally, there is some concern that we do not read into such available information more than we truly have. And in paraphrase of Ockham's admonition, "Don't search for a more elaborate rationalization to account for a particular phenomenon than you need to explain the basic facts concisely." As Roberts indicated in comparing various statements about a distribution, the principle of maximum entropy helps us to select the one involving the minimum subjectivity on the part of the observer. The larger the number of alternatives available to interpret some observation, the less sure the observer can be that he has chosen the most appropriate explanation. Truly, there are inescapable polarities between our knowledge and our ignorance. The certainty to be accorded to our information seems to vary inversely with the precision to be attached thereto.

It appears to this reviewer that Roberts has forcefully identified the source and clearly traced the consequences of bias and prejudiced data.

The CAS Detroit seminar was undoubtedly arranged for the guidance of the general membership who, like this reviewer, may not be particularly conversant with recent mathematical developments. And it may have been a singularly felicitous adventure that Roberts chose to further the research being done on information theory by scientists with prime allegiance to various disciplines other than actuarial work.

The current activity on the information theory is believed to stem from Dr. Claude E. Shannon's 1948 paper in the *Bell System Technical Journal* which was concerned with developing a statistical theory of the information sum from successive units originating as individual decisions from equally probable choices. At about the same time, R. A. Fisher was investigating a similar idea from the view of classical theory of statistics, and Norbert Wiener was founding the field of Cybernetics from a parallel source. In his reminiscences Dr. Wiener relates that although Claude Shannon was a student during his teaching days at MIT and that they then, and later, had occasions to discuss scientific matters, their respective work in information theory, as far as he could recall, was developed independently.

The Shannon initial monograph, "A Mathematical Theory of Communication," was later supplemented with an essay by Warren Weaver, and published in book form by the University of Illinois Press 1949. It is still readily available from most large libraries. The Shannon contribution does not make easy reading for the uninitiate. This reviewer struggled, with more exasperation than success, over Appendix 2 which gives the mathematical derivation of the Shannon Equation $H = - \sum p_i \log p_i$. Not that the mathematics would be impossibly difficult for the average competence required for most actuarial research. Yet it might conceivably have appeared to some that Shannon had sharpened his intuitive skills in mathematics so as to suggest a reasonable degree of contempt for those who may prefer not to flash from one intellectual peak to the next.

With the above experience, it was somewhat heartening to chance upon the observation in A. I. Khinchin's *Mathematical Foundations of Information Theory,* Dover 1962, that while Shannon was a highly competent scientist whose discoveries in information theory were truly remarkable, the mathematical display of the findings seemed to lack at certain points the rigor and clarity that one could wish for. Unfortunately, in his own development, Khinchin, while engaging in a somewhat more detailed refinement of the mathematics, seemed to parallel the general tenor of the Shannon exposition without a compensating gain in the lucidity of the mathematical argument. It is understandable, therefore, that Roberts would be satisfied just to identify Shannon's equation, and the basic criteria on which it was founded, and to offer certain observations thereon without detailing either the Shannon or Khinchin mathematical involvements — or as they may appear to any of us who might qualify as less sophisticated readers.

Roberts, it seems to this reviewer, properly highlighted the applications that have been made from the original information theory in the field of thermodynamics and thermostatics. He credits Myron Tribus with various contributions to the gradual realization of the possible extensions of the underlying concepts, and cites a number of Tribus' articles and technical papers thereon. This reviewer would like to add one further reference to Roberts' list, Tribus' text book *Thermostatics and Thermodynamics,* published by D. Van Nostrand 1961, wherein ingenuously simple and delightfully straightforward derivations of Shannon's equations are given. These are considered prerequisites to an understanding of the basic principles of information theory and its possible application to actuarial problems. Consequently they have been sketched out in an appendix to this review.

In his paper Roberts notes that often the only information available to the actuary is the average readings for some variable whose underlying loss distribution is unknown. He suggests that an extension of E. T. Jaynes' Formalism may enable the investigator to select that one distribution which affords the maximum entropy according to the Shannon development. The equation for the average reading is given in Roberts' paper as

$\overline{g}_r(x) = \sum p_i g_r(x_i)$, where $r = 1, 2, 3 \ldots m$ for m functions and $\sum p_i = 1$.

Roberts noted that the assignment of the p_i for which S is a maximum is given by the equation:

$$p_i = exp.\ [-a_o - a_1 g_1(x_i) - a_2 g_2(x_i) - \ldots .]$$

with

$$a_o = ln \sum_i exp.\ [\sum_r a_r g_r(x_i)]$$

$$\overline{g}_r = - \delta a_o / \delta a_r$$

where the "a"s are the Lagrangian multipliers satisfying the requirements of $\overline{g}_r(x)$.

On pages 70 through 74 in his book *Thermostatics and Thermodynamics* Tribus gives a good explanation of the Lagrangian multipliers and examples of their use. Somewhat later in the same chapter he outlines a fairly complete derivation of the equations underlying Jaynes' Formalism, which is one starting point of Roberts' further developments. While the mathematics are too extensive to attempt to sketch out in his review, it is believed that they are not beyond the competence required of CAS members. The interested actuary will undoubtedly find that some extra effort thereon will prove worthwhile.

It is this reviewer's belief that an author in any scientific inquiry has discharged his obligation to his readers and to his own conscience if he has advanced a logically consistent proposal or theory, examined its ramifications in the conceptual framework presently conditioning the particular field, and suggested aspects or areas in which future research may prove promising. He is not in conscience required to present a bill of particulars on the many associated details for some future implementation, although he may do so, obviously, if he chooses.

In citing three specific problems where the Roberts-Jaynes extension of the Shannon entropy concept might be used, Roberts successfully blended the daring often founded in the creative thinker with the caution associated with the successful business man. For example, while offering these equations as a method for computing deductible credits when, say, only the average loss is known, he prudently questions the assignments that would likely be made in selecting the value for the coefficients of the exponents — and inquires whether any such selection might not itself betray a prejudice.

In the particular area of loss distributions, insurance research often has more than average loss size to work with. In certain individual studies the problem has seemed to be not primarily a matter of the degree of the detail. Rather, our main problem has been, in such instances, to develop an adequate mathematical relationship among the variables so that we may interpolate readings for which direct computations are not provided by the statistics. In any such situation, the author notes that if we have more information, we should use it, since the equations in his paper apply when the data are available only in the form of expected values.

In the area of property insurance, it would appear a somewhat hazardous venture to posit a frequency distribution of losses and amounts of insurance by size in order to develop Loss Elimination Ratios for a deductible rating plan — knowing only the average value and/or the range of values. Admittedly, the underlying equation might be expected to be of the exponential form with negative exponents. But such fragmentary knowledge, while possibly of some value in the absence of other data, may be not much, if any, advantage over the intuitive skills of some knowledgeable underwriter exercising his judgment as to what a given deductible would be worth, rate wise, on a specific class of business.

Roberts also notes in his paper that this "entropy" concept might also be used in the planning of risk classification plans for rate differential purposes and in evaluations of credibility with regard to the probability distribution of error in the existing rate levels. He observes that the classification plan with the smallest entropy value would afford the most information; and conversely, the entropy value would be greatest for the most homogeneous population. He then cites the work done by R. A. Bailey (*PCAS* Volume XLVII — 1960) on classification analysis using the coefficient of variation technique and concludes that both approaches would likely afford answers of about the same order of magnitude.

It was interesting that the author would speculate that, unlike the earlier statistical techniques, the method of maximum entropy would not provide for any comparison of the hypothesis with observed events. He advises that no such testing is possible since the method uses all pertinent information available. He cites the parallel with Bayes theorem wherein solutions are complete and final and allow of no further referrals. He contrasted it with the Neyman-Pearson tradition of testing hypotheses and delimiting regions within which the "true" answer might be expected most probably to lie.

It would be understandable that the reader might entertain some misgivings on an approach somewhat strange in the light of his previous experience in the testing of hypotheses. It is possible that his uneasiness might be due only in part to the consideration that the technique may represent a break with statistical tradition. There are men of some stature in statistical theory who regard the current Bayesian trend, if not a break, at least as estrangement with statistical realities. Maybe in view of the responsibilities with which the actuary is charged, he must necessarily examine any novel proposals with a fair degree of circumspection. At the same time, he cannot afford to be indifferent to new ideas and neglect the developments that are taking place in associate disciplines. This reviewer believes, therefore, that the Roberts paper represents a valuable addition to our *Proceedings.*

APPENDIX TO DISCUSSION BY HURLEY

In terms of the criteria in Roberts' paper, the entropy or uncertainty (S):

(a) should depend only on probability distribution;

$$\therefore S = f(p_1, p_2, \ldots . p_n)$$

(b) should be monotonic function of "n," if $p_1 = p_2 = p_3 \ldots . = p_i$

(c) if W and Y are independent events and Z is a compound event of W and Y, then the uncertainty about Z should be defined as the sum of the separate events' uncertainties, or if

$$W \cdot Y = Z, \text{ then } S(Z) = S(W) + S(Y).$$

If the numerical value of "S" must be independent of the way the problem is set up, then criterion *(b)* requires $S = f(n)$, when $p_i = \frac{1}{n}$ for each "i," and criterion *(c)* requires $f(x^m) = mf(x)$ and Shannon proved that the only function satisfying this relationship is:

$f(x) = k \ln x$ where k is constant; the Tribus proof is:

(1) $f(x^m) = mf(x)$, differentiating with respect to m letting $(x^m) = U$

$$\text{Left Side} = \frac{df}{du} \cdot \frac{du}{dm} = \frac{df}{du} \cdot x^m \ln x \frac{dm}{dm}\text{; Right Side} = f(x)\frac{dm}{dm}\text{;}$$

or (2) $\frac{df}{du} \cdot x^m \ln x = f(x)$, and now differentiating (1) by x,

$$\text{Left Side} = \frac{df}{du} \cdot \frac{du}{dx} = \frac{df}{du} \cdot mx^{m-1}\frac{dx}{dx}\text{; Right Side} = mf'(x)\frac{dx}{dx}\text{;}$$

or (3) $\frac{df}{du} \cdot mx^{m-1} = mf'(x) \quad$ where $f'(x) = \frac{df(x)}{dx}$.

Next eliminate df/du from equations (2) and (3), and

(4) $\frac{f(x)}{x \ln x} = f'(x)$, or

(5, a) $\frac{f'(x)}{f(x)} = \frac{1}{x \ln x}$; or (5, b) $\frac{df(x)}{f(x)} = \frac{dx}{x \ln x}\left(\text{since } f'(x) = \frac{df(x)}{dx}\right)$;

(6) $\int \frac{df(x)}{f(x)} = \ln f(x) + C_1$ and

(7) $\int \frac{dx}{x \ln x} = \ln(\ln x) + C_2$; therefore

(8, a) $\ln f(x) + C_1 = \ln(\ln x) + C_2$; or (8, b) $f(x) = k \ln x$

From criterion (b) above, $S = f(n)$ is a monotonically increasing function of n. When all the "p_i"s are equal, equation (8, b) gives $S = k \ln(n)$ with equal "p_i"s, each $p_i = \frac{1}{n}$ and

(9) $S = k \ln \left(\frac{1}{p_i}\right)$ or

(10) $S = -k \ln p_i$

NOTES ON WHITTAKER-HENDERSON FORMULA A

NELS M. VALERIUS

VOLUME LIV, PAGE 218

DISCUSSION BY DALE NELSON

Mr. Valerius has now contributed two papers to the *Proceedings* dealing with the Whittaker-Henderson (or difference equation) method of graduation. I recall reading his earlier paper on "Risk Distributions Underlying Insurance Charges in the Retrospective Rating Plan" (*PCAS* Vol. XXIX, p. 96) while studying for Part 7 of the exams. But since "excess ratios" were my main area of concern and bewilderment at the time, little attention was paid to his remarks on graduation. Later, a long paper by LeRoy Simon on "The 1965 Table M" (*PCAS* Vol. LII, p. 1) touched briefly on Formula A graduation; but, again, I — and undoubtedly many others — took little note of the passing remarks concerning graduation.

Graduation techniques are very common in life insurance ratemaking. They are also widely used in the non-life lines, although it is probably safe to say that the techniques normally used by the casualty actuary are much less refined than the Whittaker-Henderson process — and, also, much less arduous. Now, thanks to Mr. Valerius, we have another opportunity to study this process. And, in the belief that a non-technical exposition might be in order — rather than a detailed critique of the method's fine points — most of my remarks will be toward that endeavor.

Basically, a graduation process is any technique applied to a set of ordered data to smooth out these data and to aid in uncovering any patterns or laws underlying the observed values. These data may represent a time series (such as the auto BI claim frequency for several consecutive periods of time) or, perhaps, some cross-sectional, functional relationship (such as an expense study by size of risk). But regardless of the data or the specific problem — which generally is one of prediction — the process is designed to eliminate the random (and sometimes, non-random) irregularities existent in the observed data.

We are all familiar with several methods of graduation:

(1) Graphing — where a convenient plot of the data is made and a

"smooth" curve is drawn among the data points. While done easily and quickly, graphing lacks an important quality: that of consistency.

(2) Moving averages — where each data point is replaced by a weighted average of itself and the points surrounding it. This method is used extensively, and has probably reached its highest level of sophistication in the techniques developed and used by the National Bureau of Economic Research.

(3) Mathematical models — where an "appropriate" formula is fitted to the raw data, using a standard technique such as the method of least squares. An important subcategory to this general approach is that of interpolation, where an (n-l)st degree polynomial is fitted (exactly) to the n data points.

The Whittaker-Henderson process falls under a general technique which is the inverse of the method of moving averages. Thus, under it, each of the original data points turns out to be a weighted average of the adjusted data points. Specifically, in the example used by Mr. Valerius,

$$\text{(A)}\qquad \begin{aligned} u_0'' &= 19u_0 - 36u_1 + 18u_2 \\ u_1'' &= -36u_0 + 91u_1 - 72u_2 + 18u_3 \\ u_x'' &= 18u_{x-2} - 72u_{x-1} + 109u_x - 72u_{x+1} + 18u_{x+2}\ (2 \leq x \leq 16) \\ u_{17}'' &= 18u_{15} - 72u_{16} + 91u_{17} - 36u_{18} \\ u_{18}'' &= 18u_{16} - 36u_{17} + 19u_{18} \end{aligned}$$

Note that this system can be interpretated in two distinct ways. Regarding the u_x as the raw data, it defines a moving average process. On the other hand, if the u_x'' denote the raw data, then it is a Whittaker-Henderson Formula A process. Strictly speaking, however, a given system would not be used interchangeably in this fashion. In fact, system (A) defines a very poor moving average process; and, conversely, a good moving average system will usually produce a bad difference equation process.

Although (A) is nothing more than a system of 18 linear equations in the same number of unknowns, from a computational point of view, the actual Whittaker-Henderson process is easier than directly solving these equations. It involves "factoring" this system, using the methods of difference equations, into two smaller, simpler systems which for all practical purposes are (but actually, are not) moving average processes. The main problem lies in determining the values at the end points. [Note the asymmetry of the first two and the last two equations in (A).] This problem plagues all graduation processes, but it is particularly serious in the Whittaker-Henderson process.

A new approach to this particular problem is presented in the first of the author's Notes. When one reconciles himself to the fact that graduation is a tedious task (at least when done by hand), the iterative technique suggested by Mr. Valerius seems quite satisfactory. There appears to be an important theoretical flaw in the development, though, in that no proof is given to the implied convergence of the iteration process. (However, on this point, it should be noted that I have not seen the original Henderson or Spoerl papers — and the necessary convergence properties may be developed therein.)

The second Note in the paper is the observation that the Whittaker-Henderson process is additive — a point of considerable practical value.

The third Note is concerned with an extremely important aspect of graduation: that of projection. It would be foolish to state categorically that a particular method for projection is good or bad. It suffices to say that the difference equation approach provides us with another tool. For example, in one of the other papers presented in November, 1967, on "The Minimum Absolute Deviation Trend Line" by Charles Cook (*PCAS* Vol. LIV, p. 200) a simple illustration was presented, involving the projection of the series: 110, 109, 112, 111, 115, 112, 113, 114, 112, 116, 114, 117, 119. Mr. Cook's procedure yields estimates for the next two points of 118.4 and 119.2. Fitting a straight line, via the method of least squares, yields 117.7 and 118.4. The Formula A process, using the author's specific case: $z = 2,\ a = 2,$ gives estimates of 118.9 and 120.0. (The interpolation method, fitting a 12th degree polynominal to the 13 points, yields -1723 as the next point, thus illustrating an extreme case where the measure of closeness of fit, by itself, is not adequate.) If one plots the actual data and these alternative estimates, it is easily "seen" that the Formula A estimates, in this particular case, are more realistic. Unfortunately, the procedure is extremely time-consuming in comparison to other methods. It also suffers the same fault as other methods — it is only as good as the assumed model fits the data. For example, it will not track a cyclical movement unless the latter has been programmed into the model.

Finally, in an attached appendix Mr. Valerius includes a very convenient tabulation of the coefficients for the iteration equations, corresponding to the more useful cases of Formula A.

DISCUSSION BY RICHARD H. SNADER

Mr. Valerius' notes on Whittaker-Henderson Formula A have provided casualty actuaries with an opportunity to improve one of the most powerful tools at their disposal. The problem of examining a series of data, detecting a trend, and projecting that trend is one with which we are all vitally concerned. To fully appreciate the value of his contribution, a brief synopsis of the basic concepts of graduation might be helpful.[1]

Graduation may be defined as the process of securing from an irregular series of observed values a smooth, regular series of values consistent in a general way with the observed series. The smooth series is then taken as a representation of the underlying law that gave rise to the observed values. The set of observed values is usually donated by $\{u_x''\}$ and the graduated values by $\{u_x\}$.

Graduation is characterized by two essential qualities, smoothness and fit. These qualities are not independent. An increase in smoothing results in a reduction in fit; conversely, when fit is improved, smoothness usually suffers. Whittaker-Henderson formulas are the product of the difference equation method of graduation. In this method, the graduated series is determined by a difference equation derived from an analytic measure of the relative emphasis placed on smoothness and fit.

The combination of smoothness and fit may be expressed by $F + hS$, where h is a positive number fixing the relative weight assigned to smoothness and fit. Smoothness is measured by the smallness of the sum of the squares of the z^{th} order of differences of the graduated values:

$$S = \sum (\Delta^z u_x)^2, \text{ where } \Delta \text{ is the difference operator.}$$

Closeness of fit is measured by the smallness of

$$F = \sum (u_x - u_x'')^2.$$

[1] The description of the graduation process is based almost entirely on Morton D. Miller's monograph *Elements of Graduation* published by the Society of Actuaries.

The best graduation, according to these assumptions, will result from requiring $F + hS$ to be as small as possible.

If each value of u can be considered an independent variable and $\{u_x''\}$ is considered to be a set of given constants, the expression $F + hS$ can be minimized by

$$\frac{\partial}{\partial u_x} F + h \frac{\partial}{\partial u_x} S = 0;$$

$$\frac{\partial}{\partial u_x} \sum (u_x - u_x'')^2 + h \frac{\partial}{\partial u_x} \sum (\Delta^z u_x)^2 = 0.$$

The conditions for a minimum are

$$(u_x - u_x'') + (-1)^z h \delta^{2z} u_x = 0;$$

$$u_x'' = u_x + (-1)^z h \delta^{2z} u_x,$$

where δ is the central difference operator. When second differences are minimized for smoothness $(z = 2)$, a fourth order difference equation results:

$$u_x'' = u_x + h\delta^4 u_x.$$

When third differences are minimized, $(z = 3)$, a sixth order difference equation results:

$$u_x'' = u_x - h\delta^6 u_x.$$

The difference equation can be factored into two lower order difference equations. For values of z equal to one, two, or three, the lower order equations are:

$$Eu''_{x+a} = Au'_x - Bu'_{x-1} + Cu'_{x-2} - Du'_{x+3}$$

$$Eu'_{x-a} = Au_x - Bu_{x-1} + Cu_{x+2} - Du_{x+3}$$

where $\{u_x' \pm a\}$ is an intermediate series. A new parameter, a, replaces h. The parameter, h, can be expressed in terms of a.

$$Z = 1,\ h = a(a + 1);$$

$$Z = 2,\ h = \frac{1}{4} a(a+1)^2 (a + 2);$$

$$Z = 3,\ h = \frac{a(a + 1)^3 (a + 2)^3 (a + 3)}{16(2a + 3)^2}$$

The coefficients A, B, C, D, and E are all expressible in terms of a. The purpose of a is to fix the relative emphasis to be placed on smoothness and fit. The factoring process results in the Whittaker-Henderson Type A formulas, and a practical method of utilizing the difference equation for graduation is obtained.

Practical Application

The usefulness of the Whittaker-Henderson Type A formulas in constructing mortality tables is well known. Until now, however, practical applications in casualty actuarial work have been virtually non-existent. The author points out that the graduation of a time series can be used for predicting the future. Graduation by mathematical formula is one method that can be employed; the difference equation method is another.

It is difficult to find material in the *Proceedings* concerning the problem of extrapolation of an observed series of data. Mr. Paul Benbrook discusses the need for trend and projection factors and describes an early method.[2] The method currently employed in automobile ratemaking is described by Mr. Philipp K. Stern.[3] It consists of finding the line of best fit, by the method of least squares, for several observations of average paid claim costs and extending the line to determine trend and projection factors. The same method is employed in the rate level calculations of the Multi-Line Insurance Rating Bureau and the Fire Insurance Research and Actuarial Association, except the data are observations of the Composite Current Cost Index.[4]

The procedure of extending the line of best fit is almost universally accepted. Although Charles F. Cook has given us a new method for fitting the line, no alternatives have been offered to the basic concept that trends must be determined from linear relationships.[5] It is not possible, however, that the line of best fit may not fit the observed data very well? A trend line applied to spiraling hospital costs, for example, may produce projections which are hopelessly inadequate.

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[2] Benbrook, Paul, "The Advantages of Calendar-Accident Year Experience and the Need for Appropriate Trend and Projection Factors in the Determination of Automobile Liability Rates," *PCAS* Vol. XLV, p. 20.

[3] Stern, Philipp K., "Current Rate Making Procedures in Automobile Liability Insurance," *PCAS* Vol. LII, p. 139.

[4] The Composite Current Cost Index is a weighted average of the Consumer Price Index and the Composite Cost Index. The Composite Cost Index is published by the Department of Commerce and is a composite of several indexes representative of the major types of construction.

[5] Cook, Charles F. "The Minimum Absolute Deviation Trend Line," *PCAS* Vol. LIV, p. 200.

The author's work with the Whittaker-Henderson formulas has given us an opportunity to examine what may prove to be a practical alternative to determining trends from the line of best fit. If the observed series is graduated by the difference equation method, the graduated series is a curve of predetermined complexity that fits the observed data with a predetermined degree of fidelity. When second differences are minimized for smoothness, for example, the graduated series is an approximation of a linear function. The extensions of the graduated series are linear. When third differences are minimized for smoothness, the resulting graduated series is an approximation of a second degree curve; and the extensions are points that lie on a second degree curve.

Because it is not applicable when the value of z exceeds three, Formula A is seriously limited. Higher order difference equations, however, can be solved by direct algebraic methods. For any values of z or h, the difference equation will lead to a series of n linear equations in n unknowns, n being the number of terms to be graduated. The graduated values are uniquely determined from these equations. The direct algebraic solution was once thought to be impractical, but with the advent of modern computers the degree of impracticality has been greatly diminished and should no longer be considered a deterring factor.

The following table is based on data taken from Stern's paper.[6] The raw data consists of automobile bodily injury liability average paid claim costs for twelve month periods ending in successive calendar quarters. Using the method described for Exhibit I in the appendix of Valerius' paper, two graduations have been performed and are compared with the line of best fit. The first graduation was made with $z = 2$ and $a = 2$. The second graduation was made with $z = 3$ and $a = 2$. The graduated values were extended for 18 months and projection factors calculated. The comparison indicates that the projection factor based on the line of best fit may have been inadequate.

[6] Stern, op. cit., p. 174–175.

Comparison of Values

Year Ended	Average Paid Claim Cost	Line of Best Fit	Graduation No. 1 $z=2, a=2$	Graduation No. 2 $z=3, a=2$	
3/31/60	624	600.00	604.84	611.56	
6/30/60	602	609.56	610.58	610.53	
9/30/60	603	619.12	617.39	614.29	
12/31/60	620	628.68	625.85	622.30	
3/31/61	624	638.24	635.74	633.25	
6/30/61	661	647.80	646.54	645.42	
9/30/61	669	657.36	657.05	657.14	
12/31/61	672	666.92	666.90	667.61	
3/31/62	678	676.48	676.34	677.09	
6/30/62	670	686.04	685.96	686.50	
9/30/62	690	695.60	696.39	696.82	
12/31/62	718	705.16	707.42	708.48	
3/31/63		714.72	718.44	721.49	
6/30/63		724.28	729.46	735.84	
9/30/63		733.84	740.49	751.53	Extrapolated
12/31/63		743.40	751.51	768.56	Values
3/30/64		752.96	762.53	786.93	
6/30/64		762.52	773.56	806.65	
Projection Factor		1.081	1.093	1.139	

AUTHOR'S REVIEW OF DISCUSSIONS

Mostly I have only to thank Messrs. Nelson and Snader for their kind reviews.

Mr. Nelson recalls reading my remarks of twenty-five years ago on the subject of Whittaker-Henderson formulas, incidental to a paper on tables of risks inferred from the then rather new "excess ratio" tables. He says excess ratios were his main concern and the passing remarks on Hendersonian graduations got but passing attention from him. That was the emphasis intended. I wonder if he missed, as I find others have, the graphs which were for some reason printed on pages preceding the paper.

Graphical representations are so useful. I have read that the great Karl Pearson stressed graphical treatment. Therefore I appreciate Mr. Nelson's word that when one plots the actual and the smoothed data, the measure of relevancy in graduations is "seen."

There had been no references to Whittaker-Henderson formulas in the Proceedings before 1942. We were investigating the implied distributions of risks by loss ratio, floundering in trial and error, when Dr. Franklin Satterthwaite, who was then in our companies' group insurance operations and active in this Society, suggested that Formula A, as found in C. A. Spoerl's paper, was the tool to use, and so it proved. This was my introduction to Formula A. One fixed impression as to the formula I expressed at that time: "The biggest difficulty in a Whittaker-Henderson Formula A graduation is to get the right start."

In the course of using the formula now and then over the years, not ungrateful for Spoerl's corrections for unsatisfactory starts given in his paper, the impression remained. The right start was still the stumbling block. The "involved methods," of which the Society of Actuaries' Monograph speaks, seemed not in keeping with the relative simplicity of the operating formulas. Therefore, a year or two ago, I was happy to discover that Henderson's auxiliary u''' column for deriving initial values could be lengthened out by the up-and-down iteration to any desired accuracy of initial values.

Mr. Snader tries out the fourth- and sixth-order difference equation graduations on P. K. Stern's average paid claim costs (Snader's Graduation No. 1 and Graduation No. 2). He used $a = 2$. The smaller the a, the weaker the graduating effect. I would prefer $a \geqq 3$ for Graduation No. 2 because the stronger graduating effect when minimizing the higher order of differences seems desirable. It is interesting that Graduation No. 1 produces practically the same projection factor as fitting the line to the logs of the average claim values instead of to the values themselves. This substitutes a least squares pro rate increase for a least squares absolute increase.

A comment on the time-consuming aspect may be in order. It is my experience that a person reasonably conversant with the processes could complete any of the graduations mentioned, the one in the Notes and the several in the Reviews, in an hour or two with an office desk calculator.

Both the paper and the reviews have referred to laws underlying the data. I trust this does not commit any of us to any rigid views about the nature of phenomena.

MINUTES OF THE 1968 SPRING MEETING

May 19-22, 1968

KUTSHER'S COUNTRY CLUB, MONTICELLO, NEW YORK

The Council of the Society met on Sunday, May 19, from 2:00 to 4:35 p.m. In the evening of that day there was a reception for the membership present.

The Spring Meeting was formally convened at 9:30 a.m. with President Harold W. Schloss presiding.

The registered attendance indicated the following 98 Fellows, 39 Associates and 22 invited guests.

FELLOWS

Aldrich, W. C.
Alexander, L. M.
Allen, F. S.
Balcarek, R. J.
Barber, H. T.
Barker, G. M.
Bennett, N. J.
Berquist, J. R.
Blodget, H. R.
Bornhuetter, R. L.
Brannigan, J. F.
Budd, E. H.
Boyajian, J. H.
Boyle, J. I.
Byrne, H. T.
Carleton, J. W.
Cima, A. J.
Cook, C. F.
Crandall, W. H.
Curry, A. C.
Curry, H. E.
Dahme, O. E.
DeMelio, J. J.
Dorf, S. A.
Dropkin, L. B.
Ehlert, D. W.
Eide, K. A.
Even, C. A., Jr.
Fairbanks, A. V.
Finnegan, J. H.
Fitzgibbon, W. J., Jr.
Flaherty, D. J.
Forker, D. C.
Foster, R. B.
Fowler, T. W.
Gibson, J. A., III
Gillam, W. S.
Gillespie, J. E.
Graves, C. H.
Hart, W. Van B., Jr.
Harwayne, F.
Hazam, W. J.
Hope, F. J.
Hughey, M. S.
Hurley, R. L.
Johe, R. L.
Johnson, R. A.
Kallop, R. H.
Kates, P. B.
Klaassen, E. J.
Lange, J. T.
Leslie, W., Jr.
Linder, J.
Lino, R.
Liscord, P. S.
MacGinnitie, W. J.
Masterson, N. E.
Mayerson, A. L.
McClure, R. D.
McGuinness, J. S.
McNamara, D. J.
Meenaghan, J. J.
Menzel, H. W.
Mohnblatt, A. S.
Moseley, J.
Muetterties, J. H.
Murrin, T. E.
Nelson, D. A.
Newman, S. H.
Niles, C. L., Jr.
Oien, R. G.
Otteson, P. M.
Petz, E. F.
Pollack, R.
Portermain, N. W.
Presley, P. O.
Richards, H. R.
Resony, J. A.
Riddlesworth, W. A.
Roberts, L. H.
Rodermund, M.

FELLOWS

Rosenberg, N.
Roth, R. J.
Salzmann, R. E.
Scheibl, J. A.
Schloss, H. W.
Scott, B. E.
Simon, L. J.
Skelding, A. Z.
Smith, E. R.
Stankus, L. M.
Tapley, D. A.
Tarbell, L. L., Jr.
Trudeau, D. E.
Uhthoff, D. R.
Verhage, P. A.
Webb, B. L.
Wilcken, C. L.

ASSOCIATES

Atwood, C. R.
Bell, A. A.
Ben-Zvi, P. N.
Bickerstaff, D. R.
Bland, W. H.
Brown, W. W., Jr.
Carson, D. E. A.
Feldman, M. F.
Ferrari, J. R.
Flynn, D. P.
Franklin, N. M.
Fulton, C. B., Jr.
Gill, J. F.
Gould, D. E.
Hachemeister, C. A.
Hammer, S. M.
Holt, W. T.
Hunter, J. R.
Jacobs, T. S.
Jensen, J. P.
Jones, A. G.
Kaur, A. F.
Munro, R. E.
Murray, E. R.
Peel, J. P.
Plunkett, J. A.
Quinlan, J. A.
Raid, G. A.
Ratnaswamy, R.
Royer, A. F.
Scammon, L. W.
Scheel, P. J.
Singer, P. E.
Snader, R. H.
Stein, J. B.
Strug, E. J.
Torgrimson, D. A.
Welch, J. P.
Winter, A. E.

GUESTS

*Benson, L. E.
*Blane, R.
*Connolly, C. T.
Cooper, W. P.
Denenberg, H.
Diemand, J. A., Jr.
Farr, D. G.
Foody, W.
Fox, A. E.
*Griffith, R. W.
Harrington, T. M.
*Hayden, R. C.
Heitzmann, R. D.
Horn, R. J.
*Kedrow, W. M.
*Nagel, J. R.
*O'Shea, H. J.
Plotkin, I. H.
Rothbart, H.
Song, Y. B.
Stewart, R. E.
*Strong, H. L.

*Invitational Program

The first order of business was the enrollment of Clarence R. Atwood who had fulfilled all of the examination requirements as an Associate of the Society.

President Schloss then introduced the Honorable Richard E. Stewart, Superintendent of Insurance of the State of New York, who presented some remarks on property and liability insurance rating as viewed by the insuring public, the ratemakers (representing private industry), and the rate regulatory authorities.

After a short coffee break there was a panel discussion on "Investment Income in Insurance Rates":

Moderator — Allen L. Mayerson, Professor of Insurance and Actuarial Mathematics, University of Michigan.

Panelists — John W. Carleton, Vice President, Liberty Mutual Insurance Company.
John S. McGuinness, President, John S. McGuinness Associates, Consultant in Actuarial Science and Management.
Jack Moseley, Associate Actuary and Assistant Vice President, United States Fidelity and Guaranty Company.
Irving H. Plotkin, Department of Economics, Massachusetts Institute of Technology.

There followed questions and answers between the panel participants as well as from the floor.

The Monday morning session recessed for lunch at 12:50 p.m. and the afternoon session was devoted to various Committee meetings that had been called by the Chairmen.

The meeting reconvened at 9:15 a.m. on Tuesday, May 21 with Vice President Daniel J. McNamara presiding.

During the first half of the morning session there was held a symposium on the topic "If I Were a Part of Top Management" among the following members of the Society:

Moderator — William Leslie, Jr.

Participants

William C. Aldrich	James J. Meenaghan
Charles F. Cook	Neill W. Portermain
Alan C. Curry	Jerome A. Scheibl
Charles A. Even, Jr.	Brian E. Scott
W. James MacGinnitie	Edward R. Smith

Following this there were held three concurrent seminars:

A — "Education and Examination of Future Actuaries" led by Norman J. Bennett and Richard L. Johe.

B — "Mathematical Theory of Risk" led by Lester B. Dropkin and Jeffrey T. Lange.

C — "Actuarial Aspects of Mass Marketing" led by James E. Gillespie and Richard E. Munro.

After a recess for lunch the session reconvened at 2:00 p.m. for a panel discussion "Meeting the Insurance Crisis of our Cities":

Moderator — Professor Herbert S. Denenberg, University of Pennsylvania, and Research Director and Special Counsel to the President's National Advisory Panel on Insurance in Riot Affected Areas.

Panelists — Gordon M. Barker, Actuary, Great American Group.
Edward H. Budd, Vice President, The Travelers Insurance Company.
John A. Diemand, Jr., Vice President, Insurance Company of North America.
M. Stanley Hughey, Executive Vice President, Lumbermens Mutual Casualty Company.

Following conclusion of the remarks by the panelists there ensued a lively interchange of questions and remarks from the audience and among the panelists.

The session was adjourned at 4:30 p.m. to be followed in the evening by a reception and banquet.

The meeting reconvened at 9:15 a.m. on Wednesday morning. After some opening announcements by President Schloss, conduct of the meeting was turned over to Vice President William J. Hazam.

A. Presentation of New Papers

(1) Gerald R. Hartman and Jeffrey T. Lange — "Rate Regulation and the Casualty Actuarial — Revisited" — summarized by Jeffrey T. Lange.

(2) Norton E. Masterson — "Economic Factors in Liability and Property Insurance Claims Costs — 1935–1967."

(3) Russell P. Goddard — "Total Earnings from Insurance Operations — The Investor's Viewpoint." The author's summarization was read by Ruth E. Salzmann.

B. Reviews of Previous Papers

(1) Author, Charles F. Cook — "The Minimum Absolute Deviation Trend Line." Reviewed separately by David P. Flynn and Ken-

neth L. McIntosh. In the absence of Mr. McIntosh his review was presented by Lester B. Dropkin. Mr. Cook then commented on the reviews of his paper and there were additional comments from the floor.

(2) Author, Lewis H. Roberts — "A Discipline for the Avoidance of Unnecessary Assumptions." Reviewed separately by Robert L. Hurley and Philip O. Presley. Mr. Roberts then presented his comments on these reviews.

(3) Author, Nels M. Valerius — "Notes on Whittaker-Henderson Formula A." Reviewed separately by Dale A. Nelson and Richard H. Snader. In the absence of the author, Walter J. Fitzgibbon, Jr. read the comments of Mr. Valerius on these reviews.

At this point President Schloss resumed the Chair and received the verbal reports from Messrs. Johe, Dropkin, and Gillespie relating to the discussions in the three concurrent seminars held on Tuesday morning.

Dunbar R. Uhthoff, President of the Midwest Actuarial Forum, and Roger A. Johnson, Vice President of the Actuaries Club of Philadelphia, then reported on recent activities of their respective organizations.

President Schloss announced:

(1) Appointment of the Nominating Committee — William Leslie, Jr., Chairman; Thomas E. Murrin, and Harold E. Curry.

(2) The Diplomat Country Club in Hollywood, Florida, had been selected as the site of the May 1970 meeting of the Society.

(3) A Committee on Future Sites, Paul S. Liscord, Chairman, had been appointed to make recommendations to the Council as respects potential sites for Society meetings for the next 5-10 years.

The foregoing completes the record of the May 1968 Spring Meeting of the Casualty Actuarial Society, the limitation of time not permitting the contemplated presentation to the membership of a report on Society administrative procedures and policies as well as a summarization of various Committee reports.

The Spring 1968 Meeting was adjourned at 12:00 noon.

Respectfully submitted,

A. Z. SKELDING,
Secretary-Treasurer

VOLUME LV, Part II No. 104

PROCEEDINGS

NOVEMBER 17, 18, 19, 1968

THE ECOLOGY OF AN ACTUARY

PRESIDENTIAL ADDRESS BY HAROLD W. SCHLOSS

Introduction

In scheduling this meeting, the vice presidents have kindly permitted me to make remarks at the opening session each day. I should like to think that I occupy this lead-off position because of the high respect in which they hold the office of the president. However, it is more likely that the vice presidents, knowing the propensity of some of our members to be late risers, have preferred that latecomers enter the meeting while I am on the podium rather than when the speakers to follow are presenting their material.

I had intended merely to welcome you to the meeting this morning and to speak again tomorrow morning, but the business session is particularly full and to leave more time for the admission of new members, the elections, and the presentation of new papers, I shall take this opportunity to deliver the presidential remarks.

I am glad that the By-Laws use the term *remarks* whereas formerly the president made an *address*. The word *remarks* suggests that I may speak informally and without profundity, and for this I am grateful.

In reviewing what has been said by my predecessors, I have been struck by the diversity of style. Some talks have been general and some technical, some provincial and some cosmopolitan, some simple and some sophisticated. But a common thread links them all in that each president has addressed the members on what he felt was important to their times. I shall adhere to this precedent.

The Regulatory World

Having only recently been through the national elections, we would naturally consider first the outlook for legislation and regulatory changes in the years ahead with respect to the insurance business in which we are engaged. Within the past few years sentiment has built up in opposition to prior approval rate regulatory laws and, in fact, we have had some recent successes in several states which have adopted no-file legislation. This desirable outcome exceeded the expectations of portions of the industry who would have found acceptable even a modification of prior approval laws. This year the trend will undoubtedly continue because we have already heard announcements of support for the principles of file-and-use rate regulation from the insurance commissioners of some important high volume states. We may therefore derive considerable satisfaction from this desirable trend.

However, file-and-use legislation, while helpful, is not a panacea for the industry's rate problems. It is as important to have intelligent administration of a rating law as it is to have an intelligent law in the first place. If administrative procedures are developed which require prior informal clearance with state supervisory authorities, or if there are actual or implied threats of a subsequent disapproval, then the automatic response of rates to market conditions will be inhibited and we shall not receive from file-and-use legislation the benefits which we expect. Two decades ago when prior approval laws were being enacted, they too appeared on paper to be satisfactory to most people, but the regulatory performance did not live up to the promise in some jurisdictions.

Furthermore, while we have often been able to legitimately complain that regulatory officials were not responding to the legislative mandate that rates be adequate, in some cases this complaint has been a crutch. It is desirable that we lose this excuse, so that if things go badly we should have no one to blame but ourselves.

Despite the encouraging outlook for less oppressive rate regulation, on the whole we should expect more rather than less regulation in the years ahead. However, the thrust will be different. One area which will receive increased attention is the matter of carrier insolvency. Such attention we should applaud because much damage has been done to our entire industry by the consequences of inept or irresponsible operation by a quite small and insignificant part of the business. While the relative proportions of this activity are very small, the absolute impact has been sufficiently intense to arouse the legislatures. Increasing minimum capital requirements or increasing licensing requirements would be a start but these measures are simply not sufficient. Even beyond these requirements, we need to develop guidelines which would enable us to distinguish the weak from the strong. It is not enough for a carrier to be solvent, it should be solid.

While we may all be agreed upon the desirability of reducing insolvency, there probably will be less agreement on the means to do so. For example, I suggest that stronger licensing requirements are more desirable than the proliferation of security funds. The latter approach does not forestall insolvency but merely ameliorates its effects; it taxes the efficient to subsidize the inefficient; and it reduces the carrier's ability to respond from its central resources to any demands which may be made upon it.

Much more serious I believe is the trend to regulation which circumscribes the freedom of the carrier to underwrite and which requires the business to provide markets. This is not a new development. We have had state funds for this purpose since the development of workmen's compensation insurance. Subsequently, with the growth of automobile liability insurance, assigned risk plans were developed for the purpose of supplying market needs. The latest manifestation of this trend is the recent development of FAIR plans in about two-thirds of the states. We have learned to use acronyms to improve semantics but a FAIR plan is simply another device to provide a market.

Much of the mandate to provide coverage is a consequence of inadequate rate levels, and with greater liberty in pricing the problem can be minimized. However, whenever there are segments of the market which cannot be rated appropriately, you will find cream-skimming, or unmet needs for coverage. These situations create pressures on legislatures and regulatory officials to invent schemes to spread the burden of providing this market upon the entire industry.

It has long been established, and is now without question, that unfair discrimination has no place in our business; but now there is a tendency to regard discrimination per se as undesirable, and included in discrimination per se would be fair discrimination in rates. Thus, we are caught in a bind. On the one hand, we need even greater discrimination in our rate structure to the end that we can meet the classical test of prices in the sense that they be what a willing buyer would pay a willing seller. To minimize market dislocation, our goal as ratemakers, perhaps unattainable, is to make all risks equally desirable to underwriters. On the other hand, we have these pressures for uniformity in prices and mandatory markets.

All in all, we should expect more regulation in the future although it may be in different areas than we have been accustomed. This is a sociological problem and we must not feel that we are being harrassed because we are in the insurance business. Perhaps the grass looks greener on the other side of the fence simply because we are not on the other side of the fence. It is difficult to think of an industry that escapes regulation. Surely not the tobacco companies, nor the pharmaceuticals, nor the railroads, nor the utilities. Our planet is becoming more crowded, and laws and regulations are the way we respond to the needs of society.

We still have a private enterprise system but it is no longer free in the *laissez faire* sense. We nevertheless do need the liberty to respond to legitimate needs. It is said that justice requires the government to protect the consumer, and undoubtedly our liberty to operate freely is, and will continue to be, circumscribed, but I feel that justice for the buyer of insurance and liberty for the business which provides it are compatible; they are not opposite notions. This is the American concept. After all, when we pledge allegiance to our flag, do we not proclaim "liberty and justice for all"?

The Economic World

You are all undoubtedly familiar with the report by the President's National Advisory Panel on Insurance in Riot-Affected Areas. To me, its outstanding feature was neither its recommendation of a national insurance development corporation, nor its recommendation of FAIR plans. Its outstanding feature was the simple, seven-word sentence which opens chapter two: "Insurance is first of all a business." It is heartening to note the recognition of this fact by any governmental body, even one serving only in an advisory capacity. But it is also disheartening that this lesson has had to be learned the hard way by many of us. So, in addition to observing the regulatory world, I think it is necessary for us to give consideration to the economic world in which we live.

Economic laws are just as rigid in their disciplines as man-made laws and may be disputed only at peril. We have seen in the past twenty years the inability of carriers generally to make an underwriting profit, although there are notable exceptions. For a long period of time, the stocks of property and liability carriers sold at discounts from book value. During the course of the greatest bull market in history, hard-nosed investors putting their own money on the line were telling us that it was economically more desirable to liquidate carriers than to keep them operating, that carriers were worth more dead than alive. However, instead of wholesale liquidation, decapitalization gradually occurred.

Decapitalization took a variety of forms. One obvious method was the purchase by a carrier of its own stock at discounts from book value which, in some states, was then required by law to be retired, and in others, used to fund non-insurance operations. It is a reasonable assumption that the people who tendered their stock under such a program was disenchanted with our business and likely to reinvest the funds elsewhere. Another method was the development by insurance companies of holding companies to facilitate engaging in financially related operations. While this action might not actually have involved reduced capitalization, there was nevertheless a diversion of capital from the property and liability underwriting business. Then there was decapitalization which occurred in a less obvious way. By tradition, or, may I say more properly, by habit, stock carriers have paid stockholders dividends out of investment income. When the dividend payout, however, exceeds the combined underwriting and investment income after taxes, we have in essence further decapitalization. Were this process to continue long enough, even the Internal Revenue Service would not regard such dividends as income to the recipients, but rather as a return of capital.

The year 1968 has been most remarkable in terms of changes in corporate structure in our business. There has been an acceleration of holding company formation and, in addition, there has been a marked improvement in the market position of carriers' stocks. These changes have come about because our business has attracted the attention of conglomerate corporations which, however, assuredly have not been intrigued by our profitable underwriting business. Undoubtedly, they have been attracted by the financial aspect of insurance carrier operations. We have known for some time about our inadequate returns from property and liability insurance underwriting, but a recent report which employed sophisticated, econometric techniques has validated this knowledge and measured our adjusted return vis-a-vis other industries in the United States. The business has been producing a rate of return in the neighborhood of 4% to 5%, which is much less than any other industry has been earning, and this return furthermore included the very substantial security appreciation which carriers have enjoyed in their investment portfolios. It is questionable whether security appreciation, especially if it is unrealized, may properly be regarded as income. Thus the conclusion is even stronger that capital invested in the insurance business has been under-earning. Is it any wonder that attempts will be made from within and without the insurance business to improve this return? Why be content with a 4% return if 8% or 12% or even 16% can be obtained?

An economic lesson which we must learn is that capital will go wherever it is made welcome. Nations learn this on the international scene and the insurance business is learning it on the domestic scene. While the A. D. Little Report concluded that the industry would have difficulty raising necessary capital at current levels of earnings, the industry's position is even worse because capital has actually been fleeing to more hospitable abodes. However, the flight of capital from the business is not necessarily undesirable because the productivity of the remaining capital should increase as returns seek their equilibrium, in accordance with another law of economics, the law of supply and demand.

