Modeling Efficiency Work Group
Survey Report - November 2007

The Modeling Efficiency Work Group was organized in May 2007, as a subgroup of the American Academy of Actuaries[1]' Life Financial Soundness/Risk Management Committee. It is recognized that some of the calculations envisioned by a principles-based approach to the determination of reserves and capital can be onerous. The purpose of the Modeling Efficiency Working Group is to examine ways in which these calculations can be made more manageable.

A survey of U.S. life insurers was undertaken in November 2007 to assess the current model efficiency practices that are in use today. The survey addressed these aspects of model structure and techniques.

- Scenario Design
- Mathematical or Model Design
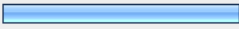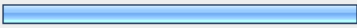- Model Data Design
- Hardware Design
- Software Design

The following report provides a summary of the responses from 30 companies for each of the five survey questions. Additional commentary about the model efficiencies in use by the respondents is included in each section. The Academy did not obtain any business proprietary or confidential information in obtaining the survey responses. The Appendix provides a list of the participating companies in this survey.

(Note: The tables show 32 responses versus an actual participating company count of 30. This was created by two respondents that opened the survey but did not complete it.)
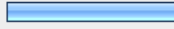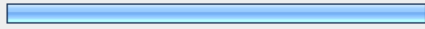
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1. Do you use Scenario Design? Here we consider how we choose or design our scenarios so as to minimize the total number of scenarios required in stochastic runs. For example, instead of using 1,000 scenarios for a model run, there may be a way to reduce this to say 100 scenarios whilst keeping the error of the metric we are looking to generate within an acceptable level of risk.		Response Percent	Response Count
Yes		40.0%	12
No		60.0%	18
Comments and techniques used, for what purpose (e.g., economic capital), and how satisfied you are. view			14
		answered question	30
		skipped question	2

Companies have used various approaches to become more effective with stochastic scenario modeling for their C3 Phase II and cash flow testing applications. The AAA sampling tool and documentation is widely used to limit the number of modeled scenarios. Additionally, other scenario design techniques used by companies include:

- For C3 Phase II RBC results, the worst 200 scenarios are captured for sensitivity testing while the complete 1,000 scenarios are used for the actual reported result.
- Chueh's scenario reduction method and other distance algorithms have been used for analysis purposes and to perform likelihood assessments on scenarios.
- One company has achieved good results with the process developed by Jeff Leitz using low discrepancy sequences to stratify interest rate scenarios.
- Another company uses parameter renormalization for risk-neutral scenarios. This process adjusts the random numbers generated so that the sample statistics exactly match the underlying distribution.
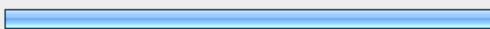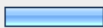
2. Do you use Mathematical and/or Model Design? Here we look at how to design a model so as to reduce calculations and/or the time to conduct these calculations. For example, instead of having to generate nested scenarios at each future point in time, we may be able to use a closed form mathematical solution.		Response Percent	Response Count
Yes		28.6%	8
No		71.4%	20
Comments and techniques used, for what purpose (e.g., economic capital), and how satisfied you are. view			9
		answered question	28
		skipped question	4

Mathematical and Model Design approaches to limit calculation time have been pursued while the results for a specific company will depend on the model platform. Examples of these design approaches include:

- In the application of C3 Phase II modeling, one company developed a single weighted average of eight return paths according to the distribution of funds greatly reducing the processing time under their APL platform. Validation was necessary to ensure the single path produced equal or greater claims than the eight separate paths.
- Various algorithms are used to project asset cash flows (especially derivatives) outside the core modeling platform and feed them to the model via externally projected asset files.
- Black Scholes is used for the pricing of closed form equity calls and put options.
- Attention begins early in the process where coding and calculation order is highly recognized in model development
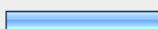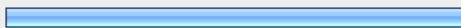
3. Do you use Model Data Design? Here we consider how to group or cluster data to reduce the number of model points required to be processed within an actuarial model. This covers concepts such as grouping contracts by issue age, duration or by contract features. Or another alternative is to use cluster analysis and survey analysis to determine an optimal sub-population of contracts that represent the overall population.	Response Percent	Response Count
Yes	83.3%	25
No	16.7%	5
Comments on techniques used, for what purpose (e.g., economic capital), and how satisfied you are. 🗩 view		20
answered question		30
skipped question		2

Most companies use traditional liability grouping techniques based on issue age, duration, like plans & features, UW class, etc. in the design of their models. Other considerations that have been recognized in model data design include:

- The level of grouping may differ by model use and purpose.
- Stratification by model point – For example, stratifying by issue date could be accomplished by creating one model point to reflect monthly issues, one model point quarterly issues and another, only annual issues. The issue distribution is not correct for each model point, but is representative across all model points.
- Recognize each product's characteristics when establishing model point criteria. For example, an older vanilla VA may need far fewer model points than a recent product with multiple guaranteed benefits.
- Asset grouping has not been actively pursued.

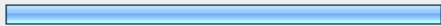| 4. Do you use Hardware Design? Here we consider how software is implemented on specific hardware. If one has a good knowledge of the hardware or software to hardware interface (the firmware), one may do small enhancements either to the hardware settings or the software settings and dramatically improve the run time. For example, if one formats the hard drive that is used to collect the data such that the swap space (this is the area of the hard drive that takes the contents of the CPU and moves it back and forth between the hard drive and the CPU to process different tasks) is in the center of the hard drive, the time it takes to move data in and out is reduced because the average travel time of the write heads to read and write data is reduced.	Response Percent	Response Count
Yes	25.9%	7
No	77.8%	21
Comments on techniques used, for what purpose (e.g., economic capital), and how satisfied you are. 🗩 view		9
answered question		27
skipped question		5

Generally speaking, limited efforts have been pursued in the area of the Hardware Design by the responding companies. Some uses of hardware design and applications include:
- Blade technology and distributive processing have been pursued to increase the number of CPUs.
- Use of offsite processor banks
- Use of IT expertise to determine the most effective hardware settings

(Note: The response percent and response counts do not tie to 100% and 27, respectively, due to a response that was answered both yes and no)

5. Do you use Software Design? Here we consider how models are programmed. If one is able to influence the design of the valuation system, there are various system optimization techniques that will aid in run time. One example that could be is that the valuation system is written in Visual Basic. If the reserve calculations are rewritten in C++ and then compiled as a Dynamic Linked Library (DLL), one can link VB to the DLL and the run time for the reserves may be improved up to 40 times.		Response Percent	Response Count
Yes		29.6%	8
No		74.1%	20
Comments on techniques used, for what purpose (e.g., economic capital), and how satisfied you are. view			9
		answered question	27
		skipped question	5

A variety of Software Design approaches have been used by companies depending on the specific platform, product type and modeling needs.

- Dynamic Linked Libraries (DLLs) are called from outside the model to more effectively model certain product options.
- Use of an object oriented model design based on the NAAJ article from July 1997, has been successfully integrated into model development
- Reliance for the most effective design is placed on the software vendor
- Model stewards or coding experts are part of a corporate model unit to ensure consistent and efficient code

(Note: The response percent and response counts do not tie to 100% and 27, respectively, due to a response that was answered both yes and no)

APPENDIX

LIST OF PARTICIPATING COMPANIES

AEGON USA (provided 2 responses)
Allstate
American Family
Ameriprise Financial
Baltimore Life
Fidelity Investments Life
Great American
Great-West Life & Annuity
Generali USA
Kansas City Life
Mass Mutual
Munich American Re
National Life
Standard Insurance
Thrivent Financial
Union Central
13 Others