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Summary of Modeling Sessions at the 2016 Life & Annuity Symposium

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At the 2016 Life & Annuity Symposium held in May in Nashville, the Modeling Section sponsored the following four sessions:

- Session 15: Model Governance
- Session 49: Model Risk Management
- Session 57: Model Efficiency, Part 1
- Session 70: Model Efficiency, Part 2

The four sessions ranged from idealized states of model management to the art of taking the ideals and transforming them into practical approaches. From best practices to getting it done rapidly, there was something for all actuaries, in all lines of business.

This article provides high-level summaries of these sessions, which have all been recorded. You can get recordings of the audio, synchronized with the slide presentations, at the archived event page: *https://www.soa.org/Professional-Development/Event-Calendar/2016/las/Agenda-Day-2.aspx*.

SOA members can order these recordings for free; nonmembers can purchase access for $299. In addition, everyone can download the slides in PDF format for free.

SESSION 15: MODEL GOVERNANCE

Model governance has received growing interest with the increasing importance of actuarial models in valuation, pricing and risk management. Moderator Jason Morton was joined by speakers Robert Stone and David Beasley in looking at model governance from the scope of the activities to the individual components to change management in the process.

Scope of Model Governance: Jason Morton, FSA, MAAA

Jason kicked off the session with the importance of model governance for actuarial work. We want results to be accurate, to be able to be relied upon for decision-making, and to be delivered in a timely fashion so that effective decisions can be made. He discussed some current leading practices to achieve those goals. Figure 1 explains what model governance involves.

Jason also explained that an update to an SOA survey on actuarial modeling controls was being conducted, driven by the need to get ready for principles-based reserving in life insurance in the United States. The survey was first conducted in 2012, and the new survey has most of the same questions as the previous one. There was a sneak peek of results at the Valuation Actuary Symposium in August 2016, and the completed survey statistics will be published later.

Components of Governance: Robert Stone, FSA, MAAA

Robert added another goal of model governance: that results from actuarial models become trusted by decision-makers. If the results aren't trusted, they won't be used to make decisions; sometimes the lack of trust comes from a lack of understanding of how the models operate and how to interpret results.

Robert's talk was broken up into three parts: the modeling environment, governance control and model industrialization. All of these pieces focused on the goal of having trusted model results. In each of the parts, he looked at a structure for understanding the components, and what elements need to be in place for successful model governance.

One key point made by Robert, beyond the need for building trust of model results, was the need for a model governance culture, and that the most difficult part of setting up a good structure is to get people to actually follow it. Robert talked about some of the practical issues of trying to get people to hew to a controlled environment in which models are both developed and executed. This involved some loss of personal control for the individual modeler but is key to the integrity of the model.

The last portion of the talk, model industrialization, was about having a complete, well-defined process, where you know the end-to-end flow from raw data to results, with as many steps as possible being automated. This is to create a mind-set that the "models are right," via testing to destruction, and presenting results with clear communication of drivers of those results. Much of the industrialization is reducing the amount of direct human "touch" on the whole process. Again, one key aspect is getting buy-in to this culture, and putting people in appropriate roles and structures.

Change Management: David Beasley, FSA, CERA, MAAA

David covered model governance in an overlapping manner with Jason and Robert, but reflecting his personal perspective and experience as a model owner for a large block of universal life with secondary guarantees. He came to the model ownership just after a large validation project had been completed; one focus was how he had to manage changes to the model. His talk focused on having to deal with practical constraints while making model changes and satisfying the needs of a variety of stakeholders.

