Performance Testing: Are you using the best reserving methods?

Today’s agenda

• Benefits of performance testing
• Defining the problem
• Performance testing — in general and in the context of reserves
• Embedding the reserving control cycle
• Case studies
• Conclusion

• This presentation is based on the paper “Loss Reserving: Performance Testing and the Control Cycle”, authored by Yi Jing, Joseph Lebens, and Stephen Lowe, that was published in Variance. It is available at www.variancejournal.org
What do we mean by the best reserving methods?

Whatever method gets you closer to the actual outcome, on average, over time

Benefits of Performance Testing

- Risk quantification
- More accurate best estimate reserves and therefore pricing
- Capital utilisation
- Increased Return on capital
- Helping you to manage your risk, capital and return
How will you answer Article 47 of the Solvency II Directive: Actuarial Function and reserving?

1. Insurance and reinsurance undertakings shall provide for an effective actuarial function to undertake the following:
   a) to coordinate the calculation of technical provisions;
   b) to ensure the appropriateness of the methodologies and underlying models used as well as the assumptions made in the calculation of technical provisions;
   c) to assess the sufficiency and quality of the data used in the calculation of technical provisions;
   d) to compare best estimates against experience;
   e) to inform the administrative or management body of the reliability and adequacy of the calculation of technical provisions;
   f) to oversee the calculation of technical provisions in the cases set out in Article 81;
   g) to express an opinion on the overall underwriting policy;
   h) to express an opinion on the adequacy of reinsurance arrangements;
   i) to contribute to the effective implementation of the risk management system referred to in Article 43, in particular with respect to the risk modelling underlying the calculation of the capital requirements set out in Chapter VI, Sections 4 and 5 and the assessment referred to in Article 44.

Questions for the Reserving Actuary

- How do you know that the methods you are currently using are the “best”?
  - What evidence supports your selection of methods?
  - What are the optimal weights for combining the results of the methods?
  - How do you decide when to change methods?
  - What is the confidence range around estimates?
  - Cost/benefit of developing new data sources or implementing more complex methods?
  - How do you manage over-confidence?
The results of our research illustrate the prevalence of overconfidence

Tillinghast Confidence Quiz

The Quiz

- Objective: To test respondents understanding of the limits of their knowledge
- Respondents were asked to answer ten questions related to their general knowledge of the global property/casualty industry
- For each answer, respondents were asked to provide a range that offered a 90% confidence interval that they would answer correctly
- Ideally (i.e., if “well calibrated”), respondents should have gotten nine out of ten questions correct

Raw Scores of Respondents

<table>
<thead>
<tr>
<th>Number of Respondents</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Respondents</td>
<td>29</td>
<td>67</td>
<td>56</td>
<td>69</td>
<td>44</td>
<td>44</td>
<td>28</td>
<td>18</td>
<td>12</td>
<td>7</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: based on 374 respondents as of 4/5/04.
Profile of respondents: 86% work in P/C industry; 73% are actuaries.

Using Performance Testing to improve results

An actuarial method consists of
- An algorithm
- A data set
- A set of intervention points

Without Performance Testing
Choose a combination of methods using ‘actuarial judgment’

Result: Subjective best estimate

With Performance Testing
Choose a combination of methods that optimises the formal measure of ‘skill’ in a rigorous manner

Result: More accurate best estimate; validated
The Approach

Hindsight Review over historical time period

Compare 'what if' predictions with actual run-off

Estimate skill level by method or component of method

Estimate optimal combination of methods

Recommend Method given constraints

Constraints and considerations
• IT
• Data
• Tools etc.

