

## THE THEORY OF LAW DIFFERENTIALS.

BY

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I have prepared this paper not with the idea that the information it contains is original, or the result of individual research on my part, but rather with the thought that some record should be made in the transactions of this Society of the interesting developments in the theory of law differentials which have grown out of the recent revision of the Workmen's Compensation Manual. In addition, it is hoped that this presentation may gain for the subject a wider range of discussion than is possible in committee work.

There can be no question concerning the proposition that the actuarial theory of law differentials is in the process of formation; it will bear much additional investigation and study. While its complete development probably cannot come until our workmen's compensation experience is available in much greater volume, the theory has certain interesting theoretical possibilities which can be profitably considered at this time. In what follows I have attempted to outline the subject in brief and to point out some of the more important differential methods which were proposed during the proceedings of the Actuarial Sub-Committee of the Augmented Standing Committee on Workmen's Compensation Rates.\*

## THE RELATIONSHIP OF THE LAW DIFFERENTIAL TO THE BASIC MANUAL.

In workmen's compensation rate making the conception of the law differential has facilitated the establishment of the principle of the so-called "Basic Manual." This principle in brief is founded upon the hypothesis that notwithstanding the widely different

\* This committee was responsible for the actuarial work of the revised Manual of Workmen's Compensation Rates. Its members were Messrs. Black, Cogswell, Flynn, Michelbacher, G. D. Moore, Mowbray, Scattergood and Woodward—all Fellows of this Society. Mr. Cogswell acted as chairman, Mr. Michelbacher as secretary.

benefit provisions and claim administrative procedure of state compensation acts, there is a fundamental definition of basic hazard for each manual classification which does not vary with territorial divisions of the country; in other words, that the collective hazard of each manual classification remains the same throughout the country, provided such factors as claim cost and administration, accident frequency, industrial activity, etc., are constant. Thus fundamental hazard relationships which do not vary with territorial divisions of the country may be established as follows:

An iron foundry represents twice the hazard of a cotton spinning and weaving establishment.

A steel foundry represents twice the hazard of an iron foundry.

General trucking represents a hazard equivalent to the hazard of a steel foundry.

Structural steel erection represents four times the hazard of general trucking.

This general law is subject to exceptions, of course, wherever the conditions under which an industry is carried on in a particular territory differ radically from the conditions under which the industry is carried on in the remaining parts of the country. The clearest instances of this character are found in connection with mining operations of various sorts and in logging and lumbering and contracting operations. However, the problem of determining which classifications shall be treated as exceptions because of local conditions and what the deviation from the basic hazard valuation for these classifications shall be, is a specific problem which is of minor importance when compared with the more general problem of determining the index of hazard for each classification in the Basic Manual.

The fundamental index of hazard may be defined as a measure of the capacity of risks in each classification to produce accidents. A premium rate, however, should not only measure the capacity of a risk to produce accidents of certain types with a certain frequency; it should also measure the cost of compensating the injured workmen who sustain these accidents. The fundamental index of hazard, inasmuch as it covers only a part of the ground, must, therefore, be supplemented by a measure of the cost of compensation. This combination of the frequency of accidents and the cost of compensation is what is known as a basic pure premium. In practice the basic pure premium represents a measure of the

capacity of risks in the individual classification to produce accidents, upon the assumption that these accidents when produced will be compensated for under the benefit provisions of a definite compensation act. This act is the basic compensation act. It may be an act under which compensation claim settlements are being made at present, it may be one that has been discontinued, or it may be a hypothetical act that has never been applied to compensation claim settlements in any state. When the theory of the basic manual was introduced, the workmen's compensation act under which the greatest amount of statistical experience had been accumulated was the original Massachusetts Act. This was, therefore, taken as the basic compensation act. The greatest volume of state experience is no longer found under the original Massachusetts Act. Nevertheless, it has been continued as the basic act principally because the rating procedure has become more or less firmly established; also because it is now permanent, in that it has been discontinued and is, therefore, no longer subject to amendment.

The function of the law differential is to measure the relative cost of the benefits of a state workmen's compensation act as compared with the cost of the benefits of the basic act. Each state act has a law differential that is subject to amendment whenever its benefit provisions are amended. Thus, the California law differential now used indicates that the benefit provisions of the Workmen's Compensation Insurance and Safety Act as amended August 7, 1915, are on the average 66 per cent. more costly than the benefit provisions of the original Massachusetts Act. The California pure premium for a classification which is not treated individually because of peculiar local conditions may, therefore, be obtained by multiplying the basic pure premium for the classification by 1.66.

