The Actuarial Profession
making financial sense of the future

Estimating and Communicating Reserving Uncertainty
4th Younger Members Convention

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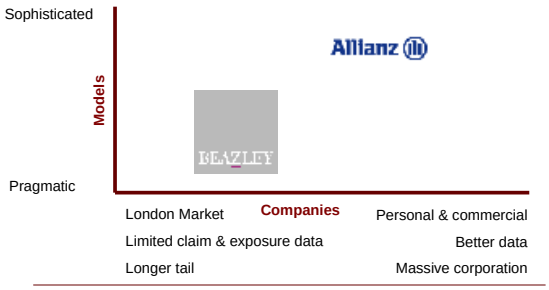
Agenda

- Section 1: Working party findings
- Section 2: Models in Allianz
- Section 3: Beazley – useful models?

Section 1: What did we learn?

- "Reasonable" actuaries come up with variable results - wider than would be expected even allowing for blind reserving conditions
- Wide range of results from different methods/models
- Range still wide even when same method/model used
- No "correct" method/model apparent

Approach vs. needs



Why measure reserve uncertainty?

Increasingly, we are being asked to quantify:

- a range of reasonable best estimates
- a range of reasonable outcomes around the actuarial best estimate
- what confidence level the held reserve is compared to the actuarial best estimate
- how likely future payments will be X% higher than the held reserve

Why measure reserve uncertainty?

In part, these questions are the result of new regulations and accounting rules, such as:

- ICA
- Solvency II
- IFRS
- Sarbanes Oxley, Morris, etc.

Reserving uncertainty

Reserving is about forecasting unpaid claims:

- The variability of a forecast includes the estimation variance and the process variance:

prediction error = (process variance + estimation variance)$^{1/2}$

- However, what we are really interested in is a predictive distribution of outstanding claims (ultimate claims and the associated cash flows)

A simple example

- Data sample Y = {3,8,5,9,5,8,4,8,7,3}
- Expected value = 6
- What is the best estimate of a new forecast value?
- What is the prediction error of a new forecast value?
- What is the predictive distribution of a new forecast value?

Analytic Solution

- Random variable is Poisson distributed

standard error $= \frac{\sigma}{\sqrt{n}}$

process variance = μ

prediction error of forecast $= \left(\mu + \frac{\sigma^2}{n}\right)^{1/2}$

Parameter Uncertainty (Bootstrapping)

- Simple method to obtain a distribution of parameters
- Many new data sets are created by sampling with replacement from the observed data
- Result is a “simulated” distribution of parameters

Parameter Uncertainty (Bootstrapping)

	Observed Data										Mean
	3	8	5	9	5	8	4	8	7	3	6

	Bootstrap Samples										Mean
1	8	5	3	7	9	3	3	5	9	7	5.9
2	3	3	9	5	8	8	8	3	5	5	5.7
3	8	3	8	7	9	4	9	5	7	8	6.8
4	4	5	5	3	8	9	3	3	7	3	5.0
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.	.	.	.	.	.	.	.	.	.	.	.
10,000	4	9	8	3	5	8	4	4	8	8	6.1
										Bootstrap standard error	0.68

Predictive Distribution

Assuming Poisson process

	Observed Data										Mean
	3	8	5	9	5	8	4	8	7	3	6

	Bootstrap Samples										Mean	Simulated Forecast
1	8	5	3	7	9	3	3	5	9	7	5.9	7
2	3	3	9	5	8	8	8	3	5	5	5.7	4
3	8	3	8	7	9	4	9	5	7	8	6.8	7
4	4	5	5	3	8	9	3	3	7	3	5.0	10
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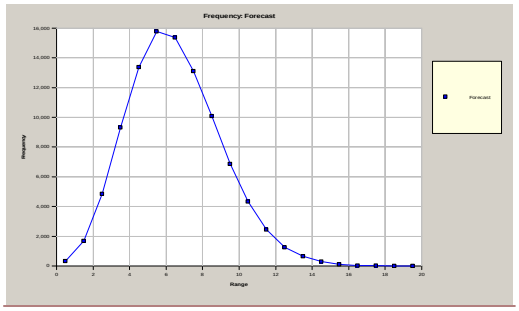
10,000	4	9	8	3	5	8	4	4	8	8	6.1	4
										Bootstrap standard error	0.68	2.54 Prediction error

Predictive Distribution



Stochastic Reserving and Bootstrapping

- Define and fit statistical model
  - Overdispersed Poisson Model
  - Mack
  - or any other model than can be clearly defined
- Obtain residuals and pseudo data
- Refit statistical model to pseudo data
- Obtain forecast

Bootstrapping the Chain Ladder (ODP)

- Fit chain ladder model
- Obtain Pearson residuals $r_{P} = \frac{C - \mu}{\sqrt{\mu}}$
- Resample residuals
- Obtain pseudo data $C^{*} = r_{P}^{*}\sqrt{\mu} + \mu$
- Use chain ladder to re-fit model, and estimate future incremental payments

Bootstrapping the Chain Ladder (ODP)

- Simulate observation from process distribution assuming mean is incremental value obtained at Step 5
- Repeat many times, storing the reserve estimates
- Prediction error is then standard deviation of results

What is being modelled?

