Article from

Long Term Care

April 2015
Issue 38

Economic Capital for LTC for "One in 200" Events

By Bruce Stahl and Elizabeth Dinc

When an insurance company's chief risk officer wants the long-term care actuary to identify the economic impact of adverse experience in the next 12 months at the 99.5th percentile (without incorporating investment income), it is to determine how 1-in-200 events are going to impact the company's capital.

The answer to this question forms the basis for identifying the risk from an LTC book, and therefore helps identify how much capital to hold under a principles-based perspective. Insurance companies are increasingly setting capital through modelling of risk rather than through factors, so this calculation is an important one to undertake.

In addition, as many of today's providers of long-term care insurance have only been around for the past 25 years at most, this question needs to be answered using stochastic modeling. Using other statistical methods would not work as well, as much of the data is non-homogenous.

BENEFITS OF MONTE CARLO SIMULATION

Monte Carlo simulations, the stochastic technique to make the one-in-200 determination, may be the easiest technique to use and understand. Monte Carlo simulations can measure combined volatility and misestimation risk as well as the interaction of each of the variables all at the same time. It allows consideration of all of the variables at one time, with the distributions for one variable recognizing the dependency on other variables.

For each variable (lapses, mortality, claim incidence, claim continuance, and claim utilization), a probability distribution is identified from the more recent experience of similar businesses, from the more recent historical experience at that particular company, or from a combination of the two. Each probability distribution has an expected value. These are called "sample" distributions, implying that that the sample may not necessarily have the same expected value as will experience from the relevant historical population.

Not knowing for certain whether a projected sample will have the same expected value is known as misestimation risk (or parameter risk). Even if the likelihood of misestimation risk is very close to zero, there could be some fluctuations around the expected value. For example: given a large enough number of tosses, an evenly balanced coin should fall heads or tails an equal number of times. However, for any sample of 20 tosses, there might be fewer heads than tails, or vice versa. In fact, there is a real—albeit very small—probability that all 20 coin tosses will land tails up. This fluctuation is called volatility risk (or process risk).

PRACTICAL LIMITATIONS AND SOLUTIONS

A simulation may identify a misestimation that could occur in the next 12 months. That misestimation's economic impact could continue into the future. Projections beyond month 12 would need to recognize that a misestimation identified in any one simulation run may continue. In other words, future expectations are not independent of the misestimation aspect of a particular simulation; rather, future expectations depend upon the simulated value. If a simulation is sufficiently adverse to prompt an insurer to file for a premium rate increase for its LTC product, future premiums may also depend upon the future adverse expectations. Therefore, the economic impact of adverse experience in the next 12 months includes the future consequences of what happens in the next 12 months.

As even a Monte Carlo simulation of 12 months requires significant computing power, projecting each trial well into the future is impractical. To ease the system requirements and simplify the process, a table of hypothetical economic reserve factors representing the present value of all future economic expectations can be incorporated into the analysis (factors expressed per unit of exposure). These factors would be derived through common deterministic projections rather than stochastic simula-

CONTINUED ON PAGE 12

Bruce Stahl, ASA, MAAA, vice president and actuary, Long Term Care, Individual Health at RGA Reinsurance Company in Chesterfield, Mo. He can be reached at *bstahl@rgare.com.*

Elizabeth Dinc, ASA, MAAA, is senior assistant actuary, Individual Health at RGA Reinsurance Company in Chesterfield, Mo. She can be reached at *mdinc@rgare.com.*

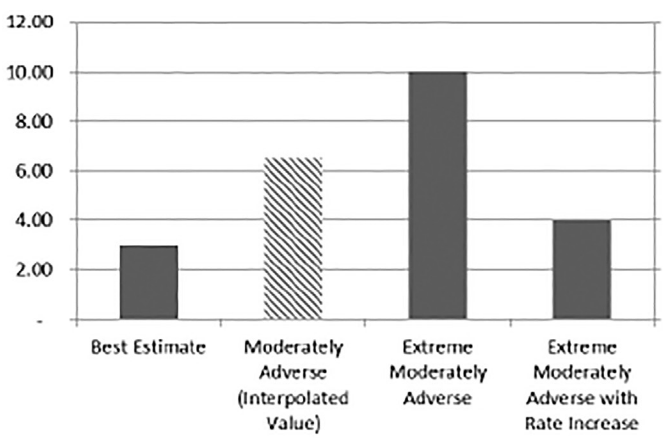
Stochastic modeling—Tool that recognizes the probabilities of variation in inputs (assumptions)

Monte Carlo simulation—Type of stochastic modeling that uses randomly selected values for a large number of trials.

tions. Then the outcome of each 12-month simulation will determine which hypothetical economic reserve factor(s) to use with the remaining exposure in the simulation.

Of course, creating a table with an infinitely large number of hypothetical economic reserve factors is also impractical. A reasonable alternative is to interpolate using three sets of factors: "best estimate," "extreme moderately adverse," and "adverse scenario that warrants rate increase." For example, a table can be created of the hypothetical economic reserve factor for the "best estimate" assumptions, and another table for the extreme end of the moderately adverse range. (The extreme moderately adverse scenario will be the set of adverse circumstances with the highest financial impact before a rate increase is filed.) Any simulated 12-month scenario that suggests adverse experience between the extreme and the "best estimate" can use an interpolated factor derived for the extreme and the "best estimate." Any simulated value that suggests favorable long-term experience can use the "best estimate" factor because it will be conservative, and not alter the perspective on the adverse 1-in-200 event.

Figure 1: Reserve Factors per Unit of Exposure



The remainder of the simulated values—those suggesting adverse experience sufficient to warrant the filing of a premium rate increase—will use a third set of hypothetical economic reserve factors. These factors will also be identified by a deterministic model, and will represent the economic future impact assuming premium rate increases will be implemented within two or three years. Normally these factors will be more favorable than the extreme moderately adverse factors.

THE TAIL

After the simulations are run, and after the reserve factors are applied to each simulation's exposure and summed with the cash flow from the simulation, the totals for each simulation should be ranked from highest to lowest. The middle simulation after such a ranking is the 50th percentile value, and called the median. The value that is being sought is the value associated with the simulation ranked at the 99.5th percentile. Anything at this point or beyond is a 1-in-200 (or less frequent) event. In this context, the value of the risk of an event less frequent or less likely than 1-in-200 (or tail event) can be quantified.

Clearly the number of simulation trials needs to be high in order to find reasonable values at the beginning of the "tail." If 1,000 trials produced values at the 99.4th, 99.5th, and 99.6th percentiles that were not close together, then it might be difficult to identify the value at the beginning of the tail. The number of trials needs to be high enough to see values that are relatively close around the beginning of the "tail." Achieving this may require 3,000 trials or more.

Figure 2: Illustration of the need for more than 1,000 trials.

	1,000 trials	3,000 trials
Median (50th Percentile)	$10,000,000	$10,000,000
99.4 Percentile	8,900,000	8,600,000
99.5 Percentile	8,700,000	8,500,000
99.6 Percentile	8,000,000	8,400,000

Using the described process to measure the risk of a 1-in-200 event, and therefore to identify the right amount of principles-based economic capital, may not work well for non-cancelable LTC policies or LTC policies with limited premium paying periods. This is because the process depends upon the ability to plan on premium rate increases. However, because the magnitude of the adverse experience is essentially capped, the process works very well to identify the right amount of economic capital for policies that can receive a premium rate increase. ■