THE EXPERIENCE RATING PLAN AS APPLIED TO WORKMEN'S COMPENSATION RISKS

BY

MARK KORMES

INTRODUCTION

In the early days of compensation insurance it was quickly recognized that the average manual rate would not in general reflect the proper measure of hazard for an individual risk having a substantial exposure.

In order to decrease the loss frequency and severity by eliminating certain causes of accidents, engineers made an extensive study of the manufacturing industries and developed the so-called "Industry Schedule" or a system of credits and charges, depending upon the physical condition of the plant.(1) This system of schedule rating was intended to encourage the employers to install safety devices on their machines and to maintain the plant in a condition which would make it less likely for an accident to occur and reduce the severity of unavoidable accidents.

This initial expression of the idea that, although the manual or average rate reflects the principle of all insurance, that is, the mathematical expectation of loss, nevertheless individual risks should be charged rates below or above such average rate depending upon whether the working conditions of the plant were more or less likely to produce accidents, led to a further question regarding a system of credits and charges for non-manufacturing risks with substantial exposure. Inasmuch as the average rate is predicated upon past experience, and as it was the practice of the underwriters to look at the risk experience when considering its acceptance or rejection, the idea of using the past experience of the risk readily suggested itself and thus the Experience Rating Plan came into existence.

In the early days of compensation insurance several papers were written discussing the rating plan in general or certain of its features. Thus we have the excellent discussion of principles by Woodward,(2) the analysis of the results of experience rating

(1) As regards literature on this subject, the reader is referred to numerous papers in the early issues of the *Proceedings*.

(2) "The Experience Rating of Workmen's Compensation Risks", by Joseph H. Woodward, *Proceedings*, Volume II, page 356.

in New York by Senior,[3] the mathematical theory underlying credibility by Whitney[4] and last, but not least, the practical application of credibility by Michelbacher.[5] These papers were written more than ten years ago, and since that time numerous changes have taken place in the structure of the rating plan and in the rules governing its application.[5a]

It is the intention of the author to present in this paper as complete a picture of the present status of the Experience Rating Plan as is possible in the frame of the *Proceedings* of this Society. By bringing together the information contained partly in the various rating plans, partly in minutes of Actuarial Committees and partly in memoranda and files of rating bureaus, the paper should provide a long needed and convenient reference on this important subject.

The paper is divided into two parts. The first part gives the historical development and the scope of the plan. In the second part methods of calculating the various elements and tables of the present plan are explained and the technique of experience rating is discussed.[5b] The paper is not limited to the Experience Rating Plan used by the so-called National Council states and by Massachusetts, New Jersey, New York, etc.; it deals also with the plans used in Ohio, Pennsylvania, West Virginia, etc., though the discussion of these plans is limited because of their local character.

The author is greatly indebted to the Staffs of the National Council on Compensation Insurance, the New York Rating Board, New Jersey, Massachusetts and Pennsylvania Bureaus, the National Bureau of Casualty and Surety Underwriters and the Aetna Life Insurance Company for their help in assembling the material and making numerous suggestions and criticisms.

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(3) "The Effect of Schedule and Experience Rating on Workmen's Compensation Risks in New York", by Leon S. Senior, *Proceedings,* Volume I, page 227.

(4) "Theory of Experience Rating", by Albert W. Whitney, *Proceedings,* Volume IV, page 274.

(5) "The Practice of Experience Rating", by G. F. Michelbacher, *Proceedings,* Volume IV, page 293.

(5a) For a comprehensive list of papers and articles on the subject of experience rating see presidential address of Paul Dorweiler, *Proceedings,* Volume XXI, page 1.

(5b) This part is in preparation and the author expects to present it to the Society in May, 1935.

PART I.

HISTORICAL DEVELOPMENT AND SCOPE OF PRESENT PLAN

Early Plans

Even today the first question put by a practical underwriter when considering an individual risk will be "What has been the loss ratio for the past few years?" This question is indeed as old as casualty insurance and even goes further back to the fire and marine business where, when adjusting the premium on risks involving many schedules, the experience of the past has been used as a guide. No wonder, then, that the first experience rating plans were based on loss ratios. There have been several of these plans in existence which, however, with few exceptions, were in effect for a period of one year only.[6] All of these plans in final analysis were very similar and may briefly be characterized as follows:

(a) *Experience Period—*

Practically every plan provided for a specified minimum and maximum period which included some or all of the experience of the current policy or the policy next preceding the one for which the rating was to be promulgated. The lowest period provided for in one plan was 21 months and the maximum period provided for in the various plans did not exceed five years.

(b) *Qualifications—*

All plans provided some minimum requirements in regard to payroll, premium, or both payroll and premium developed during the experience period.

(c) *Neutral Zone—*

All plans but the original 1915 New York plan[6] provided a so-called neutral zone, that is, they specified two loss ratios (for example, 40% and 65% in the so-called "Plan A") and all risks whose loss ratio fell between these limits were assigned manual rates. Risks where the loss ratio fell below the lower limit or above the upper limit of the zone were subject to experience rating formulæ.

(d) *Credits and Debits*—

These were calculated in accordance with the following formula (with variations[6]);

$$\frac{r_1 - r}{r_1} \times \text{Maximum Credit} = \text{Percentage of Credit} \qquad (1)$$

$$\frac{r - r_2}{100 - r_2} \times \text{Maximum Debit} = \text{Percentage of Debit}^{(7)} \qquad (2)$$

where r_1 = The loss ratio representing the lower limit of the zone
r_2 = The loss ratio representing the upper limit of the zone
r = Risk Loss ratio[8]

Maximum credits and debits varied in accordance with the plan, either being given as fixed percentages or calculated by formula.[6]

(e) *Submission of Experience*—

Most plans provided rules for the reporting of experience and the method of valuation of losses.

A very interesting discussion of these plans by Woodward and the critical study of actual results of the original 1915 New York plan by Senior will be found in the early issues of the *Proceedings* of this Society.[9]

1918 Plan and the Basic Principle of Experience Rating

For a number of reasons the plans described in the preceding section proved unsatisfactory. Risks of substantial exposure producing consistently loss ratios of 50% or even less, but within the neutral zone, were being charged manual rates. Small risks where there were no losses or very small losses received credits although the occurrence of a loss was hardly expected in connection with any particular risk having such small exposure. In all the plans the credits or charges were calculated on the basis of loss ratio without due regard to the dependability of the experience; at best was the New York plan where some recognition was given to the size of the risk in that the credits and charges were

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(6) See Appendix I for details of the various plans and a chart showing the states where applicable and the period during which effective.

(7) If risk loss ratio was 100% or more, maximum debit applied.

(8) The notation in this paper is based wherever practicable on Mr. Carlson's "Suggestions for a Standard System of Notation in Casualty Actuarial Work", *Proceedings,* Volume XX, page 264.

(9) loc. cit.

graduated for risks up to $5,000. Furthermore, a large number of tests had to be made for such risks as fell into the neutral zone, thus adding a great deal to the administrative cost. Objections to the plan were raised by supervisory authorities and the problem was given thorough study by a special committee[10] with the object of evolving a plan free from the objectionable features and providing for a more uniform and equitable treatment of the experience of individual risks. The work of the committee was very fruitful and the principles of the plan evolved are the principles underlying the present Experience Rating Plan.

This plan which we may term the 1918 Plan[11] introduced for the first time the concept of credibility as a function of risk hazard and exposure. The plans previously in effect attempted to limit the departure of experience on individual risks from the class average by artificial means, like a neutral zone and maximum credits and charges. The new plan announced that it is not enough merely to measure the departures of the risk experience from the average, but it is also necessary to examine what degree of dependability is to be placed on the indications of the departures produced by the experience of the particular risk under consideration. The theory of this measure of dependability or so-called credibility has been very ably set forth by Whitney[12] and the practical considerations leading to the final adoption of the various phases of the plan are discussed in great detail by Michelbacher.[13] The reader who wishes to have a deeper insight into the basic principles underlying experience rating of individual risks is seriously urged to acquaint himself with the contents of the above mentioned contributions to these *Proceedings* as it is not within the scope of this paper to enter into the discussion of the theoretical principles underlying experience rating and neither is it the intention of the author to repeat anything previously presented to the Society unless it is essential for the sake of continuity and clarity.

The features of the 1918 Plan, or Plan D as it was called in the

(10) This was the "National Council Reference Committee on Workmen's Compensation Insurance", the actuarial section of which consisted of W. W. Green, Chairman, B. D. Flynn, G. D. Moore, A. H. Mowbray and J. H. Woodward.

(11) It became effective in the majority of compensation states during 1918. For further details see chart and Appendix I.

(12) loc. cit.

(13) loc. cit.

National Workmen's Compensation Service Bureau states, may be briefly described as follows:

(a) *Experience Period—*

A minimum of 21 months and a maximum of 45 months was provided, the experience to be brought down to and valued as of a date three months prior to the effective date of the rating. Later this requirement was changed to provide a minimum of 18 months and a maximum of 42 months, the experience to be brought down to six months and valued as of three months prior to the effective date of renewal insurance.

(b) *Qualifications—*

The payrolls during the last 21 months (later amended to 18 months) of the experience period extended at latest manual rates had to produce at least $500 of premium (coincident with the reduction of the period to 18 months the premium requirement was reduced to $450). In certain states the requirements were somewhat different.

(c) *Use of Experience—*

The following rules governing the reporting and use of experience were provided:

1. The actual payroll for each classification shall be tabulated by year of issue for the experience period. The plan contemplates a special audit as of ninety (90) days (later six months) prior to the effective date of the renewal policy and the inclusion in the rating of the experience of nine (or six) months of the current policy.
2. "Premium subject to experience rating" shall be computed by extending actual payrolls by manual rates or schedule rates for classifications subject to schedule rating.
3. Incurred losses to be reported by year of issue in the following divisions:
   - I—Death and Permanent Total Cases.
   - II—Indemnity Losses arising from Permanent Partial and Temporary Total Cases.
   - III—*Actual Payments* on account of Medical Aid.
4. A catastrophe was defined as a single accident involving at least five deaths or permanent total disability cases and costing in excess of a certain fixed amount. Such fixed amount was considered the normal cost of a catastrophe and was the only portion of a catastrophe loss used for rating purposes.

