DISCUSSION OF PAPER PUBLISHED IN VOLUME LXXIX

WORKERS COMPENSATION EXPERIENCE RATING: WHAT EVERY ACTUARY SHOULD KNOW

WILLIAM R. GILLAM

DISCUSSION BY THE AUTHOR

"Welcome to the working week.
I know it don't thrill ya', I hope it won't kill ya'."
—Elvis Costello

Abstract

The calculation of plan parameters and rating values, which is described in Sections 5 and 6 of the original paper, has been significantly improved.[1] *The calculation of expected loss rates (ELRs) has been improved by breaking down published rates into (partial) pure premium*[2] *components before adjusting for trend, development, and amendment factors that vary by component. Coupled with other refinements, this better reflects the distribution of injuries by class, and improves on the accuracy of the ELRs. The calculation of D-ratios has been improved, using data more closely matching that of the experience period. Finally, changes have been made in the plan parameters to reduce swing in the experience modifications of small risks; in the course of implementation, this was referred to as graduating the plan.*

[1]The National Council on Compensation Insurance (NCCI) is always working to improve its products, and this discussion documents several improvements made to the Experience Rating Plan since the time of the original article. To the credit of the regulatory actuaries involved in the NAIC Examination of NCCI conducted in 1992, many of the changes stemmed from the useful recommendations made at that time.

[2]In this paper we refer to the partial pure premiums that underlie workers compensation rates simply as pure premiums, consistent with internal production staff usage.

The following discussion essentially replaces the part of the original paper beginning with Section 5D.

1. CALCULATION OF PLAN PARAMETERS AND EXPERIENCE RATING VALUES

A. Calculation of Plan Parameters

A.1. State Reference Point (SRP)

This calculation is unchanged.

$SRP = 250 \times SACC$, rounded to the nearest 5,000, and

$G = SRP/250{,}000$, rounded to the nearest 0.05,

where SACC is the state average cost per claim, at a maturity consistent with that of the experience rating period.

For the State C example in the new exhibits, $SRP = 1{,}400{,}000$, and $G = 5.6$. Individual losses in experience rating are limited to 10% of the SRP, a value called the state accident limit (SAL) on ratable losses.

A.2. B *and* W *Values*

The primary credibility ballast B is calculated using the same formula as in the original paper, but subject to a new indexed minimum, rather than the previously used \$7,500.

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

subject to a minimum of $2{,}500G$.

Similarly, the excess credibility ballast C has a new indexed minimum, rather than the previously used \$150,000.

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

subject to a minimum of $60{,}000G$.

Because typical G values in the 1990s average about 4, the new minimum B and C values already tend to be larger than \$7,500, reducing swing (i.e., responsiveness) in the modifications of small risks. Larger ballast values mean lower credibilities.

A.3. Caps On Modifications

To prevent large swings in the modification of small risks, an indexed maximum limits the calculated value as a function of risk size and G:

$$\text{Max} = 1 + 0.00005(E + 2E/G).$$

Thus a risk with \$5,000 of expected loss in a state where $G = 4$ could have a modification no larger than 1.38. This replaces a table of maximum modifications by size range, whose discontinuity occasionally led to surprise changes in the modifications of small insureds when data in preliminary modifications were updated.

B. Calculation of Rating Values

B.1. Expected Loss Rates (ELRs)

In the experience rating plan, payroll (in \$100s) by class is extended by the respective ELRs to obtain expected losses.

The purpose of Exhibit 1 is to calculate Expected Loss Rate Factors, as shown on Line 8 of Exhibit 1, Part 2. The product of these factors and the corresponding partial pure premiums for each class are summed in order to get a provisional Expected Loss Rate for that class.

The principles of the calculation have not changed, but a treatment more focused on the impacts of loss development, loss based expenses, law amendments, and trend has been implemented. Starting with the partial pure premiums underlying the rates (i.e., serious, non-serious and medical), we must back up

in time and maturity to the experience period used for modifications. Loss development, law amendment factors, and trend are all calculated by pure premium for each of the policy periods used in ratemaking. So, in Column 3 of Exhibit 1, Part 1, we calculate average serious development factors to ultimate for each of three periods to be used in experience rating—third, second, and first reports. These are weighted to get one average serious development factor. This is also done for non-serious and medical losses. Notice that medical development factors exist for both serious and non-serious medical; these are weighted to be appropriate for the entire medical pure premium.

