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ROC Reserving Uncertainty Working Party

GIRO 2008

Neil Bruce and Ian Hinder

Agenda

- UK practice
- Errors in stochastic reserving predictors
- Use of Bayesian methods
- Extensions to ODP method
- Experience in other parts of the world

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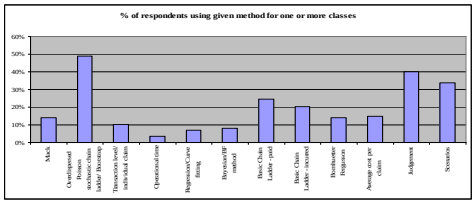
UK practice

- Largely reliant on Bootstrapping techniques and Mack



ROC Best estimates and reserving uncertainty working party (GIRO 2007)

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UK practice (cont.)

- Various models used
  - Quantitative and qualitative
  - Different “flavours” of common methods
- Judgement and scenario testing common
- Use of benchmarks via ICA process
- Limitations of data sets
  - Size
  - Ability to satisfy methods’ assumptions
- Difficult to easily allow for reinsurance
  - Exhaustion
  - Commutations
  - Changing retentions etc

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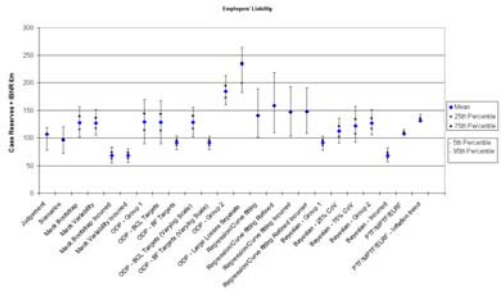
Model error



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What do the experts say?

- Various papers have considered the issue of the predictive powers of stochastic methods
- Size of errors likely to vary depending on the nature of the business being modelled
- Errors likely to be larger for non-perfect data
  - Not necessarily!
- May need to consider different models that reduce potential risk of “overfitting”
  - Bayesian as opposed to MLE based models
- No panacea

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Errors with perfect data

- Tested predictive power of various models using data generated to exactly match assumptions
- Consistent under-estimation of higher percentiles
- Effect remains when size of data triangle increases
- No consistent “scaling factor” to adjust results

Table 9.4.1 Proportion of simulations in which 'true' outcome exceeded 99th percentile

Mack 1993 (with Log-Normal)	8% to 13%
Analytic ODP (Renshaw & Verrall, 1998), Pearson dispersion	2.6%
Analytic ODP (Renshaw & Verrall, 1998), deviance dispersion	2.7%
Bootstrap ODP (England & Verrall, 1999)	3.1%
Bootstrap ODP (England 2001)	2.6%
Operational time (Wright 1992), Pearson dispersion	4.0%

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Errors with perfect data – new results

- Mack error reduces with increasing triangle size, although it doesn’t disappear entirely
- ODP bootstrap method:
  - Increasing simulations for bootstrap doesn’t fundamentally change the results
  - Reduced volatility of claims improves accuracy
  - Reducing development tail increases error
  - Increasing size of triangle (and proportionate increase in tail) improves accuracy
  - Key points are that greater statistical stability of claims and smaller development steps provides better modelling
- Combining the Mack and ODP methods produces at least as good results as either, and generally improves estimation of higher percentiles

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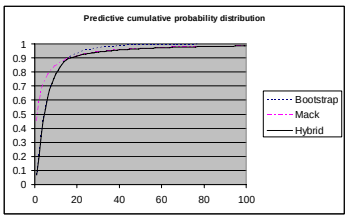
Hybrid method

- Take the most extreme of the ODP and Mack percentiles when selecting the overall distribution



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Hybrid method results

Comparison to ODP and Mack

	Standard algorithm			More stable triangles			Shorter development pattern		
	ODP	Mack	**Hybrid**	ODP	Mack	**Hybrid**	ODP	Mack	**Hybrid**
1%	2.6%	1.4%	**1.3%**	1.1%	1.1%	**0.9%**	4.3%	1.6%	**1.6%**
5%	8.3%	6.8%	**6.1%**	5.1%	5.6%	**4.7%**	11.3%	6.9%	**6.8%**
10%	14.3%	13.1%	**11.8%**	10.7%	11.5%	**10.2%**	17.8%	14.1%	**14.0%**
20%	24.8%	27.2%	**23.8%**	21.6%	22.9%	**21.1%**	28.3%	26.9%	**26.6%**

Increased triangle size

	Bootstrap		Mack		**Hybrid**	
Size	15	20	15	20	**15**	**20**
1%	3.1%	2.9%	1.0%	0.9%	**1.0%**	**0.9%**
5%	9.8%	10.5%	6.0%	5.1%	**5.9%**	**5.1%**
10%	17.2%	17.9%	12.6%	11.5%	**12.4%**	**11.4%**
20%	28.9%	30.4%	26.2%	25.8%	**25.9%**	**25.6%**

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Hybrid method - summary

- Potential for overstating extreme percentiles
- Generally better results than either “pure” method
- Follows similar level of error to that seen by individual methods – no drastic improvements, but does tend to reduce model error by selecting against results that are particularly poor
- May not be “complete” solution, but shows a potential way forward

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Bayesian methods

- MLE methods determine a single (stochastic) model to estimate reserve uncertainty
- Bayesian methods introduce a range of potential parameter sets for a given model structure
- Each parameter set is assigned a weight based on the likelihood that it is the “true” underlying model that gives rise to the observed data
- The overall uncertainty is derived from a weighted average of the results of all parameter sets included in the analysis
- This reduces the parameter/model error within the reserve range analysis compared to using a single parameter set

