For example, there was recently one very large public official loss on which there appeared to be a substantial early salvage collected. However, at least a portion of what appeared to be salvage was actually nothing more than a revision in the estimate of incurred loss. As the investigation of the case proceeded, it developed that the actual monetary obligation of the fidelity carrier was not as great as was first thought, and the reduction in the incurred loss amount was reported as salvage collected.

Another example of the difficulty in defining salvage is found in the case of disappearance of securities. Frequently a fidelity carrier will be issued duplicates of the securities which are held by the carrier for a period of time until it seems evident that the original will not be recovered. When this becomes evident, the carrier disposes of the duplicates for whatever price they will bring, and thus recovers salvage on the loss. The question is how to treat these security holdings prior to the time they produce actual salvage.

Similarly, if money from an embezzlement has been invested in real estate, the fidelity carrier frequently will issue a mortgage on the real estate, and use the monthly mortgage payments as salvage on the original loss. Thus, the salvage is reported over a period of time when actually the value of it is pretty much known soon after the discovery of the loss.

In summary, this paper is a very valuable first step in taking a new approach to fidelity ratemaking. The author has well stated the problems which require further investigation and has made some sound and constructive proposals for basing fidelity rates on statistical information.

THE COMPENSATION EXPERIENCE RATING PLAN—A CURRENT REVIEW

BY

DUNBAR R. UHTHOFF

Volume XLVI, Page 285

DISCUSSION BY R. M. MARSHALL

Mr. Uhthoff's paper serves the admirable purpose of bringing into focus the underlying features of the Experience Rating Plan Manual—1940 for Workmen's Compensation and Employers' Liability Insurance and further enlarging some of these features so that they can be examined for possible defects. Mr. Uhthoff also sets forth some of the considerations of the Subcommittee of the National Council Actuarial Committee regarding remedies for the seeming defects. I feel that the Society is indebted to Mr. Uhthoff for his timely paper.

Having spent many of these "happy hours," referred to by Mr. Uhthoff with the Subcommittee in its consideration of the Plan, it is hoped a report on the conclusions of the Subcommittee and a few comments will be in order.

The main defects of the present Plan appear to be two in number:

(1) It has failed to keep pace with the change in economic conditions, as evidenced by the continuing decrease of the ratio of primary losses to total losses.

(2) Under certain conditions the credibility formulas may give more than 100% weight to "primary" losses, although the average credibility for a risk could not exceed 100%.

With respect to defect number (1), it may be noted that the experience rating plan which was in effect prior to the 1940 Plan had a sort of "built-in inflation corrector" which tended to keep it abreast of economic conditions, at least to the extent they were reflected in the various state compensation acts. Under this previous plan the dividing line between "normal" and "excess" for indemnity losses was set at fifty times the maximum weekly compensation. Thus as economic conditions forced an increase in the maximum weekly compensation, the normal losses as used in experience rating were correspondingly increased. Also defect number (2) was prevented by the actual use of normal credibility and excess credibility, read from a table, in the formula for the experience rating modification.

As indicated by Mr. Uhthoff in his paper, formula (1) $A_p = 500 + 500(2/3) + 500(2/3)^2 + \ldots$ etc., when summed to infinity produces a maximum primary value of only $1,500. Therefore as the average cost per case goes up, the ratio of primary to total goes down. Furthermore, while the maximum primary may be increased by increasing the 500 unit or the 2/3 ratio, or both, it is rather difficult to calculate the effect of such changes. In fact not much of anything can be done without first making up a table of total losses and corresponding primary losses similar to Table I of the 1940 Experience Rating Plan. The Subcommittee experimented with various changes in both values and decided that a formula, $A_p = 750 + 750(4/5) + 750(4/5)^2 +$ etc. would produce about the desired pattern in state average ratios of primary losses to total losses (sometimes referred to as the average D ratio).