The use of the law differential is not limited to the projection of basic pure premiums, however. It has a second important function; namely, its use may be reversed and in this way losses incurred under the provisions of the California Act or any other act may be reduced to the basis of the provisions of the original Massachusetts Act which represents the basic pure premium level. By means of this reverse operation the greatest volume of compensation experience can be made available for rate making purposes, thereby rendering possible the establishment of basic pure premiums with proper consideration for the law of averages.

The law differential then, is essential to and permits the application of the principle of a basic manual of workmen's compensation insurance rates. Just how vital this principle is to efficiency in rate making may be estimated by a consideration of the improved rating conditions under compensation insurance as compared with corresponding conditions under employer's liability insurance, where a separate manual was used for each state and where rates were based upon individual state experience.

The basic manual promotes uniformity of statistical and underwriting procedure inasmuch as one set of classifications and rules is applicable to all compensation states. Furthermore, the basic manual makes it possible to treat the rate making problem as a national problem. The importance of this cannot be overestimated, for national treatment of the rating problem means, among other things, the employment of the best talent for rate making, the elimination of local influences created by competitive controversies, the maintenance of consistent rates in all states, the establishment of rates upon a broad and dependable statistical basis and the possibility of securing a birds-eye view of the entire rate situation from the standpoint of adequacy. In short, centralization makes for a more intensive study of the rating problem in all its phases. Without question, if compensation rate making continues to be considered as a national problem, it will be possible to evolve a theory of rating which will have the universal recognition now accorded life insurance actuarial science. These facts explain the importance which has been attached to the theory of law differentials.

#### DIFFERENTIATION BETWEEN THE USE OF THE LAW DIFFERENTIAL AS A REDUCTION FACTOR AND AS A PROJECTION FACTOR.

As pointed out above, the law differential may be used in two ways. It may be used to reduce past classification experience to the basic pure premium level, or it may be used as one of the factors of a multiplier to project basic pure premiums into the future as state rates. In order that there may be no confusion, it should be stated at this time that the value of the law differential need not necessarily be the same in these two operations. It is the function of the law differential to measure the cost of compensation under a certain compensation act. This definition implies a measurement not only of the compensation provisions of the act but also of the

administrative provisions, and what is still more important, of the interpretation of the benefit provisions by the administrative claim body. Undoubtedly, both interpretation and general administration of compensation acts are changing. Compensation claim procedure is still in the process of formation. Thus it may be that many more permanent partial disability cases will be recognized when the interpretation of compensation acts has reached its ultimate stage of development and that the method of compensating cases of permanent partial disability will radically change.

Because cost conditions are changing, the value of the law differential is subject to change also. The value used in the reduction of experience should represent past cost conditions; that is to say, cost conditions which obtained during the policy period covered by the experience. The value used in the projection of pure premiums should represent conditions which will be assumed to obtain during the policy period for which the rates are contemplated. For the past, definite information concerning cost conditions may be available. If so, all such available information, if dependable, should be used in the computation of the reduction differential or differentials. For the future, which usually is limited to two calendar years, cost conditions must be assumed. The assumption to be made in this connection will necessarily be a matter for judgment. It is the writer's judgment that the only sound basis for prognosticating future cost conditions is the assumption that such cost conditions will approximate the ultimate development of all factors which have bearing on determination of the rate—the ultimate distribution of accidents by kind of injury, the most liberal interpretation of compensation benefits, etc.

#### METHODS OF DIFFERENTIAL CALCULATION.

If the nature of the data upon which the calculation is made is taken as a basis, there are two general methods of differential calculation that are recognized at the present time.

