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National Council on Compensation Insurance, Inc.

The NCCI Experience Rating Plan

Some Background And Recent Developments

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Chicago, IL
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Overview

- Empirical Proof That The NCCI Experience Mod Performs Very Well
- Theory Of Individual Risk Experience Rating
- The NCCI Experience Rating Formula
- How The Mod Handles Frequency, Severity, And Skewness
- Effect On Experience Rating Of Recent Changes In Class Ratemaking
- Recent Review Of Experience Rating Plan

Individual Risk Rating: Why is it done? Does it really work ?

Why are individual risks experience rated ?

Answer: Even after manual classification relativities are applied, individual risk experience usually provides additional predictive information.

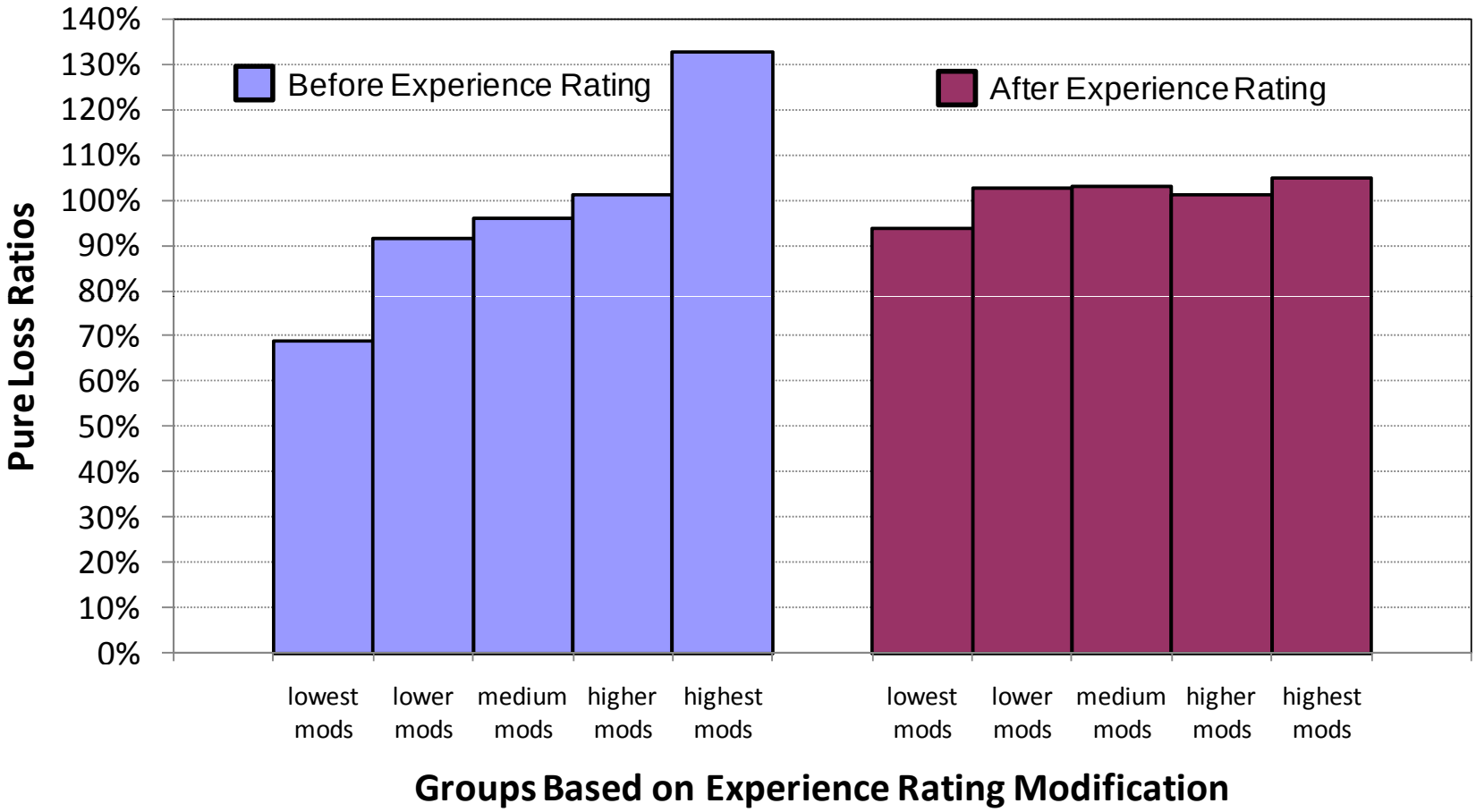
Does individual risk experience rating really work ?

