SOCIETY OF ACTUARIES
MODELING SECTION

The Modeling Platform

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Super Models

By Timothy Paris

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The Modeling Platform

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To join the section, SOA members and non-members can locate a membership form on the Modeling Section webpage at https://www.soa.org/sections/modeling/modeling-landing/.

Publication Schedule
Publication Month: Nov., 2019
Articles Due: Aug. 13, 2019

The digital edition of this newsletter can be found at https://www.soa.org/sections/modeling/modeling-newsletter/.

Chairperson's Corner

By Brenna Gardino

"Intellectual growth should commence at birth and cease only at death."

—Albert Einstein

Spring is my favorite time of the year; this year is no exception. And it is not only because of a colder than normal winter … brrr! Spring always reminds me of growth and opportunity—two topics very relevant for the Modeling Section.

As a newer section of the Society of Actuaries (SOA), the Modeling Section continues to grow and evolve. The section added a Hot Topic Discussion to its monthly call for council members and friends of the council. Monthly section calls recently included an open discussion and thought-sharing on actuarial modeling automation, as well as implications of the increased use of data on modeling. These calls have been thought-provoking and collaborative, and they promote the growth of ideas. Contact me if you would like to be added to the distribution list for monthly calls.

The Modeling Section also recently completed a 60-second survey of its members. The survey results will help guide the section's growth on new topics such as emerging modeling techniques. Planning also started for an in-person meeting this fall to support networking, section activities and the growth of new relationships.

A natural by-product of growth is opportunity, and the Modeling Section has no shortage of opportunities available. I encourage you to get involved. We are always looking for newsletter articles, speakers and moderators, along with material for meeting sessions and webinars. Speaking of webinars, you will not want to miss out on learning opportunities with the May Economic Scenario Generator webcasts. Visit *www.soa.org/prof-dev/webcasts/2019-economic-section/* for more information.

Thank you to Scott Houghton, our section's prior chairperson, and the Modeling Section council for the opportunity to work together.

I hope you find this newsletter interesting and useful. Please contact me with any suggestions on how the Modeling Section can continue to provide value. ■

ASSUMPTION DEVELOPMENT AND GOVERNANCE SUBGROUP

The establishment of this subgroup of the Modeling Section represents an evolution for like-minded actuaries from its founding on a grass-roots level by Liz Olson in 2011, to a formal subgroup with nearly 400 members in 2019.

As actuarial modeling and assumptions grow in importance and complexity, companies are under mounting pressure to provide solid governance around assumptions. In response to these demands, many are devoting additional resources to assumptions and looking for industry best practices regarding assumption management. This subgroup provides a venue for sharing and discussion around how assumptions are tested, approved, documented and implemented.

If you are not already a member, this subgroup is free and open to both Modeling Section members and non-members. To sign up for the group email list, go to *www.soa.org/sections/prof-assump-dev-gov-group/.*

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Letter From the Editors

By Mary Pat Campbell and Jennifer Wang

Hello, once again, from your friendly *Modeling Platform* editors. If you are reading this in paper form, I highly recommend you check out the digital version of this newsletter through the Modeling Section's webpage at *www.soa.org/sections/modeling/modeling-newsletter/.*

Don't forget we also keep a spreadsheet on the section landing page that provides a list of all the articles we've published in *The Modeling Platform*, along with descriptions and categorizations of them. The new digital format will be easier to read and to share compared with our prior method of simply posting a downloadable file containing the entire newsletter issue.

Let us and the Society of Actuaries (SOA) know what you think about the new format. What works for you? What doesn't? Are there features you would like to see? If you are receiving the newsletter on paper through the mail, is that your preferred format?

We've got a variety of pieces in this issue. The following list is more thematic than chronological. (In our digital world, one may be looking more for thematic unity than consecutive pieces with page numbers.)

In this issue:

- Please welcome the Assumption Development and Governance Subgroup, which has recently entered under the auspices of the Modeling Section. Timothy Paris, a member of this subgroup, introduces them. As editors, we're looking for more material from them in coming years.
- In addition, Timothy writes about the "Super Models," in which he gets into the philosophical distinction between models and assumptions. Since creating the Modeling Section, many of us have been looking at providing a definition that fits with our work, but we often find there are multiple levels of structure and choice. Timothy uses super models as a framework to approach the modeling task.
- Two sets of authors look at centralizing the modeling function in insurance companies:
  - In "Journey to Centralizing Modeling Function," Daphne Kwan has a Q&A with Cheryl Poulin, head of the Modeling Center of Excellence from Prudential Financial, and Angela Huang, head of actuarial services of New York Life. They explore how these two insurers journeyed into centralizing their actuarial modeling, giving a practical perspective for others considering the same process.
  - In "Centralizing Model Development: Is it Worth it?," authors Dean Kerr, Josh Chee and Jay Boychuk explore advantages and disadvantages to centralizing actuarial model development within an organization.
- In Modeler Q&A, Ben Neef talks with Lei Rao-Knight of Prudential Financial, looking at a modeler's perspective at an insurer. We're always looking for more Modeler Q&As (with the questions given, or your own). Let's share our knowledge and our struggles!
- In "GAAP Accounting for Long-Duration Contracts: Ramification for the Modeling Actuary," authors Dave Czernicki, Jean-Philippe Larochelle, Ryan Laine and Sean Abate look at how the recently released U.S. Generally Accepted Accounting Principles (GAAP) targeted improvements for long-duration contracts will affect the models and work cycle, as well as operational load, on modeling actuaries.
- Trevor Howes looks at the practical problem of these kinds of changes and a potential solution in "Modeling

in the Cloud." With more analyses being required in not only the U.S. GAAP changes, but also IFRS 17,[1] being able to fulfill requirements becomes more of a challenge.

- Last, but not least, Jennifer Wang compiles the first of two parts (second to come in the fall) of 2018 SOA Sessions related to modeling. Don't forget how much recorded material you have access to as an SOA member and a Modeling Section member (including free access to our older webcasts). It's a great way to get continuing education credits without having to leave the office … or pay for it!

We're looking for our fall issue submissions now. Have any reactions to our articles? Have something you'd like to share about your challenges as a modeler? Please contact your friendly editors. ■

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ENDNOTE

1 International Accounting Standards Board. 2017. International Financial Reporting Standard (IFRS) 17: Insurance Contracts. *https://www.ifrs.org/issued-standards/list-of-standards/ifrs-17-insurance-contracts/.*

Super Models

By Timothy Paris

This article emerged from a series of recent presentations I gave about the development and maintenance of policyholder behavior models, the differences between models and assumptions, and how all of this can be used to quantifiably improve risk management. An important thread running through all of this is the ability to visualize and communicate highly technical concepts to colleagues and non-actuarial stakeholders. So while a certain amount of prose is inevitable, I have suppressed exhaustive numerical details and formulas in favor of a series of figures to illustrate how super models can help you and your company manage the risks in your business more effectively.

What is a super model? Of course, beauty is in the eye of the beholder, but I posit that in this context, super models are developed based on rigorous data analytics techniques, and they provide you with a range of potential outcomes, their financial impact and metrics that you can use to evaluate when material changes are necessary. "Assumptions" can be extracted from your super model for various applications, but the super model itself is more robust than that. It is a framework for analysis and risk management, not a point-in-time set of numbers.

WHAT IS THE FORM OF THE SUPER MODEL?

While my firm's particular focus is on annuity policyholder behavior models, the key underlying issues transcend product lines. In general, we are attempting to model the probability p of an event occurring, based on a function of a combination of factors $\vec{x}$ and coefficients $\vec{\beta}$:

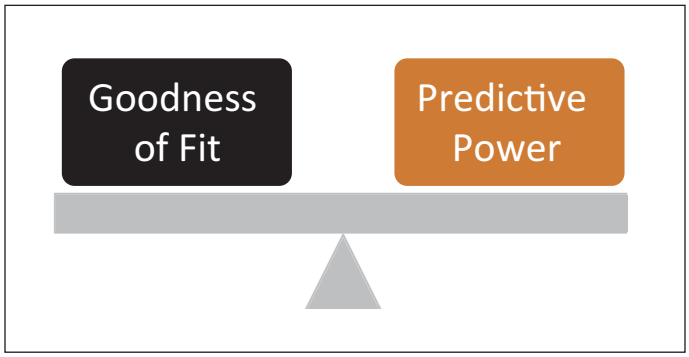
$$p = f(\vec{\beta}, \vec{X})$$

Admittedly, this is not much of a picture, yet the simplest equations are often the most beautiful. For example, we may wish to model the probability that a fixed indexed annuity contract makes a partial withdrawal in a given month, based on a combination of factors such as duration, the presence of a guaranteed lifetime income benefit, contract size, age and tax status, along with some interaction terms, as reflected in a generalized linear model. I find it remarkable when I observe companies that do not establish a baseline of functional form, and simply assemble a brittle set of numerical assumptions based on recently observed experience.

HOW WILL YOU SOLVE FOR FACTORS AND COEFFICIENTS?

Once the functional form is established, solving for the model factors and coefficients is a very challenging exercise, and there is typically a range of reasonable answers. Fundamentally, we are trying to build a model for something that will happen in the future. We typically calibrate such a model to some historical experience data, and test its predictive power against other data that is held out from that calibration process (see Figure 1). This often requires actuarial judgment and thoughtful trade-off decisions.

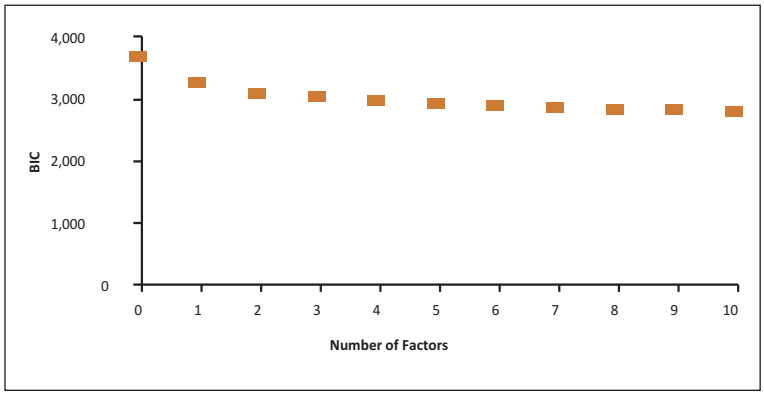
Figure 1
A Delicate Balance



MEASURING GOODNESS-OF-FIT

There are many ways to measure how well your model fits historical experience data, including metrics such as the Bayesian information criterion (BIC), as seen in Figure 2. A super model will often fit the historical experience very well using a relatively small number of factors that make business sense, sidestepping the pitfall of overfitting to noise.

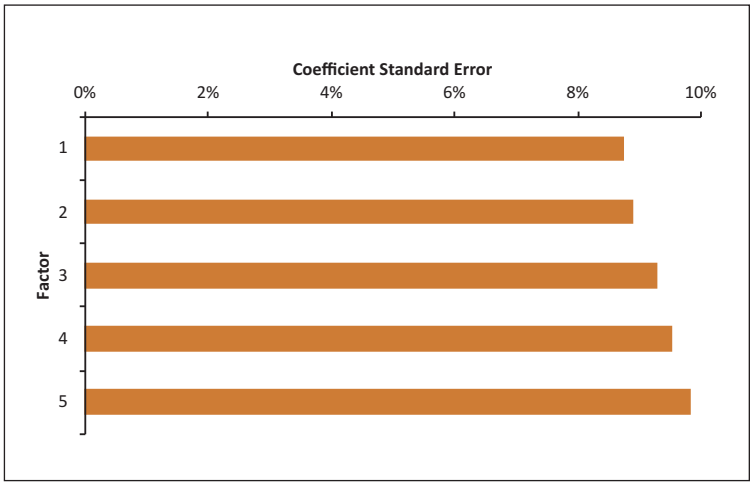
Figure 2
Bayesian Information Criterion



SUPER MODELS HAVE RANGE

Unlike mere assumptions, which are usually a defined set of numbers, sometimes quite elaborate-looking, that are often subject to endless seemingly arbitrary annual "unlocking," super models not only have baseline coefficient estimates for the model factors, but also standard error terms for each, in order to provide a sense of the range of possible outcomes based on historical data. By definition, no model is perfect, so super models attempt to quantify their own degrees of imperfection. This way, you are much better able to distinguish noise around modeled behavior from substantive changes. The pattern in Figure 3 is representative, with the most important factors having the lowest standard error terms, and hence higher confidence in the coefficient estimates.

