WORKERS COMPENSATION EXPERIENCE RATING: WHAT EVERY ACTUARY SHOULD KNOW

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Abstract

Workers Compensation experience rating affects the distribution of billions of dollars of insurance premium. It is a large-scale application of actuarial science, one which has evolved since the very first days of the Casualty Actuarial Society. A fair amount of material exists on the theory underlying the plan, and some of that material is required reading for actuarial students. This paper tries to bridge the gap between theory and practice. Most of the insureds eligible for experience rating do not think in terms of overall performance of the plan. They may agree individual risk equity is fine—as long as it does not affect them adversely. Actuaries can help relate the theoretical underpinnings of the plan to the bottom-line effect on the individual insured.

The exposition begins with a discussion of performance testing. It then puts experience rating into the context of the premium transaction for a policy, then turns to a discussion of overall financial impact. The latter part of the paper details the activity necessary to administer experience rating, including the calculation of plan parameters, the assembly of experience data, and the promulgation of rating forms.

The paper is intended to be expository, describing concepts, vocabulary, and details of the plan from an actuarial perspective. Italics are used for emphasis, which may include introduction of a new word. Phrases that demonstrate usage, as well as honest-to-goodness quotations, are shown in quotes.

1. PURPOSE OF EXPERIENCE RATING

The primary goal of experience rating is individual risk equity. This equity is not just between individual risks, but equity that pervades the relationship of insureds to their insurers and to society at large. Experience rating engenders an incentive for safety and enhances market competition. Even if not the primary goal of experience rating, these desirable results should be touted.

Equity is an actuarial concept: each insured should pay a rate correct for its inherent potential for loss. It is important to stress the word *potential*, for the experience rating modification (the *mod*) provides the means to adjust manual premium prospectively so that next year's rate will be tailored to fit the particular employer. This point is developed later.

The following passage from Dorweiler's prescient presidential address in 1934 explains in practical terms why consideration of risk experience can accomplish this goal:

> "The object of experience rating is to determine a more equitable rate for the individual risk based [to] a degree on the evidence presented by its own experience. It is recognized that individual risks within a classification are not alike and that there exist inherent differences due, for example in compensation, to variations in plants and premises, in operating processes, in the materials involved, in the management, in the morale of employees, in claim consciousness, and in the relation to the community. These differences are of such a nature that it is difficult to label them definitely and they cannot be associated with conditions measurable in advance. It is known, however, that variations in experience do exist in a way that definitely precludes ascribing all of them to chance. Experience rating is considered by many as the most practical method yet devised, or even suggested, of giving recognition to variations produced by such factors."[11]

In the parlance of risk theory, Dorweiler is talking about the *variance of the hypothetical means* or the *between variance* of risks within a class.

The greater the between variance, the greater the credibility of individual risk experience.

The original idea of applying experience rating to workers compensation was a good one. Quoting Dorweiler:

> "Compensation insurance, particularly, is subject to experience rating, for to a considerable degree the losses may be controlled and individuality of management reflected in the experience through the employer's ability to correct defective conditions and to enforce safe practices among employees by his potential power to dismiss or to withhold promotions. There are a few other lines, like employers' liability, workmen's collective, and automobile fleet collision, where the assured has similar power to affect losses." [1, p. 4]

2. MEASURING HOW WELL EXPERIENCE RATING WORKS

This question has been the subject of much study in the last 10 years, and the science has advanced far beyond what it was in the early years of the CAS.

The first principle is that experience rating be an accurate predictor of an individual insured's future experience. This is the basis of the "credibility conditions" and the empirical performance tests which are described below. It has some market implications, too, and these are now noted.

The mod is a prospective measure only. There is no intention to recoup past losses or rebate savings. The debit mod, for instance, gives an indication that more than manual premium will be needed to cover the expected losses of the particular employer next year.

The debit mod should not be thought of as a stigma. To decide between contractors bidding on a project, some owners erroneously eliminate those with mods higher than some threshold. The bid itself is far more relevant. Rating bureaus and regulators, who ought to know better, sometimes unfairly attach penalty programs to only those insureds with debits. These insureds have already paid their debt to society, so to speak.

The rationale for these programs is that a debit mod is an indicator of an unsafe operation. Although a debit mod may reflect poor safety habits, it just as often may be applicable to an employer with a good safety program who is a poor fit into the manual classifications. Contractors are especially difficult to classify. Each has a unique set of skills and an equally unique set of projects. Further, even though statistics show that poor prior experience is an indication of poor future experience, any single accident is probably a matter of pure chance.

Many aspects of a rating plan may affect its performance, but in the early days, the quality of the plan was thought to depend largely on "proper" credibility. Dorweiler proposed two conditions for correct credibility: *necessary* and *sufficient*. These are his words:

> "A necessary condition for proper credibility is that the credit risks and debit risks equally reproduce the permissible loss ratio. Also, if the proper credibility has been attained, each [random] subgroup of the credit and debit risks, provided it has adequate volume, should give the permissible loss ratio. While these conditions are necessary for a proper credibility of the experience rating plan, it does not follow that they are also sufficient. For a sufficient condition it would be required to establish that the risks within a group cannot be subdivided on any experience basis so as to give different loss ratios for the subdivisions, assuming the latter have adequate volume." [1, p. 11]

By "reproduce," Dorweiler was referring to the risk experience that would emerge in the prospective period; i.e., the losses during the time when the mod is applicable to risk premium. Given that rates today are rarely adequate, it is too much to ask that the two subgroups of risks equally reproduce the permissible loss ratio. So the necessary condition is that the two groups show equal loss ratios to standard premium in the prospective period. Since credibility is a function of risk size, the question must be posed for each size group: does the plan satisfy the necessary condition? The result of a plan satisfying this necessary condition is that insurers would find credit risks and debit risks equally desirable as insureds.

Even though Dorweiler calls the condition necessary, it may be too much to require of a plan. Early in the study leading to the 1990s revisions of the *Workers Compensation Experience Rating Plan*, it was seen that the existing plan did not perform well in simple tests (described below) based on the necessary condition, at least among the smallest and largest risks. This testing suggested the need for the changes that have recently been put into effect.

The sufficient condition is that there be no way to select subgroups of risks based on their experience that will produce significantly different loss ratios in the prospective period. It should be clear that it would be difficult, if not impossible, to test all possible a priori subdivisions of risks.

Dorweiler characterizes the sufficient condition as a goal, not a requirement. It can be used as a relative measure for judging how well a plan is working. He documented a simple method for testing credibility under this condition using the experience of 1931 experience-rated risks in New York [1, p. 12].

He first grouped risks by size. Within each size group, risks were stratified by the value of their modification. This is a "subdivision on an experience basis." Following the risks in each subdivision, or stratum, to the effective period of the modifications, he calculated the loss ratio of each stratum, first to modified (actual) premiums, then to manual premiums. The ideal result was that the loss ratios to manual premiums would track with the value predicted by the mod, but those to actual premiums would be nearly flat. A trend upward or downward in the loss ratios to actual premium across risks grouped by increasing value of the mod would show too little or too much credibility, respectively.

This author documents a refinement to this test used in developing the revised *Workers Compensation Experience Rating Plan* [2]. This is the *quintiles test* in which risks within an expected loss size range are grouped into five equal strata (quintiles) by the value of their modification. The first stratum contains the 20% of risks with the lowest mods, and so on. The subsequent ratios of actual to expected loss and actual to modified expected loss, are evaluated for each stratum. The test statistic

for each size group is the variance of the modified ratios divided by the variance of the unmodified ratios. A low test statistic indicates a plan that has eliminated much of the between variance (in risk theoretic terms) or made risks of differing experience more equally desirable.