However after testing the effect of this revised formula on actual risks, it was felt that this might produce changes which were too drastic to be readily acceptable. It was noted that if a formula such as Mr. Uhthoff's formula (15) were adopted

$$\text{"}A_p = \frac{A}{A + 3{,}000} \times 3{,}750 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (15)\text{"}$$

the curve showing the relationship of A_p to A was not as steep for the lower range of values of A, nor did it flatten out as fast for the higher range of values of A, as did the geometric series type curve. A look at the appended graph showing the relationship of A_p to A will make this clear. The Subcommittee felt that these were both desirable characteristics. Formula (15) of course has the same maximum value of 3,750 as the geometric series, but due to the different shape of the curve produces somewhat lower D ratios.

Formula (15) as Mr. Uhthoff points out is vastly superior for machine calculation, particularly for electronic computers. For example in summarizing Workmen's Compensation Unit Statistical Plan data at the Council, one of

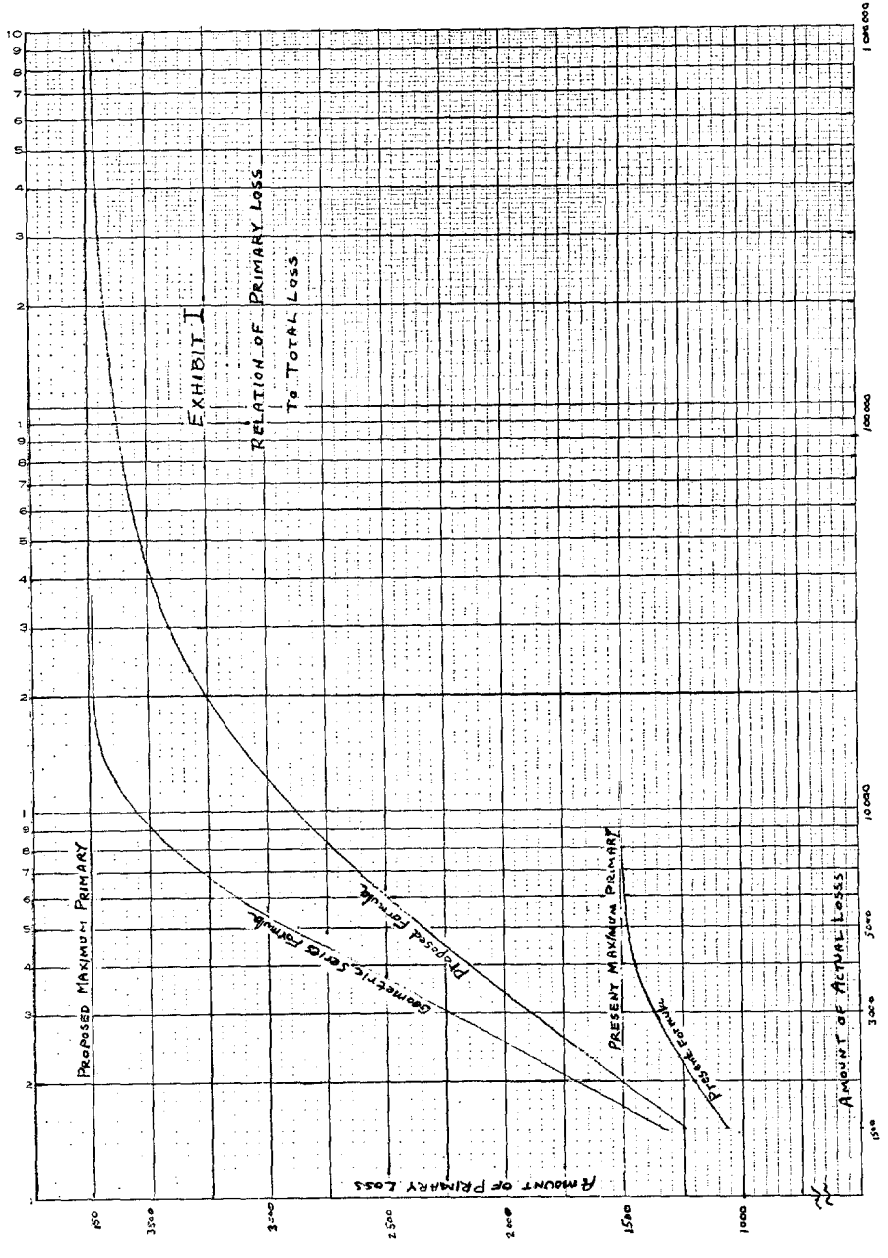
EXHIBIT I.
RELATION OF PRIMARY LOSS
TO TOTAL LOSS
PROPOSED MAXIMUM PRIMARY
PROPOSED FORMULA
GEOMETRIC SERIES FORMULA
PRESENT MAXIMUM PRIMARY
PRESENT FORMULA
AMOUNT OF PRIMARY LOSS
AMOUNT OF ACTUAL LOSS