To account for law changes between the experience period and the effective period, law amendment factors by injury type and year are weighted to calculate average benefit on-level factors for each pure premium. These are in Column 5 of the exhibit. Note that the Unit Statistical Plan (USP) period is not the same as the experience period for prospective modification. (The reader may note the magnitude of the amendment factor for serious claims in State C. This is an example of the reforms implemented in the crisis period of the late 1980s and early 1990s.)

In Column 7, indemnity on-level loss ratio trend is used for the serious and non-serious pure premiums, and medical on-level loss ratio trend is used for the medical pure premium. These trends are taken from the rate level calculations. Trend factors of two years for first report, three years for second report, and four years for third report are weighted by on-level losses from Column 6 to produce an average trend used to unwind each pure premium.

ELRs are calculated for open competition states as well as administered pricing states. Expenses in manual rates are well-documented in the rate filing. An expense left in the component pure premiums that may still need to be unwound is loss adjustment expense, which in the State C example is 12.5% of loss. There may also be a factor for loss-based assessments, which are occasionally a part of component pure premiums.

Part 2 of Exhibit 1 displays important adjustments needed to calculate final ELR factors. In Lines 1 and 2, we adjust for expenses. In Line 3, we calculate the so-called loss ratio adjustment factor, which accounts for the difference between the latest on-level financial data loss ratio used for the rate level and the trended value of the USP loss ratio. This difference stems in part from the large number of adjustments between manual rates and final prices in the workers compensation rating plan. Another part is that the USP compiles data on each policy at 18 months and annually thereafter, while the financial data is compiled from a calendar year of policies once a year, starting with a 24 month evaluation date. Testing as described in Section 2 confirms the value of this adjustment.

On Line 3a of the exhibit, we see the USP indicated change of 0.927 adjusted by a trend factor of 1.092 to be comparable to the proposed rate level change. In State C, the financial data would indicate a lower change in loss costs than the trended USP loss ratio. The final ELR factors must be higher than those that would be obtained by unwinding trend from the prospective rates; as such, the loss ratio adjustment factor is 1.066.

Line 4 is needed because ELR factors apply to the voluntary level pure premiums, which have been offset downward to account for a new assigned risk pricing program. (This huge offset is another sign of the times.) The final ELRs will be at a total market level, higher than the voluntary level.

The adjustment on Line 6 on Part 2 accounts for losses in excess of the SAL. The Excess Loss Adjustment Factors (ELAFs) are calculated using a weighting of excess ratios in the same way as described in Exhibits 5 and 6 in the original paper. Separate ELAFs are calculated to be applied to the serious pure premium, which is indemnity only, and the medical pure premium, which includes a portion for medical associated with all indemnity claims. Since the excess ratios are for ground-up serious claims including medical, there must be an ELAF applied to the medical pure premium, adjusted by the proportion of the

medical pure premium that is for serious claims. It is assumed that no adjustment for loss limitation is necessary for non-serious claims.

For State C, the Hazard Group II serious ELAF is $0.855 = 1 - 0.145$, based on an excess ratio of 0.145. Using data from ratemaking, the serious medical portion of the medical pure premium is 0.379. Thus, the Hazard Group II Medical ELAF is $1 - (0.145)(0.379) = 0.945$. The eight resulting ELAFs appear on Line 6 of Exhibit 1, Part 2.

Notice that there is no adjustment to account for the higher average quality of rated risks. Previously, ELRs were divided by 1.01 to account for this phenomenon. It has been decided that it is more appropriate to let the modification seek its own level. Rate adequacy is based on standard premium and will automatically adjust for the impact of this change on the average modification.

The provisional ELR factors to be applied to the partial pure premiums are shown on Line 8 of Exhibit 1, Part 2.