Background to company data used in paper

• Commercial Auto BI Liability with heavy environmental influences that add difficulty to estimation
  – Economic and social inflation
  – Operational changes in claim department
  – Changes in underwriting posture
Performance testing is a formal analysis of prediction errors

- Test a particular method by looking at historical performance – comparing estimates from the method with actual run-off
- Giving us insights into the most accurate method to use

Performance testing yields a formal measure of skill

- The skill of a method is measured by:
  - $mse = \text{mean squared error}$
  - $msa = \text{mean squared anomaly}$
- Skill is the proportion of variance “explained” by the method
Actuarial methods subjected to performance testing

<table>
<thead>
<tr>
<th>Actuarial Projection Method</th>
<th>Skill for Accident Year @ 42 Months</th>
<th>Overall Skill – for Latest Ten Accident Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paid Chain-Ladder</td>
<td>23%</td>
<td>13%</td>
</tr>
<tr>
<td>Incurred Chain-Ladder</td>
<td>52%</td>
<td>32%</td>
</tr>
<tr>
<td>Case Reserve Development</td>
<td>60%</td>
<td>22%</td>
</tr>
<tr>
<td>Reported Count Chain-Ladder</td>
<td>99%</td>
<td>99%</td>
</tr>
<tr>
<td>Case Adequacy Adjusted Incurred Chain-Ladder</td>
<td>52%</td>
<td>52%</td>
</tr>
</tbody>
</table>

- Note that absolute level of skill results are low due to changing case reserve adequacy and claim settlement patterns

Case Study 1 - UK Private Motor: Median Skill scores by method and maturity

Median Skill by Maturity
Case Study 1 - Distribution of Skill Scores by company

Skill Ranges for Incurred Chainladder Method

-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
12 24 36 48 60 72 84 96 108
Maturity (Months)

Case Study 1 - Company D Skill scores by method and maturity

Skill by Maturity

Paid CL
Inc CL
Case OS
Ave. Actual Unpaid Claims

Maturity (months)
Case study 2 - Empirical hindsight performance test data indicates that Mack may understate reserve risk

- Sample of 20 lines of business, “more difficult” US casualty lines
- Experience over a 15-20 year period
  - Historical best estimate reserve errors
- Mack based on most recent development triangle
  - includes parameter risk and tail factor volatility

Overview of structural stochastic claim liability simulation model

- Step 1: Remove systematic risk using historical data
- Step 2: Measure non-systematic risk from normalized data
- Step 3: Simulate future non-systematic risk
- Step 4: Overlay simulated future systematic risk
Validation results of the structural model look good!

- One can also validate the one-year model, by comparing the risk distribution generated by the model to historical one-year changes in estimates.

Validation can be performed by maturity

- Estimates of individual accident years at each maturity, expressed as a ratio to ultimate
- Collectively the historical data generates an empirical funnel of doubt
- The model’s funnel should encompass most of the empirical
Case study 3 - Installing performance testing and a control cycle

- Corporate Actuary responsible for reserves set by decentralized organization of actuaries within each business unit
- Standard templates and database used to capture quarterly projections on an ongoing basis
- Actuaries review performance test results prior to each quarterly reserve-setting exercise; perform more detailed analysis annually

Embedding Performance Testing into Business Operations

The Actuarial Control Cycle for the Reserving Process
- Embedding Reserve Risk Management

Formal Performance Testing
- Are the current methods appropriate? Would changes to methods improve estimation skill?
- Are the data and other input accurate and sufficient? Would improvements or expansion of data improve estimation skill?
- Are there opportunities to improve process flow?
- Are emerging estimation errors within tolerance?

Reserving Process Elements
- Data used
- Actuarial methods employed
- Operational input
- Judgments and intervention points
- Process flow and timeline
- Quality assurance process

Ensuring the reserving approach is continually monitored and adapted as required
The best place to start is with a pilot project

- Test a few lines of business to gain some initial learnings
  - Lines where there is a ready data history
  - Cross-section of lines with varying degrees of difficulty
  - Test current methods and new methods
    - Stochastic methods versus traditional
    - Man versus machine
- Use learnings to educate staff and demonstrate value
- Develop plan for further implementation

Benefits of Performance Testing

- Supports Solvency II
  - Formal validation of best estimates and ranges
- Embeds reserving control cycle
  - Improve accuracy of estimates
    - Inflation risk
    - Reserving cycle
  - Manage over-confidence
  - Cost / benefit of enhancements to data and systems
Discussion

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