(d) *The Method of Experience Rating*—

The plan required the division of the premium subject into two parts, first, Death and Permanent Total Disability which corresponded to the expected loss because of the occurrence of death or permanent total disability, and second, "All Other" corresponding to the expected losses because of injuries resulting in permanent partial, temporary total disability and payments for medical aid. Each of these two divisions was separately rated. The subject premium was split into two divisions in accordance with Table "B" which provided the percentages of premium corresponding to the D. & P. T. D. and "All Other" division wherein the split varied by size of rate and was entered with the risk's average rate. The incurred losses were brought to the level of premiums by means of modification factors shown in Table "A" separately for indemnity and medical losses. These modification factors included not only law and rate level changes but contained also the expense loading. The following New York Table "A" effective June 30, 1918 may serve as an illustration:

Policy Year	"All Other" and D. & P. T. D.	Medical
1914	2.34	2.34
1915	2.11	2.07
1916	1.81	1.95
1917	1.86	2.15
1918	1.86	2.15

Having thus attuned the "subject premium" and the incurred losses the computation of the experience modification was carried out separately for each of the two divisions. The adjusted premium for the D. & P. T. D. division or x_1 was determined by the formula:

$$x_1 = P_1 + z_1 (p_1 - P_1)$$

where $P_1 =$ D. & P. T. D. division of premium subject

$p_1 =$ D. & P. T. D. division of adjusted loss or indicated premium

$$z_1 = \frac{P_1}{P_1 + K_1}$$

The constant K_1 varied by state and was developed on the basis of judgment.[14] The expression $(p_1 - P_1)$ or the "indicated

[14] For details relative to the determination of "K" values, see Michelbacher loc. cit.

departure" when modified by z_1 or credibility became the "allowable departure" by which the subject premium for D. & P. T. D. could be modified. Similarly, for the "All Other" division the adjusted premium or x_2 was obtained from the formula:

$$x_2 = P_2 + z_2 \, (p_2 - P_2)$$

where the meaning of the various symbols was exactly the same as above with the substitution of "All Other" for D. & P. T. D. and where

$$z_2 = \frac{P_2}{P_2 + K_2}$$

A different constant K_2 applied for this division. The final experience modification,[15] M, was then obtained from the formula:

$$M = \frac{(P_1 + P_2) - (x_1 + x_2)}{P_1 + P_2}$$

$$= \frac{\text{Total Premium Subject} - \text{Total Adjusted Premium}}{\text{Total Premium Subject}}$$

The final modification expressed as a percentage was then applied to the manual or schedule rates.[15]

In certain classifications involving considerable catastrophe hazard the specific catastrophe elements of the rates were excluded from experience rating. (In New York after March 5, 1919 such classifications themselves were excluded from rating). A list of such classifications appeared on the so-called Table "C". The experience modification calculated for the risk applied, however, to the full rate (except in New York).

The above plan was issued and supervised by the National Workmen's Compensation Bureau (now the National Bureau of Casualty and Surety Underwriters). New Jersey, New York and Massachusetts had had separate plans printed although they were identical in major principles and the rating of risks in these states was supervised by their independent bureaus. Pennsylvania also issued a separate plan which in principle of credibility determination somewhat resembled the above. There were important differences in the loss division, whereby the more serious cases (all permanent partial and serious indeterminate cases) fell into the D. & P. T. division; in the loss modification, whereby average values for fatalities and tabular values for indeterminate

(15) Modification is used here in the sense of credit or debit.

cases were used, and the calculations were carried out with the use of pure premiums.(16)

The Organization of the National Council on Compensation Insurance and the 1920 Experience Rating Plan

Coincident with the organization of the National Council on Compensation Insurance, the 1918 Plan was revised in several details although its general structure remained the same. The principal points of departure were as follows:

(a) For classifications in Table "C" a provision was made whereby the final rate was determined by adding the catastrophe portion of the full rate to the modified remainder of the rate.

(b) Provision was inserted for the reporting of the allowance granted individual risks for maintenance of a hospital by requiring to submit together with medical losses certain percentages of the medical allowance incurred.

(c) A modification was made in the credibility formula for the "All Other" division as follows:

$$z_2 = \frac{P_2 + C}{P_2 + K + C} \quad (17)$$

(d) For risks developing a manual or a subject premium of $80,000 or more, credibility of unity was used. (Since this plan of self-rating was not adopted in many important states the discussion of self-rating will be found in connection with the 1923-1928 Plan).

(e) A change was made in Table "B" in that it provided merely the D. & P. T. D. portion of the rate which was calculated separately for each classification.

The above revision of the 1918 Plan was issued by the National Council on Compensation Insurance and supervised by that organization and by the National Bureau of Casualty and Surety Underwriters in their respective jurisdictions. A similar plan was separately printed in New York and California which was almost identical except for several features of the California Plan.(18)

(16) See chart in Appendix I for effective dates and period of application in various states.

(17) The introduction of the constant "C" was prompted by an attempt to correct for certain deficiencies in the practical results of the plan but it was found that this empirical formula did not produce the desired results and it was later abolished in favor of the normal and excess split plan. (See chapter dealing with the 1923—Present Plan).

(18) For further details see Appendix I.

1923 Plan — 1928 Plan — Present Plan[19]

The revision of the plan which became effective in 1923 altered the structure of the plan considerably and since that time there have been no really important changes made in the plan, so that we may consider the 1928 Experience Rating Plan and the present Experience Rating Plan as a modified 1923 Plan. The various present features of these plans will be described in much more detail than heretofore and occasional departures will be made from the so-called National Council Plan to cover variations in several important independent cooperating states.

(a) *Definitions—*

The plan starts with definitions of several terms used in the plan. Thus, "Risk" is construed to include all operations of any one assured within the state regardless of whether such operations or any part of them are subject to schedule rating or are insured by one or several insurance carriers. "Manual Rates" are defined as the rates printed in the Manual in force on the effective date for which adjusted rates are to be determined. "Schedule Rates" shall mean the schedule rates established in accordance with the latest inspection report and on the basis of manual rates as defined hereinbefore.[20] "Adjusted Rates" are defined as rates obtained by applying the experience modification to the manual rates for classifications not subject to schedule rating and to schedule rates for classifications subject thereto.[20]

(b) *Qualifications—*

The plan requires that the application of manual rates to the total payroll for either the latest year or the two latest years of the experience period for which experience is available, must result in a premium of not less than $1,000 and that no risk shall be rated upon less than one year's experience. The important departures from this rule will be found in Massachusetts

(19) In this connection see also paper by W. F. Roeber entitled "Recent Developments in Workmen's Compensation Rate Making", *Proceedings,* Volume XX, p. 223.

(20) Recently schedule rating has been abolished in most of the states with the exception of California, Kansas, New Jersey, New York, Texas, Utah, Virginia and Wisconsin. Because of the large premium volume in these states, the author feels that a discussion of the schedule rate as it enters the Experience Rating Plan must be retained in this description.

where the minimum amount required is $700; in New Jersey where the requirement is modified to require an average annual premium for the experience period of at least $500 or $1,000 in latest year or two years, and in New York where the application of manual rates to the payrolls during the experience period shall result in a premium of not less than $2,000 or an average annual premium of at least $500 for the last two or more years of the experience period.(21)

(c) *Experience Period—*

The experience period shall not be less than one year and not more than five years commencing six years prior and terminating one year prior to the date on which adjusted rates are to be established.(21a) Completed policy periods only shall be used. An exception to this rule is made in the case where the policy periods during the history of the risk have not been for full annual terms and where the risk involves two or more policies, varying in expiration date. In the first case, the earliest policy period, part of which lies outside of the normal five-year maximum period, shall be retained in full, provided the entire experience period does not exceed five and one-half years, and shall be rejected in full if its retention would increase the maximum experience period beyond five and one-half years. In the second instance, the experience period shall be determined for each policy separately, but there is established a so-called normal rating anniversary date and the experience period for each policy shall close

(21) Requirements for New York given above are the present requirements. They have been considerably less in the past, starting with $300 and then gradually increased coincident with the rise in the level of manual rates. Other departures in the present requirements are as follows:

California—Manual premium for the latest year, 2 years or 3 years not less than $1,000.

Kansas—Manual premium for the latest 2 years not less than $600.

Minnesota—Manual premium for the latest year or 2 years not less than $600.

Texas—Manual premium for the latest year or 2 years not less than $600.

Virginia—Manual premium for the latest year or two years of $600 or average premium of $300 per year for the experience period if more than 2 years available subject to a minimum of $600.

Wisconsin—Manual premium for the latest year or 2 years of not less than $800.

(21a) Exceptions will be found in New York and Texas where the maximum experience period is four years.

with the completed policy period terminating not less than six months prior to the rating anniversary date. For example, if the rating anniversary is January 1, 1935 and there are three other policies expiring March 1, 1934, June 30, 1934 and October 1, 1934, the experience of the policy expiring October 1, 1934 will not be used for the rating effective January 1, 1935. An important departure from this rule will be found in New York where instead of five years, the period of four years is required with similar provisions in case of short term policies or multiple policy risks.

(d) *Experience To Be Used—*

The entire experience of the risk incurred within the experience period must be reported and used in determining adjusted rates. The supervising Bureau may, in its discretion, verify any or all of the data from which the experience modification is to be determined. It should be pointed out here that in several states, including Georgia, Massachusetts, New York, North Carolina and Virginia, there exists at the present time the so-called unit system of reporting.(22) Under this system, experience on individual policies is reported in considerable detail and the information so submitted is used for experience rating purposes. In the remaining states the experience is submitted on blanks which are discussed in a later portion of the paper.

Experience data from non-member carriers or from carriers that have discontinued business are accepted only if subject to verification and after removal of all doubt as to the accuracy and completeness of information. In some states, as in New York and New Jersey, if the experience data are not available for part of the period because of the fact that the carrier has discontinued business, the experience for such period is considered neutral. In New York the present carrier is required to make a payroll audit for the period not available, whereas in New Jersey a pro rata basis of determining the payroll for such period is used.

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(22) See paper by Charles M. Graham, *Proceedings,* Volume XVII, page 191, and Mark Kormes, *Proceedings,* Volume XVIII, page 262, as well as the written discussions by Messrs. Marshall, Skelding and Magoun dealing with the Georgia, Massachusetts, North Carolina and New York Unit Statistical Plans. In Pennsylvania there is also a special detail system of reporting the experience.

Experience of self-insurers may be accepted by the supervising Bureau, provided the application is submitted on an approved form giving definite information with respect to payrolls and losses and such statement is verified by an affidavit of the employer. In New York the acceptance of self-insurers' data is subject to the approval of the Classification and Rating Committee. In Massachusetts the experience of self-insurers is not acceptable.

Where a contractor performs a construction job on a cost plus basis and a policy is issued to cover the insurable interest of both the contractor and the principal, the experience of the contractor shall govern the rate to be specified in the policy and the experience incurred under such policy shall be considered as the experience of the contractor.

(e) *Use of Past Experience and Combination of Risks for Rating Purposes—*

The rules contained in these sections of the plan deal with definitions and requirements which must be met by a particular employer in order to qualify for experience rating. The purpose of the Experience Rating Plan is to determine an indication for the future on the basis of the past, and the rules of the plan had to be very carefully worded and revised from time to time in order to meet conditions brought about by changes in legal character of the ownership of the risk. In the practical application of the plan it was found that risks with experience which would produce charges were tempted to escape such charges, and could accomplish this by establishing new legal entities which could be described as new risks and which, to all outward appearances, had nothing in common with the previous risk. For this reason it was very important and absolutely necessary to have very careful and all-embracing definitions in the rating plan in order to prevent the misapplication of the experience rating principles and to assure the application of the experience modification to risks substantially under the same ownership and management. The rules in the National Council Experience Rating Plan are rather simple. They are amplified below by various additions and amendments which are found in the New York Plan, the latter being the most elaborate on account of having had to deal with peculiar business conditions prevailing in that state.

The National Council Plan first defines separate risks as those corresponding to the operations of separate legal entities whereby the term "legal entity" is also interpreted to include copartnerships or unincorporated associations. In the determination of adjusted rates the experience incurred on all operations of a risk shall be used regardless of any change in ownership, control or management except upon the acquisition of the entire assets and good will:

(a) Through purchase or inheritance by a new individual owner not previously identified with the management of the retiring establishment.
(b) Through purchase by a newly formed copartnership, the majority interest of which is held by a new owner not previously identified with the retiring establishment.
(c) Through purchase by a newly formed corporation of new owners who have elected a board of directors and the majority of whom were not individual owners, partners or directors of the retiring establishment.

