Article from

The Modeling Platform

December 2016
Issue 106

Long-Term Care Modeling, Part I: An Overview

By Linda Chow, Jillian McCoy and Kevin Kang

The private long-term care (LTC) insurance industry continues to face significant challenges with low demand and low supply of stand-alone products. Many carriers have exited the market due to a mix of low interest rates, poor product performance and uncertainty in future product risks. Effective financial and risk management have become the primary focus for the industry. A robust financial model is the first line of defense to effectively manage this business.

Actuarial models can be used for a number of financial management activities in managing both in-force and new business, including setting premiums and analyzing profits for new business; evaluating reserves needed to fund future claims, cash-flow projection and asset adequacy testing; business planning; capital management; rate increase analysis; and reinsurance analysis.

> Companies should carefully evaluate which financial modeling approach would best fit their LTC block management strategy.

Modeling LTC products can be daunting due to the wide range of product features and components to capture, such as elimination periods, benefit periods, inflation options, benefit payout options, waiver of premium and shared care benefits. With higher capital requirements than many other insurance products, LTC insurance financial results are driven by variances in key assumptions including morbidity, mortality, lapses and investment earnings. An effective LTC model should be able to accurately project these key assumptions and their interactions over all durations of a policy (at least 50 years in many cases).

Although the industry continues to add an increasing amount of claims experience, the LTC industry is still relatively young. How experience will emerge is still largely unknown as historical experience is not always an indication of the future—even more so for a relatively short history. However, one of the indisputable trends is increasing claim costs.

It's not an easy task to manage an LTC block given the aforementioned uncertainties. Companies should carefully evaluate which financial modeling approach would best fit their LTC block management strategy. This article is the first installment of a three-part series and is focused on providing an overview of LTC modeling approaches and considerations. The second article will provide a deep dive into first principles modeling. The third article will focus on LTC model governance and model validation.

EVOLUTION OF LTC FINANCIAL MODELING APPROACHES

LTC financial models have gone through rapid evolution. Early on, most companies used either a total exposure claims cost or a healthy exposure claims cost approach to modeling. These models projected total expected claims that were pre-calculated and entered as model inputs.

As a result of needing to better manage financial results as well as the advancement of computational power, the next generation of models began to employ a first-principles modeling approach. These models keep track of the state of projected lives, including active (healthy and recovered), disabled [nursing home (NH), home health care (HHC), assisted living facility (ALF) and transfers], group conversions and terminations (active deaths, disabled deaths, lapses and benefit exhaustions). The model can be calibrated to reflect the timing of each event. Conversion from claims cost models to first-principles models for numerous blocks is on the current action list for many companies within the LTC industry.

Driven by regulatory changes (principle-based reserving) and overall insurance industry trends for long duration contracts, the third generation modeling solution of multi-state stochastic models is also on the horizon. These multi-state models are stochastic versions of the first-principles model. While stochastic techniques had historically mostly been reserved for interest-sensitive products, a desire to better understand future risks associated with long duration contracts has resulted in increased efforts to apply stochastic analysis to other risk factors, such as mortality and morbidity.

CLAIMS COST APPROACH

Early generation LTC models primarily used tabular claims cost due to technological limitations. In a nutshell, expected claims cost is the discounted value of expected future claims paid for an incident incurred at a given time period. This includes the probabilities of incurring claims as well as the severity of those claims (characterized by a length of stay and utilization of benefits).

Claims cost models for LTC commonly come in two forms: total-lives claims cost and healthy-lives claims cost. In either

approach, the model projects total exposures using total deaths and lapses as decrements. The total-lives claims cost approach pre-calculates claims cost using incidence rates based on total exposures. These pre-calculated claims costs are applied to the projected total exposures in the model. The healthy-lives claims cost approach pre-calculates claims cost using incidence rates based on healthy exposures. And for healthy-lives claims cost, an external model pre-calculates a set of "J prime" factors (defined as healthy exposure over total exposure). These J prime factors are brought into the projection model to convert projected total exposures to healthy exposures to be consistent with how claims cost is defined.

One modeling consequence of total-lives claims cost is that, even after claim, policies continue to contribute to the aggregate active-life reserves (ALR) in addition to the disabled-life reserves (DLR). Healthy-lives claims cost, on the other hand, takes into consideration the status and only applies to the active population (non-claim) with no ALR for those on claim.

For companies that choose claims cost modeling, the healthy-lives claims cost approach is recommended as there are many disadvantages to a total-lives claims cost approach—namely, that a total-lives approach only works well if the projected population mix is static. The claims cost would be less accurate and continue to deviate as the underlying population experience (claim incidence, claim termination, mortality and lapses) differs from what was assumed. A healthy-lives claims cost approach, if well managed, is a good approach to evaluate the basic financial results of the LTC block. However, neither of these approaches provides carriers with in-depth reporting capability to understand drivers of the modeling results—a first line of defense against risk.

FIRST PRINCIPLES

While a claims cost approach does provide the basic information at a high level, a first-principles approach provides greater granularity of results. In the past five years, there has been a steady theme of converting to models using first-principles components upon which the claims cost tables were originally built. There are varying degrees of specificity and intricacy on first principles to which the model tracks states (active/disabled/recovered, NH/HHC/ALF, state transitions, etc.).

Indeed, there are important reasons for a company to consider a first-principles conversion. Carriers that have never had a sophisticated projection model or have used multiple segmented models for their actuarial functions recognize the need to improve their financial modeling capability given the complexity of LTC projections. Many companies are attempting to improve their ability to understand experience drivers and their financial impacts. For some companies, their existing expected claims cost tables were provided by external resources, and the original claims cost components were not available to allow detailed analysis. Improved operational efficiency, cost reduction, alignment of various actuarial functions, and financial reporting capabilities are achievable as well.

