Upon Combining Compensation Experience from Several States.

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The essentials of compensation insurance experience for rate-making purposes are, for each classification or group of classifications, homogeneity as to process and hazard and an exposure broad enough to warrant dependable results.

For many classifications, divergencies in methods of operation, in general working conditions and, indeed, in interpreting the manual considerably impair the value of a "country-wide" experience. On the other hand equitable underwriting presently requires several hundred classifications, a majority of which cannot be rated properly upon the experience of a *single* state even where a skillful use is made of the experience of classification groups.

There is hardly reason to doubt that for many years to come experience from contiguous states will have to be combined, or in trade parlance "reduced" to the "level" of the "basic state." Accordingly the determination of a sound and convenient method for this combination is vital to compensation rate-making.

Principal Reduction Methods Hitherto Employed.

1. *Flat "Law Differential."* *—In the beginnings of American compensation rate making it was customary to apply a single factor to the total losses of each classification in the experience of a given state to reduce such losses to the basic level, which was invariably taken to be that of the original Massachusetts Act. This factor ("law differential") was determined by applying the benefit schedule of the Act of the "additional" † state to an assumed distribution of accidents according to nature and extent of injury and comparing the resultant theoretic cost with the figures similarly com-

*See I. M. Rubinow, "Scientific Compensation Rates," *Proceedings*, Volume I, Number 1, page 10, also G. F. Michelbacher, "The Theory of Law Differentials," *Proceedings*, Volume III, Number 8, page 195.

† For purposes of this paper, "additional" state means a state other than the "basic" state, contributing to the experience reviewed.

puted upon basis of the benefits of the original Massachusetts Act. Obviously, the use of the law differential, although justifiable as a pioneer expedient, wrought inequity as between classifications owing to the variance of the frequency distribution of accidents by nature and extent of injury. Moreover, this theoretical factor ignored the variability of the accident rate, as well as of interpretation and enforcement of the act, and accordingly not even an equitable differentiation between the rates of the several states was assured unless the indicated differential was corrected by a comparison of "expected" and actual losses. There are well known instances where this test was not made.*

2. *Pennsylvania 1918 Method.*†—This method, employed in the Pennsylvania rate revision of 1918, was resultant not only of the resourcefulness of the principal authors of the revision but also of the evolution since 1914 of prevailing actuarial theory. It represented a tremendous advance over the flat law differential method. Especially note-worthy was the more equitable discrimination between the pure premiums of individual classifications due to the reduction being made not by total, but by partial losses, that is, separately for "D. & P. T. D." (death and permanent total dis-

* A striking example of the unreliable results which may proceed from a strictly theoretical calculation of a law differential was revealed when in the summer of 1918 the writer had occasion to test the New Jersey law differential through a comparison of Massachusetts and New Jersey pure premiums. From the experience before the Augmented Standing Committee when reviewing rates in 1917 all classifications showing an exposure of at least one-half million dollars payroll in both New Jersey and Massachusetts were selected. The Massachusetts pure premiums were applied to the New Jersey payrolls resulting in projected losses of $939,113. The actual New Jersey losses for the same classifications were $596,742. The indicated differential, i.e., ratio of New Jersey cost to Massachusetts, was accordingly 64 per cent. This is the "direct" experience differential as later defined in this paper. The inverse experience differential indicated by the same data was 69 per cent. In the 1917 rate revision the New Jersey law differential was taken to be 98 per cent. with a correction amounting to an increase of 15 per cent. in reduced losses for the absence of administrative claim supervision in New Jersey prior to 1916. The "net" differential for purposes of the revision was, therefore, taken to be about 85 per cent. as compared with the correct differential of about 67 per cent.

† See E. H. Downey and G. C. Kelly, "Revision of Compensation Insurance Rates, 1918," *Proceedings*, Volume V, Number 12, page 243. At this writing the author is not advised as to the actuarial methods employed in the Pennsylvania 1919 Revision.

ability), "all other" (permanent partial, temporary and indeterminate disability) and "medical" losses respectively. The Pennsylvania 1918 method comprised in substance the following:

(*a*) The death and permanent total disability losses were determined for purposes of the combined experience by applying the average cost per case in the basic state (Pennsylvania) experience to the total number of D. & P. T. D. cases in the entire experience reviewed. This procedure had the merit of simplicity, but it did not regard the variance between states in ratio of reported deaths and permanent total disabilities to payroll. Later on we shall see that this variance is sometimes substantial.

(*b*) The "medical" and "all other" losses in the experience of the "additional" states were, before being combined with the basic losses, multiplied by "experience" reduction factors determined in the following manner:

Certain classifications having a substantial exposure both in the basic and in the additional state were selected. To the classification payrolls of the basic state were applied the corresponding pure premiums of the additional state and the total actual losses of the basic state divided by the total expected losses thus projected. The resulting ratio was termed the "direct" experience differential. The "inverse" differential was the result of the inverse process, namely, application of the basic pure premiums to the payrolls of the additional state and comparison of the resultant expected losses with the actual losses of the additional state. The mean of the direct and inverse reduction factors was generally selected as the factor to be employed.