The first of these methods may be termed "the injury distribution method." The basis for calculation here is one or several distributions of accident cases by ultimate nature of injury. The accident distribution that has been used to date in connection with this method of differential calculation is the Rubinow Standard Table. This table presents the ultimate results from an injury standpoint of 100,000 accidents. The table is an average table in

that it is intended to apply to all industries rather than to one specific industry or group of industries. The 100,000 accidents, which serve as the basis for the distribution, are first analyzed by broad groups of injuries. Thus, the table gives the number of accidents which ultimately result in death, the number which ultimately result in permanent total disability, the number which ultimately result in permanent partial disability, etc. These injury groups are then sub-divided. The temporary disability group, for example, is further analyzed to show the number of cases which result in disability lasting less than one week, the number of cases which result in disability lasting from one to two weeks, etc. The fatal accident group is further analyzed to show the number of deaths involving no dependency, the number involving total dependency, etc. Theoretically, upon any assumption of general accident frequency, the table will give answers to such questions as the following:

What is the probability of temporary injury to a full time yearly worker?

What is the probability of injury to a full time yearly worker involving temporary disability lasting from one week to two weeks?

What is the probability of death to a full time yearly worker?

What is the probability of death to a full time yearly worker who has no dependents?

The law differential computed on the basis of a distribution of this character in reality has the form of a mathematical expectation. The amount at stake in the event of any particular injury is the compensation payment which is necessary under the provisions of any law to indemnify a workman sustaining such injury. The probability of the occurrence of the injury can be taken from the table. Thus, it is possible to compute individual expectations for every kind of injury. The final differential is the sum of many expectations which cover the range of possible accident cases from an injury standpoint.

The second method of differential calculation may be termed "the experience method." The basis for calculation here is matured compensation experience. To be of the greatest value such experience should be classification experience, that is to say, it should be available for individual manual classifications. Inasmuch as the law differential is a comparative figure, experience must be available under two compensation acts for the computation

of any differential; an experience on the one hand under the compensation act which is taken as the basic act and an experience on the other hand under the act for which a differential is to be computed. As this method of calculation is based upon matured experience accumulated during the past, it is fairly applicable to past cost conditions. The method becomes slightly involved, however, when applied to the future. This is true whether it is applied to the same compensation act for which experience is available or to an amended act. The use of the method involves a careful investigation of the dependability of the experience, the cost conditions contemplated by the experience and other factors which in any way affect claim cost. These problems will be considered later. It is well to point out at this time, however, that the use of actual classification experience will not cover all the phases of law differential calculation. Actual experience must be supplemented by some form of injury distribution, particularly in the computation of law differentials for the projection of state rates.

It should be noted also that this method does more than produce a law differential if by this term is meant a measure of the cost of one compensation act as compared with another. The use of actual classification experience brings into the calculation such factors as increasing cost due to the age of the act or to abnormal industrial activity, variations in accident frequency, underestimates of outstanding losses, etc. For this reason the term "law differential" is rather loosely used in this connection. Strictly speaking it is impossible to compute a law differential by the experience method.

#### FORMS OF LAW DIFFERENTIALS.

Regardless of method of computation the relative cost of any compensation act may be represented by one differential or by several. The use of one differential is a very satisfactory method of comparing the relative cost of compensation acts for all industries. Under the injury distribution method of calculation the use of one differential assumes that the distribution of accidents by kind of injury is a composite of many injury distributions for individual industries or groups of industries. Where actual experience is used, one differential assumes that the average cost conditions represented by the total experience are applicable to individual industries. For this reason, wherever a compensation act places particular emphasis upon one or several kinds of injury, one differen-

tial may not be particularly well adapted to represent the cost of the act for individual industries. If the compensation for death is particularly liberal in one state as compared with another, the use of one differential to represent the cost of compensation for all industries in the two states in question does not produce results that are entirely consistent, from the standpoint of individual industries.

In recognition of the fact that one law differential does not always accurately measure claim cost for all industries within a state, it has been proposed to use more than one differential or a system of differentials to represent the cost of a compensation act. The form of a system of differentials varies. The differential may be a function of the basic rate; that is to say, it may vary with the value of the basic pure premium. It also may be a function of the industry; one differential may be established to represent the cost of a compensation act as applied to the accidents produced by the textile industry; another may represent the cost of the compensation act as applied to the accidents produced by contracting risks, etc. Finally, the law differential may be broken up into several differentials—one for each kind of benefit. Thus there may be one differential for the medical benefits of an act, another for the death benefits, a third for the temporary total disability benefits, etc.

Obviously, a complete description of the various forms of differentials cannot be attempted in a paper of this character. I shall, therefore, limit myself to a brief statement of the several forms which have just received consideration by the Actuarial Subcommittee of the Augmented Standing Committee.