The Actuarial World

Having taken a look at the worlds about us, I think we ought now to look inward at the world of actuarial practice. This can consume the entire meeting, and therefore I shall touch upon just one aspect of it. Were I limited to a one-word description of the core of an actuary's function, that word would be "valuation," and in valuation, the area of loss reserving is at once the most difficult, and our methods are still the most primitive.

We need much improvement in the statistical techniques of loss reserving. We need research which will, by utilizing the parameters of exposures, claim frequency, and claim severity, and changes in these, enable the construction of dynamic models of carrier liabilities. Actuarial science is a "soft" science and in the realm of loss reserving is perhaps as much art as science.

The organization of insurance carriers is such that the major portion of their loss reserve structures is established by claim departments and therefore only to a limited extent are actuaries directly responsible for the establishment of most reserves. What we are responsible for is an evaluation of the loss reserves established for the company. We are responsible for advising our managements whether loss reserves are adequate or redundant and we are responsible for making an estimate of the inadequacy or redundancy, as difficult as this may be.

Every facet of an insurance carrier's operation is affected by the accuracy or inaccuracy of its loss reserves, and without an attempt to appraise their position one cannot determine the underwriting results of the company and its surplus position, and what its experience has been. Without accurate agency and territorial experience marketing departments cannot formulate sales campaigns. Without accurate classification experience underwriters cannot properly determine an underwriting program. Without accurate basic experience reported to rating bureaus or used by independent ratemakers, one cannot establish appropriate manual or tariff rates no matter how refined and sophisticated the rating algorithm. Where rating plans permit the underwriter to have a part in the determination of the collected rate, accurate risk experience is required by him. Even carriers' investment departments are affected because the investment portfolios usually are tailored to balance sheet considerations.

The stocks of insurance carriers receive increasing attention and security analysts have been adjusting company results to more closely align them with operating results as would be produced with "generally accepted accounting principles" as compared with "insurance accounting principles." A common adjustment is to reflect so-called equity in premium reserves. I have never seen an adjustment for equity in loss reserves, that is, the margin between the loss reserves actually carried on the company's books and the company's liabilities. I do not think there is any difference between the loss reserves called for by "insurance" accounting principles and by "generally accepted" accounting principles. In each case, loss reserves should be accurately stated. If there is an adjustment to be made because of such a difference, very likely it is too difficult for an outsider to determine the appropriate adjustment; indeed, it would be difficult for the actuary himself even with the availability of internal statistics.

A recent study has shown a rather poor performance in the establishment of loss reserves by insurance carriers during the 1960's through 1966, and we actuaries share in the responsibility for this performance. During this period, there has been a general erosion of reserve margins, which means that statutory underwriting results have been overstated and that the actual returns to the business are probably even lower than we now believe. Furthermore, there is an indication that a number of carriers crossed the barrier between adequacy and inadequacy around 1963 and that in the next several years their loss reserves were inadequate. This inadequacy has resulted in an overstatement of the true surplus of such carriers and an overstatement of their true profit.

Within the last couple of years attempts to keep pace with reserve requirements have accentuated the currently poor underwriting results. What the recent study revealed has been confirmed by statements which have already appeared in the reports of a number of companies. Please bear in mind that the decline in reserve margins and the possible inadequacy of reserves is not confined as it used to be to the marginal carrier. I am now talking about some of the very finest names in the business and of companies which are renowned nationally for the excellence of their managements.

What has happened during this period? I referred earlier to a general indication that some carriers' reserves became inadequate in 1963. Consider the fact that while most claims are settled quickly, the large ones hang on for a number of years and on average it takes two years to settle the average claim on a dollar basis. The year 1965 produced a sharp increase in inflationary tendencies in the United States arising out of the Vietnam war and this development simply was not foreseen in 1963. So one explanation is that we have had a phenomenon at work which is analogous to Isaac Newton's first law; that is, we were able to accommodate ourselves to a moderately inflationary trend, but fell behind when it accelerated. What we knew in theory has become crystal clear to us in the last several years, that in the insurance business inflation can be a worse disaster than riots or hurricanes.

If you wish to obtain a good grasp of what has happened, take a look at our old friend Schedule P. Do not use Part 5 which develops incurred losses and therefore dampens the impact of inflation, but rather transpose Schedule P into the format of Schedule O, and obtain a real run-off of loss reserves.

Conclusion

In speaking to you about the regulatory world, the economic world, and the actuarial world, I mean to illustrate the theme that the actuary has ecological relations. When Charles Darwin produced *Origin of Species* he wrote about birds and beasts. But the idea of natural selection applies as well to institutions and professions, to insurance carriers and actuaries. Each of us must develop and adapt to our respective environments. No company can ignore this law of nature no matter how large or strong; consider the case of the dinosaur. Each of us likewise must continue to grow and adapt to the environment in which we serve in order to flourish in our professional capacities.

ON THE CREDIBILITY OF THE PURE PREMIUM

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With two exceptions, the many papers on credibility which have appeared in the *Proceedings* of the Casualty Actuarial Society have been concerned only with the credibility of the number of claims. From Whitney[1] to Mayerson[2] the theory has been based on the distribution of the number of claims alone, ignoring the distribution of claim amounts.

By assuming that the number of claims has a Poisson distribution, and approximating probabilities by use of a normal distribution, Whitney[3] and Perryman[4] developed a criterion for full credibility in terms of the expected number of claims. Bailey[5] and Mayerson[6] showed that the partial credibility formula $z = \frac{n}{n+k}$ holds for several distributions in addition to the normal. Buhlmann[7] derived this formula on a distribution-free basis for the claim amounts and the claim frequency.

Two papers which deal specifically with the credibility of the pure premium are Perryman[8] and Longley-Cook.[9] Perryman[10] states: "the volume of exposure required for full credibility of the pure premium requires the multiplication by the factor $1 + \frac{S^2}{M^2}$ of the number of claims required for credibility of the accident frequency." (M and S are the mean and standard

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[1] Whitney, A. W., "The Theory of Experience Rating," *PCAS* Vol. IV, p. 274 (1918).

[2] Mayerson, Allen L., "A Bayesian View of Credibility," *PCAS* Vol. LI, p. 85 (1964).

[3] Whitney, A. W., *op. cit.*

[4] Perryman, F. S., "Some Notes on Credibility," *PCAS* Vol. XIX, p. 65 (1932).

[5] Bailey, A. L., "Credibility Procedures, " PCAS Vol. XXXVII, p. 7 (1950).

[6] Mayerson, Allen L., *op. cit.*

[7] Buhlmann, Hans, "Experience Rating and Credibility," *ASTIN Bulletin* Vol. IV, p. 199 (1967).

[8] Perryman, F. S., *op. cit.*

[9] Longley-Cook, L. H., "An Introduction to Credibility Theory," *PCAS* Vol. XLIX, p. 194 (1962).

[10] Perryman, F. S., *op. cit.*, p. 72.

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deviation of the claim amount distribution.) Longley-Cook[11] derives Perryman's result in a slightly different form.

The credibility tables in general use are based on the distribution of the number of claims, but they are applied, in practice, to the pure premium. The standard for full credibility generally used in automobile liability insurance is 1,084 claims, corresponding to a normal distribution probability of 90% that the actual number of claims will not deviate from the expected number by more than 5% of the expected number (on the assumption that the mean is equal to the variance). For general liability insurance, the standard is usually 683 claims; this corresponds, on the assumption that the mean equals the variance, to a normal curve probability of 95% that the actual number of claims will not deviate from the expected number by more than 7½%. In neither case is the distribution of claim amounts taken into consideration, although these credibility tables are routinely used for ratemaking, where the pure premium, rather than the expected number of claims, is being determined. This procedure has recently been subject to criticism (Braverman[12]).

This paper will present a criterion for full credibility of the pure premium which does not depend on a specific distribution assumption for either the claim frequency or the claim severity.

PERRYMAN'S DERIVATION

Perryman assumed that the expected number of claims "is large so that the frequency distribution of the average claim cost is fairly normal."[13] He also followed earlier authors in assuming that claim frequency is approximately normally distributed and, in working with the pure premium, the product of the claim frequency and the average claim cost, he assumed that it, too, is approximately normally distributed. The approximate normality of the pure premium is an implication of the Central Limit theorem, rather than a consequence of the approximate normality of the claim frequency and the average claim cost. It should be noted that the density of the product of two random variables, both of which are normal, is not normal.

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[11] Longley-Cook, L. H., *op. cit.*, Appendix C.

[12] Braverman, Jerome, D., "A Critique of Credibility Tables," *JRI* Vol. XXXIV, p. 409 (1967).

[13] Perryman, F. S., *op. cit.*, p. 72.

We will show that it is not necessary to assume that the claim frequency and the average claim cost are normally distributed. Perryman's results are valid if we assume that the number of claims has any distribution with equal mean and variance, and that the pure premium is normally distributed. We will also derive a criterion for full credibility based only on the moments of the distribution of the number of claims and on the moments of the claim amount distribution—without making an assumption about the specific form of either distribution. This derivation will permit the abandonment of the usual assumption, which underlies credibility tables in use today, that the number of claims, the size of a single claim, or the pure premium is normally distributed. Credibility tables can be based on moments derived from actual data, rather than on a hypothesis about the form of the distribution of the number of claims or of the pure premium.

A CRITERION FOR FULL CREDIBILITY

In a given classification (which may be, for instance, a territory), let N be the number of claims and let $X_1, X_2, X_3 \ldots\ldots$ be the individual claim amounts, in order of occurrence. Define a random variable T to be $X_1 + X_2 + X_3 + \ldots\ldots + X_N$, the sum of a random number of random variables. T, of course, can be interpreted as the total amount of claims. We will assume that: (a) the random variables $X_1, X_2, X_3, \ldots$ are indentically distributed, (b) that the random variables $N, X_1, X_2, \ldots\ldots$ are independent, and (c) that the random variables $N, X_1, X_2, \ldots\ldots$ have fourth moments.

We now define the concept of full credibility for the pure premium derived from the experience of a given classification during a given time period. This definition will depend upon two parameters, k and P, and is identical with Perryman's criterion (the observed pure premium should be within 100 $k\%$ of the expected pure premium with probability P). We will express our criterion in terms of T, the total amount of claims. (The pure premium can be derived from T by dividing by the exposure, which is a constant.)

Definition: A classification is said to be *fully credible* (k, P) if

(A) $Pr[(1-k)E(T) \leq T \leq (1+k)E(T)] \geq P$

or equivalently, in terms of the standardized linear translate of T

(B) $Pr\left[\frac{-k\,E(T)}{\sigma_T} \leq \frac{T-E(T)}{\sigma_T} \leq \frac{k\,E(T)}{\sigma_T}\right] \geq P.$

In practice, the exact distribution of T, the total amount of claims, is not available. Some approximation must be used to determine whether, for a given k and P, inequality (B) is satisfied. Perryman used the standard normal distribution to approximate the distribution of $\dfrac{T - E(T)}{\sigma_T}$. Since the normal distribution is symmetric, inequality (B) is satisfied if and only if $t_{(1+P)/2} \leq k \dfrac{E(T)}{\sigma_T}$ where $t_{(1+P)/2}$ is the $100\left(\dfrac{1+P}{2}\right)$ percentile point of the approximating distribution for $\dfrac{T - E(T)}{\sigma_T}$, in this case the standard normal distribution. Thus, for $P = .90$ we use the value $t_{.95} = 1.645$, as given in any table of the normal distribution function.

In this paper, the percentiles of the distribution of $\dfrac{T - E(T)}{\sigma_T}$ will be approximated by the first few terms of an expansion due to E. A. Cornish and R. A. Fisher (see Bowers[14]). The Cornish-Fisher expansion expresses a percentile of the distribution of $\dfrac{T - E(T)}{\sigma_T}$ as a percentile of the standardized normal distribution and certain correction terms, which adjust for the departure from normality of the distribution of T. The expansion requires a knowledge only of the moments of T. If z_e denotes the $100e$ percentile of the standard normal distribution, and t_e denotes the $100e$ percentile of $\dfrac{T - E(T)}{\sigma_T}$, the sum of the first few terms of the Cornish-Fisher expansion is:

$$\text{(C)} \quad t_e = z_e + \frac{\gamma_1}{6}(z_e^2 - 1) + \left[\frac{\gamma_2}{24}(z_e^3 - 3z_e) - \frac{\gamma_1^2}{36}(2z_e^3 - 5z_e)\right],$$

where $\gamma_1 = \dfrac{E[T - E(T)]^3}{\sigma_T^3}$ and $\gamma_2 = \dfrac{E[T - E(T)]^4}{\sigma_T^4} - 3$. Perryman's result can be obtained by omitting all terms after the first (thereby assuming that T is normally distributed) and solving the inequality $t_{(1+P)/2} \leq k \dfrac{E(T)}{\sigma_T}$, for a given P and k, under the assumption that $E(T) = \sigma_T^2$.

We now express the moments of T in terms of the moments of N and of the X_i's. These moments are needed in inequality (B) and to compute

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

the γ's used in the Cornish-Fisher expansion (C). We will use a property of conditional expectations (see Brunk[15]):

$$E\,[g(T,N)] = E_N\,[E\{g(T,N)\mid N\}]\,.$$

In the formulas which follow:

$$E(N) = \lambda \qquad E[(N-\lambda)^i] = \lambda_i \qquad \text{for } i = 2, 3, \ldots\ldots$$

$$E(X) = \mu \qquad E[(X-\mu)^i] = \mu_i \qquad \text{for } i = 2, 3, \ldots\ldots$$

Since $E(T \mid N) = E(X_1 + X_2 + X_3 + \ldots\ldots + X_N \mid N) = N\mu$, it follows by setting $g(T,N) = T$ that $E(T) = E_N\,[E(T \mid N)] = E(N\mu) = \mu E(N) = \mu\lambda$.

Now let $g(T,N) = (T - \mu\lambda)^2 = [T - E(T)]^2$.

Since $E\,[(T-\mu\lambda)^2 \mid N] = E\,[\{(T - N\mu) + (N\mu - \lambda\mu)\}^2 \mid N]$

$= N\mu_2 + \mu^2(N-\lambda)^2$, it follows that

$$E\,[\{T - E(T)\}^2] = E_N\,[N\mu_2 + \mu^2(N-\lambda)^2]$$

$$= \mu_2\lambda + \mu^2\lambda_2.$$

We can also show, by a similar algebraic development, that:

$$E[\{T-E(T)\}^3] = \mu_3\lambda + 3\mu_2\mu\lambda_2 + \mu^3\lambda_3,$$

$$E[\{T-E(T)\}^4] = \mu_4\lambda + 3\mu_2^2(\lambda_2 - \lambda + \lambda^2) + 4\mu\mu_3\lambda_2 + 6\mu^2\mu_2(\lambda_3 + \lambda\lambda_2) + \mu^4\lambda_4.$$

We now apply the Cornish-Fisher expansion, using the moments just developed. In applications involving risk theory, $E[\{T-E(T)\}^3]$ is greater than zero, since all terms in the formula, except μ_3 and λ_3, are positive. In the usual models for the number of claims, the Poisson distribution or the negative binomial, λ_3 is positive; claim amounts, too, have positive skewness in most lines of property and casualty insurance, so μ_3 is also greater than zero. Thus the third central moment of T, hence λ_1, is positive, hence $t_{(1-P)/2}$ and $t_{(1+P)/2}$ are not equal, as they are in the case of a symmetric distribution like the normal. Because positive skewness implies that the longer "tail" of the distribution is to the right of the mean, $t_{(1+P)/2}$ is greater than $|\,t_{(1-P)/2}\,|$ for values of P of interest in credibility theory. To satisfy the inequality (B) we will set $\dfrac{k\,E(T)}{\sigma_T} = t_{(1+P)/2}$ which produces an

[15] Brunk, H. D., *An Introduction to Mathematical Statistics*, Blaisdell Publishing Co., 1965.

interval with probability greater than P and a slightly conservative full credibility standard.

For a given k and P we can let $t_e = t_{(1+P)/2} = \dfrac{k\,E(T)}{\sigma_T}$ in the Cornish-Fisher expansion. For algebraic simplicity, we will use only two terms of the expansion (C):

$$\frac{k\,E(T)}{\sigma_T} = z_e + \frac{E[T-E(T)]^3}{6\sigma_T^3}(z_e^2 - 1).$$

Substituting the moments of T just developed, we obtain:

$$\frac{k\mu\lambda}{\sqrt{\mu_2\lambda + \mu^2\lambda_2}} = z_e + \frac{\mu_3\lambda + 3\mu_2\mu\lambda_2 + \mu^3\lambda_3}{6(\mu_2\lambda + \mu^2\lambda_2)^{3/2}}(z_e^2 - 1).$$

We then have the following equation which must be satisfied by λ, the expected number of claims:

$$\text{(D)}\quad k\lambda = z_e\sqrt{\lambda}\sqrt{\frac{\lambda_2}{\lambda} + \frac{\mu_2}{\mu^2}} + \frac{z_e^2 - 1}{6}\,\frac{\dfrac{\lambda_3}{\lambda} + \dfrac{3\lambda_2}{\lambda}\dfrac{\mu_2}{\mu^2} + \dfrac{\mu_3}{\mu^3}}{\dfrac{\lambda_2}{\lambda} + \dfrac{\mu_2}{\mu^2}}\,.$$

If we ignore the term involving the third moment, we obtain the following simple equation for λ:

$$\text{(E)}\quad \lambda = \frac{z_e^2}{k^2}\left(\frac{\lambda_2}{\lambda} + \frac{\mu_2}{\mu^2}\right).$$

If we assume that the mean and the variance of the number of claims are equal, and remember that z_e is the $100\,\dfrac{1+P}{2}$ percentile of the standard normal distribution [$\sqrt{2}$ times Perryman's $f(P)$, since Perryman used a normal distribution with variance ½] and that μ and μ_2 are the mean and variance of the claim amount distribution (Perryman's M and S^2), formula (E) becomes

$$\lambda = \frac{2f(P)^2\left(1 + \dfrac{S^2}{M^2}\right).}{k^2}$$ [16]

[16] Perryman, F. S., *op. cit.*, p. 72.

THREE EXAMPLES

To illustrate the use of the Cornish-Fisher expansion, we give three examples of the calculation of λ, the expected number of claims necessary for full credibility. We will, in each case, use for k and P the values commonly used in automobile insurance credibility tables, $k = .05$ and $P = .90$.

Poisson Distribution — Automobile Insurance

If we assume that N, the number of claims, has a Poisson distribution, then $\lambda_3 = \lambda_2 = \lambda$. This is the assumption underlying most credibility work done to date.

To use the Cornish-Fisher expansion, we need the moments of X, the size of an individual claim. These may be obtained from a study of claims by size of loss, data which are not readily available. A study of one large company's 1952 experience on 2,116 automobile property damage claims yielded the following moments:

$$\mu = 89.82$$

$$\mu_2 = 26{,}060$$

$$\mu_3 = 28{,}740{,}000$$

Thus the values of the ratios $\frac{\mu_2}{\mu^2}$ and $\frac{\mu_3}{\mu^3}$ are 3.230 and 39.658 respectively.

Because of the Poisson assumption, formula (D) becomes:

$$\text{(F)}\quad k\lambda = z_e\sqrt{\lambda}\sqrt{1+\frac{\mu_2}{\mu^2}} + \frac{z_e^2 - 1}{6}\,\frac{1+3\frac{\mu_2}{\mu^2}+\frac{\mu_3}{\mu^3}}{1+\frac{\mu_2}{\mu^2}}$$

and, substituting $k = .05$, $z_e = z_5 = 1.645$ and the moments of X given above, we have:

$$.05\lambda = 1.645\sqrt{\lambda}\sqrt{4.230} + (.2843)\,\frac{50.348}{4.230}\text{, and}$$

$$\lambda = 4{,}713.$$

If, instead, we solve equation (E), we obtain $\lambda = 4{,}577$. The similarity of these two results indicates the modest effect of including the third moment of the claim distribution in the calculation, but emphasizes the importance of recognizing the effect of the variation in size of claim in credibility calculations. Assuming that claim frequency follows a Poisson distribution, it takes 4,713 claims, not 1,084, to achieve a 90% probability that actual claims will be within 5% of expected. If we solve equation (D) for k, using $\lambda = 1084$, we find that a full credibility criterion of 1,084 claims produces a probability of 90% that actual claims will be within 10.6%, not 5%, of expected claims.

Negative Binomial Distribution

The negative binomial distribtuion has now replaced the Poisson distribution in the affections of casualty actuaries. In his paper, Dropkin[17] used the negative binomial to represent the distribution of the number of auto claims per policy. His data show a mean of .163 and variance of .193, which are inconsistent with the moments of the Poisson distribution.

In Dropkin's notation, the probability function for the number of claims can be written as:

$$Pr(N = x) = \binom{x + r - 1}{x} \left(\frac{a}{1 + a}\right)^r \left(\frac{1}{1 + a}\right)^x \quad \text{for } x = 0, 1, 2, \ldots .$$

The first three moments are:

$$\lambda = E(N) = \frac{r}{a} \qquad \lambda_2 = E[\{N - E(N)\}^2] = \frac{r}{a}\,\frac{a+1}{a}$$

$$\lambda_3 = E[\{N - E(N)\}^3] = \frac{r}{a}\,\frac{a+1}{a}\,\frac{a+2}{a}.$$

From this, it is easy to verify that $\lambda_3 = \frac{\lambda_2}{\lambda}\,(2\lambda_2 - \lambda)$ and that

$$\frac{\lambda_3}{\lambda} = \frac{\lambda_2}{\lambda}\left(2\frac{\lambda_2}{\lambda} - 1\right).$$

If we assume that we have E independent exposure units and use Dropkin's data, then $\lambda = .163E$ and $\lambda_2 = .193E$, $\frac{\lambda_2}{\lambda} = 1.184$ and $\frac{\lambda_3}{\lambda} = 1.620$. We will use the same moment ratios for the claim amount distribution as in the preceding example, namely $\frac{\mu_2}{\mu^2} = 3.230$ and $\frac{\mu_3}{\mu^3} = 39.658$. We can now write equation (D) for λ, the number of claims required for full credibility, $k = .05$ and $P = .90$:

$$.05\lambda = 1.645\sqrt{\lambda}\sqrt{4.414} + (.2843)\,\frac{52.751}{4.414}\,.$$

$$\lambda = 4{,}913.$$

[17] Dropkin, L. B., "Some Considerations on Automobile Rating Systems Utilizing Individual Driving Records," *PCAS* Vol. XLVI, p. 165 (1959).

If we solve equation (E), which ignores third moments, we obtain $\lambda = 4{,}776$.

Poisson Distribution — Workmen's Compensation Insurance

Our third example will again use the Poisson distribution for the number of claims, but will use, for the moments of the claim amount distribution, the data in Dropkin[18] on the distribution of California workmen's compensation losses for major permanent partial cases and for temporary total disability cases, policy year 1961 first reports.

For the 4,721 major permanent partial cases included in Dropkin's study, $\mu = 13{,}687.67$, $\mu_2 = 85{,}715 \times 10^5$, $\mu_3 = 461{,}448 \times 10^7$, $\frac{\mu_2}{\mu^2} = .4575$ and $\frac{\mu_3}{\mu^3} = 1.7994$. Substituting these values in formula (F) and again using $k = .05$ and $P = .90$, we have:

$$.05\lambda = 1.645\sqrt{\lambda}\sqrt{1.4575} + (.28434)\frac{4.1719}{1.4575} \text{ and}$$
$$\lambda = 1{,}610.$$

If we solve equation (E), we obtain $\lambda = 1{,}578$.

For the 60,398 temporary total disability claims included in the Dropkin data, $\mu = 513.80$, $\mu_2 = 689{,}244$, $\mu_3 = 345{,}857 \times 10^4$, $\frac{\mu_2}{\mu^2} = 2.6109$ and $\frac{\mu_3}{\mu^3} = 25.4985$.

Substituting these values in equation (F), with $k = .05$ and $P = .90$, we have:

$$.05\lambda = 1.645\sqrt{\lambda}\sqrt{3.6109} + (.28434)\frac{34.3312}{3.6109} \text{ and}$$
$$\lambda = 4{,}016.$$

If we solve equation (E) with these same data, we obtain $\lambda = 3{,}908$.

CONCLUSION

On the basis of the above results, the following conclusions seem to be justified:

(1) The usual criteria for full credibility, 1,084 claims in automobile

[18] Dropkin, L. B., "Size of Loss Distributions in Workmen's Compensation Insurance," *PCAS* Vol. LI, p. 198 (1964).

insurance and 683 claims in general liability insurance, are too low. If we adopt a Poisson distribution for number of claims and the moments of the claim amount distribution derived from the automobile data available to us, 1,084 claims as a standard for full credibility results in a probability of 90% that actual claims will be within 10.6% of expected claims. The use of 683 claims as a standard for full credibility, on the assumption that the shape of the general liability claim amount distribution is not too dissimilar from that for automobile insurance, yields a 90% probability that actual claims will be within 13.4% of expected. In view of the 5% margin for underwriting profit and contingencies built into most liability insurance rates, swings of 10.6% or 13.4% in claims seem to be larger than prudent management ought to be willing to accept.

(2) If the third moment of the claim amount distribution is used, thereby recognizing the positive skewness inherent in most insurance claim patterns, the number of claims needed for full credibility is increased by 3% to 10% (based on the data used in the paper).

(3) If a negative binomial distribution is adopted for the number of claims instead of a Poisson, the number of claims needed for full credibility is increased. Credibility tables currently in use for liability insurance are based on the assumption that the mean equals the variance, as in the Poisson distribution.

(4) The number of claims needed for full credibility of the pure premium varies substantially by coverage. The results shown in the paper, 4,713 claims for automobile liability insurance, 1,610 claims for major permanent partial disability, and 4,016 claims for temporary total disability, indicate the need for separate credibility tables by coverage and, for workmen's compensation, by type of claim. (It should be noted that the automobile insurance data on which the moments of the claim amount distribution were based comprised only 2,116 claims. Thus no particular credence should be given to the particular figure of 4,713 claims until it is substantiated by a calculation based on a larger and more recent block of claims by size of loss.)

By expressing the number of claims required for the pure premium in a given classification to have full credibility in terms of the moments of the distribution of the number of claims, the moments of the distribution of claim amounts, and a selected normal distribution percentile, this paper has attempted to supply a basis for more accurate and scientific credibility tables. The formula, however, requires much more data on losses by size than is currently available. If losses by size data were available for various coverages, both countrywide and by state, it would be possible to calculate the full credibility point for each coverage and state. It should be noted, however, that the number of claims required for full credibility does not depend on the magnitude of the moments of the claim distribution, but only on the relationship between the higher moments and the mean. We suspect, therefore, that the credibility calculation for a given coverage will be relatively stable from state to state and from year to year.

THE CAPITAL INVESTMENT MARKET AND THE INSURANCE INDUSTRY

R. J. BALCAREK

"He that refuseth instruction despiseth his own soul, but he that heareth reproof getteth understanding."
— *Proverbs* 15:32

Introduction

It should be obvious even to a casual observer that something very significant is happening to the property and casualty insurance industry. It is not difficult to determine that this something appears to be connected with profitability.

On the one hand, there is a heated debate as to the size and adequacy of the profits in the industry. We have seen a study by respected professional economists, based on ten years' experience, which showed that the insurance industry is earning inadequate renumeration on the capital invested. They arrived at a figure of 4.4% for 43 property and casualty insurance groups.[1] A prompt rebuttal followed by other professional economists who, using a different approach, a different sample, and a 15-year period, came to a conclusion that a "vast majority of these companies are experiencing more than satisfactory risk-returns."[2] Members of our Society also made some contributions. As early as 1961 a president of this society said: "Private industry which does not make profit is in great trouble indeed, . . ."[3] Six years later a paper published outside the *Proceedings* contends that it is profitable for the insurers to remain in the insurance business with combined loss and expense ratios of 104.55 in casualty and 106.3 in fire.[4]

Another actuary employed by the regulatory authorities calculated that a group of representative companies made an underwriting profit from investments amounting to 3.2% of earned premium with some implication

[1] Arthur D. Little, Inc., "Prices and Profits in the Property and Liability Insurance Industry."

[2] R. L. Norgaard and C. J. Schick, "Profitability in the Property and Liability Insurance Industry."

[3] William Leslie, Jr., Presidential Address, *PCAS*, XLVIII.

[4] Frank Harwayne, "Insurance Risk, Investment and Profit," *CPCU Annals*, March 1967.

that a part of this at least should benefit the policyholders.[5] The view that the insurance industry is making excessive profits seems to be gaining some public acceptance, and there have been some regulatory decisions that some part of investment income should have been used or considered, or is to be used or considered, in rate revisions. One Commissioner decided that "the rate of return realized by any particular insurance company on its business investment is a peripheral issue at most.[6]

On the other hand, it would appear that the capital investment market came to its own decisions and put up for sale a few of our largest insurance groups to some bidders most of us have never heard of. Evidently, this is all very confusing and we could easily conclude that these outside people are not sufficiently acquainted with the insurance business, which "is *not* comparable to most other enterprises,"[6] and let our case rest. However, it is possible that it is the insurance fraternity, including the actuarial profession and the regulatory authorities, which may be overlooking certain points in the practical operation of our economic system. The purpose of this paper is to discuss and illustrate some of these points.

Some Economic Principles

First, the economic theory is that profits are necessary for an efficient allocation of resources among competing uses within the ecnomy. Capital is one of such resources and it tends to move into uses where it is most urgently required, the comparative urgency, ceteris paribus, being measured by the relative level of profits. It is generally accepted in this country that this arrangement provides the basis for the high level of efficiency in our system, compared with other systems. Strange as it seems, we have convinced even countries like Soviet Russia and other communist states, that this, in fact, is so and as a result they have introduced the profit factor, to a moderate extent, into their own system.

Second, capital used to finance given operations does not come free. Its economic cost is measured by the earnings which it would achieve in an alternative employment exposed to approximately the same degree of risk. Therefore, if in insurance the return on capital is 8%, and in an alternative employment the return is 15%, the proper economic interpretation is that we are losing seven points and not gaining eight points.

[5] R. A. Bailey, "Underwriting Profit from Investment," *PCAS* LIV.

[6] April 16, 1968 Decision of Pennsylvania Insurance Commissioner on rate revision requests filed by I.R.B.

Third, the level of profits necessary to keep the capital within the industry does not stay the same over a period of time; e.g. 8% return in insurance may look attractive if the alternative is keeping the money in bank at 3½% annual interest. The attractiveness of the investment in insurance will decline considerably if the banks decide to pay a rate of interest of 7%.

Fourth, the economic principles imply only a tendency for the capital to move from less to more profitable employment. They do not specify the length of time in which this would be accomplished. Frequently, the operation of economic laws is quite slow and therefore we may be tempted to assume that we are immune from their effect. This may result in a rude awakening because however slow they may be, unless the underlying conditions change, their effect is cumulative and inevitable.

But, capital movement from one industry to another obviously is a long process. It begins when the investors become suspicious that they may have made a mistake in investing their capital in a given industry. Their first step is to stop providing fresh capital and hope that things will take a turn for the better. After it becomes crystal clear that there is not going to be an improvement, they begin to investigate the possibilities of withdrawing this capital with as little loss as possible. The economists would refer to this as mobility of capital. In some employments, the mobility of capital is very small, especially if the capital is invested in specialized machinery and equipment limited to a particular use only. The important point is that there are few industries with a greater potential mobility of capital than the insurance industry. The mobility of capital will insure that in the long run the return on capital invested by the stockholders in the insurance business will have to be at least equal to the return in alternative employment with a similar degree of risk. This will hold regardless of the competition for the premium dollar and regardless of the action of the regulatory authorities.

There is a branch of economics known as economic history, which would be interested in the average profitability of the insurance industry over the last 10 or 15 years. Applied economics is concerned with the future and it analyzes the past only in order to determine some recent trends which could extend into the future.

"To be or not to be" — Alternative Uses for Capital Invested in the Insurance Business

At present, investment capital commands a high price. Rates of interest and investor profits are very high. No doubt, a sophisticated investor would come up with a number of possible uses of capital with an annual return of 20% or more. Let us be quite unimaginative and decide on a fairly easy transfer, namely from insurance operations to investment fund.

The figures in the appended tables are based on "Statistical Tables from Annual Statements" published by the New York Insurance Department, and refer to stock fire and casualty companies licensed in the State of New York (New York Stocks and Other States Stocks). The reason for considering stock companies only is that they are the most vulnerable to the operation of economic laws. On the other hand, stock companies have a dominating position in the insurance business and a departure of a large proportion of stocks from the insurance scene would leave a tremendous void which could not be easily filled. The figures below show that stock companies accounted for 78.5% of the capital and surplus and 69.6% of the premium writings of all insurers licensed in New York.

COMPANIES LICENSED IN NEW YORK

	Capital & Surplus at 12-31-66		Net Written Premium in 1966	
	Amount (000's)	% of Total	Amount (000's)	% of Total
Stocks	10,069,764	78.5	12,189,049	69.6
Mutuals	2,075,414	16.2	4,193,421	24.0
Lloyds Reciprocals and Co-operatives	152,779	1.2	417,301	2.4
Alien	525,535	4.0	708,493	4.0
	12,823,492	100.0	17,508,264	100.0

Appended Tables 1 and 2 develop three-year averages for the years 1964–1966 and Table 3 presents the comparison of actual results in the insurance operations with calculated results after the insurers have converted to investment fund.

The conversion from insurance operations to investment fund operations will be accompanied by a sharp reduction of nearly 50% in total assets. In other words, a large amount of assets would have to be liquidated and the interesting question arises, which? The answer is not very difficult. We would dispose of assets which are not necessary for the operation of the investment fund and which are the least profitable. This principally embraces the uninvested assets maintained for the benefit of insurance operations, and bond portfolios. The main point is that the investment fund will not dispose of its common stocks because:

(1) These have been always the most profitable investment.
(2) There are large unrealized gains in the stock portfolio and its disposal would be heavily penalized by taxation.

The rates of return on various types of assets have been assumed to be identical for the insurers and the investment fund. A market appreciation factor of 7.7% was selected to be applied to common stocks only. The actual gains in the Standard & Poor's Index were as follows:

Period	Average Gain Per Calendar Year
1950–1967	9.9%
1955–1967	7.1
1960–1967	7.4

The figures in Table 3 indicate that under these assumptions the total investment gain (before Federal income tax) would be higher for the insurers by $149,874,000 or 1.4% of Earned Premium. It means that a combined ratio of 101.4 appears to be the critical point at which it would become profitable for the insurers to abandon the insurance operations and become a rather dull, conservative, investment fund. The interesting point is that once the transition from insurer to investment fund is accomplished, the stockholders will be exposing their capital to less risk. Before the transition, their capital supported an investment portfolio some 75% higher plus a volatile insurance operation. As the capital is exposed to less risk, they should be satisfied with a lower return. Alternatively, they could increase the risk by moving into more risky and therefore more profitable investments. This would tend to lower somewhat the critical ratio of 101.4%.

The average adjusted underwriting loss for the stock companies during the years 1964–1966 amounted to $156,405,000 which, subtracted from the total investment gain for the insurers, reduces the total gain for the insurers below the figure for the investment fund. This means that stock companies licensed in the State of New York have, as a group, passed the critical point at which it would be advantageous to leave the insurance industry.

Some Implications

It has to be realized that results vary from insurer to insurer; there are stock insurers which earned a good return on their capital and consequently they would lose if they converted to an investment fund. The preceding analysis leads to the conclusion that a majority of insurers passed the critical point at which conversion becomes profitable. No doubt, some of them passed it by a substantial margin, and had they behaved in an economically rational manner, they would have left the insurance industry years ago.

In our present situation, the question whether we should include investment income in rates is of some importance. If the regulatory authorities are successful in a majority of states in reducing the indicated rate increases by application of the investment return on unearned premium reserves and/or loss reserves, such action would tend to deteriorate the operating results of insurers. As a result, the capital movement out of insurance would gain more impetus. From the economic point of view, the investment return is the entrepreneurs' profit, which is properly the reward for risk bearing. The point is that it is the stockholders, not the policyholders, who assume the risks connected with the investment portfolio, hence the policyholders are not entitled to that return. The most they are entitled to is the rate of interest, provided the price for insurance is sufficiently high to cover its economic cost.

Here it would be a good thing if we reviewed the economic theory of price which, whether we like it or not, does apply to insurance. The theory says that in the long run the price must be equal or higher than the economic cost of the product we sell. The economic cost in our case includes loss cost, expenses, and *adequate return on invested capital.* If there is an element of uncertainty in our cost, we have to include a safety margin. If the element of uncertainty is very large, the safety margin has to be higher. It may be useful to point out that we have been violating these precepts to a fantastic degree:

(1) We did not care what the adequate return on investment capital was and we did not include it in our price.

(2) As we are all aware, our costs do include an element of uncertainty and in most cases we could arrive at a number of estimates, all of them reasonable and all of them equally likely. We exhibited a most disturbing tendency (either voluntary or forced on us by regulatory authorities) to pick the lowest estimates as the final price of our product. The logic of this can be compared with tossing an unbiased coin and expecting it to come head up every time.

(3) The element of uncertainty is large in the case of property lines in some states exposed to natural catastophes. Instead of incorporating a larger safety margin, it appears that precisely in such cases we maximized the inadequacy of our rates.

Investment capital began to avoid the insurance industry some years ago. This avoidance can be described as stage one. We are now in stage two, which is characterized by the actual withdrawal of investment capital. This has manifested itself in several ways:

(1) Voluntary liquidation.
(2) Companies purchasing their common stock in the market.
(3) Formation of holding companies by the insurers.
(4) Take-overs of insurers by outside companies which have a large, unsatisfied demand for additional capital.

The first three represent the efforts of the insurers to solve the problems on their own. The last one is the most ominous as it appears to be a full-dress rehearsal of the moves planned for us by the capital investment market. If the "giant slayers" like Leasco, National General, City Investing, achieve their initial objectives and fulfill their expectations, the insurance industry will face some far-reaching changes.

For practical reasons, people making their living in insurance are not very enthusiastic about such changes, and naturally enough they are looking around for weapons to get ready for the fight. The writer has some experience in the matter, as he has witnessed such fights from a ring-side seat, much too close for comfort. The weapons could be classified into two groups: (1) effective, (2) ineffective. The list of effective weapons includes only one and that is the improvement in the profit position, so that there is a satisfactory return on invested capital. The ineffective weapons are many, mostly belonging to psychological warfare, which fail miserably when faced by determination and resolution. Could the regulatory authorities step in and bail us out by regulation or legislation designed to prevent such take-overs? In my opinion, it would be quite unrealistic to expect much from that direction. The only effective way to do this would be to curtail severely the rights conferred by the principle of private ownership of investment capital. The writer does not think that the country is ready for such extremes.

TABLE 1

STOCK FIRE AND CASUALTY INSURERS
LICENSED IN THE STATE OF NEW YORK

(in 000's)

	1964	1965	1966	3 Years Average
I. AVERAGE ASSETS				
Invested Assets:				
1. Bonds	10,369,381	10,820,309	11,368,280	10,852,657
2. Preferred Stocks	723,608*	776,543*	752,380	750,843
3. Common Stocks	9,886,481*	10,609,720*	10,279,400	10,258,534
4. Mortgage Loans	8,225	8,556	12,132	9,638
5. Real Estate	269,326	300,118	328,999	299,481
6. Bills Receivable taken for Prem.	95,509	105,700	117,527	106,245
SUB-TOTAL	21,352,530	22,620,946	22,858,718	22,277,398
Assets Not Invested:				
1. Investment Income Due & Accrued	190,414	291,410	221,691	234,505
2. Uncollected Premiums	1,658,693	1,758,832	1,891,610	1,769,712
3. Cash	716,517	670,637	659,359	682,171
4. Reinsurance on Paid Losses	70,956	98,718	112,150	93,941
5. All Other Assets	396,365	519,584	622,318	512,756
SUB-TOTAL	3,032,945	3,339,181	3,507,128	3,293,085
TOTAL ASSETS	24,385,475	25,960,127	26,365,846	25,570,483
II. PREMIUMS				
1. Net Written Premium	10,010,057	11,166,669	12,189,049	11,121,925
2. Net Earned Premium	9,897,083	10,766,865	11,750,442	10,804,797
3. Unearned Premium Reserve	6,186,847	6,497,812	6,920,961	6,535,206
III. STOCKHOLDERS' EQUITY				
1. Capital & Surplus	11,200,559	11,616,833	10,874,010	11,230,467
2. Equity in Unearned Prem. Reserve	1,670,449**	1,754,409**	1,868,659**	1,764,506**
	12,871,008	13,371,242	12,742,669	12,994,973

* Estimated

** Estimated at 27% of Unearned Premium Reserve

TABLE 2

STOCK FIRE AND CASUALTY INSURERS
LICENSED IN THE STATE OF NEW YORK

(in 000's)

	1964	1965	1966	3 Years Average
Underwriting Gain or Loss	- 275,881	- 380,193	+ 54,020	- 200,685
Plus Increase in Unearned Prem. Equity	+ 68,505	+ 118,074	+ 135,816	+ 107,465
Minus Dividends to Policyholders	- 45,412	- 56,107	- 68,574	- 56,698
Other Income	- 4,737	- 5,167	- 9,557	- 6,487
Adjusted Underwriting Gain	- 257,525	- 323,393	111,705	- 156,405
Net Investment Income Earned	963,132	836,648	920,558	906,780
Net Realized Capital Gains	154,306	205,276	298,499	219,360
Unrealized Capital Gains	673,181	188,600	-1,425,234	- 187,818
Total	1,790,619	1,230,524	- 206,177	938,322
Total Income before Tax	1,533,094	907,131	- 94,472	

Investment Income Received				
Interest on Bonds	358,565	382,565	413,013	384,714
Dividends on Preferred Stocks	22,421*	22,288*	34,842	26,517
Dividends on Common Stocks	406,038*	403,622*	630,933	487,627
Other Investment Income	59,121	67,518	72,958	66,532
TOTAL	846,145	875,993	1,151,746	965,390

* Estimated

TABLE 3 (Amounts in 000's)

STOCK FIRE AND CASUALTY INSURERS
LICENSED IN THE STATE OF NEW YORK

		Operating as Insurers 1964-1966 Average	Operating as Investment Fund
I.	AVERAGE ASSETS		
	Invested Assets:		
	1. Bonds	10,852,657	--
	2. Preferred Stocks	750,843	--
	3. Common Stocks	10,258,534	12,259,015
	4. Mortgage Loans	9,638	--
	5. Real Estate	299,481	299,481
	6. Bills Receivable taken for Prems.	106,245	--
	SUB-TOTAL	22,277,398	12,558,496
	Assets Not invested:		
	1. Investment Income due & Accrued	234,505	132,198
	2. Uncollected Premiums	1,769,712	--
	3. Cash	682,171	304,279
	4. Reinsurance on Paid Losses	93,941	--
	5. All Other Assets	512,756	--
	SUB-TOTAL	3,293,085	436,477
	TOTAL ASSETS	25,570,483	12,994,973
II.	PREMIUMS		
	1. Net Written Premium	11,121,925	--
	2. Net Earned Premium	10,804,797	--
	3. Unearned Premium Reserve	6,535,206	--
III.	STOCKHOLDERS' EQUITY		
	1. Capital & Surplus	11,230,467	12,994,973
	2. Equity in Unearned Prem. Res.	1,764,506	--
	TOTAL STOCKHOLDERS' EQUITY	12,994,973	12,994,973
IV.	INVESTMENT GAIN		
	1. Interest on Bonds	361,357 *	--
	2. Dividends on Preferred Stock	24,907 *	--
	3. Dividends on Common Stock	458,022 *	547,328
	4. Other Investment Income	62,494	55,541 **
	SUB-TOTAL	906,780	602,869
	Market Appreciation (7.7% on Common Stocks)	789,907	943,944
	TOTAL INVESTMENT GAIN	1,696,687	1,546,813
V.	ADJUSTED UNDERWRITING LOSS	- 156,405	--
	TOTAL GAIN	1,540,282	1,546,813

* Estimated by applying the distribution of Investment Income Received to Net Investment Income Earned.

** Obtained by subtracting from Other Investment Income an estimated return of 6% on Mortgage Loans and Bills Receivable.

AN ACTUARIAL NOTE ON ACTUARIAL NOTATION

JEFFREY T. LANGE

"When I use a word," Humpty-Dumpty said, "it means just what I choose it to mean — neither more nor less."

— Lewis Carroll

One of the invariants in the Syllabus of Examinations of our Society has been the study of life insurance mathematics and the associated actuarial notation. As a result probably every practicing actuary has, at one time or another, worked with this unique notation. Multiple indices appear both prefixed and suffixed to a symbol along with exponents resulting in a halo of characters about the basic symbol. Special print characters, e.g. horizontal bars, $\urcorner$, $^\circ$, $\ddot{}$, are used to modify both indices and basic symbols in order to alter the meaning of an expression. Sometimes the actuarial usage is quite different from ordinary practice; for example, exponents are not to be interpreted as exponents. The end result is that to the non-actuary the notation of the actuary may resemble the jottings of the astrologer or alchemist.

The complexity of actuarial notation results in an unusual succinctness. An intricate insurance policy involving a number of benefit options and a complicated payment plan may be reduced to a single expression. Once a problem is translated into actuarial notation, it is frequently a relatively elementary task to manipulate the symbols and solve the equations. Having learned the notation, even the student, equipped only with tables, pencil, and paper, can evaluate rather involved policy forms. The concise, compact form of the notation allows the experienced actuary to elegantly express complicated insurance schemes in a limited number of equations, which can be of great aid in obtaining a solution.

The usefulness of the notation is evidenced by the fact that from life insurance work it was extended to pension work and to health insurance. It has achieved a universal status, the current version being settled on by the 14th International Congress of Actuaries in Madrid in 1954.[1]

[1] A brief history of the notation and a general, although dated, description of it is given by F. S. Perryman, "International Actuarial Notation," *PCAS* Vol. XXXVI, pp. 123–131.

