ABSTRACT OF THE DISCUSSION OF PAPERS READ AT THE PREVIOUS MEETING

MECHANIZED UNIT REPORTING

H. T. BARBER
Volume XXXIII, Page 5
Written Discussion
R. P. GODDARD

The very title of this paper brings to some minds the thought of push-button statistics, of simply deciding upon what is wanted and "letting the machines do the work". Mr. Barber makes clear, though with due modesty he does not stress, the careful planning and continual vigilance which is required to maintain the 80-column accuracy which is a preriquisite for success in a large scale undertaking of this kind. The report indicates that the development of the mechanical process was facilitated by previous experience with the use of continuous forms in typing unit reports under the method previously employed. Every punch card is verified and carefully guarded while in transit from punching to tabulating, indicating that the personnel has had experience with the maintenance of accounting accuracy with alphabetic equipment. The ingenious use of special type-bars to translate coverage codes into symbols evokes admiration on its own account, but the final accomplishment is no mere trick, to be achieved by anybody merely by the use of special gadgets.

It is to be noted that in the mechanical process described no attempt is made to weave the preparation of unit reports into the regular fabric of accounting and loss reserve records. While this is theoretically possible, it amounts to somewhat of a tour de force for a large company and probably would not produce proportionate savings. In any event, it would not seem advisable for a company which is contemplating the mechanization of its unit reporting procedure to adopt complete mechanization at one plunge.

It goes without saying that a certain amount of adaptability is lost when a mechanical method of the type described is introduced. The fact that the Unit Statistical Plan has remained substantially unchanged over a long period of years, and the further fact that it is still performing a very useful function for both the insurance companies and the public, gives promise that it will not be abandoned or radically modified in the near future. One change which has been discussed would involve the summation of indemnity and medical for individual losses, and to this type of change a mechanical method would probably be more adaptable than the present hand methods.

Mr. Barber does not indicate the extent of the net saving in

personnel, but we can assume for the sake of argument that it was not spectacular, since items not handled in one way must be handled in another, and key-punch operators, tabulators and supervisors are as difficult to obtain as experienced clerks. The principal value of the method lies not in any potential saving in expense, but in the increased efficiency of producing the unit reports themselves, and in the more immediate availability of classification experience for review by all departments of the company. The Society, and the compensation insurance industry generally, is indebted to Mr. Barber for this exposition of this pioneering feat.

N. M. VALERIUS

This is a most clear and concise report of a new method of compliance with a statistical requirement that lays on every carrier of workmen's compensation the burden of preparing a "unit report" or risk history, giving exposures, premiums, and losses in the year in each state as to each assured, to be sent to a central statistical bureau for rate-making purposes

At the outset, the author notes that, in the fifteen years since the papers by Mr. C. M. Graham and Mr. Kormes on the subject of compensation experience unit reporting, the Compensation Unit Statistical Plan has been altered only in relatively minor respects and has become universal in states using the Basic Compensation Manual. Those papers recorded in the *Proceedings* the recent institution of the Plan and reported procedures found effective in the first years of operation.

Mechanized unit reporting as developed and used by Mr. Barber's Company is the first important development in the Unit Plan field since that time. While it does not alter the Plan, as it is only a method of compiling the statistics required in the form required, except for some permutation of the items, it portends a completely mechanized Plan in time.

Mr. Graham's paper still describes essentially the method of compliance by most companies, a description distilled down quite remarkably by Mr. Barber to less than two pages as to his Company in the sub-section, "Unit Reports by Hand". That both of the earlier papers together with the discussions they evoked in the *Proceedings* are included in the "Recommendations for Study" indicates that the methods described are still considered current.

The mechanization of unit reporting has been made possible by developments in business machines, particularly two such, eighty column punch card equipment, and alphabetic punching and tabulating equipment. Eighty column equipment was available but not commonly installed when carriers began to prepare unit reports for rating organizations and as a source of internal statistics. Mr. Masterson had described the use of such equipment at the May 1930 meeting and made some quite perspicacious remarks in respect to it and the

new-fledged Unit Plan, *Proceedings*, Vol. XVI, pp. 307-308.

Alphabetic punching and tabulating equipment was available about the same time but not taken up by insurance carriers until a good deal later.

It would seem that the evolution of the mechanized method of reporting in Mr. Barber's Company arose in part out of the previous method of compiling the reports and in part out of the ingenuity of some members of the staff, among whom he did not include himself. The previous method contributed in this way that the unit reports were being compiled from original sources and then in turn were becoming the source of the Company's own classification experience, via punch cards made from their data, and it was reasoned that a more economical procedure would be to punch first from original sources, then parallelly derive unit and classification experience.