The use of this test in the development of the revised plan demonstrated that experience rating is very effective. Test statistics for the old plan were far lower than unity, showing that, even without proper calibration, experience rating is valuable. The test statistics for the smallest and the largest insureds indicated greater credibilities for the former and smaller for the latter.

Division into quintiles represents only one "subdivision on an experience basis," so the test does not check all possible subdivisions. Another test of experience rating, which is grounded in modern risk theory (thus avoiding conflict with Dorweiler), is the *efficiency test* as documented by Meyers [3]. In this test, the sample variance in loss ratios across all risks in a size group is compared for modified versus unmodified loss ratios. The statistic is the ratio of the former to the latter sample variances: lower statistics indicate better reduction in risk loss ratio variance.

All of these tests have been used to good effect in their historical contexts. Although they have been presented in a progression, each must be considered superior to pure judgment as a means of testing plan performance. Judgment is still essential, however, in the choice of data and interpretation of results.

3. PAYING FOR WORKERS COMPENSATION INSURANCE

Introduction

Experience rating is an essential part of the workers compensation pricing system. All insureds over a certain premium size are eligible for experience rating or are *ratable*. "Eligible" is an euphemism, as there is no choice: the insured must accept its mod, be it a credit or debit (i.e., premium reduction or increase). The manual premium, based on the classification of the employer, is tailored by the mod so that it will better reflect the hazard inherent in the insured's operation.

The Premium Transactions

Figure 1 shows a simplified flow chart of the premium determination and bureau reporting process for a rated insured with a policy effective in July 1990. Loosely speaking, in the left columns are statistical plan data items generated by the transaction; in the center is the financial information pertaining to the insurance contract; on the right is an approximate time line.

During the effective period of a compensation policy, the insured generates loss and payroll experience. This is coded by the insurer and submitted to the rating bureau according to its statistical plan. At the time of quotation for a policy beginning July 1990, experience from the policies incepting July 1986, July 1987, and July 1988 has been coded on unit report cards of the Workers Compensation Statistical Plan, commonly called the *Unit Plan*. A sample unit card for a 1988 policy is attached as Figure 2. More detail on the unit cards is found below.

The employer provides his/her prospective 1990 exposure data to the agent/broker to obtain insurance. The agent can compute the insured's *manual premium* as the extension of manual rates on estimated payroll (in hundreds of dollars). The agent can obtain a 1990 rating form, such as the one in Figure 3, apply the insured's modification to manual premium, and add certain other elements to compute the *standard premium*. Note that the form shows the expected loss rates (ELRs) and discount ratios (D-ratios), defined below, for the 1990 mods. Their derivation and use is explained in Sections 5 and 6.

The standard premium is a benchmark. It gives the best indication of the true underlying expected loss of the insured. It is the basis of any premium calculation plan. From it, the agent can compute the *guaranteed cost premium*, if the insured elects the simplest plan of paying for coverage up front. The insured may also elect retrospective rating, if an agreement can be reached with an insurer on a specific plan. There may be plans other than retrospective rating wherein the risk premium is affected by the emerged losses during the policy period. For example, losses of the particular insured or of some larger group of insureds can often be the basis of dividend plans on participating policies.

FIGURE 1

POLICY TRANSACTION FLOWCHART

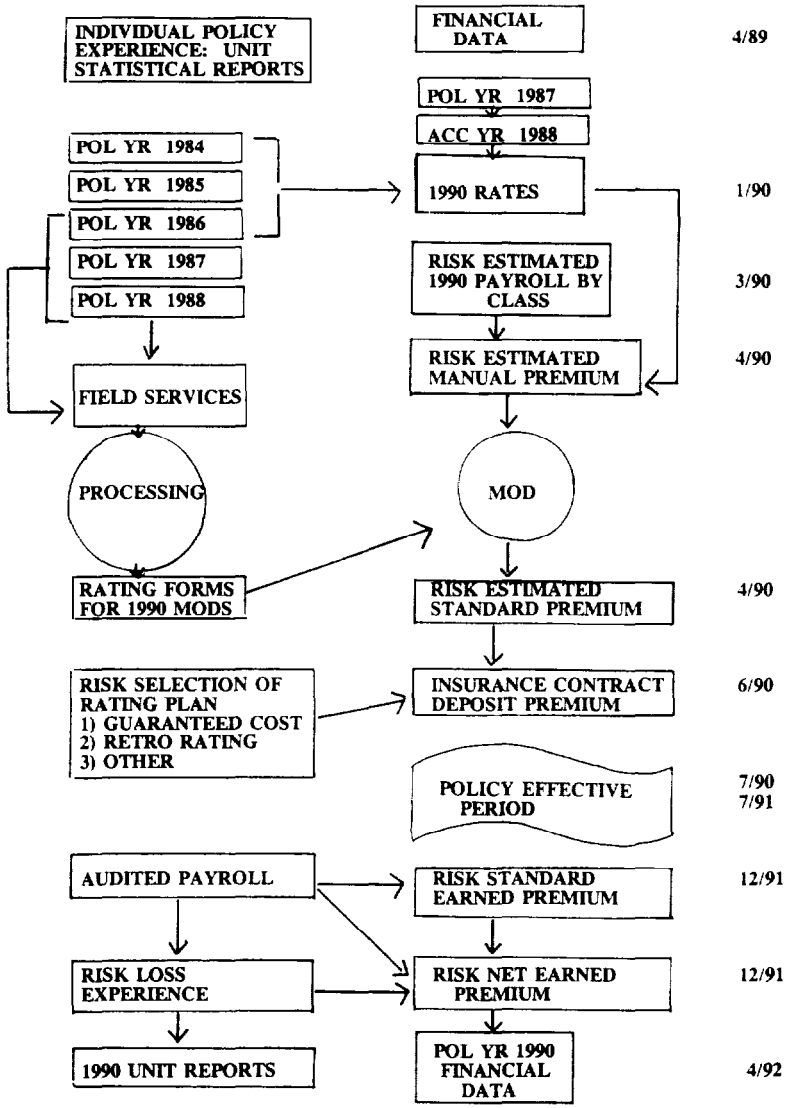

FIGURE 2

SAMPLE UNIT CARD

STATISTICAL PLAN UNIT REPORT

7-01-88 TO 7-01-89 — Hypothetical Inc.

CLASS CODE	EXPOSURE AMT	MANUAL RATE	PREMIUM	CLAIM #	ACCIDENT DATE	CLASS CODE	I N J	INDEM.	MED.	O / F	L
3030	2655246	7.12	189054								
8810	1256233	.21	2638								
8742	268048	.50	1340								
9807*		.00	3668								
				140927	03-08-89	3030	5	1696	2907	0	1
				138365	07-19-88	3030	5	2849	4120	1	1
				044319	06-14-89	3030	9	389000	325000	0	4
				039854	11-29-88	3030	9	25500	18000	0	1
				039646	11-03-88	3030	9	18875	10332	1	1
				039253	09-26-88	3030	6	0	2169	1	1
				038253	07-18-88	3030	5	1783	2410	0	1
					2	3030	5	616	1142	1	1
					34	3030	6	0	6949	1	1
TOTAL SUBJECT PREM.			196700								
EXPERIENCE MOD.			.760								
TOTAL MODIFIED PREM.			149492								
STD. 4179527 OTHR. 0			149492								
0900			140	TOTALS	43			440119	373029		