#### A SYSTEM OF LAW DIFFERENTIALS BY KIND OF BENEFIT.

The application of this form of differential to the projection of basic pure premiums would necessitate the establishment of partial basic pure premiums, one basic pure premium for each element of the total loss cost. Thus, if the present pure premiums were built up of several pure premiums, one for each kind of benefit, a system of law differentials might very well be employed to translate the basic injury pure premiums into corresponding injury pure premiums for any particular compensation act. In this way a total state pure premium for each classification might be constructed by summing its component parts. At present, however, our statistical information for individual classifications is so limited in the majority of cases that it is impossible to refine the problem of basic pure premium determination to such an extent.



It has been pointed out that the use of one differential for all classifications assumes that an average injury distribution is applicable to individual classifications. A single differential as a reduction factor may not properly reduce experience for individual classifications which have injury distributions varying from the average, particularly when the act to which the differential applies disproportionately compensates a specific kind of injury. To take an extreme case let us assume that an average distribution of injuries provides for two deaths for each one hundred non-fatal accidents, and that the death benefits of a certain act are particularly high. The single law differential for this act will reflect these conditions. This law differential will be applicable without question to any classification for which the average distribution of deaths and non-fatal cases holds. It will be too high, however, for a classification for which the normal distribution is .5 death to one hundred non-fatal accidents, and too low for a classification for which the normal distribution is six deaths to one hundred non-fatal accidents. The use of a single law differential as a reduction factor would, therefore, distort the experience for certain classifications. Such method of reduction would arbitrarily produce a fictitious excess of modified losses for classifications with death ratios higher than the average and a fictitious deficiency of modified losses for classifications with death ratios lower than the average.

The danger from this source is practically negligible at this time because there are very few classifications for which a sufficient volume of experience is available to permit the establishment of a basic pure premium upon experience alone. Rate making is still dependent upon the use of underwriting and actuarial judgment. The available experience is, of course, an excellent guide and is being used more and more in moulding judgment, but the time has not yet come when experience can be substituted for judgment in the establishment of basic pure premiums for all classifications. This time is approaching, however, and is being brought nearer by the gradual accumulation of experience. The Augmented Standing Committee this year had available experience comprising a total payroll exposure for all classifications of approximately \$4,500,000,000. This exposure represented three times the exposure covered by the experience which was available to the Committee last year. Next year this exposure may be doubled. It is, therefore, high time that consideration is given to the evolving of more accurate methods of experience reduction.

A system of law differentials by kind of benefit is not impracticable from the standpoint of experience reduction even though our present classification experience has not been fully developed and is not entirely complete.

It has been the custom in the past to provide for some analysis of compensation losses by kind of benefit. The classification of losses has not been standardized, nor has it been carried to the same degree of refinement in all experiences. It has been recognized, however, that some segregation of losses is essential and such analyses as have been available have greatly facilitated the establishment of basic pure premiums. An analysis of losses is particularly important at the present time when our compensation experience for the majority of classifications is incomplete, for even if crude an analysis makes it possible to detect abnormalities, and consequently, allows greater latitude in the use of experience. For instance, it has always been the custom to state separately death losses in classification experience. Thus, it can be ascertained at a glance whether the experience for an individual classification contains death losses at all or whether the death losses contained in the experience are greater or less than normal. In this way the actual experience pure premium has been increased in certain cases to provide for the absence of death losses, the basic pure premium being built up from incomplete experience upon the assumption that the pure premium indicated by the experience was truly representative of the loss cost of the classification for non-fatal accidents. In other cases, a part of the death losses has been eliminated and the remaining experience pure premium taken as the basic pure premium upon the assumption that the elimination of abnormal death losses produced a proper measure of the hazard of the classification.

A complete analysis of losses when available will permit greater refinement of this procedure and will eventually make possible the establishment of basic pure premiums with the least exercise of judgment. It is safe to assume, therefore, that our compensation losses will always be analyzed in this manner and that the analysis will some day become standard. Such being the case, the use of a system of law differentials by kind of injury as a method of reducing experience should receive careful consideration, inasmuch as it apparently presents a satisfactory solution of some of the difficulties which have been encountered in the use of a single differential as a reduction factor for all classifications.

The principal advantage of the use of a system of law differentials by kind of benefit in the reduction of experience arises from the fact that this method will properly reflect the actual conditions of the experience for the individual classifications, both as to the actual distribution of losses by kind of injury and as to the proper relative value of the experience on a reduced basis.