This procedure was admittedly cumbersome in application* and included explicitly at least no provision for comparing the level of the "combined" pure premiums with that of the pure premiums of the basic state. When losses are reduced by the mean of the direct and inverse experience reduction factors it is not certain that the expected losses upon basis of the combined pure premiums will fall as close to the original losses as is desirable.

Derivation of the "Reduction Factor."

The foregoing discussion brings out the following as the essentials of any method of reducing to the level of the basic state the experience of additional states:

*See E. H. Downey and G. C. Kelly, "Revision of Compensation Insurance Rates, 1918," *Proceedings*, Volume V, Number 12, page 256.

(*a*) The level of cost of the basic state should not be disturbed, that is, the combined pure premiums when applied to the payrolls in the experience of the basic state should reproduce quite closely the aggregate actual losses in such experience.

(*b*) A proper relativity between the rates for different classifications should be achieved.

(*c*) The reduction method should not involve a prohibitive amount of labor, either in preliminary work or in actual reduction.

At this date it is perhaps superfluous to urge that the reduction be made separately for each "nature of injury" or that wherever possible the use of strictly theoretic factors be avoided.

Accordingly choice of a reduction method appears to narrow down to so answering the following questions as to satisfy the foregoing criteria.

(*a*) For a given nature of injury shall the reduction be by number of accidents or by losses?

(*b*) Shall the reduction factors be determined once for the entire manual or separately for each of several schedules or other significant subdivisions?

(*c*) By what method or methods shall we calculate the reduction factors?

If we predicate our rating formula upon preservation of the basic level of cost, an interesting derivation is suggested, as follows:

Let us suppose that we have estimated or "guessed at" a factor (*R*) for reducing Massachusetts losses to the New Jersey basis; that employing this factor we have combined the Massachusetts experience with the New Jersey experience; and that we have tested the resulting "combined pure premiums" by applying them to the New Jersey payrolls, and comparing the expected losses thus projected with the actual New Jersey losses.

Suppose further that we find our expected New Jersey losses (upon basis of combined pure premiums) to differ from the actual New Jersey losses by (*D*) (where (*D*) is the *ratio* of the difference in question to the actual losses). Obviously we wish to determine that reduction factor (let us call it (*E*)) which will produce expected losses *exactly equal* to the actual.

We may express the existing and the desired situations respectively by means of the following equations:

$$\frac{\text{Expected New Jersey Losses (basis of } R)}{\text{Actual New Jersey Losses}} = 1 + D,$$

$$\frac{\text{Expected New Jersey Losses (basis of } E)}{\text{Actual New Jersey Losses}} = 1.$$

If we divide each side of the first equation by the corresponding side of the second we arrive at the following proportion:

$$(1) \qquad \frac{\text{Expected New Jersey Losses (basis of } R)}{\text{Expected New Jersey Losses (basis of } E)} = \frac{1 + D}{1}.$$

Before we may solve the foregoing for (E), the reduction factor which will preserve the basic level of cost, we must analyze the left side. In order to do this we must employ a few symbols. It is quite convenient to designate the New Jersey payrolls for each of the several classifications as respectively, J_1, J_2, etc., and the New Jersey pure premiums for each of the classifications as respectively j_1, j_2, etc., and to employ an analogous notation for the Massachusetts payrolls and pure premiums. For classification (n) the New Jersey losses may be written $J_n j_n$ and for the same classification Massachusetts losses may be written $M_n m_n$,—since losses = payroll × pure premium.

Now the combined pure premium (New Jersey basis), using (R) as reduction factor, for classification (n) is the sum of two quantities, namely, New Jersey losses and the Massachusetts losses modified by (R),—divided by the sum of the respective New Jersey and Massachusetts payrolls; which in the simple notation we have adopted may be written as

$$\frac{J_n j_n + RM_n m_n}{J_n + M_n}$$

and the expected losses for the same classification may be written

$$J_n \times \frac{J_n j_n + RM_n m_n}{J_n + M_n}.$$

Since the total expected losses for all classifications is the sum of a series of values similarly obtained, we may if we let Σ indicate summation, write total expected New Jersey losses, where (R) is employed to reduce Massachusetts losses, as follows:

$$\Sigma\left(J \frac{Jj + RMm}{J + M}\right).$$

The expected New Jersey losses where (E) is employed in place of (R) will obviously be an analogous function, so equation (1) may be rewritten as follows:

$$(2) \qquad \frac{\Sigma\left(J\frac{Jj+RMm}{J+M}\right)}{\Sigma\left(J\frac{Jj+EMm}{J+M}\right)} = \frac{(1+D)}{1}.$$