*CLASS CODE 9807 DENOTES EMPLOYERS LIABILITY EXCESS LIMITS PREMIUM

FIGURE 3

SAMPLE RATING FORM

WORKERS COMPENSATION EXPERIENCE RATING

Risk ID #: 12345 Effective Date: 7/1/90
Name: Hypothetical, Inc. State: N

	CLASS	ELR	D RATIO	PAY ROLL	EXP TOT LOSS	EXP PRM LOSS	EXP XS LOSS	ACT TOT LOSS	ACT PRM LOSS	ACT XS LOSS	STAT
07/01/86	3030	2.43	0.39	1,704,505	41,419	16,154	25,266	16,493	16,493	0	*
06/30/87	8742	0.25	0.34	62,400	156	53	103				
	8810	0.11	0.41	1,670,166	1,837	753	1,084				
07/01/87	3030	2.43	0.39	2,119,627	51,507	20,088	31,419	23,500	5,000	18,500	O
06/30/88	8742	0.25	0.34	86,389	216	73	143	13,000	5,000	8,000	O
	8810	0.11	0.41	1,346,461	1,481	607	874	10,686	10,686	0	*
07/01/88	3030	2.43	0.39	2,655,246	64,522	25,164	39,359	6,969	5,000	1,969	F
06/30/89	8742	0.25	0.34	268,048	670	228	442	714,000	5,000	28,500	@O
	8810	0.11	0.41	1,256,233	1,382	567	815	43,500	5,000	28,500	@O
								29,007	5,000	24,007	F
								4,603	4,603	0	O
								2,169	2,169	0	F
								4,193	4,193	0	O
								8,707	8,707	0	*

SRP	WT [A]	BALLAST [B]	[C]	[D]	[E]	[F]
335	0.34	19,575	163,191	63,686	99,505	186,327	76,851	109,476

CALCULATION		PRIMARY [E]	STAB. VALUE [1 − A][D] + [B]	EXCESS [A][F]	TOTALS [G]	EXP MOD [G]/[H]
	ACTUAL	76,851	85,248	37,222	199,321	1.09
		[C]	[1 − A][D] + [B]	[A][D]	[H]	
	EXPECTED	63,686	85,248	33,832	182,766	

Page: 1
Plan: RERP
Date: 04/30/90

* Total by policy year of all cases $2000 or less
@ Limited loss.
O Open claim
F Closed claim

In this case, the actual 1990 premium cannot be computed until after the policy period has elapsed. The first adjustment usually occurs 18 months after inception, or six months after the expiration of the policy. Payroll is audited so that authorized rates can be extended on payroll (in hundreds of dollars) by class. After the mod is applied, premium discounts are applied or the retrospective premium is calculated for the first (but not the last) time. The expense constant and other non-ratable elements are added. The end result is referred to as the net earned premium. At this point, the insured pays (or receives) the difference between this total and what has already been paid on deposit.

4. PREMIUM IMPACT OF EXPERIENCE RATING

A phenomenon of the 1980s has been the repetitive need for substantial workers compensation premium level increases. It is unusual that the need never seems to be satisfied. A state may grant a large rate increase as indicated in one year, only to face a filing for as large an increase the following year. The socioeconomic forces underlying this trend are the subject of much discussion and lie outside the scope of this paper.

In workers compensation, the phrase *premium level* should be understood as something apart from *rate level*. The rate level in workers compensation is a function solely of the manual rates before application of experience rating, schedule rating, premium discounts, retrospective rating, or dividend plans. A change in the premium discount plan, for instance, could engender a premium level change with no rate level change, or alternatively, could be accompanied by an offsetting rate level change to assure no premium level change.

Of particular relevance to this article is the nexus of manual premium and standard premium in ratemaking. Overall premium level needs are determined by the adequacy of total standard premium in a state. Inherent in standard premium is the experience rating *off-balance*, a term used to mean standard premium divided by manual premium or, put another way, manual premium weighted average modification.[1] In spite of the fact that

[1] California uses the term "off-balance" to denote a factor applied to rates (usually) to correct for the change in the average modification associated with a rate change.

the term "off-balance" sounds like it describes a *discrepancy* between manual premium and standard premium, it refers to the relation. Even when there is no discrepancy, we say there is "a unity off-balance."

The average modification is a function of the adequacy of rating values: ELRs and D-ratios. These values are calculated at the same time as new rates, but pertain to the experience period used in the associated ratings. Technical details on the computation of rating values may be found in Sections 5 and 6. In any case, the accuracy of these values should be judged on the aggregate totals by class (or at least by state) of emerged versus predicted loss. When the ratemakers are on target and rating values are accurate, the off-balance is usually near unity or a slight credit. The slight credit frequently results because insured risks large enough to be rated tend to have better experience than smaller risks.

Interestingly enough, even if the rating values are geared to be correct for the subpopulation of rated insureds, the off-balance is still frequently a credit. Testing at the National Council on Compensation Insurance (NCCI) has shown this to be the case. Researchers have been able to derive pairs of adjustment factors applicable to ELRs and D-ratios, in several rating years in several states, so that expected losses (total and primary) match, in aggregate, the actual emerged loss experience of rated risks. Recomputing all modifications with these adjustments, the (weighted) averages for rated risks are near unity, but definitely a credit. This suggests that the largest rated risks, those with the most credibility, have relatively better experience than smaller rated risks, at least at the first, second, and third reports. Dorweiler observed the same phenomenon in the larger risks of 1931:

> "These have more favorable experience and by virtue of their size under the experience rating plan receive larger credibility and therefore obtain credits which cannot be expected to be offset by an equal volume of less favorable experience on the smaller experience rated risks whose credibility is less." [1, p. 7]

In the NCCI committees, there is always some discussion about the effect of experience rating on premium, but no clear indication of what to do about it, if anything.

Contrary to suspicions, there is no ongoing scheme to use experience rating to assure premium adequacy. The calculation of needed premium level change at NCCI uses a loss-to-standard-premium ratio. This produces an indication that contemplates no change in off-balance between the experience period and the prospective period.

Our investigations show that, in most states, over the years the off-balance does not stray more than one or two points from unity. The all-too-common exceptions occur in states that allow rate adequacy to deteriorate for several successive years in times of increasing costs. The increasing off-balance reduces premium inadequacy. Since needed rate level changes are based on standard premium, indicated increases will be lower when the off-balance moves above unity. If adequate rates are approved, and the off-balance moves back toward unity, premium income may remain inadequate.

The production of rates and rating values is carefully monitored in the hope that changes in the off-balance will be minimal. Unfortunately, estimations of needed rates and rating values have proven to be difficult even if rate regulation is not a factor. The tendency is for too high a rate level (admittedly a rare occurrence) to result in a credit off-balance and too low a rate level (somewhat more common) to produce a debit off-balance. This is because ELRs are proportional to rates, and rates are presumed accurate. Without specific intent, then, experience rating can partially correct errors in class relativities or a rate level that is too low or too high. In the long run, there can be no net gain or loss but more stability results from experience rating.

5. CALCULATION OF EXPERIENCE RATING VALUES AND PLAN PARAMETERS

This section describes some of the actuarial tasks necessary to keep the plan functioning properly. The description is technical in nature, aimed primarily at the actuarial student.

Besides experience rating, another essential part of pricing workers compensation is ratemaking. There is ample material available documenting this part of the process that should be reviewed before entering the special realm described here. See Kallop [5] or Harwayne [6] for more detail.

We begin with a description of the data elements that underlie the pricing process.

A. Elements of Ratemaking Data

This section provides a brief background on the NCCI ratemaking procedures, especially those relevant to calculation of experience rating values.

The most basic element of the process is the *Workers Compensation Statistical Plan* (called Unit Plan here) of NCCI. The term "unit" refers to the fact that there is a separate report for experience on every policy and every state, evaluated annually to the fifth report. It is on this basis that the members of the NCCI report the data for experience rating and class ratemaking. NCCI summarizes the Unit Plan payroll and losses by risk for experience rating, and by classification within state for class ratemaking. Claims less than $2,000 may be (and usually are) summarized, but claims of a greater amount must be listed individually and categorized by injury type. Table 1 displays the codes for the types of injuries reported under the Unit Plan. For each injury type, medical and indemnity portions of a claim are reported separately. (Some states have modified this list.)