Standard actuarial notation has never been adopted for property and liability work. One of the first tasks undertaken in 1914 by the newly formed Casualty Actuarial Society was an attempt to develop such notation. A committee was formed, but it decided that casualty actuarial science was too young to permit the establishment of a stable notation.[2] Later, in 1920, an individual proposed a system of workmen's compensation notation, which was not generally accepted because of its complexity. A plea was made for a simple and universal system of notation embracing all non-life lines.[3] Still later, in 1932, another individual proposed a standard system of notation for casualty work,[4] but it was not generally used by other authors. (Even its author developed an entirely different system of notation in one of his later papers.[5])

This lack of a standard notation implies that each author of a technical paper must develop his own notation which his reader must learn. This is time consuming for both writer and reader, and can make technical papers more difficult to comprehend, thus leading to unnecessary confusion. Tracing a concept through several papers can be particularly troublesome since the same idea may appear in substantially different form in each author's notation. As a result, it is difficult to make comparisons, to recognize parallelisms, and to extend work from one area to another since the variation in notation tends to obscure similarities and impede pattern recognition. Finally, the value of the *Proceedings* as a reference work is reduced since the reader must restudy the author's notation whenever he consults a paper. Research and communication are made more difficult by the lack of any degree of standardization in non-life notation.

While life actuarial notation has achieved standardization, the notation is less than perfect. Any actuary who has attempted a typed report including some sophisticated equations in the notation probably realizes the difficulties in accurately portraying the halo of indices and the special characters. It is often hard with a typewriter to differentiate first (or last) symbols in

[2] Committee on Terms, Definitions and Symbols, *PCAS* Vol. I, p. 76, *PCAS* Vol. II, pp. 163, 317, and 497.

[3] Perkins, Sanford, "A Suggested System of Standard Notations for Actuarial Work in Workmen's Compensation Insurance," *PCAS* Vol. VII, pp. 36–56.
and
Michelbacher, G. F., Discussion of Perkins' paper, *PCAS* Vol. VII, pp. 405–407.

[4] Carlson, T. O., "Suggestions for a Standard System of Notation in Casualty Actuarial Work," *PCAS* Vol. XX, pp. 264–274.

[5] Carlson, T. O., "An Actuarial Analysis of Retrospective Rating," *PCAS* Vol. XXVII pp. 283, 317, and 318.

multiterm indices from individual basic symbols; hence, the result can be confusing. The notation is clearest in its published form, but translation into print may be both difficult and expensive due to the extraordinary nature of the notation.

Actuarial notation evolved over a long period, having first been considered by an International Congress in the last years of the nineteenth century. That it developed independently from the mainstream of mathematical thought may have resulted from two circumstances: first, the applications of probability during the late nineteenth and early twentieth centuries were limited to insurance and gambling and the actuary could consider his application of probability to be unique;[6] second, probability theory itself was rather independent from mathematical analysis prior to Kolmogorov. Hence, the actuary of fifty or seventy-five years ago would not have concerned himself with the development of a notational system consistent with the rest of mathematics.

Today's actuarial student has a strong background in mathematical analysis and views probability as a branch of function theory. He finds actuarial notation inconsistent with the mathematical notation to which he is accustomed. During his career he expects to borrow techniques from other mathematical disciplines, which will necessitate his using two different notations: one for the actuarial fraternity and one for the remainder of the scientific community. Existing actuarial notation may appear to be an anachronism and may prove to be a handicap.

Increasing use of electronic computers in actuarial work has added to the confusion in that the notation is not readily adaptable to computer programming. While each computer langauge is different, the higher level languages (ALGOL, COBOL, FORTRAN and PL/1) generally require that variables be expressed in a linear form: variable name followed by indices (in parentheses) separated by commas. Special characters cannot be used and capital letters must be used exclusively, except that the variable name may include numerics.

There is no obvious way to mechanically translate existing notation into a form which could be included in a programming language. For example, either a, $\ddot{a}$, A or $\bar{A}$ in current notation could be rendered as A. Should D be used to denote d, δ, or D of the current notation? How should the indices

[6] Borch, Karl, "The Theory of Risk," *Journal of the Royal Statistical Society*, Series B (Methodological), Vol. 29, p. 433.

which prefix the symbol be handled? What alphabetics will be used to replace the various special characters? Currently, each actuary (or programmer) must make these decisions independently. If his program needs to be revised, then someone else will have to learn his notation to work with the program. Aside from leading to wasted effort, this situation also makes the exchange of completed programs among actuaries more difficult. The discussions of the influence of computers on actuarial problem solving at the 18th International Congress of Actuaries in Munich illustrate this point. Two actuarial programming languages were presented, each designed for essentially the same type of work; however, they were notationally quite different and apparently incompatible.[7] Several other actuaries doing similar work stated that they could not incorporate either language in their own work because the languages were too different from what they had developed thus far. Many of the differences cited in the discussion seemed to be notational.

In recognition of these problems, a group of German, Austrian, and Swiss actuaries presented a revision of actuarial notation to the 18th Congress,[8] which did not take final action on the suggestion. A review of their notation serves to illustrate the degree of change which would be necessary if actuarial notation is to conform to current mathematical usage and if it is to be adaptable to a computer language format.

Actually, their paper gives two new sets of notation; a publication language designed with a view toward consistency with mathematical function theory, and a computer notation developed from a translation of the publication language into a computer acceptable format. In the former, exponents are employed only to raise a variable to a power, and indices prefixed and suffixed to a variable have been eliminated in almost all cases. The only exception arises in cases where the index was itself indexed; in the new notation the second index would be retained.

$$ {}_{n_1|n_2}a_x^{(2)} \quad \text{becomes} \quad a(x\,;n_1:n_2\,;2) $$

These changes result in the removal of the cluster of indices about the central character. The use of both upper and lower case characters has been

[7] Benjamin, Sidney, "A Language for Routine Actuarial Programming," *Transactions of the 18th International Congress of Actuaries* (*TICA*), Subject 5, pp. 771–782, and Kunz, Peter, "Die Programmierung AKTUARIAT," *TICA*, Subject 5, pp. 931–947.

[8] Boehm, Carl; Reichel, Georg and others, "Vorschlage für eine internationale versicherungsmathematische Veröffentlichungssprache und ihre computerverträgliche Darstellung," *TICA*, Subject 5, pp. 815–842.

retained as have been Greek letters, but special characters (other than the umlaut) have been deleted.

In most cases, the translation into the publication language was as follows;

$${}_{prefix}VARIABLE^{exponent}_{suffix} \quad \text{becomes} \quad VARIABLE\,(suffix;\, prefix;\, exponent)$$

where exponent denotes an index of some kind (not a power of the variable) and where multiple characters in prefix or suffix are separated by colons or commas, while the semicolon is used only to separate suffix from prefix from exponent. A few examples are given below:

$$a_x \quad \text{becomes} \quad a(x)$$

$$a_{\overline{n}|} \quad \text{becomes} \quad a(;n)$$

$$\overline{A}_x \quad \text{becomes} \quad Am(x)$$

$$A_{x:\overline{n}|} \quad \text{becomes} \quad AE(x;n)$$

While life insurance actuaries are more qualified to comment on the notation and will probably suggest revisions in it, a superficial review indicates that the notation is no more difficult than the existing and no less meaningful once one has become accustomed to it. It has the advantage of being more readily understandable since it resembles normal mathematical notation, and the disadvantages of requiring (if adopted) a rewrite of actuarial texts and of still not being in a computer format.

This later difficulty is overcome by the development of computer notation in which only upper case letters are used and in which all special characters and Greek letters are translated into alphabetics. In some cases, the resulting computer notation is more meaningful than the original; permanent and temporary annuities are denoted by *AP* and *AT* instead of a and $\ddot{a}$ respectively. While A_x can be simply rendered as $AM(x)$, more complicated expressions are not quite as obvious, for example:

$${}_{n_1|n_2}a^{(s)}_x \quad \text{becomes} \quad AT5A2\,(X, N1, N2)$$

$$A_{x:n} \quad \text{becomes} \quad AE7\,(X, N)$$

$$a^{(m)}_n \quad \text{becomes} \quad APN0A0\,(N, K)$$

While the numerics included in the variable names have been assigned in a systematic way, the resulting expressions appear more complex and less meaningful than the existing notation.

Only a few examples of the two new languages have been given, but the examples were chosen to be representative, being neither more nor less complicated that the renderings of the many other symbols translated. The examples fail to illustrate the great amount of work on the part of European actuaries in developing the extensive and intricate set of rules for translating in a consistent manner the existing notation into the two new notations.

The possibility of the development of new actuarial notation for life, health, and pension work raises several questions for casualty actuaries:

1. Should casualty actuaries, either independently or through the Society, have any role in the development of the new notation? Some casualty actuaries do work in health insurance, which would be affected, and all have studied the notation, thus giving casualty actuaries some interest.

2. Is standard notation needed for casualty and property actuarial work? Such notation might improve communication among actuaries, aid in the solution of technical problems, make the *Proceedings* a more valuable reference tool, and generally enhance the Society's scientific work; on the other hand, these arguments have not been compelling in the past.

3. If developed, should the casualty-property actuarial notation be a derivative of life, health, and pension notation? Past attempts at casualty notation never followed this avenue, but a reformulation of life insurance notation would provide an ideal time to develop a more ecumenical actuarial notation embracing all lines of business.

4. If the first three questions are answered positively, how might the problem of notation be studied further? As noted above, individuals have developed standard notations not generally accepted by other actuaries; however, group efforts have been no more successful: on May 19, 1898 the International Congress of Actuaries voted unanimously "That a Universal Notation be adopted, not only for Life Assurance, but for all other branches of assurance."[9]

[9] As quoted by Valerius, N. M., Discussion of Carlson's paper on notation, *PCAS* Vol. XXI, p. 163.

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

JOHN S. McGUINNESS

INTRODUCTION

Importance of the Subject. A chain of changes since the Southeastern Underwriters Association decision has made adequate methods of statistical time-series analysis increasingly important in non-life insurance. Narrowing of safety and profit margins in rates; the steady inflation of the dollar, an *adverse* trend contrasting sharply with the *favorable* trend in mortality that has underlain life insurance ratemaking; a highly probable understatement of loss data used in ratemaking, at least for liability insurance, due both to gradual and conscious erosion of safety margins in company loss reserves and also to actual *un*intentional understatement of reserves by many companies whose methods of estimation have not met the needs imposed by changing conditions; changes in coverages and in combinations of coverages; and doubtless many other changes; have all combined to make time-series analysis important.

In many current rate filings the use of time-series adjustments accounts for as much as, or more than, the proposed allowances for profit and contingencies. Use of such adjustments or failure to use them, and their accuracy or lack of sufficient accuracy, can mean the difference between rates that are within a suitably close range of the target and rates that are either materially inadequate or materially excessive. Such use can also mean the difference between profit and loss for the majority of insurers over any extended period of time. This difference can be due not only to the direct results of the time-series adjustments, but also indirectly to the effect that the degree of acceptance they win among rate regulatory personnel has on the speed with which rate filings are approved.

As ratemaking procedures are gradually being changed to reflect (on the basis of statistical evidence) a greater number of variables, more accurate methods of measuring the effects on loss costs of these variables, and more accurate methods of distinguishing the effects of one variable from another, are required. Continually improved methods of statistical analysis will have to be employed if the ratemaking procedures and adjustments applied to some variables are not to be overloaded or distorted in order to compensate for errors resulting from insufficient procedures used with other variables. Methods of time-series analysis can on occasion fall into either of the two groups. Use of adequate methods of time-series analysis can therefore on occasion point to the need for revision or perhaps improvement of procedures used to handle other variables.

Existing Contributions. The *Proceedings* of this Society do not appear to contain many papers on time-series analysis. A review of the indexes going back to Volume I was made under the headings of "time-series analysis," "trends," "cycles," and "seasonal," and for mention of these or similar terms in titles under the heading "ratemaking." The earliest references found were in some of J. H. Woodward's[1] and T. F. Tarbell's[2,3] interesting presidential addresses. Paul Benbrook[4] and Frank Harwayne[5] covered some methods of trend adjustment in papers primarily devoted to other topics. John W. Clarke[6] devoted a complete paper to seasonal fluctuations in automobile liability loss ratios, while David A. Tapley[7] also discussed such fluctuations in a paper on loss reserves. The most recent *Recommendations for Study*[8] contains no references to texts covering time-series analysis. It therefore seems that a paper on the subject can be useful in several respects.

The purpose of this paper is to show how methods of time-series analysis that have long been generally accepted among statisticians in all non-insurance fields where economics plays a role (e.g. all other types of business, government, and education) can be usefully employed in property and liability insurance. It will also be shown:

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1 Woodward, J. H., "The Effect of Inflation on the Business of Insurance," *PCAS*, VI, p. 1.

2 Tarbell, T. F., "Business Cycles and Casualty Insurance," *PCAS*, XVIII, p. 253.

3 Tarbell, T. F., "The Effect of Changes in Values on Casualty Insurance," *PCAS*, XIX, p. 1.

4 Benbrook, Paul, "The Advantages of Calendar-Accident Year Experience and the Need for Appropriate Trend and Projection Factors in the Determination of Automobile Liability Rates," *PCAS*, XLV, p. 20.

5 Harwayne, Frank, "Some Further Notes on Estimating Ultimate Incurred Losses in Auto Liability Insurance," *PCAS*, XLVI, pp. 59, 312.

6 Clarke, John W., "Seasonal Fluctuation in Loss Ratios for Automobile Bodily Injury Coverage," *PCAS*, XXXVI, p. 63.

7 Tapley, David A., "Month of Loss Deficiency Reserves for Automobile Bodily Injury Losses Including Reserves for Incurred But Not Reported Claims," *PCAS*, XLIII, p. 166.

8 Casualty Actuarial Society, *Recommendations for Study* (1969 Syllabus), 16th ed., 1968.

(1) how the concept behind the statistical quality control chart can be adapted to creat a rapid and simple method of adjusting for cyclical variation,

(2) that the same methods are applicable to all lines of property and liability insurance, a fact whose recognition and use could greatly simplify the problems of ratemakers in making sufficiently accurate time-series adjustments,

(3) that the prevalent practice in property and liability insurance of adjusting only for trend, while ignoring the other types of temporal fluctuations, can and does materially reduce the accuracy of results,

(4) that the economic statistician's technique of making an index number can help solve two of the actuary's problems. One of them, previously unsolved, is how to combine in one meaningful time series partly disparate data such as those arising from use of different deductible amounts. The second problem is how to overcome the sparsity of data and lessened stability of results that arises from subdividing data by type of deductible and using the subdivisions separately,

(5) how, as a result of difficulties met in applying the techniques to existing or available data, some improvements in the form and quality of data collected for ratemaking purposes can be made that will also improve the results of time-series analysis based on them.

Organization of the Paper. With the object of going from the simpler to the more complex, there are discussed in order liability coverage, automobile property coverage, and coverage on fixed-location properties. Prior to specific applications, some basic considerations applicable to all lines of insurance are reviewed.

Of the four major types of temporal movements or variations over time, seasonal adjustments will not be considered in this paper. The available data are all in yearly form. Rates are seldom reviewed or changed more frequently than one per year. It is therefore not essential at present to adjust for this type of change. At a later time, however, a paper covering methods of seasonal adjustment for internal budgeting, loss reserving, and perhaps even interim rate adjustments should prove valuable.

SOME BASICS OF TIME-SERIES ANALYSIS

Purpose and Nature. The purpose and nature of time-series analysis are well and succinctly stated by Riggleman and Frisbee:

> "One of the chief problems in modern business is that of estimating what the future changes in business conditions will be. This makes it necessary to analyze data over a period of time. If the data are merely descriptive of a situation at a certain time, the methods . . . of frequency distributions, averages, and dispersions may be all that are necessary in making an analysis. But, if the data represent changes that are taking place over a period of time, it is necessary to use special methods which will describe change or progress as well as describe a static situation. Data representing change over a period of time are known as time series, and . . . specialized methods . . . are necessary in time-series analysis."[9]

The examples they cite of practical problems met a generation ago in non-insurance industries, due to lack of such analysis, show interesting parallels to current insurance problems.[10]

The major types of movements in time series are generally considered to be:

(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.[11]

Trend may be defined as a long-term movement, usually measured over decades, reflecting a tendency either to grow or to decline.[12] *Cycles* reflect

[9] Riggleman, J. R., and Frisbee, I. N., *Business Statistics*, McGraw-Hill Book Co., Inc., New York, 1938, p. 270.

[10] *Ibid.*, pp. 270–273.

[11] *Ibid.*, pp. 275 ff.; see also Croxton, F. E., and Cowden, D. J., *Applied General Statistics*, Prentice-Hall, Inc., New York, 1939, pp. 363–376. Flaskaemper, Paul, *Allgemeine Statistik*, Vol. I, Richard Meiner Publishers, Hamburg, 1949, pp. 133–137, characterizes another basic temporal relationship: constancy. This amounts to a flat trend, or one with zero slope. The automobile collision trend reported here approximates this relationship.

[12] Riggleman and Frisbee, *op. cit.*, p. 276; Croxton and Cowden, *op. cit.*, pp. 364–367.

"the persistent tendency for business to prosper, decline, stagnate, recover, and prosper again, in apparently never-ending sequence."[13] *Seasonal* or *periodic variation* is a well-defined movement repeated each year[14] (or each month, week, day, or similar fixed period). *Irregular* or erratic *fluctuations* are those remaining in time series after the effects of the other three types have been removed.[15] Major irregular movements such as a change in the price of gold, a general war, or a widespread natural calamity such as a severe and prolonged drought, must be specifically taken into account in time-series analysis. The remainder are usually considered only to the extent that they affect the size of a calculated standard error of estimate or similar measure.

Measuring Trend. 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.[16] Insufficient data can on occasion be buttressed by a longer series of similar type, but the statistical correlation between the two series should be measured to determine the suitability of the match. In judging the amount of data required it is usually desirable to plot what are available, both on arithmetic and on semi-logarithmic graph paper, to get an over-all perspective. Descriptions of the types of curves available for fitting as trend lines[17] and criteria for selecting one curve from among these fitted[18] are readily available in standard texts.

The reason underlying the authorities' insistence on measuring trends with time-series of adequate length is well illustrated by difficulties inher-

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[13] *Ibid.*, p. 279.

[14] *Ibid.*, p. 277.

[15] *Ibid.*, p. 279.

[16] *Ibid.*, p. 289. They also caution, "It is always possible to obtain close-fitting so-called trends, by fitting lines or curves over an unrepresentative short period of time." See also Croxton and Cowden, *op. cit.*, p. 408.

[17] Cf. Croxton and Cowden, *op. cit.*, pp. 395–457, and Riggleman and Frisbee, *op. cit.*, pp. 295–310.

[18] Cf. Croxton and Cowden, *op. cit.*, pp. 418–419 and 461–462; Riggleman and Frisbee, *op. cit.*, pp. 288–290.

ent in using data for the short time periods commonly employed in both United States and Canadian ratemaking. These periods have commonly been 3¾ years in the United States and either 3 or 4 years in Canada. The data used in the United States have been twelve-month moving averages of fiscal-accident-year mean claim severity, spaced at quarterly intervals. This is equivalent to weighting the first and last quarters once, the next-to-first and next-to-last quarters twice, those second-from-first and -last thrice, and all other quarters four times. In Canada, unaveraged policy year pure premiums have been used.

State data going back far enough could not be obtained, but Figures 1, 2, and 3 illustrate the point with Canadian data. Figure 1 shows the pure premiums for private passenger liability insurance in Ontario from 1945 through 1966, and a straight trend line fitted to these data. The trend line passes reasonably close to the center of the cycles or waves in the actual data. Figure 2 shows all the different trend lines that would have been fitted to the data, starting with 1954 when the minimum of ten years' data were available, if all the data available each year had been used. By way of contrast, Figure 3 shows all the different trend lines that would have been fitted to the data had the method presently employed in Canada (with four years' data each time) been used since 1948.

It can be seen from comparing Figures 2 and 3 that the long-period trend lines have the stability that is desired for ratemaking. They overlap each other to a very high degree, because they use all the available data and use enough data. The four-year trend lines, on the other hand, go in widely different directions that give no perspective on the real long-term direction of the data.

Another means of comparison is to examine the range in estimates by the two sets of trend lines at various dates. Let us take as example a comparison of the actual pure premium index number with the short-term and long-term estimates for 1945 and 1966, the two end years, and for 1955, in the middle of the period. The table below shows the far greater differences in maximum and minimum estimates produced by the short-term trend lines. The long-term trend lines gave rise to more accurate and more stable results.

Source of Trend	Year Estimated	Minimum Estimate	Actual	Maximum Estimate	Range of Difference between Estimates
Figure 2	1945	.3456	.4049	.4275	.0819
Figure 3	1945	−1.5947	.4049	.7313	2.3260
Figure 2	1955	.8374	.8133	.8926	.0552
Figure 3	1955	.0777	.8133	.9682	.8905
Figure 2	1966	1.2884	1.6115	1.4942	.2058
Figure 3	1966	1.0828	1.6115	1.9174	.8346

Table 1. Errors of Estimate of Various Trend Lines

Measuring Cycles. Cycles are the most difficult of the various types of economic fluctuations to measure, because they are periodic and also because they fluctuate both in amplitude (height of peaks and depth of troughs) and in period (horizontal distance from peak to peak or from trough to trough) at the same time.

Perhaps for this reason they are presently almost totally neglected in non-life insurance ratemaking. It will become apparent from the data shown later in this paper, however, that there are cycles that materially affect the accuracy of ratemaking. This fact has long been recognized.[19]

If sufficient data are available, it is possible to measure the cyclical component of time series by fitting a sine or other periodic curve to the data by harmonic analysis, after the influence of trend has been removed. But since data of adequate quantity and quality for this purpose (especially data that are consistently gathered over a long period) are infrequently available, it is common to make any allowance for cyclical influences in some other manner.[20] Common methods of deriving cyclical adjustments, in addition to harmonic analysis, are: (1) residual method, (2) direct method, and (3) method of cyclical averages.[21] But all of these methods are extremely time consuming to use. They are not easily adaptable to the need for speed in promptly processing collected insurance statistics into revised rates. A simple, rapid, and flexible method is needed for use with ratemaking pro-

[19] See Dean, A. F., *Fire-Rating As a Science,* J. M. Murphy, Chicago, 1901, chapters on "The Law of Rhythm" and "Law of the Wave of Fire Destruction," pp. 32–43, and graphs of fire insurance results on pp. 118–188.

[20] Croxton and Cowden, *op. cit.,* pp. 540, 571.

[21] *Ibid.*

Figure 1.- Indexes of Yearly Pure Premiums (Base Year = 1960) for Ontario Private Passenger Automobile Liability Insurance (All-Limits Data) and Straight Trend Line

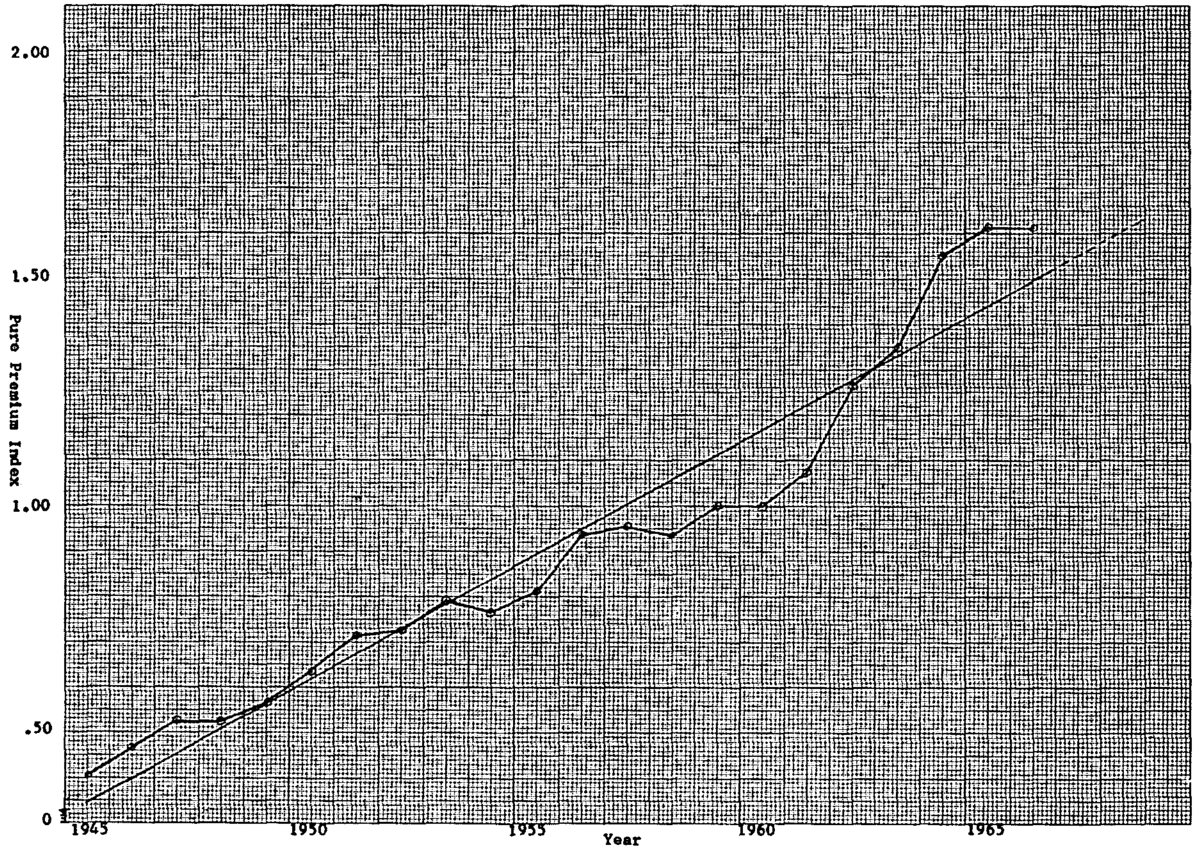


Figure 2.- Straight Trend Lines for the Periods 1945 - 1954 Through 1945 - 1966, Fitted to Indexes of Yearly Pure Premiums (Base Year = 1960) for Ontario Private Passenger Automobile Liability Insurance (All-Limits Data)

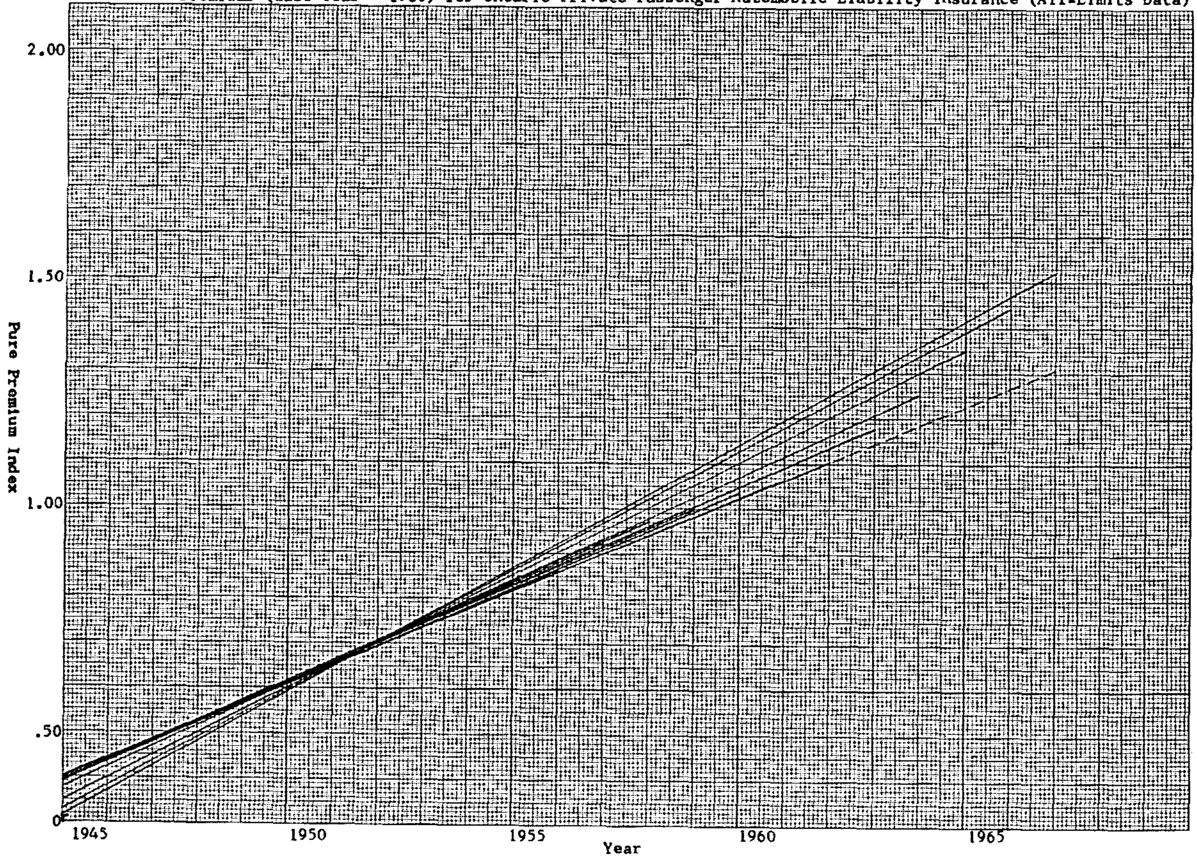
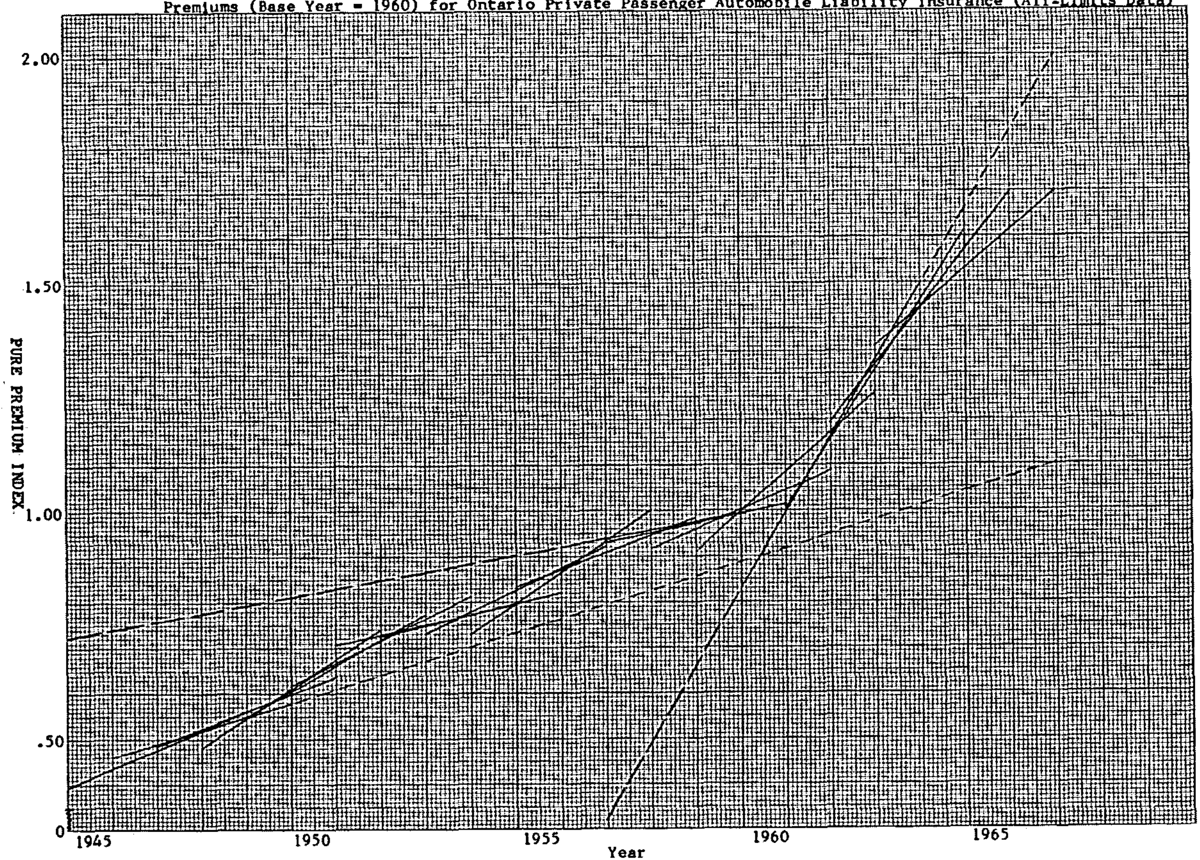


Figure 3.- Straight Trend Lines for the Four-Year Periods 1945-1948 Through 1963-1966, Fitted to Indexes of Yearly Pure Premiums (Base Year = 1960) for Ontario Private Passenger Automobile Liability Insurance (All-Limits Data)



cedures, that are often not stable over long periods, and also for analysis of such procedures. No such method was found in a search of many standard statistics tests, so in the course of practical work it became necessary to devise one.

To meet the problem, a method was devised that incorporates ideas from both the theory of runs and the well-known statistical control chart. The method involves setting up a simple rule. Guide lines or limits are set up one standard error above and below the trend, so that roughly two-thirds (68 per cent) of all data points will fall between them. A rule such as this can then be adopted for projections:

(1) If the starting point (i.e., the last datum point) falls on the trend line or within one per cent, use only the trend adjustment.

(2) If the starting point falls between the trend line and a guide line, determine toward which of the two lines an arrow placed on the last two data points is aimed. Use a cyclical adjustment equal to half the vertical distance from the starting datum point to that line.

(3) If the starting point falls outside a guide line, use a cyclical adjustment equal to the vertical distance from the starting point to the guide line.

This rule was designed to dampen extreme swings in projections and rates, while still providing a response both to the relative positions of the last datum and the trend line and to the direction of the latest identifiable cyclical movement.

The guide lines may be set any number of standard errors from the trend, depending upon the level of probability (for example 75 per cent or 90 per cent rather than the 68 per cent used here) which it is felt provides an acceptable balance between adapting to large fluctuations and maintaining stable rates. The guide line interval can best be set after testing an individual user's actual data, to see what will avoid yearly swings in rates greater than 20 or 25 per cent, and after it has been determined whether a separate catastrophe adjustment procedure is needed to remove for separate handling the extreme parts of extra large fluctuations.

The topping out or bottoming out of a cycle corresponds to the end of a run.[22] The parallel between the guide lines and the customary statistical

[22] See Hoel, P. G., *Introduction to Mathematical Statistics,* John Wiley & Sons, New York, 1947, pp. 177–182.

control chart is obvious. This rule or one like it also introduces a self-correcting tendency overtime as to errors, a highly desirable characteristic for a forecasting or projecting procedure.

Irregular Fluctuations. Large irregular fluctuations in the data require special handling. The major recent irregular influence — World War II and its attendant driving, building, price, and other restrictions — did not necessitate any adjustment in the examples given here because the data do not go back that far. The greatest irregular fluctuations in the property insurance data are probably those due to data collection procedures (e.g., use of paid losses rather than incurred losses, and less than optimal accuracy in calculating earned extended coverage premiums) so that the truly random fluctuations are partly masked. Adjustments are not usually attempted for other than major irregular fluctuations.

What Should Be Measured. It is clearly preferable to measure time-linked changes in the precise data on which the rate level is based. If the rate level is based on pure premiums, time-series analysis should be applied to those same pure premiums. If a loss ratio ratemaking procedure is used, time-series analysis should be applied to the same series of loss ratios (accurately adjusted to a single rate level) to which the ratemaking procedure is applied. To do otherwise involves the disadvantages of ignoring the most directly pertinent data, thereby increasing the margin of error or variance, and increasing the amount of needed work. Work is increased by the need to measure the statistical correlation between the directly applicable series and any series to be used in its stead, since without very high correlation the substitute cannot be satisfactory. A valid reason for using a substitute series is to overcome sparsity of data in time. For example, suitably constructed indexes combining data for fire and allied coverages, residence theft coverage, and comprehensive personal liability coverage, for the period prior to introduction of the homeowners contracts, would permit valid extension backward in time of actual homeowners data.

Because conditions differ markedly from one section of the country to another, geographic identity of data used for rate level adjustment and for time-series analysis is also important. Even though a long series of data be required, it seems unlikely that averaging state time-series results with concurrent countrywide results is ever appropriate. In addition, absence of one or more of the types of consistency mentioned in the next section of this paper makes almost all countrywide series of questionable value for this purpose. Averaging results from small volume states with those of neighboring states having similar conditions may sometimes be helpful in stabilizing indications for the former, but is an otherwise undesirable indirection. Unless the standard error about the state trend line exceeds ten, or perhaps even fifteen, per cent of the current trend value,[23] there is no apparent need for introduction of outside data. If such a large variation is noted, it is appropriate first to check for and try to eliminate or reduce fluctuations due to use of less than optimal procedures for collecting and processing the data before resorting to less directly pertinent data.

A split, rather than a substitution, may permit more precise analysis and thereby be advantageous. Separate analysis of the mean severity and relative frequency components of pure premiums may reveal facts hidden by the combination. But use only of one of the two components introduces distortions that partly defeat the purpose of the analysis. Separation and special handling of catastrophe data can markedly reduce the level of fluctuations in the remaining data, while still permitting needed reflection in the rates of catastrophe losses. A split of data according to the different forms of homeowners contracts promises some increase in accuracy over a single combined series for two or more forms. A split of such data according to perils or coverages having materially different characteristics promises even greater advantage. An example would be separation of data for (1) windstorm and hail, (2) theft, (3) fire and other property perils, and (4) liability perils. Such a split would be analogous to the longstanding split of workmen's compensation experience into medical expense, partial disability benefits, and death and permanent total disability benefits.

How Far Data Should Be Projected. Figure 4 shows the differences in six types of yearly accumulations of data used in insurance. The accumulations with "calendar" in their names extend from January through December. The rough borders of some of the accumulations reflect the changes in reserves for prior years' losses that are inaccurately assigned to the year in which an accounting change is made instead of being assigned to the year in which the underlying accident occurred. The accumulations or years with "policy" or "accident" in their names have all losses and reserve changes assigned back to the policy or accident year (i.e. exposure period) in which each loss occurred, hence are considerably more accurate for ratemaking purposes. The graph makes it easier to visualize the center of each type of accumulation of data.

[23] Extended coverage and other catastrophe-involved data are likely to have larger standard errors, as evidenced by the illustration given later.

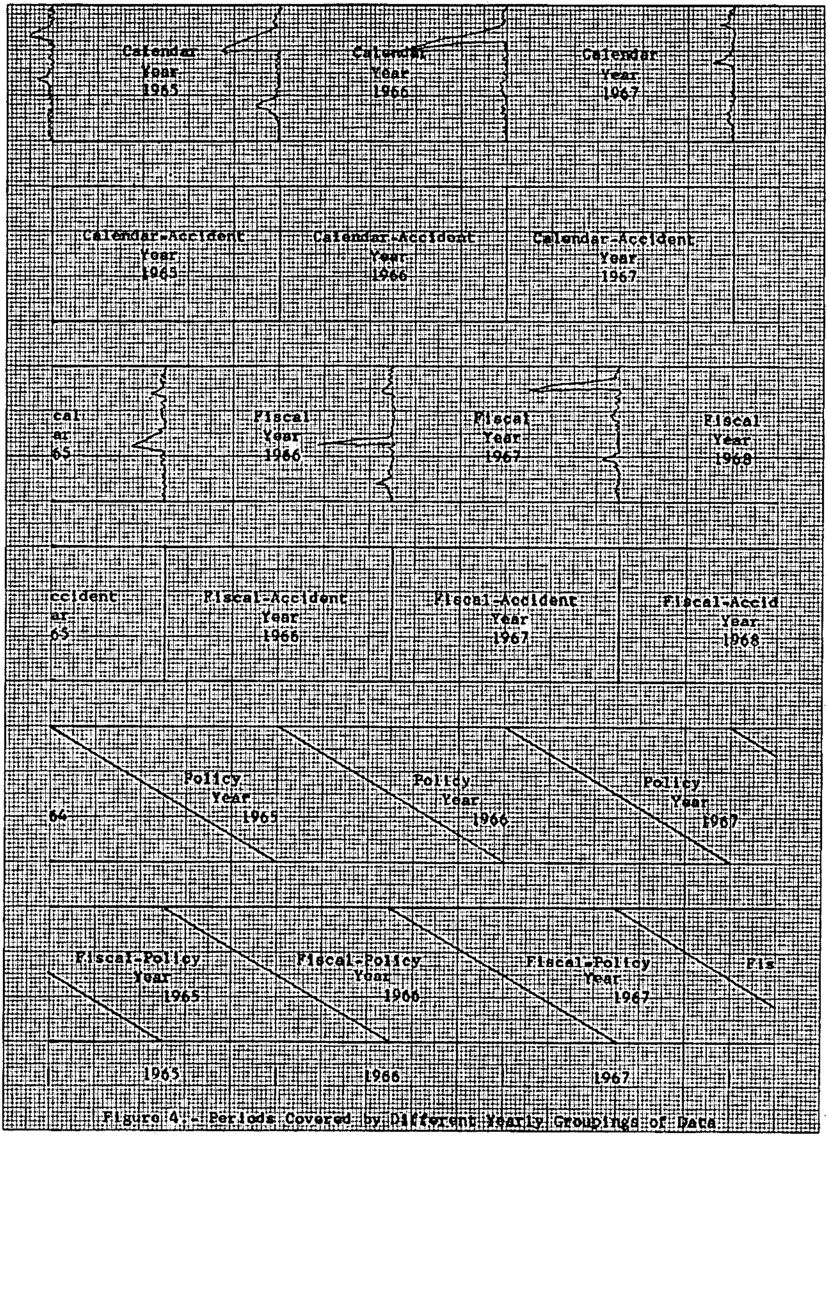


Figure 4. - Periods Covered by Different Yearly Groupings of Data

The latest actual experience data reflect results at the midpoint of the period during which they were gathered. Calendar year data reflect an average result as of midnight, 30 June. Policy year data reflect an average result as of midnight, 31 December. If data for two or more years are used jointly, both the weights ascribed to each and their respective temporal midpoints must be used to determine the effective midpoint of the combined mass of data. It is from this effective midpoint that the time-series adjustment must be projected. Determination and reflection of these midpoints is properly based on the same reasoning and procedures as determination of class midpoints in analysis of frequency distributions.[24]

The point in time to which a projection should be carried is the *effective* midpoint of the period during which the rates most likely will be in force. The great advantage of regular yearly rate adjustments in helping to determine this midpoint is clear. The advantage for this purpose of having all policies issued for the same term (or, if issued for different terms, of having the rates *guaranteed* for the same term, with interim rate adjustments permitted on longer term and continuous policies) is perhaps less clear but is no less important. Assuming regular yearly rate adjustments, and issuance of all policies for one-year terms, the midpoint of the period during which a given set of rates will be in effect is one year after the effective date of the rate filing. If the rates are guaranteed for three years and refiled every year, the midpoint of the period during which the rates will be in effect is two years after the effective date of the filing. The *effective* midpoint depends on the rate of change in the volume of business. The effective midpoint on a rising volume will be deferred past the temporal midpoint, and on a falling volume will occur prior to the temporal midpoint. Unless this rate of change is rapid, its effect will be negligible.

Failure to carry the projection an adequate distance can result in chronically inadequate rate levels if the trend in pure premiums is upward, and chronically excessive rate levels if the trend is downward.

When Data Should Be Gathered and Applied. Perhaps the chief problem faced by the time-series analyst is the difficulty in getting consistent series over a long enough period. A discussion of criteria for gathering and

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[24] See Yule, G. U., and Kendall, M. G., *An Introduction to the Theory of Statistics*, 13th ed. rev., Charles Griffin & Company, London, 1948, pp. 82–88, 91–92, and 160; also Neiswanger, W. A., *Elementary Statistical Methods*. The Macmillan Company, New York, 1943, pp. 212–225.

using data therefore applies as importantly to the design of statistical collecting plans as it does to use of the collected data.

Data should first be consistent as to form, i.e. all on an accident year, policy year, calendar year, or other single basis. They should be consistent as to timing, with all years ending on the same day and month and with no gaps or overlaps. Losses should be kept track of and actually developed to the same number of months for each year (with consistent formulas applied to estimate developments for the latest years). To minimize the degree of loss-reserving error incorporated in the data, it is preferable that they be developed to an ultimate basis. Loss adjustment expense should be uniformly included or excluded. If included, it should be on an actual and complete rather than on an estimated (formula) or partial basis for all but the latest years (those that are not fully developed).

Better results will be obtained if the adjustments are calculated, and rates adjusted, at the same time each year. The effect of rate level changes will in this manner be made uniform, and one more source of fluctuations in the data eliminated. Important simplifications in the work of adjusting data for rate level changes will also result from this precaution.

ANALYSIS OF SOME LIABILITY INSURANCE TIME SERIES

Nature of the Data. Automobile liability insurance data for one state were first analyzed. Later, data for another state and several provinces of Canada were also analyzed, with remarkably similar results. This discussion will first deal with the one-state data, and will then be generalized.

Suitably consistent parallel countrywide data were not available, so an intended test of the correlation between the state and countrywide data could not be performed. The basic data are pure premiums at \$5,000/10,000 bodily injury and \$5,000 property damage liability limits; paralleling the customary ratemaking method, they include loss adjustment expense. They are separated by coverage and grouped for (1) private passenger automobiles, (2) commercial automobiles, and (3) garages (Hazard 1, i.e. payroll-rated exposures). Data for the first two groups cover the period 1946 through 1964, while those for garages were available only for the period 1956 through 1962. The data available for private passenger vehicles were accumulated in three different ways and those for commercial vehicles in two different ways for various portions of the period. Overlapping data to be used for adjustments were available only for some of the breaks in continuity. It was possible to develop all the loss data consistently to 39 months.

Figure 4 shows the differences in six types of yearly accumulations of data. To make the six series of data as nearly continuous as possible, they were adjusted as well as possible to a calendar-accident year basis. The fiscal year data are centered at 31 December. Data for adjacent pairs of policy year and fiscal year data were therefore averaged to produce data centered at 30 June. The discrepancies between the results of this procedure and calendar year data tend to be greater for policy year data than form fiscal year data, as Figure 4 demonstrates. At a junction of fiscal and calendar year data, the latest fiscal year average was of necessity further averaged with the adjacent calendar year datum.

To make the data for the two coverages and three types of risks mutually comparable, the pure premiums were transformed into index numbers, based on the 1958–1961 average pure premium as 100.

In addition to correcting the basic data to a single (or more accurately adjusted) basis, accuracy could be improved by reflecting the changing distribution of exposures by class of use and driver, mileage driven, accident record, and limit of insurance; the increasing proportion of multiple car families, with lower exposure per car; and other factors. This could be done by development of a more complex type of index number. It would require considerably more computations and more refined and voluminous data than were available. However, it is easy to mistake the relative importance of such an adjustment in data that average a single characteristic of the whole insured population.

