

# THE FUTURE OF CAPITAL MODELING

BY PAT RENZI

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Life insurance policyholders depend on their insurer to pay claims as promised, despite the ongoing threat of market failures or other unforeseen catastrophes. Similarly, insurers rely on key assumptions and projection techniques to set aside the amount of capital they need to meet claim demands and achieve their own performance objectives. Soon, the process and rules governing reserve setting and other projections will change from deterministic formulas that have been around for 30 years to more dynamic capital models. Milliman professionals have been tracking and participating in these changes for years. In this article, we explore the background of this issue and provide some tips for getting prepared.

Historically, setting reserve requirements on life products has been a fairly straightforward, formulaic process of determining the present value of expected future benefits, less the

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present value of expected future premiums, based on prescribed assumptions. The key word was *formulaic*. This approach worked for a very long time.

That is until the paradigm for life insurance products started to shift. Companies began developing products that had significant variability due to embedded options. The result was a good deal more uncertainty as to whether appropriate reserves had been set aside to cover the benefits that would be paid out. Chief among these products were variable annuities, in which companies took on a whole new level of risk that was not captured by the prescribed reserving requirements.

Meanwhile, some companies felt that the recent changes in reserve requirements on life insurance products designed to address no-lapse guarantees using a formulaic approach generated redundant reserves (no-lapse guarantees are discussed in “A Primer on Life Insurance

Products” on p. 20). So over the past several years, the life industry has considered changes to how it sets reserves on certain products.

## **Running New and Unprecedented Risks**

New products, such as variable annuities, represent an attractive offer for customers, giving them the opportunity to invest in the equity markets while still providing protection on death, retirement, or other insurable events. On the flip side, life companies assume a significant risk of loss if the financial markets drop precipitously, unless these risks are appropriately managed and adequate reserves and capital are established. So while life companies are shifting the competitive battlefield with their new offerings, they also are venturing into areas of financial unpredictability that require a more sophisticated methodology for assessing all of the risks embedded in the new product guarantees.

## Reserves, Required Capital, and the Role of Actuaries

Accountants and actuaries know that an insurance company balance sheet is very different from that of most other companies. In an insurance company, particularly a life insurance company writing mostly term insurance,<sup>1</sup> the liabilities are future promises. It is uncertain if and when they might be paid. The expected value to be paid, and the expected timing of those payments, must be estimated. Actuaries are the professionals that provide this estimate. The estimate takes into account all of the probabilities involved in providing the insurance benefit, and the time value of money to produce a reserve.

In most other industries, liabilities are known amounts and are relatively straightforward to calculate. These liabilities include outstanding invoices, leases, and debt. While some companies may have reserves to estimate (for example, a manufacturing company would normally have a product warranty reserve), the reserve portion of the total liabilities is a relatively small percentage—5 to 10%, as opposed to a life insurance

company where reserve estimates may constitute as much as 90% of the liabilities on the balance sheet.<sup>2</sup>

In earlier times, actuaries and regulators established reserves with conservative assumptions related to life insurance in order to manage life insurance portfolios.<sup>3</sup> The resulting reserves had enough redundancy that the insurance company would be viewed as solvent if it had assets that at least covered the reserves. More recently, reserves have been calculated on a basis somewhat closer to fair estimate, and companies separately estimate the amount of capital they need. Today's regulators establish metrics for the amount of capital an insurance company needs in order for it not to be subject to day-to-day scrutiny, or to be placed into rehabilitation by the regulators.

1 Life insurance with no fund component that a policyholder may withdraw.

2 The other liabilities are mostly unpaid amounts.

3 "Conservative assumptions" in this context means assumptions that tend to increase reserves.