There are two compressions of this data made by the NCCI for ratemaking purposes. First, contract medical amounts are added to medical-only losses for use in most calculations. The second adjustment is a bit more complex. The permanent partial (PP) category, injury type 9, includes claims covering a wide range of values. For example, some claims coded as PP turn into life annuities not unlike permanent total (PT) cases. Other PP claims may be of short duration. Consequently, PP claims are separated into two categories: *major*, which becomes injury type 3, and *minor*, which becomes injury type 4.

TABLE 1
UNIT PLAN INJURY TYPE CODES

Injury Type Code	Injury Type Description
1	(F) Fatal—Medical
	Fatal—Indemnity
2	(PT) Permanent Total—Medical
	Permanent Total—Indemnity
9	(PP) Permanent Partial—Medical
	Permanent Partial—Indemnity
5	(TT) Temporary Total—Medical
	Temporary Total—Indemnity
6	(M) Medical Only
7	Contract Medical

The split is made by reference to a dollar amount called the *critical value*, which varies by state and over time. PP claims whose indemnity amount exceeds this value are considered major. The critical value is normally calculated as a part of the annual ratemaking process.

After these adjustments are made, the loss data is summarized for ratemaking purposes into three categories: 1) the indemnity portions of fatal, PT, and major are summed to one *serious* indemnity loss total; 2) the indemnity portions of minor and temporary total (TT) claims are summed to a *non-serious* indemnity loss total; and 3) the medical portions of all claims are summed to one medical loss total. Table 2 displays the groupings.

This categorization is central to the calculation of both rates and rating values. Actuaries perform the many loss manipulations associated with ratemaking (loss development, trend, law changes, multi-dimensional credibility) and compare the results with payroll by class to calculate loss costs by type for the serious, non-serious, and medical categories. These ratios are the projected partial pure premiums by category which underlie rates filed for the prospective period. Each class rate, then, has serious, non-serious, and medical components.

TABLE 2
CATEGORIZATION OF INJURY DATA FOR
CLASSIFICATION RATEMAKING

Fatal Indemnity (1) Permanent Total Indemnity (2) Major Permanent Partial Indemnity (3)	*Serious*
Minor Permanent Partial Indemnity (4) Temporary Total Indemnity (5)	*Non–Serious*
All Associated Medical (1,2,3,4,5) Medical Only (6) Contract Medical (7)	*Medical*

B. Elements of Experience Rating

Several sets of values used in the NCCI Experience Rating Plan are revised as part of the regular rate filing process. *Plan parameters*, which vary by state and by size of the insured, are the *state reference point* (SRP), *weighting* (W), and *ballast* (B) values used in the rating formula. *Rating values*, applicable to individual insureds, vary by state and by classification. These are the expected loss rates (ELRs), and the discount ratios (D-ratios). Figure 3 shows a replica rating form. These values fit into the modification formula as follows:

$$M = \frac{A_p + W A_x + (1 - W) E_x + B}{E + B}$$

where:

M = the risk modification (mod);

A = actual losses of the insured being rated
(p = primary, x = excess);

E = expected losses of the insured being rated
(p = primary, x = excess);

W = weighting value; and

B = ballast value.

E is calculated as the sum of expected losses by class:

$$E = \sum_{\text{all classes } i} E_i$$

$$= \sum_{\text{all classes } i} (\text{Payroll}_i \div 100) \times (\text{ELR}_i)$$

where ELR_i is the expected loss rate for class i.

Then

$$E_p = \sum_{\text{all classes } i} D_i \times E_i$$

$$E_x = E - E_p$$

where D_i is the discount ratio (D-ratio) for class i. The D-ratio is the estimated portion of ratable losses that will be primary.

The actual ratable losses, A, is the sum of the individual losses, indexed by n, each limited as described in the next section.

$$A = \sum_n A_n .$$

Each loss (occurrence) has a primary component:

$$A_{np} = \begin{cases} A_n \text{ if } A_n \le L \\ L \text{ if } A_n > L \end{cases}$$

where L is the primary loss limit. (L is \$5,000 today.)

The actual primary and excess losses of the insured being rated are as follows:

$$A_p = \sum_n A_{np} .$$

$$A_x = A - A_p .$$

C. Interrelationships in Calculations of Rates and Rating Values

Current practice is to calculate the experience rating values at the same time and using the same data as used in the filed rates. It is important to point out that ELRs are usually quite different from the pure loss costs underlying prospective rates. This is discussed further in Subsection E. Some of the similarities are discussed in the rest of this section.

The filed loss costs (rates) provide a best estimate of the amounts necessary by class to cover losses (and expenses) for the future period when the loss costs (rates) will actually be used. Experience rating values pertain to losses that occur a year or more before the time when loss costs (rates) and ratings will be effective. Of interest here are the relative time frames of: 1) the underlying experience used in the rate filing; 2) the prospective effective period of the rates; and 3) the associated experience period to be used in the experience ratings applicable to the prospective period. These three time frames are not the same; reference to Figure 1 will help in visualizing the differences.

A key aspect of ratemaking is the practice of limiting individual losses to minimize volatility in rates and rating values. In ratemaking, the overall change in premium is estimated in one step (overall rate level) and, in a second step, is distributed among the various classes (class ratemaking). Capped losses are used in this second step to avoid distortions in class relativities due to the effect of unusually large losses. Loss dollars excluded by these caps must be spread back to all classes, respective of industry group, because rates are designed to be adequate for unlimited losses. As of this writing, NCCI uses a multiple of the average serious loss for limitations to single losses in class ratemaking.

In experience rating, losses that are similarly limited (ratable losses) enter the calculation of the experience modification. The limit applied to a single claim is 10% of the state reference point (SRP) which is defined below. This limiting value is called the state accident limit (SAL). There

is a secondary cap on multiple claim occurrences of twice the SAL, or 20% of the SRP. There are special caps for losses incurred under the U.S. Longshoremen's and Harbor Workers Act and losses that are strictly employer's liability. The total disease losses for a policy are also capped at three times the SAL, plus 120% of the risk's total expected losses for the experience period. (There are specific rules in the *Experience Rating Plan Manual* [4] defining these experience periods.)

Another procedure lending stability to ratemaking, as well as to the calculation of experience rating values, is the imposition of swing or change limits. The rate (or rating value) for each class can change only by a specified percentage from one rate filing to the next. The average effect of the loss limits and change limits is spread to all classes in such a way that the selected rate level change is achieved.

D. Calculation of Plan Parameters

1. State Reference Point

The SRP is an index of state benefits. It is used to calculate a value G that is a scale factor for credibilities varying by state and is updated annually as part of the annual rate revision. The SRP is also used to calculate the SAL, as mentioned above.

The SRP is based on the *state average cost per claim* (SACC) for all types of claims. There is no per-claim limit on losses in this calculation, except that on employer's liability claims, which currently is $100,000. The SACC is calculated from the latest three years of undeveloped Unit Plan data. This data set is at the same maturity level as the experience period which will be used in the ratings. However, it is necessary to trend the average value from those data, since ratings will be using slightly more recent data. (In hypothetical State N, the length of the trending period is two years. Usually it would be between one year and 18 months. However, statutes in State N require that new rates be filed well in advance of the proposed effective date.) The trend rate is taken from the most recent countrywide Retrospective Rating Expected Loss Size Ranges update filing.

$$\text{SRP} = 250 \times \text{SACC, rounded to the nearest \$5,000.}$$

$$G = \text{SRP}/250{,}000.$$

G is rounded to the nearest 0.05.

