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A HISTORICAL PERSPECTIVE ON THE UNDERWRITING CYCLE
AND A REINSURER PERSPECTIVE ON CYCLE MANAGEMENT

September 20-21, 2010
Dave Clark
Munich Reinsurance America, Inc
Agenda

Industry Reserving for Current Accident Year

Implications on Calendar Year Results

A Mathematical Model for the Cycle

Reserving the Current Accident Year:
All Lines Combined
Reserving the Current Accident Year: All Lines Combined

Carried IBNR as of 24 Months Relative to Earned Premium
Industrywide All Lines of Business

Source: Highline

Reserving the Current Accident Year: All Lines Combined

Carried IBNR as of 36 Months Relative to Earned Premium
Industrywide All Lines of Business

Source: Highline
Reserving the Current Accident Year:
Commercial Multiple Peril (CMP)

Reserving the Current Accident Year:
Workers Compensation
Reserving the Current Accident Year:
Workers Compensation

Carried IBNR as of 24 Months Relative to Earned Premium

Industrywide Workers Compensation

Source: Highline

Reserving the Current Accident Year:
Workers Compensation

Carried IBNR as of 36 Months Relative to Earned Premium

Industrywide Workers Compensation

Source: Highline
Implications for Calendar Year Results

A Mathematical Model of the U/W Cycle

**Assumptions**

- Begin with deterministic steady-state for losses:
  - Each year’s expected loss is \((1+g)\) times the prior year
  - Value is unknown, but not a random variable

- Reserving is always done with a Bornhuetter-Ferguson method using the same permissible loss ratio, say, PLR=65%

- Pricing is done assuming reserving is done correctly
  - Pricing is an average of last three CY losses (adjusted for growth)
A Mathematical Model of the U/W Cycle

Basic Notation:

\[ L_j = \text{expected loss for accident year } j \]
\[ CYIL_j = \text{Booked calendar year } j \text{ incurred loss} \]
\[ g = \text{constant growth rate, such that } L_j = L_{j-1} \cdot (1 + g) \quad \forall j \]
\[ PLR = \text{Permissible Loss Ratio} \]
\[ (\beta_i)_{i=1}^n = \beta_1, \beta_2, \ldots, \beta_n \ldots = \text{Incremental payment pattern by development period } i \]

Such that \( 1 = \sum_{i=1}^{\infty} \beta_i \); and also desirable that \( \beta_i > 0 \quad \forall \ i \)

Bornhuetter-Ferguson Estimate for Current Accident Year:

\[ L_j \cdot \beta_1 + \text{Premium}_j \cdot PLR \cdot (1 - \beta_1) \]

New working paper: "How to Create a Market Cycle"
http://www.casact.org/research/wp/

The premium for a given year is based on the average of the “n” most recent calendar year incurred losses (CYIL).

This definition immediately creates a relationship of calendar year (CY) results as a rolling average of accident year (AY) results.

\[ Prem_j = \frac{1}{n} \cdot \sum_{k=1}^{n} CYIL_{j-k} \cdot (1 + g)^k \]

\[ ProfitAY_j = PLR \cdot Prem_j - L_j \]

\[ ProfitCY_j = PLR \cdot Prem_j - CYIL_j = \sum_{i=1}^{\infty} ProfitAY_{j+1-i} \cdot \beta_i \]
A Mathematical Model of the U/W Cycle

The Calendar Year Incurred Loss (CYIL) can be written in a recursive form as a weighted average of prior calendar year losses.

Technically this is known as a linear difference equation (discrete analogy to a linear differential equation).

Simplified versions of the cycle can also be generated:

\[ CYIL_j - L_j = \frac{1}{n} \sum_{k=1}^{n} \left\{ (CYIL_{j-k} - L_{j-k}) - \sum_{i=1}^{m} (CYIL_{j+1-i-k} - L_{j+1-i-k}) \cdot \beta_i \right\} \cdot (1 + g)^k \]

If \( n=1 \) and \( \beta_2 = 1 \) and \( \beta_i = 0 \) for \( i<>2 \) (all loss paid in 2\(^{nd}\) year):

\[ CYIL_j - L_j = CYIL_{j-1} - CYIL_{j-2} \]

\[ CYIL_j = a \cdot \cos \left( 2\pi \cdot \frac{j}{6} + b \right) \]

where \( a \) and \( b \) are arbitrary constants.
A Mathematical Model of the U/W Cycle

Reserve Change Predicts AY Loss Ratio Change
Conclusions

Underwriting Cycle involves both pricing and reserving

Use of Bornhuetter-Ferguson without changing PLR will perpetuate the cycle

Impact of the cycle means that reinsurance pricing actuary should:

- Select your own Loss Development Factors (LDFs) and ultimate losses by historical period
- Do not assume that recent Calendar Year results reflect current level of rate adequacy
- Compare company rate monitors versus other benchmarks