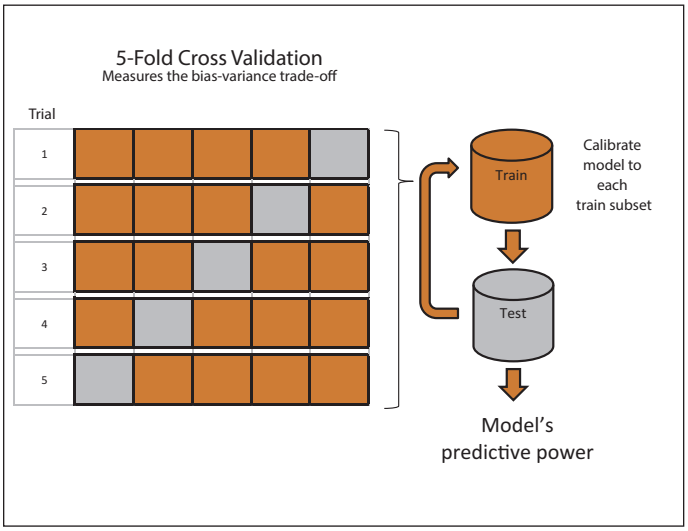
Figure 3
Example of Standard Error for Model Factors



SUPER MODELS HAVE WELL-TESTED PREDICTIVE POWER

While it is helpful to understand the model's goodness of fit to historical data, it is vitally important to quantify the model's predictive power *relative to data held out from the model development process*. This is essentially a sampling exercise, and many approaches can be insightful: simple splits like 60 percent of data for model development "training" and 40 percent for model "testing"; using the first several years of data to "predict" the last year; or cross-validation techniques like the one illustrated in Figure 4. On these bases, actual-to-expected ratios help you to determine which models perform better than others and what range of experience you may reasonably expect for the future.

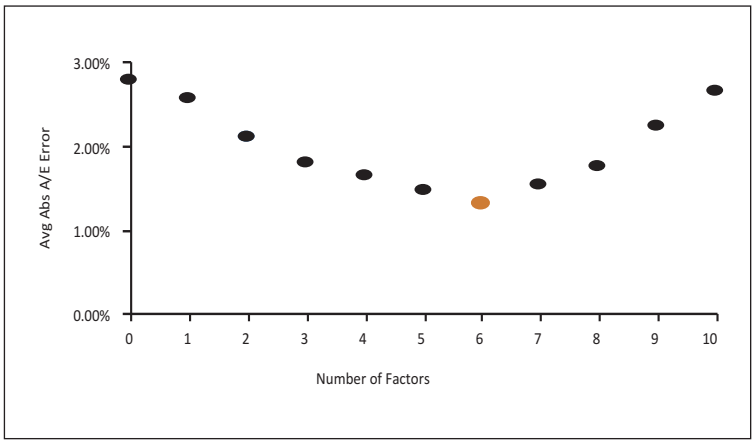
Figure 4
Cross-Validation Technique



KEEP IT SIMPLE

The more company data available to build your model, the greater the temptation to over-complicate. Initially, you will typically find that each additional explanatory factor you add to your model should improve its goodness of fit to historical data and its predictive power. So more is better—to a point. Goodness of fit tends to provide only diminishing returns with additional factors, and the improved fit to historical data is often just noise that may not be predictive of data held out from the model development, or of the future (see Figure 5). At some point you will need to employ actuarial judgment to determine when enough is enough. Ideally, this judgment will be guided by your company's objective risk management directives and actuarial governance.

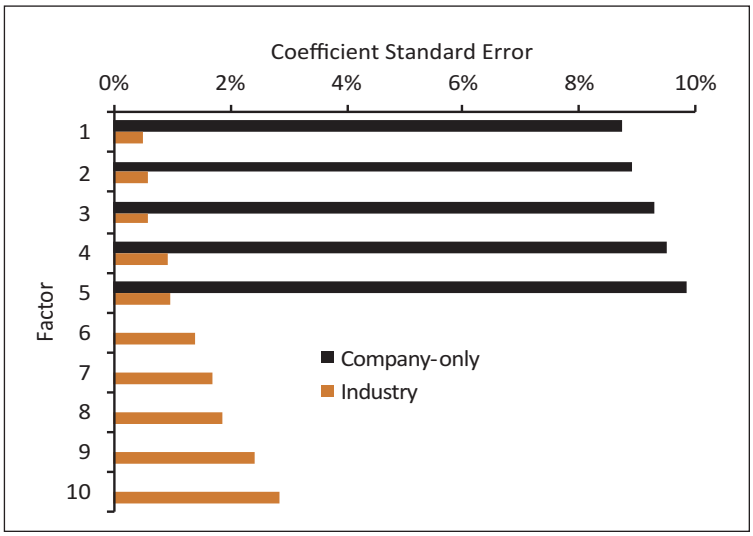
Figure 5
Diminishing Returns and Risks of Overfitting With Additional Factors



MORE DATA USUALLY BEATS MORE COMPLEX MODELS

On the other hand, if you are able to access additional relevant data to include in your model development process, such as data from external databases, industry experience studies, company affiliates, new business or reinsurers, complex models or models with many factors can often be statistically justified. Oftentimes, when limited to your own company's data, only a few model factors will be statistically justified—it is difficult to distinguish noise from real systemic effects. If you can access and use such external data, the quality of your model will tend to improve dramatically, as illustrated in the reduction in coefficient standard error terms in Figure 6 using industry data that is about 40 times larger than company-only data.

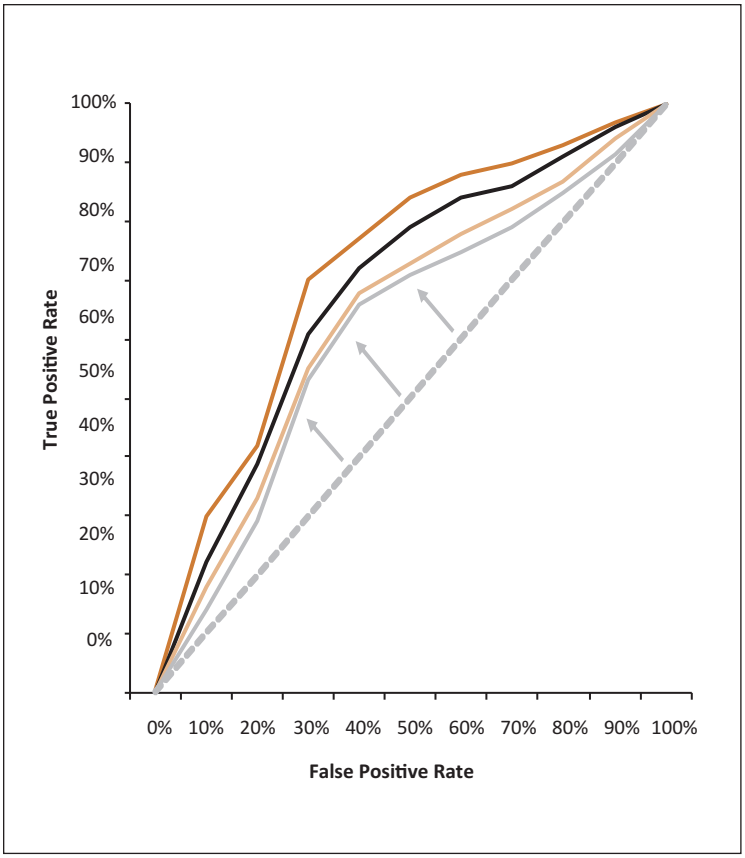
Figure 6
Additional Data Improves Model Quality



SUPER MODELS ARE SENSITIVE—AND SPECIFIC

Actuaries often use models to predict binary outcomes, such as whether withdrawals or deaths occur. Satisfactory aggregate model metrics are necessary but are not necessarily sufficient to qualify for super model status. We want a model that correctly predicts both of the possible binary outcomes. The statistical terms for these are sensitivity and specificity, and they are illustrated with the receiver operating characteristic (ROC) curve. Super models will have steep ROC curves, like those illustrated in Figure 7.

Figure 7
Receiver Operating Characteristic Curve



LOOK CLOSER

Continuing this theme, you should look closely at how well your model predicts important cohorts within the aggregate data, such as each of the modeled factors and any noteworthy factors that may not be explicitly included in the model. As illustrated in Figure 8 for one factor, super models tend to perform well at this level of granularity too, especially for the cohorts that comprise the bulk of the data as represented by the higher red dots in the center of the graph. This should give you confidence that even if your business mix changes along these dimensions, your super model will continue to look great.

Figure 8
Focus on Key Cohorts

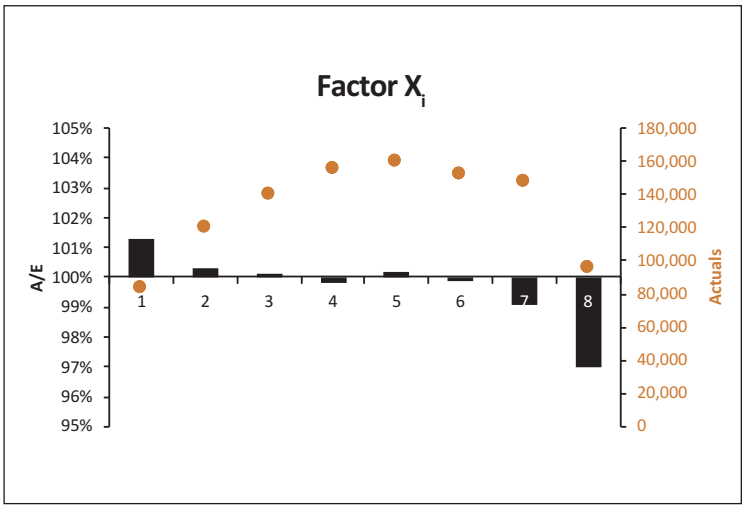


Figure 9
Lift Curve

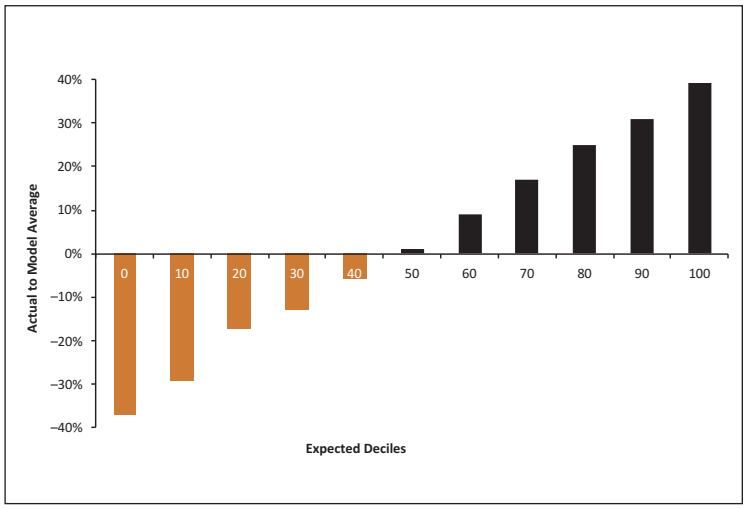
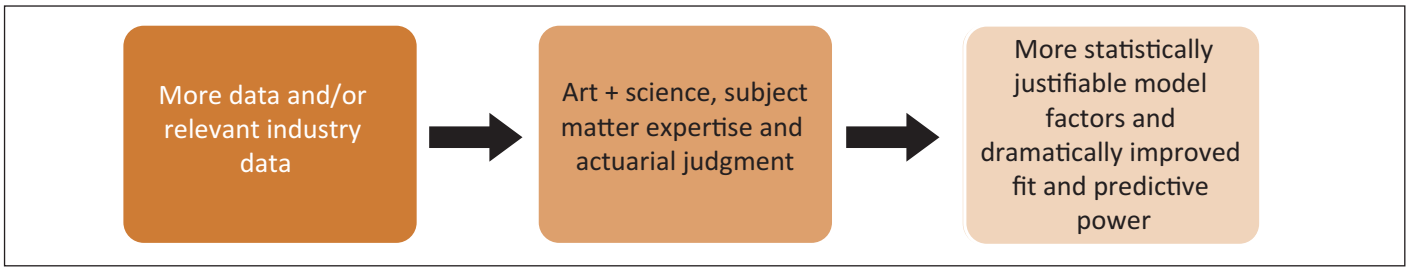


Figure 10
The Power of Super Models



SUPER MODELS GIVE YOU A LIFT

As part of your model validation process, you should find your super model also has the sensible property that, as the model's expected deciles increase, actual-to-average-expected values should also increase from negative to positive. This "lift curve" illustrated in Figure 9 is often accompanied by related metrics such as the Gini coefficient.

CONCLUSION

Actuarial super models exist. And they tend to be way better with more data, as described in my recent article in *The Actuary*.[1] I would venture that more and more actuarial super models are on the way, considering our increasing focus on this type of work. Regardless of the algorithms or software you use, their telltale characteristics are that they have a rationale for existence based on rigorous data analytics techniques, and they provide you with a range of potential outcomes, their financial impact and metrics you can use to evaluate when material changes are necessary. However, while there is a lot to like, you should not fall in love, since coefficients, factors and even the functional form of the super model itself will likely change. "Assumptions" can be extracted from your super model for various applications, but the super model itself is more robust than that. It is a framework for analysis and risk management, not a point-in-time set of numbers. So don't settle for less. And if you want your stakeholders to understand this, pictures of super models can be really helpful (see Figure 10). ■

Timothy Paris, FSA, MAAA, is chief executive officer at Ruark Consulting LLC and is also the leader of the new Assumption Development and Governance Subgroup of the Modeling Section. He can be reached at *timothyparis@ruark.co.*

ENDNOTE

1 Paris, Timothy. 2018. When is Your Own Data Not Enough? How Using External Data can Strengthen Results. *The Actuary* 15, no. 3:28–33, *http://theactuarymagazine.org/wp-content/uploads/2018/06/act-2018-vol15-iss3.pdf.*

Journey to Centralizing Modeling Function

By Daphne Kwan

Over the last few years, insurance companies have been centralizing modeling functions and moving away from a business-unit-based structure to one where modeling resources are shared by all business units. In this article, Cheryl Poulin, head of the Modeling Center of Excellence from Prudential Financial, and Angela Huang, head of actuarial services from New York Life, share their journey to centralizing a modeling function.