Because of the potential for volatility in the data, and the normal effect of inflation, it is further stipulated that G and SRP not be allowed to decrease from one year to the next, unless there is a significant benefit reduction. There also is a reasonability limit on the upward change, so that any changes over +20% will be investigated.

Exhibit 1 shows the calculation of the 1990 SRP for State N.

2. Calculation of the W *and* B *Values by the NCCI*

The B and W values are functions of G and the expected losses, E, of a particular insured. First,

$$B = E\,[\,(0.1E + 2{,}570G)/(E + 700G)\,],$$

subject to a minimum $7,500.

Also, we define the intermediate value

$$C = E\,[\,(0.75E + 203{,}825G)/(E + 5{,}100G)\,],$$

subject to a minimum of $150,000.

B and C are the respective credibility constants K_p and K_e documented by Mahler [7].

Then

$$W = \frac{E + B}{E + C}.$$

W is rounded to the nearest 0.01, with the requirement that it never increase for decreasing E. (This turns out to be a non-trivial programming challenge, although the effect on W is at most a point or two for small risk sizes and certain G values.)

EXHIBIT 1

CALCULATION OF STATE REFERENCE POINT—STATE N

Report	Policy Period	(1) Total Cases	(2) Total Incurred Losses	(3) Average Cost Per Case (2)/(1)
1st	1/86 - 12/86	165,250	$195,722,802	1,184
2nd	1/85 - 12/85	189,629	206,805,713	1,091
3rd	1/84 - 12/84	188,074	196,806,051	1,046
Total		542,953	599,334,566	1,104

(4) Indicated State Reference Point = (Total (3) × 250)	276,000
(5) Average Annual Trend = (exp ((0.09833) × (1.000)))	1.103
(6) Length of Trending Period in Years	2.000
(7) Trend Factor = (exp ((0.098333) × (6)))	1.217
(8) Trended State Reference Point = (4) × (7)	335,892
(9) Proposed State Reference Point (Rounded to the nearest 5,000)	335,000
(10) G = (9)/250,000 (Rounded to the nearest 0.05)	1.35

The above formulae are valid for all rated risks, with appropriate rounding for tabular presentation. B is rounded to the nearest $500 \times G$ in the tables that apply to values of $E < 477{,}500 \times G$. For higher values of E, B is rounded to the nearest dollar.

In particular, it should be noted that in all cases, $0 < W < 1$ and $B > 0$. Hence, no insured's rate is completely determined by its own experience.

The derivation of these formulae is explained elsewhere in the literature [2].

E. Calculation of Rating Values—Major Steps

1. Calculation of Expected Loss Rates—Overview

ELRs are used to calculate the insured's total expected loss, E, in the experience rating plan. The exposure base for the ELRs is \$100 of payroll, just as for rates. As is the case with manual rates, ELRs are calculated by the bureau for each class at the time a rate filing is made.

The class ELR should be proportional to the loss cost underlying the manual rate, but should be adjusted to the same level as the actual experience to be used in the calculation of the modification. Three major adjustments that must be made to rates to obtain ELRs stem from: 1) the loadings (if any) for expense, profit, tax and loss assessment; 2) differences in time frames; and 3) the fact that claims covered by the policy have no limit on size, but claims used in experience rating do.

The first adjustment is simple. Rates can be stripped of taxes, expenses, and profit by a single factor, the *permissible loss ratio* (PLR) in the filing. Even in states where loss costs are filed, there is a PLR, although it is close to unity.

The third adjustment is non-trivial. Its explanation is left to the detail described in the second step of the ELR calculation, below.

To better understand the second adjustment, hypothesize rating an individual policy effective 7/1/90, using rates and rating values effective 1/1/90. At the time the insured's prospective premium is being quoted, its experience for the policy effective 7/1/89 is not yet available. That policy is still in effect. Thus the policy effective 7/1/88 is the most recent one

completed. In order to increase the credibility of the individual insured's experience, three years of data are used in the rating calculation, from the policies effective 7/1/86, 7/1/87, and 7/1/88. The manual rates used for the insured's 7/1/90 policy are intended to reflect ultimate costs in the 1990 policy year. In order to calculate ELRs which can be compared to the actual losses from the experience period, the prospective rates must be adjusted to loss levels prevailing during the three expired policy years (1986, 1987, and 1988). The rate filing contains well-documented analyses of trend, loss development, and benefit changes. This information is used to derive factors to adjust the rates.

In the example, suppose that from 1/1/86 through 12/31/89 the manual rate for our hypothetical insured's class was $4, and at 1/1/90 it went up to $5 due to a benefit change. Oversimplifying, suppose that losses do not develop after first report and there has been no trend in loss experience. Assume 70% of the premium is allocated for the payment of claims, the remainder being for expenses (27.5%) and profit (2.5%). Thus, $2.80 in claims are expected for every $100 of payroll for the policy periods used in the calculation of the experience modification; i.e., 7/1/86 through 6/30/89.

It is erroneous to compare the $2.80 ELR with the $5 rate and infer that only 56% of the premium is allocated to payment of claims. Actually $3.50, or 70% of the $5 rate, is necessary to pay for claims occurring under the 7/1/90 policy, because the claims under this policy will be paid at the new higher benefit level. But, since the insured's actual claims experience used in the calculation of its experience modification is at the old benefit level, the class expected loss rate used in the calculation must also be at the old level, namely $2.80, so that a fair comparison can be made.

While the foregoing illustration is a benefit change, the concept applies to anything that would make the past class average experience, reflected in the ELR, different from the future projected average experience underlying the manual rate. Loss development and trend can both be quite significant.

All of the above elements can make the manual rate considerably higher than the ELR. An ELR of 35% of the manual rate, for instance, is not unusual.

The three major steps of the actual ELR calculation are as follows. First, calculate a factor to reduce manual rates to pure premiums (at second report) on the same benefit level as the experience period used in ratings. This is called the ELR level factor.

Second, calculate the Hazard Group ELR factors and the ELRs by class. *Hazard Groups* are classes grouped according to relative severity. For each Hazard Group, calculate the average cost per case (indemnity and medical combined) for the three serious injury types: fatal, PT, and major. These average costs are used to remove the expected loss above the SAL from the ELR, so that the expected losses correspond to the limited or *ratable* losses used as the actual experience in the rating.

Using the ratios of the SAL to the average cost per case by serious injury type and Hazard Group, find the respective *excess ratios* (ratios of expected excess losses to total losses) from the former ELPF calculation. (See Harwayne [8] for details of this calculation.) There are three excess ratios for each Hazard Group. Using injury weights for the three serious types, also varying by Hazard Group, find a single weighted excess ratio for each Hazard Group. Multiply the ELR level factor from Step 1 by the Hazard Group adjustment factors, which are the complements of the weighted excess ratios.

The resulting four Hazard Group ELR factors are applied to rates respective of Hazard Group to produce the ELRs by class.

The third, and last, step is to check the ELRs for reasonableness. The technicians use checksheets to look for unreasonable changes. These checksheets are described in Section 6.

2. Calculation of D-ratios—Overview

D-ratios currently are calculated using the most recent single policy year of statistical plan data available. (Subsequent to this writing, a change to use of three years' data has been made. There are some associated changes, noted parenthetically below.) A policy year is labeled by the

year in which the policies were written but extends over two calendar years, and the reporting, verification, and processing of unit data takes some months to complete. Consequently, a rate filing effective 1/1/90 would generally contain D-ratios based on statistical plan data from the 1987 policy year. Occasionally, 1986 data would be used.

D-ratio Factors (sometimes called partial D-ratios) are calculated for serious, non-serious, and medical losses. These factors are then weighted by the corresponding pure premium components of the class rates to produce D-ratios by class. The results are then checked for unusual changes in the average D-ratio.