Replacing the left side of (2) by an approximation *

$$\frac{\Sigma(Jj)+R\Sigma(Mm)}{\Sigma(Jj)+E\Sigma(Mm)} = 1+D.$$

Whence

$$\frac{\Sigma(Jj)+R\Sigma(Mm)}{1+D} = \Sigma(Jj)+E\Sigma(Mm).$$

Whence

* This approximation consists in regarding $J/(J+M)$ as constant for purposes of this equation, in other words, assuming that the ratio of New Jersey payroll to combined payroll is constant. Obviously such an assumption would lead to serious error if there were a wide range in the ratio of combined losses, basis of (R) to combined losses, basis of (E). A simple investigation indicates that the value of this ratio ranges between unity and R/E. It is the narrowness of this range which apparently accounts for the closeness of the approximation.

It is not difficult to derive an expression for the *exact value* of (E) (reduction factor such that the basic level of cost will not be disturbed). If the equation immediately preceding (1) be rewritten in our notation it takes the following form:

$$\frac{\Sigma\left(J\frac{Jj+EMm}{J+M}\right)}{\Sigma(Jj)} = 1,$$

whence

$$E\Sigma\left(\frac{JMm}{J+M}\right) = \Sigma(Jj) - \Sigma\left(\frac{JJj}{J+M}\right),$$

whence, by simple algebra

$$E = \frac{\Sigma\left(\frac{JM}{J+M}j\right)}{\Sigma\left(\frac{JM}{J+M}m\right)}.$$

The verbal interpretation of the foregoing formula is that instead of weighting the respective pure premiums of Massachusetts and New Jersey by the payrolls of either one or the other state in order to determine the reduction factor, we should employ as weights a function of both the re-

$$E = \frac{\frac{\Sigma(Jj) + R\Sigma(Mm)}{1+D} - \Sigma(Jj)}{\Sigma(Mm)},$$

$$E = \frac{R - D\frac{\Sigma(Jj)}{\Sigma(Mm)}}{1+D} \tag{3}$$

or

$$E = \frac{R - D\frac{\text{Total New Jersey Losses}}{\text{Total Massachusetts Losses}}}{1+D}. \tag{4}$$

Formula (3) may be rewritten in general terms if we let (B) and (b) designate respectively payroll and pure premium of the "Basic" state and (A) and (a) payroll and pure premium of the "additional" state, as follows:

$$E = \frac{R - D\frac{\Sigma(Bb)}{\Sigma(Aa)}}{1+D}. \tag{5}$$

We made no restriction whatever as to the accuracy of (R), which suggests that we may minimize labor by combining losses in the first instance without reduction, that is, by taking (R) as unity, whereupon formula (5) may be rewritten

$$E = \frac{1 - D\frac{\text{Total Losses for Basic State}}{\text{Total Losses for Additional State}}}{1+D}. \tag{6}$$

spective state payrolls, namely their product divided by their sum. The labor involved in applying this formula is about equivalent to that required by the "direct and inverse" method, substantially more than attends the approximation formula (6) which appears to yield sufficiently accurate results, according to the tests thus far made.

A study of the formula for the exact value of (E) indicates that if we assume, as we did in arriving at the approximation formula, that $J/(J+M)$ is constant for all classifications we arrive at the formula for the inverse experience reduction factor. This assumption is not safe owing to the wide range in the ratio of the New Jersey classification pure premium to the Massachusetts classification pure premium.

It may be of interest to note that each term in the numerator of the above formula for the true value of (E) is one half of the harmonic mean of the corresponding terms in the numerators of the formulæ for the direct and inverse reduction factors, respectively. Thus far we have been unable to make any practical use of this relation.

In the foregoing formula $(1+D)$ is the ratio of the expected losses for the basic state to the actual losses for that state, where the expected losses are obtained by applying to the basic state payrolls the pure premiums derived from a combination of the experience of the two states without modifying the losses of the additional state.

Illustration of the Reduction Formula.

The convenience of the procedure implied by formula (6) may be demonstrated by some examples. Tables (1), (2) and (3) illustrate this method as applied to several important related classifications in the Trucking Schedule.

Referring first to Table (1) it will be noted that column one represents New York and New Jersey payrolls combined in thousands of dollars. Column two shows the New Jersey payroll in thousands separately. Columns three, four and five exhibit respectively the "All Other" losses for New York, New Jersey and for the two states combined. Column six is the "combined" pure premium and column seven the expected losses, namely the result of applying the combined pure premiums to the New Jersey payrolls. At the foot of the table is exhibited the computation of the value of (E). Employing formula (6) results in an indication of .549 which is applied to the New York losses in column three to obtain the reduced New York losses in column eight.

The calculation in Table (2) is analogous in all respects to that in Table (1) resulting in a factor of .627 to be applied to the Massachusetts "All Other" losses. In the last column of Table (2) is shown the reduced Massachusetts "All Other" losses.

