THE PAST AND THE FUTURE OF WORKMEN'S COMPENSATION RATEMAKING

BY

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I.

A Statement of the Situation

The development of the rating system for workmen's compensation insurance in the United States has been mainly a product of the last ten or twelve years. The problem has involved most of the contingencies with which life insurance deals, even such as remarriage and degree of dependency, the most important elements of fire insurance, such as a basic manual and a schedule and then some features peculiar to itself, such as experience rating. It is safe to say that never before has such a system of rating been developed in such a short time; and perhaps this stands today in its main features, although not in its refinements, as the most comprehensive rating system in the whole insurance field.

It is undoubtedly true that the main features of the problem have now been solved and yet it is equally true that certain other important parts of the problem remain to be solved. This present time may be considered to be the end of an era that was characterized by the solution of the problem in its essentials and the beginning of a new era which will be characterized by the development of refinements, and yet refinements that are so important that the rating system will continue to be quite imperfect until they have been added.

The situation at the present time is apparently as follows: the manual, so far as the general structure goes, is in a definitive and generally satisfactory form. The most outstanding need here appears to be a thoroughgoing and encyclopedic analysis of the hazards of the various industries as a basis for a more satisfactory system of classifications; this need may be otherwise described as the putting of underwriting upon a technical engineering basis, to whatever degree may be practically feasible.

The schedule is apparently now in a very satisfactory form.

Its structural rightness on the one hand and, on the other, the reflection in its parameter values of the more important features of accident causes as given by actual statistics have made it a close measure of the hazard. Furthermore, it possesses an intrinsic flexibility which should be sufficient to take care of all future needs. Investigation into the engineering basis of hazard by classifications will undoubtedly be accompanied by still further statistical research which should give the basis for a still more refined determination of parameter values.

The fundamental structure of the experience rating plan has been justified not only by general reasoning but by actual results and yet the last word has undoubtedly not yet been said with regard to the problem of bringing this general plan into practical relationship to the facts. There are certain parameters in the experience rating plan which so far it has not seemed possible to measure statistically and the result is that we have a system which while apparently qualitatively correct is quantitatively largely a matter of judgment. While the problem is exceedingly difficult there is apparently the possibility of making a real advance in this field by an investigation that is sufficiently searching to go down into fundamentals.

But none of these developments, and they are all in the nature of refinements, is comparable in importance with what still remains to be done in the field of pure premium determination. The determination of pure premiums has always been at the real heart of the rating problem. It is the means by which we make our first approximation; it is our primary and main attack upon the problem of getting right rates.

The methods that have been developed for pure premium determination have yielded notable results and yet today we have a system which while founded upon exactness both in method and statistical material has become top-heavy with calculations that are based largely upon assumptions, and in practice it is not giving the necessary results. The difficulty arises from the fact that too much has been attempted upon too narrow a basis of analysis.

Pure premium determination involves (1) fixing the relativity between the various classifications and (2) fixing the rate-level as a whole. These two parts of the problem are distinctly separable. The relativity in hazard among classifications is in the

main independent of variations in the basic conditions upon which rate-level depends, and it is comparatively stable; in other words the general rate-level may rise or fall without seriously disturbing the relativity among classifications.

The next advance seems to demand a more explicit recognition of the practical separability of these two parts of the problem and an intensive study of the problem of rate-level. Basic pure premium determination is in a very satisfactory condition and while there are improvements possible, such as in dealing with the reducing of experience to a common basis, no serious harm would be done if this part of the problem remained stationary.

The rate-level situation is however acute. It involves not only the question of whether a particular assured is paying too much or too little but the question of whether all assureds are paying too much or too little, and not only that but the question of whether the companies are collecting too much money or not collecting enough to remain solvent. The outstanding problem of the new era is the problem of determining rate-level.

Rate-level can be satisfactorily determined upon the basis of loss ratio reports, assuming that information can be had as to the actual rates charged, that is, with regard to the effect of schedule and experience rating and of rate-cutting if present; but if such determination is to be effective the data must be fully matured and that means that it must be at least two years old. Here lies the difficulty, the two years that our rate determination is behind the times!