A further step is necessary after summing these components by class. The partial pure premiums include trend, development, and amendment factors, as well as the impact of credibility, limits on change by class, and the test correction factor to reconcile to the proposed rate level change. In the final manual rate or loss cost, a factor for manual/earned premium, which varies by industry group, is applied to the sum of the pure premiums. This rate factor should be maintained in the ELR, so it is applied in the calculation of the final ELR. For example, consider class 4021 in Hazard Group II and the manufacturing industry group in State C. Suppose it has a serious pure premium of \$3, a non-serious pure premium of \$1, and a medical pure premium of \$2. Then its provisional Expected Loss Rate is $(3)(.554) + (1)(1.085) + (2)(.520) = \$3.79$ per \$100 of payroll. If the manual to earned ratio for manufacturing is 0.98, the final ELR would be $(\$3.79)(.98) = \$3.71$. Thus \$100,000 in payroll

in this class in State C would contribute (1,000)(3.71) = $3,710 of expected losses for experience rating.

B.2. D-Ratios

In the calculation of the experience modification, expected losses by class are extended by the respective D-ratios in order to compute expected primary losses for use in experience rating.

The calculation of D-ratio factors is shown in Exhibit 2. These are weighted by the partial pure premiums by class to produce final D-ratios.

The calculation of D-ratios has changed in ways alluded to in the original paper. Specifically, partial D-ratios are based on losses in the latest three statistical plan reports, rather than the most recent single policy year. Actual losses are limited by the state accident limit ("ratable" losses), but adjusted for severity trend from the date of available statistical plan reports to the period that will actually be used for experience rating.[3] Consideration of Table 1 in the original paper should lead to the conclusion that this is normally about two years, although sometimes a bit less. Partial D-ratios are computed for each pure premium component of the rate. The serious partial D-ratio represents the ratio of serious indemnity primary losses to total serious indemnity losses. There is a similar non-serious partial D-ratio. The medical partial D-ratio is primary medical losses divided by the medical total.

Since the primary/excess split in experience rating applies to total losses of indemnity plus medical, and partial D-ratios apply to pure premiums that are (serious) indemnity only, (non-serious) indemnity only, and all medical, some care must be taken in the calculation of the partial D-ratios. This entails the separation of indemnity primary and medical primary (Columns 5 and 6 in

[3]Originally, the author wanted to leave the data untrended and deflate the split point, as this would lead to the adjustment of only one number. The concept of deflation was considered too avant-garde for a highly regulated line of business.

Exhibit 2, Part 1) in the serious and non-serious losses, and the addition of medical primary to the medical partial D-ratio (see Column 6 in the medical row of Exhibit 2, Part 1).

The calculation of final D-ratio factors must reflect the change in pure premium weights between the statistical plan period and the prospective rates. This adjustment (in production parlance, a transition from partial D-ratios to D-ratio factors) is calculated in Exhibit 2, Part 2. The partial D-ratios would be applied to the pure premiums from the calculation of classification rates. Unfortunately, these pure premiums are not in the proper proportions to represent the losses expected for experience rating. Specifically, at ultimate, there is a relatively larger proportion of serious and medical loss and a smaller portion of non-serious loss than will be found in statistical plan data at first, second, and third reports. Therefore, an adjustment is necessary or the estimate of the proportion of primary losses will be too low. The partial D-ratios are multiplied by adjustment factors, Exhibit 2, Part 2, Line 2 divided by Line 6. This is the arithmetic equivalent of adjusting the classification partial pure premiums. The results are the final D-ratio factors as shown on Line 7 of Exhibit 2, Part 2. If a particular class rate in State C was based on pure premiums of \$3 for serious, \$1 for non-serious, and \$2 for medical, then the D-ratio would be $\{(\$3)(.056) + (\$1)(.688) + (\$2)(.266)\}/(\$3 + \$1 + \$2) = .23$.

2. EX-ANTE TESTING OF NEW ELR CALCULATION

Exhibit 3 shows some of the testing done at NCCI to support the new ELR calculation. The idea is to calculate sample ELRs for a historical period, using a new method, and then apply them in their respective time period. We looked at what would have happened to average modifications by class group and ELR accuracy by class. We desired as uniform a result as possible; that is, that ELR accuracy and average modification be as close as possible for the different classes or class groups. The new calculation achieves this better than the prior methodology.