The method of procedure necessary to the use of a system of differentials of this character is as follows:

1. The losses of all state classification experience should be analyzed in accordance with some standard classification of benefits by kind of injury. For example, a standard classification of benefits might be as follows:

- (a) Death.
- (b) Permanent total disability.
- (c) Permanent partial disability.
- (d) Temporary disability.
- (e) Medical in all cases.

2. A differential for each compensation act for each kind of benefit would then be computed. In the computation of these differentials either the experience method or the injury distribution method might be used.

3. In the reduction of state classification experience, the proper differential would be applied to each division of the losses. Thus, if there were no losses other than temporary disability and medical losses for a particular classification, the differentials for these two kinds of losses and no others would be used in the reduction of the experience; if all kinds of losses were represented all the factors would be used in the reduction of the experience, etc. The reduction factor in each case would represent the relative cost per case of death, permanent total disability, permanent partial disability, temporary disability or medical benefits. In this way the fact that losses might not be normal for the classification in question would be properly taken care of. The fact that the differentials represent the cost of the specific kind of injury rather than a composite cost for all kinds of injury would insure proper reflection of the actual distribution of losses in the reduced experience. Thus if death losses predominated in the actual experience, death losses would predominate also in the reduced experience. If there were no death losses in the actual experience, then there would be no death

losses in the reduced experience. Furthermore, once the losses were reduced and combined, the experience pure premium would be a proper indication of the reduced cost of the state experience. It would not be distorted except by such minor influences as the varying distribution of death cases by degree of dependency, the physical condition of employees in different classifications or in different industries, etc.

#### A SYSTEM OF LAW DIFFERENTIALS BY HOMOGENEOUS GROUPS OF INDUSTRIES.

This form of differential has advantages when used in the projection of basic pure premiums. It is not well adapted to the reduction of experience because the arguments against the use of an average differential for all industries may be applied to the use of an average differential for a single industry particularly if the classification experience is not complete. Thus, the use of a differential which includes provision for death accidents and their compensation, for the reduction of the losses of a classification which has no death losses because the experience is incomplete may be seriously criticised.

This criticism would not apply to the projection of pure premiums because even though the basic pure premium has been established upon insufficient experience, the judgment of the Committee establishing it has taken cognizance of all deficiencies in the experience, with the result that the basic pure premium, theoretically at least, provides for a complete distribution of loss cost.

The method of applying a system of differentials of this character in the projection of basic pure premiums would be to use the proper differential for the industry to project the basic pure premiums for all classifications falling within the industry. Thus one differential might be used to project the basic pure premium for Cotton Spinning and Weaving; another for Iron Foundries; a third for Masonry work; a fourth for Street Railway operation, etc.

A system of differentials of this character might be computed by either method of calculation. The injury distribution method of calculation would require for its application a distribution of accidents by ultimate nature of inquiry for each homogeneous group of classifications. The calculation of each of the differentials would then be exactly the same as the calculation of a single differential for all industries. Each differential would represent the applica-

tion of the benefit provisions of the act in question to the distribution of accidents for the industry or homogeneous group of industries.

The application of the experience method to the calculation of a system of differentials of this character would involve the following procedure:

1. All classifications in the Manual should be classified into broad groups. The basis for classification should be such that classifications involving substantially the same distribution of accidents would fall within the same group. The number of groups should be limited possibly to a maximum of ten. The actual classification experience would be of some assistance in determining which group a classification should fall in. Where the classification experience is incomplete or abnormal, judgment should be used by the actuary and the classification assigned upon the basis of such judgment supplemented by advice from underwriters and safety engineers. This set of groups would be assumed to be standard inasmuch as it would be used generally for all states in the calculation of differentials. For the proper application of the method, it is essential that the groups be broad enough to produce dependable pure premiums, that is to say, the pure premium for each group should be based upon a sufficient spread of exposure to be reliable.

2. For the calculation of any differential, experience would be necessary for the homogeneous group, both under the basic compensation act and the act for which a differential is to be computed. The experience differential for each group should be obtained by comparing the pure premiums for the group for the basic act and for the act for which the differential is desired. There would be as many experience differentials as there were groups.