There are two possibilities, either first to make definite plans in our rating system for a two year lag in the rates, that is, to be content to use rates that are always at least two years behind the times, or second to devise methods of fore-casting, and by fore-casting I mean both bringing the experience up to the present and projecting these results into the future.

There are such serious objections to accepting a two-year lag in rates, first its fundamental inequity and second, the competitive abuse that it fosters, that it seems unlikely that this will be acceptable as a practical solution and yet there are on the other hand so many difficulties in connection with fore-casting that even a two-year lag should be given serious consideration.

The superposition of methods of fore-casting upon the loss

ratio method of rate-level determination seems, however, to be what we must look forward to as an almost inevitable necessity. Fore-casting is necessary in every other business and it is scarcely likely that we shall be able to escape from it here. The problem is partly a question of extrapolation but mainly a question of whether we can determine a correlation between rate-level and the quantities that express economic and industrial conditions that is sufficiently close to be of practical value. This is a perfectly definite research problem, but it is undoubtedly a matter of great difficulty. It seems certain that this, the determination of the relation between rate-level and economic and industrial conditions in such form that it can be used as a basis for fore-casting is the outstanding problem in workmen's compensation rate making today, and its solution will apparently be the characteristic accomplishment of the new era in workmen's compensation insurance just as the setting up of the elements of the rating problem was the characteristic accomplishment of the era that has just closed.

The algebraic statement of the problem is as follows:

Let N = Number of full-time workers.

f = Average accident frequency per worker, that is, the probability that a given worker will be injured during the year.

s = Accident severity, measured in average duration of disability in years.

w = Average annual wage.

r = Effective commuted rate of compensation, being namely, the quotient of the total compensation payable under the law to the total wages which would have been receivable during the average period of disability.

R = Average manual rate expressed as a percentage of payroll.

ρ = Loss ratio.

Then $\rho = \dfrac{N \cdot f \cdot s \cdot r \cdot w}{N \cdot w \cdot R \cdot}$.

This reduces to $\dfrac{f s r}{R}$

If we can assume that the loss ratio at a given time t_0 is known, then the loss ratio for a time t, will be expressible as:

$$\rho = \rho_0 \left(\frac{R_0}{R}\right)\left(\frac{f}{f_0}\right)\left(\frac{s}{s_0}\right)\left(\frac{r}{r_0}\right)$$

ρ_0 is supposed known (presumably from loss ratio returns), $\frac{R_0}{R}$ can be had by a comparison of the average collectible rates at the two times; the problem therefore reduces to a study of f/f_0, s/s_0 and r/r_0, that is, to a study of the functions f, s and r.

Some general statements about such a study can be made. r is mainly a function of wages, although of course also of the particular law and perhaps other variables; it can be determined in tabular form (that is precisely what is done when we evaluate the provisions of a law) and might doubtless if it seemed desirable be thrown into the form of an empirical equation. f and s are evidently functions of economic and industrial conditions and the real problem is the determination of these relative values. It is scarcely likely that we shall be able to do much with the problem from an a-priori point of view although the probable nature of the relationship is suggested in the second part of this paper. We must, however, undoubtedly depend upon an empirical correlation and for this it will be necessary to obtain a series of values of f and s either separately or combined.

We should, however, be no better off after we had established these correlations if it were not that the values of the indices expressing economic and industrial conditions can be had much more closely to date than either f and s individually or when combined. If we can establish such correlations we can bring the value of ρ up practically to the present and then by taking tendencies into account we can even project it into the future.

It was hoped that something more than a theoretical discussion of this subject could be given in this paper but everything that we have done on the problem indicates that no appreciable results can be expected except through a determined and thoroughly planned attack; in other words that the solution of the problem is a really big undertaking. For instance, fresh statistical facts must be produced; there seems to be very little now in the possession of the rating offices or of the companies that will be of appreciable value for this purpose.

It may be possible to get statistical data on which determinations of f and s can be made, but it is quite possible that the equation itself will prove to be the readiest means to the desired result.

