

- (5) The Insurance Commissioner would establish a rate or premium for each classification in each territory, reflecting the pure premiums determined under the Uniform Statistical Plan, the over-all average stock company expenses and an acceptable allowance for profit and contingencies.

Under this procedure, "a company or rating bureau, rather than filing rates, would file a series of factors representing percentages of the established base". In other words, under this plan the Commissioner would determine the rates, and a company or group of companies could deviate uniformly from such rates if such deviations could be supported.

The plan as outlined in Mr. DuRose's paper is essentially the Texas method for determining rates, and it should be pointed out that the Texas regulatory law provides for the determination of rates by the Texas Board of Insurance. Under the All-Industry regulatory law, adopted in most states, the making of rates is a function of the companies. The power of the Commissioner is one of review—not one of rate making.

It would appear that Mr. DuRose's plan was motivated by the problem of dealing with rate filings made by the large number of independent companies operating in Wisconsin. It is admitted that this is a problem, but I do not believe that insurance companies are in favor of state-made rates as the solution to this problem.

ESTIMATING ULTIMATE INCURRED LOSSES IN AUTO LIABILITY INSURANCE

BY

FRANK HARWAYNE

Volume XLV, Page 63

DISCUSSION BY J. M. CAHILL

The elaborate formulae treatment of Mr. Harwayne is dealt with by Lewis H. Roberts in an Appendix to this written discussion.

I intend to direct attention to the practical rather than to the theoretical aspects of Mr. Harwayne's treatment of this subject. It will quickly be inferred that I see little merit in embarking on the use of complicated formulae in ratemaking to ascertain what is disclosed by other available statistics that are both relevant and up-to-date.

Mr. Harwayne's whole analysis is based on that part of the New York Supplemental Insurance Expense Exhibit which shows the development of New York automobile bodily injury experience by policy year. This Exhibit carries the experience of each policy year from its initial valuation as of 12 months on through the successive annual revaluations to 84 months of development.

While this Exhibit may have some value in that it portrays the overall character of the automobile bodily injury liability experience in New York, it would not be practicable to use this type of experience data in ratemaking for the following reasons:

1. It is for all types of cars: private passenger, commercial, long haul truckmen, buses, taxicabs, hired cars, etc. in combination.
2. It is for all sizes of limits written, including for example 500/1,000 as well as the 10/20 limits required under the New York Compulsory Insurance Law.
3. It includes medical payments, uninsured motorists, death and disability coverages, etc.
4. Note that no similar information is available for automobile property damage liability insurance. But more important, for no other state is similar information on the development of the aggregate automobile liability experience (bodily injury or property damage) by policy year available through a Supplemental Insurance Expense Exhibit or otherwise. The insurance companies would probably object were these supplemental reports imposed by states generally because it truly would be for no useful purpose and would involve considerable additional expense of preparation.

May I add the gratuitous comment that this portion of the New York Supplemental Insurance Expense Exhibit is an anachronism that does not seem to serve any useful purpose.

In striving for a means of getting an up-to-date, accurate indication of the experience picture, Mr. Harwayne makes only slight reference to the vastly superior type of data now available in the form of the accident year experience compiled from the statistics reported under the Automobile Bodily Injury and Property Damage Liability Statistical Plan. While accident year data presently are compiled only for private passenger cars, the Statistical Plans were amended as of January 1, 1958 to produce this type of experience in due course for the commercial and other categories of vehicles. The accident year data can be compiled not only for the year ended December 31 but also for the year ended June 30, which for practical purposes means that it can be kept right up-to-date for use in ratemaking.

To give an indication of how superior the accident year data are to policy year data for ratemaking purposes, I merely have to cite that as of the first report (15 months after the beginning of the accident year period) the ratio of paid to incurred losses for some states is more than 55% for bodily injury and 85% for property damage. In New York where cases are settled somewhat more slowly for reasons with which you are familiar, the percentages are nearer to 30% and 70% respectively. But even these are vastly higher than the policy year relationship of the paid losses as of the first report to the

ultimate incurred losses which would be only 7% for bodily injury and 21% for property damage in New York.

Mr. Harwayne has disregarded the fact that under the Statistical Plan the losses reported are inclusive of allocated loss adjustment and that in ratemaking the necessary further provision for unallocated loss adjustment is included with the provision for losses through the use of current factors of 1.10 for bodily injury and 1.16 for property damage which are supported by a review of the countrywide experience and expense costs reported in the Insurance Expense Exhibit.