## A Primer on Life Insurance Products

### VARIABLE ANNUITIES AND MINIMUM GUARANTEES

Variable annuities originally were a way for a policyholder to invest in a mixture of equities and debt to save for retirement. This exposed the policyholder to all of the risk of market fluctuation. Starting about 10 years ago, insurance companies began writing minimum guarantees. The first of these were guaranteed minimum death benefits and they were relatively simple. They provided that the policyholder would receive at least the amount deposited if they died. These guarantees then became more complex. They offered death benefits in excess of the initial deposit. For example, the minimum death benefit might be the initial deposit increased at a specified rate of interest; or it might be reset every year to the current account value if the account value was higher than the previous guarantee. As the market became more competitive, additional minimum guarantees were added to variable annuities. These include guaranteed minimum withdrawal benefits which specify minimum amounts that may be withdrawn at specific points in time, and guaranteed minimum income benefits, which specify the minimum income the annuity would pay after it was converted to a payout annuity, even if the account value would not support that income level.

All of these minimum guarantees expose the insurance company to risk if the market goes down without a compensating opportunity to profit should the market go up. The insurance company charges a premium for these benefits—typically expressed as basis points times account value to cover the expected costs of these guarantees across a range of scenarios. Most companies hedge these risks with options available in the marketplace to reduce their exposures under extreme scenarios.

### NO-LAPSE GUARANTEES

In the early days of insurance, the typical insurance product was whole life. The insured paid a fixed premium every year to the insurance company as long as he or she was alive, and the insurance company paid a fixed death benefit when he or she died, as well as offering surrender values if the policyholder chose to surrender the coverage.

These products were frequently criticized because the purchaser could not easily tell what mortality rates were assumed and what investment they were obtaining. In the early 80s, an unbundled insurance product called Universal Life was developed. The policyholders could pay any premium they liked, within certain limits, whenever they wanted. The account value was increased each month, by adding in any premiums received and crediting interest on the balance, and reduced by deducting mortality and expense charges. If the account value went to zero, the policy lapsed. Again, as competition heated up, insurance companies found ways to enhance these products with no-lapse guarantees. Essentially a no-lapse guarantee says that as long as a specified premium is paid each year (or more commonly, a specified cumulative premium has been paid) the insurance will not lapse. The policy will pay in the event of death. A no-lapse guarantee does not guarantee any account value for the policyholder, but guarantees of the death benefit protection stay in force. Again, the insurance company has risk if interest rates are low, without a compensating return if interest rates are high. Companies embed a charge in these contracts to cover the anticipated costs of this guarantee over a range of scenarios. Fewer companies hedge these interest-related risks than is the case for stock market risks in the variable annuity arena.

Naturally, as this new paradigm began to unfold, regulators and actuaries took a closer look at what these changes meant from their respective points of view. Without the old formulas, regulators were concerned about how to set reserve requirements for products with the potential for unpredictable performance. Actuaries realized they could no longer quantify the future risks of variable products based on a single, prescribed economic environment.

### **Newfound Sensitivity to Market Volatility: A Coincidental Driver**

The poor performance of the capital markets and a newfound sensitivity to this performance on the part of insurers further fueled a new approach for setting reserve requirements that would satisfy (as much as possible) the concerns of all the interested parties. Actuaries turned to stochastic economic models and assumptions based on company experience to evaluate the distribution of possible outcomes (these models are discussed in “Reserves, Required Capital, and the Role of Actuaries” on p. 20 and in “Nested Stochastic Modeling” on p. 22). But while the use of a stochastic process and experience-based assumptions to set reserves and capital requirements made sense, it introduced a whole new dimension to the issue—judgment, which life insurance regulators view as neither easy to define nor monitor.

The industry has been discussing reserving for life and annuity products based on first principles rather than prescribed formulas for more than 20 years; hundreds of representatives from the life insurance industry, regulating bodies, and actuarial firms have weighed in on the issue. These discussions have found new traction in recent years as the industry has been unable to devise workable formulas for minimum guarantee and no-lapse guarantee products. Technology has also evolved to enable much broader, more holistic approaches. This will probably result in major changes in reserve setting on *all* life and annuity products.