Q: When did your company start centralizing the modeling function?

Cheryl Poulin: Prudential announced the centralized modeling function in September 2017, after spending the majority of the year defining the overall operating model, modeling function and organizational structure. Several actuarial departments had actually been ahead of the curve and already started to evolve their organization to be more functionalized with separate modeling functions prior to the formal announcement.

> We are operating in a world where financial institutions require more governance. Centralization helps us along the path.

Angela Huang: New York Life did the centralization in multiple steps. We established the corporate actuarial modeling team back in 2014 by pulling people from different business units. In 2016, we established a finance services organization, which is broader than actuarial functions. At that time, we pulled together even more actuarial functions by centralizing production, asset liability management and experience studies.

Q: What are the differences between a centralized modeling function and individual modeling teams?

Angela: The clear difference is that we incorporated much more governance in the process with the new organization structure. In addition to centralizing modeling work, we centralized models as well. We are consolidating multiple actuarial functions into one model (e.g., asset-liability management, valuation and pricing). By doing that, testing and development need more structure and governance to ensure changes made for a particular function wouldn't negatively impact other functions within the same model. We are documenting now at a much higher standard. In the individual modeling regime, model developments happen at a much faster pace. The focus is the accuracy of results and agility, but the models' efficiency and architectural integrity are usually not the top priority.

Cheryl: We started by defining one model strategy (or future state), but we don't have one physical model used across all business units yet. This will be a multi-phased effort, taking advantage of current and future project work to achieve the vision. Similar to Angela's model governance point, we also focus on model governance. Our governance is centralized within the Modeling Center of Excellence, although not all modeling work, such as pricing, is centralized within the center.

Angela: At New York Life, we are not at the one-model state yet. We are moving in that direction in multiple phases as well.

Q: Other than governance and infrastructure, which we just discussed, is there anything the centralized function can do but the individual modeling team couldn't?

Cheryl: The service provided by the modeling function doesn't differ, whether it sits in a centralized function or within a separate business unit structure. It *does* make it easier to communicate with the information technology function with a centralized modeling function. We have a centralized IT function that is separate from the actuarial function. Having a single source of truth on prioritization and single source of stakeholder engagement has improved our ability to prioritize their work and streamline communication. You can imagine that if the IT function is responsible for the work of four modeling groups, you may not get what you want and you will leave decision-making in their hands, which may not be in your best interest. It is also easier to share best practices on documentation and testing, and share codes or code modules within the same organizational structure. You can still make some of that happen through committees or some other kinds of structure or operating models but it will have different challenges with different trade-offs.

Angela: I agree with Cheryl. Standardization, prioritization and governance can be coordinated by a traditional corporate oversight group. However, it is much easier in a centralized team. For example, we have combined all the asset modeling.

We have one set of asset coding for all the businesses. Any investment strategy or asset classes that are available for one line of business are available for all other lines of business as well. Through centralization, we have also found a lot of minor inconsistencies or errors in coding from the past made by multiple teams.

Q: On the flip side, what are the greatest challenges you are facing with the centralized function?

Angela: The benefit is often the challenge too. Development takes a lot more time and coordination under a higher level of governance. We need to ensure codes are efficient and architecturally sound and perform appropriately for various functions and businesses. The most difficult challenge is balancing priorities across all the stakeholders due to lower agility and longer development time.

Cheryl: Prioritization and managing the unintended consequences of not being able to get everyone's work completed is a challenge. There is always more work than your staff can handle, and the business still needs to meet its customers' needs as well as respond to senior management, even if their work is at the bottom of the prioritization list. The danger of unintended consequences is that employees may start creating side models on their own and start to make business decisions based on the results.

Angela: We have the same issue here. Decisions may be based on these sandbox models, which take a fraction of the time to develop. The developments have the appropriate review process, but the coding quality, test plan and documentation would not be as well done as we'd like.

Q: If you could do this journey all over again, would you be doing it differently?

Cheryl: I would still centralize, as I see the opportunity there. From our perspective, we brought four different functions together all at once. If I could do it again, I would have piloted it or combined some teams first and then brought in some of the other groups in a staged way to test the organizational structure, make some adjustments as necessary and keep expanding the modeling group. Bringing all the different

cultures together all at once could result in a lot of change, and that could be disruptive to getting the job done.

Angela: If we were to do it all over again, we would over-communicate, over-educate and plan at a deeper level for a smoother execution. We had a lot of good thinking and wrote up detailed governance policies but could have spent more time on creating templates to make documentation easier, educating teams on how to do it, and holding them accountable. Having strong alignment and commitment from management to the appropriate level of governance is very important. Starting off with a lot more communication and training, followed by strong reinforcement and commitment to the governance policies is very helpful.

Q: What do you think are the factors contributing to a successful modeling function?

Angela: Having alignment across the board and delivering a clear message throughout the organization are key. Setting clear roles and responsibilities and committing to the right amount of change are also important. You need to have a proper framework on how the organization will operate. This includes how to/who will prioritize the work, how to/who will make decisions, and how to communicate to the stakeholders.

Cheryl: Yes, and I would also add that it's critical to have a strong alignment on strategy and, priorities as well as having the dedicated resources within the IT function.

Q: Is there anything you would like to tell your business partners?

Cheryl: One thing we have been engaging with our users on is how we work together. The modeling function doesn't really do everything by itself. We often have to leverage each other's strengths. Things can move much slower if we completely laminate responsibilities by functional role. For example, take business requirements. Users may sometimes write them, while a modeling group may write them at other times to get it moving. We need to have flexibility when expertise is needed.

Angela: One thing we have been telling our business partners is that this journey is an evolution. The roles and responsibilities will change as we continue to evolve. We will keep tweaking how we operate depending on where we see our successes and failures and where we are on our road map. We need to have open communication around what works, what doesn't work and what the challenges are.

Q: Any other final words on this journey?

Angela: A lot of the challenges we are addressing have nothing to do with centralization of modeling functions but rather a higher level of governance required in the current environment. We can keep individual modeling teams, but the rigor around documentation, testing and standardized coding remain. Many of the challenges we have discussed thus far are considered to be driven by centralization, but a large number are also due to the increase in governance. We are operating in a world where financial institutions require more governance. Centralization helps us along the path. As we move further along in our journey we continue to see benefits, and we expect more to materialize as we move closer to our future state. ■

The views expressed in this article are not those of MetLife.

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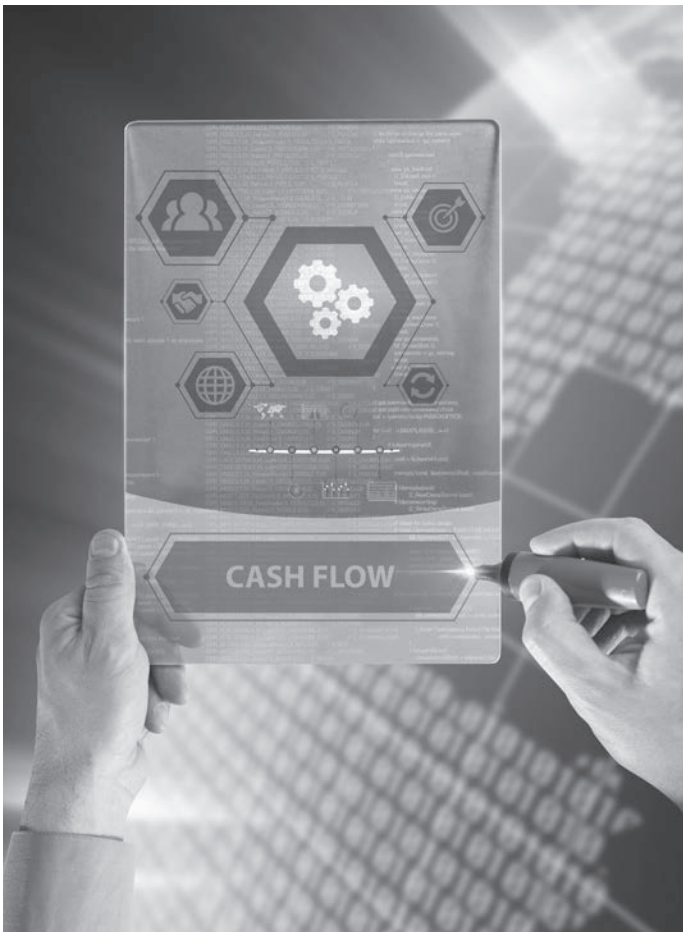
SOCIETY OF ACTUARIES®

Centralizing Model Development: Is it Worth it?

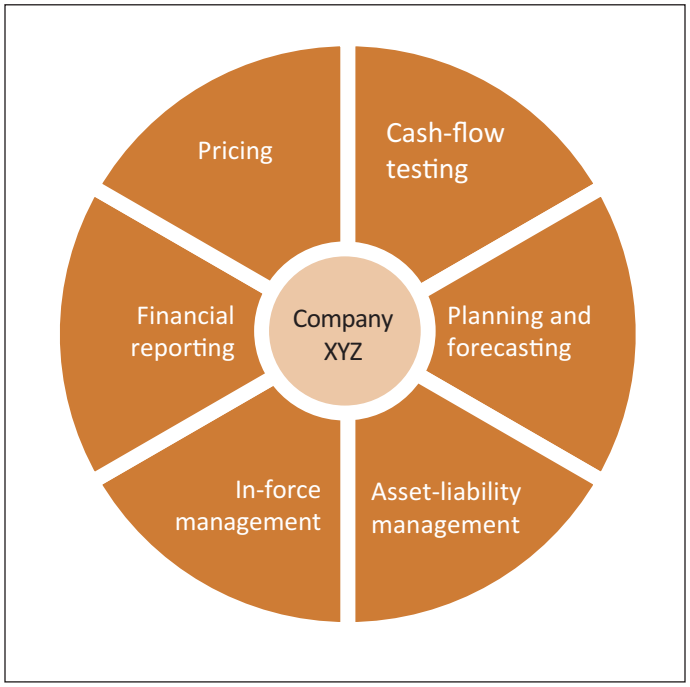
By Dean Kerr, Josh Chee and Jay Boychuk



Actuarial models serve as the backbone to a life insurer's financial success and are heavily relied upon to understand expected future cash flows, satisfy regulatory requirements, and support strategic decisions.

Actuarial model development often becomes decentralized as a natural consequence of the segregation of business units within the organization, despite a large overlap in modeling requirements. Figure 1 illustrates common actuarial business functions.

Figure 1
Common Actuarial Business Functions



Under a decentralized model development framework, a separate team is responsible for developing each model or group of models. In contrast, under a centralized model development framework, a single team is responsible for developing and maintaining the actuarial models for all business units within a company.

While many would agree that centralizing the model development function is beneficial, companies often fail to centralize development because of logistical complexity, resource requirements, and internal resistance. However, centralized development promotes standardization across business units, increases efficiency within the company, and simplifies auditability of the actuarial models.

The remainder of this article will further discuss decentralized and centralized model development frameworks and provide tips and rationale for transitioning toward centralized model development.

DECENTRALIZED MODEL DEVELOPMENT: BENEFITS AND CHALLENGES

Decentralized model development certainly facilitates the flexibility required in today's actuarial modeling environment; however, it may foster increased operational risks and longer-term inefficiencies. Key benefits and challenges of decentralized model development are outlined in Table 1.

Table 1
Benefits and Challenges of Decentralized Model Development

Benefits	Challenges
Independence Business units maintain autonomy around modeling decisions. Models have a clear owner within each business unit. Model issues and errors are isolated to the specific model.	**Standardization** Model inputs and output may differ materially between models. Model output definitions may vary between models or systems, leading to possible misinterpretations of results. Modeling systems have different limitations.
Flexibility Each business unit can use the best-in-class system for the model purpose and business modeled. Model updates can be quickly implemented.	**Efficiency** Decentralized models may result in duplication of effort. Costs may be higher due to extra system licenses, multiple modeling environments, etc.
Customization Business units can customize to the model purpose. Models only need to include necessary components.	**Operational Silos** Communication between business units may be limited. Increased key person risk (e.g., only the dedicated model owner has knowledge of intricate model details).

CENTRALIZING MODEL DEVELOPMENT *IS* WORTH IT

Naturally, the primary advantages and disadvantages of a centralized model development framework can be deduced by inverting Table 1. However, a deeper dive illustrates the tangible benefits that centralizing model development can bring a life insurer.

- **Centralizing model development facilitates standardization across business units.** It promotes consistency among modeling systems, inputs, modeling approaches, outputs, documentation and so on. Conversely, lack of standardization increases model risks. For example, an annual assumption update may become error-prone when multiple models require different data formats. Further, it is common for separate actuarial models of the same block of business (e.g., pricing, valuation, cash flow testing) to project diverging cash flows due to varying modeling approaches. Standardization improves the ability to compare and attribute results from different models.