Even if it does work, how much does it really improve ratemaking ?

Answer: See next slide.

2006 Effective Year Performance of ER Plan:

The Quintile Test



Note: Each group contains 20% of risks. Pure loss ratios are based on actual losses compared to the expected losses underlying the loss costs.

The NCCI Experience Rating Plan Works Extremely Well And Adds Much Value To Ratemaking

Empirical testing proves that the mod is highly predictive and the value it adds to ratemaking, or its "lift", is very high.

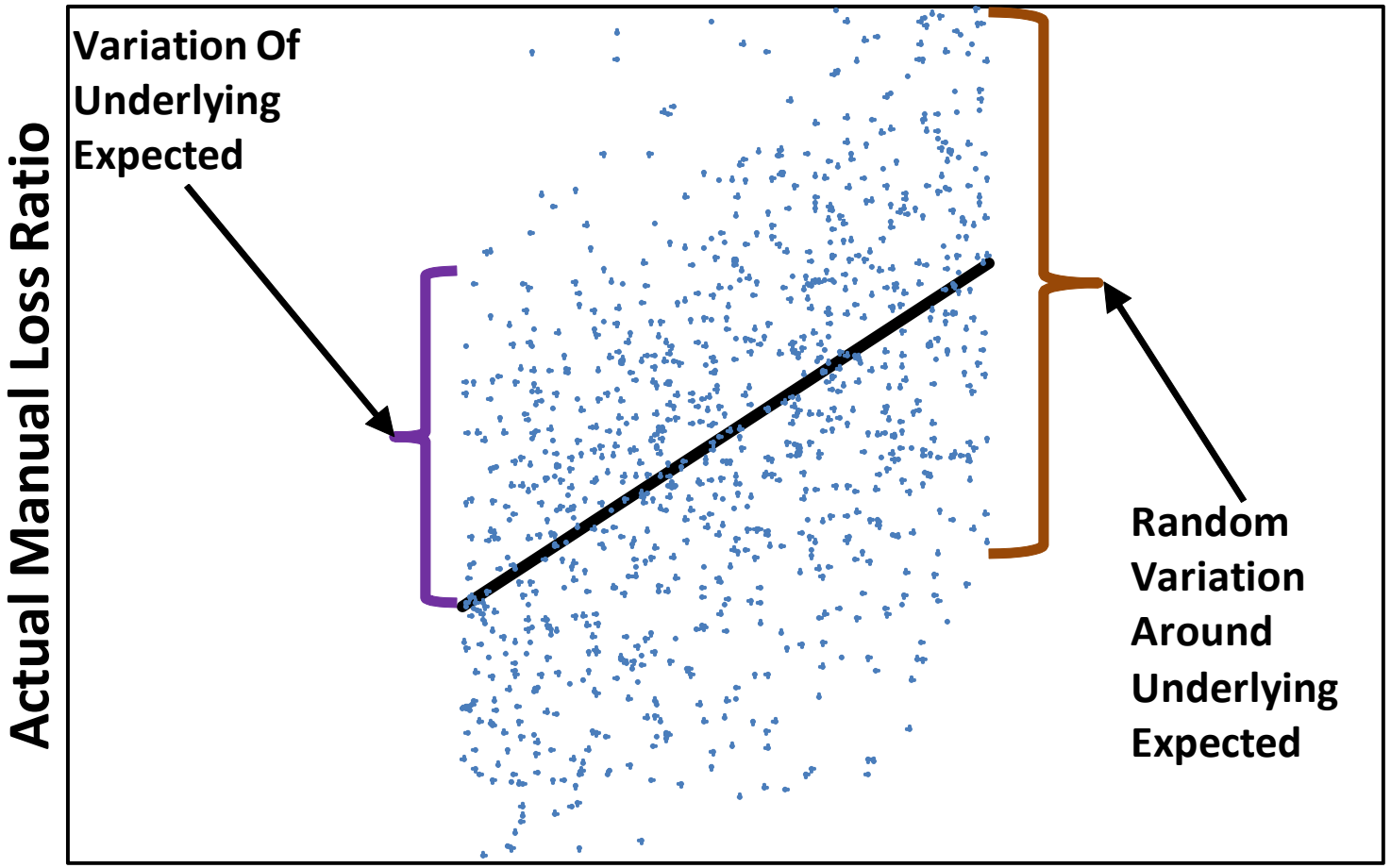
- Risks with mods above the 80th percentile produce subsequent manual pure loss ratios that are about 30% higher.
- Similarly, risks with mods below the 20th percentile produce subsequent manual pure loss ratios about 30% lower.
- After the mod is applied loss ratios are fairly close to the same for high mod and low mod risks.

