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Long-Term Care Modeling, Part 3: Model Validation

By Linda Chow, Jeremy Levitt, Laura Donnelly Knab and Yuan Yuan

The increasing complexity of models and reliance on them has been accompanied by a wave of validations. This has occurred as a result of companies recognizing the inherent risk in relying on these models, in some cases having experienced model failures, and increased regulatory scrutiny from the Federal Reserve and Own Risk and Solvency Assessment (ORSA). In addition, the expanded role of modeling in valuation for principle-based reserving, International Financial Reporting Standard (IFRS) 17 and elsewhere has contributed to the wave of validations. The primary focus of risk management—which comprises model validation—is to increase the level of transparency of what's in the model. In practice, expenditure on model validation could exceed the cost of developing the model being validated, but that does not imply that some validation cannot be done for less. What are some of the best-practice techniques to validate a long-term care (LTC) model, as part of an organization's larger risk management framework? We touch upon these techniques and discuss the answers to other questions in this article.

In the first two installments of our three-part series (published in the December 2016 and November 2017 issues of *The Modeling Platform*[1]), we compared a claims cost approach with a first-principles approach and dove deeper into first-principles modeling for LTC. In this installment, the focus is on the validation of these models. In this article, we will describe Ernst & Young's (EY's) five-pillar approach that balances practicality with comprehensiveness, and how this applies to LTC model validation.

The insurance industry continues to enhance data analytics and management reporting capabilities that lead to significantly greater granularity in respect of actuarial projection and computational models. This is particularly apparent for LTC carriers amid the financial issues that the products have caused the industry. As management increases their effort to scrutinize the financial status of their LTC block, they recognize the need to have good risk management, governance and controls around their LTC models. An important model governance step is model validation. Due to the complexity of LTC products, the assumption structure and the evolution of understanding and handling industry-wide issues such as rate increases, validating LTC models is a very involved task and requires investment from management to ensure structured protocols are followed in performing the validation.

FIVE-PILLAR MODEL VALIDATION APPROACH

The five-pillar model validation approach combines conceptual soundness, documentation/governance considerations, model performance/integrity, implementation and data quality to challenge a model effectively. These "pillars" can be tailored to the type of model and needs of the organization undergoing a model validation exercise. For example, greater emphasis can be placed on the data quality pillar if data quality is known to be poor.

A visual depiction of the previously mentioned five-pillar approach is set out in Figure 1. We apply each of these pillars to LTC model validation in the following section.

Figure 1
The Five Pillars of Model Validation

Model Validation Key Elements and Procedures
Conceptual Soundness
• Review model concept against financial, economic and actuarial theory • Check for completeness and appropriateness of inputs used to develop key assumptions • Analyze the construction of the model from component pieces and identification of interdependencies across models
Documentation and Governance
• Model risk mitigation and management • Documentation completeness
Model Performance and Integrity
• Analytical review of model output to confirm consistency with expectations • Sensitivity analysis to evaluate the stability of the model • Testing of key model drivers through attribution analysis
Model Implementation
• Independent testing of sample or full results using parallel models • Assessment of process and controls • End-user computing controls
Data Quality
• Data sources and quality review • Data quality validation and testing (e.g., data anomaly testing)

LTC CONSIDERATIONS

Both product type and organizational needs should be taken into account when applying the five pillar approach. This section details the considerations the actuary validating the model needs to take into account within the context of LTC.

Conceptual Soundness

Any model, including actuarial models, should be theoretically sound and suitable for its intended use. The main examples of conceptual soundness include assessing the reasonableness and appropriateness of the model assumptions, methodology and modeling decisions made. As part of this process, consideration should also be made to model simplifications, limitations and materiality.

There are many uses of an LTC actuarial financial model, including reserving, cash-flow projection, pricing and capital adequacy analysis. Each of these cases may have its own unique assumptions and methodology. The conceptual soundness review includes both a subjective and an objective perspective. The objective perspective looks for elements such as whether or not the model strictly follows regulatory or accounting requirements. The subjective perspective takes into account the complexity of the product design, assumption structure, management decisions and governance process, financial impact and purpose of the model.

Typical approaches to LTC modeling include first-principles and claims cost. However, there are many variations to these two approaches, including healthy claims cost vs. total claims cost, various forms of semi–first-principles models and other hybrid approaches. It's important to assess whether or not the modeling methodology is appropriate for its intended use and to make sure that the assumptions developed are appropriate for the selected model. For example, if a claims cost model was used, the validator should confirm the exposure basis for the claims cost and confirm whether or not the claims cost was appropriately applied to the right exposure basis in the model.