Table (3) represents a test of the pure premiums obtained by combining the reduced losses for Massachusetts and New York with the actual New Jersey losses and dividing by the combined payrolls for the three states. The expected losses obtained by this procedure exceed the actual New Jersey losses for the same classifications by 1.2 per cent. When we consider that our formula for the reduction factor is an approximation and that we are operating upon figures for only four classifications, the deviation of expected from actual losses seems satisfactorily small.*

*If in Table (4) New York instead of New Jersey be regarded as the basic state, formula (6) gives a result of 2.499 which is almost exactly the reciprocal of .400 (the reduction factor as computed). Similarly if we reverse the calculation of Table (5) and consider Massachusetts as the basic

We submit also an analogous set of examples in Tables (4), (5) and (6). The explanations applicable to Tables (1), (2) and (3) apply to Tables (4), (5) and (6). In this case the deviation of expected from actual losses is slightly less than 1 per cent. (See Table (6)).

Practical Application of the Reduction Formula.*

Formula (6) is so devised as to automatically satisfy the first criterion of the rating method as hereinbefore named, i.e., (*a*) preservation of the basic level of cost.

The formula may be interpreted either in terms of pure premiums or of rate of accidents per unit of payroll so we are now free to determine a method of applying the formula which will best satisfy the other two criteria, namely (*b*) a proper relativity between the rates for different classifications and (*c*) convenience in operation.

The attainment of a proper relativity between rates cannot be

state we obtain a factor of 1.696 which is very close to the reciprocal of the factor for reducing Massachusetts losses to the New Jersey basis.

This would be expected from an inspection of the exact formula for the value of (E) (see footnote page 15). With respect to any given pair of states we weight the pure premiums with the same set of factors, regardless of which state is regarded as the basic state. However, New York-New Jersey weights are not the same as New York-Massachusetts weights and consequently the Massachusetts-New York reduction factor may not be consistent with the indication of a comparison of the Massachusetts-New Jersey and New York-New Jersey factors.

The foregoing suggests that where a considerable volume of experience is reduced to a given basis, the problem of "projecting" the combined pure premiums to any other basis is a separate one for each additional state.

* It is yet too early to predict exactly what methods will eventually be found the best in computing experience differentials. Already as the result of experimentation upon the part of the Actuarial Committee of the National Council considerable advance has been made beyond the point of progress indicated by this paper. Mr. Mowbray recommends that instead of employing formula (6) in the first instance, the first approximation to the reduction factor be obtained by comparison of average pure premiums. The factor resulting from this comparison, which, by the way, involves little labor, may be tested in the manner herein illustrated and formula (6) applied as a corrective.

I believe that Mr. Perkins made to the writer substantially the same suggestion as that of Mr. Mowbray.

Mr. Mowbray has also developed an interesting and convenient variation of the exact formula (see footnote on page 15) which I hope he will bring to the attention of the Society.

entirely proved or disproved as respects all classifications, since we have no exact measure of the true (a priori) pure premiums of those classifications which have not within themselves a dependable exposure. However, we should employ a method which in reason may be expected to produce equitable results and which actually does produce results which are confirmed by trained judgment. It will help if the basic level of cost is maintained, not merely for the entire manual, but also for significant subdivisions. If the experience of the basic state be thrown into classification groups severally comprising a dependable exposure and related operative processes (not necessarily identical in the degree of hazard) the "fit" of the losses expected (upon basis of the combined pure premiums) to the actual losses should be reasonably close.

The foregoing indicates the desirability of determining experience reduction factors separately by schedules or other groups of related classifications, at least as respects "All Other" and "Medical" losses. The advisability of such procedure is confirmed by the variation in the value of (E) which we encounter as we pass from one schedule to another.* For instance, for several important class-

* One of the members of the Society raised the question as to whether the value of (E) is materially affected by the relative size of the respective payrolls in the basic and additional states; that is, more specifically, whether the value of (E) as obtained by formula (5) depends as much upon the difference between states in benefits, in administration of the act, and in accident frequency as it does upon the comparative exposure in the two states.

It appears that the value of (E) depends almost entirely upon relative pure premium level and very little upon the relative extent of exposure. If in table (4) the New York payrolls and losses are multiplied by ten and no change is made in the volume of New Jersey payrolls and losses, the value of (E) according to approximation formula (5) becomes .390. On the other hand, if the New York payrolls and losses are divided by three, in other words if the New York pure premiums remain constant while the New York volume be arbitrarily reduced to a parity with that of New Jersey, the value of (E) according to formula (5) becomes .408. Neither of these values is far off from the figure of .400 actually indicated by table (4).