If any of the above conditions are fulfilled the past experience of the risk is not to be used for the determination of the experience modification for the new owners. This is based on the theory that the new management has in no way contributed to the good or bad experience of the risk it acquired. When an establishment sells a part of its assets but continues to operate its business, all experience incurred prior to the sale must be used in connection with future ratings of the risk.

A combination of risks for rating purposes is permitted when several establishments are merged or consolidated either by means of a new corporation or copartnership formed for the purpose of perfecting the merger or by the purchase of the entire assets and good will of several separate legal entities by an *existing* establishment.

In general, the plan prohibits the combination of two or more *separate risks* for experience rating purposes except that it requires the combination of two or more *corporations* for rating purposes provided that one of the corporations holds a majority interest in and exercises an active control of and directs the management of the other corporation or corporations. Holding companies organized primarily for holding the stock of a subsidiary corporation or corporations cannot have the experience of the several units combined.

In New York the above rule is extended in that it requires that one of the corporations should hold a substantially complete interest[23] rather than a majority interest.

Furthermore, the New York Plan has a special rule relative to the operation of real estate. This rule provides that the experience developed in the administration of real property by an employer who holds legal title to such property, or by his agent, shall be used in establishing the experience modification for the employer. Experience developed, however, in the administration of real property by a banking corporation or other institution acting in a fiduciary capacity or through its agents, shall be included with the experience derived from all operations conducted by such a corporation in establishing the modification for this corporation and for the estates under its supervision. Mortgagees in possession, receivers or assignees of rent are regarded as employers in this rule unless the instrument giving possession or assigning rents limits their authority to the collection of rents only.

The establishment of the last rule is of recent origin. The previous rule provided that all experience developed under the administration of real property by an agent or trustee who stands in the position of an employer in the hire and discharge of labor shall be combined for experience rating purposes. This rule was found not only impossible to administer but of questionable legality. The Board was never certain that it had all the experience of such an agent or trustee. A separate policy is usually issued covering each owner and/or agent, and it would be to the advantage of the managing agent to seek a combination of experience only on those properties managed by him where the compensation experience is favorable. Extensive correspondence had to be conducted in each case relative to the relation of the agent to the employees with no guarantee as to the accuracy of the answers. Awards have been made against owners on the theory that the agent is simply a manager for the owner and the owner is primarily responsible for injury to an employee. On

(23) The ownership of 51% of stock is by no means considered as substantially complete interest by the New York Rating Board and a considerably higher percentage of share ownership is required.

the other hand, very bad experience incurred at one location under such rule would have to be imposed against owners of other buildings managed by the same agent the former, naturally, objecting to such imposition. In view of these difficulties it was decided to amend the rule to the effect that the experience should follow the owner rather than the agent. In the case of banks and trust companies which frequently are regarded as in the position of principal, it is permissible to use all of the experience of the bank, including not only its banking operations but also its operations connected with the administration of real property as trustee, mortgagee in possession, assignee of rents, etc. In such instances, were it in order to promulgate separate ratings for various owners, it would be necessary to issue hundreds of policies covering the various fiduciary relationships of the bank or trust company.[24]

The ever-changing business conditions will, undoubtedly, require further modification of these rules and it is very desirable that the rating plan as a part of the rate structure should reflect such changes.

(f) *Experience Modification*—

The plan provides for the establishment of a single modification for a given risk at one and the same time. Such modification once developed is to be applied to all the operations of the risk regardless of whether the operations of the risk remain the same or are assigned to new classifications because of a change in the operations or undertaking of new operations by the assured.

The plan further provides that it shall not be permissible to alter an existing contract by cancellation or rewriting or the extension of the policy for the purpose of enabling the risk to qualify under the plan, the intent of the plan being to experience rate only on the normal expiration date. For risks having several locations covered by different policies which differ as to expiration date, a special method is provided whereby a so-called anniversary rating date is established and a single modification promulgated on the anniversary date is applicable to all policies out-

(24) In this connection the reader is referred to a paper on this subject by Senior entitled "Experience Rating in *Rem and in Personam*", *Proceedings*, Volume XI, page 211.

standing or issued during the ensuing twelve months until the next anniversary date.

In the states where schedule rating applies it is further provided that if schedule rates are revised during the policy term because of interim surveys the existing experience modification will be applicable to the new schedule rates for the remainder of the policy term.

(g) *Provisions for Reporting and Tabulating Experience—*

As already indicated above, in a number of states the experience on every single policy is submitted to the supervising rating organization, which experience is then utilized for the purpose of experience rating. Effective with policy year 1935, about 17 additional states coming within the jurisdiction of the National Council will be also subject to a similar unit reporting plan. For the remaining states the following provisions as regards the reporting of the experience are given, which provisions, on the whole, coincide with the information available from the reports under the unit plan system.

The plan being compulsory, the carriers are required to submit an application for experience rating showing the entire data for such portion of the experience period as was covered by the applicant carrier. Where the applicant carrier is not in the possession of the complete record of the experience for the period, the additional data must be secured by the supervising board or bureau from previous carriers of the risk.

The plan provides for the submission of the experience on special blanks, separate and distinct blanks being used for policies excluding medical aid. These blanks provide for the reporting of actual audited payrolls for each classification by policy years during the experience period. In states where schedule rating is still used, a separation of payrolls must be made wherever parts of payrolls under the same classification are subject to different schedule modifications.

The valuation of outstanding losses must be made in the light of all available information as of not more than six nor less than four months prior to the rating date of renewal insurance. For open cases, that is, cases for which final compensation payment has not been made, a separate report on a prescribed form is required.

In New York the valuation of outstanding losses is to be made as of exactly six months prior to the rating date of renewal insurance. This provision was made in order to eliminate complications in connection with the submission of revised unit reports because of changes in the status of a number of cases which develop in the period between six and four months prior to the rating date of renewal insurance.

The plan provides for the submission of the incurred loss experience in the following divisions:

(a) Each loss must be examined as to whether it exceeds the so-called normal value as shown in Table "A" for each policy year.

(b) All indemnity and medical losses other than Death and Permanent Total cases, cases involving costs in excess of the normal value and all open cases, are summarized by year of issue separately for indemnity and medical.

(c) Cases involving excess indemnity or excess medical cost, Death and Permanent Total Disability and all open cases, must be listed individually giving the year of issue, claim number, date of accident, brief description of nature and extent of injury, and a statement whether they are open or closed and must show a separation of indemnity and medical losses for each claim into normal and excess portions.

For the purpose of rating, all Death and Permanent Total cases are reportable on an average value basis specified in Table "A" for each policy year.[25]

The above provisions contain the main difference between the 1923 plan and the 1920 plan, namely: in the 1920 plan the losses were divided into two groups, the first composed of death and permanent total disability losses and the second of "All Other" losses, whereas in the 1923 plan the losses are split into so-called normal and excess portions. The normal indemnity loss is defined as the cost of 50 weeks compensation at the maximum weekly rate of compensation. Thus, for example, in New York we would have $50 \times \$25$ or $1,250. The normal medical cost was set at $100. These values are rather arbitrary but the division of losses in this manner has proved much more equitable than under

(25) In New Hampshire there is no split between indemnity and medical losses for the purpose of experience rating.

the previous plans. It should be noted that in New York for a number of years much higher values were provided for normal costs, the indemnity normal cost being set at $2,000 and the normal medical cost at $200.

Catastrophes are defined as accidents involving injuries to two or more persons and the plan provides that each of the claims chargeable to such accidents shall be split separately into normal and excess portions. The normal portion of the indemnity loss is limited for rating purposes to twice the normal amount per case specified in Table "A" and the remainder of the normal portion together with the excess portion is to be included in the rating as excess, subject, however, to a limit equal to twice the excess value specified in Table "A". The normal portion of the medical loss is limited to twice the normal amount per case as shown in Table "A" and the remainder of the total medical loss must be included as excess subject to a limit equal to twice the value for excess indemnity shown in Table "A".

Where the carrier makes an allowance for the maintenance of the plant hospital, the amount of such allowance for a given policy year must be reported in full as normal medical losses, and where the carrier loans equipment to plant hospitals operated by the assured, 10% of the value of the loaned equipment shall be reported each year as normal medical losses. Where a contract has been entered into by the carrier for medical and/or hospital services covering several risks, the amount of such medical cost shall be reported for a given risk on a pro rata share of the total contract price based upon the number of treatments.

The plan does not permit the exclusion from the experience of any losses on the ground that the employer was not morally responsible for the accident causing such loss.

The above rule is further elaborated upon in New York in the following fashion:

"Where negligence suits have been instituted by claimants against third parties, the procedure shall be as follows: Include in the experience application all accident reports for valuation purposes regardless of whether a claimant in any particular case has instituted a suit for negligence against a third party, because failure to recover against a third party is no bar to compensation and the insurance carrier may eventually be obliged to indemnify the claimant in whole or in part for the loss sustained.

In those cases where there may be good reason to believe that the claimant will obtain full recovery against the third party and the insurance carrier saved harmless from any loss, the question as to whether the accident is to be included for experience valuation, together with a detailed statement of facts giving the nature of the injury and the circumstances under which it has been incurred, may be presented as part of the application for experience rating for review and decision by the Board."

Where the carrier receives reimbursement under subrogation rights, the treatment provided by the plan is as follows:

"In the case of accidents, other than those involving death and permanent total disabilities, only the net loss shall be reported, provided, however, that where the entire loss on any case is recovered, the case shall not be included in the rating. In the case of accidents involving death or permanent total disability, the full loss and the subsequent recovery shall be reported and the amount of loss included for experience rating purposes shall be such proportion of the average value as the net loss bears to the total loss."

(h) *Rating Procedure*—

The plan provides for decreasing weights which are applicable to both the payrolls and the losses of the respective policy years beginning with the latest and ending with the earliest year of the experience period. These weights which are 1.0, 1.0, .8, .6 and .4 are included in the payroll and loss modification factors shown in Table "A". In New York, where four years are used, the weights are 1.00, .75, .50 and .25 respectively. Where the experience period extends over the usual five years, as may be the case in connection with policies not written for full annual terms and multiple policy risks, the earliest policy year is assigned a weight of .20. The calculation of the total weighted subject premium needed for the determination of expected losses is accomplished by extending the modified payrolls at manual rates for classifications not subject to rating and appropriate schedule rates for classifications subject to schedule rating in states where schedule rating applies. In this calculation the premium accruing from the $.01 catastrophe loading contained in the rates is excluded from the weighted subject premium. The weighted subject premium as calculated above is split as between normal and excess by classifications on the basis of excess ratios shown for each classification in Table "B".