Our office has followed a somewhat different procedure, which may in part explain the slower progress of evolution in its case; possibly also a less ingenious staff should be postulated. Our office had a well-developed risk history card system covering all compensation risks, when the Unit Plan came into being. One card called the registration card carried the items which in the mechanized procedure go on the Name punch Cards, and the Payroll and Premium punch Card, Kind 6, and the other, the incurred cost card, carried the items which in the mechanization go on Loss and Valuation punch Cards, Kinds 7 and 9. The registration card received original entries as a hectograph impression at the time the application was received in the Home Office and all later entries, as audits and endorsements, were made by hand. The incurred cost card was typed up at the time the first claim notice arrived to be listed thereon and was augmented and kept up to date by typed and hand entries as more claim notices or change-of-incurred notices or closed claim notices were received from the claim department.

These risk history cards were used for reviewing individual risk experience for underwriting purposes and, as policy abstracts and claim histories, served other purposes as well. As a consequence, compliance with the Unit Plan consisted essentially in transcribing this information to the required form, although of course there had to be instituted procedures of checking the completeness and accuracy of the reports, and of routing developments after the first report to the attention of the Unit Plan division, and individual claim reports where required had to be written up from the claim files. The Unit Plan was therefore rather readily assimilated into our way of doing things and we have perhaps given less thought to other ways of achieving the result that we might otherwise have.

There has been one change of some moment since the Unit Plan became a factor. Our classification experience was being derived independently of risk histories and Unit Reports, more or less as a by-product of accounting records. The near duplication of effort

began to be evident as the unit Plan took in more territory and it was eventually concluded to expand the Unit Plan to all states for internal purposes and to punch the Home Office copies of the Unit Plan experience for the purpose of tabulating classification experience. This resulted in a considerable saving for the tabulating department in both personnel and machine time, because the volume of separate items to be handled is much reduced by the processing of original sources in making up the Unit Reports. The above developments and perhaps the lack of other developments were influenced in large degree by the situation that the statistical division did not happen at any time to be nearly as severely affected by the man-power shortage as our tabulating department.

It will be remembered that in mechanized unit reporting there is some handwork left in preparing claim reports and the mechanization does not extend to revised and second and later reports. There is an implication on page 15 also that not every bureau has accepted the result.

It is appreciated very much that Mr. Barber made the material of this paper available through the *Proceedings* and in such clarity of presentation. Any staff who might be considering such a system as this should be indeed grateful.

On page 12 at about the middle, the expression "claim cards" seems to be a typographical error for "name cards". The note with Figure 3 on page 19, "These have been prepared", etc., apparently pertains also to Figure 2 on page 18.

If all papers fare as well in the new economical format of the *Proceedings* as this first one, the change may not prove any great hardship.

MULTIPLE INJURY ACCIDENTS AND LOSSES IN EXCESS OF ANY SPECIFIED RETENTION: - PENNSYLVANIA WORKMEN'S COMPENSATION

GEORGE B. ELLIOTT
Volume XXXIII, Page 40
Written Discussion
CHARLES W. CROUSE

Pure premium rates for excess insurance are almost always very difficult to determine because losses of the classes covered by such insurance have occurred so infrequently in the past that it almost impossible to obtain a body of statistics upon the basis of which one can make reliable estimates of the probabilities of their occurrence in the future. Mr. Elliott, in the paper under discussion has presented a great body of statistical material relative to the occurrence of losses of one such class, to wit; the class of Pennsylvania Workmen's Compensation losses in excess of $10,000 in

consequence of a single accident; and thereby he has justly earned the gratitude of everyone who ever has occasion to determine a premium rate for an insurance covering losses of that class. I will not concede, as Mr. Elliott does in the introduction of his paper, that the making of such rates is at present academic, for a considerable number of such insurances are at present being written or renewed and the proper determination of the premium to be charged for them is a matter of considerably more than academic interest to the underwriters thereof and the employers thereby assurred.