As pointed out in these *Proceedings*[25] *with respect to class relativities,* ". . . pure premiums obtained from a consolidation of widely divergent bodies of experience must be used with great caution since they may contain distortions." In other words, when data are classified according to one rating criterion or variable (for example, class of driver and use) — and if the effects of other variables (such as distribution of risks by rating territory and by merit rating class) are not either (1) held constant or eliminated by a technique such as multiple correlation analysis, or else (2) all very highly correlated with the variable being examined — the resulting relativities of

[25] Stern, P. K., "Ratemaking Procedures for Automobile Liability Insurance," *PCAS,* LII, pp. 169–172.

the pure premiums may not show the true relativities in hazard due to the variable being examined, because the effects of other variables will also affect these pure premium relativities. On the other hand, in data for any one year, the distribution of risks by different variables and the correlation among variables are of no importance to the average over-all pure premium. No matter what the distribution and correlations may be, there is only one total of losses and one total of exposure units and, therefore, only one over-all average pure premium.

These distributions and correlations *could* have an effect, however, on the relationships among (and predictive value of) over-all average pure premiums for a series of years if the distributions and correlations materially change in a short time. But the same effect will apply to the components of the pure premium, mean claim severity and mean relative claim frequency, as well as to the whole. Also, if such changes are material, they will have to be reflected by yearly tests of and changes in all the different kinds of class relativities named above. Further, any such rapid and material changes would severely diminish the accuracy of loss ratio tests of relativities, because the ability of the prior year's rate differential complex to offset the effects of the current year's distribution would be reduced in the degree of the changes. Since either the pure premium (Canada) or its mean claim severity component (United States) is commonly used for fitting trends, since class relativities are not changed yearly, and since the loss ratio method of testing such relativities is in widespread use, it is reasonable to infer that the majority view in North America, among those who have actually studied the matter, is that changes in distributions by rating criteria are not large or rapid enough to affect materially the predictive value of trends fitted to the data used here.

Procedure Used with the Data. Trend lines were fitted to the data by well-accepted methods.[26] The economic environment was first considered. All available economic measures that are in the form of time series point to a steady inflationary trend since World War II. The discontinuities created by war conditions made it advisable to use only post-war data. One standard that must be met by any trend line fitted to the available data is therefore that it point upward to the right. The data are seen to conform to this constraint when graphed and visually examined (Figures 5 through 8).

[26] Croxton and Cowden, *op. cit.*, Chapter XV; Flaskaemper, *op. cit.*, pp. 143 ff; Riggleman and Frisbee, *op. cit.*, pp. 297 ff.

Figure 5.-Indexes of Yearly Pure Premiums (Base Period = 1958 - 1961) for Kentucky Private Passenger Automobile Bodily Injury Liability Insurance (5/10 Limits Data) and Straight Trend Line

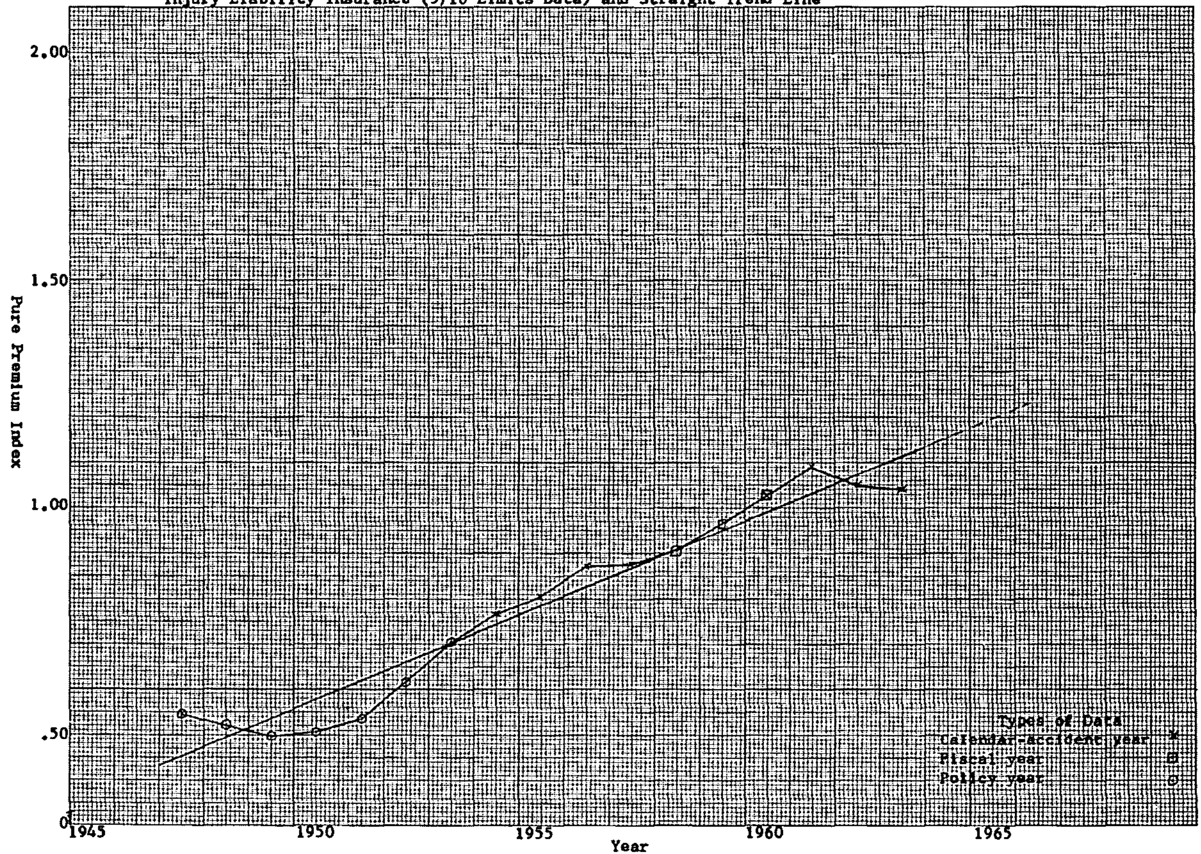


Figure 6.-Indexes of Yearly Pure Premiums (Base Period = 1958 - 1961) for Kentucky Private Passenger Automobile Property Damage Liability Insurance (5,000 Limit Data) and Straight Trend Line

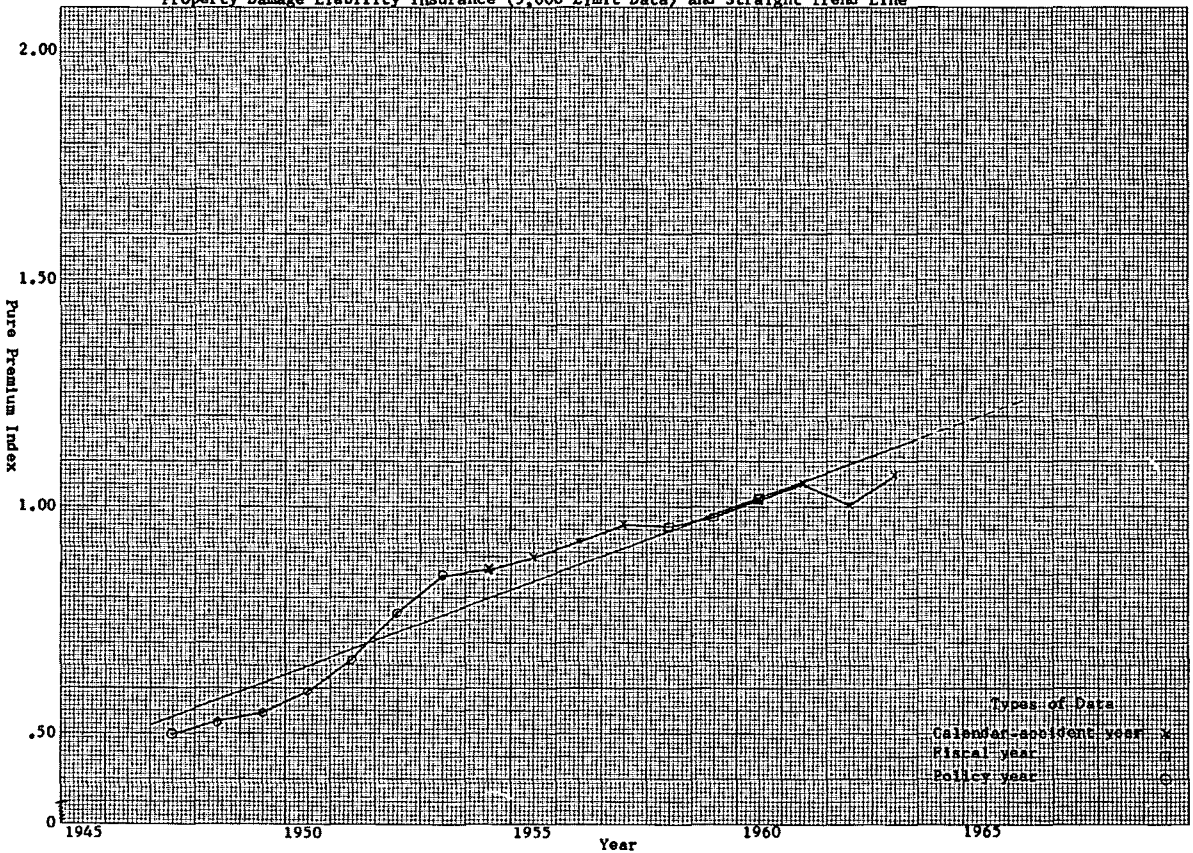


Figure 7.-Indexes of Yearly Pure Premiums (Base Period = 1958 - 1961 for Kentucky Commercial Automobile Bodily Injury Liability Insurance (5/10 Limits Data) and Straight Trend Line

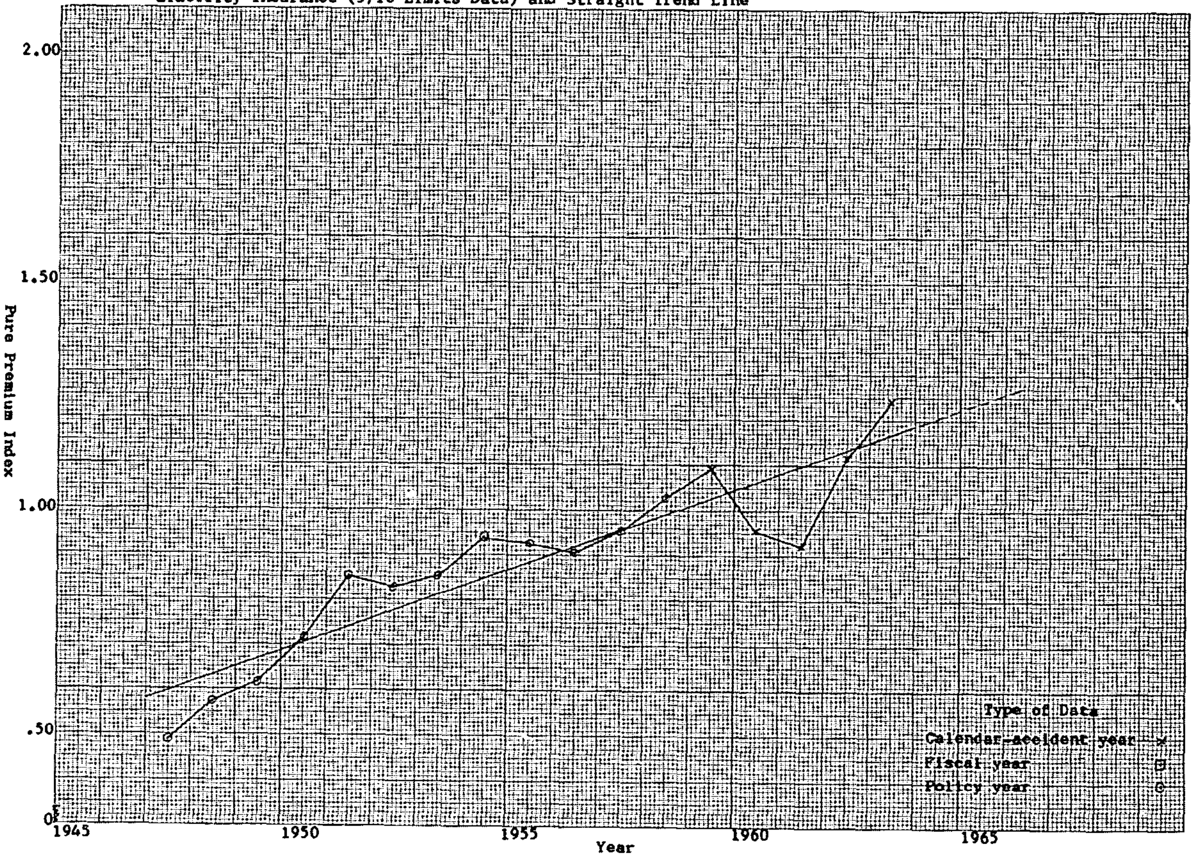
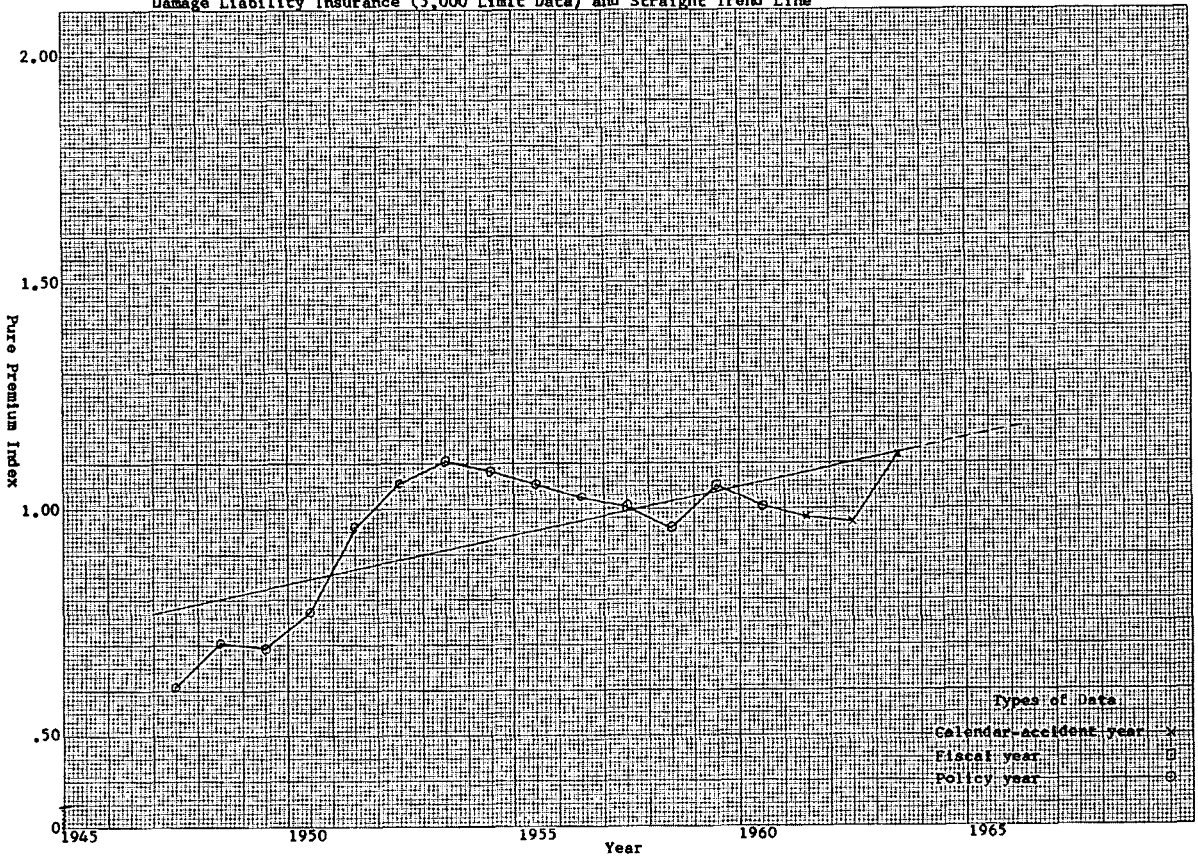


Figure 8.-Indexes of Yearly Pure Premiums (Base Period = 1958 - 1961) for Kentucky Commercial Automobile Property Damage Liability Insurance (5,000 Limit Data) and Straight Trend Line



The upward or inflationary trend is also more likely to reflect a steady rate than a diminishing or growing rate of increase over the longer term. The general economic data support this better than the insurance data available, since most of the latter are not available for long enough periods (preferably fifty or more years). The form of curve that best fits the data is therefore more likely, other things being equal, to be of second or higher degree. Most analysts have so far limited their choice of trend lines to straight lines, which do not conform to this standard. This choice is however not "wrong." A straight line has the advantage of being much easier to fit to statistical data. Possibly greater accuracy in projections is sacrificed by using a straight line, but there are also greater risks in using a less simple type.

It was hypothesized that a third degree trend might be most appropriate, based on the recent history of liability claim practices. The surge in organized activity among trial attorneys representing claimants, that began in the early 1950's, could reasonably be expected to steepen the rate of rise in pure premiums from that time on. An offsetting attempt by defense attorneys that has primarily been confined to the 1960's could be expected at least to begin to offset the results of the plaintiff-attorney activities, thereby tending to flatten the curve again. The two changes in direction of the trend line would accord with the shape of a third degree curve.

Objective criteria for selecting the most appropriate type of trend are given by one authority as follows:

(1) If the first differences are constant, use a straight line.

(2) If the second differences are constant, use a second degree curve.

(3) If the third differences are constant, use a third degree curve.

(4) If the first differences are changing by a constant percentage, use a modified exponential.

(5) If the first differences resemble a normal curve, use a logistic.

(6) If the first differences resemble a skewed frequency curve, use a Gompertz curve or a complex type of logistic.

(7) If the first differences of the logarithms are constant, use an exponential. (Fit a straight line to the logarithms.)

(8) If the second differences of the logarithms are constant, fit a second degree curve to the logarithms.

(9) If the first differences of the logarithms are changing by a constant percentage, use a Gompertz curve.

(10) If the first differences of the reciprocals are changing by a constant percentage, use a logistic curve.[27]

Examination of the first, second, and third differences gave no clear indication as to which degree of curve would fit best. This was not unanticipated, since neither the quality nor the length of the data, as explained in the foregoing section on measuring trend, is adequate fully to support fitting of a trend of higher than first degree. As a matter of interest, however, first, second, and third degree polynomial trend lines were fitted to the adjusted data for private passenger and commercial vehicles. Because of the limited data (seven years) only straight trend lines were fitted to the garage liability data. The standard error of estimate was calculated to provide the best available measure of fit.[28] Orthogonal polynomials were used to minimize computing time.[29]

Table 2 shows that a third degree curve has the best mathematical fit in three of four cases. In one of the four cases a second degree curve fits best and in two other cases second best. Of the lines fitted to the private passenger data, only the straight lines continue upward to the right, however, so they best meet all pertinent criteria. Because of the sensitivity of

Data	Standard Errors of Estimate		
	First Degree	Second Degree	Third Degree
Pvt Pass Veh BI	.051	.053	.031
Pvt Pass Veh PD	.071	.032	.033
Com-BI	.088	.075	.064
Com-PD	.117	.119	.068
Gar-BI	.160	—	—
Gar-PD	.068	—	—

Table 2. Standard Errors of Liability Insurance Data

[27] Note 18.

[28] *Ibid.*, p. 462.

[29] See Fisher, R. A., *Statistical Methods for Research Workers*, Oliver & Boyd, Edinburgh, 7th ed., pp. 148–155.

higher degree curves to small differences in data, the results obtained with them are judged to be preliminary. They do indicate however that further testing, with more refined data, is merited. Similar results with more accurately adjusted figures and (in view of their limited length) after extension of the series between endpoints that are at the same stage of a cycle would fully sustain selection of a curve of higher than first degree.

As a check on the general tendencies noted in these data, and on the capacity of the methods of trend analysis here described to handle diverse kinds of data, other data from a second state and from two provinces of Canada were examined. Although to save space only private passenger data are shown here, no difficulties with either commercial or garage data from these other areas were noted. The other state data in Figures 11 and 12 and those for two Canadian provinces, exhibited in Figures 1 and 14, all lend themselves excellently to our methods of analysis. The different legal climate in Canada gives no reason such as was mentioned for the United States for expecting a third degree trend, but the combination of bodily injury and property damage liability into a single limit package in more recent years cannot be seen to have made the Canadian pattern deviate materially from the American pattern. While the Canadian data are on the less desirable all-limits basis, this has not prevented an adequate analysis by the methods described.

A visual inspection of the data also shows a pronounced and relatively regular multi-year cyclical movement. It is easiest to see this from Figures 9, 10, and 13, from which the straight line trend has been removed. Figures 1, 5 through 8, 11, 12, and 14 show that in many years the cyclical movement causes considerably more variation in the data than does the trend movement. It is as important that this cyclical component be cared for in some orderly manner as it is similarly to care for trend.

It is seldom required or feasible to project data of as much variability as these for more than one year ahead in fields outside insurance. Insurance ratemaking may require, however, the projection of the pure premium or rate level as much as three or more years. Until the period over which the forecast or projection must be made can be reduced (by securing more recent data) to not more than, say 18 months, it therefore appears most feasible to project along or close to the trend line. However, if the point from which the projection is made departs widely from the trend line, a trend adjustment alone will produce a forecast that departs equally far from the trend line, often an improbable result. A more accurate projec-

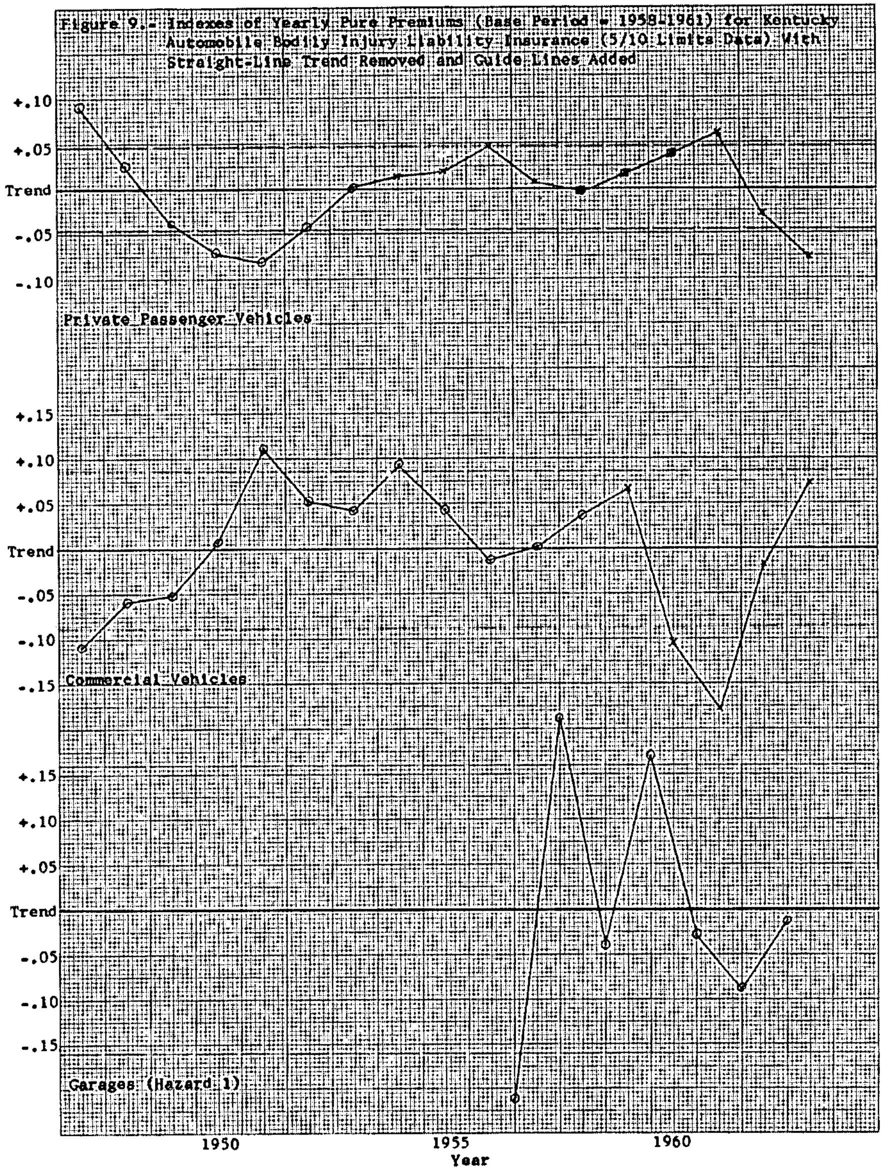


Figure 9.- Indexes of Yearly Pure Premiums (Base Period = 1958-1961) for Kentucky Automobile Bodily Injury Liability Insurance (5/10 Limits Data) With Straight-Line Trend Removed and Guide Lines Added

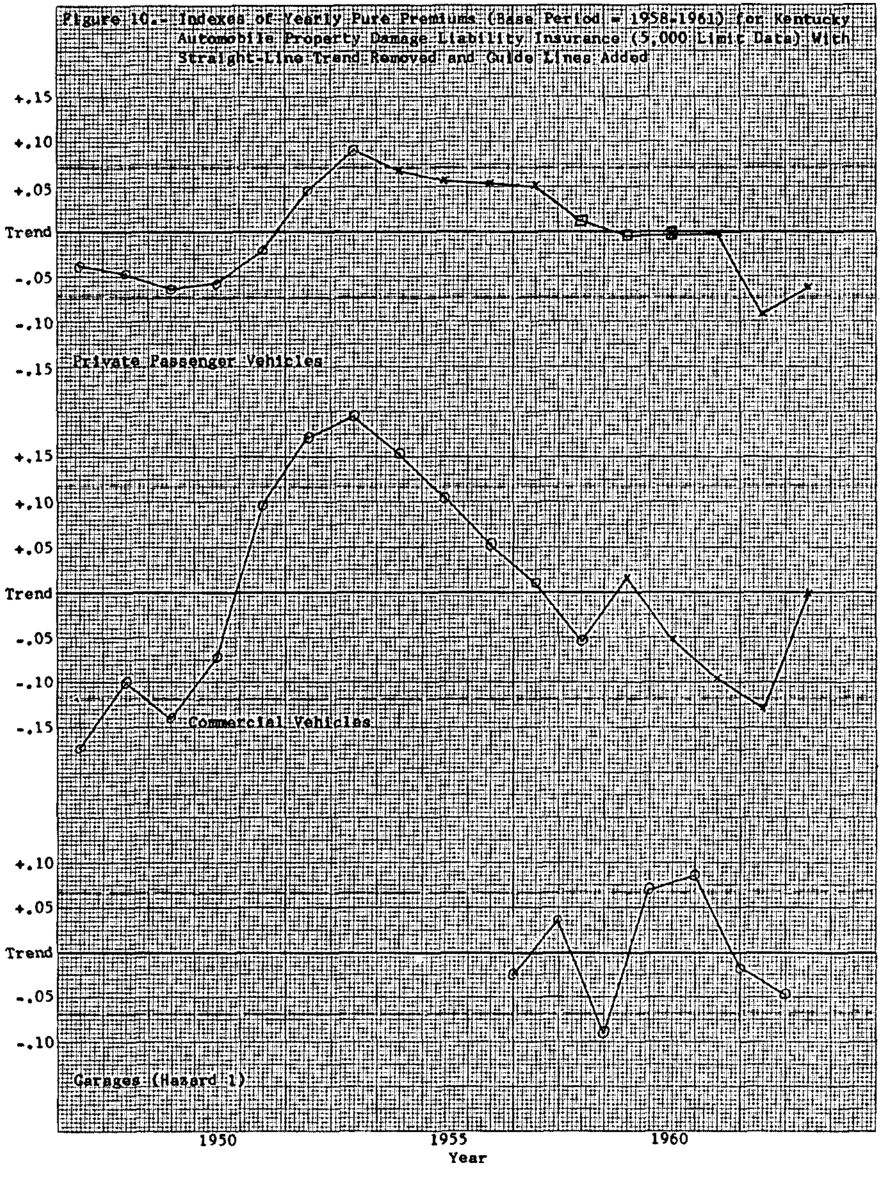


Figure 10.- Indexes of Yearly Pure Premiums (Base Period = 1958-1961) for Kentucky Automobile Property Damage Liability Insurance (5,000 Limit Data) With Straight-Line Trend Removed and Guide Lines Added
+.15
+.10
+.05
Trend
-.05
-.10
-.15
Private Passenger Vehicles
+.15
+.10
+.05
Trend
-.05
-.10
-.15
Commercial Vehicles
+.10
+.05
Trend
-.05
-.10
Garages (Hazard 1)
1950
1955
1960
Year

Figure 11.- Indexes of Yearly Pure Premiums (Base Year = 1960) for Illinois Private Passenger Automobile Bodily Injury Liability Insurance (Adjusted 10/20 Limits Data) and Straight Trend Line

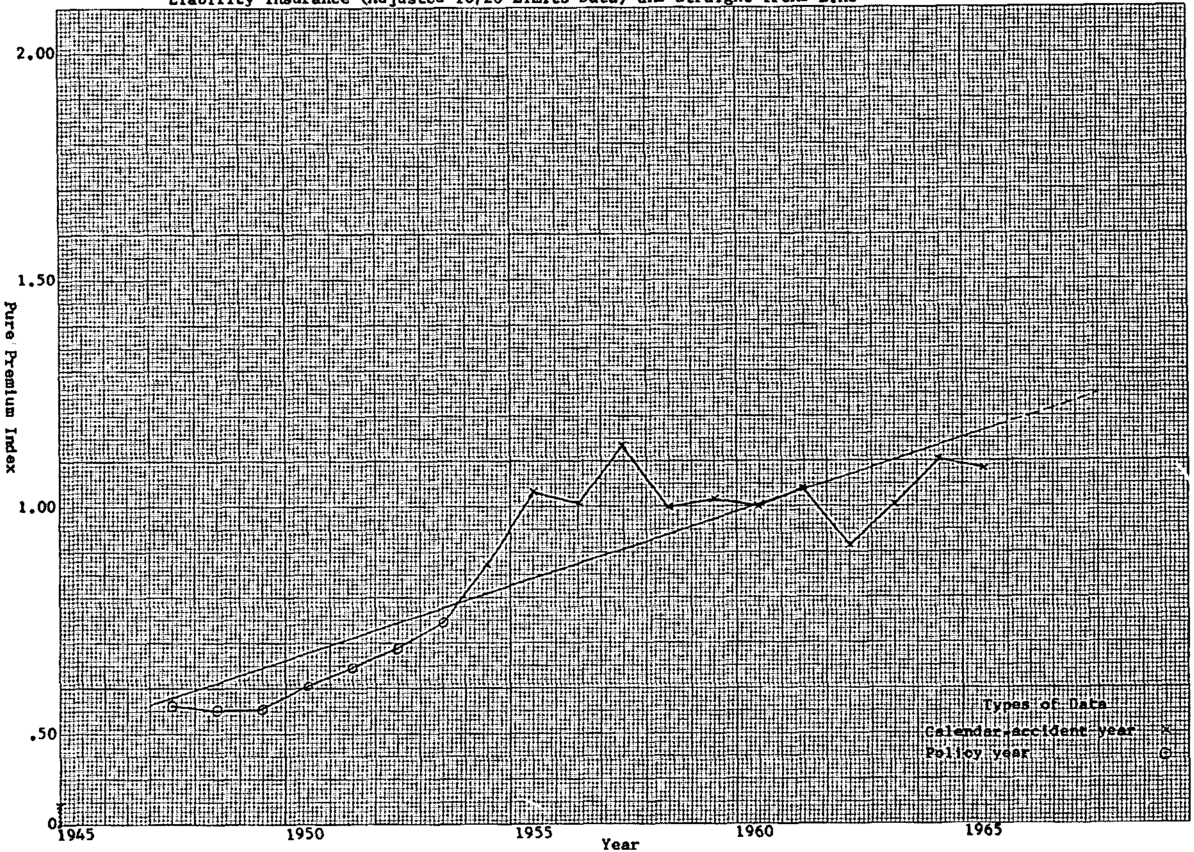


Figure 12.- Indexes of Yearly Pure Premiums (Base Year = 1960) for Illinois Private Passenger Automobile Property Damage Liability Insurance (5,000 Limit Data) and Straight Trend Line

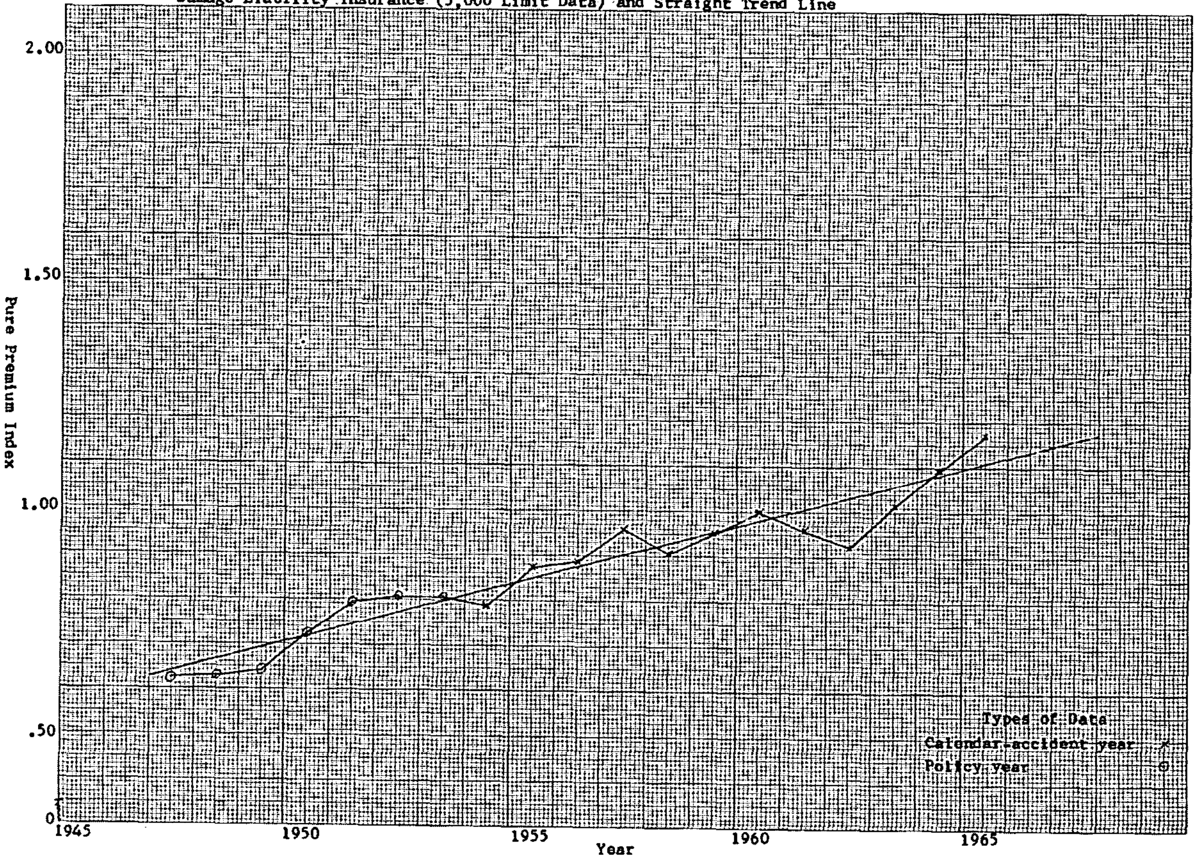


Figure 13.- Illinois Private Passenger Automobile Liability Insurance Data with Straight-Line Trend Removed and Guide Lines Added

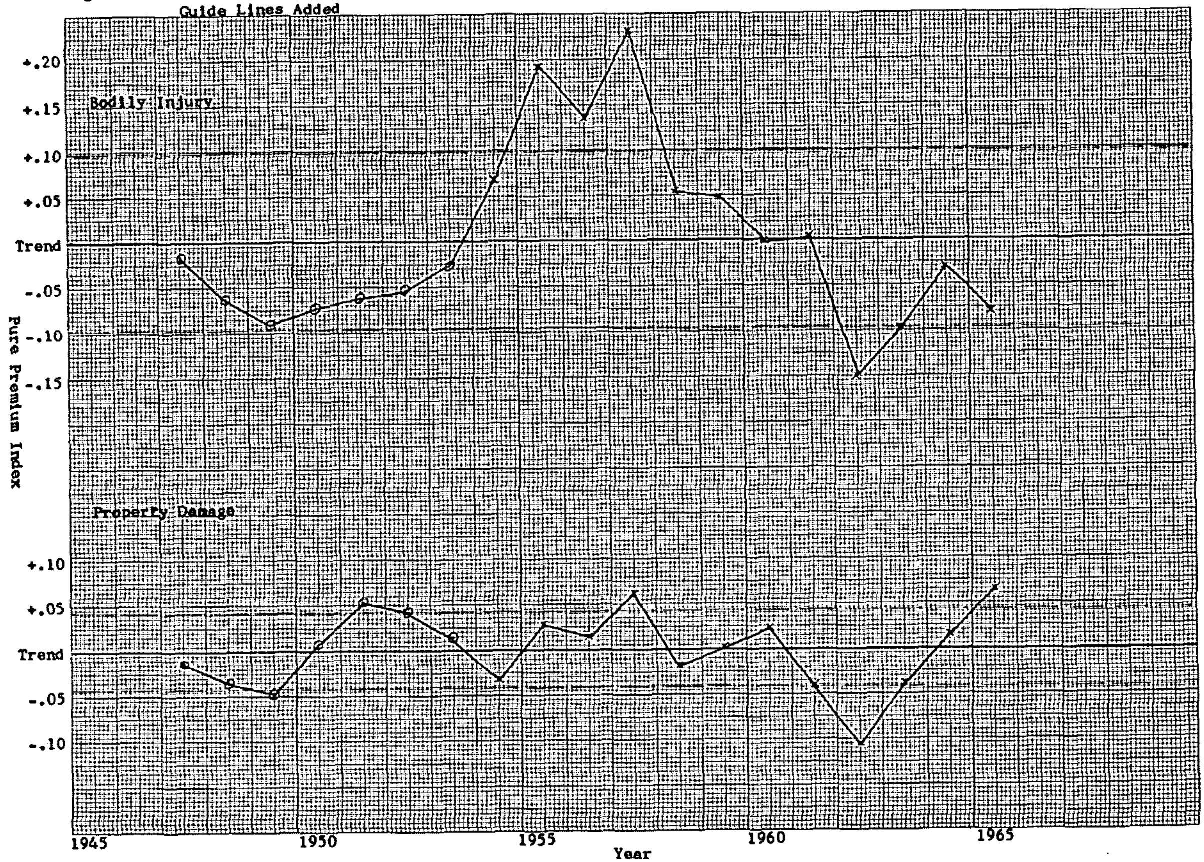
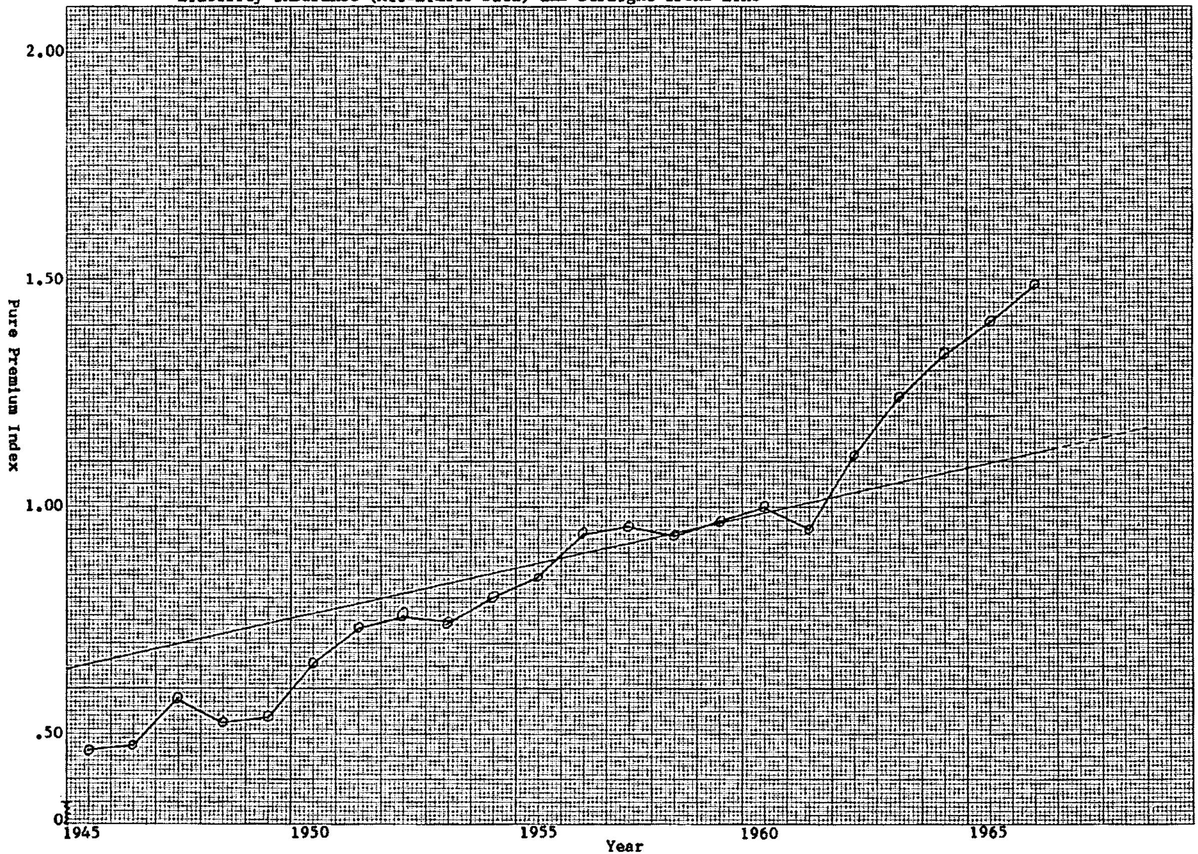


Figure 14.- Indexes of Yearly Pure Premiums (Base Year = 1960) for British Columbia Private Passenger Automobile Liability Insurance (All-Limits Data) and Straight Trend Line



tion is apt to result if an adjustment is made for the cyclical departure of the starting point from the trend line. The method previously described in the section on measuring cycles proved useful with all the data here presented. An example with the initial state data will illustrate the procedure.

The top portion of Table 3 shows the calculation of combined trend and cyclical adjustments to the six classes of liability data, which have three different midpoints in time, using the straight-trend values. The trend values were first projected forward from the last datum point, as shown in columns (2), (3), and (9). This adjustment for private passenger bodily injury liability is graphically portrayed in Figure 15. The vertical distance between the left-hand arrows is the amount of trend adjustment (.118).

The dashed guide lines in Figure 15 lie one standard error above and below the solid trend line. Since the last datum point is outside the lower guide line, the cyclical adjustment called for by the rule equals the vertical distance from the datum to the guide line. This vertical distance, between the right-hand arrows in Figure 15, is the amount of cyclical adjustment (.019). The determination of this adjustment is shown in columns (4) through (8) of Table 3.

Adding the trend and cyclical adjustments, column (10), yields the total time-series adjustment. The fully adjusted, predicted, point for 1 April 1966 would lie on the lower guide line of Figure 15, directly above the trend-adjustment arrow. Dividing the total adjustment by the trend value at the starting point yields the total time-series adjustment factor, column (11), to be applied as part of the whole rate level adjustment.

ANALYSIS OF SOME PROPERTY INSURANCE TIME SERIES

Kinds and Characteristics of Property. In contradistinction to a liability insurance loss, the size of which is relatively independent of the insured interest, the characteristics of a property insurance loss are highly correlated with those of the subject of insurance. Property insurance applies to losses to specific property, while liability insurance does not apply to losses to either specific persons or specific property. Analysis of property insurance time series must therefore take carefully into account several types of factors in addition to those considered in analyzing liability insurance time series.