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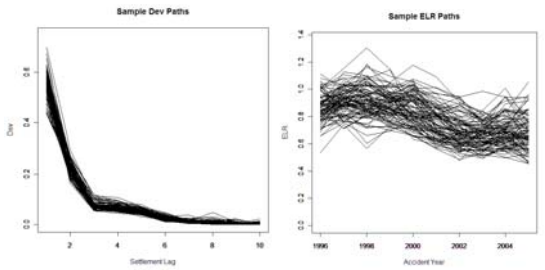
Bayesian methods - illustration



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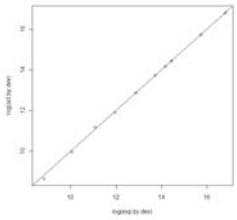
Bayesian methods – results

- MLE methods are accurate for estimating “best-estimate”
- Actual v expected future losses over the next period for each development lag for all insurers combined



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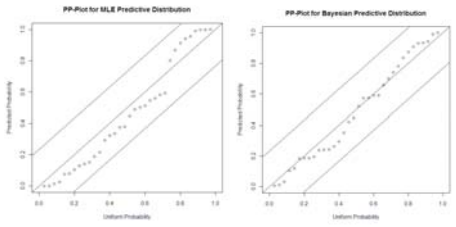
Bayesian methods - results



Bayesian results show a pattern that is closer to the diagonal, and hence a better fit

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Bayesian methods - summary

- FSA data for motor insurers was used to predict the leading diagonal of incurred data for 34 insurers using the rest of the triangle
- MLE methods produced results that were characteristic of over-fitting and understating the extremities of the distribution
- Bayesian methods gave a better fit to observed data
- The limited sample size makes definite conclusions difficult, but in conjunction with other, similar, studies the results imply that Bayesian methods can help overcome some of the problems associated with MLE methods
- Methodology partially allows for parameter uncertainty

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Other results - ODP

- We looked at modifications to the ODP method:
  - Using a variable scale parameter;
  - Moving beyond the Basic Chain Ladder: curve fitting and tail estimation;
  - Dealing with negative development factors
- All results were calculated on the EL dataset used in last years WP results
- Results show that these modifications can have a significant impact on the variability predicted, generally reducing the estimated reserve ranges produced.

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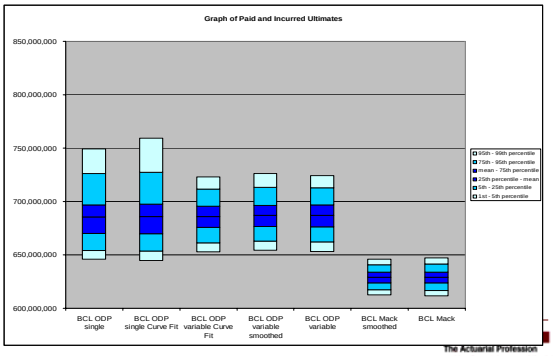
ODP variations



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Other results – Transactional methods

- We also investigated methods that rely on transactional data
- These showed smaller CoV than aggregate methods on the data set we used, but a much higher mean
- Various adjustments can be factored into these models, which may make them important in the evaluation of stress testing assumptions such as correlations and variation of claim size over development period
- They also have potential use in modelling larger and more volatile claims separately, although recombining these with the rest of the portfolio may be difficult

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Other jurisdictions (1)

- Australia
  - Previously large reliance on 1-2 papers (Tillinghast/ Trowbridge, 2001)
  - Currently undergoing revisit of standard practice
  - Area of interest more around the 75th percentile, but not entirely
  - More flexible use of bootstrapping on any methods
    - Ultimate claims (Hindsight re-estimate)
    - Reserving methods
  - Many papers and discussions arising from this process
- US
  - Forum in 2005 & 2008 (Casualty Loss Reserve Forum, 18 Sept 2008)
  - CAS working party formed
  - New journal (Variance)
- IAA
  - Risk margin group – new paper (not purely GI focussed)

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Other jurisdictions (2)

- Germany
  - Current reserving practices are prudent compared to the Solvency II and IFRS II bases
  - There is currently no requirement for actuaries to quantify the uncertainty in the reserves. Often external consultants will give a "range of reasonable best estimates"
  - Larger firms typically use similar methods for assessing reserve uncertainty as those used in the UK (Mack / Bootstrap). Small companies often do not analysis reserve uncertainty
- Switzerland
  - Reserve uncertainty is considered as part of the Swiss Solvency Test (SST) calculation.
  - SST has a one year time horizon so reserve uncertainty needs to be considered over this time period
  - Current investigations include how to parameterise one year volatilities when most statistical methods tend to estimate uncertainty to ultimate

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Papers to read

- GI ROC Best estimates and Reserving uncertainty, GIRO (2007 & 2008)
- The Analysis and Estimation of Loss & ALAE Variability: A Summary Report, CAS Forum (2005)
- Thinking Outside the Triangle, Glenn Meyers ASTIN (2007)
- Beginners guide from Prof. Verrall's Cass lectures:
  - https://talk.city.ac.uk/stochasticreserving
- Glenn's talk tomorrow (D7)

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Discussion

- Current and intended future methodology used for your own purposes
- Promising areas of research
- Potential future GIRO work

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