However, the value of the paper is not restricted to the problem of determining premium rates for excess insurances covering Pennsylvania Workmen's Compensation losses over $10,000. Anyone seeking statistical information - for whatever purpose - concerning the incidence of industrial accidents will find in the tables of the paper, an array of data on the incidence of accidents resulting in serious injuries or death of two or more workmen, the like of which is not readily to be found in any other article of American publication. For that reason, the paper will be read by persons of diverse callings; and therefore it is especially unfortunate that in the version which appears in the *Proceedings,* there are several irregularities in expression which are likely to confuse readers not thoroughly familiar with the computation of mathematical expectations of loss.*

There is a tacit assumption underlying the method of loss valuation employed in the paper, to which attention should be directed. For each accident which occurred in an operation other than Coal Mining and which caused a given set of one or more injuries (e. g. one permanent total, or five deaths and three major permanents), the value of loss in excess of $10,000 in consequence thereof, was taken to be the mathematical expectation of $10,000 under the present Pennsylvania scale of benefits in consequence of any accident causing a set of injuries similar to the given set in respect to the types of injuries, but without respect to the ages of the disabled or to the number and the ages of the dependents in fatal cases. The value of such expectation was computed on the basis of certain distributions of the claims arising out of

* The term "the amount of the probable excess over $10,000" which appears at the foot of page 43 should be interpreted to mean: The mathematical expectations of loss in excess of $10,000. The words: "the value of these probabilities is as follows", which precede the equations appearing at the foot of page 44, should be interpreted to mean: On the premise that a three-death accident has occurred, the mathematical expectation of loss in excess of $10,000 in consequence thereof, may be computed as follows. A similar remark applies with respect to the interpretation of the words "and their value is" which appear about the set of eleven equations on page 46.

insured Pennsylvania operations, not Coal Mining but otherwise irrespective of classification, in Policy Years 1939 through 1942. Such values were then used in the determination of pure premiums.

Now, the tacit assumption is that in any observation of the form "X deaths, Y permanent totals and Z major permanents were caused by one accident on a risk of class C and Size S", the numbers X, Y, and Z have more statistical significance in respect to the class C and the risk-size S than the numbers of the dependents actually involved in the X fatal cases, their actual ages and relationship, and the actual ages of the Y permanent totals. These later data are tacitly presumed to be so much subject to random fluctuation within any class of risks that a more reliable pure premium for that class will be obtained if the mathematical expectation of loss on account of X deaths, Y permanent totals and Z major permanents, calculated over *all* classes of risks (except Coal Mining), is used as the value of the loss corresponding to each observed event of the XYZ type, in place of values determined separately for each such event by taking into account the age and dependency situations actually found therein.

Now, I do not doubt that on practical grounds the use of this method of loss valuation was justified in the study reported by the paper under discussion; and I do not think that the results are any the less interesting or valuable than they would have been had some other method of valuation been employed. Moreover, I am aware that there is a sentence in the statute law of Pennsylvania* which in effect prohibits the use of the actual number of dependents in any particular fatal case in the valuation of that case for merit rating purposes, and I am aware that this sentence may have been thought to bear some implication concerning the making of rates for excess covers.

But the fact remains that the method of valuation which was used, rests *logically* upon the assumption to which I am inviting attention; and so far as I know, that assumption has not been statistically justified. The data relative to Pennsylvania losses of Policy Years 1939 through 1942 which are set forth in the paper, indicate that there is a significant difference between the frequency distribution of Coal Mining fatalities by type according to number and relationship of dependents, and the corresponding frequency distribution of fatalities arising out of operations other than Coal Mining; and that difference was recognized in the computation of pure premiums for Coal Mining risks. Similar significant differences may exist between classes of industries within the great class of all operations other than Coal Mining, e.g., between Manufacturing and Contracting. If such differences do exist, then it is hard to see how the aforesaid assumption *could* be statistically justified.

* Last sentence in first paragraph of Section 654 of "The Insurance Company law of 1921" as amended by Act of July 31, 1941, P.L. 607.

In the Conclusion of his paper, Mr. Elliott states that in his opinion "rates for excess coverage on a per-accident basis, which are expressed as a percentage of the manual rate, are not calculated on a sound actuarial basis". Now, I am almost certain that he does not mean this quite literally, for the mode of expressing a set of premium rates obviously has nothing to do with the soundness or unsoundness of the basis upon which they were calculated. I think he means that rates for such excess coverage of risks within any particular industrial category, calculated on the total experience of all risks of that category without distinction with respect to risk-size, ought not to be regarded as entirely reasonable or certainly adequate for those risks within that category for which such coverage will be purchased. With this opinion, I agree -- for, since excess covers are bought almost exclusively by Large Risks and since it is reasonable to expect that there are significant differences in respect to excess Loss experience between Large Risks and Small Risks *in the same industry,* such differences ought to be looked for and - if found - recognized in the making of rates for excess covers.