Testing this requires considerable investigation of old rate-making files and a good bit of care in programming modification calculations using hypothetical ELRs.

Consider Exhibit 3, Part 1. It shows average modifications by hazard group, industry group, and overall for four states. The prior calculation produces modifications that tend to be low for the higher severity class groups; i.e. Hazard Groups III and IV or the Contracting industry group. The revised calculation does not completely correct the problem, but decidedly reduces it. This is expected, since the highest severity classes tend to have the most weight in the serious and medical pure premiums. These two pure premiums should have the lowest ELR factors, and the ELRs for high severity classes should bear a correspondingly low relationship to the rate.

Exhibit 3, Part 2 shows statistics pertaining to ELR accuracy by class for the prior and revised ELR calculations.

One problem is that losses less than $2,000 may be (and often are) summarized in statistical plan reporting, and are always summarized in the data used for normal experience rating. We are not able to attribute these losses to class, since carriers are not required to report the class on medical only claims. As such, we leave them out of the accuracy calculation. Hence, the actual/expected (A/E) ratios tend to be 10–20% low for both calculations. We need to normalize to an overall unity A/E ratio for each hypothetical calculation of ELRs; this puts each on a level playing field when sample variance from expected is calculated as described below.

Overall sample weighted squared variation from unity in A/E by class is calculated on a statewide basis by individual class by hazard group and industry group. Performance of the proposed ELR calculation is measured by squared variation. With occasional exception, performance of the revised method is better than the prior method. In particular, the variation between hazard groups and the variation between industry groups are both

reduced. Notice that the *within* variation from the class group mean A/E ratio plus the variation *between* class groups equals the total variation. (This is a hip-pocket fact the manager can use to check the unwary student's work.)

3. CONCLUSION

It is a pleasure to report these improvements in the administration of experience rating. It is clear that such improvements will continue to be needed and will continue to be made.

EXHIBIT 1

PART 1

EXPECTED LOSS RATE CALCULATION
DEVELOPMENT, AMENDMENT, AND TREND BY PURE PREMIUM

STATE: C
EFF DATE: 7/1/1994
USP PERIOD 1/89–12/89

Experience Rating Policy Period: 7/90–7/91

(1)	(2) Losses		(3) Dev. Fact. 3rd to Ult		(4) Ultimate Losses		(5) Amend. Factor		(6) On-Level Losses		(7) Trend Factor		(8) Trended Losses
Death	11,685,084	×	1.690	=	19,747,792	×	0.411	=	8,116,343	×	1.134	=	9,203,933
P.T.	4,702,449	×	1.690	=	7,947,139	×	0.174	=	1,382,802	×	1.134	=	1,568,097
Major	236,250,583	×	1.690	=	399,263,485	×	0.711	=	283,876,338	×	1.134	=	321,915,767
Serious:	252,638,116	×	1.690	=	426,958,416	×	0.687	=	293,375,483	×	1.134	=	332,687,797
Minor	48,728,103	×	1.018	=	49,605,209	×	0.710	=	35,219,698	×	1.134	=	39,939,138
T.T.	49,596,614	×	1.018	=	50,489,353	×	0.885	=	44,683,077	×	1.134	=	50,670,609
Non-Serious:	98,324,717	×	1.018	=	100,094,562	×	0.798	=	79,902775	×	1.134	=	90,609,747
Ser. Med.	96,609,465	×	1.765	=	170,515,706	×	0.943	=	160,796,311	×	1.432	=	230,260,317
Non-Ser. Med.	87,721,420	×	1.047	=	91,844,327	×	0.943	=	86,609,200	×	1.432	=	124,024,374
Medical	184,330,885	×	1.423	=	262,360,033	×	0.943	=	247,405,511	×	1.432	=	354,284,691
USP PERIOD	1/90–12/90		SUMMARIZED										
					2nd to Ult								
Serious:	184,901,837	×	1.929	=	356,675,644	×	0.705	=	251,425,573	×	1.099	=	276,316,705
Non-Serious:	91,859,386	×	1.029	=	94,523,308	×	0.821	=	77,627,553	×	1.099	=	85,312,681
Medical	158,584,459	×	1.456	=	230,904,175	×	0.943	=	217,742,637	×	1.309	=	285,025,112