Credibility is determined on the basis of unweighted subject premium which is calculated from the weighted subject premium by applying to it the ratio of the total unweighted payrolls to the corresponding total modified payrolls. Separate credibility is assignable to normal and excess portions and the credibility values corresponding to given normal and excess premiums subject are shown in Table "E". Table "E" is constructed on the basis of of the following formulæ:

$$Z_n = \frac{P_n}{P_n + K_n} \text{ and } Z_e = \frac{P_e}{P_e + K_e}$$

where Z stands for credibility, P for unweighted subject premium, K for credibility constant and the subscripts n and e refer to normal and excess respectively. The K values are so determined that for a risk producing an unweighted subject premium of \$1,000 the maximum average charge resulting from a single claim shall not exceed 20% on an average premium split basis and the maximum charge from a single claim which does not exceed 50 weeks indemnity at the maximum weekly amount and \$100 medical cost, shall not exceed 15%.

The adjusted losses are determined separately for normal and excess in accordance with the following formulæ:

$$L_n = A_n Z_n + E_n(1 - Z_n)$$
$$L_e = A_e Z_e + E_e(1 - Z_e)$$

where L_n = Adjusted Normal Losses
L_e = Adjusted Excess Losses
E_n = Expected Normal Losses
E_e = Expected Excess Losses
A_n = Modified Actual Normal Losses
A_e = Modified Actual Excess Losses

It should be noted that these formulæ are identical with the following formulæ as can be found simply by multiplying out the terms in the parenthesis and arranging them in a different manner:

$$L_n = E_n + Z_n (A_n - E_n)$$
$$L_e = E_e + Z_e (A_e - E_e)$$

which, in words, are the familiar formulæ for adjusted losses, namely:

Adjusted Losses = Expected Losses + Allowable Departure.

The formulæ as shown above correspond to the arrangement of the calculations on the experience rating blank. Such arrangement was adopted because it saves a considerable amount of space and labor. The final modification for the risk is calculated from the formulæ:

$$M = \frac{L - E}{E}$$

$$\text{where } L = L_n + L_e$$

$$E = E_n + E_e$$

The modification as calculated above is then applied to the manual rate or schedule rate if classification is subject to schedule rating for the purpose of determining the final adjusted rate for each individual classification.

The rating procedure as outlined above represents a product of several stages of development, the most important ones having taken place in 1928. The principal changes, namely, the introduction of weights and the amendment of the self-rating plan deserve special consideration.

The idea of assigning lesser weights to early experience and greater weights to more recent experience was discussed for a long time before it was adopted. The Actuarial Committees considered a number of methods of weighting before adopting the weights now in almost general use.[26] The weighted plan is more sensitive to reflect the difference between a risk which is improving and one which is deteriorating, as it decreases credits or increases charges for bad experience and increases credits or reduces charges for good experience if such experience developed in the latest portion of the experience period. On the other hand, it undoubtedly tends to produce greater fluctuation in risk rates from year to year and introduces a slight complication into the rating procedure.

The credibility values determined from the formulæ described above produce satisfactory results for risks with small or medium premium volume. For very large risks, however, it was found that the experience modification was never sufficient to produce a normal loss ratio over a period of years. To remedy this situation it was originally decided in many states arbitrarily to assign full credibility to risks which during the experience

(26) The weighted plan, thus far, has not been adopted in New Jersey, Texas and Virginia.

period have produced $80,000 of premium subject (1920 Plan). This provision was later amended to require either a total adjusted loss of $60,000 or a total premium subject of $100,000 or more. This method of self-rating which produced a sharp line of demarcation at a self-rating point, was thought of as a practical solution but its actual application was found difficult to justify and to explain both to the public and the supervisory authorities. Minnesota, Wisconsin and, later, New York have adopted a self-rating plan which provides that the point of self-rating shall be reached by a gradual process. This is accomplished by drawing a straight line from the point of self-rating to another point on the credibility curve selected arbitrarily, this procedure being applied separately for normal and excess credibility. The credibility criteria established in the general rate revision for 100% local credibility[27] on classification rates were split as between normal and excess on the basis of the average premium splits calculated for experience rating purposes.[28] 50% of the normal criteria and 90% of the excess criteria, both in terms of the premium, were then established as the respective points of self-rating. The points of departure from the credibility curve were taken as one-half the amount of premium necessary for self-rating.

This method was incorporated in the National Council Plan and later it was decided to adopt fixed amounts for normal and excess subject premiums at the point of self-rating so as to avoid minor fluctuations every time there was a change made in the credibility criteria or in the rate level. Although infinitely superior to the original abrupt jump in credibility at a certain point, it did not completely satisfy the fastidious actuary, and finally for the states under the supervision of the National Council, the straight line from the point of self-rating was made tangent to the credibility curve. This refinement has not been adopted in New York where the method of connecting by a straight line the point of self-rating with the point corresponding to one-half the amount of self-rating is still used.[29]

(27) For further details see paper by W. W. Greene and W. F. Roeber entitled "The Permanent Ratemaking Method Adopted by the National Council on Compensation Insurance", *Proceedings,* Volume XII, page 253.

(28) For details of these calculations the reader is referred to the second part of this paper.

(29) For the mathematical derivation of the coordinates of the point of tangency, see Appendix II.

As regards the Z values themselves it may be well to point out that originally such values were calculated for each risk from the actual formula. In order to reduce the considerable amount of labor involved and also to eliminate the possibilities of error because of unfamiliarity with algebraic formulæ on the part of average clerks, Table "E" has been introduced where the Z values are shown in intervals of one-half of 1%. The premiums shown opposite a given Z value represent a limit of the premium amounts which will produce the given Z value. Thus having determined the premium subject (normal and excess) it is sufficient to look up in Table "E" the amounts between which such premium falls; the Z value opposite the larger of the two amounts shown in the table represents the Z value to be used in the rating. The credibility is based on the unweighted premium which in the rating procedure is accomplished by applying to the weighted premium subject a factor which represents a ratio of the total unweighted payrolls to the total weighted payrolls. This method introduces a slight inaccuracy for risks with an uneven distribution of payrolls, which, however, seems justifiable in view of the more or less arbitrary character of credibility and the considerable economy in the rating procedure.

(i) *Risks Involving Catastrophe Hazard*—

For a number of years the plan contained a list of classifications which were subject to a special procedure because of the fact that they were considered to contain a substantial catastrophe hazard. Table "C" where such classifications were listed showed the proportion of the rate which had to be excluded from the rating procedure and subsequently added to the modified rates. This special procedure has been recently abolished.[30]

(j) *Rating of Stevedoring and Vessel Classifications*—

Prior to the introduction of the Federal Longshoremen's and Harborworkers' Act, stevedoring and vessel risks were written either under Coverage I, which is a form of Employers' Liability insurance, or under Coverage II which is a form of voluntary compensation insurance. Since the introduction of the Federal

(30) Retained in Texas.

Act relative to longshoremen and harborworkers, the two groups of risks are being separately rated.

The difference from the standard rating procedure so far as the classifications subject to the U. S. Longshoremen's and Harbor Workers' Act are concerned, consists in different average values for death and permanent total cases. Otherwise, the rating procedure is exactly the same as that for the classifications under the State Act.

As regards vessel classifications the rating of such classifications is done in exactly the same manner as the rating of all other classifications, except that the plan does not provide any average death and permanent total values but provides only maximum indemnity values for any single case (except in Virginia, where the average death and permanent total values are used).

(k) *Interstate Rating*—

Although interstate rating was abolished July 1, 1932, it is proper to describe briefly this form of rating which had been in use for some time. Since, in a number of states, there was no restriction as to the use of experience of other states for experience rating purposes, the definition of the term "risk" was expanded to embrace all of the operations of any one assured in all of these states. The experience had to be reported and tabulated separately for each state in accordance with the provisions of the plan as applied to "intra-state" risks. The tabulated experience was then summarized and an average final modification calculated. This average modification applied in each state where the risk did not qualify for rating on an "intra-state" basis. For states where the risk did qualify for rating the state modification was adjusted by a so-called "F" factor.[31] Furthermore, a balancing factor of .975 [32] was used in the rating of all interstate risks. The complicated procedure and considerable labor involved apparently did not seem to be justified in view of the small number of risks qualifying under this plan and the reluctance on the part of regulated states to subscribe to this method of rating.

(31) The ratio of the total adjusted loss, obtained by applying the average modification to the total expected losses for qualifying states, to the sum of the intra-state adjusted losses for these states.

(32) Representing the average off-balance of rating plans.

Other States

In this chapter the author wishes to give a brief description of rating plans used in states where the method of approach is radically different from the plan described in the preceding chapter. This group, in addition to Pennsylvania and Delaware, contains noticeably all of the states having monopolistic state funds.

Nevada

There is no experience rating plan in this state but the Industrial Commission is authorized to increase rates where the experience of a particular work or establishment is found to be more hazardous than that of a similar undertaking.

North Dakota

The plan provides for an experience period of five years and a minimum average annual premium of $25 during the experience period. Credits are apparently granted both prospectively and retroactively, debits prospectively only. All losses except Death and Permanent Total cases are taken at full value. Claims resulting in Death and Permanent Total cases are taken at $3,000. If the indicated risk pure premium for the experience period is less than the classification pure premium, the risk is entitled to credit. If, on the other hand, the indicated pure premium exceeds the classification pure premium, a debit is imposed. Credits are limited to 15% and debits to 30%. The experience rating formulæ are as follows:

$$\frac{\text{Expected Losses} - \text{Actual Losses}}{\text{Expected Losses}}\ 15\% = \%\ \text{credit}$$

$$\frac{\text{Actual Losses} - \text{Expected Losses}}{\text{Expected Losses}}\ 30\% = \%\ \text{debit}$$

In the actual merit rating rules shown in the North Dakota Compensation Manual, these formulæ are not shown and reference is made to a Basic Allowance Factor and a Basic Compensation Allowance. A close analysis, however, of these terms brings out the fact that they are synonymous with pure premium and expected losses respectively. This plan is in some respects similar to the early plans based on loss ratios. It does not give any recognition to size of risk and dependability of indications.

Ohio

The period of five years and a minimum earned premium of \$100 during the period are required in this state. Traveling salesmen and clerical office employees are excluded from experience rating. Losses are divided into normal and excess portions, \$500 constituting a normal indemnity and \$200 a normal medical loss. Catastrophe losses, as specifically defined in the manual, are entirely excluded from rating. Undetermined or doubtful cases are taken at a flat value of \$500.

Experience rating formulæ are provided separately for risks producing less than \$5,000 premium and for risks for premium of \$5,000 or more. These formulæ are:

(a) for Risks under \$5,000

$$\frac{\text{Normal Losses} - \text{Normal Allowance}}{\text{Normal Allowance} + \$5{,}000} \times \text{Basic Rate} = \text{Total Modification}$$

(b) for Risks over \$5,000

$$\frac{\text{Normal Losses} - \text{Normal Allowance}}{\text{Normal Allowance} + \$5{,}000} \times \frac{\text{Normal Allowance}}{\text{Normal Allowance} + \text{Excess Allowance}} \times \text{Basic Rate} = \text{Normal Modification}$$

$$\frac{\text{Excess Losses} - \text{Total Losses} - \text{Excess Allowance} - \text{Earned Premium}}{\text{Excess Allowance} + \$50{,}000} \times \frac{\text{Excess Allowance}}{\text{Normal Allowance} + \text{Excess Allowance}} \times \text{Basic Rate} = \text{Excess Modification}$$

$$\text{Total Modification} = \text{Normal Modification} + \text{Excess Modification}$$

Normal allowance is obtained by multiplying the payrolls by the normal factor and dividing the result by 100,000, and the excess allowance is calculated similarly. Normal and excess factors, as calculated for each classification, are shown in the manual.