One such factor is the relative uniformity or diversity of the property involved. The degree of uniformity in size, shape, and value decreases as we consider in turn automobiles, items customarily scheduled in inland marine

Table 3.—Summary Comparison of Time-Series Adjustments

(1) Type of Data	(2) Starting Point or Last Datum[a]	(3) Trend Value at Starting Point	(4) Actual Value at Starting Point	(5) Deviation of Actual Value from Trend	(6) Standard Error[b]	(7) Adjustment per Rule	(8) Amount of Cyclical Adjustment	(9) Trend Value on 1 Apr 66[c]	(10) 1 Apr 66 Trend Value + Cyc.Adj.	(11) Indicated Time-Series Adjustment Factor
Automobile Liability Insurance Data										
Pvt-BI	1 Jun 63	1.112	1.042	-.070	±.051	to guide line	.019	1.230	1.249	1.123
Pass Veh-PD	1 Jun 63	1.127	1.064	-.063	.071	½ way to trend	.032	1.233	1.265	1.122
Com-BI	1 Apr 63	1.161	1.211	.050	.088	½ way to guide	.019	1.269	1.288	1.109
Com-PD	1 Apr 63	1.115	1.082	-.033	.117	½ way to trend	.017	1.179	1.196	1.073
Gar-BI	1 Oct 62	1.113	1.080	-.033	.160	½ way to trend	.017	1.292	1.309	1.174
Gar-PD	1 Oct 62	1.063	1.022	-.041	.068	½ way to guide	-.014	1.175	1.161	1.091
Automobile Property Insurance Data										
Coll	1 Mar 64	1.058	1.097	.039	.080	½ way to guide	.021	1.053	1.074	1.015
Non-coll	1 Mar 64	1.150	1.124	-.026	.116	½ way to trend	.013	1.209	1.222	1.063
Fixed-Property Data for Extended Coverage										
Combined	1 Jul 64	1.673	2.062	.399	.732	½ way to trend	-.200	1.689	1.489	.890
[Non-ded	1 Jul 58[d]	1.622	1.952	.330	.799	½ way to trend	-.165	1.694	1.529	.943]
[Deduct	1 Jul 62[d]	1.545	1.439	-.105	.495	½ way to guide	-.195	1.847	1.652	1.069]

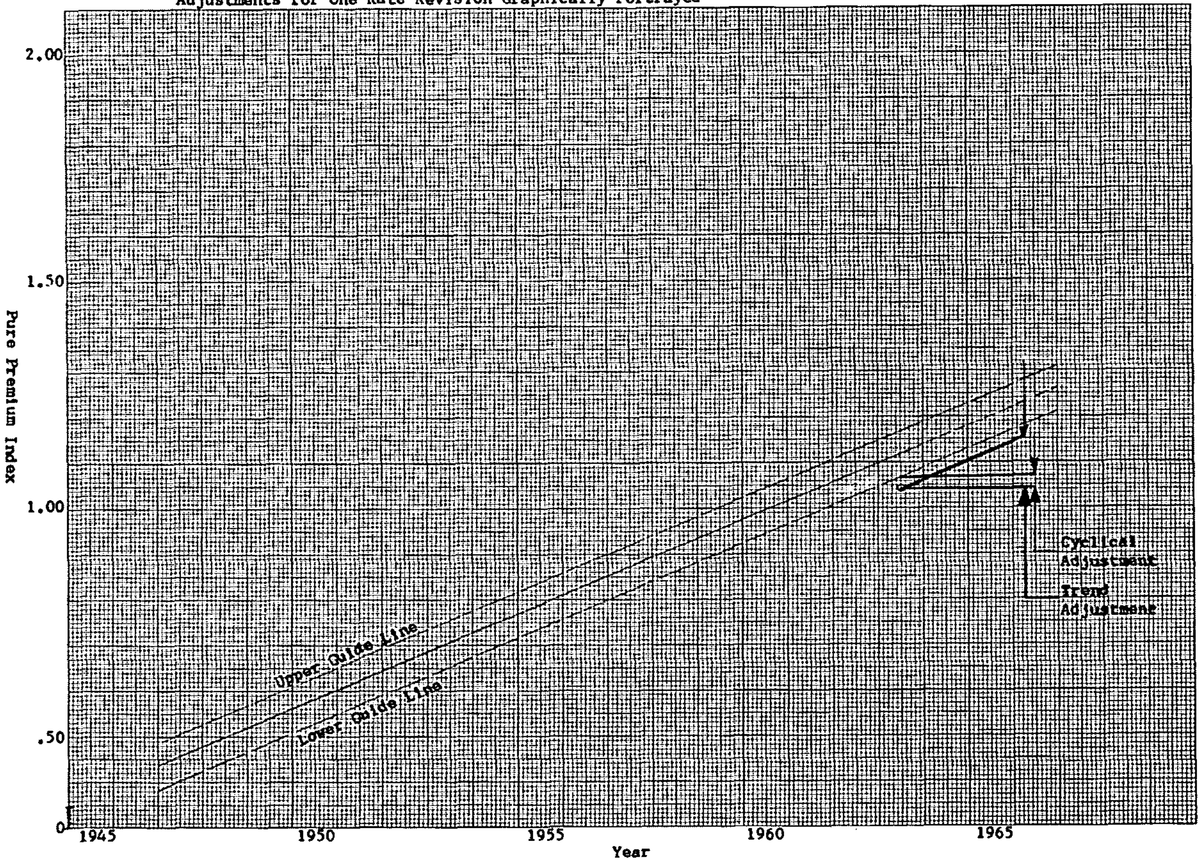
[a] This "starting point", referred to in the rule used for cyclical analysis, is either the last datum in the time series or, if two or more of the latest data are averaged (with either equal or differing weights), it is the midpoint in time of the weighted average.

[b] Distance of guide lines from trend line.

[c] 1 August 1966 for extended coverage.

[d] Eleven-year average for non-deductible and five-year average for data for deductible coverage.

Figure 15.- Kentucky Private Passenger Automobile Bodily Injury Liability Data With Indicated Trend and Cyclical Adjustments for One Rate Revision Graphically Portrayed



policies (furs, jewelry, silverware, stamp and coin collections, outboard motors and boats, etc.), personal property at fixed locations, and buildings and other structures. The degree to which the amount of insurance matches the value of the property is another factor and also roughly decreases in the same order, with perhaps the first two classes reversed. A third factor is the ability of the rating system to reflect in premium charges the degree to which amount of insurance matches value or exposure to loss. Issuance of "actual value" policies, rather than policies with a stated amount of insurance against which a stated rate is applied, has introduced this third factor, which can have an appreciable effect.

Exemplifying to some extent the two extremes listed above, some automobile time series and then two fixed property time series are analyzed below.

Nature of the Automobile Data. Total limits automobile insurance data were used in order to reflect a valid cross section of the insured risks, because the sizes of property losses are closely linked to the characteristics of the insured risks (primarily value at risk). Only data for risks rated on a per vehicle basis were available. As representative of at least 85 per cent of the total exposure for one state and at least 67 per cent in another for each year, this is deemed a sufficiently large sample. There is no apparent reason to believe that addition of the data for the omitted types of risks (dealers, fleets, garage bailees' liability, single interest coverages, etc.) would materially alter the results obtained. Data for one state were first analyzed. Suitably consistent parallel countrywide data were not available, so an intended test of the correlation between the two could not be performed.

The data are grouped separately for (1) collision and (2) non-collision coverages. Collision data for \$25, \$50, \$100, and \$250 deductible options, and non-collision data for full coverage and \$50 deductible comprehensive, specified individual perils, combined additional coverage, and towing were included. They cover the period 1947 through 1964 on a fiscal year basis, the first three fiscal years ending at a different time than the others. The data reflect paid rather than incurred losses, and exclude loss adjustment expense, although rates for these lines are usually based on data that include such expense. Losses from catastrophes occurring prior to 1958 are apparently included in the data, although a separate procedural allowance for such losses makes it preferable to exclude them. This feature seems materially to have affected the slant of the trend line for non-collision coverages. Since losses are on a paid basis, they are not developed to any consistent point.

The one discontinuity in the data was a three-month gap between June and September 1949. It was necessary to adjust the data for the first three years to a fiscal year ending three months later than that reported. This was done by averaging three-fourths of the prior year data with one-fourth of the later year data for 1947 and 1948. The data for 1949 were recentered by algebraically adding to the reported 1949 data one-fifth of the difference between them and the reported 1950 data.

To make mutually comparable the data for different coverages and for different deductibles, it was necessary to devise an index number for each series. Fisher's Ideal Index Number was selected.[30] It has the advantages of meeting the factor reversal and time reversal tests. This type of index number thereby eliminates bias due to a changing mix or proportionate distribution of risks by type of deductible. The index number also averages all the types of coverage according to the number of exposures for each, both in the base year (the year in which the index is 100 per cent) and in the year for which the index number is being computed. This type of index number also adjusts equitably for the absence in early years of data for some coverages and options. A sample calculation to demonstrate the procedure is shown in the Appendix.

The effect and value of the indexes can be seen from Figures 16 through 20. The patterns described in Figure 16 by the single state collision data for individual deductible forms are very similar to the patterns in the country-wide Canadian data in Figure 18. Similar patterns have been found in the data for other states and individual provinces.

Figures 16 and 18 show data for four different deductibles, as explained in the lower right-hand corner. Although the general tendencies of the four sets of data are similar, no one of them well represents the whole group. Also, the fluctuations from year to year are quite wide, caused in part by sparseness of data. Figures 17 and 19 show, respectively, how all the diverse data from Figures 16 and 18 can be combined by use of a well-designed index number. Much of the random fluctuation has been eliminated by use of the larger body of data reflected by each index. One can see by superimposing each index over its four components how it excel-

[30] See Fisher, Irving, *The Making of Index Numbers,* Houghton Mifflin Co., Boston, 3d ed., and Neiswanger, *op. cit.,* pp. 398–411.

Figure 16.- Separate Indexes of Yearly Pure Premiums (Base Year = 1960) for Kentucky Private Passenger Automobile Collision Insurance (All-Limits Data) for $25, $50, $100, and $250 Deductible Coverages

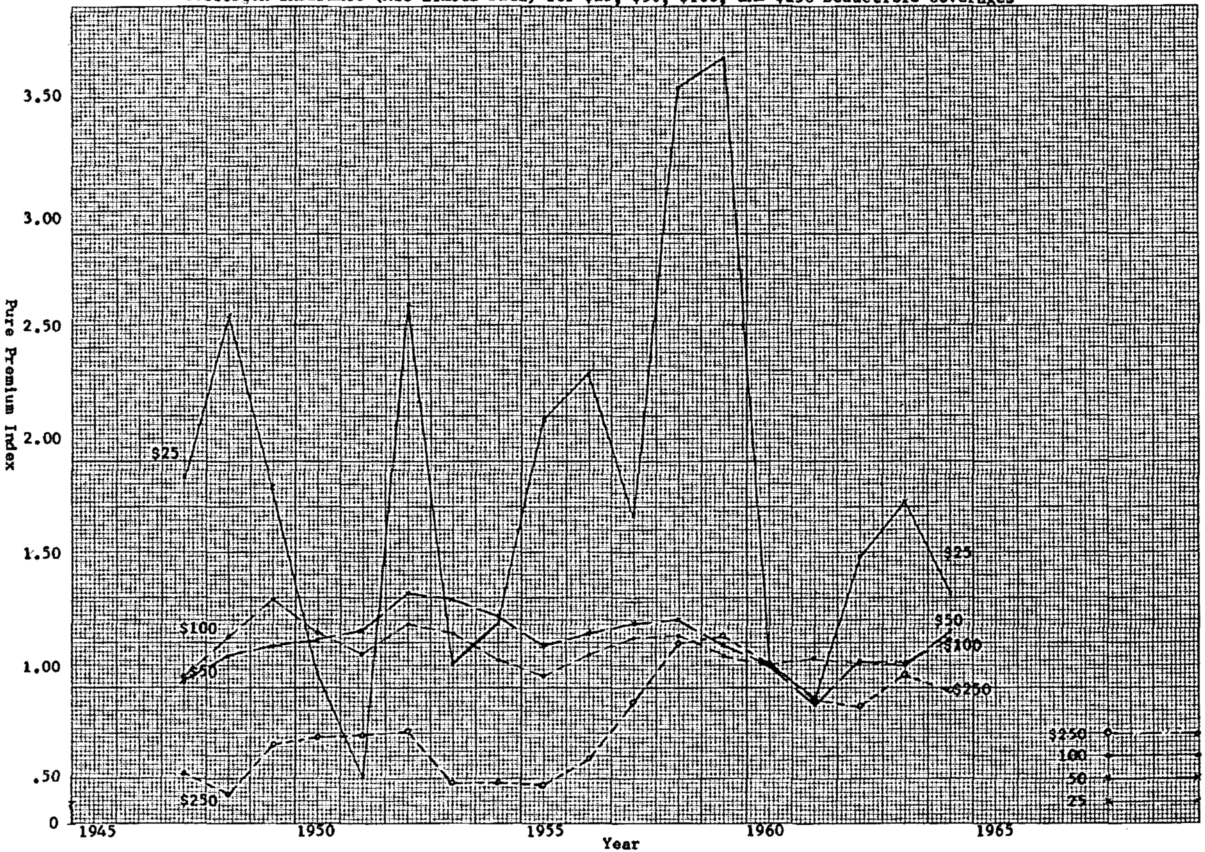


Figure 17.- Combined Index of Yearly Pure Premiums (Base Year = 1960) for Kentucky Private Passenger Automobile Collision Insurance (All-Limits Data) for $25, $50, $100, and $250 Deductible Coverages and Straight Trend Line

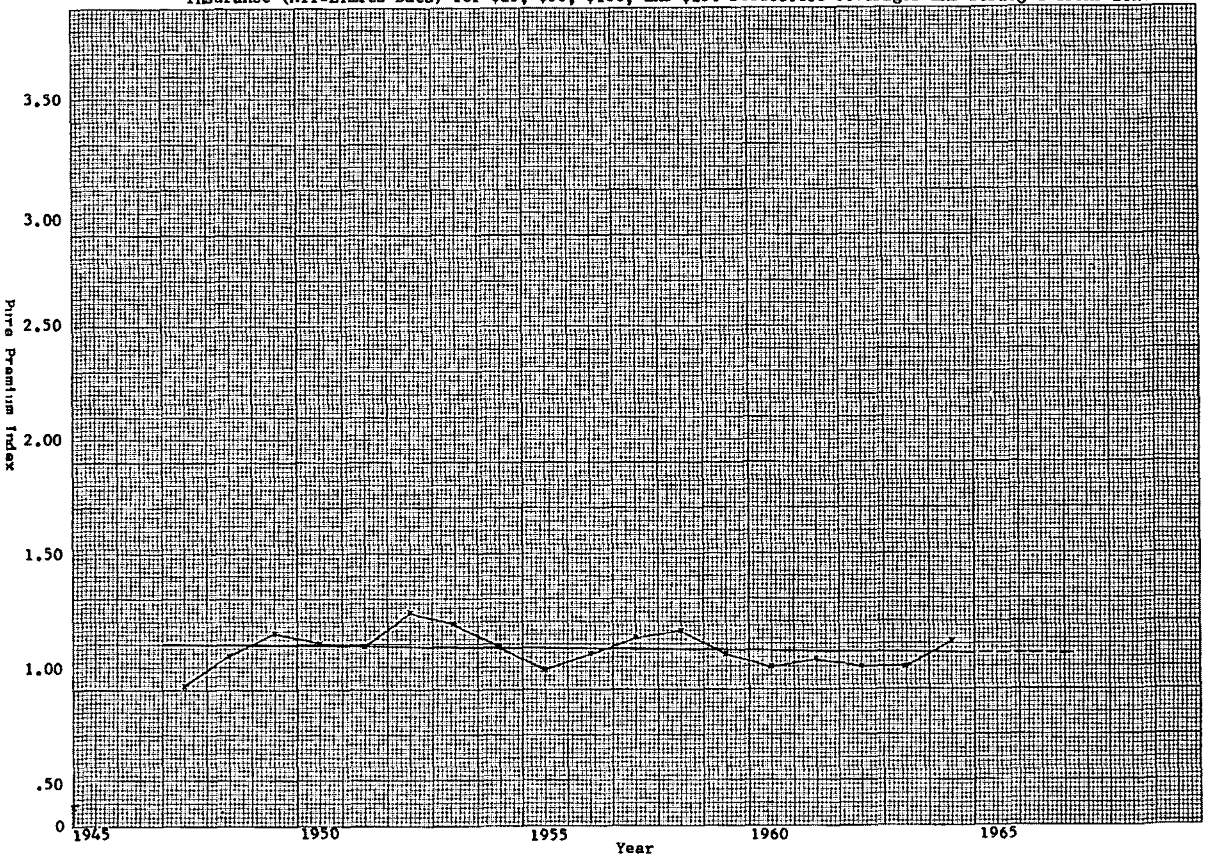


Figure 18.- Separate Indexes of Yearly Pure Premiums (Base Year = 1960) for Countrywide Canadian Private Passenger Automobile Collision Insurance (All-Limits Data) for $25, $50, $100, and $250 Deductible Coverages

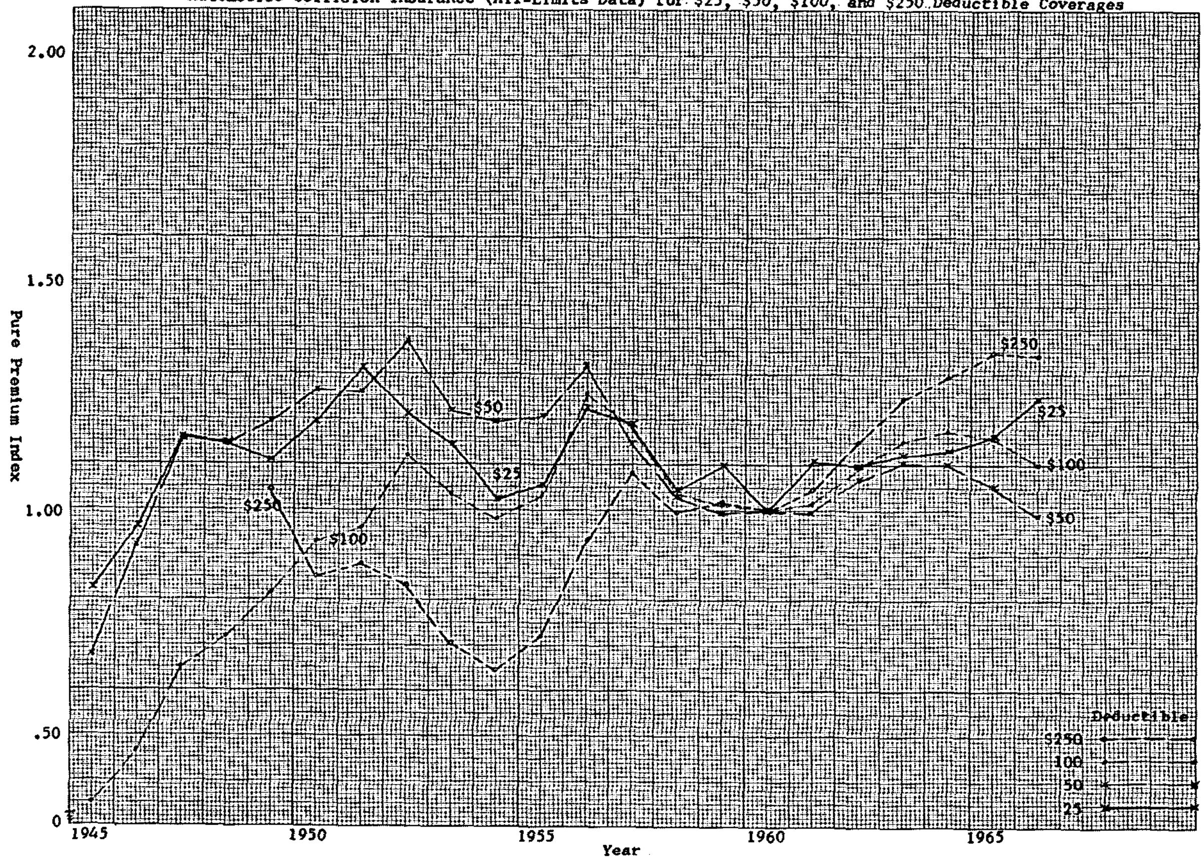


Figure 19.-Combined Index of Yearly Pure Premiums (Base Year = 1960) for Countrywide Canadian Private Passenger Automobile Collision Insurance (All-Limits Data) for $25, $50, $100, and $250 Deductible Coverage and Straight Trend Line

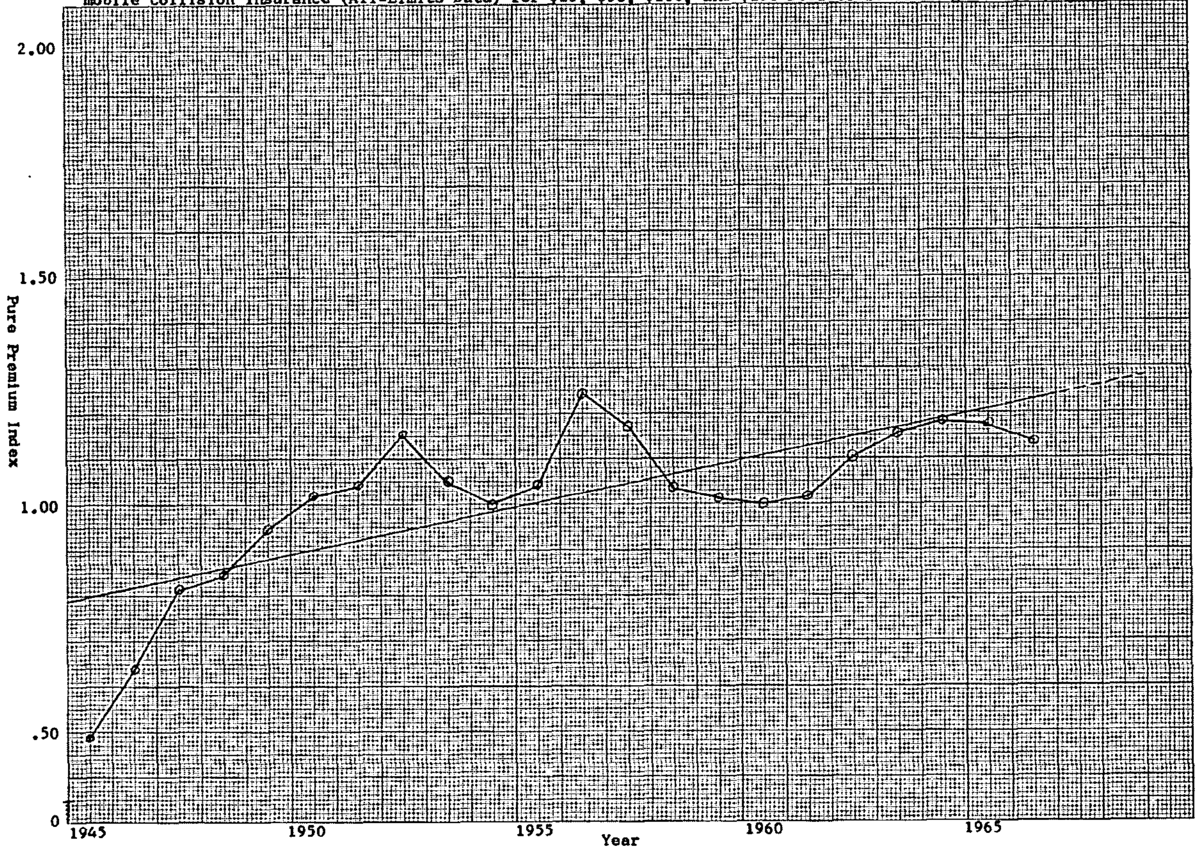
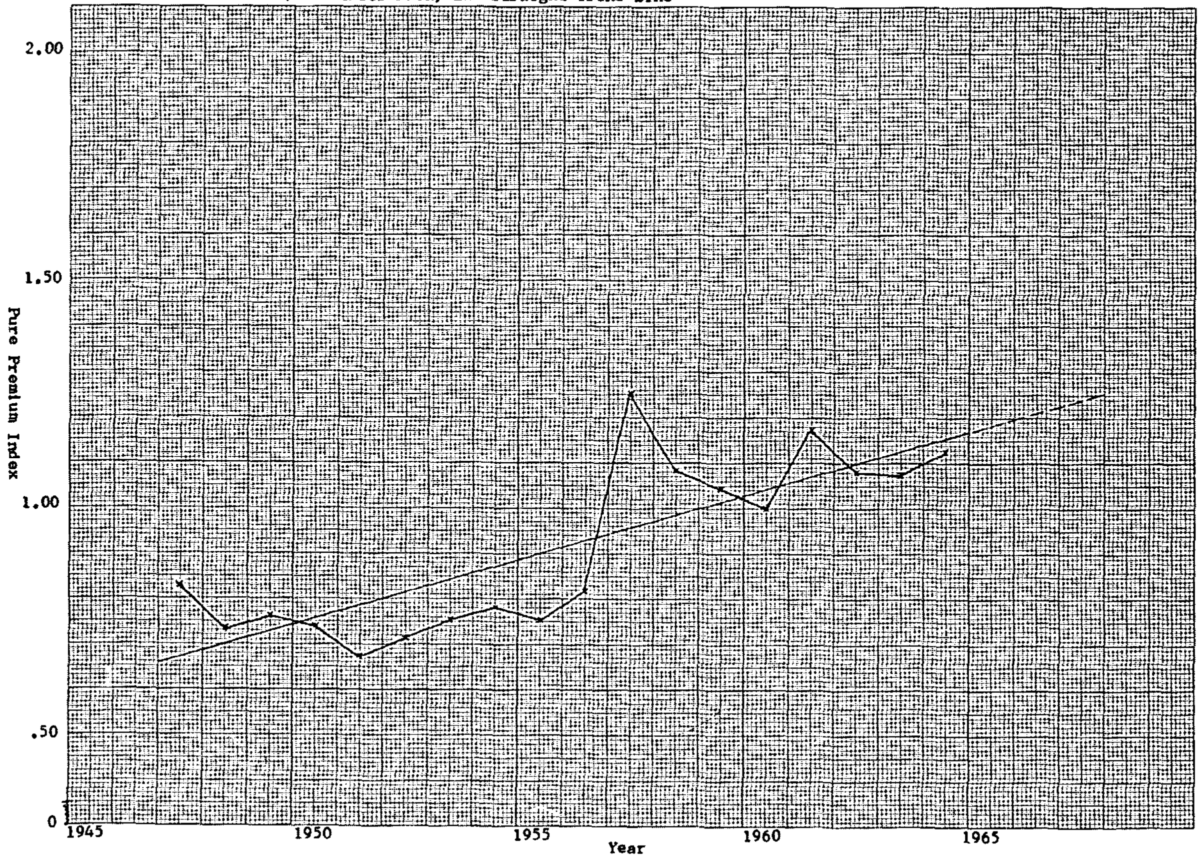


Figure 20.- Combined Index of Yearly Pure Premiums (Base Year = 1960) for Kentucky Automobile Non-Collision Property Insurance (All-Limits Data) and Straight Trend Line



lently represents the central or average tendencies of the four separate groups of data.

Accuracy of the index numbers could be improved by reflecting in addition to the mix by coverage and deductible, the changing distributions by value or price group; by use (pleasure, commercial, public, etc.); by physical type (passenger cars, trucks, buses, etc.); by rating territory; by status with respect to special charges and credits for driver experience and training, two-car families, etc.; and by all similar factors reflected in the rating system. A suitably designed stratified random sample would permit accuracy without review of 100 per cent of the data. But it is again important to point out that, since we are dealing here with a population-wide average of an individual characteristic and not with a classification or breakdown by one of several partially correlated rating criteria, the results of our procedure are of quite acceptable accuracy. The point is simply that they could be made *more* accurate.

Procedure Used with the Automobile Data. The economic environment was first considered. Most available economic measures that are in the form of time series point to a steady inflationary trend since World War II. During the first six years of this decade the price trend of new automobiles had flattened, but the mandatory addition of seat belts and anti-pollution devices has recently been reflected in new car prices and the prices of used cars and parts have continued to rise. Although there is a great likelihood that any time series reflecting property insurance losses will show a gradual increase, there are several factors which must be taken into account. Any one of these may offset wholly or partially an inflationary tendency in the others. For example, a gradual shift to higher deductibles for collision insurance may closely parallel the shift to higher valued automobiles, resulting in a stable pure premium for any given deductible amount. Although a greater number of vehicles on the roads may lead one to expect a higher relative frequency of accidents, this may be wholly or partly offset by an increase in two-car families and a consequent drop in the average number of miles each car is driven per year. Such factors as these are less likely to affect non-collision coverages, which relate to perils much more nearly outside the control of the vehicle owner.

The same outside economic factors affecting the shape of the trend, that were described in connection with liability coverages, apply equally to the physical damage coverages. A visual inspection of the data used here also shows the cycles observed in the liability data. It is very easy to see this from Figures 16 through 20, which show that in most years for both types of coverage the cyclical movement causes considerably more variation in the data than does the trend movement.

First through fourth degree trend lines were fitted to the two sets of single state data. The same criteria and considerations relating to choice of a curve shape that were discussed in connection with the liability data also apply here. Table 4 shows that the third degree curve has a better mathematical fit in both cases, particularly so for non-collision coverages. No theoretical grounds are apparent here, however (as they were for the liability data), for expecting a better fit by a curve of higher than second degree although they may, of course, exist. The facts that the excess portions of catastrophe data have been removed since 1958, and that there was a 1957 catastrophe, could have affected the relative size of the standard errors of the non-collision data. (Better data are, of course, unavailable.) These results may therefore also be judged to be preliminary. Data uniformly including or (better) excluding catastrophe results, preferably on an incurred loss basis, and reflecting in a controlled manner the variables mentioned above would support a firmer conclusion on the most appropriate shape of curve.

	Standard Errors of Estimate			
Data	First Degree	Second Degree	Third Degree	Fourth Degree
Coll	.080	.076	.064	.066
Non-coll	.116	.117	.097	.100

Table 4. Standard Errors of Automobile Property Insurance Data

Accordingly, the straight line trends were used as the best available practical alternative. Table 3 shows the calculation of adjustments to the two classes of data, based on these straight trend-line values. The procedure is the same as that used to produce the liability adjustments. Despite the difficulties with form and quality of data, the methods being described can be seen to produce most satisfactory results.

Nature of the Fixed Property Data. Extended coverage data for dwellings in one state are used to illustrate an application of time-series analysis to rates for fixed location properties and to loss ratio data. Even were consistent countrywide data available, windstorm conditions vary so markedly from area to area that it would make doubtful sense to use such data. Total limits data were available, separated by deductible status. The data for buildings are not kept separate from those for contents, however, even though different rates are used for the two classes of property. Pure premium data have not been available for fixed location properties since 1943, so loss ratios had to be used for analysis. Premiums and losses for calendar years 1947 through 1964 were secured. Since earned premiums and incurred losses were not reported prior to 1953, estimated earned premiums (brought uniformly to the 1 January 1965 rate level) were constructed for the early period by assuming that all policies were written for three years. This assumption was based on a review of annual statements for several years and several companies.

There being at the time covered by the data no formal countrywide arrangement for separating catastrophe loss data for ratemaking purposes in extended coverage insurance, the data fully reflect all such losses. That the procedure here used is able satisfactorily to overcome this difficulty is evidence of its usefulness and very general applicability. Absence of accident year data may tend slightly to understate the severity of catastrophic events, due to deferred loss settlements. Since the deferred losses are added to later data, however, the result is a not wholly undesirable smoothing. No evidence either of change or stability in the average ratio of insurance to value was available. The relatively steady turnover rate among existing dwellings and addition of new ones support the assumption of reasonable stability in this ratio.

Procedure Used with the Fixed Property Data. The economic considerations were similar to those for automobiles. Because extended coverage is ratably priced, and in the absence of any evidence of a decreasing ratio of insurance to value, however, a relatively flat trend could reasonably be expected.

The cycles noted in extended coverage results (see Figures 21 and 22) are by far the sharpest among the three sets of data. Cycles account for the vast bulk of the variation in the extended coverage series. Separate catastrophe data and remainder data (equivalents, respectively, of excess limits and standard limits data in liability insurance) were not available to overcome this difficulty. The relative sparsity of data in relation to this large cyclical amplitude therefore made it of little avail to fit other than straight trend lines. It also indicated the desirability, parallel to that demonstrated for automobile collision (Figures 16 and 18), of combining the data by an index number into a single series. Figure 23 shows the result.

Figure 21.- Indexes of Yearly Loss Ratios (Base Year = 1960) for Michigan Dwelling Non-Deductible Extended Coverage Insurance (All-Limits Data) and Straight Trend Lines (Fitted to 1949 - 1964 and 1947 - 1964 Data)

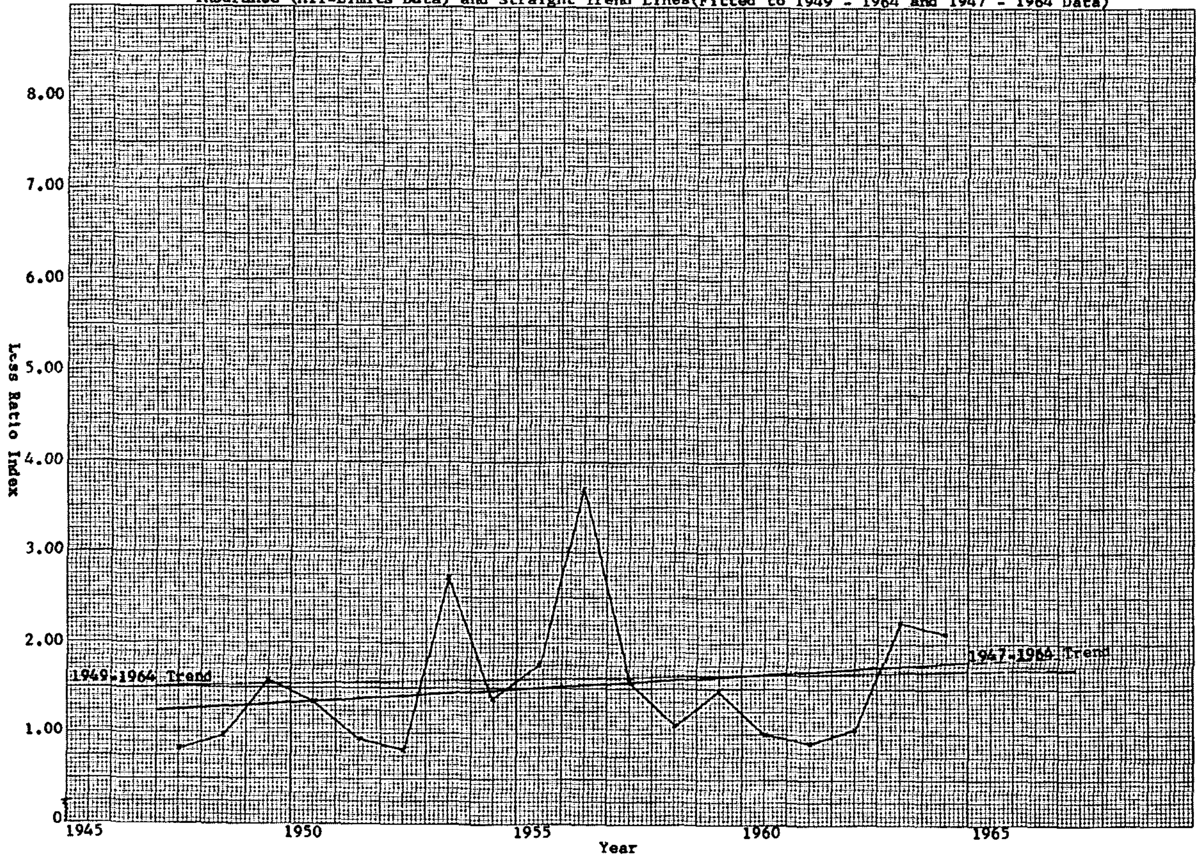


Figure 22.- Indexes of Yearly Loss Ratios (Base Year = 1960) for Michigan Dwelling Deductible Extended Coverage Insurance (All-Limits Data) and Straight Trend Line (Fitted to 1958 - 1964 Data)

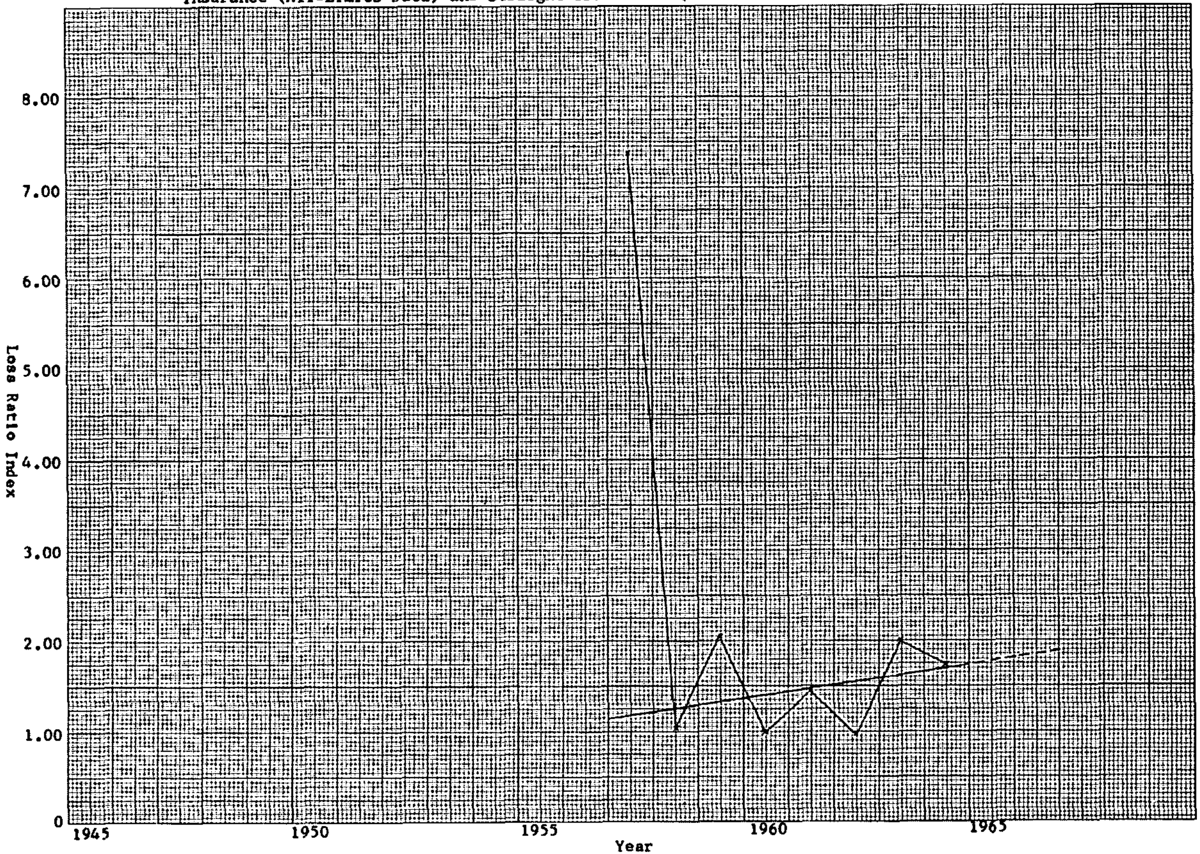
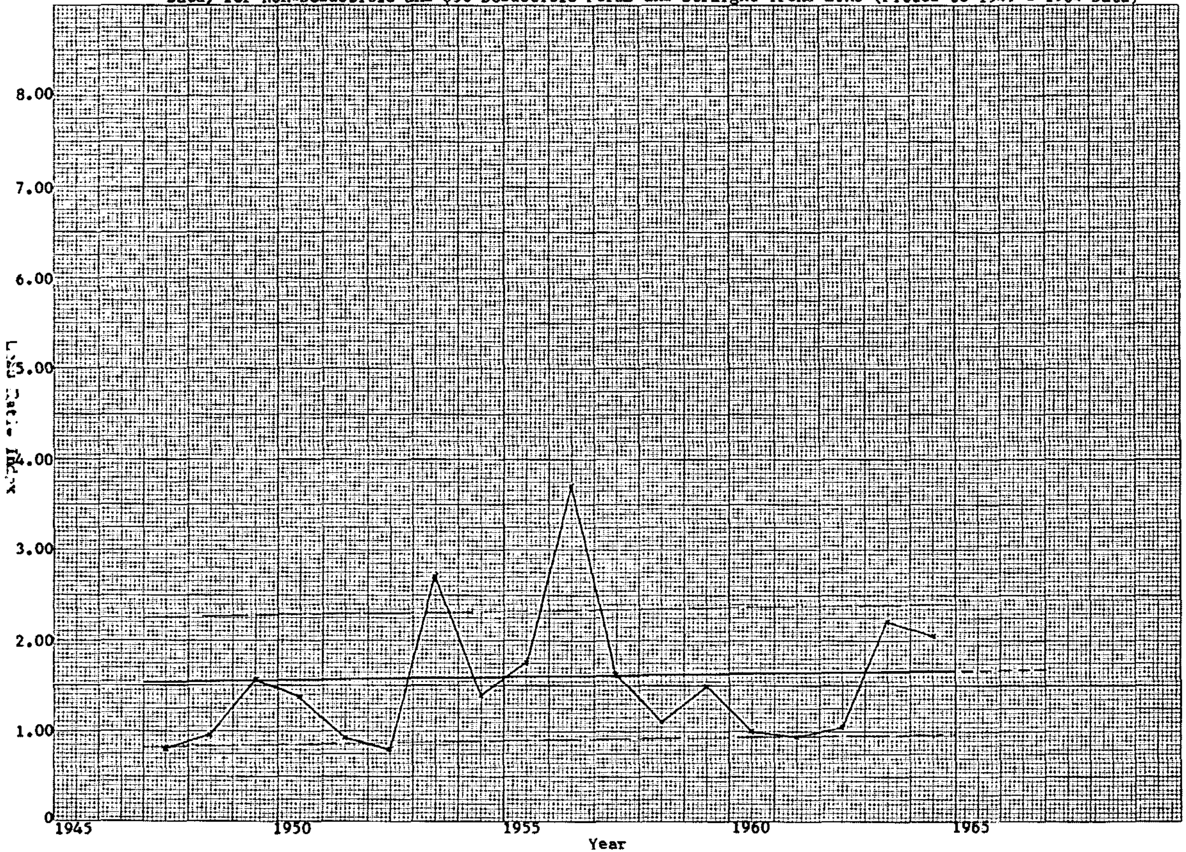


Figure 23.- Combined Index of Yearly Loss Ratios (Base Year = 1960) for Michigan Dwelling Extended Coverage (All-Limits Data) for Non-Deductible and $50 Deductible Forms and Straight Trend Line (Fitted to 1949 - 1964 Data)



Although the slope of the 1947-1964 trend in Figure 21 is not steep, it is materially influenced by the combination of the large cyclical amplitude plus the fact that the series starts near a cyclical trough and ends near a cyclical peak.[31] The first two years' data were accordingly dropped, so that start and finish would be peaks. The resulting 1949-1964 trend line in Figure 21 can clearly be seen to have a smaller slope. The adjustment reduced the slope of the trend line by a factor greater than three (the respective yearly values are .030 and .009). Since the 1949-1964 trend runs between peaks, it is biased slightly upward along its whole length. The fact that the two peaks are low ones fortunately results in a degree of bias here that can safely be ignored.

The freakishly high initial loss ratio (from sparse data) for deductible coverage would alone cause a negative slope, so it also was eliminated from the calculations that were used to produce the trend line shown in Figure 22. The separate calculations for deductible data, in view of the modest period they cover, can be considered to be mainly of academic interest.

It was not necessary to eliminate this datum in calculating the combined index in Figure 23, since the premium volume weightings solved the problem in a very neat manner. The combination of more data in the index reduced the variance below that for the non-deductible data. The calculations reflected in Table 3 are based on the usual averaging of extended coverage experience over periods of about ten years. The methods described here would permit elimination of such averaging, as well as of the arbitrary weightings that are often used with multi-year averages of data. It would be preferable to use for quantity weights in the index computations the number of $1,000 of insurance exposed per year. Second to this would be the number of risk years, which would measure only partially the size of the exposure. Lacking these, the premium volumes were used, as the best available measures of exposure. They did work satisfactorily.

These extended coverage data illustrate quite well the high desirability of having in the ratemaking process an orderly plan to separate the catastrophic losses on an objective basis (preferably stated as a ratio to volume of exposure rather than as an absolute) and to average such losses over one or more periods (from 10 to 50 years) determined by the patterns of major cycles. In this way the remaining fluctuations will be small enough to provide a reasonably stable rating base without artificial weighting. The

[31] See Croxton and Cowden, *op. cit.*, p. 408.

standard errors of estimate about the trend lines (19.4 points of loss ratio for non-deductible coverage, 12.7 points for deductible coverage and 17.8 points for the combined index) eloquently illustrate this need numerically.[32]

Application of time-series analysis and adjustments of any type to these data without some long-term averaging might be expected to result in indicated yearly swings in rates of such size and of such frequent changes in direction that most ratemakers might well consider them impractical to apply in practice. The application of the described methods to these data, which were actually used in connection with a rate filing, shows however that the methods can overcome all the difficulties usually encountered with data and produce adjustments that are both responsive and stable to a desired and measurable degree.

SUMMARY

Application of long accepted techniques of time-series analysis, as shown by actual examples from the major sectors of liability and property insurance, can be of material help in overcoming some of the increasingly difficult problems faced by ratemakers. Techniques developed by economic statisticians can produce actuarially acceptable precision in many cases where other methods fall short. This is exemplified by substitution of the measurable accuracy of the statistical control chart for arbitrary and unmeasured weighting, and by the use of factually weighted index numbers in place of using only a homogeneous fraction of the whole available data. These techniques can be used with both pure premium and loss ratio methods of ratemaking. The quality of results obtained with these as well as other methods depends largely on the quality of the data collected, and therefore on the design of the data collecting plans. Specific suggestions for improving this quality have been made in several places. The methods are equally applicable to all lines of business. Contrasting the characteristics of the various lines and the risks to which they pertain can be helpful in avoiding a proliferation of approaches in individual lines that can later cause difficulties when those lines are combined in packages. Some of these contrasts have been presented in this paper as a help toward such uniformity.

The cyclical adjustments detailed in Table 3 range from −1.2 to +2.6 per cent of the total time-series adjustment for liability insurance, from 1.1

[32] Proposals in this direction by Fire Insurance Research and Actuarial Association are in process of being implemented.

to 2.0 per cent for automobile physical damage insurance, and are 13.4 per cent for extended coverage. From Figures 1, 5 through 8, 11, 12, 14, 17, and 19 through 23, it can be seen that many cyclical changes are even greater than these, frequently dwarfing the trend change during the same year. Particularly for extended coverage, they form in our examples a material portion of the total adjustment. But even where they are small their importance is large.

Although they usually (two-thirds of the time with the guide lines spaced as in our example) lag the actual peaks and troughs by one year, they absolutely prevent the dramatic over-reactions given by the short-term "trend" lines in common use. By examining Figures 9 and 10 it can also be seen that the areas between the upper guide lines and peaks that extend above them match very well the comparable areas between the lower guide lines and troughs that extend below them. This simply indicates that undercharges and overcharges balance out quite well under the time-series adjustment system here described. Since the guide lines keep adjustments reasonably close to the trend line, the system tends to result in a rate level that is free of subjective bias.

The system also eliminates the need for all or most of the arbitrary weighting commonly used. The cyclical adjustment procedure, once set, automatically limits the effects of large fluctuations in data. In every case only the last datum need be used. There is no need to average two or more recent years' data, perhaps with arbitrary weights to boot, or to inject arbitrary judgment into individual rate decisions. In short, all available data are used, the very latest datum is the starting point for applying adjustments, major fluctuations are dampened without destroying responsiveness to recent indications, and opportunity to inject arbitrary judgment is minimized.

Areas for Further Inquiry. The results exposed in this analysis suggest the following potentially rewarding areas for further inquiry:

a. Can the theory of runs be used to develop a useful test for the existence and characteristics of trends and cycles in insurance time series?

b. Can time-series analysis be fruitfully considered as a tool for increasing and measuring credibility? For example:

(1) Does a trend line not make it possible to use a many-year series of data as the "prior distribution," gaining greater credibility as the series lengthens, and extracting the maximum indicative information from the data in an orderly manner?

(2) Does not competent time-series analysis permit in most cases supplementing the limited geographic or numerical spread of sparse data by a spread over time with a measurable credibility or margin of error?

c. Can the multi-split concept originated in workmen's compensation ratemaking and suggested here for multiple peril ratemaking be profitably applied to credibility theory?

(1) Since there are sometimes two or more pertinent "prior distributions" or sets of data available, why cannot credibility theory logically and usefully contemplate not only the traditional two-way split but also be broadened to embrace a three-way or greater split?

