DISCUSSION OF PAPERS READ AT THE
NOVEMBER 1957 MEETING

AUTOMOBILE BODILY INJURY LIABILITY RATE-MAKING ON A PROSPECTIVE BASIS

J. EDWARD FAUST, JR.

Volume XLIV, Page 11

DISCUSSION BY R. J. WOLFRUM

The paper presented by Mr. Faust is a very timely one. In this period of unsatisfactory automobile liability loss ratios, there has been considerable discussion in the industry about how to reduce the lag between the past loss experience used as a basis of ratemaking and the actual loss conditions which will exist during the time that the proposed rates will be effective. In many cases, criticism has been directed at the ratemakers, particularly the Countrywide Rating Bureaus, indicating that they are not reflecting to a suitable degree the increasing inflationary effects on both cost and frequency. It is asserted that, because of this failure, they are thereby producing outmoded and unrealistic rates.

Anyone who has had any direct knowledge of the problems of these National Rating Bureaus, however, realizes that there are two facets to the problem involved when the ratemaker departs from the indication of a solid base of past matured experience.

1. First a sound and unbiased program has to be developed which will reflect past and prospective trends or projections and which will produce trend and projection factors which appear reasonable for the future.

2. The program which has been developed has to be reduced to laymen's language in order that the state supervisory officials can be convinced that the formula is both sound and unbiased.

More and more papers of this sort, I believe, will help to bring out the considerations involved in both facets of this problem, and I am not saying this because I happen to be Chairman of the Committee on Development of Papers, *and we need more papers*. There is no doubt in my mind that short articles like this start people to think about the problem, help them to understand the scope of the problem, tempt them to present their solutions to the problem, and add to the acceptance of such procedures being applied to the regular ratemaking procedures by those people in the state supervisory officials' office responsible for the administration of final rates.

Mr. Faust indicates that his suggested method must be used separately on a carrier-to-carrier basis. It would seem to me that such a

basis would therefore be limited to only the very large independent carriers making their rates on their own experience since sufficient data must be available to make rates on a state-by-state basis. This is necessary since, to develop a formula acceptable to a state, such a formula must use state data since very few states will allow their rates to reflect trends which are not at least peculiar to their own state. However, it would appear that since the elements used in his method involved only paid losses during a year, paid claims during a year, and outstanding claims at the end of each year, sufficient information is being reported to Countrywide Rating Organizations to supply or test his method if they so desire on a state-by-state basis.

Mr. Faust's method essentially breaks down into the following steps, assuming we are looking at the problem at December 31, 1955 and all data through this date are available.

1. He forecasts an average paid claim cost for 1956 by analyzing such cost over a period of the past few years, (1952-1955) and by correlating the data with the Average Consumer's Price Index developed for these same years after finding other economic indices did not work out too well.

2. He forecasts a paid claim frequency for 1956 by an analysis of the trends in such frequency over the period 1952-1955, finally deciding that a straight-line relationship is as good as any other.

3. Multiplying (1) by (2), he develops a calendar year paid pure premium for 1956.

4. Although he points out that one might be willing to stop at this point, he indicates that a more accurate incurred pure premium can also be forecasted by developing the changes in the reserve values at the beginning and end of calendar year 1956. In this step, he ignores the reserves which might actually be carried on a case-by-case basis, and manufactures his reserves by building up the accident year components of the reserves from (a) the number of outstanding cases in each accident year as of December 31, 1955, and (b) the average paid claim cost determined above. In this process, he handles the current 1955 accident year in a somewhat different manner than the accident years prior to 1955.

5. In determining such reserves, he takes the following factors into consideration:
   (a) The past rate of liquidation of each accident year claims.
   (b) The estimated average values of claims outstanding by accident year, all in relationship to the forecasted average paid claim cost for the calendar year 1957, using past experience results as a basis of this relationship.
   (c) The increase in policies during 1957, on a purely estimated basis.

6. By adding these forecasted changes in reserve values for 1956, he converts these changes to a pure policy change and adds them to the forecasted average paid pure premium computed in (3) above. In this manner he develops a forecasted incurred pure premium for 1957.

The approach, method, and results are quite interesting and really very fascinating from an actuarial point of view. Unfortunately, Mr. Faust did not accompany his paper with any exhibits, graphs, or explanatory material which I believe could have been helpful, at least to me, in following the developments of many of his formula relationships. For instance, he indicates that the accident year 1956 reserves as of December 31, 1956 could be developed by multiplying the ratio of the projected 1957 average claim cost to the 1956 reported claim frequency by the following factor 36.1453 $(1.052)^5$. This is quite interesting, but there is no explanation of the fundamental reasoning behind such a factor nor the basis of the development of the factor.

In his apparent quest for brevity and conciseness, Mr. Faust has passed rather quickly over two points which particularly bothered me. I believe that somewhat more detailed treatment would enhance the value of the paper.

1. First, in his development of a correlation of the trend line for average paid claim costs with various indices, he first had to eliminate 4 odd years of experience to "improve the method". Finally, only 4 years out of 18 years of experience was actually used. I have no doubt that this choice of experience was justified, but I believe that some additional justification should have been given for the choice. I have always found that there is always a bit of suspicion raised in the public's mind when certain data is discarded, unless accompanied by a complete and plausible explanation of the election of only part of the data.

2. Secondly, since Mr. Faust manufactures all the reserve values and does not take the case values as set up by the company claims adjusters, it is not clear to me why there should be any change in reserve value for one accident year from one reserve date to the next, since he attempts to accurately forecast the reserve value at the first crack. I may have been confused by the symbols used, but it appears that a built-in upward development factor is assumed. This is like forecasting a certain value of the reserve and then saying in the next breath that the values forecasted are wrong. Possibly, all this could be cleared up if a series of values were actually developed in exhibit form for particular years, rather than leaving everything in a generalized form.