Ideally, perhaps, we should employ for reduction purposes a factor reflecting the functional relation between the benefit schedules, administrative systems and accident frequencies of the two states. This functional relation might reasonably be expected to vary from schedule to schedule. Its absolute value can probably never be computed. The test of formula (5) just referred to seems to encourage the view that (E) is an approximation to this ideal factor.

ifications in the logging and wood schedule, we find the value of (E) (for reducing New York "All Other" losses to New Jersey basis) to be .400 (see Table (4)) while for the most important classifications in the trucking schedule the corresponding value of (E) was .549 (see Table (1)).

In determining a procedure for reducing death and permanent total disability losses we are confronted by the fact that the number of accidents resulting in death or permanent total disability are comparatively few; while variation in extent of dependency causes such a serious irregularity in cost per case as to make the indications of actual pure premiums quite misleading from the standpoint of expected losses.

Pennsylvania established a valuable precedent in combining deaths and permanent total disabilities by number, ignoring actual losses in the individual case and making the reduced losses equal to the product of the total number of cases and the average cost per case in the basic state.

As previously stated, the Pennsylvania 1918 procedure ignored variation from state to state in frequency of "D. & P. T. D." cases per unit of payroll. This variation in "D. & P. T. D." frequency should not be ignored. The writer has made a computation, too lengthy to be reproduced here, determining the value of (E) (see formula (5)) for reducing New York "D. & P. T. D." cases by number to the New Jersey basis. The calculation was based upon New York Schedule "Z" policy year 1916 and New Jersey Schedule "Z" policy year 1917 and embraced the experience of those classifications (to the number of 100) having the most substantial volume of premium exposure in both states. The value of (E) was found to be .72.* The "D. & P. T. D." accident rates indicated by combining New York and New Jersey experience without reduction resulted in expected deaths which exceeded the actual New Jersey deaths by slightly more than 28 per cent.

A logical procedure would seem to be to modify the Pennsylvania practice by introducing the formula we have developed (for-

Another point which may merit further investigation is that the true value of (E) approaches that of the "direct" factor as a limit, where the pure premiums of both states remain constant and the payrolls and losses of the "additional" state are both increased in the same proportion.

* This wide departure from unity may partly be accounted for by the fact that the New York data were accumulated a year earlier than were the New Jersey data.

mula (5)),—in other words, to reduce the *number* of deaths and permanent total disabilities in the same way that we reduced the *losses* for the other elements of cost, and to the reduced *number* of cases apply the average "D. & P. T. D." value in the experience of the basic state.

Formula (5) is much easier to apply than is the "direct and inverse" method of computing reduction factors. Moreover it is much easier to check. A glance at Tables (1), (2), (4) and (5) indicates that most of the work can be checked by addition of columns and cross-footing of totals. Determination of the combined pure premiums and of the expected losses has to be checked item by item, but as a rule any serious error will be found if this check is confined to a careful inspection.

In view of the convenience of the formula there is no reason why in applying it we may not utilize the experience of enough classifications to comprise 80 per cent. or 90 per cent. of the entire losses of the "basic" state and of the "additional" state respectively. In selecting these classifications the selection may be made independently for each state without reference to whether a given classification has exposure in both states. The most satisfactory criterion in selecting which classifications to use is premium rather than either payroll or losses as a broad payroll exposure means little in extremely non-hazardous classifications and selection upon basis of volume of losses will tend toward misleading results.

For the convenience of the reader we summarize our suggestions as to the reduction method.

(*a*) Split experience of basic state into a number of subdivisions, such that each subdivision contains a substantial premium exposure in classifications which are related in process.

(*b*) Medical Losses: Determine separate value of (E) for "Medical" losses for each "additional" state and for each subdivision of the manual.

(*c*) All other Losses: Same procedure as for "Medical" losses.*

* In the above we have not dicussed the possibility of making the reduction for "all other" losses on the basis of accident frequencies rather than pure premiums. We believe that if such a procedure were to be adopted it would be necessary to first investigate the question of whether "all other" accidents can be combined by number by simple addition or whether it would be necessary to compute the value of (E) between states upon the basis of accident frequency. Table (7) appended to this paper indicates that for certain of the largest classifications the "direct" factor for reduc-

(*d*) D. & P. T. D. Losses: For purposes of reduction consider *number* of cases instead of actual *losses*. Determine for each "additional" state the reduction factor (*E*) upon basis of *frequency* of "D. & P. T. D." cases either for the entire volume of experience or separately for each of several subdivisions of the manual, if the exposure is sufficient in volume.

(*e*) When the experience of the several states has been combined, the combined pure premiums should be tested separately for each significant subdivision of the manual by comparing the expected losses with the actual losses.

Some General Remarks.

This paper would from a practical standpoint be incomplete without any comment upon the extent to which it is desirable to combine compensation experience from different states, or sections of the country.

It is, we believe, generally admitted that the pure premium level of each state should be determined from its own experience,—at least in all cases where there exists within the state a substantial premium volume. This limits the function of "additional" experience to assistance in the determination of a proper relativity between rates.