Experience Rating Policy Period: 7/91–7/92

EXHIBIT 1

PART 1—PAGE 2

(1)	(2) Losses		(3) Dev. Fact. 3rd to Ult		(4) Ultimate Losses		(5) Amend. Factor		(6) On-Level Losses		(7) Trend Factor		(8) Trended Losses
USP PERIOD	1/91–12/91		SUMMARIZED								Experience Rating Policy Period: 7/92–7/93		
					1st to Ult								
Serious:	102,700,971	×	2.617	=	268,768,441	×	0.816	=	219,337,131	×	1.065	=	233,594,044
Non-Serious:	96,880,811	×	0.996	=	96,493,288	×	0.894	=	86,290,577	×	1.065	=	91,899,465
Medical	152,050,518	×	1.524	=	231,692,605	×	0.968	=	224,278,442	×	1.197	=	268,461,295
THREE YEAR WEIGHTED VALUE													PRODUCT
Serious:			1.948			×	0.726			×	1.103	=	1.560
Non-Serious:			1.014			×	0.837			×	1.098	=	0.932
Medical			1.465			×	0.951			×	1.317	=	1.835

EXHIBIT 1

PART 2

CALCULATION OF ELR FACTORS BY PREMIUM AND HAZARD GROUP

	Factor	Serious	Non-Serious	Medical
1) Combined report, development, amendment, and trend factor from Part 1				
From Part 1	—	1.560	.932	1.835
LAE Factor	1.125	—	—	—
Product	—	1.755	1.048	2.064
2) Reciprocal of Factor above	—	0.570	0.954	0.484
3) (a) Adjusted USP Experience Change				
0.927×1.092 =	1.012			
(b) Financial Data Experience Change	0.9500			
(c) Loss Ratio Adj. Factor (a)/(b)	1.066			
4) Offset for New Assigned Risk Programs	0.937			
5) Average ELR Factor (2) × (3c)/(4)		0.648	1.085	0.550
6) Excess Loss Adjustment Factors				
HG I		0.873	1.0	0.949
HG II		0.855	1.0	0.945
HG III		0.803	1.0	0.898
HG IV		0.729	1.0	0.850
7) Adjustments:	None			
8) ELR Factors (5) × (6) × (7)				
HG I		0.566	1.085	0.522
HG II		0.554	1.085	0.520
HG III		0.520	1.085	0.494
HG IV		0.472	1.085	0.468

EXHIBIT 2

PART 1

STATE C

CALCULATION OF D-RATIO FACTORS
SPLIT VALUE = $5,000

	First, Second and Third Reports Combined							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Trended Ratable	Primary	Ratable Indemnity	Ratable Medical	Estimated Indemnity Primary (2) × ((3)/(1))	Estimated Medical Primary (2)–(5)	3-Yr Total Partial D-Ratio (5)/(3)	3-Yr Total Loss Dist. (3)/Tot (1)
Serious	739,637,237	44,498,824	522,295,420	217,341,817	31,422,880	13,075,944	0.060	0.377
Non-Serious	579,960,300	224,227,305	331,478,713	248,481,587	128,158,045	96,069,260	0.387	0.240
Medical Only	63,838,341	60,718,083	0	63,838,341	0	60,718,083		
Total	1,383,435,878	329,444,212	853,774,133	529,661,745	Medical	169,863,287	0.321*	0.383**

NOTE
THIS REPORT IS FOR STATEWIDE DATA
Proposed Effective Date: 07-01-94
10% of State Reference Point = 140,000
Severity Trend = 1.147
*Medical D-Ratio Factor (6)/(4)
**Loss Distribution (4)/(1)