There are certain other indices which are quoted in the paper without any detailed development shown. I thought that it might be worthwhile to compare some of these relationships with certain fig-

ures on Massachusetts Compulsory Insurance, since both sets of experience can be studied on an accident year basis. The basis of the Massachusetts figures is attached as an exhibit. First, in his build-up of the reserve at the end of a calendar year, Mr. Faust indicates that the following relationship exists between the average paid claim cost of the first following year and the average reserve cost per open case held by accident year. I have shown the corresponding relationship for Massachusetts Compulsory Coverage.

Accident Year	% of 1957 Average Paid Claim Cost	Mass. Compulsory Factor*
1955 1st Preceding	3.2965	2.140
1954 2nd Preceding	3.0943	2.330
1953 3rd Preceding	2.7363	2.240
1952 4th & Later	2.5616	2.100

*Based upon reserves held at end of 12/31/56

Although the figures necessarily are of a different magnitude since the compulsory losses are pure losses only on a basis-limit basis, it is surprising to see that the Massachusetts figures confirm that once the current accident year reserves are taken care of, the reserves on open cases of the preceding accident years have relatively uniform average values. Normally, it would be expected that the older the age of the open cases, the higher the average value. Inflationary influences, of course, would tend to distort the "expected" relationship because of higher cost on the more recent accident years.

Also, increased limits losses have a very definite effect on outstanding losses, particularly on the older cases. Hence, I would expect that, if increased limit losses were added to the basic limit losses in Massachusetts (they were not readily available in the required breakdown), the average reserve values would increase as the open cases became older and remained open.

In the paper, the following percent of claims outstanding at the beginning of a calendar year were considered to be oustanding at the end of the same calendar year. Again, I have shown comparable Massachusetts Compulsory figures:

Accident Year	%	Mass. Compulsory %
1955 1st Preceding	20	44
1954 2nd Preceding	35	53
1953 3rd Preceding	40	48
1952 4th Preceding	60	30

It will be noticed that the pattern of Massachusetts closings do not follow the experience that Mr. Faust has found in his company.

Another set of figures quoted by Mr. Faust is that 70% of the accident year reserves are paid out in the ensuing calendar year and about 90% are paid out in the ensuing two calendar years. The Massachusetts Compulsory figures indicate that only 40% of the accident year reserves are paid out in the first ensuing calendar year and 60% are paid out in the first two ensuing calendar years. It is only after the accident years are five years old that close to 90% of the first year reserve is disposed of by payments.

While these comparisons obviously are crude and not adjusted for differences in the data, it does point up the necessity of having detailed state data to recognize the obvious differences and variations by state from broad countrywide trends. Moreover, there has to be a logical explanation for these trends or satisfactory reasons why they do not jibe with what is normally expected and those which cannot be explained in logical terms.

Summarizing, Mr. Faust's paper shows a great deal of ingenuity and presents very interesting new techniques in approaching this problem of trending and projecting past experience to be more indicative of current and prospective conditions. I believe, that from an actuarial and technical basis, it is sound and worthy of serious consideration by people who understand how to apply these techniques.

From a practical standpoint, however, I believe that his formula relationships have to be reduced to more understandable terms in order to be readily accepted by insurance departments' personnel, who are somewhat influenced by the public suspicion of actuarial terminology that rears its ugly head at public hearings. However, I have always felt that, in this actuarial area of "crystal ball gazing", it is well to have several formula approaches, some technical and some non-technical, and then come to a reasonable conclusion, understandable to the public, which can be supported in large extents by all approaches. It should not always be necessary to follow to the fourth decimal place any approach that is patently a device to come to some judgment prediction of future happenings. Therefore, I sincerely hope that more and more contributions of papers of this sort will be forthcoming on this problem which will always be with us as long as our economy continues to fluctuate as it does.

MEMORANDUM NO. 5 - COMPILED JUNE 1957

EXHIBIT (b)

DEVELOPMENT OF COMPULSORY LOSSES BY YEAR OF REPORTING - ALL CLASSES

	PAID		OUTSTANDING		INCURRED		Index of Amount Incurred to 1st Report	Ratio of Amount Incurred to Previous Report	Ratio of Amount Paid to Incurred Latest Report
	No. of Claims	Amount	No. of Claims	Amount	No. of Claims	Amount			
1956									
1st Report	71,493	25,281,448	37,021	32,099,897	108,514	57,381,345	1.000	1.000	44.1
1955									
1st Report	62,734	19,923,320	34,071	27,857,576	96,805	47,780,896	1.000	1.000	41.2
2nd Report	79,200	31,112,984	14,922	17,233,541	94,122	48,346,525	1.012	1.012	64.4
1954									
1st Report	57,145	16,724,162	29,796	23,969,423	86,941	40,693,585	1.000	1.000	41.8
2nd Report	71,657	25,838,954	13,282	15,029,598	84,939	40,868,552	1.004	1.004	64.6
3rd Report	76,906	31,157,172	7,078	8,869,695	83,984	40,026,867	.984	.979	77.8
1953									
1st Report	56,228	15,185,078	28,690	21,569,742	84,918	36,754,820	1.000	1.000	42.1
2nd Report	69,807	23,120,430	13,093	13,995,437	82,900	37,115,867	1.010	1.010	64.1
3rd Report	74,440	27,634,095	7,829	9,263,365	82,269	36,897,460	1.004	.994	76.7
4th Report	78,064	31,538,641	3,762	4,509,120	81,826	36,047,761	.981	.977	87.5
1952									
1st Report	57,749	14,988,968	29,924	20,827,196	87,673	35,816,164	1.000	1.000	43.5
2nd Report	72,802	22,972,872	13,056	13,366,423	85,858	36,339,295	1.015	1.015	66.6
3rd Report	77,499	27,226,388	7,565	8,619,503	85,064	35,845,891	1.001	.986	79.0
4th Report	80,685	30,518,594	4,003	4,716,669	84,688	35,235,263	.984	.983	88.5
5th Report	83,024	33,031,860	1,275	1,440,037	84,299	34,471,897	.962	.978	95.8

AUTHOR'S REVIEW OF DISCUSSION

J. EDWARD FAUST, JR.

It is a pleasure to review Mr. R. J. Wolfrum's discussion.