Theory Of Individual Risk Experience Rating

Individual risks may have different expected manual pure loss ratios. If this is true then actual losses for individual risks vary from the manual expected due to systematic differences and random unsystematic differences.

If the differences tend to persist over time, the past experience will be partially indicative of future results at the individual risk level.

Hypothetical Illustration Of The Predictive Power Of Individual Risk Experience



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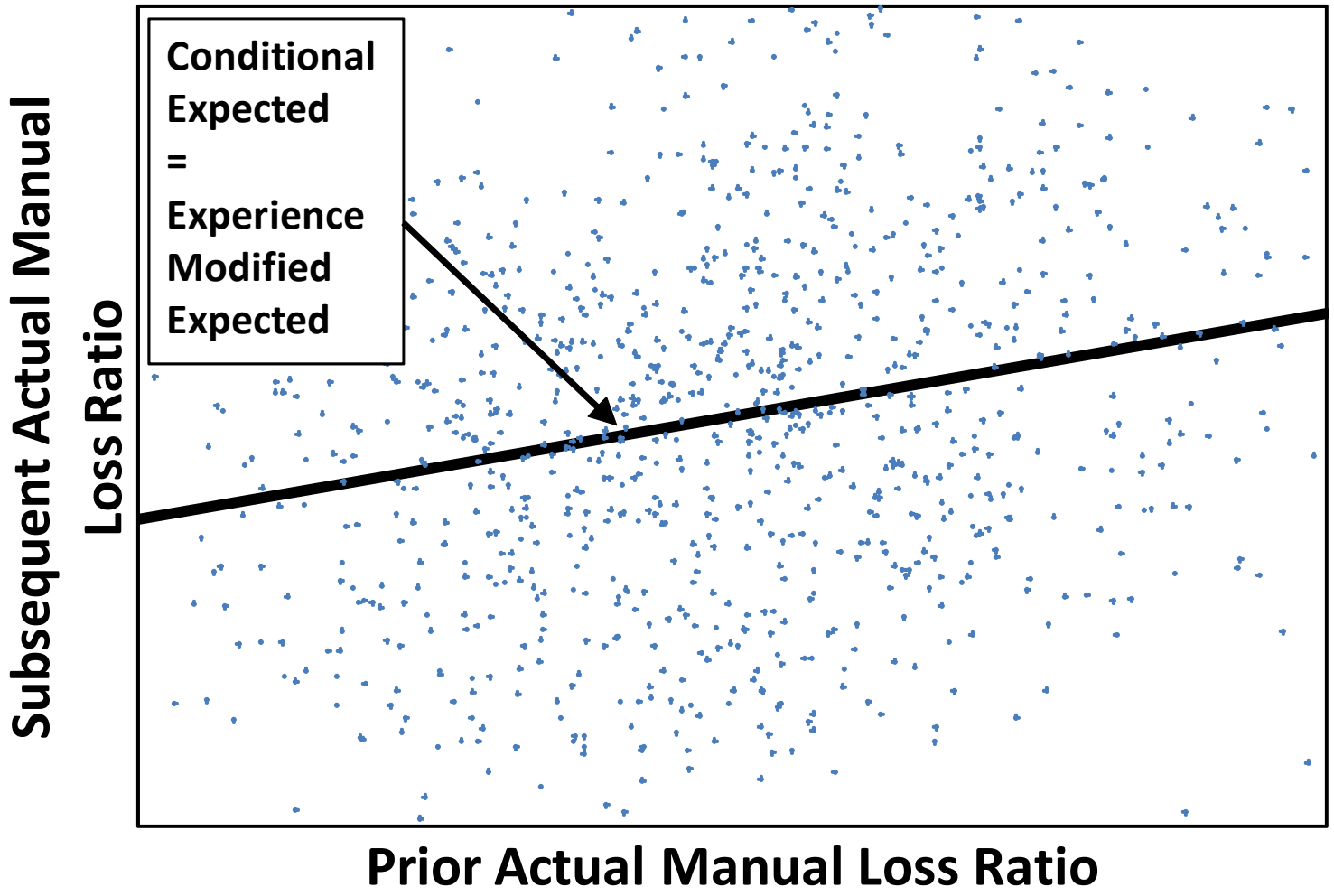