EXHIBIT 2

PART 2

CALCULATION OF D-RATIO FACTORS

Adjustment For Use With Ultimate Pure Premiums

	(A) Serious	(B) Non-Serious	(C) Medical	(D) Total
1. Three Year Partial D-ratios, Part 1, Col. 7	0.060	0.387	0.321	XXX
2. Three Year Loss Distribution, Part 1, Col. 8	0.377	0.240	0.383	1.000
3. Ultimate USP Experience On-Level	950,281,470	319,380,590	1,009,590,996	XXX
4. Rate Factors Applied by Parts	0.980	0.979	1.060	
5. Experience Underlying Final Rates (3) × (4)	931,275,841	312,673,598	1,070,166,456	2,314,115,894
6. Experience Distribution (5)/sum(5)	0.402	0.135	0.463	1.000
7. Final D-ratio Factors (1) × (2)/(6)	0.056	0.688	0.266	XXX

EXHIBIT 3

PART 1

REVISION TO ELR CALCULATION

Ex-Ante Test of Effect on Average Mod
Rating Year 1992

	HAZARD GROUP I			HAZARD GROUP II			HAZARD GROUP III			HAZARD GROUP IV		
State	Prior	Revised	% Diff	Prior	Revised	% Diff	Prior	Revised	% Diff	Prior	Revised	% Diff
A	1.011	1.008	−0.3%	1.010	1.024	−1.4%	1.032	1.049	1.6%	0.967	1.001	3.5%
B	1.035	1.016	−1.8%	1.012	1.008	−0.4%	0.980	0.984	0.4%	0.922	0.936	1.5%
C	1.062	1.060	−0.2%	1.102	1.106	0.4%	1.003	1.001	−0.2%	0.945	0.960	1.6%
D	1.025	0.992	−3.2%	1.001	0.997	−0.4%	0.979	0.984	0.5%	0.950	0.970	2.1%
Total	1.035	1.022	−1.3%	1.023	1.024	0.1%	0.996	1.002	0.6%	0.934	0.952	1.9%

	MANUFACTURING			CONTRACTING			ALL OTHER			ALL RISKS		
State	Prior	Revised	% Diff	Prior	Revised	% Diff	Prior	Revised	% Diff	Prior	Revised	% Diff
A	1.003	1.012	0.9%	0.974	1.003	3.0%	1.032	1.046	1.4%	1.006	1.025	1.9%
B	1.013	1.008	−0.5%	0.927	0.941	1.5%	1.001	0.998	−0.3%	0.974	0.978	0.4%
C	1.166	1.167	0.1%	0.949	0.954	0.5%	1.000	1.008	0.8%	1.030	1.036	0.6%
D	1.008	1.006	−0.2%	0.952	0.970	1.9%	0.993	0.989	−0.4%	0.980	0.985	0.5%
Total	1.033	1.032	−0.1	0.940	0.956	1.7%	1.007	1.009	0.2%	0.988	0.996	0.7%

EXHIBIT 3

PART 2

NEW ELR CALCULATION

Ex-Ante Test of Class Accuracy
State B, Rating Year 1992

Hazard Group	Actual Ratable Loss	Observed Actual/Expected Ratio:		Weighted Average Squared Deviation By Class from State Avg.		Weighted Average Squared Deviation By Class from HG Avg.	
		Prior	Revised	Prior	Revised	Prior	Revised
All	1,171,432,952	0.8401	0.8522	0.1999	0.1976	0.1965	0.1958
1	84,552,535	0.8084	0.7704	0.0602	0.0684	0.0588	0.0592
2	404,926,751	0.9024	0.8933	0.5062	0.4865	0.5007	0.4842
3	294,811,475	0.8472	0.8571	0.0807	0.0788	0.0806	0.0788
4	387,142,191	0.7852	0.8279	0.0349	0.0353	0.0306	0.0344
Between Variation		0.0034	0.0018				

Hazard Group	Actual Ratable Loss	Observed Actual/Expected Ratio:		Weighted Average Squared Deviation By Class from State Avg.		Weighted Average Squared Deviation By Class from HG Avg.	
		Prior	Revised	Prior	Revised	Prior	Revised
All	1,171,432,952	0.8401	0.8522	0.1999	0.1976	0.1963	0.1966
Mfg.	284,558,957	0.9109	0.8975	0.2869	0.2744	0.2798	0.2716
Ctg.	443,594,453	0.7845	0.8248	0.0327	0.0324	0.0283	0.0314
AO	443,279,542	0.8582	0.8528	0.3302	0.3217	0.3298	0.3217
Between Variation		0.0035	0.0011				