#### A SYSTEM OF LAW DIFFERENTIALS BY RATE GROUPS.

This form of differential is closely analogous to the system of differentials by homogeneous groups of classifications; in fact the method which is outlined below may be applied either to rate groups or to homogeneous groups of classifications. Like the latter form of differential, it is not particularly well adapted to reduction under present conditions. It, however, presents some interesting considerations as a projection factor.

The only method available for the computation of this form is

the experience method. The first approximation to the experience differential for all classifications may be obtained by a comparison of the combined pure premium for the state experience for which a differential is desired with the corresponding pure premium for the experience under the basic act. This approximation is necessarily rough because it does not take into consideration the relative distribution of the business in the two experiences. Inasmuch as the pure premium measures loss cost it fluctuates with the hazard. Thus, an experience which covers light manufacturing industries will indicate a lower pure premium than an experience which covers mining and quarrying industries. Any method of differential calculation based upon actual experience must recognize this condition and meet it in some way or other. The system of differentials by homogeneous groups of classifications described above meets this condition in some measure by grouping classifications in such manner that those of the same hazard with substantially the same distribution of injuries are thrown together for the purpose of differential calculation. This procedure does, however, neglect the actual payroll distribution within the groups.

The system of law differentials by rate groups as considered by the Actuarial Sub-Committee of the Augmented Standing Committee provides an exceptionally good method of avoiding this difficulty. This method was proposed by Mr. Albert H. Mowbray.

The basic pure premium represents the average distribution of accidents for the classification plus the benefit cost conditions of the basic act. Theoretically if a large enough experience were available under the basic act, the basic pure premiums could be established upon such experience alone. Some experience is available for the basic act. Consequently, it is a comparatively simple matter to project the basic pure premiums into the payrolls of such experience and then to compare the losses produced in this manner with the actual losses. Because of the definition of the basic pure premium, the correspondence between the projected losses and the actual losses should be very close, if the total volume of payroll for the basic act is broad enough to be dependable. The experience under the present basic act is known as Massachusetts Schedule Z—Part I. Test shows that the basic pure premiums adopted by the Augmented Standing Committee this year when projected into the payrolls of Massachusetts Schedule Z—Part I, reproduce the actual losses with the remarkably narrow margin of 8/10ths of 1

per cent. It may, therefore, be assumed that the basic pure premiums are on the average accurate measures of compensation cost under the original Massachusetts Act. It follows, that if these pure premiums are projected into the payrolls of any state classification experience, the result will represent losses which would have been incurred upon the assumption that these payrolls were exposed to payments under the terms of the basic act. If these projected losses are then compared with the actual losses for the same experience a measure is obtained of the relative cost of the act under which the experience was accumulated. The effect of varying distribution of business is automatically eliminated, for both projected losses and actual losses are referable to the same payroll exposure.

The actual method of computing a system of law differentials for New York would be as follows:

(a) Classification experience is available for New York in the form of Schedule Z, which the New York Insurance Department requires all compensation carriers to file with it.

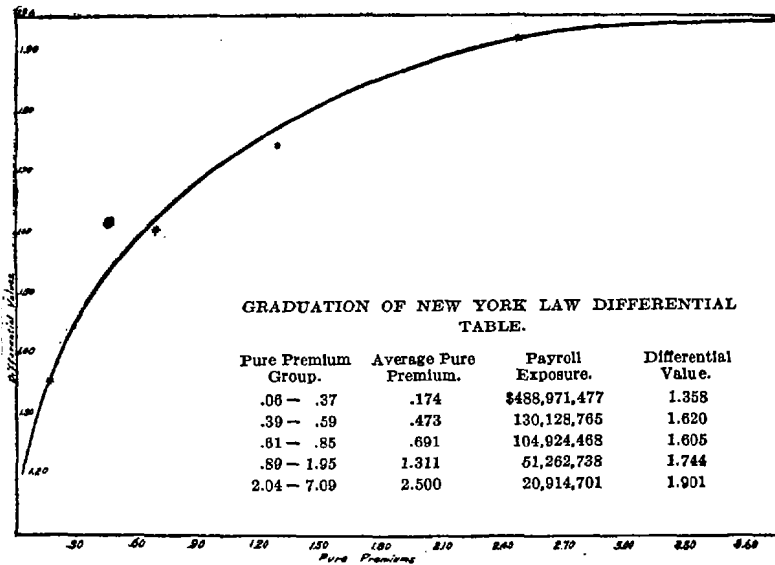
(b) The elements necessary to the computation of an experience differential for New York are:

1. The payroll exposure of Schedule Z for each classification.
2. The incurred losses of Schedule Z for each classification.
3. The basic pure premium for each classification.