Mr. Wolfrum, of course, correctly points out that there are two facets to the problem. First, a sound basis for forecasting must be developed and secondly, it must be made intelligible to supervisory officials.

I would also agree with his order of importance. I am sure Mr. Wolfrum will agree that our first duty as actuaries is to present technically competent answers to problems, within the framework of our Society, without regard to how understandable they will be to the layman. If that were not true, progress would be paced by the layman rather than by those who are technically competent. The success in being able to make any technical solution intelligible depends to a large degree on the knowledge and background of the so-called layman. It is, of course, difficult, if not impossible, to teach a course in Differential Equations to one who has no knowledge of Calculus or Algebra but that does not lessen the value of Differential Equations.

A physician may have little success in explaining to some people how the Salk Polio vaccine prevents Polio. This, of course, does not lessen the value of the vaccine nor did it stop Dr. Salk from proceeding with and concluding his research.

Mr. Wolfrum comments on my statement that this method must be applied to each carrier separately. I will agree that the use of the word "must" is rather strong.

Since the underwriting and claim practices of a given carrier could alter the value of the statistics which are developed, it does seem to me that it would be best to develop them on the basis of a carrier's own experience instead of using averages developed from several companies.

Since the factors would apply to a carrier's total Automobile Bodily Injury Liability writings, it would seem that many companies would have a sufficient volume of data to produce credible results.

Mr. Wolfrum states that rates must be made on a state-to-state basis. I wonder, however, if this requirement relates to trend or projection factors since many casualty rating laws contain the phrase "Due consideration shall be given to past and prospective loss experience within and outside this state. . . ."

If a carrier has a sufficient volume of data there is the possibility that it can determine state projection factors although this does not seem to be a necessary qualification for using this approach.

Mr. Wolfrum expressed the desire for an explanation of the factor "36.1453 $(1.052)^5$" which when multiplied by the ratio of the forecasted average paid claim cost next year to the reported claim frequency this year gives the average reserve per outstanding claim for the current accident year.

Although this relationship was developed empirically it does have some logical basis.

It was observed that the average reserve need for the current accident year does vary as follows:

(1) Directly with the average claim cost next year; and,

(2) Inversely with the reported claim frequency for the current accident year.

It was found that a high reported claim frequency was usually caused by a larger number of not-too-serious claims which were settled in a relatively short time which, of course, reduces the average reserve need for current accident year claims.

Mr. Wolfrum points out that ultimately certain data was discarded in the development of a correlation of the trend line for average paid claim costs with various indices.

As was pointed out in the paper, 18 years of experience was used first and the degree of correlation found established that there was a significant relationship between the average paid claim cost one year hence and the Wholesale and Consumer Price Indices taken either separately or jointly. I didn't want to burden the reader with the details of the computation of these simple straight line correlation coefficients. Actually, the regression line produced by using all 18 years would give satisfactory results.

Having established the validity of the correlation between the average paid claim cost and these indices, I thought the results could be refined to give better results by eliminating the four years and this was confirmed by an increase in correlation. Although these results were satisfactory, I had knowledge of an operational change in claim practice which I know would have an effect on the average sized claim.

The thing that seemed significant to me was that whether or not 18 years, 14 years or 4 years of experience was used, the high degree of correlation between the average paid claim cost one year hence and the current levels of the economic indices used was established.

I am puzzled by Mr. Wolfrum's statment, "it is not clear why there should be any change in reserve value for one accident year from one reserve date to the next—". I am sure he didn't mean this for it would be very unusual if an accident year reserve didn't change from one date to another. Perhaps Mr. Wolfrum had in mind the value of Incurred Losses rather than reserves.

I thought Mr. Wolfrum's insertion of Massachusetts Compulsory experience was very instructive. I was delighted to find that this experience confirms my results in that the average reserve need in terms of open claims decreases with age.

This seems to me to be an entirely logical possibility. While it is true that the average paid claim will tend to increase with age, it is also true that a higher percent of open claims will be closed without payment as they age. I found that the combination of these two op-

posing factors produced the results that the average reserve need as expressed in terms of open claims actually decreases with age.

My figures for the percent of claims outstanding at the beginning of the year which were incurred in the "nth" preceding calendar year, which still remain unpaid at year end, were also established empirically. This item is really of minor importance in the proposed method. My results would tend to indicate that the rate of disposing claims tends to decrease with the age of the claims.

With the data used to prepare my paper I developed a Loss Development table which shows the expected value of paid claims as a percent of incurred losses.

The following is the table:

Year in which Accident Year Incurred Losses are Paid	Percent of IncurredLosses Paid In Indicated Year
Current	33%
1st succeeding	42
2nd succeeding	16
3rd succeeding	6
4th succeeding	2
5th succeeding	1

In order to determine the average length of time it takes to pay a dollar of incurred claims we need only to take the first moment, as follows, under the assumption that claims are paid on the average in the middle of the year and are incurred in the middle of the accident year:

Percent of Incurred Claims (a)	Average length of time for payment in years after they are incurred (b)	First Moment (C) = (a) x (b)
33%	0	0.00
42	1	0.42
16	2	0.32
6	3	0.18
2	4	0.08
1	5	0.05
	Total	1.05

On the average, therefore, a dollar of incurred loss is paid about a year after it is incurred.