Figure 1
Span of Model Governance: Typical Target State Architecture
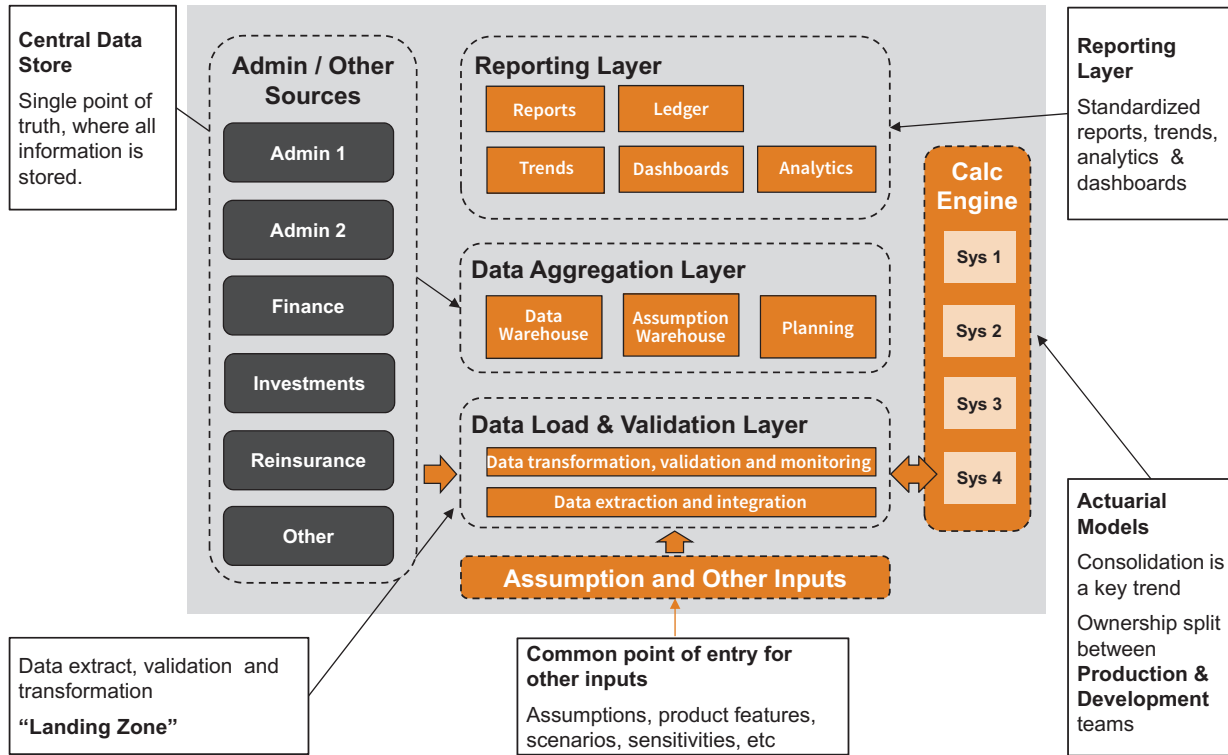
David walked through the change management steps he used as part of annual planning when he was the model owner. His prioritization was to take care of errors first, then look at model control issues. The potential impact on key metrics also factored into the prioritization, to focus efforts on the most material issues.

When focusing on changes to be implemented, David looked at the effort to make the change in terms of hours of staff, the expected impact on model validation and the expected impact on a key metric. He also talked about the 11 testing techniques he used, where most of these were implemented in parallel for timely results. These 11 were a toolbox, where the specific tests would be chosen depending on the change being made. The key is to maximize efficiency in applying the tools. Model risk is partly managed through documentation of the changes, to provide enough information for the change management team to evaluate the change.

SESSION 49: MODEL RISK MANAGEMENT

Moderator Mark Mennemeyer kicked off this early morning session by noting the universality of interest in model risk management. Actuaries have many different functions (pricing, valuation, risk management, etc.) but almost all use models in some

way. There were a few survey questions for the audience with regard to model risk management, showing that, indeed, pretty much everyone has dealt with models and model risks.

Motivations and Challenges: Mark Mennemeyer, FSA, MAAA

Mark provided his own definition of model risk: the possibility that inadequate modeling leads to adverse outcomes. There are many potential sources of such model risk: improper model design, incorrect model production, model misuse and poor communication of model results. There are both internal and external drivers toward implementing model risk management in your own work.

Mark covered some of the challenges to model risk management: complexity of the models and modeling process, increasing external and internal demands on reporting results (whether regular or ad hoc), corporation organizational issues in preventing a unified approach, inefficient modeling processes and lack of clarity or ownership in terms of model risk.