At the earlier stages of development by policy year, the losses reported in the New York Supplemental Insurance Expense Exhibit contain substantial bulk reserves established by the companies for "Incurred But Not Reported", "Future Adverse Development," etc. These reserves are determined by formulas and methods that vary by company, and may be moved forward annually with little change. If a company tended to establish an excessive reserve for future development beyond 36 months, for example, the credit runoff would be repeated policy year after policy year although there was no substantial change in the number of dollars in the bulk reserve. It is important to note that such bulk reserves cannot be included in the losses reported for ratemaking purposes under the Statistical Plan.

While the New York Supplemental Insurance Expense Exhibit contemplates that the automobile bodily injury liability losses reported by policy year will be exclusive of all loss adjustment, for most companies the individual case reserves are set up inclusive of allocated loss adjustment. In practice, almost without exception the companies do not establish separate case reserves for the indemnity and the allocated loss adjustment portions. When a company sets up a loss reserve of say \$5,000, it is intended to cover whatever loss payment may eventually be made and also whatever allocated loss adjustment expense may be incurred. From the standpoint of solvency, it makes no difference whether the amount is used to settle a just claim, whether it is used in defense of an unjust claim, or whether it is eventually paid partly as indemnity and partly as allocated loss adjustment expense.

A few companies do establish individual case reserves separately for indemnity and for allocated loss adjustment. But even for these companies there seems to be a tendency to understate the allocated loss adjustment reserve and to rely on the indemnity reserve to provide an adequate reserve in the aggregate. Many more companies use a formula relationship to adjust the outstanding losses to reflect the elimination of allocated loss adjustment in preparing the New York Supplemental Insurance Expense Exhibit.

Nevertheless, it is probable that, through the mechanics of insurance accounting under the Annual Statement, amounts subsequently paid as allocated loss adjustment expense are transferred to the loss adjustment expense account with the end result that an overstated credit development with respect to the incurred losses is indi-

cated in the New York Supplemental Insurance Expense Exhibit. The credit development of outstanding losses to the extent of 12% and 14%, which is demonstrated in Mr. Harwayne's paper to have occurred in connection with the development of the New York automobile bodily injury loss experience by policy year as reported in the New York Supplemental Insurance Expense Exhibit, is largely a fictitious credit development for the reasons explained above, and does not occur in any such magnitude in the data used for ratemaking which are reported under the Statistical Plan to be inclusive of both losses and allocated loss adjustment.

For identical reasons, the same sort of development occurs in the countrywide Schedule "P". By a simple calculation combining the annual statement loss adjustment account with the incurred loss account in Schedule "P" by policy year, a measure can be obtained as to whether in the aggregate the company estimates of incurred losses for bodily injury including all loss adjustment are accurate. For the member companies writing more than 90% of the volume of the National Bureau, the development of the loss and of the loss adjustment experience for policy years 1950 through 1954 from 36 months is shown in the following table:

<i>Item</i>	<i>Development From 36 Mos. of Policy Year</i>				
	<i>1950 to 72 Mos.</i>	<i>1951 to 72 Mos.</i>	<i>1952 to 72 Mos.</i>	<i>1953 to 60 Mos.*</i>	<i>1954 to 48 Mos.*</i>
Incurred Auto B.I. Losses	-3.2%	-3.4%	-3.4%	-2.9%	-1.5%
Incurred Auto B.I. Loss Adj.	+7.3	+8.0	+11.9	+12.1	+10.2
Combined	-1.7	-1.8	-1.3	-0.9	+0.1

* Latest available as of Dec. 31, 1957

Note how the incurred loss adjustment account moves up as the incurred losses go down. In combination there is comparatively little development from 36 months on. Any development that occurs is reflected in the ratemaking process where the development of the losses including allocated loss adjustment as reported under the Statistical Plan is carried out to 60 months for bodily injury and to 36 months for property damage in the case of private passenger cars.

For automobile bodily injury, the ratio of allocated loss adjustment to premium was 4.7% countrywide for National Bureau member companies; for automobile property damage it was 2.1%. In terms of incurred losses, these ratios would be approximately 6.5% B.I. and 3.5% P.D.; these ratios would be far higher, of course, in terms of the outstanding losses at the various stages of development. Therefore, this potential transfer item to which Mr. Harwayne has referred only in a footnote is not negligible by any means.