Therefore, since the cost of claims which is governed by the level of wages, medical cost, etc., is on the average determined a year before they are paid, it is logical that it was found that the change in value of the average paid claim cost is accurately measured by the change in the price levels as measured by the Consumer Price Index for the previous year.

PRINCIPLES AND PRACTICES IN CONNECTION WITH CLASSIFICATION
RATING SYSTEMS FOR LIABILITY INSURANCE AS APPLIED TO
PRIVATE PASSENGER AUTOMOBILES

JOSEPH M. MUIR

Volume XLIV, Page 19

DISCUSSION BY G. R. LIVINGSTON & T. O. CARLSON

Mr. Muir's paper presents a very useful and interesting historical discussion of rating systems for automobile liability insurance coverage on private passenger cars over a span of approximately three decades. Such information has not been readily available previously for the benefit of students and the younger members of our Society, however familiar it may be to the old guard.

In connection with the present rating plan, Mr. Muir makes the observation: "It would appear that a distinction between large city areas and rural and small city areas is not particularly significant and that a more realistic analysis would be on the basis of zones constructed to give recognition to the comparable operating conditions in various sections of the country." Presumably, this comment refers to geographical distinctions without regard to the rural or urban character of the areas. It might be noted that throughout the 1930's the experience used in determination of classification differentials for commercial cars was tabulated in five population groups; that the experience outside of New York City was so similar that, except for emergency trucks, a single set of differentials was established; and that when tabulations were resumed after the war the idea of geographical distinctions outside of New York City was abandoned. Perhaps a study of this sort for private passenger cars would be desirable but the experience of the commercial car study may be taken as indicating that in the present extreme pressure of other important considerations in the private passenger car field this may be one of the lesser problems. In addition, we can envision difficulties with supervisory authorities, producers' organizations, and the public generally on grounds of dissimilarity in driving conditions between the states being combined, if we make certain combinations of states rather than maintaining our use of countrywide differentials outside of New York; in all likelihood we would be reduced to a different set of differentials for every state. On the other hand, the present variation between large city and rural or small city areas is in the main recognized as a logical split by the people affected.

In speaking to safety measures generally, Mr. Muir says: "Classification Rating for private passenger automobiles could be synchronized with such insurance to emphasize the beneficial results which would accrue to policyholders as a result of safer operating conditions."

This is a few cautious steps short of the stand taken by our old leader, Mr. Whitney, in an article entitled "The Future Development of Casualty Insurance" back in 1933: ". . . giving reductions for good conditions is the natural medium through which the companies should make their contribution to the public for accident prevention work. . . . a matter for instance that should be given serious study is the possibility of schedule rating cities for traffic conditions". And in May of 1941 in an article that appears in Volume XXVII in the Proceedings of this Society, Mr. Whitney elaborated his 1933 idea for exploring the possible application of schedule rating principles to territorial rating of automobile liability insurance on private passenger cars. Perhaps some concrete suggestions on the rather general point that Mr. Muir is making would be of value.

Mr. Muir goes on to discuss such topics as "Merit and Demerit", "Driver Education", and "Classification of Safety Devices", reviewing developments to date, and going into the reasons why these features have or have not been reflected in the classification rating system. In connection with his discussion of safety devices he points that there is no evidence to show that they will necessarily improve liability experience, but he makes no mention of the possible effect of certain types of devices on medical payments claims. As respects seat belts, for example, the immediate benefit is to the occupants of the car equipped with seat belts, so that unless all cars are so equipped any reduced costs for this safety feature could not be reflected in the indemnity portion but could only be reflected in the medical payments portion of the rates for bodily injury liability coverage.

Mr. Muir includes in his discussion reference to the consideration that the industry has given to rating automobile liability insurance on a "per operator" rather than on a "per car" basis; certainly no one is better qualified to discuss this particular aspect of the entire subject, which is the cause of so much misunderstanding among insurance department personnel as well as the insuring public today.

The very interesting subject of occupational rating is not mentioned. Studies made as far back as the early 1930's revealed that loss costs varied materially by occupation. In the earliest study that we have, ministers, salesmen, and students were the most hazardous "occupations" in that order. By 1932 students had moved to the top of the list, and ministers were apparently driving with improved circumspection. These studies, with groupings of occupations using cars for business purposes and occupations not so using cars, were the foundation for the original "business use" differentiations, and also for the differentiation of the younger drivers, although this latter differentiation was supported by the "Accident Involvement by Age" data obtained from the Motor Vehicle Department records in certain states. In recent years one of the larger companies made a study of risk by occupation for policy years 1950-1952 and the three most hazardous groups were "military—enlisted personnel", "unemployed"

and "students" in that order; "church men and church workers" are below entertainers, traveling salesmen, and liquor industry personnel are only slightly more hazardous than the legal profession and insurance agents.

In the discussion of young drivers the figures recited are presumably averages, and it must be remembered that they will vary considerably from state to state according to the minimum licensing age, although any figures available indicate clearly the general fact that drivers under age 25 as a group are considerably more accident-prone than drivers over 25 years of age as a group. In referring to assigned risks, the statement is made that all 48 states have adopted plans, but it would be somewhat clearer to emphasize that such plans are voluntary agreements that have been made effective. Perhaps this is a matter of idle semantics.

Although the paper is primarily historical in nature, Mr. Muir has subdivided his subject in a clear and orderly manner and what he has produced is obviously the result of diligent and exhaustive research that has been well directed by his rich experience.