Credits are applicable retroactively, debits prospectively. If the total modification is less than 3% the basic manual rate applies (it should be noted that the Ohio rates do not contain any loading for expenses and are comparable with pure premiums).

Aside from the fact that the plan is extremely complicated so that it is difficult to understand its significance, it is also intrinsically discriminatory as between small and large risks. The author has made several calculations and found that it is possible, for example, for a risk with a premium of $4,999 to enjoy a credit of 10% while a risk with a premium of $5,000 having exactly the same loss experience would receive a 10% debit.

Oregon

The merit rating plan is written into the Workmen's Compensation Law, Section 43-1825-b. It provides that any employer whose contributions to the fund during the entire period he has been subject to the law, but not more than five years, have been $50 or more, per annum, shall enjoy reductions in the rate of his contributions or shall have the rate of his contributions increased in accordance with the following schedule:

If Losses Paid Out During Experience Period Are	The Rate of the Contributions Shall be Decreased (—) or Increased (+) by Percentages Indicated
Less than 50% of contributions	— 40%
50% but less than 55% of contributions	— 25%
55% " " " 60% " "	— 20%
60% " " " 65% " "	— 15%
65% " " " 70% " "	— 10%
70% " " " 80% " "	—
80% " " " 85% " "	+ 5%
85% " " " 90% " "	+ 10%
90% " " " 95% " "	+ 15%
95% " " " 100% " "	+ 20%
100% or more contributions	+ 30%

It is further provided that no employer shall be subject to any reduction if the Commission shall find that during the preceding fiscal year he has willfully failed to install or maintain any safety appliance, device or safeguard required by statute. Average values are provided for Death and Permanent Total cases, such average values to be calculated on the basis of the cost of Death and Permanent Total cases during the last fiscal year.

Pennsylvania and Delaware

There have been several plans in effect in Pennsylvania and we shall sketch briefly the early plans and describe the existing plan in more detail. These plans apply also in Delaware (with separate modification factors since December 31, 1931).

Plan effective September 1, 1918 to December 1, 1919. This plan provided for an experience period of at least 18 months and not more than three years next preceding the current policy. An average premium at latest rates of $500 per year for the experience period was required. Losses were modified in that fatalities were taken at average values, indeterminate cases were taken from a table except that an optional treatment of indeterminate cases of the latest policy year was permitted. Losses were divided into two portions, the first, so-called "Death and Permanent" portion included fatalities, permanent total cases and all indeterminate cases except those of the last policy year. The second or the "All Other" portion included all the remaining indeterminate cases, temporary cases and medical cases. The "All Other" portion was subject to modification by factors bringing the losses to the latest level of cost. Catastrophes which were defined as accidents involving five or more death or permanent total cases were excluded from experience rating.

In order to obtain the experience modification the plan provided for the calculation of adjusted pure premiums separately for each of the two divisions of losses and in accordance with the following formulæ:

$$X_1 = p_1 + \frac{p_1 N \; (I_1 - p_1)}{p_1 N + 60{,}000}$$

$$X_2 = p_2 + \frac{p_2 N \; (I_2 - p_2)}{p_2 N + 5{,}000}$$

where X = Adjusted Pure Premium
p = Manual or Schedule Rate Pure Premium
N = Payrolls/100
I = Indicated Pure Premium for Risk

and where the subscripts 1 and 2 refer to the two divisions of experience. Final adjusted rate was determined from the formula:

$$\text{Adjusted Rate} = 1.05 \times [1.58 \; (X_1 + X_2) + 10]$$

There were attached to the plan indeterminate valuation tables as well as tables showing partial pure premiums varying by size of rate.

It should be noted that the above formulæ for adjusted pure premiums may be written in the form:

$$X_1 = p_1 + Z_1 (I_1 - p_1)$$
$$X_2 = p_2 + Z_2 (I_2 - p_2)$$

where $Z = \dfrac{\text{Expected Losses}}{\text{Expected Losses} + \text{Constant}}$

which brings out the similarity of this plan to the 1918 Plan of the National Workmen's Compensation Service Bureau described in a previous chapter.

Numerous changes were made in this plan and amendments followed in very quick succession. The experience period was changed to require a minimum of 2 years (effective May 1, 1919) and a maximum of 4 years (effective December 1, 1919). Qualifications were amended to require $1,000 premium over the experience period (effective February 1, 1921). The treatment of catastrophes was repeatedly amended, involving as well a change in the definition of catastrophe (effective October 31, 1920, whereby catastrophe is defined as an accident involving two or more death or permanent total cases). The catastrophe losses have been included in rating with limitation to the effect that an accident should not increase the rates more than 10% and a single accident shall not enter the rating at a value greater than the expected death and permanent total losses. The modification formula underwent a number of changes assuming, in general, the form:

$$\frac{\text{Expected Losses} - \text{Realized Losses}}{\text{Expected Losses} + \text{Constant}}$$

The constant in the above expression was first $15,000, then it was changed to $12,000 and then back again to $15,000. Self-rating was introduced for risks having expected or realized losses of $50,000 or more. Credibility was increased by limiting the value of the denominator in the modification formula to $50,000 whenever the expected losses were between $35,000 and $50,000.

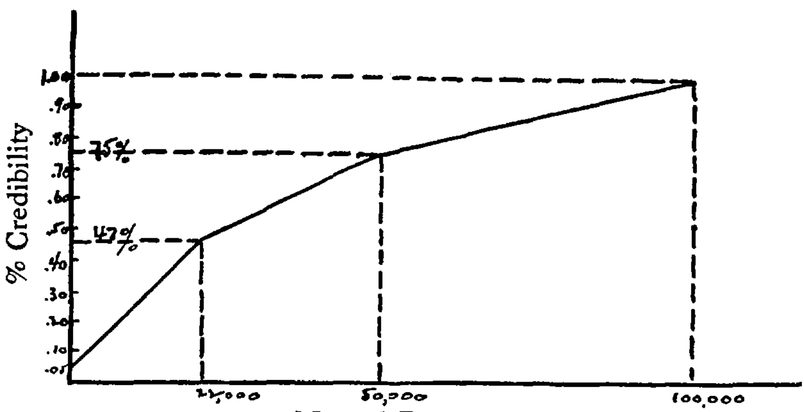
Plan effective from December 31, 1921 up to the present time with slight modifications. The experience period provided is five years but not less than two years (later amended to one year which is the present minimum requirement). A premium of at least $1,000 for the experience period is required, such premium to be based on extension of payrolls at latest manual rates.

Losses are brought to pure premium level in several divisions using average values for Death and Permanent Total cases and there is provided a table of maximum values which can be assigned to one accident, such values varying in accordance with the size of premium. At present the plan provides medical loss multipliers and wage factors applicable to all losses. Clerical and salesmen payroll is not subject to experience rating unless those two classifications by themselves, meet the rating qualification requirements.

The modification is derived by the formula:

$$M = \frac{\text{Realized Losses}^{(33)} - \text{Expected Losses}}{\text{Expected Losses}} \times C$$

where C represents credibility. The credibility value varied originally from 5% for a risk with a manual premium of \$1,000 to 100% for a risk with a manual premium of \$80,000. The present table provides for full credibility at a manual premium of \$100,000. The present credibility values follow a straight line for premiums from \$1,000 to \$22,000, another straight line with lesser slope for premiums between 23,000 and 50,000 and finally for risks between \$50,000 and \$100,000 the slope is still further reduced, as illustrated in the graph below:



The broken line resembles a great deal the Z curve (see Chart II). The rate for a risk whose manual premium is \$100,000 or

(33) It should be noted that realized losses are actual losses adjusted as mentioned above.

whose losses are $60,000, is obtained by dividing the total losses modified as explained above by the payroll (per $100) adding one cent and loading the result for expenses by the factor $\frac{1}{.60}$. A risk rated in this way shall continue to be so rated for one full policy year after it first fails to qualify under this rule.

The Pennsylvania Coal Mining Plan. There were several rating plans for coal mining in Pennsylvania. We shall limit ourselves here to the description of the present plan. In order to qualify, the coal mine risk must be subject to schedule rating except that Surface Mining, Culm Recovery and Coke Burning Classifications which have developed an average annual payroll of $10,000 or more during the experience period, shall be subject to experience rating based upon the manual rates for such classifications. The experience period is three years but not less than one year. The aggregate payrolls and losses of each classification are treated as a unit for calculation of the experience rate for each class. Catastrophes which are defined as accidents resulting in five or more deaths are excluded from the calculation.

Losses are valued as follows:

1. Death and Permanent Total—$4,600 on anthracite classes and $4,400 on Bituminous classes (any accident which at the time of valuation has caused disability lasting two years and is still undetermined is valued as a Permanent Total Disability).
2. Each permanent disability enumerated in section 306 (c) of the Law must be valued in accordance with the provisions of the schedule specified in said section.
3. Each other permanent disability is valued as per award or if no award has been made it is valued as an indeterminate disability.
4. Each temporary disability is valued at the amount paid or accrued to the date of reporting and no accident is classed as temporary unless disability has wholly ceased at the date of reporting.
5. Accidents which caused disability for more than seven days, which disability has neither terminated nor its extent ascertained, are valued in accordance with an indeterminate table, but no such case should exceed the values set for Death and Permanent Total Disabilities.

Neither payrolls nor losses are modified. The experience modifications are obtained in the following manner:

Indicated Rate = Expense loading × Risk Pure Premium

or

$$r = 1.50 \times \frac{\text{Losses}}{\text{Payroll}}$$

$$\text{Modification} = \left(\frac{\text{Payroll}}{\text{Payroll} + 1{,}500{,}000}\right) \times (s - r)$$

where s is the schedule rate of the mine less the catastrophe rate (such catastrophe rate is \$.05 for anthracite mining and \$.15 for bituminous mining).

Self-rating is granted to a risk which develops \$4,000,000 payroll during the experience period. The modification is then found from the formula:

$$M = s - r$$

The experience modification is subtracted from the schedule rate of a credit, or added to the schedule rate of a debit.

Washington

In this state the rates are computed and charged per man-hour. The experience rating plan is incorporated in the act which provides "The Department of Labor shall . . . determine the premium rate . . . and in so doing shall take into consideration the average cost experience of each employer . . . over the five year period immediately preceding September first of the year in which the rate is being determined and in so computing the cost experience of any employer, the fixed sum of four thousand dollars (\$4,000) shall be charged against his experience for each injury resulting in Death or Total Permanent Disability——". The actual premium rate for each employer is obtained by taking 40% of the basic rate and adding thereto 60% of the employer's indicated cost per man-hour during the experience period, subject to a maximum rate of 160% of the basic rate. The minimum period of one year is required in order to qualify for this procedure. Thus, bar the new risk, every risk is experience rated, the maximum credit or debit being 60%. This is a simple plan with a fixed credibility of 60% as applied to the individual risk with an upper limit for debits. Because of its simplicity, however, it is bound to produce violent fluctuations in rates from year to year, especially on smaller risks, and in view of the labor involved in its practical application in a state with a considerable number of risks would increase the administration expenses beyond the bounds of reasonable relationship to the results.