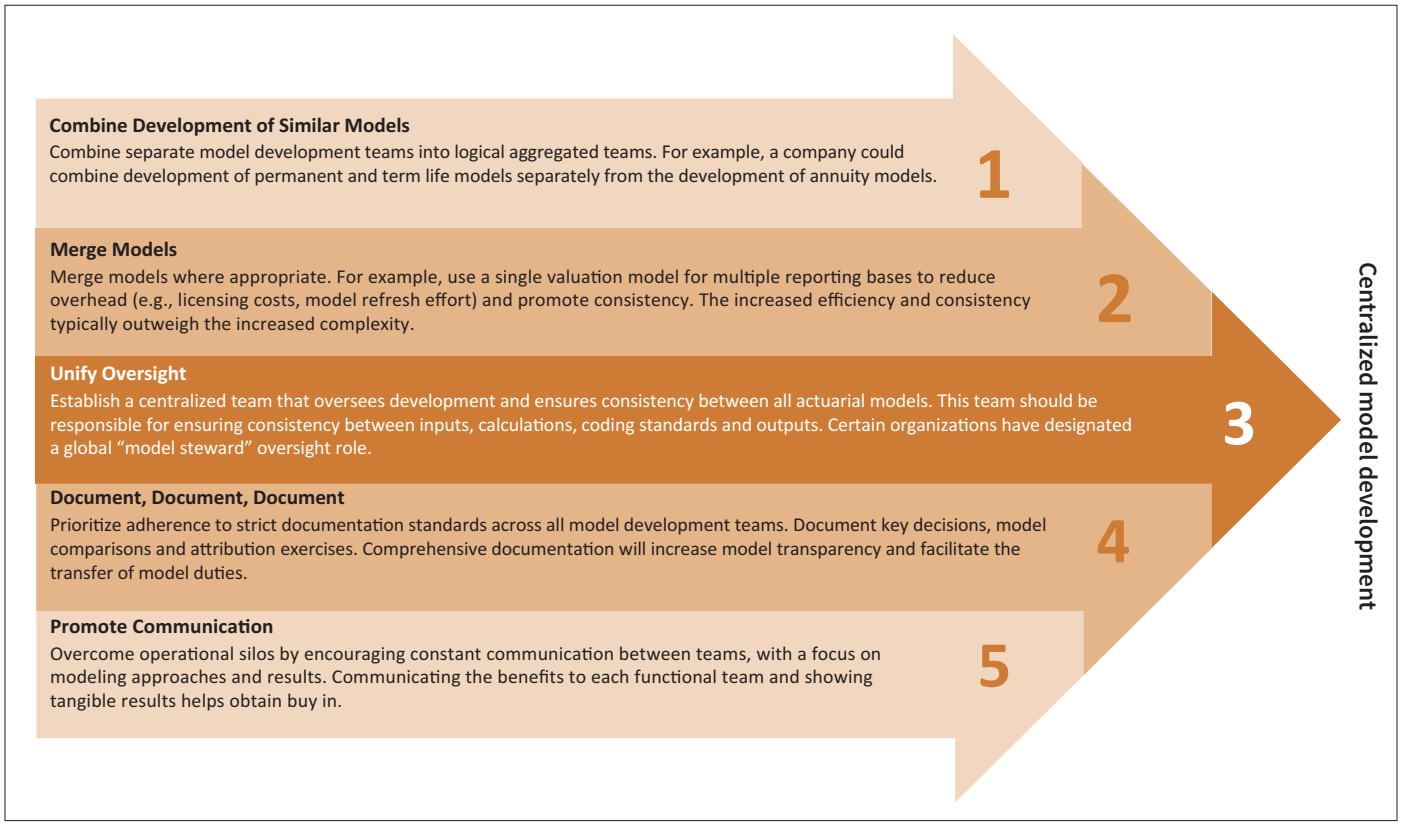
- **Centralizing model development creates long-term efficiencies by combining multiple teams.** Reducing staff allocated to model development, decreasing turnaround time for analyses impacting multiple models, and increasing time available to validate and analyze results are concrete examples of common efficiencies achieved in a centralized framework.

- **Centralizing model development simplifies auditability and external interactions.** Consistency among models, coupled with a unified team that understands those models, results in efficient and effective conversations with external parties, such as auditors, regulators, and rating agencies.

NATURAL TENDENCY TOWARD DECENTRALIZED MODEL DEVELOPMENT

Decentralized model development tends to fall out of the natural evolution of a life insurer. Consider Decentralized & Co., which has been selling traditional life products since 1970 and in 2015 began selling fixed annuity products with living benefit riders. Jane has led the traditional life U.S. Generally Accepted Accounting Principles (GAAP) and statutory valuation team for 25 years and has a well-established process for converting pricing models to financial reporting models in an actuarial software system in place since 2000. However, the newly hired team developing the fixed annuity product and models found the legacy traditional life system to lack robust annuity and hedge modeling functionality and opted to implement a second actuarial software system. In 2017, Decentralized & Co. considered upgrading the traditional life models and integrating the life and annuity modeling teams but was met with resistance from Jane's team due to their unfamiliarity with the new system and product line, and from finance due to the implementation costs. The company has deferred its integration plans but intends to revisit in a few years.

Figure 2
Tips for Transitioning to a Centralized Development Structure



TIPS FOR CENTRALIZING MODEL DEVELOPMENT

Organizations often view centralizing the entire model development process as a daunting task. Strategically centralizing specific aspects of model development allows companies to retain a range of decentralization benefits while addressing several challenges with minimal effort, logistics or resistance. Figure 2 outlines tips to consider when transitioning to a centralized model development structure.

CONCLUSION

Actuarial modeling is a vital component of insurance company operations; however, models are often developed under a decentralized framework, resulting in increased operational risk and other challenges.

Organizations often view centralizing the entire model development process as a daunting task. In such situations, prioritizing centralization of certain aspects of the model development process promotes some clear near-term "wins," which may help overcome resistance to a broader centralization effort. As the industry and key stakeholders continue to emphasize and prioritize model risk management, centralizing model development is critical. ■

The views or opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of Oliver Wyman.

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Modeler Q&A With Lei Rao-Knight

By Ben Neff

Lei Rao-Knight, FSA, MAAA, is vice president and actuary in the Modeling Center of Excellence at Prudential Financial. She graduated from the University of Connecticut with a Master of Science in Actuarial Science. Lei has 20 years of actuarial experience spanning pension consulting, valuation reporting and modeling for individual life, annuities and retirement.

Q: What kind of modeling work do you do, and what software platform(s) do you use?

We focus on asset-liability management modeling for the individual life business using Moody's AXIS. The main responsibilities include:

- Gathering or reviewing business requirements
- Model design and development
- Model testing
- Production model implementation
- End-to-end process development and run automation

The models are used for pricing activities, statutory reserve reporting, forecast projections, asset adequacy testing, replication portfolio cash flow projection, capital management and other internal management purposes.

> Our models are often used for reporting purposes, and these need fast turnaround times and robust controls during production.

Q: Since you use software that is vendor-maintained, can you describe what you mean by model design and development and what, if any, model coding you need to do?

We cover the following model design and development:

- Defining input requirements including input data, rate tables, assumptions and other key switches that are used by the AXIS model
- Creating tools if needed to transform required inputs to the format that the AXIS model can utilize
- Translating business requirements into technical specifications in AXIS
- Evaluating AXIS capability and redesigning the modeling methodology to fit in AXIS existing structures or to request modifications
- Determining model configuration in AXIS such as the structure and contents of the model including funds, subfunds and cells
- Creating new tables, including coding in formula tables
- Designing batch process to improve the model runtime or run automation
- Designing output solutions to meet business requirements

Q: How do you plan or prepare for a modeling change?

The request for a modeling change typically goes through an intake or prioritization process. After key stakeholders reach an agreement to proceed with a modeling change, we follow a well-defined model development life cycle (MDLC). The complete MDLC generally includes the following steps:

1. Prepare business requirements for the model change
2. Model design based on business requirements
3. Model development
4. Model testing
5. Production model implementation

Our modeling team is responsible for steps 2 to 5, while users are responsible for business requirements in step 1, user acceptance testing in step 4 and production support in step 5.

Q: When you find a bug that has an immaterial impact on results, can you let it go or not?

The answer is case specific, and it can go either way. These are general steps we take:

1. If the bug has an immaterial impact on results, we typically reach out to key stakeholders who use these model results and jointly reach an agreement on whether it needs to be fixed.

2. If the decision is to fix it, even if it causes an immaterial impact, we will determine when will be the proper time to change the model for this bug.

3. If there is ample time to incorporate this fix in the future model development cycle, we will treat it the same as one of many model change requests and follow the MDLC in the future model development cycle.

4. If it is time constrained, we will follow a simplified version of the MDLC by skipping unnecessary steps such as preparing business requirements to speed up the development cycle.

Q: Documentation—as you go along or after you're done?

When we follow a well-defined MDLC, documentation is defined and created during these key steps:

1. Business requirement documentation is produced when users prepare business requirements for the model change.

2. Functional specs are generated by the modeling team when they work on model design based on business requirements.

3. Technical specs will be finalized when the modeling team completes related model developments.

4. Testing plans and testing files are created when both the modeling and user teams perform various model testing.

5. The user manual is updated when the new version of the production model is implemented and released. In addition, sign-off and model affirmation will be also produced at the end.

Q: Do you have a modeling pet peeve?

My pet peeve would be insufficient documentation of coding. This really makes it difficult for others to review or understand what the code is trying to achieve.

Q: What's the most frequent piece of code or software feature that you can never remember the syntax/setup for?

The most frequent piece of code that I can never remember the syntax for is coding to connect external files within formula tables in AXIS.

Q: What was the last problem you encountered that had an easier-than-expected solution?

One example that my team encountered recently was we needed to build a blending rate table in AXIS. However, it appeared to only allow equity index selections but not bond selections. It turned out that if a link to bond is created, this link will then be available. Without this workaround, we will need to use formula tables or explore a different modeling approach. Lesson learned is that AXIS is quite flexible and it allows for creative solutions.

Q: What's something new you picked up recently that you'd like to share?

Our models are often used for reporting purposes, and these need fast turnaround times and robust controls during production. Having a well-thought-out vision of the complete end-to-end process upfront is very helpful for large conversion projects. It can provide good guiding principles for the model design and reduce redesigns of models later to meet requirements of the end-to-end process.

Q: Can you share a favorite time-saving coding technique or feature of your current software that you like to use?

One member of my team shared that R is a lot faster than Excel or VBA [Visual Basic for Applications] at generating random numbers (for sampling, simulations, etc.).

Q: Have you seen any dangerous or inefficient coding or model configuration practices that you would advise other modelers to avoid?

Our team raised a few examples, which include hardcoded plan codes and assumption tables, and setting a variable and overriding it later within a different set of code.

Q: What is the funniest or most surprising modeling error you have encountered?

These are a few examples shared by the team:

- Copying a blank field to SQL and SQL changed it to NULL.
- Lookup functions in AXIS let you specify a default value when the lookup fails. In our initial model build, the developer used the string ".NULL." as the default value, instead of just assigning the variable the value .Null., which is how AXIS denotes null values. If you specify a null value when assigning tables to cells, it will skip that record and not try to assign anything, but when you code the string ".NULL." the system will treat that as an actual table name and look for a table called ".NULL." This leads to some interesting model errors. This was frustrating to debug because just from looking at the table, it was hard to tell if AXIS was using a null value or a string called ".NULL."
- Language used in AXIS queries is different from VBA, where zero means false.

Q: What do you wish consultants understood about your models?

We have good relationships with our consultants and they often come up with quick solutions to solve model issues. I look to consultants to balance the need for a quick solution with long-term considerations in the following areas:

- Does it require any manual updates to maintain the model for the future? Ideally, we would like to avoid manual updates for the routine production updates.
- How easy is it to expand to other products or usages? It will save overall time if a solution doesn't require major redesigns every time the model is expanded.
- How does it fit to the requirements for the end-to-end process? We are driving a more controlled and automated end-to-end solution especially for many production reporting purposes. Some solutions work well for ad hoc situations, but not for the production model.

Overall, it will be more effective for the consultant to understand our long-term goals so that we can work together to develop a more robust model. ■

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GAAP Accounting for Long-Duration Contracts: Ramifications for the Modeling Actuary

By Dave Czernicki, Jean-Philippe Larochelle, Ryan Laine and Sean Abate

In August 2018, the Financial Accounting Standards Board (FASB) issued the Accounting Standards Update[1] (ASU No. 2018-12) titled "Targeted Improvements to the Accounting for Long-Duration Contracts" with the objective to improve and simplify the financial reporting of long-duration contracts under Generally Accepted Accounting Principles (GAAP).

This accounting change impacts virtually every functional area within an insurance company, and the actuarial modeling process is not spared. During the short implementation period, life insurance actuaries will need to integrate new data sources into significantly revised actuarial models, while also working with other insurance functions to implement changes in information technology infrastructure and model governance.

In this article, we examine some important implications of long-duration targeted improvements (LDTI) for the modeling actuary.