GRADUATION OF EXCESS RATIO DISTRIBUTIONS BY THE METHOD OF MOMENTS

LEWIS H. ROBERTS

Volume XLIV, Page 45

DISCUSSION BY L. H. LONGLEY-COOK

Mr. Lewis Roberts' paper on Graduation of Excess Ratio Distributions by the Method of Moments is not light reading. The paper is highly technical and it is most tempting to set such papers aside for that later study, which never somehow gets done. Nearly all of us are so engaged in the day-to-day practical problems of insurance that we have little time for fundamental research, but it is only by such fundamental research, by the careful consideration of the theoretical justification of our methods, that our Society can carry out the objects set forth in its Constitution.

The problems of the graduation of crude experience data so that it can be presented as a smooth table or tables, which can form the basis of premium rates or charges, is fundamental to actuarial work, is a major feature of the development of a new mortality table and has many applications in the fire and casualty fields, probably none of which is so important as the development of "excess pure premium ratios." As the author points out, previous papers on the subject have appeared in our Proceedings from such authorities as Dorweiler, Bailey and Carleton. The present paper provides a careful development of the appropriate formulae for the variance, skewness and kurtosis of the distribution, taking into account the grouping used in the original data and sampling error.

There is practically nothing on the treatment of sampling error in our Proceedings and the author is to be congratulated for drawing attention to the necessity of taking sampling error into accord in actuarial work, because this is so often overlooked. It might be well to mention that where a mathematical model is available, the mathematical approach based on the model is more statisfactory than the empirical one used by the author.

There are many methods of graduating data and the selection of the most appropriate method is an actuarial skill which can be acquired only by experience. The reading set for our Examination is, perhaps, somewhat deficient in giving instruction in this respect and probably accounts for the frequency with which Pearson type curves are used over other methods. My own view is that an excess table is likely to follow a logarithm curve and a graduation performed in this manner is likely to be more simple and provide a better fit than any other.

In graduation as in all other actuarial work, the use of judgment is most important, and in our concern with the technical details of our work we must never allow this to be forgotten.

Mr. Roberts is to be congratulated on an excellent, painstaking paper which is a valuable addition to our Proceedings.

REVISION OF RATES APPLICABLE TO A CLASS
OF PROPERTY FIRE INSURANCE

C. OTIS SHAVER

Volume XLIV, Page 63

DISCUSSION BY R. M. BECKWITH

A review of Mr. Shaver's paper entitled "Revision of Rates Applicable to a Class of Property Fire Insurance" must be predicated on an appreciation of the point that because of their recent adoption he was not informed, at the time his paper was prepared, of the basic principles and methods of fire rate level adjustments, recommended nationwide fairly recently by Inter-Regional Insurance Conference.

With an appreciation of this point in mind it is understandable that his paper diverges in a number of respects (some matters of detail, some matters of serious moment) from the basic principles and method now recomended generally to fire rating organizations.

In reviewing Mr. Shaver's paper we were struck by a number of rather positive statements, the tone of which implies a certain authenticity for the view expressed, whereas those statments in fact can only represent the views of the author.

Rather than attempting to pinpoint the divergencies mentioned above it occurs to this reviewer that a more constructive course to pursue would be to append the newly adopted Basic Principles for

Rate Level Adjustments as recommended to rating organizations nationwide by Inter-Regional Insurance Conference, together with a detailed statement showing the procedure recommended in the application of those basic principles. That material follows:

INTER-REGIONAL INSURANCE CONFERENCE

BASIC PRINCIPLES—RATE LEVEL ADJUSTMENTS

1. The principle of a 6% underwriting profit factor as set forth in the 1921 Profit Formula of the National Board of Fire Underwriters as modified in the 1949 Subcommittee Report of the NAIC shall be maintained. No over-all rate level adjustment shall be made if the indicated profit is within a tolerance zone of two percentage points above or below such 6% factor.

2. Review of over-all rate level shall be annual; however, it is not the intent to require annual adjustment of rate levels.

3. Underwriting profit as referred to above shall be determined with use of direct earned premiums and incurred loss and incurred expense figures without regard to reinsurance.

4. All available and relevant premium and loss statistics, including loss adjustment expenses, of member and subscribing stock companies, adjusted to reflect current tariff rate levels, shall be used. Loss adjustment expenses shall be included with loss statistics. The premium and loss statistics of other companies may be included in the determination of actual and adjusted loss ratios to the extent that the use of such loss experience is necessary and pertinent.

5. In the case of fire rate levels the loss experience of not less than the most recent 5-year period shall be used, while in the case of windstorm or extended coverages which involve the windstorm peril the loss experience of not less than the most recent 10-year period shall be used.

6. As to expenses other than loss adjustment expenses, only the experience of member and subscribing stock companies reflecting comparable methods of operation and acquisition costs during the most recent available year shall be used. Such expense figures shall be treated as a unit and shall not be separated into their several components.

7. Due consideration shall be given to loss experience, expenses and all other relevant factors within and outside the State, including the important element of informed judgment and the reflection of all developments and trends which may affect prospective loss experience and expenses.

INTER-REGIONAL INSURANCE CONFERENCE

New York, New York

RECOMMENDED PROCEDURE FOR RATING BUREAU REVIEW OF THE OVERALL FIRE RATE LEVEL BY STATE

I. OBJECTIVES:

It is the purpose of this procedure to determine in a reasonable and uniform manner the overall fire underwriting experience within the State and the indicated overall fire rate level adjustment, in reflection of the nationwide recommended "Basic Principles—Rate Level Adjustments" and consistent with applicable statutory requirements. The "weighting" of the overall earned fire premiums adjusted to reflect current rate levels over a period of six years is contemplated, as well as the "weighting" of incurred losses for the same period. This "weighted loss ratio" method, previously recommended as appropriate and reasonable on the basis of considered judgment, is designed to enhance the effect of the experience of the more recent years in order to provide a more accurate reflection of the experience as of the date of the rate level review. The indicated overall fire rate level adjustment, if any, will serve as a guide to such revisions in class or schedule rate levels within the State as are felt to be appropriate and desirable in reflection of the classified experience.