the steps included in the program could be to add the indemnity and medical on each case and divide the total by the total plus 3,000. The resulting ratio could be either punched out or stored. At the end of the summary process we would have the summation of total losses and summation of the ratio $\frac{A}{A + 3{,}000}$. The summation of this ratio when multiplied by 3,750 gives the summary of primary losses for the state. In this summary process some special treatment is required for cases where the total loss is less than 750, or the primary loss will be greater than the total losses. These cases can be held out from the summary process and added in later as 100% primary, or a further condition put into the computer program that $A + 3{,}000$ must equal at least 3,750.

If this summary is made separately for serious loss, non-serious loss, and non-compensable medical losses (although we would not expect a non-compensable medical case over 750) we have the material for calculating classification D ratios directly from proposed pure premiums, by weighting such partial pure premiums by

$$\text{Serious P. P. Weight} = \frac{\text{Total Primary Serious Losses (Indemnity + Medical)}}{\text{Total Serious Indemnity Losses}}$$

$$\text{Non-Ser. P. P. Weight} = \frac{\text{Total Primary Non-Serious Losses (Indem. + Med.)}}{\text{Total Non-Serious Indemnity Losses}}$$

$$\text{Medical P. P. Weight} = \frac{\text{Non-Compensable and Contract Medical Losses}}{\text{Total Medical Losses}}$$

Before leaving this subject, a comparison of a normal value equal to fifty times the maximum weekly compensation in 1940 and today with the corresponding primary value for various size losses under the present Plan and as proposed may be of interest. In 1940 a maximum weekly compensation of $20 was common, today the figure is nearer $40. The comparison follows:

Size of Total Loss	Normal at 50 Times Maximum Weekly Comp.		Primary Under Multi-Split Plan	
	1940	Now	Present	Proposed
500	500	500	500	500
1,000	1,000	1,000	830	940
2,000	1,000	2,000	1,200	1,500
3,000	1,000	2,000	1,370	1,870
4,000	1,000	2,000	1,440	2,140
5,000	1,000	2,000	1,470	2,340
7,500	1,000	2,000	1,500	2,680
10,000	1,000	2,000	1,500	2,880
20,000	1,000	2,000	1,500	3,260
50,000	1,000	2,000	1,500	3,540
100,000	1,000	2,000	1,500	3,641

Although we still do not have any automatic transition that will keep pace with economic conditions, we at least have a gear shift lever in the formula $A_p = \frac{A}{A + 3{,}000} \times 3{,}750$ which will make it easier to shift up in the future when conditions warrant.

We now come to defect number (2), "the credibility formulas may give more than 100% weight to primary losses." Under the formulas for modification $M = \frac{A_p + K}{E_p + K}$ below the Q-point, or $M = \frac{A_p + WA_e + B}{E_p + WE_e + B}$ above the Q-point, there is no indication as to what the primary credibility or the excess credibility, or even the average credibility, may be. In fact even to calculate the average credibility we resort to the axiom that "the average credibility is equal to the credit for clear experience, i.e. no actual incurred losses". And since we are occassionally exceeding 100% primary credibility without any apparent serious consequences, the question may arise, "Why worry about a primary credibility greater than unity as long as the average credibility is less than unity?"