The Limits Of Individual Risk Experience Rating

- Experience rating is only a best estimate of the underlying unobservable mean, or equivalently the most predictive filter of past experience.
- Credibility (for a stationary process) is the ratio of systematic variance to total variance. For credibility to approach 100% random variance must approach 0.

$$Z = \frac{\sigma^2_{systematic}}{\sigma^2_{systematic} + \sigma^2_{random}}$$

- This can be achieved when experience from many risks is pooled to determine a relativity for a class or other rating factor.
- However, at the individual risk level near 0 random variation corresponds to predictable expenses rather than insurable losses. So, credibility must be much less than 100%.

The Limits Of Experience Rating

Individual experience rating can only capture a fraction, equal to Z, of the total variance of the underlying, and most importantly not directly observable, systematic variance.

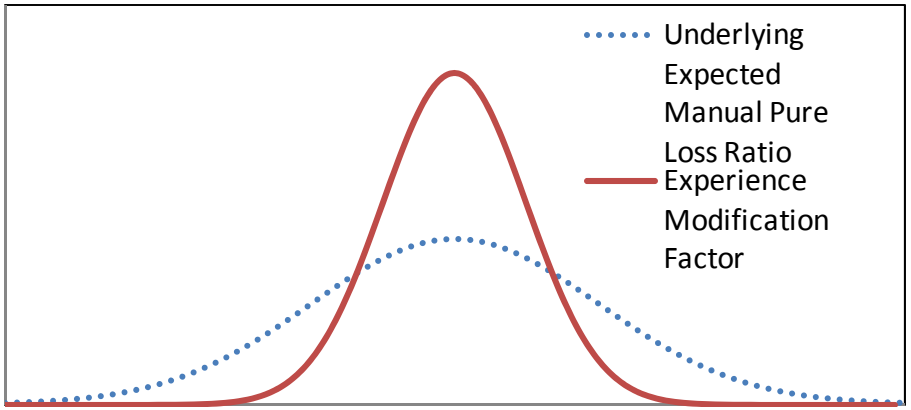
$$M = Z\ LR + (1 - Z)$$

$$\sigma_M^2 = Z^2 \sigma_{LR}^2$$

$$= \left(\frac{\sigma_{systematic}^2}{\sigma_{systematic}^2 + \sigma_{random}^2} \right)^2 \left(\sigma_{systematic}^2 + \sigma_{random}^2 \right)$$

$$= \frac{\left(\sigma_{systematic}^2 \right)^2}{\sigma_{systematic}^2 + \sigma_{random}^2} = Z\ \sigma_{systematic}^2$$

Hypothetical Example Of Densities For Z = 25%



The NCCI Experience Rating Formula

$$M = \frac{A_p + wA_x + (1-w)E_x + B}{E + B} = 1 + Z_p \frac{A_p - E_p}{E} + Z_x \frac{A_x - E_x}{E}$$

$$Z_p = \frac{E}{E + B} \qquad Z_x = \frac{wE}{E + B} = wZ_p$$

$$E_p = DE \qquad E_x = (1-D)E = E - E_p$$

M = the experience mod factor

Ap = actual primary loss from the experience period

Ax = actual excess loss from the experience period

E = expected loss for the experience period

Ep = expected primary loss for the experience period

Ex = expected excess loss for the experience period

D = D-ratio, fraction of expected loss that is primary

w = Weight

B = Ballast

Zp = primary credibility

Zx = excess credibility

Note: The mod calculation also involves a cap that varies by size of risk on the maximum mod, a 70% exclusion of medical only losses from experience, and miscellaneous state exceptions.