It is also the purpose of this procedure to utilize to the maximum extent the pertinent and available loss and expense statistics developed by the Actuarial Bureau of the National Board of Fire Underwriters, including the early overall data newly available for the immediate past year. This latter arrangement will minimize the delay otherwise unavoidable due to the time required for development of annual classified experience.

II. STATISTICS:

This procedure contemplates use of the following fire statistical data, available by State from the Actuarial Bureau of the National Board and from other sources:

(a) *Direct Written Premiums and Paid Losses*—National Board classified experience *by year* for five years.

(b) *Direct Written Premiums and Paid Losses, Immediate Past Year*—The overall experience of the immediate past year, which in the Spring of the next year (in the absence at that time of classified data) will be furnished together with Incurred Losses by the National Board from Company Annual Statements as filed with the Several State Insurance Departments.

NOTE: As to both (a) and (b), the overall written and paid loss experience of other member or subscriber Stock Companies not included in the National Board statistical data should be obtained from other authorized statistical agencies or from Company Annual Statements; also, other member or subscriber (non-Stock) Company loss experience may be obtained, where necessary and pertinent and as available, from other authorized statistical agencies or from Company Annual Statements.

(c) *Direct Earned Premiums and Incurred Losses*—National Board classified experience *by year* for five years (first available in 1953), exclusive of the immediate past year for which classified data will not be available until later in the next year. With this data is indicated the total Written Premiums of those same Stock Companies reporting Earned-Incurred experience to the National Board, with which Earned to Written Premium ratios can be derived. The Paid Loss totals by year of those same Stock Companies reporting such Earned-Incurred experience may be secured from the National Board upon request, with which Incurred to Paid ratios can be derived.

NOTE: For the immediate past year the Incurred to Paid ratio can be derived from the overall totals of Paid and Incurred Losses which will be furnished in the Spring of the next year by the National Board; estimated Earned to Written Premium ratios for the immediate past year will also be furnished by State.

(d) *National Board Totals of Insurance Expense Exhibits of Reporting Subscribers*—This annual nationwide exhibit may be secured from the National Board upon request, from which the countrywide allocated fire Loss Adjustment Expense ratio related to Earned Premiums may be obtained for the most recent year available.

(e) *National Board Composite Totals of Expense Data*—These are annual State expense totals (including Loss Adjustment Expenses) together with the total direct premiums written by the same reporting Companies, from which the Stock Company fire expense ratio may be derived for the most recent year available, and from which an earned premium-expense ratio can be calculated as set forth in the following procedure. This data may be secured from the National Board upon request.

III. RECOMMENDED PROCEDURE:

The statistical data referred to under II above is applied as follows:

1. *Overall Stock Company Direct Written and Paid Experience— Major Peril 10:*

These are the annual totals of the National Board classified experience on a Direct Written Premium and Paid Loss basis for the 5 years

prior to the immediate past year. The similar overall Written-Paid experience for the immediate past year s compiled in the Spring of the next year by the National Board is to be included pending availability of classified experience. To these totals by year should be added the experience by year of other member or subscriber Stock Companies not included in the National Board experience, which may be obtained from other authorized statistical agencies or from Company Annual Statements.

NOTE: To the above Stock Company experience by year may be added, if necessary and pertinent, the experience of other member or subscriber (Non-Stock) Companies from Company Annual Statements or from other authorized statistical agencies.

2. *Adjustment of Overall Written Premiums to Current Rate Levels:*

The estimated overall net effect to the date of review of all class or schedule rate revisions, and other changes having rate level effect, which have been made during the six year experience period under review should be applied to the foregoing Direct Written Premiums to arrive at Adjusted Direct Written Premiums by year reflecting current rate levels. The method of calculation of the factors by year is set forth in the attached example.

3. *Derivation of Earned to Written and Incurred to Paid Ratios:*

These State ratios should be calculated *by year* from the totals of the direct Earned-Incurred classified experience compiled by the National Board for Major Perils 10 and 11, related to the indicated or available total Written Premiums and Paid Losses of the same Stock Companies reporting Earned-Incurred experience to the National Board.

NOTE: The totals of the direct Written-Paid classified experience compiled by the National Board should *not* be used in calculating these ratios inasmuch as these totals do not reflect the experience of exactly the same Companies reporting Earned-Incurred classified experience. For the immediate past year the Incurred to Paid ratio can be derived from the overall totals of Paid and Incurred Losses which will be furnished in the Spring of the next year by the National Board; estimated Earned to Written Premium ratios for the immediate past year will also be furnished by State.

NOTE: If at the time of overall rate level review the Earned-Incurred classified experience for the immediate past year is available from the National Board, the ratios calculated from this classified experience should be used in lieu of the foregoing.

4. *Calculation of Adjusted Earned-Incurred Experience:*

The State ratios derived under Step 3 should be applied against the Adjusted Direct Written Premiums and Direct Paid Losses by year

to arrive at the Adjusted Direct Earned Premiums and Direct Incurred Losses.

5. *Derivation of "Weighted Loss Ratio":*

   (a) The following factors, previously recommended as appropriate and reasonable relative "weightings" on the basis of considered judgment, should be applied by year to the Adjusted Direct Earned Premiums and Direct Incurred Losses developed under Step 4:

Most recent year	30%
Preceding Year	25%
Next Preceding Year	15%
Next Preceding Year	10%
Next Preceding Year	10%
Next Preceding Year	10%

As illustrated in the attached example, the 6-year totals of Weighted Adjusted Direct Earned Premiums and Weighted Direct Incurred Losses should then be used to calculate the Weighted Adjusted Earned-Incurred Loss Ratio, which does not include Loss Adjustment Expenses.