Implementing and maintaining a first-principles approach requires a higher level of sophistication when it comes to systems

and data management. For some carriers, this might imply a small refinement to their current existing organizational structure, while for others this might require significant up-front investment to improve systems and data warehouse or reallocate talent.

Unsurprisingly, implications of model conversions extend outside the model. Relative to claims cost models, first-principles models require an increased level of product and technical competency to support the increase in both the sophistication of modeling techniques and level of assumption detail. Additionally, the data requirements to support these assumptions are more intensive given the level of detail in reviewing the experience for each component and credibility considerations. The models are compared further in Table 1.

MULTI-STATE STOCHASTIC MODEL

A multi-state model is a full-scale first-principles model that allows detailed tracking of a policyholder's state, benefits payable and timing of key events. A multi-state stochastic model uses the probability of transitioning among states as input assumptions and employs techniques (e.g., Monte Carlo method) to simulate the distribution of random events due to the potential variation in assumptions.

A robust stochastic process should include two steps:

1. **Stochastic analysis around the mean on key assumptions by duration.** This assumes the assumptions (the mean) are always correct and would measure the variations around the mean.

2. **Parameterization analysis of the mean.** This helps to understand the probability the mean is incorrect.

To analyze long-term care business, random events can be stochastically modeled. Potential risk parameters to consider are

active death, disabled death, incidence rates, claim continuance, claim recovery, inflation, utilization, lapses, benefit exhaustion, conversions, care path and transfers. Although doing so is challenging, rate increase actions and their impact to experience should also be considered in the stochastic process.

Stochastic models can enable better measurement of tail risks and extreme scenarios. However, they certainly add another layer of complexity in terms of model implementation, assumption setting, stochastic scenario selection, probability distribution calibration and technology requirements. The requirement

Table 1
Strengths and Weaknesses of Models

	Claims Cost	First Principles
Strengths	Succinct way to summarize incurred benefits Intuitive summary from valuation models Faster model run time	Possibly greater appreciation of in-force movement Simpler, more direct implementation in models More direct application to metrics and source of earnings Ability to obtain paid claims
Weaknesses	Required calculation as an intermediate step before the model Limitation of incurred claims without paid claims Less direct understanding of underlying metrics and source of earnings Potentially prohibitive number of claims cost tables	Greater focus on assumptions Slower model run time than claims cost Higher complexity (auditability, analysis, etc.) Question of credibility

of principles-based reserves has led to the implementation of stochastic techniques in major modeling platforms for life and annuity business. This evolution has also been brought to the horizon for LTC carriers.

MODEL GOVERNANCE, MODEL RISK FRAMEWORK AND MODEL VALIDATION

The previous sections highlighted increased model capabilities for first-principles models. Yet the constantly increasing intricacies and sophistication of financial models in today's world demonstrate the importance of managing model risk, which may arise from decisions based on the incorrect selection, implementation or usage of models. A model risk management (MRM) framework calls for three lines of defense:

1. **Model owners.** The objective is to manage the organization's model risk by developing, using and maintaining models consistent with enterprise policies. There should be a conscious focus on thoughtful and transparent model development, well-controlled and tested model implementation, rigorous change management procedures and ongoing performance monitoring.

2. **Model governance and validation.** The objective is to manage the organization's model risk by establishing and implementing a model risk management policy. Key roles include maintaining and monitoring model and input files (including assumptions) inventory, performing independent model validation and providing effective push-back challenge throughout the model development process.

3. **Internal audit.** The objective is to assess and validate that the first and second lines of defense comply within the organization's model risk management policies.

A sound model change control process should lay out a framework for an array of change categories for the model including assumptions, new feature implementation and model refinement. This change framework should include principles around choosing appropriate metrics for validation and acceptable tolerances to enable and achieve proper reconciliation.

OVERVIEW OF MODEL VALIDATION

Model validation is an important step of financial model management and covers five pillars across a modeling life cycle: conceptual soundness, data quality assurance, implementation, model performance and integrity, and documentation and governance.

The aforementioned LTC modeling approaches would require different levels of review throughout a model validation process. Generally, model validation should at minimum include:

1. **Model verification.** This includes verification of data source quality, static validation, assumption review and testing, formula review, conceptual soundness, cell level testing and aggregate result review.

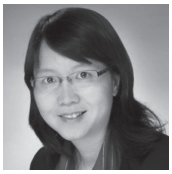
2. **Model fitting.** This includes retrofitting and dynamic testing to assess and validate that the model accurately tracks past experience.

3. **User acceptance testing.** Actual users of the model test run the model with realistic assumptions and scenarios to validate that all perspectives of the models are functioning correctly before going into production.

CONCLUSION

Companies should choose a financial modeling approach that best fits their LTC block management strategy. Given the complexity of LTC models, questions remain about what an effective model entails, how a company could make the most of a first-principles model, and what a company should do to properly implement and manage such models. Overall, the conversion process of going from a claims cost regime to a first-principles world is a non-trivial exercise of splitting "aggregated" tables into components with necessary attribution at each step—this can be an expensive exercise for a slow-growing or closed block. But there are many benefits of first-principles models, and we continue to see conversions to first principles.

Stay tuned for the next two installments of our three-part series as we look to discuss first-principles implementation considerations and implications, as well as guiding principles of a robust model risk management framework. ■



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

Jillian McCoy, FSA, MAAA, is a director and actuary at New York Life Insurance Company. She can be reached at *jillian_c_mccoy@newyorklife.com.*

Kevin Kang, FSA, MAAA, is a senior consultant at Ernst and Young. He can be reached at *kevin.kang@ey.com.*