However, unless classification experience is thrown into groups comprising fairly similar processes, we shall find ourselves, even when the experience of the entire United States is combined, unable to determine a proper relation between the rates of the respective classifications. If such group experience is considered, we find it is possible to attempt a direct statistical approximation to the rates for the most important classifications of a given jurisdiction without going further than neighboring states for additional experience.

Speaking generally, owing to variation in processes and in working conditions from one section to another, the more limited the geographical spread of the experience the better, provided an adequate premium exposure is developed. Exceptions to this principle would be indicated for industries or occupations known to conform to standard regardless of location (as for example, because of unity

ing New York and Pennsylvania "all other" accidents to the New Jersey basis, is .890. The data employed in this calculation are taken from Schedule Z of the several states for the following policy years: New York 1915, Pennsylvania 1916, and New Jersey 1916.

of management) also for those classifications or groups for which no dependable exposure will be forthcoming unless for the entire country.

State, sectional or national experience should, then, be utilized, according to the respective requirements of each situation. Such a course will commend itself far better to the judgment of intelligent employers than will the indiscriminate use of a country-wide combination of experience for all classifications.

The problem of compensation insurance rate-making is a national one, but business sense indicates that there is no magic in mere breadth of exposure. Our viewpoint should be national, but the experience used to make rates should be that portion of the available data which may logically be expected to measure most closely the expected losses within a given area.

If our problem is national we should then maintain our classifications upon a substantially uniform basis. There are cases which justify inconsistency as between the classifications employed in different states, but from an ultimate standpoint these cases should prove few in number. We recognize the substantial use which must be made of experience gathered from broad geographical areas, or from the country at large,—and such broad volumes of experience cannot be presented conveniently, much less intelligently, unless there is general standardization in classification wordings and code numbers.

The present manual is marred by numerous redundancies, inconsistencies and ambiguities in classification wording. Let us immediately "trim out" this dead wood and the useless underbrush, taking care, however, not to bark any live trees, and taking pains to set out new trees where there is room for them.

TABLE 1.

CALCULATION OF REDUCTION FACTOR—N. Y. TO N. J.—ALL OTHER (CERTAIN SPECIFIED CLASSIFICATIONS).

Classification.	Code.	Payroll in Thousands.		Losses.			Combined P. P.	Expected Losses.	Reduced N. Y. Losses.
		Combined.	N. J.	N. Y.	N. J.	Combined.	((5)÷(1)).	((2)×(6)).	((3)×.549).
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Drivers N. O. C.	7,205	33,927	7,075	154,519	23,270	177,789	.524	37,075	84,831
Truckmen—general (discontinued)	7,208	6,721	1,127	79,462	8,080	87,542	1.303	14,681	43,625
Trucking—light (discontinued)	7,211	3,175	702	25,914	5,590	31,504	.992	6,962	14,227
Chauffeurs N. O. C.	7,380	16,372	5,273	52,951	11,502	64,453	.394	20,777	29,070
		60,195		312,846	48,442	361,288		79,495	171,753

$$E = \frac{1 - D\dfrac{\Sigma \text{ N. J. Losses}}{\Sigma \text{ N. Y. Losses}}}{1 + D},$$

$$\text{where } (1 + D) = \frac{\text{Total Col. (7)}}{\text{Total Col. (4)}} = 1.641.$$

$$E = \frac{1 - .641 \times .155}{1.641} = .549.$$

TABLE 2.

CALCULATION OF REDUCTION FACTOR—MASS. TO N. J.—ALL OTHER (CERTAIN SPECIFIED CLASSIFICATIONS).

Classification.	Code.	Payroll.			Losses.			Comb. P. P.	Ex. Losses.	Red. Mass. Losses.
		Mass.	N. J.	Comb.	Mass.	N. J.	Comb.	((6)÷(3)).	((2)×(7)).	((4)×.627).
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Drivers N. O. C.	7,205	25,004	7,075	32,079	131,995	23,270	155,265	.484	34,243	82,761
Truckmen—general (discontinued)	7,208	7,557	1,127	8,684	86,182	8,080	94,262	1.086	12,239	54,036
Trucking—light—discontinued)	7,211		702	702	—	5,590	5,590	.796	5,590	—
Chauffeurs N. O. C.	7,380	11,320	5,273	16,593	47,295	11,502	58,797	.354	18,666	29,654
		43,881	14,177	58,058	265,472	48,442	313,914		70,738	166,451

$$E = \frac{1 - D\dfrac{\Sigma \text{ N. J. Losses}}{\Sigma \text{ Mass. Losses}}}{1 + D},$$

$$\text{where } (1 + D) = \frac{\text{Total Col. (8)}}{\text{Total Col. (5)}} = 1.46,$$

$$E = \frac{1 - .46\dfrac{48442}{265472}}{1.46} = .627.$$

TABLE 3.