   (b) To the foregoing Loss Ratio should be added the nationwide allocated fire Loss Adjustment Expense Ratio for the most recent year available to arrive at the Weighted Adjusted Earned-Incurred Loss Ratio (including Loss Adjustment Expense Ratio). This Loss Adjustment Expense Ratio related to Earned Premiums should be obtained from the National Board annual exhibit "Totals of Insurance Expense Exhibits of Reporting Subscribers."

6. *Calculation of Stock Company Fire Expense Ratio for the Most Recent Year Available, Less Loss Adjustment Expense Ratio:*

   (a) From the National Board annual exhibit of "Composite Totals of Expense Data" by State for the most recent year available, which include Loss Adjustment Expenses, calculate the State ratio of Fire Expenses to the Total Written Premiums for the same Stock Companies reporting such expenses.

NOTE: This ratio should be for the same year used in 5 (b).

   (b) Calculate the ratio of *Stock Company 6-year unweighted* Adjusted Written Premiums (Step 2 above) to 6-year *unweighted* Adjusted Earned Premiums (Step 4 above).

   (c) The Written Premium Expense ratio for the most recent year available calculated under (a) is adjusted to an Earned Premium basis by application of the Written-Earned Premium ratio calculated under (b).

    (d) From this Earned Premium Expense ratio subtract the allo-
cated fire Loss Adjustment Expense Ratio for the same year
((b) above) to arrive at the Earned Premium Expense ratio
(excluding Loss Adjustment Expense Ratio) for the most re-
cent year available.

7. *Calculation of the State Indicated Overall Fire Rate Level Ad-
justment:*

    (a) To the Stock Company Earned Expense Ratio for the most re-
cent year available (6 (d) above) add the 6% Underwriting
Profit Factor.

    (b) Subtract the combined ratio as determined under (a) from
100.0% to arrive at the current "Balance Point" Loss Ratio.

    (c) The Weighted Adjusted Earned-Incurred Loss Ratio (includ-
ing Loss Adjustment Expense Ratio), determined under 5 (b)
above, divided by the foregoing "Balance Point" Loss Ratio re-
sults in the Indicated Overall Fire Rate Level Adjustment on
a percentage basis, illustrated as follows from the attached
example:

$$\frac{\text{Weighted Adjusted Earned-Incurred Loss Ratio (incl. Loss Adj. Exp.} = 56.2\%}{\text{"Balance Point" Loss Ratio} = 50.0\%} \times 100 = 112.4\% - 100\% = +12.4\% \text{ (Increase)}$$

NOTE: No Overall Fire Rate Level Adjustment is indicated if
the Weighed Adjusted Loss Ratio is within a tolerance zone of two
percentage points above or below the "Balance Point" Loss Ratio. In
the event the Weighted Adjusted Loss Ratio is less than the "Balance
Point" Loss Ratio, an Overall Fire Rate Level decrease would be in-
dicated, e.g.:

$$\frac{\text{Hypothetical Weighted Adjusted Earned-Incurred Loss Ratio (incl. Loss Adj. Exp.)} = 43.5\%}{\text{"Balance Point" Loss Ratio} = 50.0\%} \times 100 = 87.0\% - 100\% = -13.0\% \text{ (Decrease)}$$

8. *Indicated Overall Annual Fire Premium Adjustment in Dollars:*

In order that the percentage Indicated Overall Fire Rate Level Ad-
justment (under 7 (c) above) may serve to best advantage as a guide
to such revisions in class or schedule rate levels within the State as
are felt to be appropriate and desirable in reflection of the classified
experience, this percentage should be expressed in dollars of indicated
overall annual fire premium adjustment.

Accordingly, it is suggested that the percentage Indicated Overall Fire Rate Level Adjustment be applied to the actual written premium total for the most recent year for which classified experience is available to arrive at an approximate dollar figure of indicated overall annual fire premuim adjustment on an actual written premium basis.

IV. COMMENTS:

(a) *Annual Overall Review*—As set forth in the nationwide recommended "Basic Principles—Rate Level Adjustments", a review of the overall fire experience should be made annually and in the manner outlined above. It is not, however, the intent that class or schedule rate level adjustments be required annually.

(b) *Class or Schedule Rate Level Adjustments*—The indicated overall fire rate level adjustment, arrived at in the manner outlined above, is intended to serve as a guide to such revisions in class or schedule rate levels within the State as are felt to be appropriate and desirable in reflection of the classified experience and all other relevant factors within and outside the State, including the important element of informed judgment and the reflection of all developments and trends which may affect prospective loss experience and expenses.

NOTE: Even though an overall fire rate level adjustment is not indicated, the classified experience should be reviewed to determine any class or schedule rate level revisions within the State which may be felt to be appropriate and desirable in reflection of the classified experience or to maintain rate level relativity.

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DISCUSSION OF PAPERS READ AT THE

MAY 1958 MEETING

Auto B.I. Liability Rates—Use of 10/20 Experience in the
Establishment of Territorial Relativities

Martin Bondy

Volume XLV, Page 1

Discussion by LeRoy J. Simon

Many times an actuary is confronted with a problem for which no exact solution exists or for which the cost, in either time or money, of obtaining an exact solution makes it prohibitive. In such cases we often have an idea of the range within which the exact solution lies or we know that we will take some positive action if the solution is

within certain bounds. To assist in making the decision, a hypothesis is advanced and then tested for "reasonableness". This hypothesis must be skillfully formulated so that the solution we arrive at for our problem has the maximum probability of being the exact solution. In testing the hypothesis, rigorous mathematical proofs will be used and the best statistical or actuarial tools will be employed. When we now reach the point of drawing a conclusion, the difference between a "reasonable" solution and an exact solution becomes apparent. If we have an exact solution, there is little difficulty because it is final, unique and not subject to argument—the conclusion to be drawn should be an obvious one. A "reasonable" solution is quite different because it is only *one* reasonable solution to the problem and it does not preclude other reasonable solutions from equal acceptance. This brings out clearly that the actuary is more than a technician applying certain mathematical developments to the data available to him. He must continually draw on a broad background of knowledge and experience so that his reports will include important judgment decisions on the most appropriate solution to a given problem. When judgment affects the final conclusion, reluctance to concede that an exact solution has not been achieved too often leads us to gloss over this fact. I feel we should instead spotlight the judgment area and indicate the line of reasoning followed. Actuarial judgment will thus emerge and be evaluated alongside our other working tools. If it is good, it will stand the test.