6. CALCULATION OF RATING VALUES—DETAIL

STEP 1—Calculation of the ELR Level Factor

Exhibit 2 shows the worksheets for calculation of the ELR Level Factor. The explanation of the columns on Exhibit 2 follows:

Column 1: The three policy years of the experience rating period. The experience period ends one year before the prospective period of the new rates. This time period is usually later than the periods of statistical data actually available at the time rates are made.

Column 2: A factor to correct for the natural off-balance produced by experience rating. This factor compensates for the fact that, on average, insureds large enough to be eligible for experience rating have better loss experience than the average of the total population, including non-rated risks. This factor is the result of a broad-based analysis of data, but may well be subject to a more state specific procedure in the future.

Column 3: The factors necessary to take the third, second, and first reports that will be available for ratings to the benefit level of the proposed manual rates.

Column 4: Loss development factors to take third, second, and first reports to their ultimate level. These factors are calculated using statistical plan data to fifth report and financial data from fifth report to

EXHIBIT 2

CALCULATION OF ELR LEVEL FACTOR—STATE N

STEP 1

FACTORS DERIVED FROM LATEST RATE REVISION

(1) Policy Year	(2) Off-Balance Adjustment	(3) Benefit Changes	(4) ELR Loss Development	(5) Composite Factor	(6) Expense Factor	(7) Product (2) × ... × (6)	(8) Reciprocal 1 / (7)
01/86-12/86	1.01	1.067	1.072	1.145	1.574	2.082	0.480
01/87-12/87	1.01	1.047	1.122	1.145	1.574	2.138	0.468
01/88-12/88	1.01	1.012	1.216	1.145	1.574	2.240	0.446
						ELF Level Factor	0.465

ultimate. In using the financial data, it is assumed that all development beyond the fifth report is due to serious claims only.

Column 5: The composite factor for miscellaneous changes in the rates. Particularly important is the ratio of the proposed financial data loss ratio to that of the Unit Plan. This ratio includes the impact of trend between the dates of the statistical plan data and the effective period of the proposed rates.

Column 6: The reciprocal of the PLR.

Column 7: The product of Columns 2 through 6.

Note that Column 7 has three factors necessary to take the third, second, and first report loss costs to the same level as the proposed manual rates. Since we wish to perform the reverse operation, we take the reciprocals of the three values and record them in Column 8. The arithmetic average of the three reciprocals is at the foot of Column 8. This average is the ELR Level Factor which is carried into subsequent steps of the calculation.

Columns 3, 4, 5, and 6 are based on analysis of the actual data periods used in ratemaking. Exhibit 3 is the worksheet for these factors and shows how law amendment and loss development factors by injury type are weighted by policy period losses. The data used for weighting generally are not of the same policy period as the ones used for ratings. They are, however, put at the same stage of development. The development factors used in this exhibit were derived as part of the regular ratemaking procedure.

It should be noted that the filing schedule of State N has led to a minor inconsistency. The use of latest second, first, and first reports as weights usually matches the policy year of the experience rating period for two of the three years. In State N, however, 1985, 1986, and 1986 are used to weight experience period years 1986, 1987, and 1988. Usually the weights would be based on 1986, 1987, and 1987.

EXHIBIT 3

CALCULATION OF ELR LEVEL FACTOR—STATE N EFFECTIVE 01/01/90

1. (a) Financial Data Loss Ratio — 0.8250
   (b) Unit. Stat. Plan Loss Ratio — 0.7170
   (c) = (a) / (b) — 1.151
2. Other Adjustments[+] 0.995 × 0.9997 — 0.005
3. ELR Composite Factor (1c) × (2) — 1.145
4. (a) Target Cost Ratio — .7115
   (b) Loss Adjustment Expense — 1.12
   (c) Permissible Loss Ratio 4a/4b — 0.6353
   (d) Reciprocal — 1.574

1/85-12/85 Loss Weights	A.F.[*]			For: Policy Year 01/86-12/86			
			2nd/3rd Dev. Fac.		3rd to Ult. Dev. Fac.	
Death	6,281,433 × 1.056					
PT	3,794,997 × 1.041					
Major	54,973,297 × 1.045	68,030,880 ×	1.131	76,942,925	1.130	86,945,505
Minor	23,816,205 × 1.048					
TT	23,155,932 × 1.057	49,435,203 ×	1.005	49,682,379	0.999	49,632,697
Ser. Med.	34,533,326 × 1.088	37,572,259 ×	1.036	38,924,860	1.180	45,931,335
N. Ser. Med.	60,250,523 × 1.088	65,552,569 ×	1.036	67,912,461	0.998	67,776,636
Total	206,805,713	220,590,911		233,462,625		250,286,173
Benefit Charge =	1.067	Loss Development = 1.072				

1/86-12/86 Loss Weights	A.F.[*]			For: Policy Year 01/87-12/87			
			1st/2nd Dev. Fac.		2nd to Ult. Dev. Fac.	
Death	7,187,873 × 1.028					
PT	2,920,892 × 1.026					
Major	38,424,936 × 1.026	49,809,952 ×	1.247	62,113,010	1.278	79,380,427
Minor	26,561,811 × 1.027					
TT	25,482,907 × 1.030	53,526,374 ×	0.966	51,706,477	1.004	51,913,303
Ser. Med.	27,226,941 × 1.067	29,051,146 ×	1.065	30,939,470	1.222	37,808,032
N. Ser. Med.	67,917,442 × 1.067	72,467,911 ×	1.065	77,178,325	1.034	79,802,388
Total	195,722,802	204,855,383		221,937,282		248,904,150
Benefit Charge =	1.047	Loss Development = 1.122				

1/85-12/85 Loss Weights	A.F.[*]			For: Policy Year 01/88-12/88
			1st to Ult. Dev. Fac.	
Death	7,187,873 × 1.012			
PT	2,920,892 × 1.012			
Major	38,424,936 × 1.012	49,116,105 ×	1.594	
Minor	26,561,811 × 1.012			
TT	25,482,907 × 1.012	52,669,255 ×	0.970	
Ser. Med.	27,226,941 × 1.013	27,580,891 ×	1.301	
N. Ser. Med.	67,917,442 × 1.013	68,800,369 ×	1.101	
Total	197,722,802	198,166,620		
Benefit Charge =	1.012	Loss Development = 1.216		

[+] Includes change in trend, minimum premium multiplier change, C&R decision, etc.

[*] To latest law level effective 1/1/90

STEP 2—Calculation of Hazard Group Adjustment Factors

Exhibit 4 is the start of the calculations underlying Step 2. The most recent first, second, and third reports from statistical plan data are used. The average cost per case is calculated for fatal, PT, and major claims. These three serious injury types are the likely source for claims exceeding the SAL. Medical and indemnity losses of three policy periods are added for each of the three injury types. The number of cases for the policy periods is also added by type. The average cost per case is thus calculated for three years of claims (medical and indemnity) at their respective maturities. An adjustment for trend similar to that used for the SRP is made to the losses.

Exhibit 5 shows the final calculations of the Hazard Group ELR Factors. These final calculations adjust for the limitation of losses in the experience ratings.

Line 1: The SAL, which is 10% of the SRP as calculated in the proposed rate filing.

Lines 2, 5, and 8: The average cost per case for fatal, PT, and major claims by Hazard Group. These are from Exhibit 4 and are calculated as part of the rate review.

Lines 3, 6, and 9: The ratio of the SAL from Line 1 by type to the average cost per case by type from Lines 2, 5, and 8.

Lines 4, 7, and 10: The excess ratios. These are the fractions of the pure premium for the portion(s) of individual loss(es) above the entry ratios on Lines 3, 6, and 9. The excess ratio tables are those used in the former ELPF calculation as described in Harwayne [8].