Typically LTC policies offer multiple contractual options for even an immaterial benefit feature. Assessments should be made to confirm whether the model adequately covers all variations of the contractual language. LTC-specific product design (base coverage, riders and special features) should be considered in validating a model.

In addition to the original contractual terms, attention should also be paid to any endorsement, amendment or modification triggered by a rate increase. If a company has been approved to increase rates, one should consider the potential implications to both assumptions and reserving under the various accounting approaches. For example, one of the rate increase options currently available to certain insurers is referred to as the "landing spot" option, where an insured life is allowed to choose an actuarially equivalent reduced inflation option instead of taking a premium increase. This option is a newly approved concept by regulators. There is a generally accepted (and regulator-approved) treatment that applies in this situation. For example, when validating statutory reserve models, one should assess whether or not the net valuation premium and benefits were properly modified to reflect the reduced inflationary benefits.

Other conceptual LTC model considerations include appropriateness of the projection period and the explanatory parameters (e.g., whether internal rate of return is an appropriate measure of profit) to make sure that the right modeling decision is made for the intended purpose.

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Documentation and Governance

Model documentation sets out technical details to facilitate knowledge transfer and improve model transparency. It supports the proper use of model results through understanding of intended uses and model limitations, and allows independent model validators to review the model. Documentation that contains a sufficient level of details allows parties unfamiliar with the model to reproduce the documented progress successfully and thus reduces key-person risk.

Documentation should be created during model development, and reviewed and updated periodically. Although the documentation is usually tailored toward the product, business use case and modeling platform, it usually contains the following sections:

- Model purpose and use
- Key data/inputs, assumptions, outputs and process flows
- Known model limitations and risk areas
- Evidence of model validations and peer review
- User manuals, including procedures, for model use
- Upstream and downstream model and model users
- Model and documentation versioning

With these considerations, the complexity of the documentation should align with the risk and complexity inherent in the model. For LTC models, model documentation should cover

product-specific topics such as development of the claims cost tables and the procedure to update incidence rate assumptions.

Model governance plays the role of model risk mitigation and management through effective change control procedures and assumptions governance. The model owner/steward is responsible for updating the model documentation when there are significant model changes. Older versions of the model and documentation should be archived for auditability. Various stakeholders, including the end users, model development team and model steward, should develop rigorous standards with regard to documentation while leveraging actuarial standards such as Actuarial Standard of Practice (ASOP) No. 23, Data Quality and ASOP No. 41, Actuarial Communications. To align with the enterprise-level risk framework, the developed model should be evaluated against company model development standards and model governance policies.

Model Performance and Integrity

The model should be assessed for performance quality and robustness relative to expectations. This component of the validation process should assess whether the model is capable of providing timely and accurate information to the relevant stakeholders, and to gauge the level of approximations used in the model. Additional areas that should be assessed are usability of the model, the ability of the model to provide actionable analysis, the level of model automation and whether the model still performs as expected under different sensitivities and scenarios. Of importance is a review of the final output produced by the model, how these outputs are signed off and reported upon, and subsequent processes used for generating any final reports or analyses required by stakeholders.

Owing to the complexity typically inherent in LTC models, it is essential that performance quality and robustness are assessed. Sample assessment techniques include the following activities:

- Compare historical data against projected model output calibrated to the period over which the historical data applies. Dynamic validation on key LTC model cash flows may be elected, too. This entails assessing whether the LTC model results—such as premiums, morbidity outflow, lapses and recoveries—follow a reasonable trend in line with historical data.

- Vary one variable at a time (stress testing) or multiple variables at a time (scenario testing) to assess the robustness of the model.

- Stress test morbidity rates, duration of disablement and lapses, as these variables play an important role in driving claim outflow. Similarly, scenario testing on variable combinations, such as a downward interest rate and upward lapse stress, should be performed.