Suppose the experience is available for a series of years $f_1, f_2, f_3, \ldots$ The equation $\rho = \rho_0 . \frac{R_0}{R} . \frac{f}{f_0} . \frac{s}{s_0} . \frac{r}{r_0}$ can be written in the form

$$\frac{f\,s}{f_0\,s_0} = \frac{\rho}{\rho_0} . \frac{R}{R_0} . \frac{r_0}{r}, \text{ and this yields}$$

$$\frac{f_1\,s_1}{f_0\,s_0} = \frac{\rho_1}{\rho_0} . \frac{R_1}{R_0} . \frac{r_0}{r_1} = A_1$$

$$\frac{f_2\,s_2}{f_1\,s_1} = \frac{\rho_2}{\rho_1} . \frac{R_2}{R_1} . \frac{r_1}{r_2} = A_2$$

$$\frac{f_3\,s_3}{f_2\,s_2} = \frac{\rho_3}{\rho_2} . \frac{R_3}{R_2} . \frac{r_2}{r_3} = A_3$$

. . . , where A_1, A_2, A_3 . . . can be had from the experience.

From these equations we have:

$$f_0\,s_0 : f_1\,s_1 : f_2\,s_2 : f_3\,s_3 \ldots = 1 : A_1 : A_1 A_2 : A_1 A_2 A_3 \ldots$$

This gives us a trend which will serve as a basis of possible correlation with the various indices of economic and industrial conditions.

II

A Survey of the Possibilities of Solving the Rate-Level Problem

The study of the correlations between f, s and r and industrial conditions involves a study of the business cycle and all its attendant economic changes. Let us for a minute review some of the characteristics of the complete cycle as it moves forward starting say at the trough or lowest point of the wave and note

the probable effect upon industrial accidents. At this point wages and employment are at their lowest points. Selection has operated to eliminate inefficient employees. Overtime work is comparatively rare and work is done at the steady pace of the unrushed efficient laborer. Both accident frequency and severity are probably at a low ebb, frequency because the best workers are engaged in their regular work with which they are entirely familiar, and severity, not only for this reason but also because the man who malingers or stays away from his job too long is apt to lose it since workers are plentiful. However, the tendency of employers to economize in such a period by neglecting ordinary safety education and accident prevention measures may be assumed partially to offset the expected accident slump. Wages tend to be stationary because efforts to obtain higher wages are not apt to be successful when there are plenty of the unemployed.

Suppose then that industry begins to pick up. During the depression, people economized, used old supplies as long as they would last, lived on the savings of the more prosperous years, and in general buying was at a low ebb. Merchants were cautious in laying in new stocks of goods, buying only in small lots and in response to the demand for staple goods. But old stocks, both public and private become exhausted in time and buying must begin again, though slowly at first. Then the small beginning reacts upon itself and as new goods are demanded, they must be manufactured and so work is supplied to a larger number of men. These in turn, as they become able to buy, themselves increase the demand.

It is thus that the pendulum starts on its forward swing gathering momentum as it progresses. And what is the effect upon accidents? The new employees are not only in general the less efficient workmen but many of them go into an industry with which they are entirely unfamiliar so that the hazard per employee immediately begins to rise unless the employer offsets the tendency by increased attention to accident prevention and safety training among his employees. This movement continues, employees gradually becoming more proficient in their work and less liable to accidents until full employment is reached. But wages continue to rise as competition is felt, as employees find themselves in a position to make their demands effective, and as the argument gains weight that increased prices make

increased wages imperative if the standard of living is to be maintained. And the increased wages in turn are reflected in increased commodity prices and the rise continues. But the increase in wages is not uniform in all industries and so labor turnover increases. Men leave one industry to enter another which pays higher wages and so green help continues to affect the frequency and severity of accidents, while plenty of work results in the retention on the payroll of the careless and unreliable employees thus preventing the attainment of the low accident frequency experienced in the trough of the wave.