In the first section, we focus on what we have found to be the most critical area of LDTI for actuaries: modeling implications of new GAAP standards for market risk benefits (MRB). Under LDTI, insurers have to identify MRBs within their product set, implement fair valuation in actuarial systems and retroactively determine at-issue valuation inputs for transition. This requires complex and computationally intensive calculations drawing upon market-calibrated risk-neutral scenario generation.

In the second section, we examine the modeling implications of the other aspects of the accounting change, including liability for future policy benefits (LFPB), deferred acquisition costs (DAC), and other transition and disclosure requirements. We cover some key considerations such as specific data requirements, impact on assumption management and disclosures.

This article is not meant to be exhaustive; we aim to provide a general overview of key considerations and potential pitfalls for the modeling actuary.

MODELING IMPLICATIONS OF MRBs

The new standard introduces a product classification called MRBs that aims to bring consistency to the accounting of features associated with deposit products that include market-based guarantees.

Any product or product feature classified as an MRB must be accounted for at fair value under the new guidance. Previously, such features were inconsistently accounted for under one of two different accounting models: the insurance accrual model (formally known as SOP 03-1[2]) or as an embedded derivative under the fair value model. This is illustrated for common variable annuity (VA) and fixed indexed annuity (FIA) MRBs in Table 1.

Table 1
Common Market Risk Benefits

Feature	Current GAAP	Post-LDTI
VA GMDB/GMIB	SOP 03-1	Fair value
VA GMWB	Fair value*	Fair value
VA GMAB	Fair value	Fair value
FIA GMDB/GMWB	SOP 03-1	Fair value

* Practice varies as some reserve portions of the contract under SOP 03-1
GMDB = Guaranteed minimum death benefit
GMIB = Guaranteed minimum income benefit
GMAB = Guaranteed minimum accumulation benefit
GMWB = Guaranteed minimum withdrawal benefit

It is important to note that FASB does not explicitly define what features constitute an MRB, but rather requires insurers to review any product or product feature against the criteria to determine the proper classification.[3]

Transition

FASB requires insurers to perform a full retrospective exercise to support the calculation of the opening balance for all MRBs as part of transition. The exercise involves calculating at-issue values of projected MRB benefits and associated fees using fair value concepts. Depending on the accounting model chosen, these amounts are needed to derive the associated attributed fee ratio that causes the MRB to have a fair value of zero at contract issue (under a non-option valuation model) or the host contract adjustment needed to offset the fair value of the MRB at contract issue (under an option-based approach). These requirements align with ASC 820[4] guidance that effectively requires contracts with embedded derivatives to show no accounting gain or loss at issue.

Insurers will have to gather at-issue policyholder data and market information along with assumptions that were effective across the period when the business was sold. FASB allows the use of hindsight, as defined in the ASU, should insurers not have access to all applicable historical assumptions:

> An insurance entity may use hindsight in instances in which assumptions in a prior period are unobservable or otherwise unavailable and cannot be independently substantiated.[5]

Disclosures

MRBs have specific disclosure requirements. For instance, detailed attribution of period-to-period change in fair value is required, with breakdown by components such as:

- Policy transactions, including new issuance, interest accrual, attributed fees collected and benefit payments
- Effect of changes in interest rates, equity market and index volatility
- Policyholder behavior
- Assumptions
- Instrument-specific credit risk

How Will Models Support the Requisite Fair Value Calculations?

Modeling actuaries should be aware of key considerations involved with fair value given the increased reliance on this valuation methodology under LDTI. The objective of this framework is to calculate a value that would, in theory, reflect market conditions as if the MRB were to be actively traded on financial markets. We outline specific elements that warrant attention beyond having the fundamental cash flow projection mechanics in place.

Fair value of insurance liabilities, such as those provided in the earlier overview, is typically derived from the average of discounted cash flows under a risk-neutral measure. This valuation model estimates MRB cash flows across a range of stochastically generated risk-neutral scenarios created by a risk-neutral generator.

Risk-neutral generators must be calibrated such that MRB valuation reflects market conditions. This is typically done using observable market information such as current yield curve and market value of actively traded instruments. Risk-neutral scenario sets produced by these generators must be tested with care, to confirm that market prices are reproduced and that arbitrage-free conditions are met (i.e., the "1 = 1 test").

Some MRB features are currently valued under the insurance accrual model, which uses real-world scenarios. Modeling actuaries should consider how these assumptions might now change under a risk-neutral framework.

Last, fair value often requires large scenario sets to reach a desired convergence threshold. This is particularly true for path-dependent MRB features such as ratchet death benefits. Modeling actuaries may explore variance reduction techniques to manage runtime and computing costs, but proper testing should be performed to confirm that the fair value has converged, with values stabilized and without the propensity for unexplained variances.

How Will Models Address the Demands of Transition?

Insurers will need to perform a retrospective exercise to retroactively calculate the components of MRB cash flows using fair value concepts. While this exercise may appear to hinge on an insurer's ability to gather necessary data as of issue, the burden of the exercise may end up falling on the modeling actuary.

Actuarial modeling will first have to implement historical assumptions, which includes loading mortality rates, coding dynamic lapse formulas and implementing any other assumptions such as rider utilization. Actuaries may also find creative

ways to streamline the MRB retrospective exercise by implementing automation within actuarial systems to reduce the need to produce at-issue source files.

Each aspect of the retrospective exercise needs to go through the proper testing and validation process. This is particularly important, as future reporting periods will reflect the fee ratios or host adjustment calculated as of issue under the retrospective exercise.

The modeling and testing effort would significantly increase should companies calculating fee ratios by cohort be required to reflect the actual new business at issue, including policies that have since lapsed.

Further, insurers will need to strike the right balance between fidelity and practicality for models, assumptions and data.

How Will Models Handle the Required MRB Disclosures?

Actuarial models will have to be adapted to calculate the fair value for each attribution item required by the guidance, in addition to any other line items elected by the insurance company. Beyond the calculations themselves, accessing process orchestration or batching tools, along with access to the right granularity of data, will prove important.

Modeling actuaries should be cautious in managing the associated runtime. A single fair value calculation can be calculation intensive, and so performing such calculations multiple times for different scenarios may warrant additional distributed processing capabilities beyond current capacity.

What Should be Considered for FIAs?

The implementation of fair value for MRBs on FIAs requires working through some additional key methodology considerations. This is unlike variable annuities, where fair value has already been introduced for guaranteed minimum benefit features that are currently classified as embedded derivatives. Few FIAs have MRB features requiring fair valuation under the current accounting model. The crediting mechanism on such products is based not only on market performance, but also on general account returns and cost of derivatives. This introduces complexity in fair value calculations not previously encountered.

Key methodology considerations affecting modeling of these guarantees mostly relate to the interaction of the MRB with the index-crediting mechanism of the base contract, which is itself fair valued. These include:

- Should general account assets and interactions with liabilities be modeled under risk-neutral scenarios?
- Given the methodology used for general account assets, how should the index-editing reset mechanism be handled?
- Should a full-blown fair valuation framework be established, capturing stochastic interest, equity returns and equity volatility, or are simplifying assumptions justifiable?
- Are there any additional methodology considerations for MRB given the existing accounting for index credit embedded value for FIAs?

These questions may have important implications for modelers implementing MRBs. For instance, fair value is typically performed on a policy basis, whereas general account assets are typically modeled in aggregate. Developing risk-neutral projections for a volatility surface is no small feat either.

Modeling actuaries may be called upon to test the financial impact of proposed methodologies, especially as the industry works through what risk-neutral valuation of such features really means. We caution modeling actuaries to monitor how these new features and methodologies affect core modeling in terms of model fidelity and runtime speed. It is advisable to keep track of any approximations or simplifications used.

How Will Models Handle Forecasting Needs Associated With MRBs?

Insurers that aspire to continue forecasting GAAP financial results will have to adapt their forecasting functionality accordingly. While certain core forecasting concepts such as inner and outer looping remain, calculating the fair value of MRBs has unique considerations relative to the insurance accrual model.

For instance, risk-neutral generators should always be calibrated to observable market prices, and this should remain true in a forecast setting. This is no small feat as it requires the risk-neutral generator to be embedded within the actuarial forecasting model and to be calibrated on the fly as the model transitions from forecasting to fair valuation.

Unfortunately, many actuarial systems may not be equipped to handle this level of sophistication, requiring insurers to rely on inaccurate projections for financial planning purposes.

MODELING IMPLICATIONS OF NON-MRB COMPONENTS

Liability for Future Policyholder Benefits

The mechanics of determining the LFPB have changed for long-duration contracts. These contracts include nonparticipating traditional life insurance and limited pay contracts. We highlight important changes introduced for LFPB in Table 2.

Table 2
Changes to Liability for Future Policyholder Benefits

Key Components	Current GAAP	LDTI
Assumptions	Locked in at issue	Reviewed annually
Margin for adverse deviation (MfAD)	Yes	No
Loss recognition testing	Yes	No
Net premium ratio (NPR) cap	None	100% cap
Discount rates	Expected investment yield at the contract issue, minus a pad	Upper-medium grade fixed-income instrument yields

Previously, FAS 60[6] provisions covered setting and management of assumptions, and the specific reporting requirements were virtually nonexistent. Under LDTI, LPFB reflects actual historical experience, to be reviewed annually, instead of locked-in assumptions.

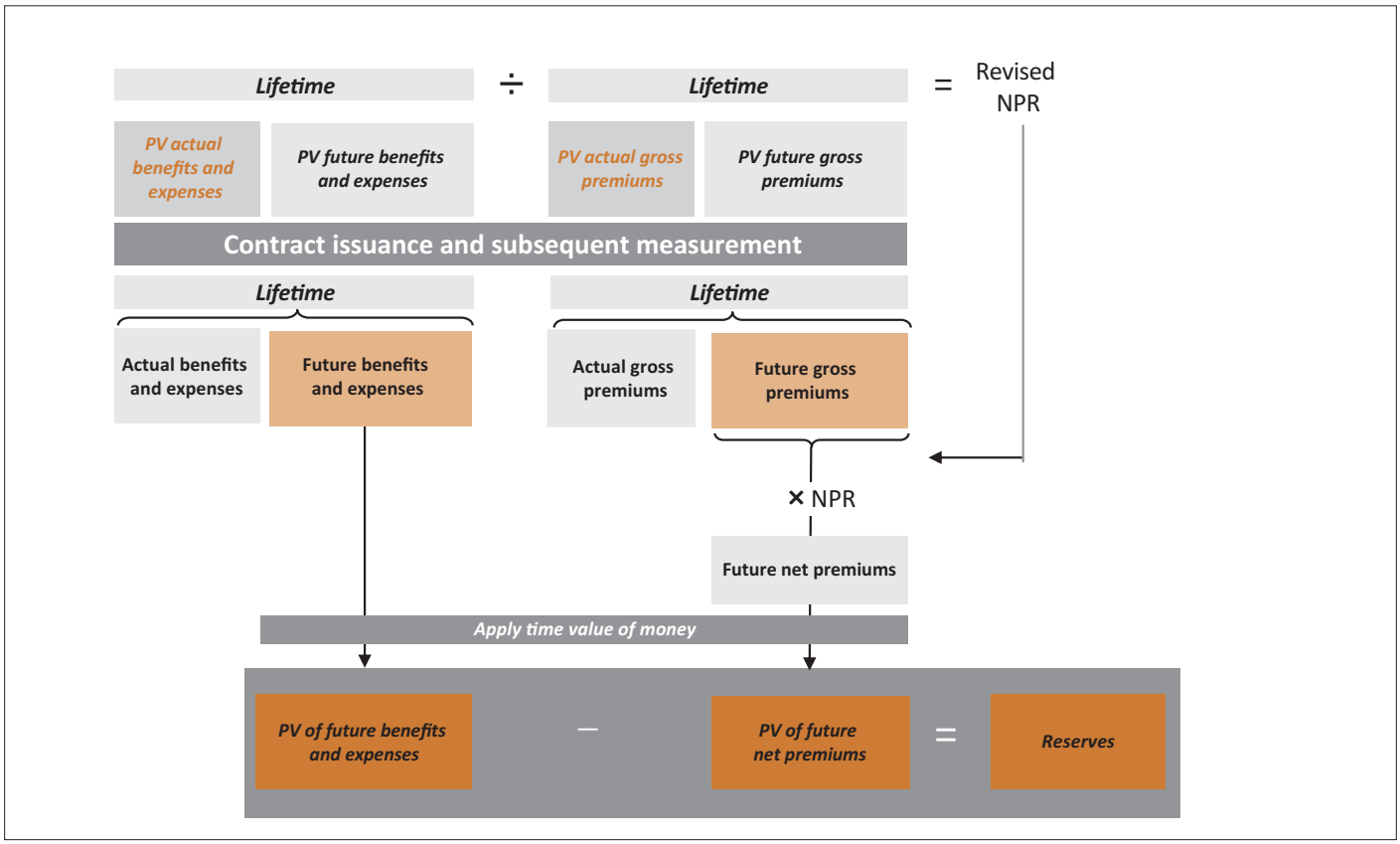
Although the new guidance keeps the fundamental net level premium approach, it requires insurers to review and update assumptions on an annual basis, or more frequently, if evidence suggests the need. The revised NPR is calculated using actual historical experience. Current assumptions for future cash flows are illustrated in Figure 1.