However, I do not think that the existence of *such* significant differences has been demonstrated in this paper. It is true, as Mr. Elliott points out, that the pure premium for excess losses on Large Manufacturing Risks, set forth in column (6) of Table I, is three times the pure premium for excess losses on Small Manufacturing Risks. But the pure premium for *all* losses on Large Manufacturing Risks, which is shown in column (5), is 1.31 times the pure premium for *all* losses on Small Manufacturing Risks. Now, in Pennsylvania Large Risks under full cover in almost any industry are - as a class - better than Small Risks under full cover in the *same* industry, just as they are in almost every other jurisdiction. In fact, the weighted mean of the deviations from manual rates determined by the Pennsylvania prospective experience rating procedure for Large Manufacturing Risks, is approximately -40%. Clearly the most probable explanation of the fact that the pure premium for all losses on Large Manufacturing Risks is *greater* than the corresponding pure premium for Small Manufacturing Risks, is to be found in the proposition that a relatively large part of the payroll for Large Risks was earned on very hazardous operations, whereas a relatively small part of the payroll for Small Risks was earned on such operations. But this proposition may also explain the fact that the pure premium for *excess* losses on Large Manufacturing *Risks* is greater than the pure premium for *excess* losses on Small Manufacturing Risks. Similar remarks with a few modifications could be made concerning risks in the categories labeled "Contracting and Quarrying" and "Other Industries."

In order to determine whether or not there is any significant difference in respect to excess losses per $100 of payroll between Large Risks and Small Risks in the *same* industry, that is to say,

any such difference which is independent of the apparent correlation between risk-size and degree of inherent hazard, one would have first to classify the payrolls and losses by degree of hazard inherent in the physical operations on which they were incurred; then to compute the quotient of excess losses by payroll for each of at least two risk-sizes within each class by degree of hazard; and finally to apply to the resultant three dimensional point-set, the well established methods of multiple and partial correlation analysis

MARK KORMES

The problem of "excess" insurance ratemaking is one of great interest to me and I am, therefore, glad of the opportunity to offer several comments and remarks on the results of the Pennsylvania Study of Excess Costs which is the subject matter of Mr. Elliott's paper.

As Mr. Elliott states in the introduction, the methods used represent a statistical approach to the problem. It seems, therefore, proper to analyze somewhat the methods themselves before discussing the results of the study. I have little quarrel with the method of payroll modification; although, if better statistics for various industries were available, the results might be quite different by classification or even industry groups. I have, however, considerable doubts on the validity of the use of average loss values as used in the 1946 rate revision and assumption that such average values reflect a proper adjustment of losses to a current level. For losses in the minor and temporary classifications this method may produce satisfactory results because the large number of such cases in each and every year increases the likelihood that the distribution by extent of injury and wages will not vary materially from year to year. This can hardly be assumed for the more serious type of cases, especially deaths and permanent totals. With the trend toward smaller families and giving due consideration to the degree of abnormality of the distribution during war years, the cases of deaths without dependents will present a considerable variation during a period of fifteen years and it is quite possible that there may be found quite a definite trend in the change of distribution of such cases by industries and classifications. The cost of permanent total cases depends not only on the wage distribution but also on the age distribution of the working population. It is my opinion that some degree of refinement and possibly the evaluation of individual cases on basis of projected payrolls, together with adjustments for apparent trends, may constitute a better statistical approach and eliminate some of the objections to the use of average values.

I also have grave doubts as respects the validity of the calculation of mathematical expectation of the excess cost as calculated in this study. The various probabilities are combined as if the

events were independent, which is an assumption yet to be proved. There, again, it would appear less objectionable to determine the excess cost on the basis of each actual occurrance after making such adjustment in the data as may be reasonable and adequate. In this respect the study made by the New York Compensation Rating Board (1) was definitely more satisfactory and less open to criticism. It might be proper at this point to call attention to the typeographical error as respects the calculation of the mathematical expectation of the cost of a three-death accident where the value of the probabilities was left out.

Let us turn now to the conclusions drawn by Mr. Elliott from the results of the study.

Assuming that the differences which might have resulted from the application of more accurate methods as suggested above would not be very material, the paper brings out clearly the fact that certain types of industries have a much more pronounced tendency to produce catastrophies and the incident excess cost. In my opinion, the subdivision by industrial groups is highly unsatisfactory. Thus, for example, we have a wide variation of hazards in the manufacturing (excluding explosives) and the All Other Industry Groups. The small manufacturing risks include a very large number of small non-hazardous risks, such as clothing manufacturing; while the large risks include the heavy manufacturing industries with greater hazards and, therefore, greater likelihood of excess losses.

