Reading: Couret.Venter
Model: 2015.Q5
Problem Type: Calculate Multi-Dimensional Credibility

Given An actuary estimated the loss cost for workers compensation insurance using a multi-dimensional credibility method.

Given the following:
- There were 2 classes in Hazard Group X.
- There were no major or minor permanent partial losses.
- Premium information was not available.
- Holdout sample of odd years was used as a proxy of the true mean.

Claim Count by Injury Type for Hazard Group X

	Even Year 1			Even Year 2		
	Fatal (F)	Permanent Total (PT)	Temporary Total (TT)	Fatal (F)	Permanent Total (PT)	Temporary Total (TT)
Class 1	2	10	1,000	1	12	1,000
Class 2	3	10	1,000	2	13	1,000
Total	5	20	2000	3	25	2000

Find

Optimal Weights for Estimation of Permanent Total Injury Ratio

Fatal	Permanent Total
0.2	0.3

a.) Determine the ratio of permanent total injury to temporary total injury for Class 2 using a multi-dimensional credibility method.

b.) Fully describe the steps involved in performing a quintile test to evaluate the actuary's work.

c.) Briefly describe one shortcoming of the individual class sum of squared errors test and briefly describe why the quintiles test is a better way to evaluate the actuary's work.

Solution

a.) Since we're told there are no Major or Minor injuries, we only have F, PT, and TT to work with. This means the equation we need is:

$$E[w_2] = E[W] + b_w * (V_2 - E[V]) + c_w * (W_2 - E[W])$$

Here, we're using V for Fatal claims and W for PT claims. There is no variable for TT because we are calculating relativities to TT claims.
The subscript 2 is used because we want the credibility for class 2 using information about the Hazard Group F and PT claims.

Notice we're given the "optimal weights". This means we're given the credibilities produced by the multi-dimensional credibility technique.
That is, we know $b_w = 0.2$ and $c_w = 0.3$

We calculate E[V] and E[W] using both years of data (told both are <u>even</u> years) from the hazard group, i.e. across all classes in the hazard group.

$$E[V] = \frac{5+3}{2000+2000}$$

$$E[W] = \frac{20+25}{2000+2000}$$

We repeat this to get V_2 and W_2
Where this time we only use the information from class 2 for both years.

$$V_2 = \frac{3+2}{1000+1000}$$

$$W_2 = \frac{10+13}{1000+1000}$$

Substituting all of the above into the first equation gives the answer
$E[w_2] = 0.011425$

b.) Calculate ratios for all classes using the multi-dimensional credibility technique for all classes in the training set.
Rank the classes from smallest to largest by credibility relativity. Group into five quintiles and
calculate the relativity of the quintile ratio to the hazard group ratio for the following 3 predictions:
multi-dimensional credibility process, raw data, hazard group relativity.
Calculate the sum of squared errors for each of the 3 against the holdout data.
The method with the lowest sum of squared errors is the best.

c.) There is too much noise in the individual test. Grouping into quintiles reduces class specific variation
This gives more credible results, allowing us to assess the effectiveness of the credibility method.