With respect to discount rates, the new guidance requires insurers to update rates used to measure the liability for future policyholder benefits. The liability is first measured using the discount rate at contract inception. It is then remeasured using the updated discount rate. The difference is recorded in other comprehensive income (OCI).

Deferred Acquisition Costs

Perhaps the biggest reprieve for modeling actuaries comes in the form of changes to DAC. LDTI eliminates complex amortization bases such as estimated gross profits or estimated gross margins under current GAAP with a simplified, straight-line basis over the life of the contract for DAC. LDTI also eliminates the need for impairment testing and shadow DAC.

Figure 1
Contract Issuance and Annual Review of Assumptions



Under the new guidance, DAC can be amortized by individual contracts under a straight-line basis or by grouped contracts under a constant-level basis that approximates the seriatim straight-line.

Transition

FASB provides insurers two options in implementing the amendments for LFPB and DAC. The default option is the modified retrospective approach, but the insurer has the option to apply the amendment full retrospective if the insurer can provide the appropriate support.

Under the modified retrospective approach, the transition values are set equal to the existing carrying amounts.

Under the retrospective approach, insurers apply the new accounting standard going back to contract inception and then record the difference in values as a cumulative catch-up adjustment as of the transition date to retained earnings. This approach, if elected, must be used consistently to all products entitywide and requires the availability of actual, historical data at the level of granularity necessary to perform the required calculations. Estimates of such data are not acceptable.

Disclosures

Insurers are required to provide enhanced disclosures designed to increase transparency for users of the financial statements. The additional requirements of LDTI impact both annual and interim financial statements. An insurer needs to evaluate its current process, systems and controls in preparation for these disclosures.

How Will My Models Consider the New Data Requirements of LDTI?

Now that NPRs need to reflect actual historical experience for nonparticipating traditional life and limited pay contracts, insurers are required to update the front-end processes for their actuarial models, including sourcing and receiving of new data. This is not a new concept for insurers that already amortize DAC under a retrospective unlocking method and have a process in place to update estimated gross profits with actual experience for such business. Nevertheless, it may prove challenging to source the data, particularly for older vintages of FAS 60 business.

Under LDTI, insurers need to capture actual historical cash flows at the cohort level for nonparticipating traditional life and limited pay products. The actuarial models need to be updated with the revised NPR calculation, using actual historical experience and current assumptions for future cash flows.

Insurers should assess the current state of their data for availability, accuracy and level of granularity. Systems and data flow process need to be identified to feed the actuarial models. Insurers should perform a gap analysis on data, systems and processes under the new standard to understand the enhancements required.

How Will Assumption Management Practices Change?

Prior to the new guidance, assumptions were "locked-in" unless a premium deficiency existed when calculating the LFPB. The new guidance requires assumptions to be best estimate assumptions, which will encourage insurers to assess their current assumption setting and management processes. Most insurers should be able to leverage aspects of current processes and models currently using best estimate assumptions.

For LDTI, insurers need to increase the robustness of controls, warehousing and documentation of assumption data. The increased demand for experience analysis puts a greater focus on automating the process and increasing the integrity of the underlying data. Finally, with best estimate assumption sets becoming more prominent, insurers will want to create synergies by unifying these assumption sets to promote a "single source of truth" for their assumption data.

This increased focus around the best estimate assumptions used in actuarial models provides a great incentive for insurers to evaluate their assumption setting and management processes. The evaluation should consider how the insurer will be positioned when LDTI becomes effective.

How Will Actuarial Models Support the New Disclosure Requirements?

Insurers will be required to make additional disaggregated disclosures, including roll-forwards and quantitative and qualitative information about significant inputs, judgments and assumptions used in the measurement of liabilities.

The new guidance not only requires actuarial modelers produce additional granularity in their reports but also that

additional projections be performed to produce the roll-forwards. Insurers will want to perform a gap analysis to identify the additional output data elements required for GAAP reporting and their associated level of granularity. Based on that gap analysis, modelers will be better able to evaluate the actuarial modeling process for reporting. Insurers will want to develop an automated production process to produce the new disclosure requirements and provide sufficient analysis to meet business needs.

These additional requirements being placed on the actuarial modeling process will put pressure on the financial close process. Insurers should evaluate their current process and assess where enhancements will be required to fulfill the new requirements.

PUTTING IT ALL TOGETHER

The U.S. GAAP targeted improvements bring some interesting challenges, with considerations to actuarial modeling going far beyond simply updating the calculation methodology.

In addition to the implementation considerations, it is important for modeling actuaries to take an active role in helping to plan their company's transition by developing a near-term action plan to orchestrate elements of this transition. It will also be important for modeling actuaries to keep refining financial impact assessments as models are adapted for the new framework while effectively communicating results to management.

Moving into the post-implementation phase, there will be heightened focus on the actuarial modeling process, increasing pressure on an insurer's ability to effectively manage the modeling environment. This includes data quality and management, assumption and model governance, and general modeling oversight. ■

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ENDNOTES

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Modeling in the Cloud

By Trevor Howes

Actuarial modeling teams are under pressure from many directions. Standards and regulations are changing everywhere, imposing new methods, more granular models and assumptions that must be updated to reflect current estimates. For International Financial Reporting Standard (IFRS) 17,[1] and U.S. Generally Accepted Accounting Principles (GAAP) with targeted improvements, models must also be run again many times within a reporting cycle to analyze and decompose the causes of change for disclosure purposes.

With the pace and magnitude of change, governance of model changes and control over the process of model improvements becomes an even greater challenge. At the same time, actuaries' work is subject to increased scrutiny.

> Massively scalable cloud processing has come online that can enable faster actuarial model run completion ...

It would be wonderful if actuarial modeling teams were given more time to perform the required calculations and investigate and test the results for quality. While that is an attractive idea, it is not going to happen. Reporting windows are narrowing, more post-processing of actuarial calculations are needed, and data aggregation and disaggregation must also occur. Actuarial models are being caught in a perfect storm of change.

However, there is good and timely news from the technology side that may help address these pressures and challenges. Massively scalable cloud processing has come online that can enable faster actuarial model run completion without the commensurate capital and operating cost investment. Here is why cloud processing options can be such a benefit.

Actuarial models, especially those involving stochastic processing and hedging calculations, have required increasing computational power in recent years. The solution thus far has been to find ways to distribute the model calculations over server farms, organized as grids. This allows many independent cores to work in parallel to finish a complete run in a fraction of the time that a single core, or a single computer with multiple cores, requires to complete the same task.

It has worked well, to a degree, but has depended, at least in the beginning, on each company designing, purchasing, installing, configuring and operating its own private complex of powerful servers. The hardware purchased was carefully configured in terms of the size and speed of processors, the numbers of cores and amount of disk capacity per box, the operating software and middleware, and the network connectivity to suit not only the actuarial modeling system but also other enterprise applications demanding a share of that precious resource.

The grid capacity has had to be sufficient to meet peak needs during critical reporting windows yet also be reasonably well-occupied by other tasks between these windows. As needs have rapidly and unexpectedly increased, extra capacity has been difficult to plan, fund and bring online, impacting capital budgets and straining information technology support personnel.

The public cloud has been offering convenient alternatives for massive compute capacity for some time. The combination of newly available compute instances (including GPGPU-enabled instances) and reduced prices, plus the ability of actuarial modeling systems to exploit that new cloud capacity quickly, conveniently, and securely, is coming at an optimal time.

The greatest advantage of harnessing the cloud for large-scale modeling runs probably comes from the massive processing capacity in the cloud, which can be designed and suited to actuaries' modeling requirements. Cloud users can configure the exact number and type of compute instances with the power and associated disk space that is most effective for their needs. The virtual farm can be spun up and readied in minutes. The modeling run can commence without waiting in a queue for resources to be freed up, and without the risks of other tasks and users interfering with the performance of the run.

If multiple models need to be run for different purposes, or there are other teams or applications in the same company with the same reporting windows, they can all start their jobs and have them running simultaneously because each one is in effect requesting its own independent and private farm in the cloud.

The result is not only faster turnaround, but also greater predictability of run times, and more capacity to cope with emergency reruns of critical steps.

Assuming that cloud usage of the grid computing is only charged as it is allocated to a job, there are no wasted costs

of idle resources between runs or reporting periods, and no downside to requesting as many cores as can be managed by the modeling software—provided they can be kept busy on parallel tasks.

Furthermore, the requisition of cloud resources, provisioning of the farm, transfer of the model to and from the cloud, and release of the cloud on completion can be fully automated. This results in no extra burden on IT personnel, no upfront capital costs and planning effort, and no fighting for priority and access on the new facility. Compare that to your life sharing a fixed-infrastructure or traditional server farm. As an added bonus, the cloud allows you to quickly exploit new state-of-the-art hardware without waiting for the expiry of your current equipment lease.

So if actuaries can get prepared to harness the new capabilities and elasticity of the cloud for their modeling work, they may confidently face the aggressive challenges of IFRS 17 or U.S. GAAP targeted improvements in a timely and effective way. And maybe, that same new modeling capability will help unlock new analytics, added value and transformational change. ■

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ENDNOTE

1 International Accounting Standards Board. 2017. International Financial Reporting Standard (IFRS) 17: Insurance Contracts. *https://www.ifrs.org/issued-standards/list-of-standards/ifrs-17-insurance-contracts/.*

2018 SOA Modeling Sessions, Part 1

By Jennifer Wang

Here are modeling-related sessions from some of the major 2018 Society of Actuaries (SOA) meetings: Life & Annuity Symposium, Health Meeting and the Valuation Actuary Symposium. SOA members have free access to audio recordings synchronized with slide presentations from these meetings, so check them out.

2018 LIFE & ANNUITY SYMPOSIUM

SESSION 14 PANEL DISCUSSION: THE SEARCH FOR MODEL EFFICIENCY THROUGH DATA COMPRESSION

Moderator: Trevor C. Howes, FSA, FCIA, MAAA
Presenters: Dan (Danielle) Li, FSA; Andrey Marchenko

Models are essential for many critical purposes that demand fast completion and accurate results, yet runtimes are exploding with new stochastic methodology, stress testing and the need to reflect individual policy characteristics. The costs of IT infrastructure and actuarial resource support are unsustainable. Compression of business data files using techniques like data clustering can be an effective way to address this issue. Presenters provided an overview to clustering as it is commonly applied in practice, and discussed roadblocks to implementing clustering and how these roadblocks might be overcome. Research into techniques including artificial intelligence methodologies that can help automate the implementation, configuration and validation of clustering algorithms were presented. (See session slides at *https://www.soa.org/pd/events/2018/las/pd-2018-05-las-session-014.pdf.*)

SESSION 15 PANEL DISCUSSION: TRADE-OFFS IN MODELING: BALANCING COMPETING GOALS

Moderator: Ricardo Trachtman, FSA, MAAA
Presenters: Brian D. Holland, FSA, MAAA; Yara Rogers-Silva

Predictive modeling inherently involves various trade-offs. Actuaries have balanced those trade-offs since the smoothness vs. fit issue in graduation, if not before. Presenters looked in depth at the trade-offs between smoothness and fit; accuracy and communicability; and description and prediction, the bias and variance trade-off from machine learning. (See session slides at *https://www.soa.org/pd/events/2018/las/pd-2018-05-las-session-015.pdf.*)

SESSION 33 TEACHING SESSION: FURTHER RESEARCH ON SOA EXPERIENCE STUDY CALCULATIONS

Moderator: Cynthia MacDonald, FSA, MAAA
Presenters: Hezhong (Mark) Ma, FSA, MAAA; John K. McGarry, ASA, Ph.D.

Expanding on the SOA's Experience Study Calculations educational tool published last year, the authors presented further research on the absolute and relative errors arising from the main study methods, how these errors accumulated in a calendar year study, and a method that largely eliminated the errors, as well as user feedback on the original paper. (See session slides at *https://www.soa.org/pd/events/2018/las/pd-2018-05-las-session-033.pdf.*)

SESSION 46 PANEL DISCUSSION: NEWLY PROPOSED ASOPS: PRICING, MODELING AND SETTING ASSUMPTIONS

Moderator: Donna Christine Megregian, FSA, MAAA
Presenters: Donna Christine Megregian, FSA, MAAA; James A. Miles, FSA, MAAA; Michael W. Santore, FSA, MAAA

Seasoned presenters discussed three important Actuarial Standard of Practice (ASOP) exposure drafts recently proposed by the

Actuarial Standards Board: Pricing of Life Insurance and Annuity Products, Modeling and Setting Assumptions.

Actuaries use numerous models that have various applications [e.g., economic capital, Generally Accepted Accounting Principles (GAAP) reporting, pricing, etc.]. It's important that the use of assumptions is appropriate in light of the model's intended purpose. Focused topics of discussion addressed what these newly proposed ASOPs mean for the actuary. (See session slides at *https://www.soa.org/pd/events/2018/las/pd-2018-05-las-session-046.pdf*.)

SESSION 52 PANEL DISCUSSION: EXPERIENCE STUDY COMMON FORMATS

Moderator: Lindsay Keller Meisinger, FSA, MAAA
Presenters: Michael Anthony Cusumano, FSA; Katherine Warner McLaughlin, FSA, MAAA; Erin Colleen Wright, FSA, MAAA

Many companies contribute to a variety of industry studies, experience studies sponsored by reinsurers and consultants, and statistical agent data calls. Having a shared understanding of experience study data would improve efficiency, promote better communication and facilitate deeper understanding of the industry experience. The National Association of Insurance Commissioners' VM-51[1] was designed in part to aid companies in the collection of experience data in a format specified for principle-based reserve (PBR) purposes. This data format is used for industry experience analysis but has limitations.