(2) Can objective criteria be devised for selecting and weighting or otherwise relating the sets of prior data or prior distributions among themselves, and also with the current statistical data, in forming a "posterior distribution"?

d. Can more specific criteria be developed for selecting the distance (number of standard errors) of guide lines from the trend line?

e. Can a concise summary for curve fitters of all possible second degree, third degree, fourth degree, and possibly higher degree families of curves, including their characteristics and handy criteria for selection and fit such as Karl Pearson's Beta-1 and Beta-2, be developed in a form analogous to W. Palin Elderton's *Frequency-Curves and Correlation* (2d ed., London: C. & E. Layton, 1927)?

f. Can an objective significance test be designed that will permit a decision, based on a given degree of credibility or else on a predetermined confidence interval, on whether two sets of data should or should not be used together for ratemaking purposes? Such a test could apply to deciding whether data from adjacent states or provinces are sufficiently similar to permit combining them to increase credibility, to deciding whether the results from two different areas are sufficiently dissimilar to warrant making them separate rating territories, and to deciding whether two groups of data from different time periods are sufficiently similar to combine for ratemaking purposes.

g. Can the short-term (4 or 5 years) trended averaging now widely used for "trends" in insurance be useful in rating spread loss reinsurance, where a means of keeping up with adverse reserve developments and worsening claim severity is needed, but where no prediction of future levels is required?

APPENDIX

CALCULATION OF AUTOMOBILE PHYSICAL DAMAGE PURE PREMIUM INDEXES

The long standing problem of how to combine or average data for the same coverage but for different deductible amounts can be handily solved by use of the economic statistician's index number. This device does not permit combining apples and oranges, but it does permit combining in meaningful form the *prices* and *quantities* of apples and oranges. It permits the ratemaker to combine in meaningful fashion the prices of $50 deductible apples and $100 deductible oranges, deriving therefrom a greater spread or stability of experience.

The basic logic of all price indexes is to combine in a suitably ordered manner the prices and quantities of disparate items. For insurance ratemaking, the prices may be in gross (rate or other unit premium) or net (pure premium) form. The quantities are exposure units. The terms used in the following calculations may be defined as follows:

p_n = price or pure premium for year n
p_o = price or pure premium for base year
q_n = quantity or number of car years for year n
q_o = quantity or number of car years for base year
$p_n q_n$ = total losses for year n

The formula for the Fisher Ideal Price Index is

$$I_p = \sqrt{\frac{\Sigma p_n q_o}{\Sigma p_o q_o} \times \frac{\Sigma p_n q_n}{\Sigma p_o q_n}}$$

The following calculations for the fiscal 1948 non-collision and collision coverage pure premium indexes should be self explanatory.

Year to 30 September 1948	p_n = Current Pure Premium	q_n = Current Number of Car Years	p_nq_n = Current Losses	p_nq_o (o=1960)	p_oq_n (o=1960)
Non-Collision Coverages					
Full coverage comp	$ 5.41	$ 83,334	$ 450,700	$1,068,464	$ 673,339
$50 deduct comp	0	0	0	0	0
Fire and theft	4.80	8,297	39,824	19,512	24,476
Towing & road svc	.10	9,878	1,036	7,634	2,272
Fire, theft, CAC	5.96	5,537	32,987	247,745	25,858
Fire, theft, wind	4.29	3,665	15,735	5,577	9,749
	$ 4.88	$110,711	$ 540,282	$1,348,932	$ 735,694

$$I_{non\text{-}coll} = \sqrt{\frac{1{,}348{,}932}{1{,}825{,}286} \times \frac{540{,}282}{735{,}694}} = .7367$$

Year to 30 September 1948	p_n = Current Pure Premium	q_n = Current Number of Car Years	p_nq_n = Current Losses	p_nq_o (o=1960)	p_oq_n (o=1960)
Collision Coverages					
$ 25 ded collision	$53.10	$ 731	$ 38,819	$ 4,513	$ 15,307
50 ded collision	32.73	43,549	1,425,456	1,635,682	1,373,971
100 ded collision	28.36	12,523	355,194	3,293,362	316,456
250 ded collision	36.16	642	23,212	134,190	54,088
	$32.08	$ 57,445	$1,842,681	$5,067,747	$1,759,822

$$I_{coll} = \sqrt{\frac{5{,}067{,}747}{4{,}825{,}322} \times \frac{1{,}842{,}681}{1{,}759{,}822}} = 1.0487$$

A REVIEW OF NUCLEAR ENERGY INSURANCE

RICHARD D. McCLURE

It is now over eleven years since the first binder was issued by the nuclear insurance pools and it seems appropriate to take a new look at nuclear energy insurance. This cover is one of the smallest, but fastest growing, and certainly the most unique of modern times. It is important to understand, not only for its own sake, but also for the innovations in the formation of pools of insurance companies, the complete cooperation between stock and mutual companies, the close coordination with government agencies, and the many efforts to foster and encourage a growing, dynamic industry.

There are two sides to the story — liability insurance and property insurance. They will be treated here sometimes together, sometimes separately. As to liability insurance, we already are indebted to Mr. Richard H. Butler for his very fine paper, "Liability Insurance for the Nuclear Energy Hazard," published in Vol. XLVI of the *Proceedings*. The reader is strongly advised to review that work. It is surprising how little has changed since 1959. It is this writer's difficult task to follow in Mr. Butler's footsteps, summarize much of the information, set forth what changes have occurred, and (with the incalculable advantage of hindsight) comment on the underwriting experience. As to property insurance, the trail has not been blazed so thoroughly, but it is also a fascinating story and one of equal importance.

Atomic Energy Act of 1954

When President Eisenhower signed this act he inaugurated an era of the peaceful use of atomic energy. He invited the utility industry, medicine, research, geophysical exploration firms, and others of a wide variety of private endeavor to experiment with nuclear materials, either for profit or for advancement of knowledge, or both. A great deal of literature was declassified, and nuclear materials were made available under careful controls.

Response was initially slow. To the average man, nuclear energy was equated with the atom bomb and vast destruction. It was all so new and, so far as he knew, highly dangerous. One cannot see ionizing radiation, or feel it, or sense it in any way. Also, the financial planning required to launch a power reactor was enormous. Most of them, in the beginning, were frankly experimental in nature, designed more as pilot plants to learn more about this new energy source than as practical money-makers.

Need for Huge Limits

It became obvious rather quickly that the nuclear reactor owners would require limits of liability far in excess of those available at the time. Liability insurance in amounts of $10 million, $25 million, $50 million, or even more was asked for. The values for property insurance started out at about $20-25 million, but very soon much larger installations were planned, having values over $75 million initially.

Demands in these amounts were quite beyond the capacities of individual insurance companies, even with heavy reinsurance, and it soon became clear that large pools of insurance companies would have to be formed.

Formation of Pools

During 1956 three nuclear energy insurance pools were formed, two of stock companies and one of mutual companies. One stock pool handles liability insurance only — Nuclear Energy Liability Insurance Association (NELIA). The other handles property insurance only — Nuclear Energy Property Insurance Association (NEPIA). They conduct their affairs quite separately. The mutual pool, Mutual Atomic Energy Reinsurance Pool (MAERP), is so constituted as to handle both liability and property insurance. The allocation of capacity to the two lines is made by its underwriting committee.

NELIA originally had 138 members and an underwriting capacity of $46,500,000 per risk. NEPIA originally had 189 members and an underwriting capacity of $50,000,000 per risk. MAERP originally had 105 members and an underwriting capacity of $13,500,000 per risk for liability and $10,000,000 per risk for property insurance. In each case the actual capacity of the pool was somewhat more than the indicated underwriting capacity; a margin was maintained so that fluctuations from year to year would not cause changes in limits afforded to those insureds purchasing maximum limits.

The combined pools thus could issue policies up to $60,000,000 separately for liability and for property, risking a possible exposure of $120,000,000 in one occurrence. Such figures were quite without precedent and are a great tribute to the courage and energy of the pioneers who undertook to put the pools together, and of the company executives across the country who subscribed unusually large amounts. Even after eleven years of good experience no one will deny this is risky business indeed, but imagine how uncertain it looked then.

In 1965 the three pools made successful drives for new capacity and effective January 1, 1966 the underwriting limits stood at:

NELIA	— \$57,350,000
MAERP (liability)	— 16,650,000
NEPIA	— 60,000,000
MAERP (property)	— 14,000,000

Thus for each line of insurance a single insured can purchase liability insurance policies with limits totaling \$74,000,000, and the same for property insurance, or a total of \$148,000,000 riding on one occurrence.

At the time of the writing of this paper the pools once more are seeking capacity. Success is uncertain. Not only have the numerous mergers acted to cancel some subscriptions, but also there has been a definite shrinkage in the reinsurance markets of the world, for a variety of reasons.

Mechanics of Policy Issuance

NELIA issues a "subscription" liability policy; that is, there are some forty-four pool members as primary insurers on the policy at present. These are the companies which are licensed to write liability insurance in all states. Each one insures "severally, not jointly," for a fixed percentage stated in a schedule attached to the policy. Of course, the entire policy is reinsured by NELIA as a whole.

Rather than involve so many companies, the mutuals organized a 6-company underwriting association — Mutual Atomic Energy Liability Underwriters — to write its liability policies. MAELU, indeed, is the name by which most people know the Mutual pool, rather than by its parent MAERP. These six large mutuals likewise insure severally, not jointly, for stated percentages.

NEPIA similarly issues a multi-insurer policy. This is the method used by the Factory Insurance Association, and since NEPIA is administered largely by FIA it is natural they do so. The mutuals, on the other hand, when issuing nuclear property insurance, do so through a single company, which is reinsured 100% back into MAERP.

Whether mutual or stock, the policy forms and rates are identical. When separate policies are issued insuring a single installation, they are on a pro rata participating basis, and one is never excess of the other.

For annual statement purposes, nuclear property insurance is coded to line 5, Commercial Multiple Peril, and liability insurance to line 17, Liability Other Than Auto (B.I.).

Reinsurance

NELIA and MAELU mutually reinsure each other, and so do NEPIA and MAERP. Inasmuch as the policies are identical in substance and the pools reinsure each other on all domestic risks, the net underwriting results of NELIA and MAELU over the years have been substantially the same, and likewise those of NEPIA and MAERP.

The reinsurance percentages correspond roughly to the relative contributions to capacity. NELIA reinsures 77.5% of everything that MAELU writes, and MAELU reinsures 22.5% of evertyhing that MELIA writes. These liability percentages have been unchanged since the inception of the pools. The property percentages have changed slightly from year to year. Presently NEPIA and MAERP exchange reinsurance on every domestic risk on the basis of 81.1%-18.9%.

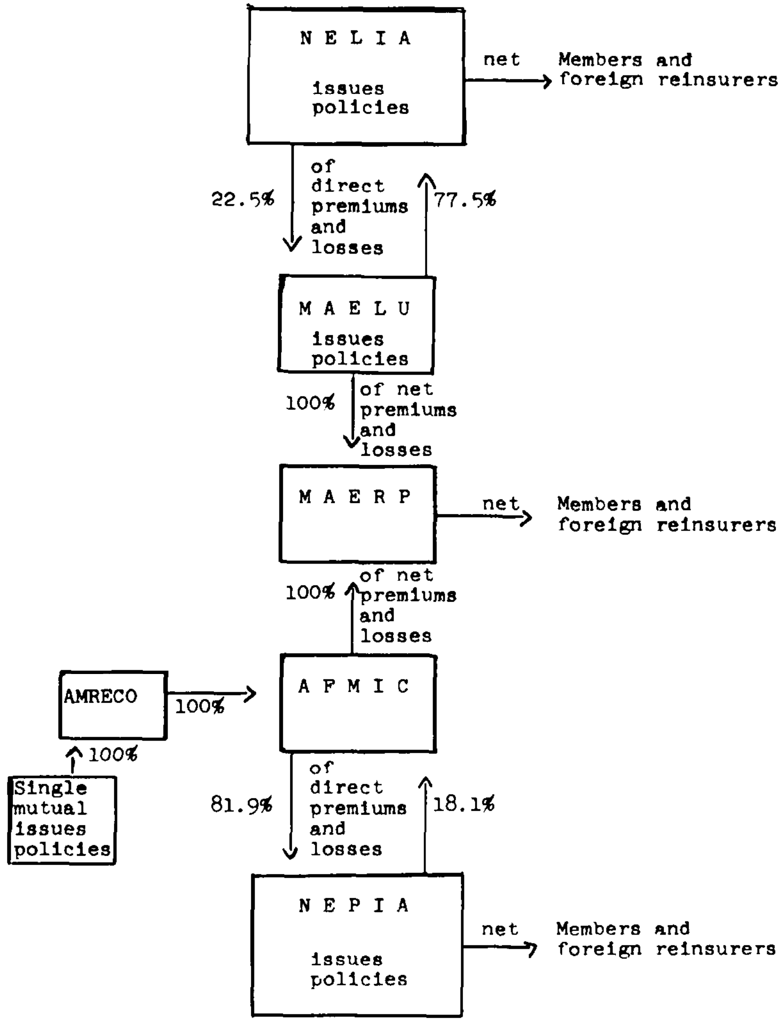
We have said that the original property policy on the mutual side is issued by a single insurance company. For technical reasons, this policy is not ceded directly to NEPIA, but rather is first ceded to American Mutual Reinsurance Company, then 100% to Associated Factory Mutual Insurance Companies (AFMIC), which in turn cedes it 100% to the parent pools.

About one-third of the capacity of all American nuclear pools is provided by foreign reinsurance. This is a tremendous amount, over $50 million, all on a pro rata basis. Support has been forthcoming from not only England and Europe, but also from companies in Sweden, Finland, Argentina, Colombia, Ecuador, India, Japan, and other countries around the world. Thus a contamination loss in Iowa may have its ultimate effect (very small, to be sure) on an insurance company in Australia.

Many of these countries have their own nuclear energy insurance pools, a few of which are supported by NELIA, NEPIA, or MAERP. For example, Nuclear Insurance Association of Canada (NIAC) draws some support from the American pools. These underwriting results are not shared among the American pools; only domestic risks are mutually reinsured, and the pools do not cooperate with respect to foreign risks.

Exhibit A illustrates the flow of reinsurance among the domestic pools and to foreign reinsurers. The whole thing appears rather complex, and certainly there have been problems, but it has worked out rather smoothly once the concepts were agreed on and the contracts exchanged.

EXHIBIT A



NELIA - Nuclear Energy Liability Insurance Association
MAELU - Mutual Atomic Energy Liability Underwriters
MAERP - Mutual Atomic Energy Reinsurance Pool
AFMIC - Associated Factory Mutual Insurance Companies
NEPIA - Nuclear Energy Property Insurance Association
AMRECO - American Mutual Reinsurance Company

Exhibit B sets forth the capacity story of the pools from 1957 to the present.

Exclusion Endorsements on Ordinary Policies

Almost all kinds of policies now carry some kind of exclusion for loss arising from the nuclear hazard. Insurers and reinsurers, having responded to the maximum to the appeal of the nuclear pools for support, simply cannot afford to exceed this maximum. Thus very careful steps have been taken to prevent any pyramiding of limits.

The Fire policy exclusion clause reads as follows:

> "The word 'fire' in this policy or endorsements attached hereto is not intended to and does not embrace nuclear reaction or nuclear radiation or radioactive contamination, all whether controlled or uncontrolled, and loss by nuclear reaction or nuclear radiation or radioactive contamination is not intended to be and is not insured against by this policy or said endorsements, whether such loss be direct or indirect, proximate or remote, or be in whole or in part caused by, contributed to or aggravated by 'fire' or any other perils insured against by this policy or said endorsements; however, subject to the foregoing and all provisions of this policy, direct loss by 'fire' resulting from nuclear reaction or nuclear radiation or radioactive contamination is insured against by this policy."

An identical clause appears in the standard homeowner's policy, and a similar clause is included when the fire policy includes extended coverage. A very similar exclusion appears in the typical inland marine policy, of whatever sort. The various special multi-peril and commercial multi-peril policies all contain these wordings.

Automobile and aircraft physical damage policies all carry the simple exclusion "This policy does not apply to loss due to radioactive contamination."

The general boiler and machinery policy states:

> "This policy does not apply. . . . .
> to loss, whether it be direct or indirect, proximate or remote (a) from an accident caused directly or indirectly by nuclear reaction, nuclear radiation or radioactive contamination, all whether controlled or uncontrolled, or (b) from nuclear reaction, nuclear radiation, or radioactive contamination, all whether controlled or uncontrolled, caused directly or

EXHIBIT B

HISTORY OF

NUCLEAR INSURANCE CAPACITY

(as of each January 1)

000 omitted
Even years omitted

Physical Damage	1957	1959	1961	1963	1965	1967	1968
NEPIA							
Domestic	$ 39,532	$ 39,307	$ 39,167	$ 36,432	$ 34,942	$ 40,517	$ 40,437
Foreign Reinsurers	18,615	18,497	17,004	16,329	17,518	21,240	21,837
Total	58,147	57,804	56,171	52,761	52,460	61,757	62,274
MAERP							
Domestic	7,161	7,255	7,255	7,278	7,301	9,532	9,508
Foreign Reinsurers	3,491	3,489	3,149	3,264	3,660	4,997	5,135
Total	10,652	10,744	10,404	10,542	10,961	14,529	14,643
Total Phys. Dam.	$ 68,799	$ 68,548	$ 66,575	$ 63,303	$ 63,421	$ 76,286	$ 76,917
Liability							
NELIA							
Domestic	$ 34,435	$ 34,056	$ 33,712	$ 33,220	$ 33,271	$ 38,610	$ 38,345
Foreign Reinsurers	16,108	15,886	14,230	14,474	16,235	20,334	19,916
Total	50,543	49,942	47,942	47,694	49,506	58,944	58,261
MAELU							
Domestic	9,889	10,019	10,019	10,051	10,083	11,985	11,915
Foreign Reinsurers	4,679	4,675	4,229	4,379	4,920	6,002	6,209
Total	14,568	14,694	14,248	14,430	15,003	17,987	18,124
Total Liability	$ 65,111	$ 64,636	$ 62,190	$ 62,124	$ 64,509	$ 76,931	$ 76,385
Grand Total	$133,910	$133,814	$128,765	$125,427	$127,930	$153,217	$153,342
Domestic Stock	73,967	73,363	72,879	69,652	68,213	79,127	78,782
Domestic Mutual	17,050	17,274	17,274	17,329	17,384	21,517	21,463
Foreign Reinsurance	42,893	42,547	38,612	38,446	42,333	52,573	53,097
Total	$133,910	$133,184	$128,765	$125,427	$127,930	$153,217	$153,342

> indirectly by, contributed to or aggravated by an accident; nor shall the Company be liable for any loss covered in whole or in part by any contract, carried by the insured, which also covers any hazard or peril of nuclear reaction or nuclear radiation."

Notice that the fire policy does cover loss from fire even if a nuclear incident started the fire, while the boiler policy excludes any loss caused by a nuclear incident, or any nuclear damage caused by a non-nuclear accident. Also, the policy will not share a loss, nuclear or non-nuclear, with a policy which does cover nuclear damage.

The plate glass policy says:

> "The insurance does not apply . . . . . to nuclear reaction, nuclear radiation, or radioactive contamination, or to any act or condition incident to any of the foregoing."

All liability policies (save only aircraft liability) carry an exclusion which we will examine in some detail later on. Thus, the only ordinary fire and casualty policies which carry no nuclear exclusion are workmen's compensation, accident, burglary, fidelity, surety, and (curiously) ocean marine policies.

Radioactive Contamination Assumption Endorsement

In spite of all the foregoing, the fire insurance companies have responded to a demand by users of certain nuclear materials (such as hospitals with radiation sources, or factories using radioisotopes in thickness gauges) for clean-up insurance in the event of a spillage or other accident. So long as the loss arises from material on the premises, a limited coverage is granted. The Radioactive Contamination Assumption Endorsement (Broad Coverage) reads (in part):

> "In consideration of the premium for this coverage, and subject to the provisions herein and in the policy to which this endorsement is attached including endorsements thereon, the provisions of this policy, including other endorsements, are hereby modified and this policy is extended to insure against direct loss by sudden and accidental radioactive contamination, including resultant radiation damage to the property covered, provided such radioactive contamination arises out of material on the Insured's premises at the location(s) described in this policy, and provided, at the time of such loss, there is neither a nuclear reactor capable of sustaining nuclear fission in a self-supporting chain

reaction, nor any new or used nuclear fuel which is intended for or which has been used in such a nuclear reactor, on the Insured's premises at the location(s) described."

This type of accident cannot pyramid with other nuclear loss arising from a source *outside* the premises, so that it may be dealt with singly. However, caution must be exercised when issuing the Radioactive Contamination Assumption Endorsement. The company should check its reinsurance contract. The typical reinsurance contract excludes contamination, excepting only by radioactive isotopes. A laboratory studying plutonium in minute amounts, for example, would not be reinsured.

Nuclear Insurance Policy — Property

We are now ready to turn to the property policy which the pools issue.

It is an all-risk policy. In the beginning, some thought was given to insuring only nuclear perils, leaving the fire and other perils under ordinary insurance. This was found not feasible, however, because of the difficulty of distinguishing a nuclear from a non-nuclear loss. If we had separate policies on a power reactor, and an explosion occurred, it might be very difficult to determine whether the nuclear damage was caused *by* the explosion, or whether some untoward nuclear occurrence caused the explosion. The same dilemma occurs when we consider the fire peril.

The solution is to include all perils in the same policy, excluding only what is specifically excluded. The insuring clause reads:

"The Company . . . agrees to indemnify the insured and legal representatives, to the extent of the actual cash value of the property at the time of loss, but not exceeding the amount which it would cost to repair or replace the property with material of like kind and quality within a reasonable time after such loss, without allowance for any increased cost of repair or reconstruction by reason of any ordinance or law regulating construction or repair, and without compensating for loss resulting from interruption of business or manufacture, nor in any event for more than the interest of the Insured, against RADIOACTIVE CONTAMINATION AND ALL OTHER RISKS OF DIRECT PHYSICAL LOSS, EXCEPT AS HEREINAFTER PROVIDED, to the property described in the Declarations and situated at the location(s) specified therein." (Capital letters *not* mine.)

The policy also includes limited insurance for debris removal and decontamination, for property of others, and for removal of property from premises.

The exclusions follow (some are quoted here in full for their special interest, while others are abbreviated):

(1) "Gradual accumulation of radioactive contamination."
Comment: All nuclear installations are subject to gradual contamination, cleaned up from time to time, and this is virtually uninsurable.

(2) "Radioactive contamination at any location specified in the declarations, resulting from matter released from any source outside the premises of that location."
Comment: Here again is the precaution against "doubling up" on the limits.

(3) Neglect . . . to save and preserve. . . .

(4) Mysterious disappearance, or shortages.

(5) Fraud, etc., by an officer.

(6) Order of civil authority.

(7) Theft, pilferage, burglary or larceny, etc.

(8) "Depletion, depreciation, wear and tear; or deterioration, including that of fuel element cladding."

(9) Damage to stock in process from manufacturing operations.

(10) Dampness, dryness, rust, corrosion, etc.

(11) Water damage, variously described.

(12) Earthquake, volcanic eruption, landslide or sinking of land, etc.
But the Company agrees, with respect to exclusions 7 to 12 inclusive, to be liable for ensuing loss by fire, explosion, radioactive contamination or any other peril not excluded.

(13) Accounts, bills, currency, deeds, etc.

(14) (a) "Records, manuscripts, and drawings, for loss in excess of their value blank plus the cost incurred for actually transcribing or copying them, except as provided in (b);

(b) media, data storage devices, and program devices for electronic and electro-mechanical data processing or for electronically controlled equipment, for loss in excess of the cost of reproducing such media, data storage devices and program devices from duplicates of from originals of the previous generation of the media, and no liability is assumed hereunder for the cost of gathering or assembling information or data for such reproduction."

(15) "Land, unless otherwise provided by endorsement added hereto."

(16) "Animals, lawns, plants, shrubs or trees."

(17) "Vehicles licensed for highway use, aircraft or watercraft, except when such vehicles, aircraft or watercraft are being used for the servicing of or in connection with the operation of the property covered by this policy."

There follows the usual war clause which, however, also excludes "loss caused directly or indirectly by . . . any weapon of war employing nuclear fission or fusion whether in time of peace or war."

There is a mandatory deductible clause with the provision that it shall not apply to a loss in excess of 50% of the amount of insurance applicable to the location covered under the policy. The mandatory deductibles are:

1. Fuel fabricators, fuel processors, etc., with no reactor on the premises over one megawatt thermal capacity: — $1500 plus ¼ of 1% of the amount of insurance, not to exceed $5000.
2. Reactors over one megawatt thermal capacity, other than power reactors: — $2500 plus ¼ of 1% of the amount of insurance, not to exceed $10,000.
3. Power reactors and fuel reprocessing plants: — $5000 plus ¼ of 1% of the amount of insurance, not to exceed $50,000.

An apportionment (other insurance) clause follows, providing for the usual pro-ration on the basis of limits. It becomes meaningful when we consider the larger locations requiring a policy from both the stock and the mutual pools.

The remaining parts of the policy, except those below, are those usually appearing in the typical property policy. The unusual clauses follow:

1. INSPECTION AND SUSPENSION. *Comment:* This clause permits the Company to suspend the insurance on the spot should an engineer or inspector discover a dangerous condition with respect to a machine or vessel, and the insured does not comply with a request to take such vessel or machine out of service for correction. The suspension notice must be in writing. Any reinstatement must be by an endorsement issued to form a part of the policy.

2. SUBROGATION: *Comment:* (a) Except as provided in (b), the Company enjoys the usual right to require action by the insured against any one responsible for a loss, except that prior to a loss the insured may waive any or all right of recovery against a specific party.

   (b) "This Company hereby waives any right of subrogation acquired against any party, furnishing services, materials, parts or equipment in connection with the planning, construction, maintenance or operation, or use of property covered hereunder by reason of any payment under this policy arising out of any loss resulting from the radioactive, toxic, explosive or other hazardous properties of 'source material,' 'special nuclear material,' or 'by-product material' as such terms are defined in the Atomic Energy Act of 1954 or any law amendatory thereof."

   Comment: Part (a) of the clause permits an insured, prior to a loss, to agree to hold anyone harmless from liability for such loss, be it a fire loss, or a boiler explosion or what have you. Part (b) is a blanket waiver with respect to nuclear losses, as defined, before such losses may occur. It is of considerable importance to the liability pools, who may be insuring the designer of or a supplier to an installation, and it minimizes the possibility of the property pools seeking recovery from the liability pools for a loss.

3. AGGREGATE LIMIT OF LIABILITY AND REDUCTION OF POLICY AMOUNT BY LOSS. "The amount of insurance at any one location as stated in the Declarations is the limit of this Company's liability for the aggregate of all losses occurring within the policy period . . ." (etc.). *Comment:* A loss reduces the insurance Reinstatement, optional with either party, is only by endorsement. Years ago this is the way all property policies worked, but gradu-

ally automatic reinstatement of loss came about in its place. Not so with nuclear policies.

Rating Nuclear Property Insurance

Rates and forms are prescribed by the Nuclear Insurance Rating Bureau, through committees and subcommittees appointed for that purpose. Theirs was never an easy task. It is seen from the discussion of the policy coverage above that the perils are those of fire and EC, vandalism and malicious mischief, boiler and machinery, nuclear and whatever perils are left by virtue of the all-risk coverage. The traditional fire coverages as such pose no insuperable problems. But since it was decided to base the entire policy premium on the amount of insurance, like fire insurance, it becomes necessary to translate boiler and machinery premiums from ones based on schedules of objects to ones as loadings in the fire rate. This is hard under the best of circumstances, and even more difficult in view of the large deductibles associated with some of the larger power reactors.

Let us assume a nuclear power reactor is to be insured. First, an exhaustive inspection is made by the pool engineer, and a copy submitted to the local fire rating bureau for development of advisory fire and EC, vandalism and malicious mischief, and sprinkler leakage rates, as guides to the Nuclear Insurance Rating Bureau. This is much the same as is done for a highly protected risk, which, indeed, most of these installations are. The Nuclear Insurance Rating Bureau then adds to these rates the boiler and machinery increment mentioned above, a nominal loading for the all-risk, and a loading for the nuclear exposure.

Calculation of the nuclear loading in the rate for reactors is a somewhat complex affair, with the final rate depending on (a) the type of reactor, (b) its use, (c) its authorized power level, and (d) how well it is contained. A number of "value units" is assigned, depending on these factors.

The value units are multiplied by a base rate to arrive at the nuclear rate, in cents.

A similar plan is established for premises, other than reactors, which are used to store, handle, or process nuclear materials (such as fuel fabricators), and for adjacent buildings. There is another schedule of rates for nuclear materials in transportation (there is a Supplier's form and a Carrier's form), and one for nuclear risks in the course of construction, the Builders Risk policy.

All rates are annual rates. Although the effective date of the nuclear property policy may be at any time during the year, its term may not exceed one year.

Deductible Credits

An insured may elect a deductible in excess of the mandatory deductible, and it has been the practice of some of the larger utilities to elect the maximum, $250,000. The table of credits follows:

Deductible	% Credit
$ 1,500	7.0
2,500	9.7
5,000	13.2
10,000	15.0
25,000	20.0
50,000	25.0
75,000	27.5
100,000	30.0
250,000	32.9

In applying the deductible credits, it is assumed that the rates promulgated for the all-risk and nuclear loadings already reflect the mandatory deductible. The fire and EC rates published by the local fire bureau, of course, are base rates.

The formula for mandatory deductibles produces odd amounts, which are rounded to the nearest $5. Thus, a deductible of $1,975 may be required for a certain installation. A graph is used for interpolating the above table to arrive at the proper credit. The following are examples of the application of the credit schedule (omitting consideration of the boiler and machinery component of the rate):

a. Typical fuel fabrication facility

Amount of insurance: $45,400,000 P.D. with $5,000 mandatory deductible

	Make-up Reflecting Credit for Mandatory Deductible	Make-ups Reflecting Optional Deductibles				
	$5,000	$10,000	$25,000	$50,000	$75,000	$100,000
Fire and EC	.042	.041	.038	.036	.035	.033
Nuclear	.060	.059	.056	.053	.052	.050
All risk	.015	.015	.014	.014	.013	.013
Total	.117	.115	.108	.103	.100	.096
% Credit in total rate (Ex B & M)		1.7%	7.7%	12.0%	14.5%	17.9%

b. Typical power reactor facility

Amount of insurance: $53,006,000 with $50,000 mandatory deductible

	Make-up Reflecting Credit for Mandatory Deductible	Make-ups Reflecting Optional Deductibles	
	$50,000	$75,000	$100,000
Fire & EC	.044	.043	.040
Nuclear	.289	.282	.275
All risk	.015	.015	.015
Total	.348	.340	.330
% Credit in total rate (Ex B & M)		2.4%	5.2%

When business interruption insurance is afforded (presently prohibited on reactors and fuel separation plants), the rates promulgated contemplate the "72 hour waiting period," after the style of ordinary fire and inland marine insurance. If a dollar deductible is also required, this is established and then the above table applies.

Coinsurance

The nuclear property policy carries a mandatory 90% co-insurance clause (a few reporting form policies are on a 100% co-insurance basis). The rates published are 90% rates. With a capacity of $74 million available, utilizing both pools, there is seldom any difficulty. The pools are running into an increasing number of situations, however, where the value of the property exceeds the insurance available. Under these conditions it is necessary to introduce a reduced coinsurance, and, since the first part of any loss up to $74 million is still to be covered, an increased rate is in order. The following table is used:

Percentage of Coinsurance	Multiple of 90% rate	Multiple of 100% rate
100%	—	1.00
95	—	1.02
90	1.00	1.05
85	1.03	1.09
80	1.07	1.13
75	1.12	1.18
70	1.18	1.24
65	1.25	1.31
60	1.34	1.41
55	1.45	1.53
50	1.58	1.66
45	1.73	1.84
40	1.88	2.02
35	2.06	2.23
30	2.34	2.51
25	2.67	2.89
20	3.15	3.42
15	3.90	4.28
10	5.28	5.80

While the policy coinsurance percentage is rounded to the nearest 5%, the rate multiplier is interpolated exactly, using a special graph which consists of a straight line on log-log paper.

As an example, let us suppose we have a power reactor whose insurable value is $99 million. With a capacity of $74 million, a 75% coinsurance clause is indicated. For such a clause, the 90% coinsurance rate is to be increased by a factor of 1.12.

Nuclear Property Insurance Losses

The physical damage loss and expense ratio since inception is in the middle fifties. Were this the normal case of thousands of policies with nominal limits, an easing of the rates would be called for. Here, however, we have a limited number of policies, some at huge amounts, and in the absence of a big loss it is imperative that the experience be excellent, or else support of the pools would slip. In literally one second a meltdown can occur, the cost of which can run into many millions.

In number, most of the physical damage losses which have occurred have been non-nuclear. There have been numerous small fires, transformer burnouts, damage to nuclear fuel in transit, failure of turbine blades, ruptured pressure lines, and the like. There have been at least two large bona-fide nuclear losses, both resulting in momentary over-heating of the reactor core. The first, at Waltz Mills, Pa., cost the pools about $1,000,000. The second, at Lagoona Beach, Mich., is still being settled at the moment, but it appears the loss will be very near $2,000,000. Two nuclear loses occurred at a new fuel separation plant at West Valley, N. Y., costing the pools over $550,000. In general, in spite of intensive loss prevention work, there probably will be a similar variety of losses in the future. Intensive efforts will be made to avoid the large losses.

It is interesting to observe that only rarely has a physical damage loss also resulted in a liability loss.

Let us now turn to the liability side of the story.

Government Indemnity
Price-Anderson Act of 1957

Before examining the liability policies we must take a look at the Price-Anderson Act passed by Congress in 1957. By virtue of this legislation the government agrees to indemnify certain persons for any liability they may have to others for nuclear injuries or damage arising out of a specified nuclear installation. Although a charge is made by the government to the persons indemnified, it is a very small one, and the protection afforded is in effect a subsidy to the small but fast-growing nuclear industry. Indeed, without this additional protection most nuclear reactors would not be able to operate, because early studies indicated that while a really large loss is extremely remote, it nevertheless *could* happen and might result in damages theoretically running a billion dollars or more. The amount of the indemnity is $500,000,000, which applies in excess of an amount of "financial protection." The Atomic Energy Commission, which administers the law, specifies how much "financial protection" is required to be carried, and if this is forthcoming grants the indemnity. The financial protection may be posted in the form of cash, qualified self-insurance, or private insurance. So far, only NELIA and MAELU liability policies have actually been used to satisfy the financial protection requirements of the law.

If a loss theoretically could run a billion dollars or more, an insured with $60 million insurance from the pools and $500 million government indemnity, $560 million in all, might still refuse to operate, deeming the protection insufficient. The Price-Anderson Act takes care of this by limiting the licensee's liability to $500 million plus the amount of financial protection stipulated. It cuts off any further liability, and sets up procedures for pro-rating all claims should it appear possible that such a high figure may be exceeded.

The AEC is required to execute contracts of indemnity with all qualified owners of reactors, critical facilities, and plants designed for the separation or purification of the isotopes of uranium or plutonium (chemical, aqueous, or gaseous diffusion). It is within the discretion of the AEC to afford indemnity to other types of nuclear plants, such as uranium mines and ore mills, fuel fabricators, research laboratories, etc. But the AEC in its wisdom has decided not to exercise this discretion. Thus the mines, ore mills, fuel fabricators, research laboratories, etc. are without indemnity. Most of them, of course, buy liability insurance from the nuclear pools. A few of them buy very high limits, while some buy none at all.

The law specifically provides that the AEC *may* require financial protection of those firms having direct operational contracts with the AEC (contractors, not licensees). It has been a disappointment to the pools that the AEC has not done so, but rather has indemnified its contractors from the ground up. Efforts by the pools over the years to persuade the Congress to change "may" to "shall" have hitherto failed.

Another disappointment to the pools has been the *amount* of financial protection that the AEC has prescribed. To be sure, the law itself specifies that the amount must be the maximum private insurance available, as respects reactors of 100,000 electrical kilowatts or more. However, in the beginning there were very few this large, and for the smaller ones the AEC specified only a proportionate amount, down to a minimum of $250,000 for the smallest reactors, and for critical facilities. An amendment to the act in 1958 requires the AEC to indemnify non-profit educational institutions (colleges and universities) above $250,000 without any financial protection requirement, it being optional with the licensee whether they carry pool coverage or not.

However, over the years more large reactors have become operational, and premiums have slowly increased. Furthermore, the AEC did eventually revise its guidelines, employing a more sophisticated formula to arrive at the amount of financial protection, and generally increasing the amount of insurance required.

The indemnity, like the insurance, runs only to a nuclear incident. The law states "the term 'nuclear incident' means any occurrence within the United States causing bodily injury, sickness, disease or death, or loss of or damage to property, arising out of or resulting from the radioactive, toxic, explosive or other hazardous properties of source, special nuclear, or by-product material." We have seen these latter phrases in the subrogation clause of the nuclear property policy, and we shall see them again all through the liability forms.

The person indemnified under the Act "means the person with whom the indemnity agreement is executed *and any other person who may be liable for public liability.*" (Emphasis added.) This is of tremendous importance to the liability insurers. Since the policy must correlate closely with the government indemnity, it means that the insured on the policy must include any and all other persons liable, whether named or not. This omnibus provision, as we shall see, has its direct effect on every ordinary liability policy (OL&T, M&C, auto, etc.) issued in this country.

Two other sections of the Act add to the unusual nature of nuclear energy liability insurance. The first excludes indemnity for claims under State or Federal Workmen's Compensation Acts of employees of persons indemnified who are employed at the site of and in connection with the activity where the nuclear incident occurs. Notice that employees working elsewhere are not excluded; indemnity runs to the employer should they be injured in a nuclear incident, and the pool policies must afford like coverage.

The second feature has proven far more troublesome to the liability pools. It provides coverage for damage to property owned by the indemnitee, excluding only "property which is located at the site of and used in connection with the activity where the nuclear incident occurs." This off-site clause is intended to place the owner of a nuclear installation in the same position as any other property owner in the vicinity, with respect to other property he may own away from the premises. Should such other property become damaged because of a nuclear incident arising out of his own nuclear installation, he can in effect sue himself and recover under the terms of the NELIA-MAELU policy and under government indemnity. This provision may have appeared reasonable enough at the time it was framed, but its original designers surely did not foresee what was to happen. It has become increasingly commonplace to build power reactor #2 right next to reactor #1. Indeed there are plans for several clusters of three reactors and, in Canada, there is to be one of eight in a row. Now, when #2 is being built, the AEC deems it off-site to #1, by not broadening the site definition in the indemnity agreement applying to #1. The broadening is not done until nuclear fuel intended for #2 actually arrives on the premises. Thus the liability insurance pools, whose policies must be closely parallel with the indemnity, are put in the very awkward position of affording property insurance (for the nuclear hazard only, to be sure) for this builder's risk exposure. It was a bitter pill for them to swallow.

The Price-Anderson Act has been amended to bring the nuclear ship Savannah within the purview of government indemnity, extending protection up to $500 million to any person who may be legally liable for a nuclear incident in connection with the design, development, construction, operation, repair, maintenance, or use of this, the first, nuclear-powered merchant vessel. The amendment extends the indemnity to occurrences outside as well as inside the U.S.A. It specifies that the AEC *may* require financial protection, i.e., underlying private insurance. The liability pools offered, separately, to provide such insurance, but the AEC has seen fit to grant indemnity from the ground up. The decision, in this case, comes as no disappointment to the pools, which really were not oriented toward ocean marine protection and indemnity insurance.

Another amendment extends the indemnity to persons or firms under contract with government, with respect to their activities *outside* the U.S.A., with the amount reduced from $500 to $100 million. This amendment is for the protection of the named contractor only and does not include the omnibus interests provision. The Congress was reluctant to make as much as $500 million subject to the vagaries and uncertainties of the courts of foreign countries.

A further change was made when, effective January 1, 1966, the liability pools increased their combined maximum limit from $60 to $74 million. The Congress simultaneously enacted an amendment reducing government indemnity for those purchasing the maximum from $500 to $486 million. Thus the total protection to the public remains at $560 million. The government has professed a hope that the day will come when private insurance becomes available in such large amounts that the indemnity may be dropped altogether, and of course the insurance industry also would be happy to reach this ideal position.

1966 Amendments to Price-Anderson Act

There has always been some uneasiness on the part of legislators and others that the insurance companies, following a nuclear incident, might unduly resist claims, and prolong settlements until liabilities were finally and ultimately established. Some lawyers have indeed felt that, with respect to nuclear installations, ordinary tort liability should be replaced by absolute liability. The insurers have always argued that the public will receive prompt and adequate treatment. However, they wanted no part of absolute liability, largely because of the danger of such a precedent carrying over into other areas of high hazard. After long discussions between the AEC, the nuclear industry, and the insurance companies, a system was evolved under which the companies, under certain conditions, will waive defenses based on negligence or fault.

Effective January 1, 1966 the Congress amended the Price-Anderson Act, so that the AEC may require provisions in its indemnity contracts and in the insurance policies, which

(a) waive any defense as to conduct of the claimant or the fault of the persons indemnified,
(b) waive the defense of charitable or governmental immunity, and
(c) waive any defense based on a statute of limitations, if suit is instituted within three years from the date on which the claimant first knew of his injury, but in no event more than ten years after the date of the nuclear incident.

The law applies only to "extraordinary nuclear occurrences" which are defined as "any event causing a discharge or dispersal of source, special nuclear or by-product material from its intended place of confinement in amounts off-site, or causing radiation levels off-site, which the Commission determines to be substantial, and which the Commission determines has resulted or will probably result in substantial damages to persons off-site or property off-site."

The Commission has promulgated its regulation as to what constitutes substantial damages. Briefly, it will deem a nuclear occurrence to be extraordinary if:

(a) 10 or more people are killed or hospitalized, or
(b) any one person sustains damage of $2,500,000, or the total damage is $5,000,000 or more, or
(c) 50 or more persons sustain damages of $5,000 or more each, provided the total damage is at least $1,000,000.

Another section of the amendment deals with emergency payments to the public. It authorizes the AEC, also NELIA and MAELU, to make immediate emergency payments to victims of an extra-ordinary nuclear occurrence. NELIA and MAELU, of course, do not require authorization to make such payments. But the AEC does, in the area of government indemnity, so the pools were swept in. Such payments will probably be in reimbursement of out-of-pocket medical expenses, living expenses and the like. No release will be required, nor will any payment constitute an admission of liability. However, such payments will be limited to 15% of the overall estimated aggregate loss. In most cases liability will be fairly apparent immediately, and the payments reduce the ultimate amount to which a claimant is entitled.

Very soon after the Price-Anderson Act was passed in 1956, NELIA and MAELU contracted to handle, on behalf of the AEC, claims in the area of government indemnity. The agreement has obvious benefits for the pools, one of which is to eliminate the vexing problem of how to adjust claims if the total loss is likely to run more than the insured limit of liability. Without the contract, the insurers would have to delay settlements until every last liability had been determined. With the contract they are able to settle without really caring whether it is an insurance claim or a government indemnity claim. That matter can be determined later between the pools and the AEC. Of course, the company adjusters do not have carte blanche to settle any and all indemnity claims; there are reasonable restrictions and procedures. The companies, for their services, are paid their out-of-pocket expenses and an hourly rate on the time of their men involved.

How government indemnity would work in the event of a nuclear holocaust remains to be seen, fortunately. But there is no doubt that this unique legislation has worked well to solve a complex problem — to encourage a budding industry and at the same time to provide protection to the public in very large amounts. It is a credit to the original drafters that before the Act expired in 1967, it was extended an additional ten years to 1977, without change. It is also a credit to the private insurance industry that it has been able to accommodate to the Act's unusual terms by providing underlying financial protection in the form of insurance coverage which is very nearly indentical in form and content.

Nuclear Energy Liability Exclusion Endorsement

We have already commented on the absolute necessity that an insurance company's total liability, after a nuclear occurrence, not cumulate among two or more policies. Each company has already pledged to the pools an amount it considers maximum, and to incur any further loss through duplication or pyramiding of other policies is considered intolerable. Therefore it was decided to concentrate *all* liability for a nuclear occurrence in the nuclear energy policies, and to provide *no* nuclear energy insurance in any other policy. Thus nearly all non-nuclear liability policies carry a clause excluding nuclear liability. Major exceptions are automobile liability insurance in New York, and statutory automobile liability insurance in Massachusetts, where the exclusion was never approved.

There is a short form and a broad form endorsement. The short form is intended for all personal policies, as opposed to business or commercial policies. It apears, for example, in the Family Automobile Policy and in Section II of the Homeowner's Policy. The clause follows:

> "This policy does not apply to bodily injury or property damage with respect to which an insured under the policy is also an insured under a nuclear energy liability policy issued by Nuclear Energy Liability Insurance Association, Mutual Atomic Energy Liability Underwriters or Nuclear Insurance Association of Canada, or would be an insured under any such policy but for its termination upon exhaustion of its limits of liability."

The point is, anyone liable is an omnibus insured under the policy issued by NELIA, MAELU or NIAC. Should a nuclear incident appear to be covered both by a NELIA policy issued to Corporation A and also by a Family Automobile Policy issued to Mr. B, the latter is automatically an insured under the NELIA policy, and thus his auto policy therefore affords no liability coverage, by virtue of the quoted exclusion. Duplication of limits has been avoided. If there is no nuclear policy in force covering the incident, the company could be liable, but the chance of an FAB policy becoming involved in a nuclear incident is so remote that the companies are not concerned.

The chance that a firm or corporation could get involved under a commercial policy is far greater, and for this reason the Broad Form endorsement is much more complex. It begins the same way:

"It is agreed that the policy does not apply:

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

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

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

Paragraph 1(a) is the short form already discussed. Part (1) of paragraph 1(b) knocks out insurance for the nuclear hazard when *any* person is required to maintain financial protection. Such person is required to carry his own nuclear insurance, and will receive a contract of government indemnity, both of which have the omnibus protection for all persons liable. Part (2) of the clause is needed in those situations where there is indemnity without financial protection. Government contractors are in this position; with respect to the hazardous properties of nuclear material the standard liability policy will not cover them or their suppliers. The Broad Form endorsement continues:

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

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

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

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

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

"IV. As used in this endorsement:

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

'nuclear material' means source material, special nuclear material or by-product material;

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

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

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

'nuclear facility' means:

(a) any nuclear reactor,

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

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

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

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

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

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

A detailed analysis of all these words, which is necessary for their complete understanding, is out of place here. Rather we shall comment on how some of the more important elements of coverage work out.