When the crest of the wave is reached, again there is a short period of stability, when wages and employment change little. The slower turnover of this period should result in a smaller number of accidents. Safety work now is probably at its height and wages being high in comparison with compensation malingering is not encouraged. But the influences which call a halt upon unlimited expansion have been felt. The merchant has begun to feel that he may be overstocked and grows more cautious in his buying. Money lenders fear the over expansion of industry and tighten up on loans. Up to a certain point increased production may be accomplished without increased facilities and it is when this saturation point is reached that profits are greatest. But at the crest of the wave this point has been passed and profits are diminishing, a fact which of itself tends to a slowing down of rapid expansion. All these influences are soon felt upon employment, as orders decrease in size or are canceled altogether, and the laying off of help begins, the more inefficient going first. A change in number of accidents per unit of exposure may, however, be retarded by the holding of men on the payroll and the reduction of the number of hours worked per man. For a while malingering is encouraged, compensation being drawn as long as possible by the man whose job has gone to somebody else. Malingering has also been known to have been encouraged at such a period by the employer whose work is slack and who is interested in holding an old employee without cost to himself while the insurance company pays for a disability that has ceased to exist. The necessity for economizing leads the average employer to neglect his safety program. But there are offsetting factors caused by the slowing down of industry and the discharge of the newer and less efficient employees.

This analysis follows in a general way ideas which have been frequently expressed by Mr. S. B. Perkins and which we understand he has tested to some extent by the experience of the Travelers Insurance Company. However, we have no conclusive proof and the analysis, it is true, is only theoretical as yet. But you will agree, we believe, that accident frequency and severity are directly dependent upon economic conditions and not a matter of chance. It has been argued that the current growing sympathy for the laboring man and increasing socialistic tendencies have led to an increased liberality in the interpretation of state compensation laws. It is true that these tendencies are undoubtedly expressed in the increased benefits provided by the various laws, many of which are liberalized at practically every session of the state legislature, but such changes are easily taken account of in rate determination and it is doubtful if the increased liberality of interpretation could materially affect loss costs throughout the United States within a four or five year period. If there is such a steady upward trend, however, our investigations should reveal that fact.

The chief difficulty in the way of solving our problem is the lack of adequate statistical data, not only for recent periods but for any period. Let us go back to the formula as stated in the first part of this paper and examine it to see just what our requirements are. To take the simpler problem, suppose we are trying only to determine rates on the basis of present, not future conditions. Referring to the equation on page 152, suppose the time t_0 is the last policy year for which a complete Schedule Z is available. p_0 and R_0 may be obtained directly from the experience. s_0 should be obtainable from accident punch cards, though we suspect that further studies of this factor may show that it varies little from year to year except as affected by changes in the compensation law such as decreases in the waiting period, and by changes in distribution of industry. The first condition can be taken care of with a fair degree of accuracy by theoretical calculations while the second is one which must be eliminated from our comparisons of rate level and taken care of by proper attention to correct relativity factors between classifications. Investigation should be made, however, of the correlation between accident severity and industrial conditions to determine whether malingering has an appreciable effect. r_0

reduces to $\frac{\text{average cost per case}}{s \times w}$. Average cost per case defined as total loss divided by number of compensable cases is obtainable from Schedule *Z*, while the present statistical program of the National Council on Compensation Insurance calls for regular semi-annual reports of wage data. The determination of the value of f_0 presents greater difficulty. We have a value for $N_0 f_0$ which is the number of accidents and we also have the value of $N_0 w_0$, or the total payroll. If we can assume that the value of the average wage reported to the National Council on accident cases is equal to w_0, the average wage of *all* employees, then we may determine N_0 by dividing the total payroll by the average yearly wage. f_0 is equal to the total number of compensable accidents divided by the number of full-time workers.

Suppose we wish to determine the value of ρ_1, the loss ratio to be expected under current conditions. Let us see what approximations we must use and what difficulties would be encountered in securing the necessary factors.

R_1 may be determined by applying present manual rates to the payrolls produced during the time t_0, having adjusted the total premium so calculated for the effect of schedule and experience rating. The effect of both these merit rating plans on current business can be determined from current applications. f_1, s_1 and r_1 present serious difficulties and it is these values which we propose to determine by establishing correlations with economic and business conditions. It should be noted that it is not necessary to establish absolute values, but that the ratios between values at the different periods is sufficient. It is possible also that values of $\frac{s_1}{s_0}$ and $\frac{r_1}{r_0}$ based upon a standard accident distribution would be entirely satisfactory. That however can be decided by a study of past experience.

