CREDIBILITY OF RATES

1. IT IS A MEANS TO PRODUCE FAIRNESS IN PRICING
2. A DYNAMIC CONCEPT AND KEEP PRICING NEAR EXPERIENCE
3. CUSTOMERS AND REGULATORS APPRECIATE
4. IMPORTANT TOOL IN RATE MAKING
5. BECOME SIGNIFICANT IN DE-TARIFFED CONTEXT

BASIC PROBLEMS OF RATE MAKING

- Fixing pure premium based on available data
- Adding adequate but tolerable loading for ensuring security of the Fund
- Loading for Expenses and profits
- Credibility aspects determine what premium is sound and reasonable

WHAT IS CREDIBILITY THEORY ABOUT?

- Rates based on past data is static
- A static Rate is insufficient to be applied in the next exposure
- How reliable is such a Rate – Is there a measure for it
- If not, how to fine tune the emerging rate to make it also dynamic
- These are what Credibility Theory attempts to answer

HOW CREDIBILITY THEORY WORKS –(A)

- THEORY AIDS TO FIX A MEASURE FOR RELIANCE ON RATE BASED ON PAST DATA
- FIXES A CRITERION FOR ASSIGNING FULL CREDIBILITY OR TOTAL RELIANCE
- STATISTICALLY, LARGER THE DATA THE MORE RELIABLE THE STATISTIC DERIVED FROM IT – BUT HOW LARGE IT SHOULD BE? CREDIBILITY THEORY HELPS FIND THIS

HOW CREDIBILITY THEORY WORKS –(B)

- WHAT IF THE DATA SIZE IS SMALLER THAN THE IDEAL FIXED BY THEORY? THE THEORY HELPS ASSIGN A PARTIAL CREDIBILITY MEASURE

- THE SHORTFALL IN CREDIBILITY IS FILLED BY RATE DERIVED FROM COLLATERAL DATA

HOW CREDIBILITY THEORY WORKS – (C)

- CREDIBILITY FACTOR Z TAKES VALUE 1 FOR FULL CREDIBILITY
- PARTIAL CREDIBILITY IS ASSIGNED A VALUE BETWEEN 0 AND 1
- Z MUST BE AN INCREASING FUNCTION WITH EXPSOURE
- BALANCE CREDIBILITY IS TAKEN AS (1-Z) AND ASSIGNED TO RATE DERIVED FROM OTHER SOURCES
- SO, CREDIBILITY BASED RATE =

  Z * (Rate based on Data) + (1-Z) * (Rate based on Collateral Data)

CLASSICAL CREDIBILITY THEORY

- It fixes a basis for the minimum size of experience in hand to assign full credibility
- To arrive at this minimum experience
  - We determine estimates of Mean & SD of risk
  - Choose a Confidence Interval Standard
  - Assume a Normal approximation for the risk
  - Estimate volume of experience required to achieve the chosen Confidence standard under a Normal Distribution

CLASSICAL CREDIBILITY THEORY

- If the experience in hand is the same or larger than the size dictated by theory, we then assign full credibility ie. $Z = 1$

- If not, only a partial credibility is possible

  To determine the partial credibility we apply the square root rule derived from the theory

CLASSICAL CREDIBILITY THEORY

The Square Root Rule

- Let NF denote exposure required for full credibility and NE the actual exposure in hand
- Partial Credibility Z is assigned a value

$$Z = \mathrm{SQRT}\left[NE/NF \right] \text{ where } NE<NF$$

and so $Z < 1$

CLASSICAL CREDIBILITY THEORY

- When assigned Credibility is partial i.e. Z<1, then Credibility rated Risk cost is

Risk Cost = {Experience Risk Cost} x Z

+ {Other Source Risk Cost} x (1-Z)

Here we have to find a suitable other source for an alternative estimate of Risk Cost

BAYESIAN CREDIBILITY ANALYSIS

- We model the risk to conform to a distribution with available data
- We then determine the posterior distribution given the experience by applying Bayesian Statistical Analysis
- For specific sets of distributions we may obtain a experience based Risk Cost as a sum of two terms involving the model and the experience
- Risk Cost = Z x (experience) + (1-Z) x (model)

EMPERICAL BAYESIAN CREDIBILITY THEORIES

- Bayesian Analysis cannot always produce an explicit Posterior
- Empirical Bayesian is an approach to circumvent this problem.
- There are various solutions suggested by researchers and we choose the Bhulmann solution because it is simple and enjoys a large measure of acceptance

BHULMANN CREDIBILITY

- The total experience is applied to estimate the Process Variance (EPV)
- The variance of the Year wise (exposure wise) Means is also determined (VYM)
- Bhulmann Constant K =(EPV)/(VYM)
- We set Z = (VYM)/{(VYM)+(EPV)} and note Z = 1/(1+K)
- When we consider N exposures it can be shown that Z = N /(N +K) and applies to Current Experience based estimate of Risk Cost
- (1-Z) credibility will apply to Previous estimate of Risk Cost so that

New Risk Cost = Z*Current + (1-Z)* Previous

BHULMANN CREDIBILITY

- Since Z's value increases with exposure N the quantity N/(N+K) will tend to 1 but will never attain 1
- This means the relevance of the previous risk cost is always there however small
- We move to new experienced based rates if (1-Z) is significantly small or go by previous risk cost if Z is significantly small

REMARKS ON THE THREE APPROACHES

- Classical is simple easy to apply and be appreciated – but objection is it uses a Normal approx. Confidence interval chosen is also subjective. Collateral data assumed to possess the same risk characteristics
- Bayesian is more rigorous but rarely successful and the choice of a model to suit the analysis is SUBJECTIVE- Analysis Complex to appreciate
- Bhulmann is a compromise approach which is statistically relevant but the resulting statistic is based on assumptions. Easier to explain once the statistics is accepted as sound

WHAT TO CHOOSE?

- Depends on available data and model fitted
- Judgment of the actuary is important
- Whatever method chosen it is necessary to continue with it for the sake of consistency
- When recent data displays too much divergence the method may have to be recast

THANK YOU !