The difference in the results for small and large risks should have been more or less anticipated under this method of grouping. The grouping of classifications by inherent hazard, as was done in the New York study, would have produced an entirely different picture, and one, which would be more consistent with the expectation of the average underwriter.

I agree with Mr. Elliott and Mr. Crane that the rates for "excess" coverage should not be expressed as percentages of average manual rates as I have already said on a previous occasion (2). It must be remembered that a risk whose premium would be $10,000 or less is hardly a good prospect for self-insurance, and I am sure that few excess underwriters would care to place excess coverage on a self-insurer of such a small size. Again, the group of risks which are self-insured may present a different "excess" cost picture than the so-called large insured risks, I must reiterate what I have said in my discussion of Mr. Cahill's paper (2) that some type of experience rating will be necessary if this coverage should be made attractive and produce adequate results. In actual practice this is recognized by many "excess" insurers in the form of a

(1) See Mr. Cahill's paper Proceeding Vol. XXVII, p. 77.
(2) See written discussion of Mr. Cahill's paper, Proceeding Vol. XXVII, p. 363.

"contingent" profit-sharing provision in their contracts.

Perhaps a more scientific approach lies in the considerations contained in Mr. Carleton's paper dealing with non-random accident distribution (3).

In conclusion, I would like to express the hope that the various reinsurance companies will find a way of pooling their experience under such risks and present the results of their study for the benefit of the members of this Society and the insuring public in general.

ROGER A. JOHNSON JR.

Mr. Elliott's concise paper presents a novel approach to the subject of ratemaking for excess coverage.

The author's conclusion that "the cost in excess of $10,000 per accident under current Pennsylvania benefits is so small as to be almost negligible" may be true, but it certainly would not apply in New York, whose average values are roughly double those used by Mr. Elliott in his Pennsylvania study. An analysis of five years of New York losses made several years ago indicated that about 7½% of total losses are in excess of $10,000 per claim and about 8% in excess of $10,000 per accident. Under current conditions even higher percentages would probably apply. Furthermore, there are other states with higher benefit levels than Pennsylvania where the excess cost may be significant.

Rates for this type of coverage are needed in New York in view of the fact that the Chairman of the Workmen's Compensation Board has promulgated new rules relative to the privilege of self-insurance and as a part of those rules has required that all self insurers make provision for catastrophe losses *either* by depositing additional security *or* by filing proof of excess coverage on a standard form of policy with specified limits written by a carrier licensed to do an excess or reinsurance business in the State of New York. Since the Superintendent of Insurance has ruled that such coverage is in the nature of reinsurance and as such the rates are not subject to his approval, the Compensation Insurance Rating Board has published "advisory" rates for the guidance of its members in writing this coverage.

It is Mr. Elliott's opinion "that rates for excess coverage on a per-accident basis, which are expressed as a percentage of the manual rate, are not calculated on a sound actuarial basis, in view of the well-defined differences between 'large' and 'small' risks." Since, in Pennsylvania, manual rates are made excluding the experience of large ($10,000 or over) and minimum premium risks, it is logical for him to carry this theory over into a study of this nature.

(3) Volume XXXII, p. 21.

It should be emphasized that the "percentage" method, as applied in New York, provides for varying percentages of manual rate depending upon the classification. Without going fully into the ratemaking method employed, which was fully covered in J.M. Cahill 's paper*, let it suffice to say that all classifications were assigned by actuarial and engineering judgment to three hazard groups. A single ratio of excess losses to serious losses was determined for each hazard group based on a study of more than 2,300 cases. The classification percentage recognized this ratio, the classification ratio of serious to total losses, and a proper loading for expenses. Assuming that the excess losses (or excess pure premium) vary widely by classification, it is more likely that the indicated variations between "large" and "small" risks are primarily due to the types of classifications which predominate in those groups. This theory gains more credence when it is noted that in some industry groups the large size has a higher pure premium while in others it is lower, thus indicating that size of risk, in itself, is not necessarily significant. While time does not permit actual testing, I suggest that if the "percentage" rates were extended by a set of classification payrolls (for New York or any other state) further subdivided by size of risk, the average rates obtained would vary in much the same manner as the pure premiums developed by Mr. Elliott's study. If so, this would seem to refute his argument that such rates are actuarially unsound merely because of a demonstrable variation between premiums sizes groups in a give industry group. Obviously, the method which was employed may be subject to criticism of one type or another, but to be classed as "actuarially unsound" seems unnecessarily harsh.

* P.C.A.S. Vol. XXVII