To the actuarial mind the idea of a credibility greater than unity is unacceptable; it corresponds to the absurdity that the probability of an event happening is greater than certainty. To be actuarially sound the Plan should be corrected so that neither the primary nor the excess credibility can be greater than unity, regardless of whether or not the actual credibility figure may be readily determined.

The question may arise as to how it comes about that primary credibility may be greater than unity. The formulas underlying the Old Experience Rating Plan were comparatively precise. Actual and expected losses were divided into normal and excess, normal and excess losses were assigned separate credibilities from a table depending upon the formulas $Z_n = \frac{P_n}{P_n + K_n}$ and $Z_e = \frac{P_e}{P_e + K_e}$ supplemented by a straight line drawn from an empirically selected self-rating point to be tangent to the curves represented by the above formulas. While being actuarially precise, the rating procedure was rather slow and cumbersome, required table look-ups on every risk, and did not lend itself readily to interstate experience rating.

The 1940 Plan, on the other hand, was greatly simplified and required a minimum of table look-ups. However, when the formula for modification

$$M = \frac{A_p + WA_e + B}{E_p + WE_e + B}$$

were substituted in Mr. Uhthoff's formula (2), the formula for modification

expressed in terms of Z_p and Z_e, it is found that Z_p equals the ungainly expression $\frac{E}{E_p + WE_e + B}$, as shown in Mr. Uhthoff's formula (3).

At and below the Q-point, as Mr. Uhthoff brings out in his paper, $W = O$ and therefore $Z_p = \frac{E}{E_p + B}$. It is evident from this that B must be chosen so that it is always greater than E_e, no matter what the ratio of E_p/E (commonly known as the D ratio) may be. One sure way to accomplish this would be to set B greater than the total expected losses at the Q-point. Other considerations, mainly, that the charge ($\triangle$ M) for a maximum loss for a risk which is of such size as to just qualify for experience rating shall be 25%, prevents the B value (or K value as it is termed for values of E below the Q-point) being set that high.

This suggests the possibility of a variable B value below the Q-point; as the value of E decreases below the Q-point B could also decrease and we would still be assured of Z_p value less than 1.000. This however would seriously detract from the simplicity of the rating formula $M = \frac{A_p + K}{E_p + K}$, where K is constant, which presently applies to the great majority of risks. The most we can do is to try to guess what the minimum ratio of E_p/E will be and juggle our Q-point and K values, and hope for the best.

For simplicity, the above discussion has been restricted to total expected losses below the Q-point. Some figures which were worked out for the Subcommittee showing the minimum value for a classification D ratio at the Q-point for a number of states, may be of interest. Such minimum D ratio is called here the "Critical D Ratio"; if the risk average D ratio falls below this amount, the primary credibility will become greater than 1.000. The table follows:

State	Critical D Ratio	State	Critical D Ratio
Alabama	.36	Kansas	.48
Connecticut	.48	New Mexico	.39
Florida	.45	Virginia	.36
Georgia	.39	Wisconsin	.48

Examination of Table II of the Experience Rating Plan for Compensation shows D ratios for a number of classifications in some of the above states, already below the above critical values.

Above the Q-point the chance of a primary credibility greater than unity is even greater than at the Q-point. A relatively simple calculation will determine the critical value for D at various premium sizes. On the basis of the present rating values for Wisconsin, which assume a "g" value of .40, the minimum allowable D ratio to prevent Z_p exceeding 1.000 varies with the risk expected losses, as follows:

	E	W	B	Critical D
Less than	10,500	.00	5,500	.476
	13,095	.01	6,460	.502
	23,475	.05	10,094	.547
	36,450	.10	14,175	.568
	75,375	.25	23,344	.587
	140,250	.50	28,375	.595
	205,125	.75	20,594	.598
	244,050	.90	9,775	.599
	257,025	.95	5,144	.600
	267,405	.99	1,070	.600
	270,000 and Over	1.00	0	Self-rated

This difficulty could probably be solved by increasing the value of "g" (the maximum excess ratio). This of course would require careful consideration of the effect this would have on the various rating values and resulting modifications.