Line 11: The weights for fatal, PT, and major claims by Hazard Group.

Line 12: The fraction of the total pure premium expected to be above the SAL. It uses Line 11 to calculate a weighted average of Lines 4, 7, and 10.

Line 13: The Hazard Group adjustment factors.

Line 14: The ELR Level Factor from Step 1.

EXHIBIT 4

ELR Factor Worksheet—State N

Average Cost Per Case

Injury Type	Statewide
Fatal	$ 89,073
PT	245,992
Major	45,537

Based on total losses and total claims, each by type, undeveloped, from the three-year experience period used for rates.

Hazard Group

	I	II	III	IV
Fatal	$ 83,036	$ 98,104	$117,074	$132,575
PT	249,377	292,786	302,965	381,999
Major	50,210	51,983	58,190	63,233

Uses countrywide Hazard Group Severity Relativities, adjusted to balance to state total, and appropriate severity trend from the ratemaking experience period to the experience rating experience period.

EXHIBIT 5

ELR FACTOR WORKSHEET—STATE N

		Hazard Group			
		I	II	III	IV
1.	10% of Proposed State Reference Point	33,500	33,500	33,500	33,500
2.	Average Fatal Cost	83,036	98,104	117,074	132,575
3.	Ratio to Average for Fatal (1) / (2)	0.40	0.34	0.29	0.25
4.	Excess Ratio for Fatal	0.693	0.752	0.801	0.840
5.	Average PT Cost	249,377	292,786	302,965	381,999
6.	Ratio to Average for PT (1) / (5)	0.13	0.11	0.11	0.09
7.	Excess Ratio for PT	0.941	0.954	0.954	0.966
8.	Average Major PP Cost	50,210	51,983	58,190	63,233
9.	Ratio to Average for Major PP (1) / (8)	0.67	0.64	0.58	0.53
10.	Excess Ratio for Major PP	0.399	0.417	0.457	0.494
11.	(A) Fatal Weight Factor	0.014	0.022	0.048	0.096
	(B) PT Weight Factor	0.022	0.030	0.040	0.058
	(C) Major PP Weight Factor	0.328	0.344	0.432	0.433
12.	Weighted Average Excess Ratio	0.161	0.189	0.274	0.351
13.	Adjustment Factor = 1.0 − (12)	0.839	0.811	0.726	0.649
14.	ELR Level Factor	0.465	0.465	0.465	0.465
15.	Hazard Group ELR Factors	0.390	0.377	0.338	0.302

Line 15: The Hazard Group ELR Factors. This line is the product of (3) × (14). One of the factors is applied to the rate of each class, depending on the Hazard Group assignment of the class, to produce the final class ELR.

STEP 3—Expected Loss Rate Checksheet

In addition to the standard calculation of the ELR as described above, the NCCI also has checksheets to identify cases where the ELR Factor (averaged over the Hazard Groups) changes significantly from the previous year. A more detailed investigation is conducted if the change is more than 10%. These checksheets are included in Exhibit 6.

Exhibit 6, Part 1 examines ELRs as a function of macroscopic changes in rates. Exhibit 6, Part 2 considers the microscopic changes by component to provide insight into the cause of ELR changes.

The checksheet in this exhibit shows a significant decrease in ELR factors over the previous year, which would normally result in an investigation of changes in State N. In this case, it was determined that the shift was due to a change to the experience rating plan formula, so that the change in ELR factors was justified. This can plainly be seen on Part 2, where the change in the excess ratio factor is 0.814, explaining most of the decrease.

STEP 4—Calculation of D-ratio Factors

The worksheet for this calculation can be found in Exhibit 7.

Line 1: Total Indemnity Losses (unlimited on a per-claim basis).

Line 2: Total Medical Losses (unlimited on a per-claim basis). Even though ratable losses are limited as described above, use of unlimited losses in the calculation of D-ratio factors provides a measure of conservatism. This is offset to some degree by the use of losses at first report, when severities are likely to be less skewed and D-ratios too high. (At the same time as the NCCI changes to a three-year experience period, it will begin using limited losses in this part of the calculation.)

EXHIBIT 6
PART I

EXPECTED LOSS RATE CHECKSHEET—STATE N
EFFECTIVE DATE: 1/1/90

If amount on Line 8 is greater than 1.100 or less than 0.900, the underlying cause of the large change should be determined and brought to the attention of Rates Department Supervisor.

1.	Effective Date of Last Change in ELRs		01/01/88
2.	Rate Change Approved Effective on (1)		1.159
3.	Rate Change Proposed Effective on (1)		1.168
4.	Average ELR Factor Underlying Rate Proposal on Line 3 (Proposed ELR HGII + Proposed ELR HGIII) / 2		0.447
5.	Interim Rate Changes Approved		
	Eff.	a.	1
	Eff.	b.	1
	Eff.	c.	1
	Eff.	d.	1
6.	CurrentAverage ELR Factor ((4) × ((3)/(2)))/((5a) × (5b) × (5c) × (5d))		0.451
7.	Proposed Average ELR Factor (Proposed ELR HGII + Proposed ELR HGIII) / 2		0.358
8.	Change in ELR Factors (7) / (6)		0.794
9.	Proposed Rate Change		1.164
10.	Indicated Change in Expected Losses (8) × (9)		0.924

EXHIBIT 6
PART 2

EXPECTED LOSS RATE CHECKSHEET—STATE N
EFFECTIVE DATE: 1/1/90

		(1) Last Approved Filing	(2) Proposed Filing	(3) Change (2) / (1)
1.	Benefit Changes			
	a. 3rd Report	1.084	1.067	xx
	b. 2nd Report	1.064	1.047	xx
	c. 1st Report	1.031	1.012	xx
	d. Average	1.060	1.042	xx
2.	Loss Development			
	a. 3rd Report	1.052	1.072	xx
	b. 2nd Report	1.080	1.122	xx
	c. 1st Report	1.175	1.216	xx
	d. Average	1.102	1.137	xx
3.	Off-Balance	1.01	1.01	xx
4.	Composite Factor All Reports	1.144	1.145	xx
5.	Financial Data Loss Ratio	0.8115	0.825	xx
6.	USP Loss Ratio	0.720	0.717	xx
7.	Loss Ratio Factor (7) / (8)	1.127	1.151	xx
8.	Profit and Exp. Factor All Reports	1.570	1.574	xx
9.	Reciprocal of the Combined Effect of these Factors**			
	a. 3rd Report	0.483	0.480	xx
	b. 2nd Report	0.480	0.468	xx
	c. 1st Report	0.455	0.446	xx
10.	Comparable ELR Level Factors Average (9)	0.473	0.465	0.983
11.	Excess Ratio Factor	0.945	0.769#	0.814
12.	Overall Change in ELR Factors (10) × (11)	xx	xx	0.800

** $1/[((1) \times (2) \times (3) \times (4) \times (8)]$

From Exhibit 5, Line 13, (HGII + HGIII) / 2

EXHIBIT 7

CALCULATION OF DISCOUNT RATIO FACTORS—STATE N

		(A) Serious	(B) Non-Serious	(C) Medical	(D) Total
1.	Total Indemnity Losses	49,351,958	52,329,922	xxx	xxx
2.	Total Medical Losses	27,437,361	45,660,200	22,648,393	95,745,954
3.	Total Losses (1) +(2)	76,789,319	97,990,122	22,648,393	197,427,834
4.	Total Primary Losses	7,124,224	55,450,538	22,028,546	xxx
5.	Estimated Indemnity Primary (4) × ((1)/(3))	4,580,876	29,610,587	xxx	xxx
6.	Estimated Medical Primary (4) - (5)	2,543,348	25,839,951	22,028,546	50,411,845
7.	Primary for D-ratios A & B = (5), C = (6D)	4,580,876	29,610,587	50,411,845	xxx
8.	Total Losses for D-ratios A & B = (1), C = (2D)	49,351,958	52,329,922	95,745,954	197,427,834
9.	First Report Partial D-ratios (7) / (8)	0.093	0.566	0.527	xxx
10.	First Report Loss *Distribution* (8) / Sum of (8)	0.250	0.265	0.485	1.000
11.	WCSP Experience Adjusted, On Level	290,981,723	178,348,670	390,464,152	859,794,545
12.	Adjusted Experience *Distribution* (11) / Sum (11)	0.338	0.208	0.454	1.000
13.	Final D-ratio Factors (9) × (10)/(12)	0.069	0.721	0.563	xxx

Line 3: Total serious and non-serious losses. These include associated medical amounts.