While I feel that there is no need to base the ratemaking process on the type of data reported in the New York Supplemental Insurance Expense Exhibit or upon elaborate and complicated formulae which inherently would fail to recognize the effect of such changes as the raising of the limits required by Financial Responsibility laws, nevertheless it is encouraging to note the recognition given in Mr. Harwayne's paper to the need to measure trend and to reflect the indications of the latest available experience. Within the past year and a half the National and Mutual Bureaus had to request a hearing and then successfully appeal to the Appellate Court on a disapproval by a former New York Superintendent of Insurance based largely on the premise that two years of policy year experience was too short a period to use for ratemaking purposes and that preferably the experience period should be of five years duration. A quick glance at the New York loss ratios by policy year shown in the various tables in Mr. Harwayne's paper shows the worsening trend of the experience and the clear need for substantial rate increases. In Table F-X, for example, the steady increase in the incurred loss ratios (excluding all loss adjustment) shown from 51.8% in policy year 1953 to 73.0% in 1957 depicts the serious deterioration of the New York automobile bodily injury liability experience. The corresponding expected loss ratio excluding all loss adjustment was only approximately 51%. The last rate revision effective during this period was in 1956, which makes it self-evident that the rates were seriously inadequate in 1957 when the National and Mutual Bureaus proposed rate increases which were disapproved in November, 1957 and which became the subject of hearings and court action.

Thus, while I do not favor the introduction of the elaborate formulae outlined by Mr. Harwayne, I do welcome his paper which supports the recognition of trends as implied in the aggregate loss ratios shown in such reports as the New York Supplemental Insurance Expense Exhibit. But better tools for this purpose are now available, and in due course even better methods of measuring and predicting trends will be evolved.

APPENDIX

LEWIS H. ROBERTS

It is always gratifying to see mathematics applied to the varied and complex problems of casualty insurance. As such methods of analysis are brought to bear more often, reduction of the nebulous areas of intuitive estimate not only places our science on more certain ground, but frees the mind to concentrate on the key decisions which are the proper province of judgment.

Such papers as Mr. Harwayne's, which boldly attack important problems in spite of their mathematical difficulty, are therefore received with pleasure by this reviewer even when he takes exception to the author's methods and conclusions.

Mr. Harwayne approaches the problem of estimating ultimate incurred losses in two independent ways. The first way is to discount outstanding losses reported for ratemaking purposes by a factor which essentially represents allocated loss adjustment included in loss reserves on the Insurance Expense Exhibit. Since the fallacy of this procedure has been already shown in detail by Mr. Cahill it will not be discussed further here.

The author's second approach is to discard reported information on outstanding losses, and to estimate ultimate incurred losses solely from paid losses as of a given date. It is difficult to believe that any mathematical procedure which discards information can be expected to yield better rates than a time tested method that uses all reported information.

A possible ground for doubting the value of outstanding losses as reported may have been the mistaken conclusion reached in the first approach, referred to above. Apart from that, no evidence has been adduced by the author to justify discarding reported amounts of outstanding losses as worthless. Furthermore, even if those reported amounts were worthless the claim count on outstanding claims is incontestable, and used in conjunction with a reasonable estimate of average claim cost at date of settlement should provide a far sounder evaluation of outstanding losses than an estimate based on paid claims alone. This should be evident, not only from considerations of credibility (paid claims as of 12 months, for example, represent according to the author's figures only 7% of ultimate incurred losses) but from the effect of trend of average paid claim costs during the run-off period on the percentage of ultimate incurred losses paid at a given stage of maturity.

In estimating average cost at date of settlement of outstanding claims, the element of trend enters in such a way as to be susceptible to separate treatment. But if we estimate ultimate incurred losses on the basis of a past observed ratio of paid to ultimate incurred losses, the effect of trend is so intimately involved in this ratio that the task of adjusting the ratio to allow for changes in trend is greatly complicated. Although the author did not discuss the trend problem it is inseparable from this approach, and neglect of such adjustment is equivalent to the assumption that the future trend of average claim cost will follow the same pattern as obtained during the development of the experience from which the ratio of paid to ultimate incurred losses was derived.

Because of this reviewer's objection to the use of paid losses alone to estimate ultimate incurred losses, the mathematical techniques that were used to develop this approach are in his opinion immaterial although generally sound and ingenious. There are, however, a number of technical defects that could be remedied.