Model Validation Best Practices: Kristen Dyson, FSA, MAAA

In laying out the challenges in model risk management, Mark set the stage for the next portion of the session. Kristen Dyson

spoke on best practices for model validation. She covered definitions of model validation, the importance of validating models to improve the model process and reliability of results, and the best practices approach to methodically validate models.

The best practices include developing a test plan, creating a baseline report before validation, categorizing findings while doing reviews of the model, and continued monitoring of models once the validation foundation has been laid down. For each of these steps, Kristen provided practical details.

She noted this thorough approach does take a great deal of time to set up and implement, but, once it has been established in enough detail, there is less effort in fixing problems going forward. The continued monitoring can be easy once the model validation baseline review has been done.

Case Study: Daron Yates, FSA, MAAA

While Kristen talked about best practices, Daron Yates explained Allianz's development of approaches and their own practical experiences within the United States. He started with the evolu-

> It can be difficult to get senior management and regulator buy-in for some of the techniques.

tion of model risk management he has seen from the early 2000s to today. This covered not only actuarial-specific software and models but also spreadsheet standards.

Daron talked specifically about getting models compliant with the Solvency II Directive, as Allianz is an EU-domiciled company. Pitfalls included a lack of resources, the need to greatly increase the amount of documentation and controls to a potentially onerous level, and to adjust a system set up for financial reporting to be workable for Solvency II. There was also the issue with regard to validation, and how much is too much—this takes a great deal of time to do.

Ultimately, the U.S. branch of Allianz got a reprieve—there is a temporary equivalence of U.S. standards to be used for reporting U.S. business under Solvency II. However, in many ways, this effort was good preparation for developments going on with U.S. regulations as well as international capital standards. Allianz created its own model risk and governance standard used within the organization. This section, showing the practical challenge of taking current business closer to best practices, gives an idea of the challenges and opportunities actuaries have with these pressures.

SESSION 57: MODEL EFFICIENCY, PART 1

Two back-to-back sessions were devoted to model efficiency, looking at it through different lenses, culminating in a full-bore case study showing the power of modeling efficiency techniques. As speaker and moderator for the model efficiency sessions, Tony Dardis noted the core concept in model efficiency is to have one's models run as quickly as possible without giving up too much with regard to accuracy of numerical results.

A Wander Through the Model Efficiency Countryside:
Tony Dardis, FSA, CERA, FIA, MAAA
In this session, and Session 70, Tony gave some details from an article he wrote for the April 2016 issue of *The Modeling Platform*, "Model Efficiency in the U.S. Life Insurance Industry." In this first part, Tony covers a model efficiency taxonomy, developed from the American Academy of Actuaries' Model Efficiency Work Group (MEWG) that came into being to support principles-based reserves and capital projects in U.S. life/annuity regulations. The modeling efficiency taxonomy splits into two large areas: actuarial/modeling techniques and technology solutions. The first is more about conceptual model design, compressing or simplifying models in some way, such that the numerical results one gets may be somewhat different compared to a "full" model. In contrast, technology solutions are methods of designing software and/or hardware to optimize model implementation. The calculated results do not change—the issue is more runtime as well as development time.

Tony covered some of the history of model efficiency in the actuarial world, with a specific focus on the U.S., starting from the 1980s into present day. There is a model governance issue with model efficiency techniques—these are often mathematically complicated, and it can be difficult to get senior management and regulator buy-in for some of the techniques.

Clustering and Variable Annuity Case Study:
Tung Tran, ASA, MAAA
Tung Tran looked specifically at clustering techniques, which fall into the actuarial/modeling technique portion of the model efficiency taxonomy. Tung covered the general approach to clustering. One needs to decide what variables are being used for clustering—"location" (will be used to determine "distance") and "size" (weighting of a model point)—and the amount of compression to be attempted. He went through a simplified example, to show how clustering was determined, and then looked at the results from a more complicated variable annuity example. Specifically, there was a runtime improvement of 95 percent, with fair value fit of 98 percent. This was in exchange for one day's work to create the clusters. The clusters here were for liability cells, but the technique can be applied on either the scenario or liability side.