West Virginia

All risks are subject to experience rating. Experience period of one year only used. The rate for each risk is calculated by dividing the last calendar year's net paid losses by the payrolls during that period. If the resulting pure premium is more than 65% of, or less than 220% of the basic rate, such pure premium is "loaded" for expenses by adding thereto 20% of the base rate and the resulting amount represents the rate. If the pure premium is less than 65% or more than 220% of the base rate, then 65% or 220% of the base rate is used in its place, subject to the same loading.

Wyoming

There is no experience rating plan in this state. Ever since the inception of the Act, a flat rate of $1.50 per $100 of payroll was charged for all industries with the provision that if any employer's account with the Workmen's Compensation Department of the State Treasury becomes overdrawn and is not sufficient to take care of injuries to his employees the rate of such employer is automatically raised to $4.00 per $100 of payroll until such time as his overdraft is taken care of.

APPENDIX I.

Chart I shows for all of the states the various plans applicable therein as well as the periods during which they were effective. It is based mainly on a compilation by the Aetna Life Insurance Company in September, 1929, which was revised and brought up to date in November, 1934. In this appendix there is given a brief description of the various plans which will permit the reader to recognize their characteristics with ease.

In the following description the words "latest manual rates" refer to the rates effective on the date when the policy for which the adjusted rates are being calculated will be issued. The words "current manual rates" refer to the rates effective during the period next preceding the effective date of the policy for which adjusted rates are being calculated.

NATIONAL WORKMEN'S COMPENSATION SERVICE BUREAU PLANS

I—*Plan A*

1. Experience Period: Minimum 2 years, maximum 5 years.
2. Qualification: Minimum: $100,000 payroll or $50,000 if not schedule rated and $500 premium at latest manual rates over minimum experience period. For longer periods increased pro rata.
3. Loss Modification: Average values in weeks used for the various kinds of losses: Fatal, Permanent Total, Dismemberments, Other Compensation, in dollars for Medical. Loss ratio determined by comparing indicated pure premium from modified losses with average manual rate.
4. Neutral Zone: For risks with loss ratios from 40% to 65% no experience modification.
5. Principle of Calculation:

   A. For Risks subject to Schedule Rating.

   (a) $\frac{40 - r}{40} \times$ Maximum Credit = Percentage of credit for risks with loss ratios less than 40%.

   (b) $\frac{r - 65}{100 - 65} \times$ Maximum Debit = Percentage of debit for risks with loss ratios between 65% and 100%.

   Maximum credits and debits vary from 5% for $500 premium to 20% for $5,000 premium and over.

   Modification is combined with schedule modification by adding together and the sum is subject to a maximum of 40% credit.

   B. For Risks Not Subject to Schedule Rating.

   (a) $\frac{40 - r}{40} \times 25 =$ Percentage of credit for risks with loss ratios less than 40%.

   (b) $\frac{r - 65}{100 - 65} \times 25 =$ Percentage of debit for risks with loss ratios between 65% and 100%.

   C. For risks with a loss ratio of 100% and over maximum debit of 25%.

State sheets showing average values for Fatal, Permanent Total, Various Dismemberment and other Compensable cases and also average Medical values were attached to the plan.

6. This plan was compulsory for member companies. The name Plan "A" was given for reference when a second plan was issued, superseding the first, and called Plan "B".

II—*Plan B*

1. Experience Period: Minimum 21 months, maximum 45 months, including 9 months of current policy.
2. Qualification: Minimum $50,000 payroll or $30,000 if not schedule rated and $300 premium at latest manual rates over minimum experience period. For longer periods increased pro rata.
3. Loss Modification: D. & P. T. Indemnity, flat charge per case. Other losses—modification factors applied to bring to latest level of cost in two divisions: Indemnity and Medical.
4. Neutral Zone: No modification for the "All Other" portion granted for risks with loss ratios between 45% and 65% for the "All Other" part of the experience.
5. Principle of Calculation: Modification determined from comparison of adjusted premium reflecting risk experience departure and manual premium with various limitations as shown below:
   (a) Fatal and Permanent Total Losses—adjusted premium determined from manual partial premium for this coverage by subtracting percentage credit for no losses and adding a flat charge per case.*
   (b) All Other—adjusted premium determined from modification proportioned to all other partial loss ratio. Loss ratio obtained by dividing modified losses by partial manual premium.

   For risks with a loss ratio of 100% or more maximum debit applied.* For risks with loss ratios between 45% and 65% no modification granted.

   $$\frac{45 - r}{45} \times \text{Maximum Credit*} = \text{Percentage of credit}$$

   for risks with loss ratios less than 45%.

* Maximum allowable credits and maximum allowable debits in (b) and flat charges in (a) varied by seven risk groups depending on size of rate. Individual state rate sheets showing risk rate groups and maximum amounts charged or credited for each group as well as loss modification factors were attached to the plan.

$$\frac{r - 65}{100 - 65} \times \text{Maximum Debit*} = \text{Percentage of charge}$$

for risks with loss ratios between 65% and 100%.

(c) Final modification was determined by comparing total adjusted premium under (a) and (b) to total manual premium. Maximum credit over all is limited to 30%. Maximum debit is limited to 30% except when Death and Permanent Total losses were incurred in which case there was no limit. Experience modification was combined with schedule modification by adding, sum being subject to a maximum credit of 40%.

6. This plan was compulsory for member companies.

III—*Plan C—Employers' Liability*

Employers' Liability Plans do not belong properly in this description but since Employers' Liability insurance and Workmen's Compensation insurance are linked very closely together, brief summaries of Employers' Liability plans are included in this appendix.

1. Experience Period: Minimum 30 months, maximum 54 months including six months current policy.
2. Qualification: Minimum $50,000 payroll and $500 premium at latest manual rates for minimum period; increased pro rata for longer periods.
3. Loss Modification: Actual incurred losses (subject to limit of $2,000 per case) including first aid and allocated claim expense, brought to current level of cost by factors. Loss ratio determined by comparing modified losses to manual premium. State sheets showing loss modification factors by policy years were attached to the plan.
4. Neutral Zone: For risks with loss ratios between 35% and 55%.
5. Principle of Calculation: Modification proportioned to risk loss ratio as follows:

(a) $\frac{35 - r}{35} \times 30\% =$ Percentage of credit for risks with loss ratios less than 35%.

* Maximum allowable credits and maximum allowable debits in (b) and flat charges in (a) varied by seven risk groups depending on size of rate. Individual state rate sheets showing risk rate groups and maximum amounts charged or credited for each group as well as loss modification factors were attached to the plan.

(b) $\frac{r - 55}{55} \times 40\% =$ Percentage of debit for risks with loss ratios between 55% and 100%.

(c) Risks with loss ratios of 100% or over were given maximum debit of 40%.

6. This plan was compulsory for member companies.

IV—*Plan D—1918 Plan*

This plan is described in detail in the body of the paper.

National Council Plans

This group of plans includes the Industrial Experience Rating Plans 1920, 1923 and 1928, all of which are described in detail in the body of the paper.

Employers' Liability Plans Issued by The National Bureau of Casualty and Surety Underwriters

V—*Employers' Liability Experience Rating Plan—1923 (Amended December 1, 1926)*

1. Experience Period: Minimum 1 year, maximum 4 years (5 years effective December 1, 1926) terminating 1 year prior to effective date of rating.
2. Qualification: Minimum $500 ($600 effective December 1, 1926) premium at latest manual rates for standard limits, on payrolls of experience period. This requirement was revised on December 1, 1932 to require $400 premium at latest manual rates on basis of payrolls of last year or last two years.
3. Loss Modification: Losses including allocated claim expenses as incurred, whether on "first", "full" or "no" medical aid basis, but subject to standard limits, are modified by factors to bring to current premium level. Modified case losses subject to limiting values of $\frac{.2P}{Z}$ and losses of one accident to limit of $\frac{.4P}{Z}$ so no claim should affect the rate over 20% and no accident should affect rate over 40%. In the edition of December 1, 1926 the rating basis changed from premium comparison to loss comparison: Modification factors bring losses to current level of cost. Modified losses

subject to standard limits. Limiting values become $\frac{.2E}{Z}$ and $\frac{.4E}{Z}$. Experience rating on full aid or ex-medical basis only. Risks with first aid medical only are rated on ex-medical basis.

4. Principle of Calculation: Indicated premium or modified losses compared to premium at latest manual rates, at "no", "first", or "full" aid (as written) with following credibility for indicated premium departure:

   Credibility $Z = \frac{P}{P + 10{,}000}$ where $P =$ Subject Premium

5. The plan was compulsory except that risks carried prior to June 1, 1916, could be carried with special rates.

New York Plans

VI—*Plan Issued in January, 1915*

1. Experience Period: Minimum 2 years, maximum 5 years, terminating at effective date of rating. (Contemplates liability experience—number of accidents by type and payroll.)
2. Qualification: $25,000 payroll in experience period.
3. Loss Modification: Losses valued on schedule of valuation with injuries reported by number and kind. Loss ratio determined by comparing indicated pure premium and manual rates.
4. Principle of Calculation: Modification proportioned to risk loss ratio with various limitations. Graphs were provided from which debits and credits could be read, given the loss ratio and payroll size group.

   A. For risks subject to Schedule Rating.

   $25,000 - $50,000 payroll:

Loss ratio less than or equal to	25%	credit of 10%.
Loss ratio more than and less than	25% 50%	credits from 10% to 0.
Loss ratio more than and less than	50% 75%	debits from 0 to 10%.
Loss ratio equal to or more than	75%	debit of 10%.

$50,000 - $100,000 payroll:

Loss ratio less than or equal to	20%	credit of 15%.
Loss ratio more than and less than	20% 50%	credits from 15% to 0.
Loss ratio more than and less than	50% 80%	debits from 0 to 15%.
Loss ratio equal to or more than	80%	debit of 15%.

Over $100,000 payroll:

Loss ratio less than or equal to	15%	credit of 20%.
Loss ratio more than and less than	15% 50%	credits from 20% to 0.
Loss ratio more than and less than	50% 80%	debits from 0 to 20%.
Loss ratio equal to or more than	80%	debit of 20%.

Subject to a maximum credit of 20% when combined with result of moral hazard rating section of Schedule. Practically only a guide for determination of discretionary credits in case of schedule rated risks.

B. For risks not subject to Schedule Rating.

$25,000 - $50,000 payroll:

Loss ratio less than or equal to	20%	credit of 18%.
Loss ratio more than and less than	20% 50%	credits from 18% to 0.
Loss ratio more than and less than	50% 80%	debits from 0 to 18%.
Loss ratio equal to or more than	80%	debit of 18%.

$50,000 - $100,000 payroll:

Loss ratio less than or equal to	20%	credit of 24%.
Loss ratio more than and less than	20% 50%	credits from 24% to 0.
Loss ratio more than and less than	50% 80%	debits from 0 to 24%.
Loss ratio equal to or more than	80%	debit of 24%.

Over $100,000 payroll:

Loss ratio less than or equal to	20%	credit of 30%.
Loss ratio more than / and less than	20% / 50%	credits from 30% to 0.
Loss ratio more than / and less than	50% / 80%	debits from 0 to 30%.
Loss ratio equal to or more than	80%	debit of 30%.

5. Experience rating optional.

VII—*Plan Effective June 30, 1916 to June 30, 1917**

This plan is like Plan A of Workmen's Compensation Service Bureau.