Equation (4) in Part IV of the first paper was obtained by trial and error by altering the coefficient developed in Eq. vii of Appendix A, the reason for the adjustment being the unbalanced fit provided by

the latter equation. Inspection of the differences from observed values for Eq. (4) compared with those for Eq. vii suggests that this adjustment has, if anything, increased the unbalance since the positive differences for higher values of t have been reduced only slightly at the expense of introducing negative differences for lower values of t . These difficulties could have been avoided by changing the signs of Eqs. i, ii and iii (Appendix A) and taking logarithms, thus yielding linear equations in the unknown parameters a , b and c . Solution for these values by least squares (with appropriate weighting) would have permitted use of as many observed values as available rather than just the first three, thus avoiding the unbalance inherent in the author's method.

It is also worth remarking that the differences between values calculated from Eq. (4) and observed values can not be regarded as random. Where an equation is derived from a set of data having only one observed value for each value of the independent variable (time in this case), and particularly when the fit is made to selected points, there is always question as to whether the differences are not due to bias in the fit, so that future data would show differences from the fitted function in the same direction as the observed data. Use of several years' experience with the least squares method would eliminate these doubts if the function chosen is really suitable for the data to be fitted.

Use of function for periods of less than a year does not appear to be justified, according to the table in Part IV.

With respect to the rate level adjustment factor (Part V), parentheses are required around the expression $\frac{L_A}{P_A R_A}$ to avoid ambiguity.

Expression (7) in Part V is actually a hybrid policy year. In this writer's opinion more information is to be obtained from the data by showing the incomplete policy years separately and averaging them, if appropriate in consideration of volume and other relevant factors, after adjustment for trend.

With calendar-year-accident-year data soon to become available on a fiscal year basis for all types of cars, however, there seems to be little need for elaboration of methods of analyzing policy year experience.

Equation IV of the second paper was derived without regard for the boundary conditions implied by its use as a periodic function (i.e., as descriptive any year) which require that the accident frequency and its first derivative should be the same at the last instant of the year as at the first instant. This omission impairs subsequent calculations for periods of time such as one, two, ten or eleven months, or for periods exceeding a whole number of years by these numbers of months.

The author's derivation of the functions $F(t)$ and $G(t)$ is otherwise a commendable example of mathematical construction which this

reviewer greatly appreciated reading. Mr. Harwayne's papers are therefore a welcome addition to our literature, notwithstanding the before mentioned objections to certain of his methods and conclusions.

DISCUSSION BY F. J. HOPE

In the introduction of his paper, Mr. Harwayne cites the serious need for insurance premiums which will be adequate in the face of an inflationary economy. He suggests that this need can be met, in part at least, by taking steps to bridge the time-gap between the cut-off date of basic ratemaking data and the effective date of rate revision. Certainly there can be little quarrel with either the need for adequate rates or the desirability of achieving them through use of the most recent factual information available.

In general design, his proposal to narrow the time-gap is patterned after the rate level adjustment factor widely used in Workmen's Compensation ratemaking. In this approach, the detailed elements which constitute the basic ratemaking data are adjusted by a single factor derived from more recent data available in "bulk" only. In Workmen's Compensation, the "bulk" data are calendar year earned premiums and incurred losses reported by state at six months' intervals. Mr. Harwayne proposes the use of premiums written and losses paid. He suggests the use of the latest policy year of such data, since that is readily available in the New York Supplemental Insurance Expense Exhibit, but points out the possibilities of adapting his proposal to other types of compilations, such as calendar-accident year.

Although the paper is divided into five parts, it can be summarized as being based on these two fundamental premises:

1. That policy year incurred loss ratio data evaluated as of 36 months or later can be projected to "ultimate" by a simple adjustment of outstanding losses, and
2. There is a consistent and measurable relation between policy year paid losses as of 12 months and "ultimate" incurred losses.

The first premise is familiar to most of us under the name of loss development. It is generally assumed that reserves on outstanding losses include what might be termed a "margin of safety". Mr. Harwayne terms this the "conservative practices required by prudent company operations". When a body of ratemaking data includes a number of reserves on open claims, it has been common practice to adjust the data to reflect future developments. The traditional approach has been to develop factors based on the ratio of incurred losses at a later date to the same losses as of an earlier date, and to apply these factors to more recent data. The theory appears to be that, in the aggregate, reserving practices demonstrated in the older years have continued with respect to later years. The factors are usually, but not always, less than unity, as might be expected. Mr. Harwayne adopts a somewhat different approach, suggesting that since the sav-