

Paradigm Shifts in General Insurance Actuarial Analysis

Manalur Sandilya
Max Europe Holdings Ltd
Dublin

FOCUS

- FROM CLASS ANALYSIS TO INDIVIDUAL ANALYSIS
- EVOLUTIONARY PACE
- EXTERNAL DRIVERS
- AVAILABILITY OF TECHNOLOGY
- PROCESS HAS PICKED UP MOMENTUM IN THE LAST TWO DECADES

From Class to Individual

- Early Years -- Workers Compensation
- Six major classes of severity
- Multiple classes of exposures
- Longshoremen and Rail workers treated uniquely
- Blue Collar / White Collar
- Can White Collar become more risk prone?

Analytical Methods

- Group Analysis
- Consistent with Insurance Principle of Risk Sharing – Risk Bearing Trade-off
- Development Triangles
- Class Relativities
- Role of Market Conditions
- Role of Regulation

Implications of Methodology

- Focus to obtain robust results
- Stability versus Responsiveness
- Issue of a large number of classes
- Two variable example
- Ill defined Matrix in multiple class situation
- Actuarial Solution?
- Relativities were not changed often; Base Rates were modified more often
- Potential for Anti Selection?

Implications of Methodology

- Similar situations exist in other lines
- Motor
- Homeowners
- Exposure measures
- Commercial General Liability
- Property

DATA Issues

- Centralized Data Collection in the US
- Statistical Agents
- NCCI, ISO, etc.
- Advantages
- European experience -- Data owned by the companies
- Indian Experience?

Market Development (US)

- Bit of digression from the general theme
- Bureau Rates
- Growth of Mutuals
- General Agency System
- Ability to carve out a niche
- Exclusive Agency System
- Induction of Computers

Seminal Articles

- Insurance Rates with Minimum Bias – Bailey
- An Analysis of Excess Loss Development -- Pinto & Gogol
- An Examination of Credibility Concepts – Philbrick
- The Credibility of a Single Private Passenger Driver -- Mahler

Underlying Principles

- Each Individual Risk pays its own Premium
- Collective of Risks meet their combined risk cost
- Implication -- Homogeneous classes
- Reserving -- Best estimate basis

Mathematical underpinnings

- Loss Development method -- fitting of piecewise linear functions -- parameters estimated using a weighted average
- Can be modelled using a Kalman Filter approach
- Bailey procedure to estimate relativities -- issue of ill-defined matrices

External Factors

- Paradigm Shift 1 -- triggered by hurricanes Hugo and Andrew -- model based estimates of loss costs
- Paradigm Shift 2 -- Competitive Factors in the US -- Progressive and Data Mining -- UK/Europe turn to GLM
- Paradigm Shift 3 -- ERM? hopefully we will be able to arrive at a consensus on this issue

Role of Technology

- Availability of Technology was a major factor
- Ability to capture risk characteristics at a low cost
- Ability to analyze data efficiently -- quickly and at a low cost

Analyzing Catastrophes

- Large Loss Method
- Market Share Method
- US GAAP -- Does not allow reserves for potential catastrophes
- Europe GAAP ? Equalization Reserve?
- Seminal article -- Karen Clark (1985?)
- Risk Bearing versus Risk Sharing

Catastrophe Characteristics

- Very low probability but very high severity event
- Impacts not just an individual risk but a portfolio of risks -- failure of the principle of large numbers
- Not insurable?
- Paradigm Shift 1 -- How to insure -- How to price -- How to manage

Analyzing Hurricanes

- Damage Function -- determined from engineering analysis -- Function of wind-speed and construction type
- Exposure Function -- Location -- is address a sufficient statistic?
- Discussion of Hurricane Factors -- Pressure, spin, terrain, etc
- Storm Surge -- physical effect and market effect

Analytical Tools

- Distributions are available (Accuracy?)
- Convolution?
- Simulation
- Details
- Potential for Errors
- Address Field
- Testing for reasonableness

Paradigm SHIFT Consequences

- Combining estimates from different methods
- Combining Loss Ratio/Base Rate/Relativity estimates with a “Pure Premium” estimate
- Territory Factors -- Same Risk will have multiple territories depending on the peril being covered -- Hurricane, Earthquake, Fire, etc., in the case of homeowners

DATA Implications

- GIGO becomes a major issue
- Data Capture
- Increase in the number of fields
- Danger of being overwhelmed by DATA systems beginning to dictate methodology whereas the business model should be driven by actuarial and underwriting analysis

Related Issues

- Other Natural Catastrophes
- Terrorism
- Special Implications for Workers Compensation
- Calculation of Risk Load
- Local Factors
- Choosing Models

Paradigm SHIFT 2 -- Market Forces

- Each Risk pays its appropriate premium versus each class pays the class premium
- Are these two compatible?
- Can they be made compatible
- More and More homogeneous classes
- What about credibility?
- US Market Driver -- Non-Actuarial Pricing
- UK/Europe -- GLM

GLM

- Linear Regression, ARIMA are powerful tools in Statistics
- Surprisingly, did not become popular in actuarial literature for a long time
- Don't Fix if it ain't broke
- Primary reason maybe -- Normal or some similar non-compatible assumptions
- Actuarial distributions are non-normal -- a need to locate a mean and include a tail

Generalizing the Linear Model

- GLM theory bridges this gap
- Linear Regression -- based on minimizing errors in estimates
- GLM -- based on maximizing Likelihood
- Relationship is linear in the predicting parameters
- Recall -- MLE and Minimizing errors lead to the same estimate for normal distribution

Available Distributions

- Can use distributions from the exponential family
- Specifically, we can use Poisson and Gamma
- Build separate Frequency & Severity Models
- Can use Logit type of transformation
- Effectively, we can locate the mean where needed and model a tail

GLM Basics

- Specified by
- Error Structure -- relationship between the mean and the variance
- Link function -- specifies the range of the fitted values
- Functional Form of the Linear Predictor
- The distribution is specified using the mean and variance

GLM Methodology

- Define & Estimate Frequency Function
- Define & Estimate Severity function
- Pure Premium is equated to the Product of frequency and severity
- Include a risk premium
- Issues to be considered -- costs, market, regulation, capital, etc.

Discussions

- Thesis -- Quantification of Collective Risk is primary
- Antithesis -- Quantification of Individual Risk becomes primary -- due to external factors
- Synthesis -- How to fix the dichotomy --

Will this become the new Paradigm for actuarial analysis?