Of course, in compressing the model to these clusters, some accuracy was given up. Other drawbacks of clustering include increased difficulty in explaining the model and the lack of seriatim results.

The payoff, however, is improved runtime, which allows for more sensitivity analysis. While the clustering may not be appropriate for certain applications, like seriatim valuation, it can be very helpful in making estimates of financial impact in assumption changes.

Model Efficiency Through Technology Solutions:
Trevor Howes, FSA, FCIA, MAAA

While Tung looked at a mathematical process to simplify a model, Trevor Howes focused on software and hardware approaches in making models run more efficiently. There are three layers to the model implementation to consider: the application software in which the model "lives," the system software (operating systems, etc.) the application runs in and that deals with interfaces and, finally, the hardware being used. Trevor detailed the efficiency opportunities in each of these three layers. The kind of improvements one can get from each layer differs greatly, with different pros and cons and different impacts on model governance.

In addition to these layers, Trevor covered some specific approaches in breaking up the modeling job into smaller pieces. He looked at two approaches to task distribution: one that can be done "manually" (which doesn't require extra programming necessarily) and automated task distribution mediated by application software. The concept is to use grid computing, with segments and scenarios distributed across the grid to be executed in parallel. However, it may not be effective for complex situations with nested stochastic processes, due to a coordination issue. This works well when there are non-interacting pieces that can be easily distributed and then consolidated.

SESSION 70: MODEL EFFICIENCY, PART 2

Session 70 continued the topic of model efficiency, focusing heavily on the use of proxy models to improve runtime with good accuracy.

The Family of Proxy Modeling Methodologies: Case Studies:
Tony Dardis, FSA, CERA, FIA, MAAA

Tony finished up covering his *Modeling Platform* article in this session, looking specifically at proxy modeling. This is part of the actuarial/modeling technique aspect of model efficiency taxonomy.

A proxy model is like a "light" model, where one has something very easy to calculate from a simplified set of drivers. You use the full or "heavy" model to develop what the fitting and validation points are. As Tony mentioned, proxy models are not replicating portfolios. He covered the pros and cons of proxy models, with both theoretical and practical issues.

He talked about three approaches—plain curve fitting, least squares Monte Carlo and radial basis functions. These are often multidimensional, and fitting can be quite complex and require a lot of up-front calculation.

Forecasting Stochastic Required Capital: Ron Harasym, FSA, CERA, FCIA, MAAA, and Andrew Ng, FSA, MAAA

In this presentation, Ron Harasym and Andrew Ng talked about their work at New York Life, using a real life case study (with some altered numbers) of capital forecasting for a life/annuity block of business. They combined multiple techniques to achieve a great amount of compression, noting the scenario reduction was 50,000 down to 50 scenarios. Ron mentioned this approach wouldn't be appropriate for valuation, but could be appropriate for their capital forecasting. In their capital forecasting, they had a one-year horizon, with their risk metric being conditional tail expectation (CTE) of the run-off at one-year from the in-force date as the metric being calculated. The highly compressed approach could be used to test sensitivity of required capital to changes in interest rates, equities and credit market dynamics in an efficient manner.

The main issue was that their project was considered impossible, in-house, because a brute force simulation approach would not have been practical, using too much time and calculation to get good results. They used a variety of approaches on the problem to get it into a tenable size for computation: least squares Monte Carlo, scenario stratification, stress scenario selection and then LSMC proxy fitting. They started with 50,000 scenarios for their CTE calculation and got it down to 54 simulation runs for each stochastic required capital calculation.

Ron and Andrew talked about the technology aspects—being able to use modular apps to hack away at different parts of the problem to improve efficiency—as well as the organizational aspects, such as having a team with diverse skills to attack the problem.

DISCUSSION AND THE FUTURE

In each of these sessions, there was active audience participation, sometimes in the middle of the talk to provide clarification. Many of these techniques and concepts are still being developed.

If you weren't able to attend, you should check out the recordings of the sessions. Have any reactions to these concepts? Have other modeling-related meeting sessions to relate or your own practical experience to share? Why not write about it for our newsletter? ◼

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