Presenters evaluated the current practice in preparing experience data, discussed the limitations and potential improvements to a common format for experience analysis, and reviewed regulatory activities to better capture the experience data. (See session slides at *https://www.soa.org/pd/events/2018/las/pd-2018-05-las-session-052.pdf*.)

SESSION 55 PANEL DISCUSSION: WHEN IS YOUR OWN DATA NOT ENOUGH?

Moderator: Robert E. Winawer, FSA, MAAA
Presenters: Leonard Mangini, FSA, MAAA; Timothy S. Paris, FSA, MAAA

Complex long-term products with a short history and interrelated policyholder options can be particularly challenging for those responsible for experience studies and assumption models. Sophisticated data analytics techniques, in conjunction with own-company and industry data, can dramatically improve these processes, providing greater insights into the experience data, more clarity in areas where expert actuarial judgment is needed and even the opportunity to reinsure these risks. Presenters used policyholder behavior data and examples from the variable annuity, fixed indexed annuity markets and life insurance markets. (See session slides at *https://www.soa.org/pd/events/2018/las/pd-2018-05-las-session-055.pdf*.)

SESSION 58 PANEL DISCUSSION: MODELING FUNCTION: TO CENTRALIZE OR NOT TO CENTRALIZE?

Moderator: Joshua S.Y. Chee, FSA, MAAA
Presenters: Joshua S.Y. Chee, FSA, MAAA; Sean Michael Hayward, FSA, MAAA; Michael Porcelli, FSA, MAAA

In reaction to a spate of model conversion activity and rising acceptance of model risk management techniques, many companies have centralized, or are in the process of centralizing, their modeling function to accommodate both governance and efficiency demands. These operating model changes have produced a wide range of questions and issues, such as division of labor, roles and responsibilities, and selection of tasks to keep decentralized, among others. Presenters framed a series of key modeling function considerations and shared lessons learned with the audience. (See session slides at *https://www.soa.org/pd/events/2018/las/pd-2018-05-las-session-058.pdf*.)

SESSION 59 TEACHING SESSION: MACHINE LEARNING AND RISK

Moderator: Dan Kim, FSA, CERA, MAAA
Presenters: Dan Kim, FSA, CERA, MAAA; Anthony D. Green, FSA, CERA, FCA, FRM, MAAA, MPhil

Machine learning techniques including predictive modeling are getting popular in life and annuity insurance underwriting, pricing and valuation. The same is true for risk management and risk calibration purposes. Presenters illustrated some machine learning techniques and how they could be used for risk management. Examples included how a predictive model used for a best estimate assumption could be used to develop risk margins and inform risk management on the accuracy or uncertainty of its predictions. (See session slides at *https://www.soa.org/pd/events/2018/las/pd-2018-05-las-session-059.pdf*.)

SESSION 72 PANEL DISCUSSION: EXPERIENCE STUDIES AND ASSUMPTION-SETTING CONTROLS

Moderator: N. Shane Leib, FSA, MAAA
Presenters: Kelly Jin, FSA, MAAA; Carrie Lee Kelley, FSA, MAAA; Kimberly M. Steiner, FSA, MAAA

In light of new principle-based reserve regulations, presenters explored the background for increased review over experience studies and assumption-setting practices. For PBR, there is a need to produce more experience studies and there has been more focus from external parties, including regulators and external auditors.

As there is increasing scrutiny over these area, and as actuaries continue to focus on controls, more will be heard about current industry practices for companies with limited resources and views from external parties. (See session slides at *https://www.soa.org/pd/events/2018/las/pd-2018-05-las-session-072.pdf*.)

SESSION 80 PANEL DISCUSSION: MODEL VALIDATION FRAMEWORK AND BEST PRACTICES

Moderator: Joshua David Dobiac, JD, MS, CAIA
Presenters: James Stuart McClure, FSA, MAAA; Zohair A. Motiwalla, FSA, MAAA

The refrain "All models are wrong but some are useful" is a common aphorism in the actuarial field. Certainly, models are at the core of what actuaries do. Irrespective of whether actuaries are involved in the pricing, valuation, risk management or hedging functions, their work means building, using, modifying or reviewing models in some fashion.

In recent years, there has been strong insurance industry focus on model validation and governance frameworks, typically at the direction of senior management and regulators. When properly carried out, such a framework can increase stakeholder confidence in the company financials. Such stakeholders include senior management and other end-users. Presenters discussed the approaches used in the industry to construct this framework, and best practices for concepts such as baselining, model inventory, model validation, effective challenge and user-acceptance testing for actuarial and non-actuarial functions. (See session slides at *https://www.soa.org/pd/events/2018/las/pd-2018-05-las-session-080.pdf*.)

2018 HEALTH MEETING

SESSION 11 PANEL DISCUSSION: CREDIBILITY ISSUES FOR LONG-TERM DISABILITY INSURANCE

Presenters: Paul L. Correia, FSA, CERA, MAAA; Tasha S. Khan, FSA, MAAA

Historical experience is used by group disability insurers to inform their pricing, underwriting and reserving work. Understanding the statistical credibility of that experience is crucial to making well-informed decisions. The panelists in this session provided a detailed discussion of credibility analysis specific to long-term disability insurance, including a summary of recent SOA research on the topic. (See session slides at *https://www.soa.org/pd/events/2018/health-meeting/pd-2018-06-health-session-011.pdf*.)

SESSION 15 PANEL DISCUSSION: BENEFIT MODELING MADNESS

Moderator: Joseph P. Slater, FSA, MAAA
Presenters: Hobson D. Carroll, FSA, MAAA; Joshua R. Strupcewski, FSA, MAAA; Dustin D. Tindall, FSA, MAAA

Panelists discussed the issues driving the increasing complexity of health benefit plans. They also described the traditional tools used to value health benefit plans and how those tools handle the more complex health benefit plans. Finally, they reviewed the new generation of benefit plan valuation models being developed to address the more complex plan health benefit plans. (See session slides at *https://www.soa.org/pd/events/2018/health-meeting/pd-2018-06-health-session-015.pdf*.)

SESSION 38 PANEL DISCUSSION: USE OF BIG DATA TO OPTIMIZE PLAN DESIGN

Moderator: David V. Axene, FSA, CERA, FCA, MAAA
Presenters: Jordan Armstrong; David V. Axene, FSA, CERA, FCA, MAAA; Timothy W. Smith, ASA, MAAA

Actuaries can utilize consumer information to help optimize benefit plan designs to proactively impact health care costs and utilization of benefits. This session presented a recent case study showing how this was accomplished. This makes use of "personas," detailed health care analytics, and actuarial health cost models. This is based upon an actual client project. (See session slides at *https://www.soa.org/pd/events/2018/health-meeting/pd-2018-06-health-session-038.pdf*.)

SESSION 41 PANEL DISCUSSION: IS IT TIME TO REVIEW YOUR TREND MODEL?

Moderator: Joan C. Barrett, FSA, MAAA
Presenters: Joan C. Barrett, FSA, MAAA; Bethany McAleer, FSA, MAAA

Most health plans have a system to project pricing trends, but given today's dynamic environment, the system may need to be reviewed and refreshed. In this session, the presenters discussed methods to determine if changes are worth the effort, a review of techniques for determining trends, key factors that may impact trends in the near future and techniques for adapting trend models to measure risk and determine actionable steps to reduce costs. In addition, longer-term factors were discussed in some detail. (See session slides at *https://www.soa.org/pd/events/2018/health-meeting/pd-2018-06-health-session-041.pdf*.)

SESSION 65 LECTURE: MEDICAID RISK ADJUSTMENT: PHYSICIAN-BASED MODEL CORRELATION

Presenters: Chris Dickerson; Barry Jordan, ASA, MAAA

The use of health status-based risk adjustment is a common practice in health care, in particular for Medicaid programs as part of capitation rate development. With more and more emphasis being placed on alternative payment methods, including subcapitation and incentive arrangements that cover a specific subset of services within the Medicaid program, the use of new or recalibrated risk adjusters geared to predict the utilization of specific services shows more and more potential. While this is not in itself a new concept, the presenters shared their findings of calibrating existing risk adjustment products to focus on a specific set of professional services. The presenters shared the results of how calibration of

risk adjustment tools toward a specific set of physician services correlates among multiple states, as well as discussed some of the potential uses of this approach as states and health plans continue to emphasize effective payment strategies specific to a subset of services. (See session slides at *https://www.soa.org/pd/events/2018/health-meeting/pd-2018-06-health-session-065.pdf*.)

SESSION 73 LECTURE: ADVANCED ANALYTICS AND PREDICTIVE MODELING IN LOSS RESERVING

Presenter: Mark M. Zanecki, ASA, MAAA

Actuaries typically estimate insurance liabilities with models focused on triangle development patterns and other assumptions that comprise standard practice(s) of modern actuarial analyses. Advances in computing technology has led to improvements including stochastic methods, finer segmentation and frequent analysis, but machine learning/predictive methods hold the promise of improved accuracy and reliability. By using machine learning/predictive modeling build on graphics processing unit (GPU) servers, we can expect extraordinary advances that will fundamentally transform actuarial analyses in the years ahead. The presenter began with a brief overview of advanced modeling methods to estimate claim level liabilities. He also reviewed the challenges of claim level analysis and the benefits of claim triage to identify key characteristics early in the analysis of claims. He proceeded to a review of a first-generation application of machine learning to actuarial reserve analysis. (See session slides at *https://www.soa.org/pd/events/2018/health-meeting/pd-2018-06-health-session-073.pdf*.)

SESSION 79 PANEL DISCUSSION: USING PREDICTIVE ANALYTICS TO DEVELOP ASSUMPTIONS

Moderator: Jonathan D. White, FSA, CERA, MAAA
Presenters: Missy A. Gordon, FSA, MAAA; Brian M. Hartman, ASA

Predictive modeling is no stranger in the world of health insurance. The primary focus of such analysis for medical insurance has been on the near future and disease management. However, presenters discussed how predictive analytics has been used to develop projection assumptions for long-term care insurance by applying experience adjustments to a benchmark. They examined how predictive modeling can be used to overcome challenges with traditional actual-to-expected studies and how it produces more statistically robust projection assumptions. They also explored how to use predictive modeling to understand the range of potential error in the projection assumption and whether emerging experience is deviating materially from assumptions. The discussion focused on morbidity assumptions for long-term care insurance, but the concepts can translate to various other assumptions (e.g., mortality) and other lines of business (e.g., disability, life and Medicare supplement) where one wants to experience adjust a benchmark assumption. (See session slides at *https://www.soa.org/pd/events/2018/health-meeting/pd-2018-06-health-session-079.pdf*.)

SESSION 94 PANEL DISCUSSION: BEYOND RISK IDENTIFICATION: PREDICTIVE ANALYTICS IN HEALTH

Presenters: Elena V. Black, FSA, EA, FCA, MAAA; Yi-Ling Lin, FSA, FCA, MAAA; Michael Y. Xiao, FSA, CERA, MAAA

In health, complex business problems are being tackled with a wide range of predictive analytics techniques, from traditional risk assessment linear regressions to innovative machine learning methodologies. One such example is applying a gradient boosting machine (tree-based) learning technique to predict a population's health plan elections among a menu of available plan options and pricing. Exploring and understanding mathematical underpinnings of methodologies, utilized in predictive analytics, is one necessary step in harnessing the power of this new actuarial toolbox. Demystifying the "black box" is necessary but not sufficient. An entire chain of necessary steps is required: formulating relevant business problems in the right way, understanding and visualizing the data and potential trends, applying appropriate optimization tools and, finally, interpreting modeling results to solve the business problem at hand. Presenters illustrated these steps through case studies. They discussed the attributes of business problems in the health care area that can greatly benefit from sophisticated machine learning and other analytical techniques; demonstrated how these algorithms are applied, leading to results that aid in an informed decision-making process; and showed how data exploration and visualization can lend a powerful hand in understanding not only data but modeling results. (See session slides at *https://www.soa.org/pd/events/2018/health-meeting/pd-2018-06-health-session-094.pdf*.)

SESSION 100 PANEL DISCUSSION: PREDICTIVE MODELS FOR DISABILITY INSURANCE

Presenters: Jeffrey S. Bowden, FSA, MAAA; Mark J. Costello, FSA, MAAA

Attendees learned about the various uses for predictive models in disability insurance. Panelists discussed both theoretical approaches and actual applications in beta or production today. The session explored text mining in the management of disability claims and text mining in evaluating medical records. Presenters discussed the use of multivariables in disability pricing and risk selection. (See session slides at *https://www.soa.org/pd/events/2018/health-meeting/pd-2018-06-health-session-100.pdf*.)