The problem which Mr. Bondy sets out to solve quite clearly involves this concept of a "reasonable" solution. One way of stating the problem presented in his papers is: "Will the possible range of chance error introduced by allowing rates to be made at 10/20 limits instead of 5/10 limits fall within a reasonable tolerance?" Once the confidence limits of the values have been found by employing certain statistical tools, the question of reasonableness still remains. The author concludes in the paper that his results *are* reasonable for the purpose to which they will be put. Note that this is just one of many reasonable solutions to this problem. If the results had been $35 \pm $3, instead of $35 \pm $1, the author's conclusion might have been the same. On the other hand, someone else may conclude that $35 \pm $1 is not a reasonable tolerance and the use of judgment comes into play.

The practical workmanship of Mr. Bondy's paper makes it a valuable addition to the Proceedings. He had a practical problem to solve in the course of rate making deliberations and he proceeded to apply certain tools in its solution. In setting up the 90% confidence limits, there would be two alternatives with a skew distribution such as the Poisson distribution: (a) determine k such that $|-k| = |+k|$ and that 90% of the curve lies between the two points or; (b) determine a value $(+k_1)$ such that 95% of the curve lies below it and a value $(-k_2)$ such that 5% of the curve lies below it. The more usual method used is alternative (b). The table below compares the author's results

under alternative (a) with the results under alternative (b) for the four cases discussed in the body of the paper.

		Number of Claims Used in Establishing the Limits of the 90% Confidence Interval*	
Number of Claims	"True" Pure Prem.	Alternative (a)	Alternative (b)
135	$35.00	±20	−19, +21
68	32.75	±13	−13, +14
270	39.75	±27	−26, +28
26	57.00	± 8	− 8, + 9

The largest difference is only one claim and therefore will not affect the conclusions at all.

In the opening paragraphs of the paper, the author sets forth the assumption of a .03 excess loss claim frequency and a $4500. average excess loss cost. Using the letters f and A to represent frequency and excess claim amount, respectively, we realize that the pure premium for the excess limits range between 5/10 and 10/20 is given by

$$P = \frac{\Sigma A_i}{E} = \frac{n\left(\frac{\Sigma A_i}{n}\right)}{E} = \frac{n\overline{A}}{E} = f\overline{A}$$

where E = exposure, n = number of claims, $\overline{A}$ = average amount and P = pure premium. The author then sets out to study the effect of chance variation on P. He does this by studying the effect of chance variation in f and multiplying by the average value $\overline{A}$. However, no consideration is given to the effect of chance variation in $\overline{A}$. Is it not the concomitant variation of f and $\overline{A}$ that causes variation in P? Unless each excess loss claim is to have its actual value replaced by some fixed value when rates are made, there is also the sampling error in $\overline{A}$ to reckon with.

A number of lines of attack seem open at this point. Mr. A. L. Bailey has considered an empirical solution to this problem.** This would probably be the best to follow using the logarithmic transformation and establishing the probability distribution directly. Extensive loss distributions are necessary for this, however, and these are not conveniently available.

A second method of measuring this concomitant variation would be to apply the formula from mathematical statistics***:

(Footnotes on next page.)

$$\left(\frac{\sigma_P}{\overline{P}}\right)^2 = \left(\frac{\sigma_n}{\overline{n}}\right)^2 + \left(\frac{\sigma_{\overline{A}}}{\overline{A}}\right)$$

where σ designates standard deviation and bars designate means. This approach would require a subdivision of the rate making data (probably into one year blocks of information) so that two or three estimates of n and $\overline{A}$ could be made. From theory, $\sigma_n = \sqrt{n}$ and $\sigma_{\overline{A}}$ could be calculated directly from the data. The equation above could then be solved for σ_P.

It might also be possible to calculate the standard deviation of $\Sigma\overline{A}_i$ by direct reference to the subdivided data mentioned previously. The ratio of the mean value of $\Sigma\overline{A}_i$ to its standard deviation would equal σ_P the ratio of P to which could then be solved for σ_P.

In summary, I like the problem solving approach of the paper, feel that confidence interval should be asymmetrical, and fear that the intervals will be larger than the paper implies if we take into account the joint variation in the claim frequency and the size of loss.

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*Results in the two smaller cases taken from "Poisson's Exponential Binomial Limit." E. C. Molina. Van Nostrand, New York. 1945. The two larger cases utilized the formulas m upper $= \frac{1}{2}\chi^2_{05}$ for 2(m+1) degrees of freedom and m lower $= \frac{1}{2}\chi^2_{.95}$ for 2m degrees of freedom taken from "Statistical Theory with Engineering Applications." A. Hald. 1952. John Wiley and Sons, Inc. In addition, it was necessary to use the fact that $\sqrt{2\chi^2} - \sqrt{2(\text{degrees of freedom})} - 1$ is distributed normally with a unit variance.

**Sampling Theory in Casualty Insurance, Arthur L. Bailey. P.C.A.S. XXIX page 50 and XXX page 31.

***Statistical Theory with Engineering Applications. A. Hald. 1952. John Wiley and Sons, Inc.