1. Experience Period: Minimum 2 years, from June 30, 1914. (Workmen's Compensation only).
2. Qualification: Minimum $100,000 payroll ($50,000 for "contracting" risks) and $500 earned premium in minimum experience period. For longer periods, increased pro rata.
3. Loss Modification: See Plan A.
4. Neutral Zone: No experience modification for risks with loss ratios between 40% and 65%.
5. Principle of Calculation: Modification determined from loss ratio.

   Loss ratios less than 40% $\left(\frac{40 - r}{40}\right) \times$ Maximum Credit = Percentage of Credit.

   Loss ratios more than 65% and up to 100% $\left(\frac{r - 65}{100 - 65}\right) \times$ Maximum Debit = Percentage of Debit.

   Loss ratios over 100% — Maximum Debit applied.

   Maximum Credits and Maximum Debits varied from 5% for $500 premium to 20% for $5,000 and over in accordance with formula.

   $$\text{Maximum Debit or Credit} = 5\ \frac{\text{Premium} - 500}{300}$$

   Modification was combined with schedule modification, if any, by adding together and the sum was subject to a maximum credit of 40%.

6. This plan was compulsory. Table of average values for losses was attached to the plan.

* No rating plan was in effect during the period from June 30, 1917 to June 30, 1918.

VIII—*Plan Effective June 30, 1918 to June 30, 1920**

This plan is like Plan D of the National Workmen's Compensation Service Bureau with differences noted:

1. Experience Period: Minimum 21 months, maximum 45 months including 9 months of current policy; not amended.
2. Qualification: Minimum $500 premium at latest manual rates over last 21 months of period; not amended.
3. Loss Modification: Catastrophe value changed to $18,750 from $12,500 effective March 5, 1919. Classes with special catastrophe hazards eliminated entirely from rating effective March 5, 1919.

IX—*Plan Effective June 30, 1920 to June 30, 1923*

This plan was like the Industrial Experience Rating Plan 1920 of the National Council with differences noted:

1. Qualification: $500 premium instead of $450.
2. Principle of Calculation: No self-rating rule provided.

X—*Plan Effective June 30, 1923 to Present*

This plan is like the Experience Rating Plan—1923 of the National Council, with differences noted:

1. Experience Period: Minimum 1 year, maximum 4 years, terminating 1 year prior to effective date of rating.
2. Qualification: $2,000 premium at latest manual rates over experience period or $500 average annual premium over last two or more years.
3. Principle of Calculation: Credibility formulæ apply up to $60,000 normal partial premium and $80,000 excess partial premium. Self-rating points are $120,000 normal partial premium and $160,000 excess partial premium. Credibility values for normal premiums between $60,000 to $120,000 and excess premiums between $80,000 to $160,000 taken from lines drawn from Z-formula curves to the point of self-rating. Weights of 1.00, .75, .50 and .25 introduced May 1, 1928 for the experience of the policy years from latest to earliest.

* No rating plan was in effect during the period from June 30, 1917 to June 30, 1918.

California Plans

XI—*Plan Effective July 1, 1921 to September 30, 1924*

1. Experience Period: Minimum 1 year, maximum 3 years, next preceding current policy period.
2. Qualification: $1,000 premium at latest manual rates over experience period.
3. Loss Modification: Death and Pension cases used at average values given. Indeterminate cases valued from table. Other cases at carriers' values. Loss modification factors provided for all losses to bring them to current level of cost in two sets—All Other and Medical. Catastrophe losses from one accident limited to $12,500 and this amount placed in Death and Pension losses for any accident which involved five or more Death and Pension cases or cost in excess of $12,500.
4. Principle of Calculation: Modification dependent on departure of actual from expected losses, with weighting, in two divisions—Death and Pension and All Other. Partial pure premiums to determine expected losses in two divisions given by classifications in a table attached to the plan.

   Modification was obtained from the following calculations:

$$X_1 = \frac{\text{Expected D. \& Pension Losses} - \text{Actual D. \& Pension Losses}}{15{,}500 + \text{Expected D. \& Pension Losses}}$$

$$X_2 = \frac{\text{Expected A. O. Losses} - \text{Actual A. O. Losses}}{6{,}000 + \text{Expected A. O. Losses}}$$

$$\text{Final Modification} = \frac{X_1 \times \text{D. \& Pension Expected Losses} + X_2 \times \text{(A.O.) Expected Losses}}{\text{D. \& Pension Expected Losses} + \text{A.O. Expected Losses}}$$

5. Risks with classifications in table of extra hazardous classifications not subject to rating unless the classifications are minor for the risk. Tables were attached which contained loss modification factors, indeterminate case values, classification partial pure premiums and list of classes not subject to rating.

XII—*Plan Effective September 30, 1924 to March 1, 1929*

This plan is like the Experience Rating Plan—1923 of the National Council with credibility formula constants (K values) determined on same criterion but without a self-rating provision. Weights were not introduced. The qualification requirement calls for $1,000 premium at latest manual rates within last 3 years of experience period.

XIII—*Plan Effective March 1, 1929 to Present*

This plan is like the Experience Rating Plan—1928 of the National Council with credibility constants (K values) on same basis, has the same weights for the experience years but credibility is determined from the Z-formulæ for all risks.

Massachusetts Plans

XIV—*Plan Effective May 1, 1916 to December 31, 1918*

1. Experience Period: Minimum 1 year, maximum 5 years, including 6 months of current policy. (Workmen's Compensation experience only.)
2. Qualification: $25,000 payroll during experience period.
3. Loss Modification: Average values used for various kinds of losses: Fatal, Permanent Total, Dismemberment, all other tabulatable accidents and medical. Loss ratio determined by comparing indicated pure premium from modified losses with average manual rates.
4. Neutral Zone: No experience modification for risks with loss ratios between 45% and 65%.
5. Principle of Calculation: Modification proportioned to risk loss ratio with various limitations as follows:

   Credit = (45 − Loss Ratio) × ⅔% subject to a maximum of 30% for risks with loss ratios of less than 45%.

   Debit = (Loss Ratio − 65) × 1% subject to a maximum of 30% for risks with loss ratios over 65%.

   Modification combined with schedule modification, if any, by adding together.

   Sum modified by factor of 4/7 and further subject to a maximum credit of 40%.

XV—*Plan Effective December 31, 1918 to December 31, 1920*

This plan is like Experience Rating Plan D with the following exceptions:

1. Experience Period: 21 months minimum, 45 months maximum, including nine months of current policy. (This provision remained without change throughout the period during which the plan was applicable.)
2. Qualication: $100,000 payroll or $300 premium at latest manual rates during last 21 months of experience period.

XVI—*Plan Effective December 31, 1920 to December 31, 1923*

During this period the National Council 1920 Plan applied with the exception that the qualifications required $100,000 payroll in the last 18 months of the experience period, or a payroll producing $250 premium at latest rates. Another exception was the requirement for self-rating of $120,000 instead of $80,000.

XVII—*Massachusetts Experience Rating Plan—1923*

This plan, effective December 31, 1923 to December 31, 1928 is like the 1923 Experience Rating Plan of the National Council, with same criterion for credibility constant (K values) determination. Differences:

1. Qualification: $350 premium at latest manual rates on latest year or 2 years of experience period.
2. Principle of Calculation: Self-rating point at $135,000.

XVIII—*Massachusetts Experience Rating Plan—1928*

This plan, effective December 31, 1928 to the present, is like the 1928 Experience Rating Plan of the National Council, with the same credibility rule and the same experience year weights. The differences are:

1. Qualification: $350 premium at latest manual rates on latest year or 2 years of experience period. (Revised March 1, 1933 to $700.)
2. Principle of Calculation: The formula credibility curves operate up to $45,000 normal partial premium and $25,000 excess partial premium. After these respective limits the normal and excess credibility are taken from lines tangent to the curves and reaching the point of self-rating at $97,000 normal partial and $75,000 excess partial premiums.

New Jersey Experience Rating Plans

Plan A and Plan B applied in New Jersey. The Compensation Rating and Inspection Bureau of New Jersey issued a separate plan effective June 30, 1918 to February 1, 1921 very similar to the National Workmen's Compensation Service Bureau Plan D. The Industrial Experience Rating Plan—1920 of the National Council applied in New Jersey from February 1, 1921 to July 4, 1923. Since July 4, 1923 the New Jersey Experience Rating Plan —1923—like the National Council's 1923 Plan—has applied, with a new printing effective July 1, 1931 and a new edition effective June 30, 1934.

XIX—*Plan Effective June 30, 1918 to February 1, 1921*

This plan is like the Plan D of the National Workmen's Compensation Service Bureau. Differences:

1. Experience Period: Minimum 21 months, maximum 45 months, including 4 months of current policy.
2. Qualification: Minimum $500 premium at latest manual rates on last 21 months of experience period.
3. Loss Modification: Permanent Total Table for valuing Permanent Total cases dependent on duration at valuation. Replaced by average Death and Permanent Total values July 1, 1919. Indeterminate Disability valuation table provided.

   The rule of Plan D excluding special catastrophe elements in certain rates was removed from the New Jersey Plan July 1, 1919.

   Catastrophe: Same rule as Plan D excluding cost above $12,500 but in addition no loss could be used at value greater than 20% of premium subject. This special provision removed July 1, 1919.
4. Credibility decreased July 1, 1919 by raising constants.

XX—*Plan Effective July 4, 1923 to Present* (*Reprinted July 1, 1931 and new edition issued June 30, 1934*)

This plan is like the 1923 National Council Plan with the following differences:

1. Experience Period: Minimum 1 year, maximum 4 years, terminating 1 year prior to effective date of rating. Revised January 1, 1924: Minimum 1 year, maximum 5 years.

2. Qualification: Average annual premium \$300 over experience period at latest manual rates, \$600 minimum.

Revised 11-14-23	\$ 600 latest two years or	\$300 average
7- 4-25	\$ 700 latest year or 2 years or	\$350 average
6- 1-26	\$ 750 latest year or 2 years or	\$375 average
6-30-27	\$ 800 latest year or 2 years or	\$400 average
7- 1-29	\$ 900 latest year or 2 years or	\$450 average
7- 1-30	\$1,000 latest year or 2 years or	\$500 average
11- 1-31	\$1,100 latest year or 2 years or	\$550 average
6-30-33	\$1,000 latest year or 2 years or	\$500 average

3. Principle of Calculation: Z values (credibility) determined from expected losses, not premiums, but keyed to National Council criterion (20% maximum charge from single claim on \$1,000 premium risk).

   Change effective January 1, 1930. Credibility determination modified like 1928 National Council Plan. Tangents drawn to credibility curves from self-rating points corresponding to average normal portion of \$125,000 total subject premium and average excess portion of \$250,000 total subject premium. (\$283,000 effective July 1, 1930.)
4. Table attached to plan giving classification excess ratios as well as a table showing credibility values.
5. Catastrophe Treatment: No accident to be used in the rating at a value greater than two Death or Permanent Total cases.

Pennsylvania Rating Plans

The plans in effect in Pennsylvania and Delaware (in the latter state separate modification factors introduced since December 31, 1931) are described in the body of the paper in the chapter entitled "Other States".