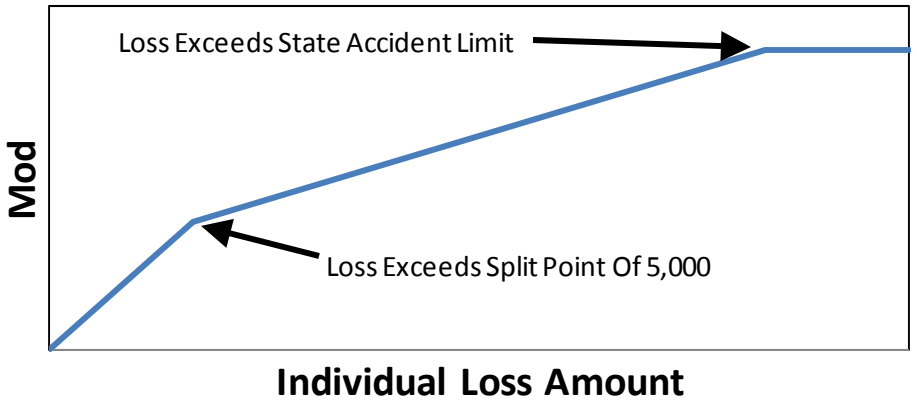
How The Mod Handles Frequency, Severity, And Skewness

Linear credibility and least squares type formulas are geared towards single random variables that are symmetric, and preferably even follow a Normal distribution. However, per risk losses consist of multiple claims, whose individual amounts follow a highly skewed distribution, with a point mass at zero for the outcome of no claims.

The mod formula accounts for this by splitting individual claims into 3 layers, and applying, different credibility to each.

- The loss layer below the split point of 5,000 receives primary credibility.
- The loss layer between 5,000 and the state accident limit (SAL, typically around 100k to 200k) receives excess credibility.
- The loss layer above the SAL is excluded from the formula entirely.

Hypothetical Illustration Of Response Of Mod To A Single Claim



The Parameterization Underlying Current W And B Values

$$K_p = E\left(\frac{C_p\,E + G\,D_p}{E + G\,F_p}\right) \qquad K_x = E\left(\frac{C_x\,E + G\,D_x}{E + G\,F_x}\right)$$

$$Z_p = \frac{E}{E + K_p} \qquad Z_x = \frac{E}{E + K_x}$$

$$B = K_p \qquad w = \frac{Z_p}{Z_x}$$

G is an index proportional to the average of all claims statewide. It adjusts credibility for differences in benefit costs between states and inflation in benefit costs over time. G changes for each state filing. The other 6 parameters are fit countrywide and remain constant across states for many years.

Current Formula Parameter Values

	Primary	Excess GERT, RERP	Excess ERA
C	0.10	0.75	0.375
D	2,570	203,825	150,000
F	700	5,100	5,100

Predictive Fitting Of Credibility And Predictive Testing Of Performance

The formulaic use of the constants *Cp, Dp, Fp, Cx, Dx,* and *Fx* is developed from a model for process and parameter variance by size of risk.