The Subcommittee however favored the approach set forth by Mr. Uhthoff in Section V of his paper, namely to use a calculated value of $\frac{E_e}{E}$ for each risk in place of "g". The procedure outlined in the paper of replacing $W = \frac{E\text{-}Q}{S\text{-}Q}$ by $W = \frac{E}{S}$, of removing the square of the coefficient of K in Mr. Uhthoff's formula (17) was followed. It was discovered that if these steps were followed Z_p turned out to have the value $\frac{E}{E+K}$ as Mr. Uhthoff points out, and the possibility of a primary credibility greater than unity was thus permanently eliminated. $Z_e = W \cdot Z_p$ as before. Inserting these values of Z_p and Z_e in formula (2) produces revised formulas for modification as follows:

$$M = \frac{A_p + E_e + K}{E_p + E_e + K} \text{ below the Q-point and}$$

$$M = \frac{A_p + WA_e + (1\text{-}W)E_e + B}{E_p + WE_e + (1\text{-}W)E_e + B} \text{ above the Q-point, where } B = K\,(1\text{-}W)$$

These formulas are given in a somewhat different form from the corresponding ones in Mr. Uhthoff's paper, in order to show their similarity to the present formulas for modification. It may be noted that the difference from the present formulas is the presence of a factor $(1\text{-}W)E_e$ in both the numerator and denominator, and, of course, a different formula for B. Many of you will recognize these formulas as those which apply in California. In order to use this formula, it is merely necessary to amend the present intrastate experience rating form by adding a block to include $(1\text{-}W)E_e$ in the numerator and denominator of the fraction representing the modification, where Tables of B and W values would be printed, i.e. adopt the California intrastate form.

Since the revised formula for B is K(1-W) the modification formula may be modified to

$$M = \frac{A_p + WA_e + (1\text{-}W)\ (K+E_e)}{E_p + WE_e + (1\text{-}W)\ (K+E_e)}$$ where $(K+E_e)$ would be calculated for each risk with no table look-up for B.

This in turn suggests a procedure for interstate rating during the transition period until approval of the revised formulas can be secured in all states. Under the present interstate rating procedure B and W values are calculated for each state on the basis of the risk's total expected losses and are then weighted by the expected losses for each state to determine average B and W values to use in the rating. During the transition period, let the term common to numerator and denominator for states using the revised formulas, namely $(1\text{-}W)\ (K+E_e)$, be set equal to B′. A value of B′ for each new-formula state could be calculated using $K = 7{,}500$, E_e equal to the total expected excess losses for the risk using old-formula states and new-formula states, and (1-W) calculated on the basis of a W value for each new-formula state calculated on the basis of the total expected losses for all states included in the rating. Then B′ values for the new-formula states could be averaged with the B values for the old-formula states to determine an average B value. Average W values could be determined as at present, and the calculation of the interstate modification could then proceed in the usual manner.

When all states have adopted the revised formula, it can be demonstrated that the average value of B′, as defined in the previous paragraph, is equal to $(K+E_e)\ (1\text{-}W_{aver.})$. Therefore there would be no need to calculate values of B′ by states; an average W value calculated in the usual manner would be sufficient.

In closing it may be noted that the Subcommittee recommended a universal Q-point of 10,000 and a universal K value of 7,500. If the self-rating points could be consolidated into only a few different values, the number of tables of W and B values required could be greatly reduced from the present number. The Subcommittee is currently investigating the possibility of a revised basis for establishing the self-rating point.

DISCUSSION BY R. A. JOHNSON

Mr. Uhthoff is to be congratulated for a fine technical analysis of the various components of the Multi-Split Experience Rating Plan. Were certain of his suggestions to be adopted, particularly his proposed method of determining primary losses, the Plan could no longer be called by that name, as is proved by the title of his paper. This paper should be, or may already have been, of considerable value to the Subcommittee of the National Council Actuarial Committee on whose shoulders the task of considering possible revisions of the Experience Rating Plan has been placed.

While admiring the excellent handling of technical details on the one hand, this writer failed to be impressed by Mr. Uhthoff's underlying premise, namely, that a major change in the present Plan is required. The school of