### **A Look at the New Models**

A number of key assumptions go into developing the new models, but principal among those is the economic scenario generator—the mechanism for projecting a set of possible scenarios of future equity returns and interest rates that is consistent with the current market. The American Academy of Actuaries (AAA) developed a generator from which they provided a set of 10,000 economic scenarios for companies to use in performing the C3 Phase II analysis. Companies may use a subset of the set provided or may use a different generator, as long as it can be demonstrated that the scenario set being used has the same characteristics as the set of 10,000 provided by the AAA.

As a principles-based reserves system is implemented in coming years, we expect changes to the life industry that go well beyond how the system is put to work. These changes will drive further discussions about managing and governing, particularly in assessing an organization's appetite for risk.

The challenge for the life industry now is one of preparing for the inevitable, including understanding how the new process will work and what its implications are for key performance measures. We believe that a short list of effective preparation priorities for the near future will include the following:

- Investigate and assess company-wide hardware needs to accommodate the new modeling techniques
- Explore specially-developed software tools that support the type and number of calculations involved, not just for compliance with the new reserve and capital requirements, but to properly reflect the requirements in pricing, business planning, and risk management
- Review implications for internal planning and controls as they relate to regulatory tracking and third-party auditing of findings
- Consider additional management actions required under more dynamic modeling processes, such as risk identification and mitigation strategies, documenting and supporting judgment calls, and defining and implementing a peer review process.

Let's take a closer look at how technology and management considerations underpin these priorities.

### **Technology Needs to Accommodate New Modeling Techniques**

Two aspects of the new approach will dictate a change in both hardware and software functionality: the sheer number and size of calculations (discussed further in “Nested Stochastic Modeling” on p. 22); and the ability to audit, analyze, and justify results and assumptions.

Traditionally, companies had reserving systems that were “locked down,” in terms of the assumptions and formulas to use. From an audit control perspective (especially post-Sarbanes-Oxley), it was easy to implement procedures around the old systems due to this controlled and prescribed methodology.

If we attempt to use locked down systems with stochastic modeling, we confront the “black box problem”—results are opaque rather than transparent. An actuary has to explain these results to management, regulators, and rating agencies—often without clear understanding of what the results mean.

So how do companies overcome the black box problem? The next generation of modeling software must allow users to drill down through and across various dimensions, to access as much detail as necessary for the actuary to understand and audit the calculations.

The cost in time and infrastructure of implementing this major change in reserve calculation presents a significant concern, particularly for smaller companies that lack the requisite human or financial resources and expertise to develop the infrastructure. It is important that software developers and consultants focus on solutions that can benefit all sizes of affected companies.

### **Additional Management Actions**

As a principles-based reserves system is implemented in coming years, we expect changes to the life industry that go well beyond *how* the system is put to work. These changes will drive further discussions about managing and governing, particularly in assessing an organization's appetite for risk, in establishing internal controls to monitor or contain risks, and in selecting consultants to support the company's risk management efforts.