1. There is no insurance under medical payments coverage or under the immediate medical aid clause of the insuring agreement, for bodily injury loss resulting from the nuclear hazard.
2. No coverage is afforded for nuclear loss arising from a nuclear facility owned or operated by an insured, or arising from spent fuel or waste at any time owned or handled by an insured. The NELIA-MAELU policy stand ready to furnish such insurance.
3. One will recognize paragraph III (c) to be a product liability exclusion. It appears to eliminate coverage for all products (including the furnish-

ing of services or goods) going into reactors but it is far less drastic. In effect it says "No coverage is afforded for products claims arising from the nuclear hazard (a) for damage to any facility itself or property thereat, when located in the U.S.A. or Canada, or (b) which occur *to or from* a facility located outside U.S.A. or Canada."

A great deal of products coverage still remains. If there is no nuclear energy liability insurance policy in force for the facility and an incident occurs at the facility within the U.S.A. or Canada, the ordinary product liability policy, even with the exclusion endorsement attached, still covers all the bodily injury claims it would cover in the absence of the endorsement, *including* claims arising from the nuclear energy hazard. Likewise, it would cover all property damage claims otherwise covered, except damage to the facility itself.

For example, let us suppose there is a product liability policy covering a valve manufacturer who has sold valves used in a liquefied petroleum gas tank owned by a reactor operator. Because of a faulty valve there is a tremendous explosion without, however, any radiation or contamination damage. The product policy, even with the exclusion endorsement attached but subject to its normal exclusions and conditions, covers all resulting claims, excepting damage to the valve itself.

Now let us suppose the valve is part of the reactor system and causes losses arising from the nuclear energy hazard. If there is no nuclear energy liability policy in force for the reactor the same product policy still covers resulting bodily injury claims, and property damage claims except to the facility itself and to all property thereat.

Notice that in the one case the only property damage excluded is damage to the valve itself (the insured's own product) while in the second the exclusion runs to the entire facility and all property thereat.

The two examples cited above are based on the assumption that paragraph I of the exclusion endorsement has no application to our insured, that is, there is no nuclear energy liability insurance in force covering him. If he is an omnibus insured under that policy, by virtue of Paragraph 1(a) of the Exclusion Endorsement, the nuclear policy affords the insurance, and coverage is eliminated from the product liability policy.

A supplier may wish to purchase product liability insurance against nuclear damage to a nuclear facility. It is true that the property pools permit their insured owner to waive right of recovery against a specific party in advance of a loss, and, more important, to waive right of subrogation against any supplier for nuclear loss as defined. But the supplier observes that nuclear energy property insurance contains a deductible, and the owner may wish to seek recovery for at least the deductible. An uninsured or underinsured reactor owner may go after him for all or part of the loss. The pools even now will not afford business interruption insurance to power reactors, and following some incident the reactor owner may wish to attempt to recover against the negligent supplier for loss of use of the facility. But the supplier will find he cannot buy insurance to protect him for such loss. There simply is no market for it, for the oft-repeated reason of lack of capacity.

Commercial Radioactive Isotopes and Source Material

A great variety of commercial radioactive isotopes are used in medicine, biology, laboratory research, and also in industry. An example of the latter is the isotope used in a gauge which measures the length of cigarettes in their manufacture. Massive doses of cobalt-60 are also used to irradiate various foods for sterilization and to retard spoilage. It is the intent of the exclusion endorsement *not* to knock out coverage for the use of such isotopes, and a minute examination of all the definitions will reveal this has been accomplished. Thus, coverage for small amounts of nuclear material in a "hot" laboratory remain under the laboratory's conventional OL&T or CGL policy. Occasionally, when the concentration of isotopes on a premises becomes unusually large, the conventional insurer may become nervous and ask the pools to take over. The pools can do so, but have been quite successful in persuading the carrier to stay on. Incidentally, the experience from such operations has been excellent. As to irradiation of foods and other substances, the pools have decided to decline to cover, without exception.

Coverage for liability arising from source material is also to be retained under the conventional liability policy; the endorsement does not exclude it as such. Source material generally is unenriched uranium and thorium and is not hazardous. Thus uranium mines and mills are insured in the conventional market and not by the pools.

Nuclear Energy Liability Policies

At long last we are able to discuss the policies of insurance which NELIA and MAELU issue. There are two forms. The first Facility Form, is issued to nuclear reactors, fuel fabricators, fuel separation plants, and other such facilities having quantities of nuclear material on the premises.

The second, Supplier's and Transporter's Form, is intended for suppliers to nuclear facilities and for transporters of nuclear materials.

Facility Form

This is the policy which is furnished as financial protection by an indemnitee under the Price-Anderson Act. The grant of coverage, except for the limit of liability is substantially the same as the indemnity granted by the government. It is unique in so many ways that it is hard to know where to start.

First, the Facility Form covers all persons liable (excepting only the United States of America or any of its agencies). We have already discussed this omnibus provision. It is necessary in government indemnity to provide the fullest protection of the public. The inclusion of the omnibus provision in the policy permits us to concentrate nuclear liability insurance in the pools, and away from conventional liability policies, by way of the exclusion endorsements on the latter. And its inclusion in the Facility Form certainly reduces to the vanishing point possible delays in settlements which might result from bickering over which person is liable, whether liability is to be shared among several defendants, etc.

Next, the limit of liability is an *aggregate* limit for the entire life of the policy. At the same time, the policies are written *without expiration*. These two features in combination act to prevent cumulation or pyramiding of an insurer's liability. Consider, for example, a radiation injury which is sustained over a period of several years. If a series of one-year policies were issued, each policy could be called upon to respond, and the overlapping of limits could become intolerable to the insurers. For the same reason, an aggregate limit is used, rather than the usual "per accident" or "per occurrence." Following the payment of a loss, the limit on the policy is automatically reduced. Loss expense is included as loss. Restoration of limits may be made, at the option of the insured and of the pools, but the pools will do this for a large loss only after a careful scrutiny of the situation, and along with plenty of engineering and legal advice. The limit of liability, as in the government indemnity, includes both bodily injury and property damage liability. Policies may be terminated, but only by formal cancellation. The insured must give 30 days notice, and the companies 90 days notice, with a copy to the AEC. The policy also is cancelled, without notice, if the limits of liability become exhausted by reason of payments for losses and loss expense.

In the case of a facility which is indemnified by the government, the public is not short-changed by the lack of insurance which has become exhausted by reason of payments. Where the insurance leaves off the indemnity takes on, without a gap.

The policy applies "only to bodily injury or property damage (1) which is caused during the policy period by the nuclear energy hazard and (2) which is discovered and for which written claim is made against the insured, not later than two years after the end of the policy period." The two-year discovery clause may be extended by payment of a small additional premium. Also, some insureds upon termination of nuclear activities have chosen to keep the clause open indefinitely, by not terminating the policy and by paying a greatly reduced annual premium. The endorsement needed to accommodate the policy to the new provisions in the Price-Anderson Act involving "extraordinary nuclear occurrences," which we discussed earlier, has not yet finally been worked out at the time of this writing. However, it obviously will have an effect on the two-year discovery clause.

Nuclear property insurance, you will recall, was all-risk in nature, covering not only the nuclear hazard but also all other perils not excluded. Nuclear liability insurance, in contrast, covers the one peril only. The reactor owner must also purchase an ordinary M&C, OL&T, or CGL Policy to have protection for trips, falls, and other non-nuclear occurrences.

Another unique feature of the Facility Form is the Common Occurrence Clause, also born of the importance that a pool subscriber never be charged for more than his subscription. It defines a common occurrence as one which (a) arises out of nuclear materials discharged or dispersed from more than one facility at the same time, over a short or a long period, or (b) involves two or more Facility Form policies covering nuclear materials in the course of transportation. In the event of such a common occurrence the clause provides that the applicable limit of liability is the sum of the limits on all the policies which afford coverage, subject, however, to a total aggregate limit equal to the pool capacities, separately. The total aggregate NELIA limit is $57,350,000, and MAELU limit $16,650,000, and these numbers appear in the clause. In the event the arithmetical sum of the limits exceeds these numbers, the clause sets forth a procedure for pro-rating. This clause, hopefully, may never be invoked, but is considered absolutely necessary to the pool members. The example of a common occurrence which comes easiest to mind is the nuclear pollution of a watershed by two or more independent reactors.

The policy excludes:

1. Workmen's compensation. But other provisions in the policy operate so that the policy reimburses a workmen's compensation carrier for injury to off-site employees.

2. Liability assumed under contract (with some exceptions).

3. "Bodily injury or property damage due to the manufacturing, handling or use at the location designated in Item 3 of the declarations, in time of peace or war, of any nuclear weapon or other instrument of war utilizing special nuclear material or by-product material."

4. War.

5. Damage to property at the facility site (excepting vehicles used in connection with the facility). Note that owned property, located elsewhere, is not excluded.

6. Damage to nuclear material moving to or from the facility. The preceding exclusion, with this one, operates to exclude all damage to nuclear material. Insurance for this hazard may be purchased from the property pools.

There is a save and preserve clause, adapted from the standard fire policy, inserted to apply to damaged off-site property owned by the insured.

Supplier's and Transporter's Form

Even though the Facility Form will cover, as an insured, anyone liable, many corporations early in the game expressed a desire for their own policies. These are largely manufacturers and suppliers to the nuclear industry, and transporters of nuclear materials (truckmen and railroads). They reason that it may be unwise to rely on somebody else's policy because:

1. That policy may carry lower limits of liability than they would carry for themselves. Many university educational reactors carry only $250,000. Further, some facilities such as fuel fabricators, do not enjoy government indemnity; interestingly, many of them carry pool insurance with rather substantial limits of liability, but not all of them do.

2. There may be no facility policy at all. Some university reactors self-insure the $250,000. Further, some large chemical fuel converters do not carry pool insurance.

The Supplier's and Transporter's Form is like the Facility Form in many ways:

1. It covers only the nuclear energy hazard.
2. The limit of liability is an aggregate one for the entire life of the policy, and the policy is written without expiration. Loss expense is included as loss.
3. It likewise has the two-year discovery feature, also probably to be modified when the language to adapt "extraordinary nuclear occurrence" is finally shaped up.
4. When used in both policies, the definitions are identical.

The S. & T. policy differs from the Facility Form in three major respects:

1. It covers only the named insured, and any employee, officer, director or stockholder thereof while acting within the scope of his duties as such. No omnibus coverage here. However, with respect to the transportation hazard, and in line with the standard automobile liability policy, the policy does cover "any other person or organization with respect to his legal responsibility for damages," excepting only the U.S.A. or any of its agencies.
2. A very carefully worded provision specifies that the limit of liability for an occurrence for all nuclear energy liability policies shall not cumulate beyond the pool aggregate limit, separately for each pool. First, the limits for all S. & T. policies applicable to an incident are added together, and pro-rated if the aggregate capacity is exceeded. Further, any Facility Form insurance applicable is primary and is subtracted and there may very well be such insurance in effect. Indeed, if there is a Facility Form policy carrying the maximum limit, all S. & T. insurance becomes zero.
3. Since the S. & T. policy is not designed to be used for "financial protection" under the Price-Anderson Act, it need not cover injury to off-site employees or damage to owned off-site property, and those features are omitted.

The exclusions are:

(a) Workmen's compensation.

(b) Employer's liability. These two coverages are available under the regular workmen's compensation policy.

(c) Certain contractual. The exclusion may be modified, just as in a conventional liability policy.

(d) "Bodily injury or property damage arising, directly or indirectly, out of an explosion, however caused, of an atomic weapon." Insurance for this hazard is simply not available.

(e) War.

(f) Property damage to any facility, except to vehicles used in connection with it. The property pools stand ready to insure this hazard, for the owner. The best a supplier can do is to persuade the reactor owner to execute a hold harmless agreement in his favor. Also, you will recall that the nuclear property policy waives the right of subrogation acquired against any party furnishing services, materials, parts, etc., with respect to the nuclear energy hazard only.

(g) Property damage to nuclear material in the course of transportation by or on behalf of the named insured. As we have already noted such coverage may be purchased from the property pools.

(h) Bodily injury or property damage arising out of:

1. Nuclear material outside of the U.S.A. The three-mile limit is considered the dividing line. *Comment:* Both NELIA and MAELU, however, have a Foreign Form and write considerable overseas coverage.

2. Nuclear-powered vesels, if the pools have issued a Marine Form policy on the vessel. No Marine Form policy has yet been issued, so this exclusion presently has no force.

3. A nuclear facility owned or operated by the named insured. The Facility Form policy is available for that.

4. Nuclear material in the course of transportation to or from a nuclear facility owned by the insured. Again, nuclear property or cargo insurance is available both to the owner and to the transporter.

5. This exclusion, formerly "the disposal of waste," is now deleted.

6. "Any radioactive isotope while away from any nuclear facility." This exclusion (h) 6 is removable, for a premium, although (as mentioned) the pools prefer to see the hazard remain under con-

ventional liability policies. When (h) 6 is deleted, another exclusion is introduced — the familiar automobile exclusion with respect to damage to property owned by, rented to, in charge of or transported by or on behalf of the named insured. However, for a truckman this second exclusion may be modified so that the policy affords coverage for damage to companion cargo. The example that comes to mind is the shipment of a load of camera film along with some high energy isotope in a leaky container.

(i) Any loss with respect to which (1) any person or organization is required to maintain financial protection, or (2) the insured is entitled to indemnity from the government. Division 2 of the exclusion may be eliminated, for an extra premium, which means the policy will perform in the area of government indemnity. The insurance companies may take pride in the fact that some large policyholders prefer the prompt and reliable response of private insurance to the uncertainties of government indemnity, and purchase this protection even when the latter is available to them.

These admittedly brief remarks conclude the discussion of the policy forms issued by the nuclear pools. In the interest of simplicity and clarity, much of the complexity actually contained in the policies has been omitted, and the actual document should be consulted for complete accuracy. The curious student, in so doing, will be rewarded by a look-see at one of the most unique and unusual of all contracts in the history of casualty insurance.

Nuclear Energy Liability Rates and Premiums

NELIA and MAELU use identical premium structures. The mutuals pay no dividends on this insurance. NELIA's rates are established by the Insurance Rating Board (formerly the National Bureau of Casualty Underwriters), and MAELU's by the Mutual Insurance Rating Bureau. There is no manual of rates as such; rather each risk is processed in accordance with the (a)-rating procedure of the applicable state. In actual practice, committees and subcommittees of the two bureaus sit jointly in making rates, and their sessions are usually attended by pool personnel. The underwriters are frequently assisted by nuclear engineers and claims people, who operate under a committee system themselves.

Now, how does one make rates for this brand new hazard? The early ratemakers faced a formidable task. Th only "experience" was that of the government, and that was a very good record. While a great deal of material had been declassified, i.e., no longer made secret, only a few engineers and university experts knew anything of this strange new source of energy. Clearly, the making of rates here would involve much improvisation and a great deal of judgment.

The problem was compounded by the limits of liability involved. Even if it is felt that the proper premium for a policy of $1 million insurance has been established, what's the rate for $60 million? In partial answer to this question, it was decided that the premium base would be the amount of insurance. The basic unit would be the premium for the first million. Succeeding millions would cost less and less. The following table was evolved for reactors:

Layer of Limit of Liability	*% of Premium for the First Million*
1st million	100%
next 4 million	50%, each
next 5 million	20%, each
next 10 million	10%, each
next 20 million	5%, each
next 20 million	2.5%, each
next 14 million	2.0%, each

Thus it can be shown that if, for a power reactor, the premium for the first $1 million for a Facility Form policy is $50,000, the premium at the full pool capacity is $339,000. All premiums are annual.

Even ten years ago it appeared that power reactors would eventually comprise the greater part of the premium income of the pools. Thus the power reactor was deemed to be the standard exposure, and all other nuclear exposures were more or less related to it. So the problem boiled down to — what is a proper premium for the first $1,000,000 of coverage for a typical power reactor?

A formula eventually was set up, very much like the "value units" approach we have already seen in connection with property insurance. Five factors are considered: type, use, size, location and containment, with units set up in accordance with the physical characteristics of the reactor under consideration. The values for the five factors are determined, and compared to those established for a theoretical typical reactor, and the premium is thus obtained.

There are many other premium schedules used by NELIA and MAELU. For example, factors in rating fuel fabricators include rural or urban, how much nuclear material is present, presence of plutonium, etc. The cost for subsequent millions is somewhat simpler, as follows:

Amount of Insurance	*Premium*
First million	Base premium
Second million	50% of base premium
Each additional million	$500 per million

Limits of liability less than $1 million are available as follows:

Limit	*Premium*
$250,000	50% of base premium
500,000	75% of base premium
750,000	90% of base premium

Minimum premiums frequently come into play. $1,000 is the least for which the pools will write the first million for any power reactor, and this minimum applies per million right up through the 74th million, regardless of size of the reactor. All other reactors have a $1,000 minimum premium for the first million ($1,500 for universities) but only $500 minimum for each additional million. The minimum premium for virtually all other kinds of coverage which the pools will issue is $500 for the first million and $250 for each subsequent million.

Even if the hazard is so remote as to be non-existent, the pool companies must get a meaningful return when issuing policies with unusually high limits. The last minimums quoted produce, for $74 million limit, a premium of $18,750, or 0.253% of the insurance. This compares favorably with what a commercial bank charges a customer for standby money. For one-quarter to one-half percent, the bank agrees to be ready to loan money to its customer; that is, the money will be there when he needs it. When actually borrowed, the usual rate of interest is paid. You can see that the insurance is much more risky than a standby loan, yet the minimum rates are about the same or less.

The pools have premium schedules for package reactors, university reactors, and critical facilities, and for a whole variety of miscellaneous nuclear exposures. For example, for firms specializing in the storage and disposal of low-level waste on land, the pools quote a premium of \$1,000 for the first million, and \$500 for each additional million. There are special rates for decontamination laundries, laboratory operations, scrap recovery, etc. As for Supplier's and Transporter's Form policies, the folowing schedule is generally applied to truckmen and railroads:

1st million	\$750
Next 9 million	375 each million
Over 10 million	250 each million

All other S. & T. policies carry premiums of at least \$1,000 for the first million.

To wind up this section on premiums, it probably is fair to say that NELIA and MAELU still do not know if the premiums being charged are about right. A great deal of attention is devoted to adjusting rates so that risks with about the same hazard get the same charge. But whether the premium level as a whole is too high or too low is simply not known yet. Very few losses have in fact emerged. If the premium level has been pitched too low, there is grief ahead for the insurance companies. If too high, the companies have two defenses. First, the rate level has not been increased since the start; in fact it has been lowered somewhat for power reactors. N. E. Masterson in his paper "Economic Factors in Liability and Property Insurance Claim Costs," presented to the Casualty Actuarial Society in May, 1968, sets forth indexes which show that bodily injury claim costs have increased about 63% in the last decade, while property damage liability claim costs have trended up about 45%. The pool rates have not been increased.

More important, if the liability premiums prove to be too high, there is an automatic correction through the Industry Credit Rating Plan, a kind of retrospective rating or premium return plan which applies to all domestic risks.

Industry Credit Rating Plan

Every policy issued by NELIA or MAELU on risks in the U.S.A. is subject to the Industry Credit Rating Plan, and carries an endorsement to that effect. The plan provides that to the extent that expected losses or loss expense fail to emerge, the policyholders will be refunded premium, dollar for dollar. The expected loss and loss expense ratio has worked out to be just about 70% for the last eleven years. Thus about 70% of all NELIA-MAELU premiums has been set aside in special reserve funds, to be paid out as loss or loss expense, or to be refunded to policyholders.

It is a revolving ten-year plan. It applies to all the policies as a whole, and not individually to each policy. Thus a loss suffered by one will affect premium returns to all by the same percentage. At the end of the first ten years, the policyholders in the first year get a return premium in proportion to their first-year premium (if incurred losses are low). A return was actually made in 1967 to 1957 policyholders (1957 was the first year the pools operated). A further return was made in 1968.

Let us look at the mechanics of the 1968 returns (NELIA and MAELU combined):

Computation of Industry Reserve Premium Refund

Calendar Year 1958

Industry reserve premiums	1957–67	$11,959,906.99
Less incurred losses	1957–67	112,377.75
Less prior refunds (1957 refund)		46,436.22
Reserve fund at 12-31-67		$11,801,093.02

The formula for the return premium is:

$$\frac{\text{Industry reserve premium 1958}}{\text{Industry reserve premium 1958–1967}} \times \text{reserve fund at 12-31-67}$$

or

$$\frac{\$243{,}479.51}{\$11{,}912{,}200.16} \times \$11{,}801{,}093.02 = \underline{\underline{\$241{,}208.52}}$$

The denominator above is less than the 1957–67 reserve premiums because this year the 1957 reserve premium, $47,706.83, is omitted. The ten-year period is moving along.

The standard premium for 1958 was $357,465.01, so that over 68% of it went into the reserve fund. It is seen that about 99% of this 68% has been refunded to the policyholders. The same was true for the 1957 refund.

The refund is distributed to the policyholders of a calendar year in proportion to their relative contributions to the standard premiums in that year. Facility Form policyholders and S. & T. Form policyholders are considered alike, but all foreign insurance is excluded.

To assist in the accounting, every policy is given a rating anniversary of January 1. A policy may take effect at any time during the year, but its initial premium is pro-rated to year-end. Thus, like Massachusetts statutory automobile bodily injury premium, all nuclear energy liability premium is earned at year-end.

The Plan is a credit plan only; no policyholder is ever required to pay a surcharge for poor experience. If, through misfortune, the entire reserve fund is used up for losses and loss expense, the individual pool members must be assessed to make up the needed difference.

The money in the reserve funds, separately for NELIA and MAELU, can never come back to the companies. It has formally been set up in special accounts, to go out either as actual loss or loss expense to claimants, or as premium refunds to policyholders. The beauty of the Plan is not only that it largely corrects for redundant premiums, if they are redundant, but also permits the pools to build a tax-free cushion against future loss. Money flowing into the funds is considered unearned premium, and the companies pay no Federal tax on it. They do, of course, pay full tax on any investment income derived fròm the fund. As we have seen, the combined reserve funds for NELIA-MAELU at December 31, 1967 was \$11.8 million. With the influx of 1968 advance premiums ,the funds now stand at nearly \$14 million. This will help defray a pretty large loss, and makes it increasingly attractive for an insurance company to support the pools, since brand new pool members get the same protection from the reserve funds as companies that were in from the start.

The future of the reserve funds has been the subject of some debate. Its growth, all admit, has been much slower than its originators had in mind. But the nuclear industry is now burgeoning and by 1980 will be much larger than anyone had dreamed. Under the circumstances, there is a strong argument that the funds should grow sufficiently large to pay off one total loss, i.e., \$74 million. Not unnaturally, the bigger policyholders, largely the utilities, take the other view, not liking to see such substantial chunks of their money tied up for ten years. They urge a lesser figure, or a reduction in the plan period from ten years to something less. However, it is likely no changes will be considered until the premium volume (presently about \$3 million annually) and the trust funds grow much larger.

Nuclear Liability Insurance Losses

It is a fact that NELIA and MAELU have been very fortunate. The total 10 year losses and loss expense incurred has been only $112,000. There have been only two large claims. One arose from a Rhode Island accident in 1964 at a fuel fabrication plant, involving an unintended criticality and the death of an employee. The on-site workmen's compensation exclusion was not effective in this case; Rhode Island is a state which permits fellow-employee actions, and suit was brought against a supervisor and others. The other is a disputed bodily injury case, the plaintiff alleging that radiation of an employee caused a child to be born a mongoloid. All other claims have been very minor spillages, mostly of nuclear materials in transit. It is a great credit to the insurance industry, the nuclear industry, and to the Atomic Energy Commission that the safety record has been so fine. But the magnitude of possible loss is such that the pressure for continued safety must be unremitting.

The Future of Nuclear Energy

It is a fact that the utilities generating electricity must double their output every ten years just to stay even with America's insatiable demand for electric power. Coal and oil reserves are not inexhaustible, and hydroelectric power can be increased only very slowly. Nuclear energy is the answer.

At the end of 1966 the liability pools insured seven relatively small power reactors, having a combined output of 1564 thermal megawatts. In 1967 three new reactors became operational, with 2,935 megawatts. By the end of 1969 four large plants go into operation, producing over 8,000 megawatts of power. Thus in only three years power output will have increased eight-fold.

But that is only the beginning. Nuclear power has now been demonstrated to be at least as economical as oil or coal-fired plants in almost all parts of the country. Orders for nuclear plants have nearly overwhelmed the manufacturers and are spaced out in the future up to 1975. Twenty-one power reactors are presently under construction, totalling about 40,000 megawatts. And an additional fifty-seven reactors are proposed or planned, providing another 110,000 megawatts. By 1980 the AEC estimates that one-third of all electrical power generated in this country will be from nuclear stations. The trend line goes right off the chart.

Nuclear energy insurance will likewise grow in volume and importance, at last justifying the lavish care and attention given to it in its early years.

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

J. ROBERT FERRARI[1]

In recent years, insurance literature and research reflect a great deal of attention to investment return in property and liability insurance companies and a number of important considerations have been discussed. Many issues, however, have not necessarily been resolved and there remains a dearth of thoughtful material on property and liability company finance. There has been so little analysis of investment matters from an actuarial point of view that there is still a need for further development of and agreement on fundamental principles. Accordingly, this paper is written for the purpose of formulating some simple but basic relationships which depict the manner in which investment return, financial leverage, underwriting results, and the utilization of underwriting capacity (or the so-called insurance exposure) all combine to determine the return to stockholders of an insurance company.

The Choice of the Investment Base

In the Arthur D. Little study of insurance company profits and prices, the issue was raised concerning the choice between total assets (investable funds) or net worth (capital and surplus) as the appropriate investment base for computing rates of return. The study concentrated primarily on return on total investable funds to "overcome the difficulties caused by seasonal variations in assets and differences in debt/equity ratios."[2] It was argued further that from society's point of view the critical measure of return is on total assets since society is the ultimate winner or loser regardless of how the resources in a business venture are financed. While the Little study did present computations of return to net worth, it was admitted that the "study does not present a framework for making a risk/return comparison for returns on net worth."[3] These aspects of the choice of an appropriate in-

[1] The author acknowledges the assistance of Dr. Anthony J. Curley, Assistant Professor of Finance at the University of Pennsylvania, who first introduced the author to certain leverage relationships in non-insurance enterprises and by so doing unintionally stimulated this paper.

[2] *Prices and Profits in the Property and Liability Insurance Industry* (A Report to the American Insurance Association by Arthur D. Little, Inc.), 1968, p. 28.

[3] *Ibid.*, p. 40.

vestment base are subject to debate but an analysis of the objectives and methodology of the Little study is not the purpose of this article. What will be shown, however, is the exact relationship between return on assets and return on equity via the well-known concept of financial leverage.

Total Return on Equity — The Basic Equation

It can be argued sensibly that an insurance company operates with a levered capital structure. The leverage, however, does not result from the use of debt capital,[4] but, instead, is an "insurance leverage" resulting from the deferred nature of insurance liabilities. This concept of insurance leverage can be used to explain in simple terms the relationship between return on assets and return on equity.

For convenience let us establish the following notation:

T — Total after-tax return to the insurer
I — Investment gain or loss (after appropriate tax charges)
U — Underwriting profit or loss (after appropriate tax charges)
P — Premium income
A — Total assets
R — Reserves and other liabilities (excluding equity in unearned premium reserves)
S — Stockholders' equity (capital, surplus, and equity in unearned premium reserve)

Using this notation:

$$\frac{T}{S} = \text{Total return on equity}$$

$$T = I + U \text{ and } S = A - R$$

Therefore: $$\frac{T}{S} = \frac{I + U}{S}$$

or: $$\frac{T}{S} = \frac{A}{A} \cdot \frac{I + U}{S} = \frac{A\,(I + U)}{AS}$$

[4] Recently it has been recommended that property-liability insurance companies be permitted to issue debt obligations to obtain capital. See New York State Insurance Department, *Report of the Special Commitee on Insurance Holding Companies*, 1968, p. 8. It should be recognized that the introduction of true debt into the capital structure may be possible only at interest rates well above an insurer's present cost of capital.

Using simple algebra:

$$\frac{T}{S} = \frac{AI + AU + IR - IR}{AS}$$

$$= \frac{I(A-R)}{AS} + \frac{IR}{AS} + \frac{AU}{AS}$$

$$= \frac{IS}{AS} + \frac{IR}{AS} + \frac{U}{S} \qquad (1)$$

$$= \frac{I}{A} + \frac{IR}{AS} + \frac{U}{S} \cdot \frac{P}{P}$$

finally yields: $$\frac{T}{S} = \frac{I}{A}\left(1 + \frac{R}{S}\right) + \frac{U}{P} \cdot \frac{P}{S} \qquad (2)$$

Hence, we see that the total return to stockholders is equal to the sum of investment return on assets (I/A) multiplied by an insurance leverage factor $(1 + R/S)$ dependent on the size of reserves relative to surplus — plus — the underwriting profit[5] (or minus the underwriting loss) on premiums (U/P) multiplied by an insurance exposure term (P/S) relating premiums to surplus. The formula does not require a mutually exclusive choice between equity or total assets as an investment base but rather clearly points out their interdependence. In fact, the formula contains a third rate of return measure in the form of the U/P ratio, a familiar and traditional benchmark for measuring underwriting results. Thus, in one simple equation we see the relationship among return on equity (the investors' viewpoint), return on assets (society's viewpoint), and return on sales (the regulators' and actuaries' viewpoint).

Formula (2) contains the P/S ratio which is sometimes referred to as the insurance exposure and has been advocated on occasion as a rule-of-thumb indicator of insolvency risk.[6] In the basic formula, however, it can be seen that the P/S ratio and the U/P ratio contribute to the return on equity

[5] Since the primary objective of the formula is to measure return for investors and not regulators, underwriting profit or loss on an adjusted basis would be preferable to statutory results since the former would show more correctly the true incidence of expenses. Whatever adjustment is used, it should reflect the fact that it is the cash flow from underwriting that directly affects the investable assets.

[6] For example, see J. W. Middendorf, II, *Investment Policies of Fire and Casualty Insurance Companies* (New York: Wood, Struthers and Co., 1954), pp. 26–30; and Roger Kenney, *Fundamentals of Fire and Casualty Insurance Strength* (Dedham, Mass.: Kenney Insurance Studies, 1967), pp. 97–102.

in much the same manner as do sales margins multiplied by turnover rates in the analysis of return for manufacturing or merchandising concerns.

Reserves Viewed as Non-Equity Capital

Another interesting aspect of this formulation is revealed by placing it in a different form as follows:

$$\text{from (1)} \quad \frac{T}{S} = \frac{I}{A} + \frac{IR}{AS} + \frac{U}{S} \cdot \frac{R}{R}$$

$$\text{therefore} \quad \frac{T}{S} = \frac{I}{A} + \frac{R}{S} \left(\frac{I}{A} + \frac{U}{R}\right) \tag{3}$$

An interpretation of formula (3) requires that R be viewed as "reserve capital," that is, the amount of total investable assets that has been supplied by other than the owners. In this form the leverage factor R/S is applied separately to interest income on total assets and underwriting profit or loss related to the reserve capital contributed by policyholders. In the case of underwriting losses, formula (3) is plainly analogous to the use of debt capital for financial leverage.[7] With this viewpoint, underwriting losses can be considered as the "interest" that the insurer has paid for the use of R dollars of reserve capital.[8] Naturally, reserve capital differs from the usual debt capital in that with the former the cost of "borrowing" is a variable rather than a fixed interest rate.[9] Formula (3) indicates that it is to the benefit of the owners to continue to write insurance in the event of underwriting losses as long as ratio I/A exceeds the absolute value of a negative ratio U/R. This does not mean that underwriting losses are a desirable objective, but it merely indicates the advantage of continuing to write insurance (ignoring other constraints on cutbacks) during periods of unprofitability. Only when losses make the absolute value of negative U/R larger than I/A does the leverage from the insurance portfolio become unfavorable and detract from the return to stockholders.

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[7] The development of a counterpart of this formula for analysis of leverage through debt financing appears in C. A. Westwick, "A Graphical Treatment of Gearing," *Journal of Accounting Research*, Vol. 4, No. 2, Autumn, 1966.

[8] Similarly, underwriting profits can be viewed as a negative cost of reserve capital.

[9] The bulk of the reserve liabilities obviously are not obligations that extend over durations comparable to long-term debt instruments. They do, however, resemble short- and intermediate-term debt and it can be argued that all forms of indebtedness, regardless of term, should be included in the measurement of leverage. See Ivan R. Woods "Financial 'Leverage' and 'Gearing' in Perspective," reprinted in Edward J. Mock (editor) *Financial Decision Making* (Scranton, Pennsylvania: International Textbook Co., 1967), pp. 533–534.

The Impact of Insurance Leverage

The significant impact of leverage in insurance operations can be illustrated by applying formula (3) to the four hypothetical examples of operating results shown in Table 1.[10] The percentage return on equity as calculated by formula (3) for each company and for each insurance situation is shown in Table 2. While these results can be calculated directly, formula (3) is useful for visualizing in each instance the contribution to or subtraction from the total return on equity resulting from the effect of leverage in the insurance companies. The figures in Table 2 show the increased absolute and relative variability of operating returns that result from increased leverage, and this variability would have been even more significant had the investment rate of return been allowed to vary. Hence, the leverage ratio or the reserve-surplus ratio serves as an indicator or a partial determinant of the riskiness of the owner's investment in the firm.

Actuarial Determination of the Optimum Capital Structure

The preceding view of reserves as leverage-inducing, non-equity capital, if it is accepted, has significant implications for the scope of actuarial analysis. With this view, the actuary, dealing primarily with premiums and reserves, cannot, and indeed should not, ignore one of the fundamental problems in the theory and practice of financial management — the problem of determining the optimal capital structure of the firm.

The problem of finding the optimal composition of liabilities and owners' equity at which the value of a firm will be maximized appears on the surface to be as relevant to a stock insurance company as to any other business enterprise. The two crucial variables that are generally accepted as the determinants of the value of a firm are the expected earning stream and the rate at which that stream is capitalized by the market. It is intuitively obvious and it has been shown in formula (3) that non-equity financing from reserves will add to the income stream as long as the costs of financing the reserves are less than the returns from invested assets. The central issue of the optimal capital structure is the effect of non-equity financing such as reserves on the quality (variance) of the insurer's earnings

[10] The figures in Table 1 are in no sense assumed to be realistic or representative of any one company. They are used only to point out the direction of the impact of the leverage variable and many other considerations have been ignored. For example, nothing has been said about the fact that insurance companies with such diverse leverage ratios are not likely to have identical investment or underwriting results. Also, no attempt is made to discuss the implications of the varied blends of income and gains and losses that can underlie the return on invested assets.

Table 1

Hypothetical Operating Results

Company A: An unlevered investment trust
Invested assets: \$20,000,000
Owners' equity: \$20,000,000
Investment return: 5%
Leverage ratio[3]: 0

Company B: Insurance company — "low" leverage
Invested assets: \$20,000,000
Reserve liabilities[1]: \$6,666,667
Owners' equity[2]: \$13,333,333
Investment return: 5%
Leverage ratio[3]: ½

Company C: Insurance company — "medium" leverage
Invested assets: \$20,000,000
Reserve liabilities[1]: \$10,000,000
Owners' equity[2]: \$10,000,000
Investment return: 5%
Leverage ratio[3]: 1

Company D: Insurance company — "high" leverage
Invested assets: \$20,000,000
Reserve liabilities[1]: \$13,333,333
Owners' equity[2]: \$6,666,667
Investment return: 5%
Leverage ratio[3]: 2

Insurance operating results[4]: Situation 1 — +6% (profit)
Situation 2 — 0% (breakeven)
Situation 3 — −6% (loss)

[1] Excluding equity in unearned premium reserve.
[2] Including equity in unearned premium reserve.
[3] Reserve liabilities divided by owners' equity.
[4] Underwriting profit or loss as a percentage of reserve liabilities.

Table 2

Return on Owners' Equity Based on Data in Table 1

	Company A	Company B	Company C	Company D
Situation 1	5.0%	10.5%	16%	27%
Situation 2	5.0	7.5	10	15
Situation 3	5.0	4.5	4	3

and, hence, on the rate at which the earnings are capitalized by the market for valuation purposes. It is in the determination of the impact of insurance obligations (as reflected in reserves) on the magnitude and variance of future earnings that the talents of the actuary are required. What this suggests is that the actuarial determination of the probability of ruin or insolvency should be extended to include the determination of the probabilities of unfavorable returns to owners and the attendant lowering of market valuation of the company or at the extreme a departure of equity capital from the business.

The analysis of reserve capital (or insurance leverage) is undoubtedly more complicated than the analysis of debt capital. As was stated previously, the cost of the latter is fixed while the former has an expected cost with a variance. Additionally, an increase in the relative amount of debt capital generally entails demands by the creditors for a progressively higher interest rate to reflect the increased risk of larger fixed commitments, but the relative profitability of expanding an insurance portfolio is not as predictable. The ability to reduce the relative variance of underwriting results by sheer volume and logical diversification may offset the costs of taking additional and possibly poorer risks.

The actuarial analysis of the optimal capital structure (or optimum reserve-surplus ratio) of the insurer must also include an analysis of the quality and earning capacity of the assets. One of the major determinants of the amount of non-equity capital that may safely be undertaken by the firm is the degree of variability in the investment earning stream. The traditional position is that the greater the variability of earnings the lower the prescribed debt-equity ratio. Thus, the optimum reserve position for an insurer is not independent of the investment policy that is followed.

Of what practical application is an analysis of the optimal capital structure of a property and liability insurer? If the industry does have a capacity problem from the insuring public's viewpoint, it may be explained by a capital structure that from an investor's viewpoint is optimal at a relatively low reserve/surplus ratio. Furthermore, one can inquire whether a capacity problem is attributable only in part to rating formulas and/or regulation and is affected also by overly aggressive investment portfolios that set the optimal capital structure at a relatively low reserve/surplus ratio. Alternatively, and in the author's opinion more realistically, if the optimal capital structure is at a higher reserve/surplus ratio than is maintained currently in the typical company, then one might conclude that the industry is over-capitalized with investor capital. This situation would explain the financial motivation behind the recent emphasis on holding-company formations to absorb insurance company capital. Interestingly, the fact that investor capital might be in excess appears to have been overlooked or ignored as a possible logical explanation of the general unprofitability alleged by the Arthur D. Little study of prices and profits.

Conclusions

If present regulatory and financial trends continue, the actuary is going to be forced to narrow the analytical gap between the insurance and investment sides of the business.[11] The arguments presented here reinforce the position that investment return can no longer be ignored by the actuary, but they do not prescribe the manner in which investment should be included in the current ratemaking process. It is suggested that somehow simply plugging a rate of return into current ratemaking formulas is too narrow an approach. Once the actuary introduces investment returns into his analysis, he must logically be concerned with the rather broad financial management objectives affecting total performance of the firm. The basic formulas derived in this paper show the role that the insurance operations play in the over-all determination of total return to stockholders. According to financial theory, it is this return that management should be attempting to maximize. It appears, however, that management in general, and actuaries in particular, have been over-zealous in addressing themselves to regulators rather than the shareholders. In order to remedy this imbalance, current techniques of ratemaking and rate regulation may have to undergo traumatic procedural and philosophical changes to properly accommodate the introduction of investment considerations into the ratemaking process. Perhaps the only solution with enough flexibility is a system of open competition.

[11] The existence of this separation was described to this Society in S. Davidson Herron, Jr., "Insurance Company Investment," *Proceedings of the Casualty Actuarial Society*, 1966, pp. 238–239.

FUNDING THEORIES FOR SOCIAL INSURANCE

JAMES C. HICKMAN

Within the social sciences the influence of Paul Samuelson, the MIT economist, is almost omnipresent. The majority of fledgling students of economics learn the rudiments of the subject from a textbook he has written. Technical papers he has penned have appeared in most of the major journals devoted to economics, political science, or statistics. Readers of the popular magazine Newsweek have grown accustomed to his periodic essays on current political and economic topics. One of these essays, "Social Security,"[1] was devoted to making the point that because of the growth of population and of real per capita income, the participants in a social insurance system which involves transfer payments from active to retired workers will receive more in benefits than they will contribute in social insurance taxes which are set on a pay-as-you-go level. In an earlier technical paper Samuelson had discussed the same idea.[2]

Henry Aaron has further formalized this idea in the form of a theorem.[3] Aaron's paper containing this theorem was reprinted in a compendium of papers on policy issues in public and private pension systems published for the use of the Joint Economic Committee of Congress.[3] Therefore, presumably, Aaron's theorem is better known at the center of political power than are most such formal propositions. To label a statement a theorem seems to sanctify it, to place it on a plane above controversy, and to thereby silence anyone who would question its eternal truth. Because the proof of Aaron's theorem is a simple exercise in actuarial mathematics, and because actuaries have a professional interest in social insurance, it seems appropriate to record the theorem and a modified proof in actuarial literature. A few of the developments in the proof are closely related to some found in a paper by Nowlin.[4]

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[1] Samuelson, Paul "Social Security," *Newsweek*, Feb. 13, 1967.

[2] Samuelson, Paul, "An Exact Consumption-Loan Model of Interest With or Without a Social Contrivance of Money," *Journal of Political Economy*. Vol. 66 (1958).

[3] Aaron, Henry, "The Social Insurance Paradox," *Canadian Journal of Economics and Political Science*, Vol. 32 (1966). Reprinted in Old Age Assurance, A Compendium of Papers on Problems and Policy Issues in the Public and Private Pension System, Part V: Financial Aspects of Pension Plans, submitted to the Subcommittee on Fiscal Policy of the Joint Economic Committee, Congress of the United States.

[4] Nowlin, Paul, "Insufficient Premiums," *Transactions, Society of Actuaries*, Vol. 11 (1959).

Theorem. If the annual rate of growth in the number of entrants into the working population plus the annual rate of growth of real average wages exceeds the annual rate of interest, which is assumed equal to the marginal rate of time preferences and the marginal rate of transformation of present into future goods, then the introduction of social insurance pensions equal to current average real wages on a pay-as-you-go funding basis will improve the expected welfare position of persons in the population who receive average real wages.

This statement of the theorem indicates that the conclusion is concerned with *expected* results for a person with *average* income. Aaron did not place this emphasis in his original statement. Those with above average incomes may not individually fare so well because of the average benefits paid retired workers.

Proof. We will adopt a continuous model and the following notation and assumptions.

1. The symbol $s(x)$ will denote the survival function for the population under consideration. We will assume that $s(x) = 0$ when x is greater than some finite limiting age.
2. The symbol h will denote the annual rate of increase of the average of the real wages paid those in the working population. This rate is assumed to be constant.
3. The symbol g will denote the annual rate of increase in the number entering the working population each year. This rate is assumed to be constant.
4. The average age of entry into the working population will be denoted by a and the average age of retirement will be denoted by r.
5. The annual rate of interest (force of interest) will be denoted by δ and it will be assumed that this rate is equal to the marginal rate of time preference and the marginal rate of transformation of present into future goods. This rate is also assumed to be constant.

The expected number in the working and retired populations at time t, where t is greater than the limiting age less the average age of entry, is denoted by $P(t)$ and is given by

$$P(t) = k\int_a^r e^{-(x-a)g+gt}[s(x)/s(a)]dx + k\int_r^\infty e^{-(x-a)g+gt}[s(x)/s(a)]dx,$$

where k is the annual rate of entry into the working population at an arbitrary starting time designated at time zero. The first integral in this expression represents the expected number in the working population and the second integral represents the expected retired population. Note that the same expected population would be achieved at time t by a constant increase in the survival function for each entering cohort at a constant annual rate g, as would be obtained by assuming a corresponding annual increase in the rate at which entrants come into the working population.

The expected total amount of wages to be received by a person who enters the work force at time t is denoted by $W(t)$ and is given by

$$W(t) = W(O) \int_a^r e^{h(x-a)+ht}[s(x)/s(a)]dx,$$

where $W(O)$ is the average annual wage rate at time zero.

The expected amount of benefits to be received by a person who enters the work force at time t, if benefits are paid at a rate equal to current average real wages, will be denoted by $R(t)$ and will be given by

$$R(t) = W(O) \int_r^\infty e^{h(x-a)+ht}[s(x)/s(a)]dx.$$

The constant payroll tax rate needed to fund, on a pay-as-you-go funding basis, the benefit payments is denoted by the symbol f and is given by

$$f = \frac{\int_r^\infty e^{-(x-a)g+gt+ht}[s(x)/s(a)]dx}{\int_a^r e^{-(x-a)g+gt+ht}[s(x)/s(a)]dx}$$

$$= \frac{\int_r^\infty e^{-gx}s(x)dx}{\int_a^r e^{-gx}s(x)dx} = \frac{{}_{r-a|}\bar{a}_a}{\bar{a}_{a:\overline{r-a}|}}$$

where the life annuity symbols are valued at force of interest g.

The expected accumulated value of taxes, at age r, paid by a worker who enters at time t is denoted by $C(t)$ and is given by

$$C(t) = fW(O) \int_a^r e^{(x-a)h+ht+(r-x)\delta}[s(x)/s(r)]dx.$$

The phrase "expected accumulated value" used in the definition of $C(t)$ does not imply the accumulation of a fund in this pay-as-you-go scheme. Rather the phrase uses the word "value" in a more subjective sense. The symbol $C(t)$ denotes the expected value, at age r, for decision making purposes that a person with marginal rate of time preference δ would attach to the taxes he is required to pay for a social insurance program.

The present expected value, valued at age r, of benefits paid to a worker who enters the program at time t is denoted by $B(t)$ and is given by

$$B(t) = W(O)\int_r^\infty e^{(x-a)h+ht-\delta(x-r)}[s(x)/s(r)]dx.$$

For an average participant we seek to determine which of the relationships $B(t) > C(t)$, $B(t) = C(t)$ or $B(t) < C(t)$ holds. The relationships $B(t) \gtreqless C(t)$ are equivalent to

$$\frac{\int_r^\infty e^{(x-a)h-(x-r)\delta}s(x)dx}{\int_r^\infty e^{-gx}s(x)dx} \gtreqless \frac{\int_a^r e^{(x-a)h-(x-r)\delta}s(x)dx}{\int_a^r e^{-gx}s(x)dx}.$$

We denote the right hand term of this expression by $R_1(\delta)$ and the left hand term by $L_1(\delta)$ and we note that the relationships indicated by $B(t) \gtreqless C(t)$ are equivalent to $L_1(\delta) \gtreqless R_1(\delta)$. We observe that $L_1(g+h) = R_1(g+h)$, therefore, if $\delta = g+h$ then $B(t) = C(t)$. Because $d\ L_1(\delta)/d\delta < O$ and $d\ R_1(\delta)/d\delta > O$, we have that if $\delta < g+h$, then $L_1(\delta) > R_1(\delta)$ and $B(t) > C(t)$, and if $\delta > g+h$, then $L_1(\delta) < R_1(\delta)$ and $B(t) < C(t)$. We may verbalize this result by saying that for a person with average real wage level, if $\delta < g+h$, then the present expected value of his social insurance benefits exceeds the expected accumulated value of the required social insurance taxes. On the other hand, if $\delta > g+h$, then this pay-as-you-go social insurance system is a poor bargain for him.