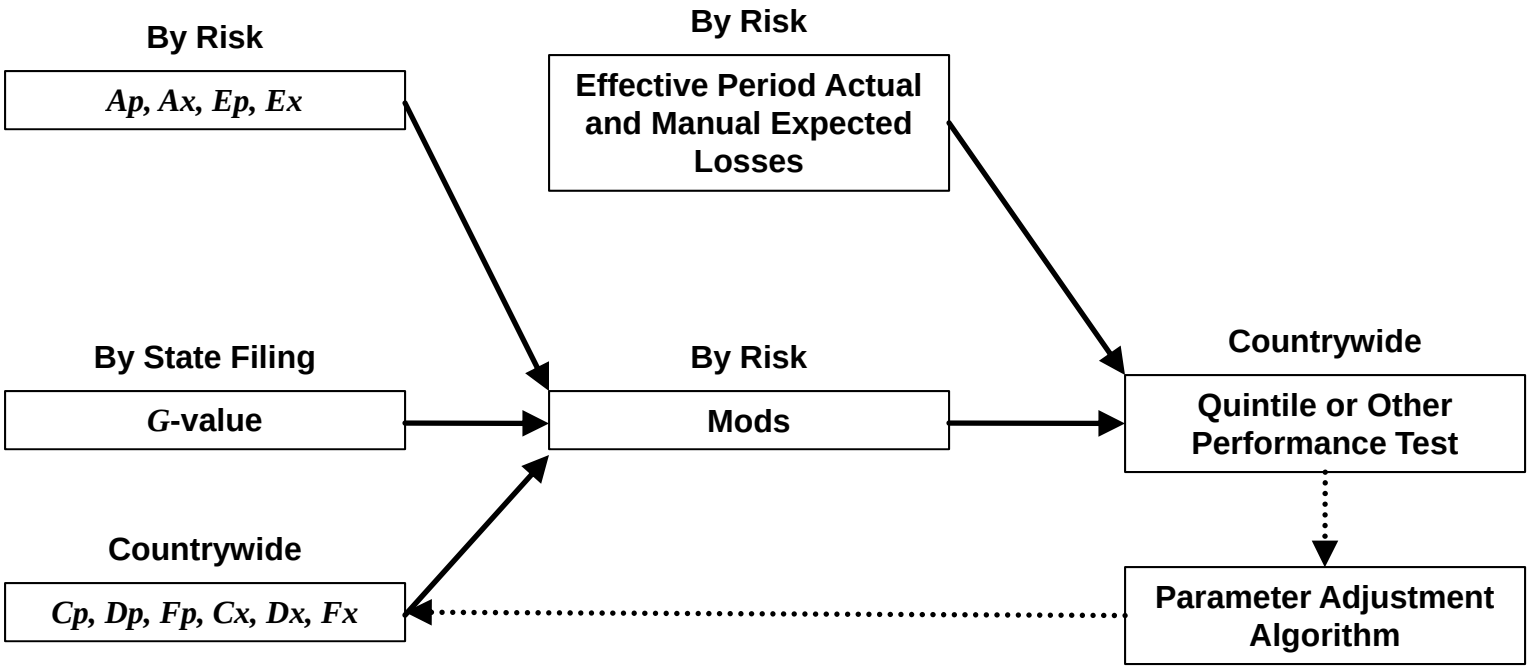
For details see:

"Parametrizing the Workers Compensation Experience Rating Plan"; Gillam, William Robin, *PCAS LXXIX*, 1992.

However, the specific values of the constants are determined by empirical fitting that maximizes the predictive value of the mod. The mod, based entirely on previous experience, is tuned to predict subsequent experience. This accounts for various other real world effects that differ from a basic static Bühlmann credibility model, such as changes in the underlying process between the experience period and the effective period.

The mod is also frequently tested on a predictive basis, usually the quintile test.

The Credibility Parameter Fitting Process



How Recent Changes In NCCI Class Ratemaking Affect Experience Rating

Expected Impact of Changes to ELRs

Removing the Ratemaking Excess Provision	
Old Methodology	New Methodology
There is no separate adjustment to remove the unlimited to limited ratio applied in ratemaking by industry group (IG). Excess losses are removed by hazard group (HG).	The excess provision applied by hazard group (HG) in ratemaking is removed.
Expected Impact (All Other Adjustments Being Equal)	
Classes for which the old relative IG (loss cost) provision is more than the old relative HG (ELR) removal will see a decrease in ELR. Classes for which the old relative IG (loss cost) provision is less than the old relative HG (ELR) removal will see an increase in ELR.	