(c) The basic pure premium for each classification should be projected into the payroll for the classification. The sum of the losses produced in this manner for all classifications should then be compared with the sum of actual Schedule Z losses. The result is a differential based entirely upon experience. It represents a measure of the relative cost of compensation under the benefits of the New York Act as compared with the cost of compensation under the benefits of the original Massachusetts Act.

The method may be refined. Thus, the results may be combined by rate groups or by homogeneous groups of classifications and a system of differentials obtained in this manner. As a matter of fact, an experience differential for each classification may be computed by comparing the projected losses for the classification with the actual losses. But the fact that the payroll exposure for individual classifications is insufficient makes it necessary to group the experience for several classifications in order that a large enough exposure may be obtained to produce dependable results.

During the last conference this method was applied to the experience of all states for which experience was available. Particular attention was paid to the system of differentials for New York because of the high benefits for death and permanent total disability. For New York the classifications were grouped by pure premium symbols, that is, by basic hazard, and a system of five experience differentials was obtained. This system of five differentials was then plotted, a graph constructed and a complete graduation of the differential accomplished by the graphic method. Thus, a law differential was determined for each pure premium symbol. The graph which served as the basis for this graduation is given below:



It was then recognized that the experience which had been used as the basis for this graduation represented past cost conditions. These cost conditions were for the most part sub-normal. In the first place, a large part of the experience was accumulated during a period of industrial depression. In the second place, the experience covered the first year of compensation in New York and therefore did not represent ultimate cost conditions. The average experience differential for all classifications was 1.60. Computation by the injury distribution method produced a law differential



of 1.89. It was decided that the graduation should produce an average differential for all classifications of 1.89. Consequently, the values for individual pure premium symbols were increased in the ratio of 1.89 to 1.60. In this way experience was supplemented by the assumption of future cost conditions and the system of law differentials was made to represent more nearly the conditions of the future period for which rates were to be projected. This graduated law differential was not adopted by the Augmented Standing Committee as the basis for the projection of New York rates because of the feeling on the part of the majority of the Committee that the Schedule Z experience was not thoroughly dependable, particularly for the high rated and low rated classifications. Furthermore, the Committee took this action upon the ground that the graduation of the law differential made necessary the graduation of other important factors of the multiplier and the time at the Committee's disposal was insufficient for the accomplishment of this work.

There is one serious danger in the use of a system of law differentials by rate groups which should be noted. The basis for grouping is the basic pure premium. The system of differentials, however, is designed to take into consideration the various distributions of injuries by classifications. Inasmuch as the basic pure premium does by no means throw together those classifications which are analogous from the standpoint of injury distribution the scheme fails to accomplish the purpose for which it was intended. A certain pure premium value may be obtained in many ways; in fact any pure premium symbol group will contain a number of combinations of accident frequency, injury distribution and loss cost. Under this plan classifications with identical injury distributions but with different measures of accident frequency, will be thrown into widely separated groups, whereas they should in reality be thrown into a single group for differential calculation. In this respect a system of law differentials by homogeneous groups of classifications is preferable. This would, however, interfere with the retention of the principle of the basic manual. Moreover, difficulty arises when the actuary is called upon to set up homogeneous groups of classifications with our comparatively limited experience to guide him.

The future will undoubtedly bring some satisfactory solution of these difficulties. The development of adequate experience in great

volume is in sight and it is only upon the basis of such experience that we may hope to establish a theory of law differentials which will be scientific as well as adapted to the practical necessities of compensation rate making.

#### CONCLUSION.

I have purposely refrained from recommending any particular form of differential or method of differential computation inasmuch as my intention was merely to present a resumé of the work of the Actuarial Sub-Committee of the Augmented Standing Committee as it had a bearing on the theory of law differentials. In this connection, it should be noted that prior to its adjournment the Augmented Standing Committee adopted a resolution which provides that this subject shall be actively studied by the Actuarial Sub-Committee during the coming year. We may, therefore, expect some considerable advancement in the scientific treatment of differential problems by the time the next manual revision is undertaken.