This result is intuitively obvious to most actuaries and they would probably accept the conclusion without a mathematical development. The theorem simply states the technical conditions for the success of an assessment system. At the Seventeenth International Actuarial Congress, several papers discussed "assessmentism" as a funding method for pension programs.[5,6,7] The direct transferring of income from the current working generation, with the benefits tied to current living standards, is related to the "repartition" system developed for private pensions in France.[8]

In commenting on his theorem, Aaron makes the following acknowledgment: "If savings and, hence, investment and, hence, the rate of growth of income are reduced as the level of social insurance increases, this conclusion does not necessarily follow." This possibility is, in fact, a very critical factor to consider in drawing any public policy conclusions from Aaron's theorem. Nevertheless, the tone of Aaron's paper is such that it is natural to infer that the conventional economic assumption is that, in fact, $\delta < g + h$ and therefore $B(t) > C(t)$. However, it would be wise to point out that on our finite planet we cannot tolerate, for any extended period of time, a rate of increase in the working population (g) other than zero. Hopefully the rate of increase in real income (h) will remain positive, although historically it has tended to average out at only around three per cent. On the other hand δ, the force of interest, which is assumed in this theorem to be the marginal rate of time preference may be, for at least certain members of the working population, relatively high. For example, the economic behavior of many young people in not taking advantage of potentially valuable educational opportunities and in acquiring current goods through expensive installment plans indicates that their preference for current goods may be very high.

The thrust of these remarks is not to refute Aaron's theorem, for it is quite valid. Rather the remarks are intended to indicate the limited scope of the theorem and to stress that it is seldom possible to justify a broad and long-term public program by a strictly formal chain of reasoning.

Robert J. Myers, Chief Actuary, Social Security Administration, has written a penetrating review of Aaron's paper.[9] Myers has provided a guide to some technical errors in the original paper and raises some interesting points concerning the economic reasoning that Aaron followed.

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[5] Hagstroem, K. G., "National Pension Schemes: Necessity of Investment," *Transactions, 17th International Congress of Actuaries,* Vol. 3.

[6] Kaikkonen, M., "Pensions and the Cost of Living in Finland," *Transactions, 17th International Congress of Actuaries,* Vol. 3.

[7] Mazoué, L., "Variations in Retirement Pension Schemes in France under the Influence of Monetary Instability," *Transactions, 17th International Congress of Actuaries,* Vol. 3.

[8] Dyer, J. K., "Variable Pensions: An International Survey," *Proceedings of the Conference of Actuaries in Public Practice,* Vol. 16 (1966–67).

[9] Myers, Robert. J., "Review of 'The Social Insurance Paradox,'" *Transactions, Society of Actuaries,* Vol. 20 (1968).

It is instructive at this point to examine a similar development in which a distinction is made between δ, the marginal rate of time preference, and δ', the marginal rate of transforming present goods into future goods. We shall determine a social insurance payroll tax rate by the principle of equivalence.

That is, we will set the present expected value of benefits at the average wage level, equal to the present expected value of payroll taxes for each individual. This tax rate will be analogous to an entry age normal rate in the momenclature of pension funding. In this case we are dealing with a financial system which may generate a fund which will earn interest at a continuous annual rate δ'. The tax rate, denoted by n, applicable to those who enter the working population at time t turns out to be independent of t and given by

$$n = \frac{\int_r^{\infty} (e^{gt+[t+(r-a)]h+(x-r)h-(x-r)\delta'})s(x)dx}{\int_a^r (e^{gt+[t+(x-a)]h+(r-x)\delta'})s(x)dx}$$

$$= \frac{\int_r^{\infty} (e^{-(\delta'-h)x})s(x)dx}{\int_a^r (e^{-(\delta'-h)x})s(x)dx} = \frac{{}_{r-a|}\bar{a}_a}{\bar{a}_{a:\overline{r-a}|}},$$

where the life annuities are evaluated at force of interest $\delta' - \mathrm{h}$. The accumulated expected value at age r of contributions at rate n of real wages for a person entering the working population at time t will be denoted by $Y(t)$ and is given by

$$Y(t) = nW(O)\int_a^r (e^{(x-a)h+th+\delta(r-x)})s(x)/s(r))dx.$$

Once again the amount $Y(t)$ does not represent an expected individual reserve fund; rather it is the value at age r, for decision making purposes, that a person with marginal rate of time preferences δ would attach to the taxes that he has paid for the social insurance plan. If δ' replaces δ in the integral which defines $Y(t)$, the result would be the expected fund at age r for a life which entered at time t and survived until age r. The factor $e^{[(x-a)+t]h}$ plays the role of a salary scale in conventional pension mathematics.

It remains to determine if $B(t) > Y(t)$, $B(t) = Y(t)$ or $B(t) < Y(t)$. The relationships $B(t) \gtreqless Y(t)$ are equivalent to

$$\frac{\int_r^\infty (e^{(x-a)h-(x-r)\delta})s(x)dx}{\int_r^\infty (e^{-(\delta'-h)x})s(x)dx} \gtreqless \frac{\int_a^r (e^{(x-a)h-(r-r)\delta})s(x)dx}{\int_a^r (e^{-(\delta'-h)x})s(x)dx}$$

We denote the right hand term of this expression by $R_2(\delta)$ and the left hand term by $L_2(\delta)$ and observe that if $\delta = \delta'$, then $R_2(\delta) = L_2(\delta)$ and $B(t) = Y(t)$. Because $d\ L_2(\delta)/d\delta < O$ and $d\ R_2(\delta)/d\delta > O$, we have that if $\delta < \delta'$, then $L_2(\delta) > R_2(\delta)$ and $B(t) > Y(t)$, and if $\delta < \delta'$, then $L_2(\delta) > R_2(\delta)$ and $B(t) > Y(t)$. Once again this result conforms to what our actuarial intuition would indicate; if the marginal rate of time preference is less than the marginal rate at which present goods may be transformed into future goods, the expected value of social insurance benefits exceeds the expected value of the associated taxes when these taxes are determined by the principle of equivalence. If the marginal time preference rate is greater, the converse value judgment would hold.

A final interesting comparison is between the expected accumulated value of taxes under the pay-as-you-go funding plan $(C(t))$ and under what is essentially an entry age normal funding plan. We seek to determine whether $C(t) > Y(t)$, $C(t) = Y(t)$ or $C(t) < Y(t)$ holds. The relationships $C(t) \gtreqless Y(t)$ are equivalent to the relationships $f \gtreqless n$ which in turn are equivalent to

$$\left.\frac{{}_{r-a|}\bar{a}_a}{\bar{a}_{a:\overline{r-a|}}}\right|_g \gtreqless \left.\frac{{}_{r-a|}\bar{a}_a}{\bar{a}_{a:\overline{r-a|}}}\right|_{\delta'-h}$$

where the bar symbol is intended to indicate that the left hand member of the relationships is valued at force of interest g and the right hand member is valued at force of interest $\delta' - h$.

It comes as no surprise that if $g = \delta' - h$, then $f = n$ and $C(t) = Y(t)$. Because the derivative of ${}_{r-a|}\bar{a}_a/\bar{a}_{a:\overline{r-a|}}$, with respect to the force of interest is negative, we may conclude that if $g > \delta' - h$, then $C(t) < Y(t)$ and if $g < \delta' - h$, $C(t) > Y(t)$. That is, if the population growth rate exceeds the marginal rate of transformation of present goods into future goods less the rate of increase in average real wages, then the expected value of taxes required on an individual under pay-as-you-go funding is less than that required by entry age normal funding. If the rate of population growth is less than the marginal rate of transformation of present goods into future goods minus the rate of growth of real wages, the entry age normal type of funding appears to be more favorable when judged by the size of the expected accumulated amount of social insurance taxes.

These developments are summarized in the following table:

	If	Then
(1)	$\delta < \delta' < g + h$	$C < Y < B$
(2)	$\delta < g + h < \delta'$	$Y < C < B$
(3)	$g + h < \delta < \delta'$	$Y < B < C$
(4)	$g + h < \delta' < \delta$	$B < Y < C$
(5)	$\delta' < g + h < \delta$	$B < C < Y$
(6)	$\delta' < \delta < g + h$	$C < B < Y$

Symbols

δ = Annual marginal rate of time preference

δ' = Annual marginal rate of transformation between present and future goods

g = Annual rate of increase in the rate at which new entrants come into the working population

h = Annual rate of increase in average real wage rate

C = Accumulated expected value at age r of payroll taxes on a pay-as-you-go funding method

Y = Accumulated expected value at age r of payroll taxes on an entry age normal funding method

B = Present expected value of social insurance benefits at age r

Inequality (1), in which the marginal time preference rate is less than the marginal rate of transformation between present and future goods, tends to support a social insurance system funded on a pay-as-you go basis. Inequality (2) on the other hand, in which marginal rate of transformation of present into future goods is high, tends to support a social insurance system with entry age normal funding. Inequality (3) supports entry-age normal funding as the only economic alternative. Inequalities (4) and (5), in which the time preference rate is relatively high, imply that a social insurance system would be an uneconomic innovation. Inequality (6), in which there is a low marginal rate of transformation, indicates that pay-as-you go funding would conform to the value judgment of the average worker.

The situations described in these inequalities, in which the marginal rate of time preferences is not equal to the marginal rate of transformation of present into future goods, are not in economic equilibrium. Classical economic theory describes the market forces which tend to push these two rates together. The practical answer to these possible objections to the results exhibited in the foregoing table, based on the disequilibrium of the interest rates, is that even in a free market economy there are forces at work which tend to disturb perfect equilibrium. In fact, part of the explanation for the driving force in a competitive economy may come from the fact that the marginal rate of time preferences for many persons exceeds the marginal rate at which present goods may be transformed into future goods. Even in an economy which is at approximate equilibrium position, there will probably be groups within the economy for which each of the inequalities in the table is a reality.

Of course these formal results simply reinforce conventional actuarial wisdom about the characteristics of various funding methods for social insurance systems. However, before becoming smug about this reinforcement, we should recall the rather artificial nature of the static assumptions made in this demonstration. In the real world probably no particular order relation among the rates under study would remain unchanged over a number of years. Indeed, it is practically impossible for some of the rates to remain positive indefinitely. The results exhibited in the table were obtained by averaging. In fact very different inequalities might be obtained for subpopulations whose real wages are not average. All that these results can do is to provide an analytic machine which may be helpful in examining proposals for social insurance programs. Social insurance programs evolve as a result of practical political compromises rather than abstract reasoning. However, it is our professional actuarial responsibility to examine by analytic methods the economic implications of proposed social insurance programs.

MINUTES OF THE 1968 ANNUAL MEETING

November 17-19, 1968

MARRIOTT MOTOR HOTEL, WASHINGTON, D. C.

On November 17, prior to the formal convening of the Annual Meeting on the following date, the Council met at the Marriott Hotel from 2:00 p.m. to 5:00 p.m.

On the evening of November 17, the Council sponsored an extra-curricular "get acquainted" reception hour for the new members and their wives who, later during the Annual Meeting, would be presented with Fellowship diplomas.

The 1968 Annual Meeting was formally convened at 9:00 a.m. on November 18 by President Harold W. Schloss who welcomed the gathering and then introduced Mrs. Margaret Haywood, Member of the City Council of the District, representing Mayor Walter E. Washington who was unable, because of the pressure of his official duties, to be with us as planned.

Mrs. Haywood welcomed the gathering to the city and presented, at some length, her views on urban problems with particular reference to the city of Washington.

President Schloss then delivered his Presidential Address which appears in the present *Proceedings* of the CAS.

Vice President Daniel J. McNamara then assumed the Chair and introduced the scheduled discussions, in the following order, of three "Topical Actuarial Subjects":

I "The Role of the Casualty Actuarial Society in Industry Affairs. What is the CAS position when queried on insurance matters that are being publicly discussed?" Discussion leaders:

Daniel J. McNamara, Assistant General Manager, Insurance Rating Board and Paul S. Liscord, Vice President and Actuary, The Travelers Insurance Companies.

II "Education and Examination of Future Actuaries. What should future actuaries know and how should they be tested?" Discussion leaders:

Norman J. Bennett, Assistant Secretary and Actuary, Continental Insurance Companies and Richard L. Johe, Vice President and Actuary, United States Fidelity and Guaranty Company.

III "The Federal Government, Fair Plans and Flood Insurance. What are the mechanics and how will they work?" Discussion leaders: Philip G. Buffinton, Vice President, State Farm Fire and Casualty Company and Frederic J. Hunt, Jr., Assistant Secretary, Insurance Company of North America.

After a short coffee break, three concurrent seminars on the above topics were held with the previously named discussion leaders presiding over their individual seminars.

Adjournment was then taken for lunch.

At the luncheon the guest speaker was James H. Hunt, Consultant to the Federal Insurance Administration and Commissioner of Banking and Insurance for the State of Vermont.

The meeting reconvened at 2:30 p.m. under the chairmanship of Vice President McNamara who introduced Past CAS President Thomas E. Murrin, Senior Vice President of the Fireman's Fund American Insurance Companies who was to act as Moderator of the scheduled Panel "An Executive View of the Insurance Scene."

Mr. Murrin introduced the panelists:

Charles C. Cox, President, Insurance Company of North America;

Harold E. Curry, Past President of the CAS and Senior Vice President, State Farm Mutual Automobile Insurance Company;

John W. Joanis, President, Sentry Insurance Group;

Seymour E. Smith, Past President of the CAS and Senior Vice President, The Travelers Insurance Companies.

After the conclusion of their individual presentations, the panelists directed questions to other members of the panel and then numerous questions were directed to the panelists by members of the audience.

The November 17 session of the CAS recessed at 4:45 p.m. after which several committee meetings which had been called by the respective chairmen were held.

In the evening there was a social hour followed by a Society banquet.

Immediately after the banquet the gathering was favored with the surprise presentation of a skit "Son of Of All Sad Words, A Property-Liability Play with Decreasing Credibility," written by Matthew Rodermund and produced by the Special Entertainment Committee, Ruth E. Salzmann, William J. Hazam, and Matthew Rodermund. In view of the great enthusiasm with which this skit was received by the audience it is deemed desirable that at least the names of the cast be recorded for posterity in the order of their appearance:

Harold W. Schloss
Allen L. Mayerson
Luther L. Tarbell, Jr.
Charles C. Hewitt, Jr.
Charles L. Niles, Jr.
John R. Bevan
John H. Muetterties
Norman J. Bennett
Jack Moseley
Robert L. Hurley
Dunbar R. Uhthoff

The meeting reconvened at 9:00 a.m. on November 19, President Schloss presiding.

The Secretary-Treasurer announced that a quorum was present.

The gathering then stood in a minute of silence in memory of recently deceased members:

William Breiby
Paul Dorweiler
William F. Dowling
Harold S. Spencer

It was voted to dispense with the reading of the minutes of the May 1968 meeting, which will appear in the *Proceedings*.

The Secretary then reported on actions by the Council since the 1967 Annual Meeting and also on the financial results for the 12 month fiscal period ended September 30, 1968. The Secretary-Treasurer's Report is attached hereto and made a part of the minutes.

President Schloss then presented diplomas to the following 20 new Associates and 6 new Fellows:

ASSOCIATES

Bartik, Robert F.
Beckman, Raymond W., III
Bergen, Robert D.
Comey, Dale R.
Eyers, Robert G.
Ferguson, Ronald E.
Fossa, E. Frederick
French, James T.
Grady, David J.
Hardy, Howard R.
Hartman, David G.
Jones, Del R.*
Jorve, Barry M.
Klingman, George C.
Linquanti, August J.
Lyon, Linda C.
Moore, James E.*
Nelson, John K.
Spitzer, Charles R.
White, William D.

* In absentia

FELLOWS

Ben-Zvi, Phillip N.	Hachemeister, Charles A.	Ryan, Kevin M.
Bland, William H.	Naffziger, Joseph V.	Sturgis, Robert W.

Past President Norton E. Masterson, Secretary of ASTIN, reported to the gathering on recent activities of ASTIN.

Daniel J. McNamara reported on recent activities of the American Academy.

President Schloss reported that the CAS had been named as one of the beneficiaries under the will of the late Paul Dorweiler and that such will is now in the process of probate.

President Schloss also announced that the Woodward-Fondiller prize had been awarded to Charles F. Cook, Associate Actuary, General Accident Group, for his paper "The Minimum Absolute Deviation Trend Line."

The next order of business was the election of President, two Vice Presidents, Secretary-Treasurer, and three members of the Council, with the following elected:

President	William J. Hazam
Vice President	Daniel J. McNamara
Vice President	Richard L. Johe
Secretary-Treasurer	Albert Z. Skelding
Members of Council	M. Stanley Hughey Paul S. Liscord Jack Moseley

The membership, acting under the provisions of Article V of the Constitution, voted to ratify the following re-elections made by the Council:

Editor	Matthew Rodermund
Librarian	Richard Lino
General Chairman — Examination Committee	Norman J. Bennett

At this point Vice President Hazam assumed the Chair.

Reviews of previous papers and presentation of new papers followed:

Reviews

(1) "Rate Regulation and The Casualty Actuary — Revisited," by Gerald R. Hartman and Jeffrey T. Lange. Review by Harry T. Byrne — presented in absentia by Walter J. Fitzgibbon, Jr.

(2) "Economic Factors in Liability and Property Insurance Claims Costs 1935-1967," by Norton E. Masterson. Reviewed separately by Edward M. Smith (presented in absentia by Harry R. Richards), Richard D. McClure, John F. O'Leary, Jr., Jeffrey T. Lange.

(3) "Total Earnings from Insurance Operations — The Investors Viewpoint," by Russell P. Goddard. Reviewed separately by Frank Harwayne, James J. Meenaghan.

New Papers

(1) "The Credibility of the Pure Premium," by Allen L. Mayerson, Donald A. Jones, and Newton L. Bowers, Jr. Presentation made by Allen L. Mayerson.

(2) "The Capital Investment Market and the Insurance Industry," by R. J. Balcarek.

(3) "An Actuarial Note on Actuarial Notation," by Jeffrey T. Lange.

(4) "Elements of Time-Series Analysis in Liability and Property Insurance Ratemaking," by John S. McGuinness.

(5) "A Review of Nuclear Energy Insurance," by Richard D. McClure.

(6) "The Relationship of Underwriting, Investments, Leverage, and Exposure to Total Return on Owner's Equity," by J. Robert Ferrari.

(7) "Funding Theories of Social Insurance," by James C. Hickman. Presented in absentia by Norman J. Bennett.

The foregoing concluded the scheduled program and the Annual Meeting adjourned 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 35 wives, attendance by 89 Fellows, 65 Associates and 21 Invited Guests, as follows:

FELLOWS

Alexander, L. M.	Bornhuetter, R. L.	Drobisch, M. R.
Balcarek, R. J.	Boyajian, J. H.	Dropkin, L. B.
Bennett, N. J.	Cook, C. F.	Elliott, G. B.
Ben-Zvi, P. N.	Crandall, W. H.	Finnegan, J. H.
Berquist, J. R.	Curry, A. C.	Fitzgibbon, W. J., Jr.
Bevan, J. R.	Curry, H. E.	Flaherty, D. J.
Bland, W. H.	DeMelio, J. J.	Gibson, J. A.

FELLOWS

Gillam, W. S.
Gillespie, J. E.
Goddard, R. P.
Graham, C. M.
Hachemeister, C. A.
Harwayne, F.
Hart, W. Van B., Jr.
Hazam, W. J.
Hewitt, C. C., Jr.
Hope, F. J.
Hunt, F. J., Jr.
Hurley, R. L.
Johe, R. L.
Klaassen, E. J.
Lange, J. T.
Leslie, W., Jr.
Linden, J. R.
Liscord, P. S.
Longley-Cook, L. H.
MacGinnitie, W. J.
MacKeen, H. E.
Masterson, N. E.
Mayerson, A. L.
McClure, R. D.
McGuinness, J. S.
McNamara, D. J.
Meenaghan, J. J.
Menzel, H. W.
Mohnblatt, A. S.
Morison, G. D.
Moseley, J.
Muetterties, J. H.
Murrin, T. E.
Myers, R. J.
Naffziger, J. V.
Niles, C. L., Jr.
Oien, R. G.
Otteson, P. M.
Perkins, W. J.
Petz, E. F.
Phillips, H. J.
Pollack, R.
Portermain, N. W.
Richards, H. R.
Riddlesworth, W. A.
Roberts, L. H.
Rodermund, M.
Roth, R. J.
Ruchlis, E.
Ryan, K. M.
Salzmann, R. E.
Scheibl, J. A.
Schloss, H. W.
Scott, B. E.
Simon, L. J.
Skelding, A. Z.
Smith, S. E.
Sturgis, R. W.
Switzer, V. J.
Tarbell, L. L., Jr.
Trudeau, D. E.
Uhthoff, D. R.
Valerius, N. M.
Walsh, A. J.
Webb, B. L.
Williams, D. G.
Williamson, W. R.
Wilson, J. C.

ASSOCIATES

Adler, M.
Atwood, C. R.
Bartik, R. F.
Beckman, R. W.
Bergen, R. D.
Bickerstaff, D. R.
Brian, R. A.
Buffinton, P. G.
Carter, E. J.
Chorpita, F.
Comey, D. R.
Copestakes, A. D.
Crawford, W. H.
Davis, R. C.
Durkin, J. H.
Eyers, R. G.
Faber, J. A.
Ferguson, R. E.
Ferrari, J. R.
Flack, P. R.
Fossa, E. F.
Franklin, N. M.
French, J. T.
Gill, J. F.
Gossrow, R. W.
Gowdy, R. C.
Grady, D. J.
Harack, J.
Hardy, H. R.
Hartman, D. G.
Heer, E. L.
Hunter, J. R.
Jacobs, T. S.
Jones, D. R.
Jorve, B. M.
Kilbourne, F. W.
Klingman, G. C.
Linquanti, A. J.
Lowe, R. F.
Lyon, L. C.
McIntosh, K. L.
Mokros, B. F.
Moore, J. E.
Munro, R. E.
Nelson, J. K.
Perreault, S. L.
Plunkett, J. A.
Raid, G. A.
Ratnaswamy, R.
Richardson, J. F.
Scammon, L. W.
Scheel, P. J.
Scheid, J. E.
Singer, P. E.
Spitzer, C. R.
Stern, P. K.
Stevens, W. A.

ASSOCIATES

Trees, J. S.
Walters, M. A.
Walters, M. A.
Welch, J. P.
White, W. D.
Wooddy, J. C.
Young, R. G.
Zory, P. B.

GUESTS

*Battaglin, B. H.
*Blanc, R.
Connolly, C. T.
Cox, C. C.
Eddins, J. M.
Foody, W.
Gamble, R. A.
*Hayden, R. C.
*Hazelwood, G. L., Jr.
*Hewey, H. V.
Hunt, J. H.
Joanis, J. W.
*Kedrow, W. M.
Knox, F.
*Nagel, J. R.
O'Leary, J. F., Jr.
*O'Shea, H. J.
*Peery, G. A.
Redd, T. B.
Smith, C. F.
Walsh, J. E.

* Invitational Program

Respectfully submitted,

A. Z. SKELDING,
Secretary-Treasurer

REPORT OF THE SECRETARY-TREASURER

Subsequent to the 1967 Annual Meeting of the Society the Council took the following actions:

Meeting of January 30, 1968

Adopted the revised Syllabus and "Recommendations for Study" recommended by the Education Committee to become effective with the May 1969 examinations.

Voted that the Casualty Actuarial Society join with the Society of Actuaries as co-sponsors of an "Actuarial Conference on Simulation" to be held at Duke University, October 31, through November 2, 1968, subject to a maximum contribution of $250 by the CAS.

Meeting of May 19, 1968

Reviewed the previously issued "Guidelines" to the Nominating Committee and reaffirmed them to be applicable to the November 1968 elections.

Reviewed the Invitational Program procedures and reaffirmed them.

Voted that our organizational membership dues in the Insurance Society of New York, largely for the maintenance of the CAS library, be increased to $300 from the then present $150. Also adopted certain revised borrowing procedures from the library, which are printed in the current Year Book.

Voted that, upon request, the Secretary-Treasurer, will furnish one copy, per inquiring employer, of the names and addresses of students registering for Parts 1 and 2 of the examinations. Similar information would not be furnished for other parts of the examinations or with respect to those who had already attained the status of Associate or Fellow, except as set forth in the Year Book.

Meeting of September 17, 1968

Voted that the Committee on Sites be retained as a permanent committee of the CAS and that the Committee explore the following sites as possibilities and report back to the Council:

Spring Meetings	Fall Meetings
1971 — Greenbrier, West Virginia	1971 — Philadelphia, Pa.
1972 — Lake Geneva, Wisconsin	1972 — Boston, Massachusetts
1973 — Catskill, New York State	1973 — Ann Arbor, Michigan
	1974 — New York City
	1975 — Chicago, Illinois
	1976 — Hartford, Connecticut
	1977 — Dallas, Texas

Voted to accept, subject to a final report, the recommendations of the Temporary Committee to Review the Education and Examination Functions of the Society. Perhaps the most important feature of that report is a recommendation for consolidation of the Examination and Education Committees.

Adopted guidelines relating to election procedures.

Meeting of November 17, 1968

Voted to adopt the revised Report of the Temporary Committee to Review the Education and Examination Functions of the Society, Harold E. Curry, Chairman. This report provided, in part, for the consolidation of the Education and Examination Committees under one General Chairman, with separate chairmen for the Examination and Education sections.

The foregoing, in the interest of brevity, is confined to what are deemed to be the more important actions of the Council.

Copies of the Financial Report of the Secretary-Treasurer for the 12 month fiscal period ending September 30 are available at the registration desk. In summary that report shows that income exceeded disbursements by $3,646.53.

(The Financial Report is printed on the following page of these *Proceedings*. — Ed.)

It will be noted that as of September 30, 1968 the assets of the Society consisted of

Cash in checking account	$ 8,418.10
Cash in savings account	4,403.26
Investments	18,992.57
Total	$31,813.93

It is anticipated that a large part of the surplus funds in the checking account will be used to purchase interest bearing securities.

FINANCIAL REPORT

Income and Disbursements

from October 1, 1967 through September 30, 1968

Income		Disbursements	
Members dues	$12,615.00	Printing and stationery	$15,700.09
Examination fees	5,015.95	Secretary's office	2,400.00
Sale of *Proceedings*	1,524.72	Examination expense	2,148.64
Sale of Readings	395.05	Meeting expense	3,069.82
Spring and annual meetings	1,262.69	Library fund	65.19
Registration fees	3,220.00	Insurance	100.00
Invitational program	1,680.00	To Actuaries' Club N. Y.	1,000.00
Bond interest	437.51	Accrued interest on bonds purchased	168.75
Savings account interest:		Investment expense	37.00
Bowery	396.33	Insurance Society of N. Y.	300.00
Chase	264.71	Memorial to Paul Dorweiler	25.00
Michelbacher Fund	836.45	International Congress	25.00
For Actuaries' Club N. Y.	1,050.00	Miscellaneous	30.39
Salvage	18.00		
Total	$28,716.41	Total	$25,069.88

Assets

As of 10-1-67		As of 9-30-68		GAIN
Checking account	$ 5,416.04	Checking account	$ 8,418.10	$ 3,002.06
Bowery Savings	9,006.93	Bowery Savings	4,403.26	—4,603.67
Chase Savings	8,744.43	Chase Savings	—	—8,744.43
Investments	5,000.00	Investments	18,992.57	13,992.57
Total	$28,167.40	Total	$31,813.93	$ 3,646.53

(Accumulation of Michelbacher Fund: $18,405.67 + $836.45 = $19,242.12)

All investments are carried at cost except the two $1,000 U. S. Treasury Bonds due November 15, 1974 which are carried at the maturity value of $2,000.00.

Investments

Two U. S. Treasury Bonds 3 ⅞ % Nos. 1673-4 due November 15, 1974 for $1,000 each.

Three $1,000 U. S. Treasury Bills Nos. 557909A-10A-11A due April 22, 1969.

One $5,000 U. S. Treasury Bill No. 262911A due April 22, 1969.

One $5,000 U. S. Treasury Bond, 5¾%, No. 299, due February 15, 1974.

One $5,000 U. S. Treasury Bond, 4%, No. 5263, due February 15, 1980.

Insurance

Employers' Fire Insurance Company Policy No. F16-1099-81 for $5,000 on books and book cases stored at 200 East 42 Street and $2,000 on material 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. 03-223577 with coverage B Employers' Liability endorsement for $25,000 in Maryland Casualty Company. Expires 5-10-69.

Owners', Landlords' and Tenants' Liability Policy No. 511412 in Maryland Casualty Company for 100,000/300,000/5,000. Expires 4-23-69.

This is to certify that we have audited the accounts and the assets shown above and find same to be correct.

Auditing Committee
HENRY W. MENZEL, Chairman
JOHN H. BOYAJIAN
THOMAS W. FOWLER

1968 EXAMINATIONS — SUCCESSFUL CANDIDATES

The examinations for Parts 3 through 8 of the Casualty Actuarial Society were held May 8, 9, and 10, 1968. Parts 1 and 2 were jointly sponsored by the Casualty Actuarial Society and the Society of Actuaries, and were given May 15, 1968 and November 13, 1968. Those who passed Parts 1 and 2 were listed in the joint releases of the two Societies dated July 1, 1968 and January 9, 1969.

The list of successful candidates for Casualty Actuarial Society examinations Parts 3 through 8 follows:

ASSOCIATESHIP EXAMINATIONS

Part 3 (a)

Antonacci, Richard H.
Banfield, Carole J.
Beckman, Raymond W. III
Bill, Richard A.
Bovard, Roger W.
Brooks, James C., Jr.
Cadorine, Arthur R.
Delorme, Claude
Drennan, John P.
Evans, Houston W.
Fresch, Glenn W.
Friedberg, Thomas H.
Guarini, Leonard
Hartman, David G.
Haselmayer, Joe
Haseltine, Douglas S.
Irvan, Robert P.
Jersey, Joseph R.
Jones, Del R.
Lindquist, Robert J.
Napierski, John D.
Neidermyer, James R.
Pilon, Andre
Potvin, Robert
Shoop, Edward C.
Stephenson, Elton A.
Stewart, Charles W.
Uhlenhop, Henry L.
Verhoeven, Stanley M.
White, Hugh G.
White, William D.
Wilson, Oliver T.
Young, Edward W.

Part 3 (b)

Beckman, Raymond W. III
Bovard, Roger W.
Bradshaw, John G., Jr.
Crow, Sandra B.
Fresch, Glenn W.
Gilmartin, Leo J.
Grippa, Anthony J.
Guidali, Lynn L.
Hartman, David G.
Haseltine, Douglas S.
Hearn, Vincent W.
Jones, Del R.
Jorve, Barry M.
Levin, Joseph W.
Napierski, John D.
Obermeyer, Charles T.
Potvin, Robert
Quirk, William J.
Rosenblatt, Susan F.
Simons, Martin M.
Stewart, Charles W.
Sturgeon, Purser K.
Sullivan, Jerry J.
Vogel, Jerome F.
White, Hugh G.
White, William D.
Williams, David R.
Wright, William S., Jr.
Young, Edward W.

ASSOCIATESHIP EXAMINATIONS

rt 4

Banfield, Carole J.
Bartik, Robert F.
Beckman, Raymond W. III
Bergen, Robert D.
Bradshaw, John G., Jr.
Catania, Anthony E.
Comey, Dale R.
Eyers, Robert G.
Ferguson, Ronald E.
Fossa, E. Frederick
French, James T.
Gilmartin, Leo J.
Grady, David J.
Hardy, Howard R.
Klingman, George C.
Levin, Joseph W.
Linquanti, August J.
Lyon, Linda C.
Moore, James E.
Nelson, John K.
Phlamm, James D.
Spitzer, Charles R.
Tyrcha, Donald J.
Wade, Roger C.

FELLOWSHIP EXAMINATIONS

art 5

Amlie, William P.
Flynn, David P.
Gossrow, Robert W.
Gowdy, Robert C.
Hachemeister, Charles A.
Hunter, John R., Jr.
Olsen, Dennis W.
Price, Edith E.
Scheel, Paul J.
Scheid, James E.
Trees, John S.
Ward, Michael R.
Welch, John P.
White, William D.

Part 6

Brian, Robert A.
Conner, James B.
Fulton, Clyde B., Jr.
Gowdy, Robert C.
Hachemeister, Charles A.
Hartman, Gerald R.
Heer, E. Leroy
Holt, William T.
Jacobs, Terry S.
Kilbourne, Frederick W.
Murray, Edward R.
Snader, Richard H.
Walters, Mavis A.

Part 7

Brown, William W., Jr.
Faber, James A.
Honebein, Carlton W.
Lowe, Robert F.
Quinlan, John A.
Ryan, Kevin M.
Ward, Michael R.
Welch, John P.

Part 8

Ben-Zvi, Phillip N.
Bickerstaff, David R.
Bland, William H.
Hachemeister, Charles A.
Heer, E. Leroy
Munro, Richard E.
Naffziger, Joseph V.
Perreault, Stephen L.
Richardson, James F.
Scheid, James E.
Sturgis, Robert W.

NEW ASSOCIATES

Clarence R. Atwood, who successfully completed the examinations in November 1967, was admitted as an Associate of the Society at the Spring Meeting, May 20, 1968.

The following 20 candidates, having been successful in completing the examinations in May 1968, were admitted as Associates at the Annual Meeting November 19, 1968:

Bartik, Robert F.	French, James T.	Linquanti, August J.
Beckman, Raymond W. III	Grady, David J.	Lyon, Linda C.
Bergen, Robert D.	Hardy, Howard R.	Moore, James E.
Comey, Dale R.	Hartman, David G.	Nelson, John K.
Eyers, Robert G.	Jones, Del R.	Spitzer, Charles R.
Ferguson, Ronald E.	Jorve, Barry M.	White, William D.
Fossa, E. Frederick	Klingman, George C.	

NEW FELLOWS

The following 6 Associates, having been successful in completing the examinations, were admitted as Fellows of the Society at the Annual Meeting November 19, 1968:

Ben-Zvi, Phillip N.	Hachemeister, Charles A.	Ryan, Kevin M.
Bland, William H.	Naffziger, Joseph V.	Sturgis, Robert W.

BOOK NOTES

Helen H. Avnet and Mata K. Nikias, *Insured Dental Care,* Group Health Dental Insurance, Inc., 371 pages, 1967.

Reviewed by ALLEN L. MAYERSON

Many authors have stated that insurance against the cost of routine dental care is impractical (e.g., see Mayerson, *Introduction to Insurance,* page 14) but in recent years both insurance companies and non-profit dental service corporations have begun to provide such coverage, mostly on a group basis. The first non-profit prepaid dental plan was Group Health Dental Insurance, Inc. of New York, which had 170,000 members as of April, 1966. The book *Insured Dental Care* is a statistical study of the demographic characteristics of the subscribers of Group Health Dental Insurance, Inc., and of the frequency and type of utilization of dental services by plan members, during the period 1958–1964.

The numerous statistical tables and graphs contained in the book are based on a 10% stratified sample of the GHDI membership. Utilization rates and the frequency of various types of dental services are tabulated by age, sex, occupation, marital status, duration of coverage, size of family, and every other classification for which data were available and which might conceivably influence the rate of utilization of dental care. Not surprisingly, age, social class (as measured by occupational class), and sex were the principal variables, along with the degree to which the insured had a choice to buy or not to buy the coverage. A separate study of 574 members of "voluntary groups" and their dependents, i.e., persons who paid their own insurance premium, with no employer or labor union contribution, showed a utilization rate 50% higher than in those groups where the employer paid all or most of the insurance cost. Those groups where the employer paid only part of the cost also showed substantially higher utilization rates than those where the employer paid the entire cost, thus indicating a significant degree of anti-selection. This anti-selection is heightened by a higher lapse rate among the voluntary groups, after their pre-existing dental problems had been taken care of, than among groups in which the employer paid part of the cost.

One surprising statistic which, regrettable as it may be from a social point of view, may make the actuary's task easier, is that 16% of professional, executive, and sales occupations, 17% of clerical and skilled workers, and 42% of semi-skilled and unskilled workers never used any covered dental services during five years of coverage! Only 24% of professionals and executives, 14% of clerical and skilled workers, and 2% of semi-skilled and unskilled workers used dental services in each year of the five year period. The GHDI data also demonstrated that the cost of insurance for various sex, age, and occupation groups does not necessarily follow the frequency of use. As is the case in many other types of insurance, average claim cost often varies inversely with frequency, with those groups logging the fewest dentist visits often needing more expensive care. Thus the age group 6-14 made 2½ times as many dental visits as the age 55 and over group, but the pure premium for each group was the same.

It is interesting to compare the GHDI experience with that summarized in Table I of James H. Durkin's paper, "A Glance at Group Dental Coverage," *PCAS* LI, page 60, which was derived from the U.S. National Health Survey, July 1957 to June 1959. Mr. Durkin's table shows an average of 130 dental visits per year for males and 170 for females, per 100 persons exposed to risk, as compared to 159.6 for males and 209.5 for females in the GHDI experience. The pattern of utilization by age does not appear to differ significantly between the two studies, with females aged 15 to 24 the most frequent dental patients, and children under age 2 the least frequent, followed by those over age 55.

In their introductory chapter, Mrs. Avnet and Dr. Nikias list actuarial uncertainties as one of the reasons for the low priority historically given to dental insurance, and state that "the absence of actuarial data has deterred dental insurance expansion." If this is indeed the case (though I, for one, doubt that it is a major reason for the slow growth of dental insurance), the publication of *Insured Dental Care* has made it extremely difficult for any actuary to plead ignorance; the book tells him almost more than he wants to know about claim frequency under a dental insurance plan.

OBITUARIES

S. BRUCE BLACK

WILLIAM BREIBY

PAUL DORWEILER

WILLIAM F. DOWLING

S. BRUCE BLACK

1892 — 1968

S. Bruce Black, a charter member of the Casualty Actuarial Society, died at his home in Waban, Massachusetts, on December 7, 1968. He was chairman emeritus and honorary director of the Liberty Mutual Insurance Company and the Liberty Mutual Fire Insurance Company.

Mr. Black, for 32 years president and for six years chairman of the board of the Liberty Mutual Insurance Company, was a native of Wisconsin. A graduate of the University of Wisconsin, he joined Liberty Mutual in 1917 as treasurer of the firm. Two years later, he was elected vice president and actuary and in 1923 he was elected vice president and general manager. That same year he was elected vice president and treasurer of the Liberty Mutual Fire Insurance Company.

At the age of 32, in 1924, Mr. Black was elected president and a director of the Liberty Mutual Insurance Company and a director and vice president and general manager of the Liberty Mutual Fire Company. In 1942 he was also elected president of the Liberty Mutual Fire Insurance Company.

In 1962, Mr. Black was made honorary chairman of the board of both companies and in 1966, he was elected chairman emeritus and honorary director of the two firms.

From 1963 to 1966, he was a director of the Liberty Life Assurance Company.

At the time of his death, Mr. Black was a member of the Academy of Arts and Sciences, a member of the board of the Mutual Boiler and Machinery Insurance Co., a trustee of Northeastern University, and a member of the boards of Ripon College and the Medical Foundation of Boston.

In 1949, Mr. Black received an honorary Doctor of Laws and Letters degree from the University of Maine, and in 1957 he received an honorary Doctor of Humane Letters degree from Tufts.

Mr. Black is survived by his wife, Adele; three sons, Donald T. Black of Burtonsville, Maryland, Robert Bruce Black, Glen Echo, Maryland, and Wallace Gordon Black of Hadley, Massachusetts, who is currently on a two-year work tour in Africa for the University of Massachusetts; nine grandchildren; a sister, Mary Stott Black of Whitewater, Wisconsin, and a brother, Harry Black of Fort Atkinson, Wisconsin.

WILLIAM BREIBY

1884 — 1968

The death of William Breiby, chairman of the board of Western Travelers Life Insurance Company and former vice president and director for Pacific Mutual Life Insurance Company, brought to a close a 66-year career in the actuarial field. He was a charter member of the Casualty Actuarial Society and a Fellow of the Society of Actuaries. He died in Los Angeles on August 5, 1968 at the age of 84.

Mr. Breiby entered the New York office of consulting actuary David Parks Fackler in 1902. In 1919 he became a partner and with Edward B. Fackler continued as Fackler and Breiby, specializing in the investigation of insurance companies and pension funds. Their partnership continued until 1937.

During this period he served as consulting actuary for the United States Veterans Administration Government Life Insurance and introduced that organization's policyholder dividend plan. He also appeared before United States Senate committees as a pension expert in relation to legislation for railroad employees. Later, in 1943, he assisted Governor Earl Warren and the California Legislature in revising the State Teachers Retirement Plan.

His long relationship with Pacific Mutual Life began in 1937 when he joined the company as a vice president and continued beyond his official retirement 22 years later. His experience was exceedingly valuable during Pacific Mutual Life's successful steps toward complete mutualization which was achieved in 1959. That same year, although Mr. Breiby retired as an executive and director, he opened his own offices as a consulting actuary and advisor on retirement plans and life company operations. He was elected to the chairmanship of Western Travelers' board in 1961.

Mr. Breiby was a member of the Fraternal Actuarial Association, International Congress of Actuaries, Insurance Society of New York, the Actuarial Club of the Pacific States, and the Los Angeles Actuarial Club.

He also made substantial contributions to the literature of life insurance, in the field of management as well as actuarial science.

Ethel DeGray Breiby preceded her husband in death in 1963. They had been married for 49 years.

PAUL DORWEILER

1880 — 1968

Paul Dorweiler, past president of the Casualty Actuarial Society, died in his sleep, May 18, 1968, after a day of typical activity. He was 88 years old and had been a member of the Society for fifty years, having become an Associate in 1918 and a Fellow in 1920.

He was born in Kossuth Co., Iowa and grew up on the family farm there. As was not uncommon in those days, he taught elementary school for a time before he graduated from the University of Iowa in 1904. Thereafter he spent a dozen years as a mathematics instructor, first in the high school of Sioux City, Iowa, then at Armour Institute of Technology in Chicago and at Carnegie Institute of Technology in Pittsburgh. He studied also at the University of Chicago and at the University of Michigan in this period.

His first insurance connection was with the Reliance Life Insurance Company in Pittsburgh. William Leslie was the actuary of that Company. Mr. Dorweiler had joined the staff of the National Workmen's Compensation Service Bureau at New York City, when his insurance career was interrupted for service in World War I. This organization was a forerunner of the National Bureau of Casualty and Surety Underwriters and the present Insurance Rating Board. At the Bureau he worked with others whose names are, like his own, familiar to casualty actuaries — Professor A. W. Whitney, G. F. Michelbacher, Marcus Meltzer, and Miss Olive Outwater.

When Dorweiler was separated from the service as Captain, U.S. Army, he returned to the Bureau, but immediately the Ætna Life Insurance Company invited him to Hartford for its casualty operations. His affiliation with this group of companies began on February 1, 1919, not to terminate until his retirement in 1957. He was elected actuary of the Accident and Liability Department of Ætna Life in 1928 and later actuary of the Ætna Casualty and Surety Company, when the business other than Life and Accident and Health was being consolidated in the latter company and other subsidiaries.

Mr. Dorweiler not only served the companies well as their casualty actuary but also the industry as Ætna's representative on actuarial and related committees, over a period of three decades. Apposite comments on some of Dorweiler's professional contributions are found in the late Dudley Pruitt's delightful history entitled "The First Fifty Years," in *PCAS* LI, specifically, on page 172.

In 1932 Paul Dorweiler became President of the Casualty Actuarial Society and served two terms. His papers in the *Proceedings,* both before and after his presidency, and his presidential addresses were authoritative contributions to casualty actuarial technology, as witness the retention of several in the 1969 Syllabus of readings for students, years after their author's retirement.

The last official act of Dorweiler's as President of the Society was to preside at the twentieth anniversary celebration in November 1934. Older members may recall, and smile again, with no disrespect to the memory of their past presidents, Tarbell and Dorweiler, over one of the skits citing the actuarial firm of Tarweiler and Doorbell.

Paul Dorweiler's devotion to his profession and the Society carried beyond his death as he remembered the Casualty Actuarial Society in his will.

In his last year before retirement, Dorweiler participated in the preparation of *Multiple Line Insurance,* a book of the McGraw-Hill Insurance Series, by G. F. Michelbacher and a group of cooperating specialists. Thereafter, for a few months he assisted with the actuarial work of the Connecticut Insurance Department.

Among other things, Mr. Dorweiler was for many years a member of the American Standards Association's committees concerned with standardization of work injury experience. The American Statistical Association and the Association of Casualty Accountants and Statisticians were also among his professional affiliations.

He was also a member of the First Unitarian Congregational Church, Hartford, and retired Chairman of that Society's Committee.

Mr. Dorweiler was of a rather large family. A bachelor himself, he cherished the members of the immediate generations of his family and devoted considerable time to research of the family tree.

A man well versed in sports, particularly baseball, which he played in his youth as catcher on the West Bend town team, he would be found on a fall Saturday afternoon at the Yale Bowl, or at Trinity, Wesleyan, or Coast Guard.

Paul Dorweiler was a friendly, kindly, and loyal man, mourned by all who knew him, withal of signal ability and integrity.

WILLIAM F. DOWLING

1901 — 1968

William F. Dowling, an Associate of the Casualty Actuarial Society since 1941, died in his home in Garden City, New York, June 29, 1968.

Mr. Dowling attended Pace Institute in New York and shortly thereafter received his certificate as a Certified Public Accountant. He was employed at the Royal-Globe Insurance Company and thereafter with the consulting firm of Wolfe, Corcoran and Linder. He joined the Lumber Mutual Casualty Company in 1928 as chief accountant. In that company, whose name was subsequently changed to New York Mutual Casualty Company, he progressed to assistant treasurer, vice president, executive vice president, and then president. When the New York Mutual was merged with the Empire Mutual in 1965, Mr. Dowling became a principal in Nymco Insurance Agency and was with that organization until he retired in 1966.

Mr. Dowling was a former director of the New York Motor Vehicle Accident Indemnification Corporation, and he also served on the advisory committee of the Chase Manhattan Bank.

Mr. Dowling is survived by his wife, Margaret; a son, Dr. William F. Dowling, Jr., a dentist; and three daughters, Sister Mary Regina, SSND, Regina, and Agnes; also five grandchildren, a brother, and three sisters.

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