Expected Impact of Changes to ELRs

Removing Losses Excess of the State Accident Limit	
Old Methodology	New Methodology
Inverse polynomial curves are used to remove undeveloped losses excess of the state accident limit by hazard group. There are four hazard groups.	Updated inverse polynomial curves are used to remove the layer between the SAL and ratemaking limit. There are seven hazard groups.
Expected Impact (All Other Adjustments Being Equal)	
The range of adjustment in the state accident limit to ratemaking limit layer is now wider so lower Hazard Groups (towards A) will see larger ELRs while higher Hazard Groups (towards G) will see lower ELRs.	

Expected Impact of Changes to ELRs

Removing Loss Development	
Old Methodology	New Methodology
Losses are developed in ratemaking by • serious indemnity • non-serious indemnity • serious medical • non-serious medical	Losses are developed in ratemaking by • likely indemnity • not-likely indemnity • likely medical • not-likely medical
Losses are "de-developed" for ELRs by • serious indemnity • non-serious indemnity • medical	Losses are "de-developed" for ELRs by • indemnity • medical
Expected Impact (All Other Adjustments Being Equal)	
Classes with a greater proportion of likely-to-develop losses will see higher ELRs while classes with a lower proportion will see lower ELRs.	

Expected Impact of Changes to D-Ratios

Calculating the Expected Primary/Excess Loss Proportions	
Old Methodology	New Methodology
Removed by • serious indemnity • non-serious indemnity • medical	Removed by • indemnity • medical
The same factors are used for all hazard groups.	Separate factors are used by hazard group.
Expected Impact (All Other Adjustments Being Equal)	
Higher hazard groups will see lower D-Ratios, lower hazard groups will see higher D-Ratios.	

ELRs and D-Ratios By Hazard Group
Filing A

Hazard Group	Old Method				New Method				Change	
	Primary	Ratable	Avg. D-Ratio	Avg. ELR	Primary	Ratable	Avg. D-Ratio	Avg. ELR	Avg. D-Ratio	Avg. ELR
A	6,474,002	32,670,052	0.20	0.41	8,159,888	35,899,752	0.23	0.45	15.0%	9.8%
B	24,049,941	124,895,588	0.19	0.43	29,328,306	136,439,780	0.21	0.47	10.5%	9.3%
C	47,664,021	258,765,218	0.18	0.18	53,700,890	274,351,267	0.20	0.19	11.1%	5.6%
D	19,065,631	108,858,815	0.18	0.50	19,501,341	113,124,736	0.17	0.52	-5.6%	4.0%
E	33,347,954	194,003,279	0.17	0.42	32,517,523	196,569,953	0.17	0.43	0.0%	2.4%
F	38,136,830	229,469,711	0.17	1.64	33,378,543	218,869,706	0.15	1.56	-11.8%	-4.9%
G	9,715,121	61,411,882	0.16	2.12	8,190,056	57,880,703	0.14	2.00	-12.5%	-5.7%
Total	178,453,500	1,010,074,545	0.18	0.38	184,776,546	1,033,135,897	0.18	0.39	0.0%	2.6%

Recent Review Of Experience Rating Plan

- In the past several years NCCI has been conducting a review of the Experience Rating Plan.
- The analysis performed has been presented and discussed at meetings of the Individual Risk Rating Working Group (IRRWG).
- Discussions have covered topics such as:
  - Severity Index
  - Loss Limits
  - Mod Cap
  - Plan Performance
  - State and Class Exceptions
  - ELR, ELAF, and D-Ratio Calculations
  - New Class Ratemaking System
  - Weights and Ballasts
  - Eligibility Thresholds
  - Split Point

Meetings And Presentations

- First discussion at the August 10, 2006 IRRWG meeting
- 13 more meetings since
- Approximately 46 more presentations, excluding general updates, since then.

Year	IRRWG Meetings	ER Plan Review Presentations
2006	1	1
2007	2	5
2008	3	13
2009	7	25
2010 to date	1	3

Summary

- Empirical testing proves that the mod performs well and adds much value to ratemaking.
- The mod is rooted in Bühlmann credibility but is also designed to account for frequency, severity, skewness, and changing parameters over time.
- Individual risk experience ratemaking is intrinsically limited since the very nature of an insurable risk leads to credibility much less than 100%.
- NCCI has been reviewing the Experience Rating Plan through its Individual Risk Rating Working Group.

Questions