One recent attempt to secure values of $\frac{f_1}{f_0}$, that is, current accident frequency trend, is worthy of note here. In spite of all the objections to the use of premium volume as a basis of exposure, it is a basis readily obtainable from the books of casualty insurance companies and does reflect, though probably with a considerable lag, employment and wage conditions. With this

in mind the New York Association of Casualty and Surety Statisticians has compiled an exhibit of premiums in force and accident notices by month for calendar years 1921, 1922 and the first nine months of 1923. The premiums have been modified by the index numbers for factory payrolls in New York State for the corresponding months and an accident frequency factor calculated per $100,000 of modified premium. The combined data is published herewith by consent of the secretary of the Association. The results look fairly reasonable and comparable with similar results obtained from other sources. It would seem, however, that the inaccuracies in such material are too great to make the indications usable for rate making purposes. Advance estimates of premiums vary according to past wage and employment trends and are also influenced by the competitive situation. Premiums in force and number of accident notices are not available by state nor are country-wide index numbers for payrolls available. Only a few states publish statistics showing current employment conditions, but the number is increasing, and we believe that the possibilities along this line should be carefully investigated.

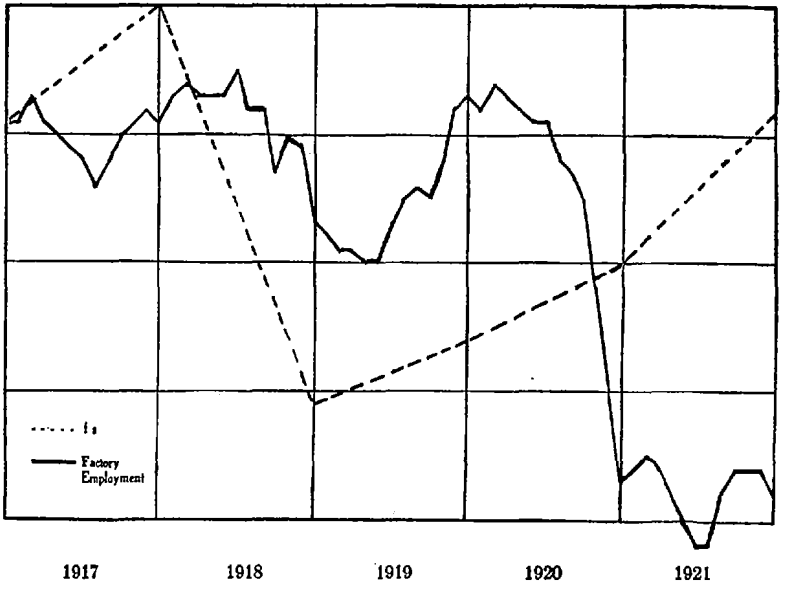
In order to test the possibility of securing accident trend data to use for correlation tests we used National Bureau Schedule Z experience for New York State for policy years 1916* to 1921 inclusive. The indicated values were substituted in the equation as written on page 153, values of r being determined by using the actual average cost per case and a value of s determined from the American Accident Table distribution. Using subscripts to denote the values for the successive policy years and letting $f_{16}\, s_{16} = 1$, we have

$$\begin{aligned} f_{17}\, s_{17} &= 1.076 \\ f_{18}\, s_{18} &= .818 \\ f_{19}\, s_{19} &= .862 \\ f_{20}\, s_{20} &= .906 \\ f_{21}\, s_{21} &= 1.006 \end{aligned}$$

Plotting these figures roughly with those for New York State factory employment published by the Industrial Commission, and assuming the above values for policy years as indicative

*The data for policy year 1916 is the total for all companies writing in the state.

of conditions at the end of the respective calendar year, we have something like this:



Another problem to be solved is the method of eliminating the effect of changes in distribution of industries. Accident frequency factors by classification are unsatisfactory even for the largest classes and for several states combined. Rate-level factors, like the projection and wage factors now used, can only be expected to fit the average, not the individual risk or class. Peaks of employment, high wages, etc., do not occur at exactly the same time in all industries. Even though refinements may enter later, we must remember at this stage that we are trying primarily to solve the problem of general rate-level, not individual class or industry level. The question as to how far it is practicable to go in fitting the average rate for all industries to the proper rate for the individual risk is still open, but should not be confused with the general rate-level problem.