SESSION 109 PANEL DISCUSSION: MEDICAL COST REDUCTION OPPORTUNITIES AND CARE MODEL DESIGN

Moderator: Christopher A. Schmidt, FSA, MAAA
Presenters: Jeffrey J. Burke, ASA, MAAA; Christopher A. Schmidt, FSA, MAAA; Mike Van Den Eynde

The cost of health care in the U.S. has been on an unsustainable rise for some time driven by fundamental delivery and financing challenges. Health plans need to seek greater control and effectiveness of care management resources, while consumers are demanding care be more personalized and patient-centric. Health plans need to use data analytics to identify opportunity areas with the most potential for reducing costs through care model redesign. Understanding key care model trends, design concepts, and steps for developing and enhancing comprehensive care design models will lead to reduced costs for health plans. (See session slides at *https://www.soa.org/pd/events/2018/health-meeting/pd-2018-06-health-session-109.pdf*.)

SESSION 124 TEACHING SESSION: A PRACTICAL GUIDE TO MACHINE LEARNING FOR ACTUARIES

Presenter: Dave M. Liner, FSA, CERA, MAAA

Machine learning is rapidly transforming how many industries function. This session described the evolving machine learning landscape, provided a pedagogical introduction to common machine learning methods and identified how actuaries can use machine learning to gain better insight. Many machine learning methods are built on principles that many actuaries have acquired through basic actuarial education. (See session slides at *https://www.soa.org/pd/events/2018/health-meeting/pd-2018-06-health-session-124.pdf*.)

2018 VALUATION ACTUARY SYMPOSIUM

SESSION 31PD: (DATA) SWAMP THING: MANAGING YOUR ORGANIZATION'S MOST VALUABLE ASSET

Moderator: Stephen J. Bochanski, FSA, CERA, MAAA
Presenters: Yusuf Abdullah; Lisa M. Nurse, ASA, MAAA

Data has always been the actuary's most precious commodity. Today, we're seeing an increased focus on data at the enterprise level as an organizational asset with the advent of enterprise data strategies, chief data officer roles and data stewards. And yet, the current state of data at many companies resembles the Wild West. This session explored strategies and technologies being used to wrangle, sift, organize and manage the disparate data sources that feed the data swamp. (See session slides at *https://www.soa.org/pd/events/2018/valact/pd-2018-08-valact-session-031.pdf*.)

SESSION 42PD: ASSET MODELING CHALLENGES FOR VM-20 PROJECTIONS

Moderator: Jason E. Kehrberg, FSA, MAAA
Presenters: Jason E. Kehrberg, FSA, MAAA; Reanna Marie Nicholsen, FSA, MAAA; Benjamin Morris Slutsker, FSA, MAAA

With the first year of the National Association of Insurance Commissioners (NAIC) VM-20[2] transition period under the U.S. life insurance industry's belt, there has been significant focus on overcoming modeling challenges for principle-based reserve valuation. This session informed actuaries of the technical challenges encountered when modeling assets for VM-20, including both a modeling and regulatory perspective. Attendees became better positioned to deal with modeling issues related to starting assets, future hedges, negative reserves and asset modeling simplifications. Additionally, many companies have started to turn the page from implementing point-in-time PBR reserves for statutory reporting to projecting PBR reserves at future dates. This session also profiled specific challenges that can arise when actuaries use models to project PBR reserves at future dates, such as determining starting assets and setting VM-20 asset assumptions at future valuation dates, and other technical issues related to modeling assets within nested model structures that have both inner and outer loop projections. (See session slides at *https://www.soa.org/pd/events/2018/valact/pd-2018-08-valact-session-042.pdf*.)

SESSION 50WS: ASSUMPTION SETTING UNDER VM-20

Moderator: Paul Fedchak, FSA, MAAA
Presenters: Arnold A. Dicke, FSA, CERA, MAAA; Leonard Mangini, FSA, MAAA

In this buzz group format session, attendees discussed assumption setting under VM-20. (See session slides at *https://www.soa.org/pd/events/2018/valact/pd-2018-08-valact-session-050.pdf*.)

SESSION 53PD: COMBINATION PRODUCT HOT TOPICS—VALUATION, TAX AND MODELING

Moderator: Lo Linda Chow, FSA, MAAA
Presenters: Lo Linda Chow, FSA, MAAA; Ryan LaMar Holt, FSA; Craig R. Springfield, J.D.

Combination products [e.g., 26 U.S. Code § 7702B long-term care (LTC) riders, 26 U.S. Code § 101(g) chronic illness benefits or linked benefits] continue to gain momentum amid the private long-term care insurance crisis. There is an increasing amount of carriers considering adding either chronic illness riders or LTC riders to their life policies. This session covered hot topics related to combination products, which include industry valuation approaches, NAIC development (including PBR), tax reform and its implication, assumption and modeling considerations. (See session slides at *https://www.soa.org/pd/events/2018/valact/pd-2018-08-valact-session-053.pdf*.)

SESSION 57: NEWLY PROPOSED ASOPS (MODELING AND ASSUMPTIONS)

Moderator: James A. Miles, FSA, MAAA
Presenters: James A. Miles, FSA, MAAA; Yifeng Mu, FSA, CERA, FCIA; Michael W. Santore, FSA, MAAA

The proposed Assumptions Actuarial Standard of Practice (ASOP) will "apply to actuaries performing actuarial services which include setting and/or assessing the reasonableness of assumptions." The proposed Modeling ASOP will "apply to actuaries in all practice areas performing actuarial services when selecting, designing, building, modifying, developing, using, reviewing or evaluating all types of models that are not simple models." Actuaries use numerous models that have various applications (e.g., economic capital, GAAP reporting, pricing, etc.). It's important that the use of assumptions are appropriate in light of the model's intended purpose. Focused topics of discussion addressed what these newly proposed ASOPs mean for the actuary. (See session slides at *https://www.soa.org/pd/events/2018/valact/pd-2018-08-valact-session-057.pdf*.)

SESSION 62PD: SETTING ASSUMPTIONS FOR ANNUITIES UNDER VM-21

Moderator: Kendrick D. Lombardo FSA, MAAA
Presenter: John Thomas Dizer, FSA, MAAA

This session covered assumption determination for annuities under VM-21[3] with emphasis on contract holder behavior assumptions, prudent estimate mortality assumptions and measuring credibility. (See session slides at *https://www.soa.org/pd/events/2018/valact/pd-2018-08-valact-session-062.pdf*.)

SESSION 66PD: PREDICTIVE ANALYTICS APPLICATIONS

Moderator: Alexander Jonathan Laurie, MAAA, FCAS
Presenters: Emily Marie Cassidy, FSA, MAAA; Talex Diede, MS; Richard Marshall Lagani Jr., MA; Alexander Jonathan Laurie, MAAA, FCAS

Predictive modeling is the latest tool in the insurer's arsenal, which derives deeper insights from data to extract more informational value. Predictive modeling techniques are being used to review assumptions more efficiently, develop risk margins and inform powerful business decision-making. This session provided guidance for implementing predictive modeling techniques to improve experience studies and set modeling assumptions for life and annuity products. Using a case study and real-world issues, presenters walked through the predictive model development and validation process, explained how to interpret results and discussed considerations for operationalizing the new assumption structure within a traditional valuation/projection model. (See session slides at *https://www.soa.org/pd/events/2018/valact/pd-2018-08-valact-session-066.pdf*.)

SESSION 67PD: MODELING ASSETS AND OTHER ALM MODELING CONSIDERATIONS

Moderator: Nicholas B. Brink, FSA, MAAA
Presenters: Nicholas B. Brink, FSA, MAAA; Stephen G. Smith, FSA, MAAA; Matthew Ming Zhou Zhang, FSA, CERA, MAAA

This session focused on asset modeling in a liability projection system that includes the link between asset modeling and investment strategy, the impact of modeling choices and discussion around discount rates. (See session slides at *https://www.soa.org/pd/events/2018/valact/pd-2018-08-valact-session-067.pdf*.)

SESSION 77PD: POST-MODEL TRANSFORMATION … TRANSFORMATION!

Moderator: Bryan Christopher Lindsley, FSA, MAAA
Presenters: Graham Miller Bryce, FSA; Yonghai Chen, FSA; Benjamin Carl Farnsworth, FSA, CERA, MAAA

Many insurers and reinsurers have modernized/converted their models over the last five years to meet new financial reporting requirements and strengthen efficiency, controls and governance. Conversion projects are often subjected to timeline and data constraints that limit the end-state model from meeting its full potential. The panel facilitated an interactive discussion with the audience through a live survey and addressed key items that can often be improved upon on post-conversion. (See session slides at *https://www.soa.org/pd/events/2018/valact/pd-2018-08-valact-session-077.pdf*.)

SESSION 78PD: MODEL GOVERNANCE IN AN OPEN-SOURCE WORLD

Moderator: Sean Michael Hayward, FSA, MAAA
Presenters: Rohan Noel Alahakone, ASA, MAAA; Dorothy L. Andrews, ASA, MAAA

Many companies struggle with the decision to adopt open-source versus closed-source systems for modeling. Models are used to price products, project future profits and determine how much capital to hold, providing important financials for financial reporting as well as management decision-making and predictive modeling. An error in a model or the modeling process can lead to huge losses, penalties, loss of reputation and even financial failure.

The banking industry has mature and regulated governance processes around its models. The insurance industry has a renewed impetus to advance a mature model governance framework due to recent awareness and new valuation regulations emphasizing model governance to reduce model risk. Model risk is an important consideration when choosing between open- or closed-source systems. A common belief in the industry is that closed-source systems pose less model risk than open-source systems, and coding flexibility is sacrificed. The presenters believe this notion is flawed. The perceived model risk of open-source systems can be successfully minimized by imposing an appropriate governance framework over the modeling process to mitigate model risk without sacrificing the coding flexibility of an open-source system.

The purpose of this session was to provide the attendees with the major pros and cons of open versus closed systems to inform on decision-making when choosing between the two systems under a complete model governance framework. (See session slides at *https://www.soa.org/pd/events/2018/valact/pd-2018-08-valact-session-078.pdf*.)

SESSION 80PD: PRACTICAL ANALYSIS OF PBR MORTALITY CREDIBILITY FOR TERM INSURANCE

Moderator: Mark C. Rowley, FSA, MAAA
Presenters: Steven C. Ekblad, FSA, MAAA; Jordan Edward Givan, FSA, CERA, MAAA

In determining principle-based reserves for U.S. life insurance, the credibility level of company mortality experience often has a large impact on the level of PBR deterministic reserves for term insurance. Generally, the lower the credibility of company experience, the higher the blended mortality rates since industry mortality often is higher than individual company mortality experience. In addition, the mortality margin increases with lower credibility levels of company experience. Other factors impacting the blended mortality rates are a company's own mortality experience and mortality improvement assumptions used to project reserves in future nodes needed for pricing products. (See session slides at *https://www.soa.org/pd/events/2018/valact/pd-2018-08-valact-session-080.pdf*.)

SESSION 87PD: MODEL VALIDATION AND GOVERNANCE IN THE PBR WORLD

Moderator: Vikas Sharan, FSA, FIA, MAAA
Presenters: Vikas Sharan, FSA, FIA, MAAA; Uri Sobel, FSA, MAAA; Erzhe Zhang, FSA, MAAA

Most life insurance companies have spent significant time unraveling PBR requirements. As these models are rolled off the assembly line, it becomes necessary to put in place a governance and validation framework. The validation becomes complicated as the model has three independent components and involves stochastic models. Additionally, experience studies become increasingly important and a rigorous process to do data analysis to derive assumptions and govern these assumptions is required. Companies also need to create attribution reports to explain results from one time period to another. Presenters discussed model governance, assumption governance, model validation and analysis of results. (See session slides at *https://www.soa.org/pd/events/2018/valact/pd-2018-08-valact-session-087.pdf*.)

SESSION 88PD: TAX REFORM: IMPLICATIONS ON MODELS

Moderator: Melanie Dunn, FSA, MAAA
Presenters: David V. McKay, ASA, MAAA; Samuel Carter Schauf, FSA, CERA, MAAA; Yang Yu, FSA, CERA, ACIA

Tax reform took effect on Jan. 1, 2018, and included sweeping changes in the nation's taxation policy for insurance companies and individuals. Actuaries should be prepared to quickly implement the new policies in actuarial models and address any challenges. Presenters focused on understanding the implications on modeling for existing products sold by life and annuity companies. The session began with a brief overview of the tax policy changes, followed by a discussion of the implications on actuarial models. This session focused on modeling implications but could be combined with implications on financial reporting, cash flow testing, product pricing and reinsurance strategy. (See session slides at *https://www.soa.org/pd/events/2018/valact/pd-2018-08-valact-session-088.pdf*.) ■

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ENDNOTES

1 National Association of Insurance Commissioners (NAIC). 2018. *Valuation Manual.* Valuation Manual 51: Experience Reporting Formats. *https://www.naic.org/documents/prod_serv_2018_valuation_manual.pdf.*

2 National Association of Insurance Commissioners (NAIC). 2018. *Valuation Manual.* Valuation Manual 20: Requirements for Principle-Based Reserves for Life Products. *https://www.naic.org/documents/prod_serv_2018_valuation_manual.pdf.*

3 National Association of Insurance Commissioners (NAIC). 2018. Valuation Manual. Valuation Manual 21: Requirements for Principle-Based Reserves for Variable Annuities. *https://www.naic.org/documents/prod_serv_2018_valuation_manual.pdf.*

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