NEW YORK, MASSACHUSETTS, NEW JERSEY (CERTAIN SPECIFIED CLASSIFICATIONS). TEST OF COMBINED PURE PREMIUMS.

Classification.	Code.	Payroll in Thousands.		Reduced Losses.				Combined. P. P.	Expected Losses.
		N. J.	Combined.	N. Y.	Mass.	N. J.	Combined.	((6)÷(2)).	((1)×(7)).
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Drivers N. O. C.	7,205	7,075	58,931	84,831	82,761	23,270	190,862	.324	22,923
Truckmen—general (discontinued)	7,208	1,127	14,278	43,625	54,036	8,080	105,741	.740	8,340
Trucking—light (discontinued)	7,211	702	3,175	14,227	—	5,590	19,817	.624	4,380
Chauffeurs N. O. C.	7,380	5,273	27.692	29,070	29,654	11,502	70,226	.254	13,393
		14,177	104,076	171,753	166,451	48,442	386,646		49,036

$$\frac{\text{Projected Losses}}{\text{Actual Losses}} = \frac{49036}{48442} = 1.012.$$

TABLE 4.

CALCULATION OF REDUCTION FACTOR—N. Y. TO N. J.—ALL OTHER (CERTAIN SPECIFIED CLASSIFICATIONS).

Classification.	Code.	Payroll in Thousands.			Losses.			Combined P. P. (6)÷(3).	Expected Losses (1)×(7).	Reduced N. Y. Losses (5)×.400.
		N. Y.	N. J.	Combined ((1)+(2)).	N. J.	N. Y.	Combined ((4)+(5)).			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Logging and lumbering.....	2,702	1,426.0	254.6	1,680.6	1,749	40,642	42,391	2.522	6,421	16,257
Saw mills.....	2,710	870.0	223.5	1,093.5	1,859	29,053	30,912	2.826	6,316	11,621
Sash, door and blind mfg...	2,730	1,226.0	715.6	1,941.6	3,393	19,891	23,284	1.199	8,580	7,956
Planing and moulding mills.	2,731	2,721.0	535.0	3,256.0	5,378	36,284	41,662	1.279	6,843	14,514
Box mfg.—wood, mfg. shooks from sawed lumber and assembling	2,760	1,231.0	392.4	1,623.4	1,814	15,193	17,007	1.048	4,112	6,077
Carpentry—shop only.....	2,803	2,055.0	718.9	2,773.9	5,588	35,845	41,433	1.493	10,733	14,338
		9,529.0	2,840.0	12,369.0	19,781	176,908	196,689		43,005	70,763

$$E = \frac{1 - D\frac{\Sigma \text{ N. J. Losses}}{\Sigma \text{ N. Y. Losses}}}{1 + D},$$

$$\text{where } (1 + D) = \frac{\text{Total Col. (8)}}{\text{Total Col. (4)}} = 2.174,$$

$$E = \frac{1 - 1.174\,\frac{19781}{176908}}{2.174} = .400.$$

TABLE 5.

CALCULATION OF REDUCTION FACTOR—MASS. TO N. J.—ALL OTHER (CERTAIN SPECIFIED CLASSIFICATIONS).

Classification.	Code.	Payroll.			Losses.			Comb. P. P. (6)÷(3).	Expected Losses (2)×(7).	Red. Mass. Losses (4)×.592.
		Mass.	N. J.	Comb.	Mass.	N. J.	Comb.			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Logging and lumbering	2,702	686.2	254.6	940.8	11,714	1,749	13,463	1.431	3,643	6,935
Saw mills	2,710	601.2	223.5	824.8	6,535	1,859	8,394	1.018	2,275	3,869
Sash, door and blind mfg...	2,730	774.5	715.6	1,490.0	6,115	3,393	9,508	.638	4,566	3,620
Planing and moulding mills.	2,731	1,602.9	535.0	2,137.9	44,612	5,378	49,990	2.338	12,508	26,410
Box mfg.—wood, mfg. shooks from sawed lumber and assembling	2,760	4,591.1	392.4	4,983.5	45,039	1,814	46,853	.940	3,689	26,660
Carpentry—shop only	2,803	2,030.6	718.9	2,749.5	9,040	5,588	14,628	.532	3,825	5,351
		10,286.5	2,840.0	13,126.5	123,055	19,781	142,836		30,506	72,845

$$E = \frac{1 - D \times \frac{\Sigma \text{ N. J. Losses}}{\Sigma \text{ Mass. Losses}}}{1 + D},$$

$$\text{where } (1 + D) = \frac{\text{Total Col. (8)}}{\text{Total Col. (5)}} = 1.542,$$

$$E = \frac{1 - .542 \times \frac{19\,781}{123\,055}}{1.542} = .592.$$

TABLE 6.

