SOA Model Efficiency Study Results

Bruce Rosner

28 June 2012

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Quality In Everything We Do

SOA Model Efficiency Study

Participating Companies:

Allstate Financial	ING
Ameriprise Financial	Lincoln
Assurity	MetLife
Aviva	Milliman
Commonwealth	Nationwide
Horace Mann	Sun Life

Overview of techniques

Technique	Description
A. Transfer Scenario Order	Determine the ranking of scenarios based on the ranking from running a subset of policies
B. Representative Scenarios	Select a subset of scenarios that are “representative” of the full scenario set based on certain characteristics of the scenarios
C. Replicating Liabilities	Use optimization to determine a reduced scaled subset of policies that will have similar characteristics to the full inforce
D. Curve Fitting	Determine an underlying distribution that fits well to the measured distribution of a variable, and report with the underlying distribution
E. Cluster Modeling	Mathematically locate policies whose results are “close” and combine them to produce a reduced scaled subset of policies that will have similar characteristics to the full inforce
F. Importance Sampling	Sample more scenarios in parts of the distribution that are more critical to the result, and subject those scenarios to reduced weight

Transfer scenario order

- Determine the ranking of scenarios based on the ranking of a subset of policies from the inforce
- Can be adjusted by (a) Changing the size of the subset used for the initial run, (b) Running more scenarios in the final run
- Study includes three companies testing AG43
- Tests ranged from 300 – 500 scenarios in the final run

Transfer scenario order results

	Error	Scenarios Captured	Compression
Company A	0.00%	100%	51%
Company B	0.00%	100%	51%
Company C, Block 1	-0.43%	91%	51%
Company C, Block 2	-3.80%	65%	51%

- Definition of error
- Definition of compression

Transfer scenario order summary

- The technique is easy to understand, easy to apply and easy to audit.
- Unlike most scenario reduction techniques, this technique should theoretically be more powerful under a CTE90 metric than a CTE70 metric.
- This technique is clearly limited to tail metrics.
- Bias toward reserve understatement can be an issue.

Representative scenarios

Four variations of this technique were tested:

- Significance Method
  - Calculate the following for each scenario: $\sqrt{\sum PV01_t^{\,2}}$
  - Order the scenarios
  - Select every n^{th} scenario
- Modified Euclidean Distance Method
- Relative Present Value Distance Method
- Scenario Cluster Modeling

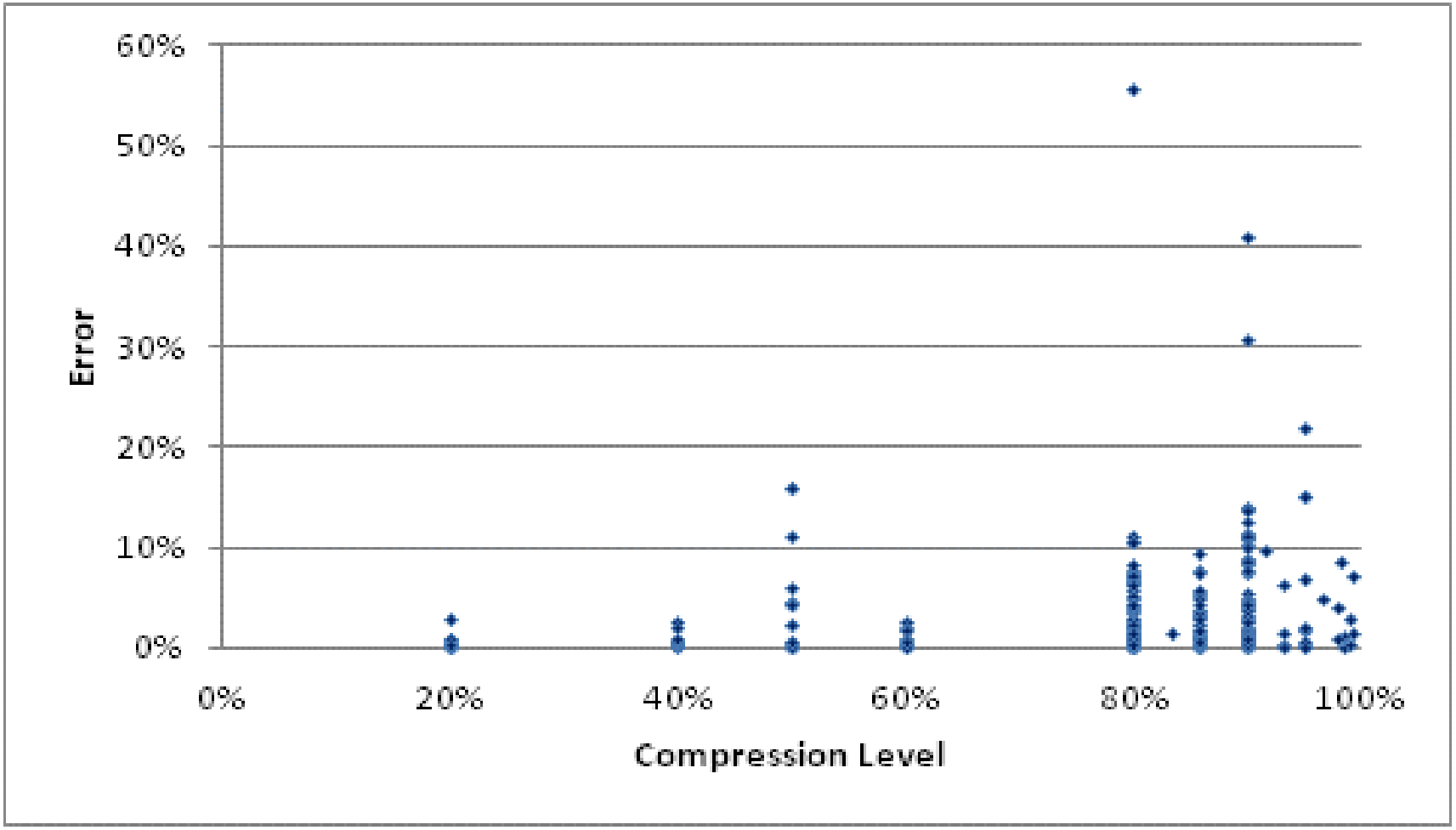
Two companies tested AG43 and three companies tested various metrics based on the mean of the results.