Line 4: Primary Losses. These are the first $5,000 of each claim. (When other changes described above are made, the split point used in this calculation will be deflated over the appropriate year or two by an appropriate severity trend.)

Lines 5, 6, 7, 8: The denominators of the D-ratio factors for serious and non-serious losses will be indemnity losses only. Medical will be all medical, as can be seen in Line 8. This is appropriate because the pure premium weights are serious indemnity, non-serious indemnity, and total medical. Lines 5 through 7 adjust the primary losses in Line 4, which are on a combined basis, to a more proper basis.

Line 9: The first report D-ratio factors. The ratios are, from left to right, primary to serious indemnity, primary to non-serious indemnity, and primary to total medical.

Lines 10, 11, 12: An adjustment is necessary because the pure premiums used to weight the partial D-ratios contemplate a future distribution of losses into serious, non-serious, and medical. Rather than compute component pure premiums by class for the earlier time period, it works well to put the distribution change adjustment in the partial D-ratios.

Line 13: The final D-ratio factors. These are the partial D-ratios from Line 9, adjusted by the distribution change Line 10 / Line 12.

The D-ratio for class XXXX in State N is:

$$\frac{\text{Serious Pure Premium (class XXXX)}}{\text{Total Pure Premium (class XXXX)}} \times \text{Serious D–ratio Factor}$$

$$+ \frac{\text{Non–Ser. Pure Premium (class XXXX)}}{\text{Total Pure Premium (class XXXX)}} \times \text{Non–Serious D–ratio Factor}$$

$$+\frac{\text{Medical Pure Premium (class XXXX)}}{\text{Total Pure Premium (class XXXX)}}$$

$\times$ Medical D–ratio Factor

STEP 5—D-ratio Checksheet

Exhibit 8 shows the D-ratio checksheet. The average D-ratio for all classes should not decrease from the past one by more than 10 points, or increase at all. The normal change expected from inflation is a decrease. Greater changes would be investigated. The maximum D-ratio is 0.90 and the minimum is 0.25 for the revised experience rating plan.

Once calculated, these D-ratios are included with the rate filing and go into effect if and when the new rates are approved.

7. ADMINISTRATION OF EXPERIENCE RATING

The accumulation and processing of the experience data for every individual insured is a remarkable undertaking and, when it goes smoothly, it is an often-forgotten function of the NCCI and other bureaus. Promulgation of a mandatory rate modification for every insured of qualifying size is also a monumental task, though it is seldom forgotten. The players in this piece—insurers, insureds, workers, bureaus, and regulators—all have self-interested points of view about the process. Actuaries should have a belief in the objective intent of this measurement of individual risk quality and its promotion of a correctly functioning market.

In order to calculate the modification factor for an individual employer, data from three annual policies is usually required. Data may come from more than one state, more than one insurer, and more than one medium. The move to electronic media has been slow, and many reports are still collected on unit cards. For each insured there is one card per state, per insurer, per year, and per evaluation. All these cards must be organized so that the data for each insured are in one place to do the rating.

A sample unit card for the first evaluation of a policy is shown in Figure 2. The card shows payroll, rates, premium, and loss for a single

EXHIBIT 8

DISCOUNT RATIO (D-RATIO) CHECKSHEET—STATE N

If the value of line (9) is ≥ 1.000 or ≤ 0.900, the underlying cause should be determined and brought to the attention of the supervisor.

	A. Current Values Effective 01/01/88				B. Proposed Values Effective 01/01/90			
	Serious	Non-Serious	Medical	Total	Serious	Non-Serious	Medical	Total
1. D-ratio Factors	0.271	1.175	0.253	xx	0.069	0.721	0.563	xx
2. Total Adjusted Losses For All Industry Groups	204,002,232	133,319,839	345,267,373	xx	282,506,527	173,154,049	401,299,231	xx
3. Payroll/$100	xx	xx	xx	682,220,187	xx	xx	xx	811,960,370
4. Average Pure Premium (2) / (3)*	0.299027	0.195421	0.506094	xx	0.347931	0.213254	0.494235	xx
5. Effect by Parts Used in Filing								
a. Law	1.025	1.030	1.000	xx	1.014	1.014	1.000	xx
b. Trend	1.071	1.071	0.960	xx	1.016	1.016	0.973	xx
c. Assessment	1.000	1.000	1.000	xx	1.000	1.000	1.000	xx
d. Total	1.098	1.103	0.960	xx	1.030	1.030	0.973	xx
6. Adjusted Pure Premium (4) × (5d)	0.328332	0.215549	0.48585	1.029731	0.358369	0.219652	0.480891	1.058912
7. Average D-ratio Sum ((1) × (6))/Total of (6)	0.086409	0.245958	0.119371	0.451738	0.023352	0.149558	0.255679	0.428589
8. D-ratios for:								
a. Code 2041 (HGI)	xx	xx	xx	0.42	xx	xx	xx	0.53
b. Code 7380 (HGIII)	xx	xx	xx	0.43	xx	xx	xx	0.38
c. Code 7405 (HGIV)	xx	xx	xx	0.54	xx	xx	xx	0.43
d. Code 8742 (HGIII)	xx	xx	xx	0.43	xx	xx	xx	0.40
e. Code 8810 (HGII)	xx	xx	xx	0.42	xx	xx	xx	0.44
9. Expected Average Change in D-ratios: (7B) / (7A) =	0.948756							

*These pure premiums reflect the average only if each class code in a state is 100% credible, but they can be used for comparative purposes.

state. The modification shown is the one applicable to the premium of the policy reported. The experience of that policy will be used to calculate a modification applicable to subsequent policies.

A somewhat simplified form is used for subsequent evaluations, so that only those items that change, such as loss reserves, need to be updated. This form makes things easier for the insurer, but requires careful processing by the administrative personnel to assure that the updated totals are correct. In addition to annual update cards, the staff handles numerous off-anniversary corrections and replacements for cards already submitted.

In any case, there could easily be enough activity on the account of a large intrastate insured so that six unit cards would be required to do a rating. A 1990 rating would need one card for the first report (1988 as of 18 months); two cards for the next most recent policy year at second report (1987 as of 18 months, updated at 30 months); and three cards for the most mature policy year. In practice, there are seldom so many cards used to do an intrastate rating, so that the average number of cards is less than four. As a rule, these insureds tend to be smaller and enjoy a large number of loss-free years, which do not need to be updated. In addition, many newly formed businesses grow so fast that their first rating is based on only two completed policy years.

When rating an interstate insured, the potential number of cards is multiplied by the number of states with subject payroll. There also may be a variety of subsidiary operations, each with its own compensation insurer. The average number of cards for these insureds is more than 15, with some insureds requiring many more than average. Collecting these cards and determining if all states and all years are in hand is a non-trivial activity, occasionally causing delay in the release of modifications. This delay may be due in part to the size of the clerical undertaking. It is also caused by the slowness of some insurers, which in some cases may stem from the low incentive to submit unit cards for non-renewing insureds.

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