- For a given model and for a given data set:
  - uncertainty in a forecast around an assumed development pattern due to observed historic variability taking account of
    - parameter risk
    - process risk
  - assuming
    - development pattern is the same for all origin periods
    - origin periods are independent

What is not being modelled?

- Model risk
  - if the underlying model is wrong, the results will be wrong
- Risks that do not appear in the data
- Other risks
  - some operational risks
  - regulatory risk
  - future changes in legislation
  - etc.

Use of Models at Allianz

- Additional Management Information
- Preparation for Solvency II and IFRS Phase II
- Internal Risk Capital Assessment (not yet fully implemented)
- Additional Insight into Traditional Reserving Process

Section 3: Beazley – useful models?

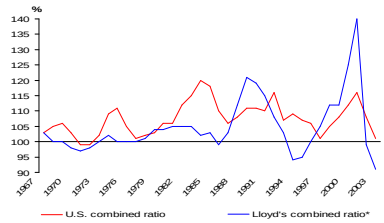
Beazley's objectives

- Business planning – Efficient capital use
  - Capital cost over lifetime of policy
  - Risk adjusted returns on capital
- Reserve setting – Prudential risk margins
  - Is the level of prudence in our reserves changing?

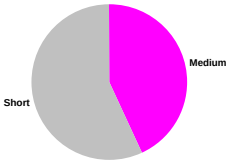
Section 3: Beazley Background

Market cycles

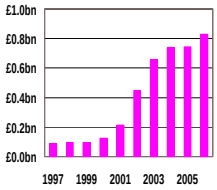
- Are London Market swings more severe?



Section 3: Beazley Background



Tail Length

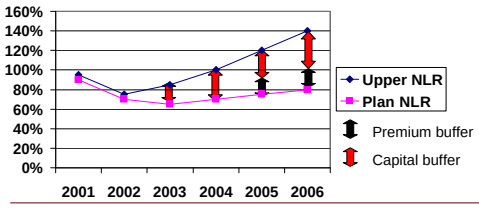


Stamp growth

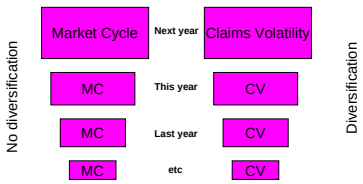
Section 3: Review objectives

We need to produce the following chart

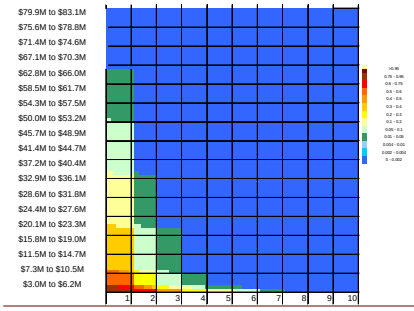
- By class and team for interest
- Company level is key



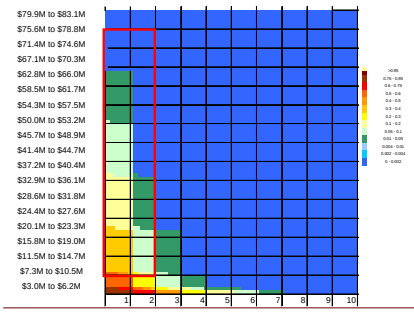
Section 3: Beazley approach



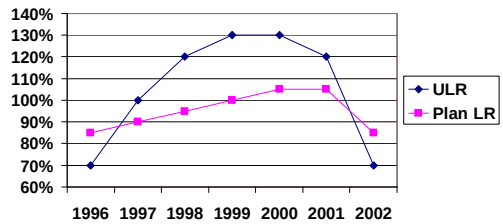
Section 3: Claims volatility



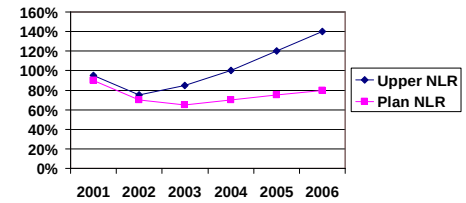
Section 3: Claims volatility



Section 3: Market cycle



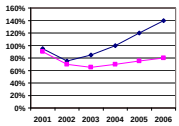
Section 3: Risk reduction



Incurred as % Ultimate	95%	85%	50%	40%	20%	0%

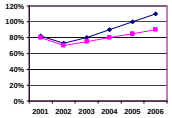
Section 3: Combination (e.g. 2006)

Class 1



Prem $100m
Div 40% - $40m
UnDiv 20% - $20m

Class 2



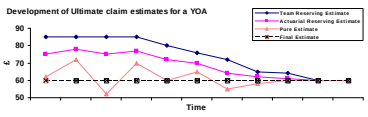
Prem $200m
Div 5% - $10m
UnDiv 10% - $20m

Total
Prem $300m
Div 15% - $45m
UnDiv 13% - $40m

Section 3: Uses - Reserve strength

Example of the range of possible outcomes for one class and year

- 100: ICA level (eg 140% ULR)
- 61: Team Reserving Estimate (eg 85% ULR)
- 57: Actuarial Reserving Estimate (eg 80% ULR)
- 50: Pure Estimate (eg 70% ULR)



Gives a reserve strength index over time

Questions?