Representative scenarios results

	Metric	Product	Variation	Error	Compression
Block A	Mean	Indexed UL, NLG	Significance	0.9%	58%
Block B	CTE70	VA	Cluster Modeling	1.1%	79%
Block C	Mean	Indexed UL	Significance	1.3%	58%
Block D	Mean	EIA	Significance	2.0%	58%
Block E	Mean	VA	Significance	2.4%	91%
Block F	Mean	VA	Significance	3.3%	85%
Block G	Mean	VA	Significance	5.3%	93%
Block H	CTE70	VA	Cluster Modeling	10.7%	79%
Block I	CTE70	VA	Various	11.8%	73%

(cont.)

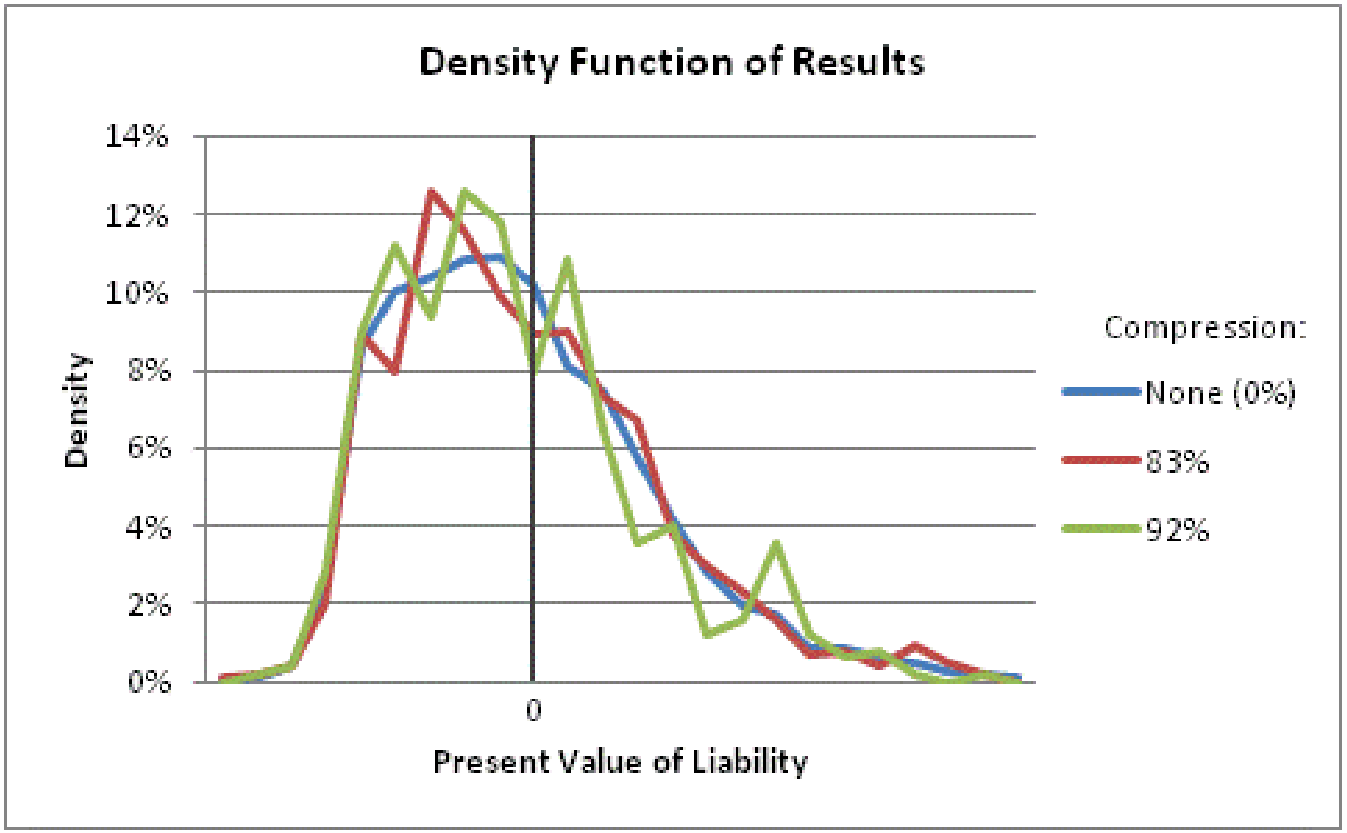
Representative scenarios results (cont.)