Texas Experience Rating Plans

XXI—

The Experience Rating Plan—1923 became effective in Texas April 1, 1924. A separate plan was issued January 1, 1926 to comply with legal requirements but the plan was essentially the same except that the experience period was 1 to 4 years and there was no self-rating provision. A revised plan was issued effective March 1, 1930 which is also like the 1923 National Council Plan. The experience period remains 1 to 4 years. Credibility constants (K values) are determined so that a single claim shall not result in a charge of more than 30% on an average premium basis. The catastrophe classifications provision remains with Table "C" giving the catastrophe splits not subject to rating. There is no self-rating and the experience is not weighted by policy years.

Wisconsin Experience Rating Plans

XXII—*Plan Effective July 1, 1926 to April 1, 1929*

This plan was based on the 1923 National Council Plan but was more similar to the 1928 National Council Plan.

1. Principle of Calculation: Like 1928 National Council Plan. K values determined on same criterion. Credibility formula: At points corresponding to \$44,000 normal subject premium or more and \$26,150 excess subject premium or more, the credibility is taken from a table. Credibility values lie on straight lines from these points to the self-rating points at approximately \$83,000 and \$88,000 partial subject premium.

XXIII—*Plan Effective April 1, 1929 to Present*

The 1928 National Council Plan became effective in Wisconsin on April 1, 1929 with the exception that the premium qualification for experience rating is \$800 and the points of self-rating require a total subject premium of \$132,000 for full normal credibility and a total subject premium of \$230,000 for full excess credibility.

APPENDIX II.

Tangent to the Credibility Curve

The credibility curve is given by the equation

$$Z = \frac{P}{P + K} \tag{1}$$

In order to obtain the slope of the curve we have to find the derivative of Z with respect to P or $\frac{dZ}{dP}$:

$$\frac{dZ}{dP} = \frac{(P+K)-P}{(P+K)^2} = \frac{K}{(P+K)^2} \tag{2}$$

The equation of a straight line passing through a point is

$$y - y_1 = M\,(x - x_1) \tag{3}$$

or in our case the tangent to the credibility curve passing through the point of self-rating will be:

$$Z - Z_s = \frac{K}{(P_t+K)^2}\;(P - P_s) \tag{4}$$

where the subscript s denotes the point of self-rating and the subscript t denotes the point of tangency.

In order to find the coordinates of the point of tangency or Z_t and P_t expressed in terms of the premium at the point of self-rating, consider that since such point must lie on the tangent it will satisfy (4). We have therefore:

$$Z_t - Z_s = \frac{K}{(P_t+K)^2}(P_t - P_s) \tag{5}$$

On the other hand by definition

$$Z_t = \frac{P_t}{P_t + K} \tag{6}$$

Substituting in (5) for Z_t its value and observing that $Z_s = 1$, we obtain

$$\frac{P_t}{P_t+K}(P_t+K)^2 - (P_t+K)^2 = K\,P_t - K\,P_s$$

$$\text{or }\; 2\,P_t = P_s - K$$

$$\text{hence}\quad P_t = \frac{P_s - K}{2} \tag{7}$$

Substituting in (6) the value of P_t as given in (7) we obtain

$$Z_t = \frac{P_s - K}{P_s + K}$$

Chart II shows the points of tangency to the present New York normal and excess credibility curves as well as the straight line actually used in that state.

Chart I

CHART OF STATES SHOWING PLANS APPLIED AND PERIODS DURING WHICH EFFECTIVE*

STATE	TYPE OF PLAN AND THE PERIOD DURING WHICH EFFECTIVE					
	PLAN A **	PLAN B **	1918 PLAN †	1920 PLAN †	1923 PLAN †	1928 PLAN †
Alabama	——	——	——	8-1-1921 to 4-1-1924	4-1-1924 to 7-1-1929	7-1-1929
Arizona	No Experience Rating Plan.					
Arkansas	No Compensation Legislation — Employers' Liability Plan — 1923 (9-1-1923)**					
California	Special Plans — See Appendix I					
Colorado	——	——	4-1-1919 to 7-1-1921	7-1-1921 to 7-1-1924	7-1-1924 to 7-1-1929	7-1-1929
Connecticut	10-1-1916 to 8-1-1917	8-1-1917 to 8-31-1918	8-31-1918 to 1-1-1921	1-1-1921 to 6-1-1924	6-1-1924 to 7-1-1929	7-1-1929
Delaware	See Pennsylvania.					
Dist. of Col.	1923 Employers' Liability Plan** 9-1-1923 to 7-1-1928					7-1-1930
Florida	No Compensation Legislation — Employers' Liability Plan — 1923 (9-1-1923)**					
Georgia	——	——	——	——	3-1-1924 to 7-1-1929	7-1-1929
Idaho	——	——	1-1-1920 to 12-1-1920	12-1-1920 to 1-1-1924	1-1-1924 to 7-1-1929	7-1-1929
Illinois	10-1-1916 to 8-1-1917	8-1-1917 to 8-31-1918	8-31-1918 to 1-1-1921	1-1-1921 to 6-1-1924	6-1-1924 to 7-1-1929	7-1-1929
Indiana	——	8-1-1917 to 8-31-1918	8-31-1918 to 1-1-1921	1-1-1921 to 6-1-1924	6-1-1924 to 7-1-1929	7-1-1929
Iowa	10-1-1916 to 8-1-1917	8-1-1917 to 8-31-1918	8-31-1918 to 1-1-1921	1-1-1921 to 7-1-1924	7-1-1924 to 7-1-1929	7-1-1929
Kansas	10-1-1916 to 8-1-1917	8-1-1917 to 8-31-1918	8-31-1918 to 1-1-1921	1-1-1921 to 6-1-1924	6-1-1924 to 7-1-1929	7-1-1929
Kentucky	——	——	7-31-1918 to 10-1-1921	10-1-1921 to 2-1-1925	2-1-1925 to 7-1-1929	7-1-1929
Louisiana	10-1-1916 to 8-1-1917	8-1-1917 to 8-31-1918	8-31-1918 to 1-1-1921	1-1-1921 to 9-1-1924	9-1-1924 to 7-1-1929	7-1-1929
Maine	——	10-1-1917 to 12-28-1918	12-28-1918 to 7-1-1924	——	7-1-1924 to 7-1-1929	7-1-1929
Maryland	10-1-1916 to 8-1-1917	8-1-1917 to 8-31-1918	8-31-1918 to 6-1-1920	6-1-1920 to 1-1-1924	1-1-1924 to 7-1-1929	7-1-1929
Massachusetts	Special Plans — See Appendix I					
Michigan	10-1-1916 to 8-1-1917	8-1-1917 to 8-31-1918	8-31-1918 to 1-1-1921	1-1-1921 to 6-1-1924	6-1-1924 to 7-1-1929	7-1-1929
Minnesota	10-1-1916 to 8-1-1917	8-1-1917 to 8-31-1918	8-31-1918 to 1-1-1921	1-1-1921 to 11-1-1924	11-1-1924 to 7-1-1929	7-1-1929
Mississippi	No Compensation Legislation — Employers' Liability Plan — 1923 (9-1-1923)**					
Missouri	See Plan C** 11-1-1917 to 9-1-1923		Employers' Liab. Plan—1923** 9-1-1923 to 1-9-1927		1-9-1928 to 7-1-1929	7-1-1929
Montana	——	8-1-1917 to 8-31-1918	8-31-1918 to 12-1-1920	12-1-1920 to 6-1-1924	6-1-1924 to 7-1-1929	7-1-1929

* The dates shown in this chart are based on the study made by the Aetna Life Insurance Company in September, 1929, and revised in November, 1934.

** For characteristics see Appendix I.

† This plan is described in Part I of the paper.

¶ The exact period of application uncertain.

NOTE: Where the second date is not shown, the plan is still in effect.

Chart I
(Continued)

CHART OF STATES SHOWING PLANS APPLIED AND PERIODS DURING WHICH EFFECTIVE*

STATE	TYPE OF PLAN AND THE PERIOD DURING WHICH EFFECTIVE					
	PLAN A **	PLAN B **	1918 PLAN †	1920 PLAN †	1923 PLAN †	1928 PLAN †
Nebraska	10-1-1916 to 8-1-1917	8-1-1917 to 8-31-1918	8-31-1918 to 1-1-1921	1-1-1921 to 6-1-1924	6-1-1924 to 7-1-1929	7-1-1929
Nevada	Special Plan — See Chapter on "Other States" in Part I					
New Hampshire	See Plan C** 10-1-1917 to 7-1-1924		—	—	7-1-1924 to 7-1-1929	7-1-1929
New Jersey	10-1-1916 to 8-1-1917	¶	6-30-1918‡ to 2-1-1921	2-1-1921 to‡ 7-4-1924	7-4-1924 ‡	
New Mexico	—	—	6-8-1919 to 12-1-1920	12-1-1920 to 6-1-1924	6-1-1924 to 7-1-1929	7-1-1929
New York	Special Plans — See Appendix I					
North Carolina	1923 Employers' Liability Plan** 9-1-1923 to 7-1-1929					7-1-1930
North Dakota	Special Plan — See chapter on "Other States" in Part I.					
Ohio	Special Plan — See chapter on "Other States" in Part I.					
Oklahoma	—	—	6-27-1919 to 9-1-1921	9-1-1921 to 12-1-1924	12-1-1924 to 7-1-1929	7-1-1929
Oregon	Special Plan — See chapter on "Other States" in Part I.					
Pennsylvania	—	10-1-1917 to 9-1-1918	Special Plan — See Chapter on "Other States" in Part I			
Rhode Island	10-1-1916 to 8-1-1917	8-1-1917 to 8-31-1918	8-31-1918 to 1-1-1921	1-1-1921 to 6-1-1924	6-1-1924 to 7-1-1929	7-1-1929
South Carolina	No Compensation Legislation — Employers' Liability Plan — 1923 (9-1-1923)**					
South Dakota	—	—	7-1-1919 to 1-1-1921	1-1-1921 to 6-1-1924	6-1-1924 to 7-1-1929	7-1-1929
Tennessee	—	—	—	2-1-1921 to 7-1-1925	7-1-1925 to 7-1-1929	7-1-1929
Texas	10-1-1916 to 8-1-1917	? to 9-1-1918	9-1-1918 to 3-1-1922	3-1-1922 to 4-1-1924	4-1-1924‡	—
Utah	—	—	7-1-1919 to 7-1-1921	7-1-1921 to 7-1-1925	7-1-1925 to 7-1-1929	7-1-1929
Vermont	—	8-1-1917 to 8-31-1918	8-31-1918 to 12-1-1920	12-1-1920 to 7-1-1924	7-1-1924 to 7-1-1929	7-1-1929
Virginia	—	—	—	8-1-1920 to 1-1-1924	1-1-1924	—
Washington	Special Plan — See chapter on "Other States" in Part I.					
West Virginia	Special Plan — See chapter on "Other States" in Part I.					
Wisconsin	—	—	—	—	7-1-1926 to‡ 4-1-1929	4-1-1929‡
Wyoming	Special Plan — See Chapter on "Other States" in Part I					

* The dates shown in this chart are based on the study made by the Aetna Life Insurance Company in September, 1929, and revised in November, 1934.

** For characteristics see Appendix I.

† This plan is described in Part I of the paper.

‡ See Appendix I for different features.

¶ The exact period of application uncertain.

NOTE: Where the second date is not shown, the plan is still in effect.

CHART II

Normal and Excess Credibility Curves—Present N. Y. Plan