NEW YORK, MASSACHUSETTS, NEW JERSEY (CERTAIN SPECIFIED CLASSIFICATIONS). TEST OF COMBINED PURE PREMIUMS.

Classification.	Code.	Reduced Losses.				Payroll.				Combined P. P. ((5)÷(8)).	Expected Losses ((7)×(9)).
		N. Y.	Mass.	N. J.	Total.	N. Y.	Mass.	N. J.	Total.		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Logging and lumbering	2,702	16,257	6,935	1,749	24,941	1,426	686.2	254.6	2,366.8	1.053	2,681
Saw mills	2,710	11,621	3,809	1,850	17,340	870	601.2	223.5	1,694.7	1.023	2,286
Sash, door and blind mfg.	2,730	7,956	3,620	3,393	14,969	1,226	774.5	715.6	2,716.1	.551	3,943
Planing and moulding mills	2,731	14,514	26,410	5,378	46,302	2,721	1,602.9	535.0	4,858.9	.953	5,099
Box mfg.—wood, mfg. shooks from sawed lumber and assembling	2,760	6,077	26,660	1,814	34,551	1,231	4,591.1	392.4	6,214.5	.556	2,182
Carpentry—shop only	2,803	14,338	5,351	5,588	25,277	2,055	2,030.6	718.9	4,804.5	.525	3,774
		70,763	72,845	19,781	163,389	9,529	10,286.5	2,840.0	22,655.5		19,965

$$\frac{\text{Projected Losses}}{\text{Actual Losses}} = \frac{\text{Total Col. (10)}}{\text{Total Col. (3)}} = 1.0093.$$

TABLE 7.

DIRECT REDUCTION FACTOR—{New York 1915 and Pennsylvania 1916 to New Jersey 1916}—BASIS ALL OTHER ACCIDENT FREQUENCY.

Classification.	Code.	"Other"* Payroll in Thousands.	"Other"* Perm. Partial, Temp. and Indeterminate Disabilities. (Number.)	"Other"* Perm. Partial, Temp. and Indeterminate Disabilities. (Rate.)	N. J. 1916 Payroll in Thousands.	N. J. 1916 Perm. Partial Temp. and Indeterminate Disabilities.	"Other"* Accident Rate Applied to N. J. 1916 Payroll ((6) X(5)).
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Wool spinning and weaving	2,286	18,826	433	2.300	6,876	84	158.1
Silk mfg.	2,303	27,537	213	.774	12,726	91	98.5
Finishing of textiles—new goods	2,413	6,622	163	2.477	4,556	146	112.8
Tanning	2,623	5,456	223	4.087	2,741	77	112.0
Iron and steel works	3,030	2,908	253	.870	561	23	4.9
Foundries—iron	3,081	16,691	1,112	6.662	1,976	70	131.6
Wire drawing	3,241	991	125	12.616	551	30	69.5
Machine shop—with foundry	3,631	20,116	1,379	6.855	4,504	184	308.8
Machine shop—without foundry	3,632	59,947	3,337	5.567	10,458	406	58.2
Projectile shell case mfg.	3,633	7,789	259	3.325	885	27	29.4
Electric apparatus mfg.	3,643	6,885	274	3.980	5,281	211	210.2
Millwright works	3,724	4,818	222	4.608	1,182	69	54.5
Auto. mfg.	3,808	9,266	327	3.529	3,123	61	110.2
Masonry	5,022	9,901	916	9.252	1,439	112	133.2
Iron works	5,040	2,336	460	19.693	289	41	56.9
Plumbing	5,183	13,724	589	4.292	1,735	55	74.5
Concrete works	5,204	3,554	507	14.264	380	23	54.2
Carpentry	5,401	7,695	1,062	13.802	1,393	106	192.3
Painting and decorating—not interior	5,461	3,334	304	9.117	473	29	43.2
Painting and decorating—interior	5,490	9,501	320	3.368	880	17	29.6
Roofing	5,545	2,146	243	11.321	236	23	26.7
Additions	5,602	5,324	212	3.982	2,040	49	81.2
Drivers and helpers	7,205	53,504	3,012	5.629	4,847	212	272.8
Truckmen—general	7,208	6,064	796	13.127	611	54	80.2
Truckmen—heavy	7,211	2,545	235	9.232	212	23	19.5
Chauffeurs and helpers	7,380	18,487	844	4.565	2,292	109	104.6
Coal merchants	8,220	1,390	131	9.425	229	13	21.6
Auto. livery	8,380	19,609	762	3.886	1,809	74	70.3
		346,966	18,714		74,285	2,419	2,719.5

* "Other" means Pennsylvania 1916 and New York 1915 combined.

The "direct" experience factor for reducing N. Y. and Pa. "all other" accidents to the N. J. basis (by number)

$$= \frac{\text{Actual N. J. Accidents}}{\text{Expected N. J. Accidents}} = \frac{2419}{2719.5} = .890.$$