In conclusion it should be understood that although the fundamental equation which has been stated in this paper is obviously correct, the analysis of the problem as built thereon is admittedly only hypothetical, and its chief value lies in its suggestiveness,

not in any absolute truth which has been discovered. We have tried only to outline in brief the problems which must be solved and possible ways of attacking them. Our study of the problems, however, leads us to believe that the difficulties are not insurmountable and that a thorough investigation of the possibilities will lead to valuable concrete results.

WORKMEN'S COMPENSATION EXPERIENCE COMPILED BY THE N. Y. ASSOCIATION OF CASUALTY & SURETY STATISTICIANS

Year	Month	Countrywide Premium in Force	Index No.*	Modified Premium	No. of Notices	Accident Frequency†	
						Modified	Actual
1921	January	10,153,287	203	10,153,287	13,883	137	137
	February	10,263,530	201	10,161,921	13,635	134	133
	March	10,387,259	204	10,438,157	15,034	144	145
	1st Quar	30,804,076	..	30,753,365	42,552	138	138
	April	10,426,862	195	10,016,044	14,666	146	141
	May	10,397,093	188	9,628,748	16,046	167	154
	June	10,428,023	184	9,451,960	17,227	182	165
	2nd Quar	31,251,978	..	29,096,752	47,939	165	153
	July	10,232,760	177	8,921,943	17,501	196	171
	August	10,208,875	178	8,951,142	19,477	218	191
	September	10,062,350	182	9,021,903	18,184	202	181
	3rd Quar	30,503,985	..	26,894,988	55,162	205	181
	October	10,072,706	183	9,080,544	19,259	212	191
	November	10,003,886	181	8,919,465	17,555	197	175
	December	9,667,250	185	8,809,765	17,486	198	181
	4th Quar	29,743,842	..	26,809,774	54,300	203	183
	Total	122,303,881	..	113,554,879	199,953	176	163
1922	January	9,643,503	179	8,503,641	14,050	165	146
	February	9,817,323	182	8,802,212	12,980	147	132
	March	9,803,444	188	9,078,969	15,611	172	159
	1st Quar	29,264,270	..	26,384,822	42,641	162	146
	April	9,901,098	182	8,877,324	15,176	171	153
	May	9,889,419	187	9,110,133	17,406	191	176
	June	9,894,508	192	9,358,226	19,129	204	193
	2nd Quar	29,685,025	..	27,345,683	51,711	189	174

WORKMEN'S COMPENSATION EXPERIENCE COMPILED BY THE N. Y. ASSOCIATION OF CASUALTY & SURETY STATISTICIANS—*Continued*

Year	Month	Countrywide Premium in Force	Index No.*	Modified Premium	No. of Notices	Accident Frequency†	
						Modified	Actual
1922	July	9,961,037	191	9,372,340	19,589	209	197
	August	10,173,151	198	9,922,891	22,876	231	225
	September	9,983,062	207	10,179,728	21,654	213	217
	3rd Quar.	30,117,250	..	29,474,959	64,119	218	213
	October	10,071,053	213	10,567,556	22,968	217	228
	November	10,160,258	222	11,111,258	21,423	193	211
	December	9,885,426	228	11,103,310	20,625	186	209
	4th Quar.	30,116,737	..	32,782,124	65,016	198	216
	Total	119,183,282	..	115,987,588	223,487	193	188
1923	January	10,014,173	227	11,197,848	20,097	179	201
	February	10,000,682	226	11,133,759	19,131	172	191
	March	9,995,395	241	11,866,533	20,661	174	207
	1st Quar.	30,010,250	..	34,198,140	59,889	175	199
	April	10,070,415	241	11,955,597	21,166	177	210
	May	10,144,264	244	12,193,405	23,872	196	235
	June	10,101,167	244	12,141,603	24,217	199	240
	2nd Quar.	30,315,846	..	36,290,605	69,255	191	228
	July	10,202,053	240	12,061,887	26,777	222	133
	August	10,166,749	234	11,719,212	27,835	238	274
	September	10,191,790	234	11,748,076	25,842	220	254
	3rd Quar.	30,560,592	..	35,529,175	80,454	226	263
	Total	90,886,688	..	106,017,920	209,598	198	231
Grand Total		332,373,851	..	335,560,387	633,038	189	190

*New York State factory payrolls as reported by the N. Y. State Industrial Commission.
†Per $100,000 of Premium.