(cont.)

Representative scenarios results (cont.)

One company provided us with a full distribution of results for the base run and the reduced runs using the Significance Method:



Representative scenarios summary

- Two companies noted that the technique appears to give better results for the mean of the distribution.
- The Significance Method is easy to understand, and easy to use.
- In the full distribution of results provided by one company using the Significance Method, there was no bias observed.
- This technique can be applied using a wide range of reduction levels based on the need for accuracy. Higher reduction can potentially be used for sensitivity testing.
- This technique does not require the company to generate additional scenarios
- The scope of the testing was very limited for everything except the Significance method, and we encourage companies to test the other three variations further.

Replicating liabilities

- Use optimization to determine a reduced subset of policies that will have similar characteristics to the full inforce.
- Constraints can be based on certain fields from the inforce file or results from prior runs.
- Three companies tested this technique on a variety of metrics.

Replicating liabilities results

	Metric	Product	Error	Compression
Company A	CTE70	VA	1%	97%
Company A	CTE90	VA	1%	97%
Company A	Mean	VA	1%	96%
Company B	CTE70	VA	5%	97%
Company B	CTE90	VA	5%	97%
Company C	Mean	ISL	9%	99%

Replicating liabilities summary

- This technique produced results with errors ranging from 1% - 9% at extremely high levels of compression, depending on the block of business.
- The calculated errors did not vary by metric for results from companies that measured various metrics.
- Participating companies noted that while the setup time was relatively large, once they were over the learning curve, it is easy to modify and rerun the technique.

(cont.)

Replicating liabilities summary (cont.)

- It will take some effort to get management comfortable with producing results based on such a small set of policies.
- Replicating liabilities is inherently an all-or-nothing approach, and tends to produce extremely high levels of compression that may or may not meet the user's standards for accuracy.
- As with all compression techniques, it is necessary to be aware of the potential for differences due to bias.

Summary of results

Technique	Initial Effort Required	Runtime Reduction Experienced	Limitations Experienced
A. Transfer Scenario Order	Low	Low	Only useful for tail metrics
B. Representative Scenarios	Moderate	Moderate	More useful for the mean; limited by accuracy of baseline scenarios
C. Replicating Liabilities	High	High	Bias is a concern for all compression techniques
D. Curve Fitting	High	Unknown	More useful for tail metrics; bias is a significant concern
E. Cluster Modeling	High	High	Bias is a concern for all compression techniques
F. Importance Sampling	Moderate	Moderate (subject to limitations)	More useful for out-of-the-money options

Measuring accuracy

- Obstacles to measurement include:
  - Inadequate sample size
  - Results with a mean close to zero
  - How to define the tolerance for error
  - Accuracy of baseline run

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