Implementation and Testing

The purpose of this step is to assess the efficiency and sustainability of the model implementation. This could be accomplished by reviewing implementation controls performed by the model owners, through independent recalculation of the model output. The validator will have to identify a sampling process for selecting policies to test and determine a test plan, which includes intervals to test (e.g., time zero only, every 10th projection year) and testing thresholds (i.e., allowable differences). Considerations should be given to materiality, current risk exposure and potential future risk exposure when deciding on the sample policies. While recalculation could be performed in many ways, best practice is the use of an independent "challenger" model, which is an industry-vetted modeling platform different from the platform currently used. Different independent calculators will be needed for disabled lives vs. active lives, for different accounting bases (statutory, GAAP, tax, etc.) and for different purposes (e.g., gross premium valuation reserves vs. cash flow testing). This pillar is often the most time-consuming, as the independent recalculation process should cover appropriateness of the data input and methodology, implementation of the assumptions, and having matching results. Often, model differences will likely exist between the model being tested and the challenger model. It is the role of the validator to determine if those differences are acceptable approaches in the industry or if the model being tested needs refinement.

In addition to independent calculation, the validator should also manually review formulae in the models to see if they reflect underlying theory and methodology. If the model doesn't have open source codes, the validator should at least check the organization of the models.

Sensitivity testing should also be performed to review reasonableness of the model results. LTC models typically include a wide range of modeling assumptions, especially under a first-principles approach. Separate sensitivity should be performed on at least all of the key assumptions (e.g., incidence, disabled life mortality, recovery, cost of care, utilization, active life mortality, lapses and economic scenarios). Sensitivity analysis could also be considered at a granular level so that it varies by segment and by policy or claim duration. Careful considerations should be given to the interdependencies among the assumptions when analyzing results.

Other testing techniques should also be considered and used. Similar to the techniques already discussed in an earlier section,

they may include static and dynamic validation, and retrospective testing.

In addition to reviewing the core model calculation engine, the validator should also look at controls and governance around the model. These are typically done through reviewing model documentation and management testing/review evidence, checking for user access restrictions, maintenance of change log and historical archive history. Further details in respect of documentation and governance are described in the "Documentation and Governance" section.

Data Quality

Having quality input and output data is critical, yet it is an area where many companies struggle. Throughout the data flow, starting from in-force file creation to model results compilation, there are many areas where data could be mismanaged if proper controls are not in place. Reconciliation steps should be performed during in-force file creation, and the data creation itself should be as automated as possible. Similarly, assumption updates should be automated and checklists of changes should be created and verified with department heads. Post-processing procedures are typically more manual and thus leave more room for user error. Model output edits and overwrites are sometimes necessary, but they should be clearly documented and well-understood by all essential parties. Putting appropriate controls in place around data quality helps to make the model output more reliable and meaningful.

Specifically for LTC models, data dictionaries should be available to model users. The dictionary should allow users to understand the components and complex assumptions that make up a first-principles model. Additionally, having a thorough data dictionary helps to reduce key-person risk. This data dictionary should be reviewed and approved by all relevant functional units to ensure data accuracy.

Another concern for LTC models relates to assumptions. Given that there is limited industry data for LTC products, it is often up to the company to use their own experience in developing assumptions. Many other products are able to use industry tables already built into the model, but LTC products often do not have this luxury. There is a risk that updates to company-specific assumptions are not made correctly, thus causing the model to use poor quality data. Therefore, checklists should be created for assumption updates, and controls should be in place to review the updates.

CONCLUSION

Model validation is crucial to ensure the LTC model developed is conceptually sound, fit for purposes, produces technically accurate results, and has business requirements and constraints adequately allowed for. In light of this, LTC providers should consider best practices in respect to their model validation efforts—one of which is the five-pillar approach we've highlighted. A well-documented model that undergoes sufficiently thorough testing enables users of the model to place greater reliance on the output and make more informed decisions. The benefits of ensuring a comprehensive model validation structure is in place are significant, and the implications should not be underestimated. ■

The views expressed are those of the authors and do not necessarily reflect the views of Ernst & Young LLP or any other member firm of the global EY organization.

Linda Chow, FSA, MAAA, is a senior manager at Ernst and Young. She can be reached at *lo.chow@ey.com*.

Jeremy Levitt, FSA, FIA, is a senior consultant at Ernst and Young. He can be reached at *jeremy.levitt@ey.com*.

Laura Donnelly Knab, ASA, MAAA, is a senior consultant at Ernst and Young. She can be reached at *laura.knab@ey.com*.

Yuan Yuan, FSA, MAAA, is a senior consultant at Ernst and Young. She can be reached at *yuan.yuan@ey.com*.

ENDNOTE

1 See *https://www.soa.org/sections/modeling/modeling-newsletter/* for these and other recent archives of the newsletter.