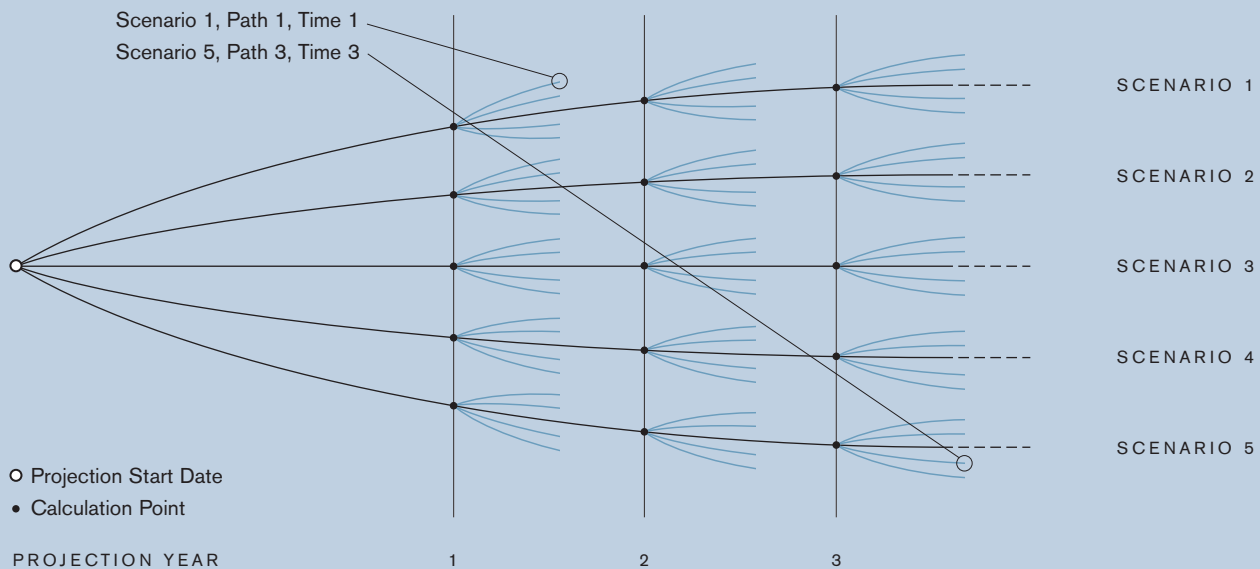
## Nested Stochastic Modeling

Stochastic modeling is a complex, mathematical process that uses a combination of probability and random variables to forecast financial performance, or, in the case of reserve setting, to forecast financial requirements. The word *stochastic* comes from a Greek word that means “skillful in aiming.” So the term refers to a process of tightly targeting a numerical probability or projected end result.

“Nested” stochastic models, as the name implies, are stochastic models inside of other stochastic models. They are not explicitly part of the principles-based reserve method, but since the setting of reserves and capital will be based on a stochastic valuation, earnings projections will require stochastic projections at each future projection date, across all scenarios. This means that nested stochastic models are needed to appropriately manage the business, price new products, project

earnings, or measure risk. These models are not for the technologically challenged—a 1,000 scenario model with reserves and capital based on 1,000 paths at each valuation point for a 30-year monthly projection requires the cash flows for each policy to be projected 360 million times. Layer on top of this the desire to look at the implications of stochastic mortality or credit and we have introduced additional nested loops into the projections.

The ability to run these types of projections and analyze the resulting information will require significant changes in the hardware and software infrastructure at most companies. Ultimately, a solution for many of these challenges will involve grid computing (linking many PCs together under common control). Some companies are already running stochastic and nested stochastic projections on grids with as many as 1,500 PCs.



Turbulent financial markets and heightened regulatory scrutiny have put risk management in the spotlight, but it is shareholder interest in how well the company lives up to its intentions that will add or detract from the company’s perceived value. This broader definition of risk management will influence both internal model development and the professional judgment that will be exercised in implementing the new models.

### Riding the Wave of the Future

In the end, successful handling of the new requirements will involve strength both in theory and in practice. Our firm has been involved with these changes since their inception, including the research we have undertaken to understand their implications. We have invested in developing our capabilities in both the science and the application. As a result, we’ve been able to develop a knowledge base and tools to support the implementation of the new reserve and capital requirements. Having a long history of client advisory services, we’re prepared to help our clients understand—and

implement—the capital requirements of their businesses both today and into the future.

We recognize, too, that our own role as actuarial consultants is changing. Greater accountability for our “judgment calls” demands a more institutionalized approach to use of stochastic models as well as the capability to deliver a broader array of compliance skills and services. Clients will be looking for help from firms like ours who can combine knowledge of issues and needs with the tools to resolve and fulfill them. We stand ready to embrace that challenge—and that opportunity. **M**

*PAT RENZI is a Principal based in Milliman’s Seattle Life Insurance Practice and is Product Manager for MG-ALFA®, the industry-leading actuarial projection and pricing software. She oversees development, planning, marketing, and client service for MG-ALFA. Pat has presented at Society of Actuaries meetings on topics directly relevant to this article, including general modeling techniques, real-time stochastic analysis, and complex liability modeling issues.*