



**MoSes**

**Variable Annuity Hedging Application**

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The U.S. variable annuity (VA) market has undergone major changes in recent years. After the recent economic crisis, implied volatility levels reached historic highs, and risk-free interest rates remained at very low levels. As a result, VA writers held large blocks of in-force business with guaranteed benefit riders that were significantly in the money, which required increased reserves and capital levels.

In response to these changes, VA writers have reduced their risk exposure by redesigning product features and increasing fees for guaranteed benefit riders. Despite these changes, marketable guaranteed benefit features are still fairly rich and continue to expose writers to considerable risk.

Part of the solution to manage this risk is for VA writers to improve the effectiveness of their hedging program. These improvements often include:

- Hedging additional market risk
- Employing more accurate modeling approaches
- Using a hedge modeling system that allows them to perform hedging calculations more quickly so they may conduct more thorough analysis in support of strategic decision making

The MoSes VA Hedging Application can help you improve your hedging program in all of these aspects.

## Variable Annuity Risk Management

There are four guarantees currently offered in the VA market, which are listed in *Figure 1*. (VA writers often use the term GMxB to represent any or all of these guarantees.)

These guarantees represent a risk to the writer if there are adverse changes in economic conditions. VA writers can manage this risk by calculating Greeks, which measure the sensitivity of the value of these guarantees to changes in economic factors. Some of these factors are typically represented by Greek letters used in financial calculus, as described in *Figure 2*.

A VA writer can use these Greeks to adjust a portfolio of hedge assets by selecting hedging instruments with sensitivities that offset the sensitivities of the guarantees for any risk or combination of risks. Such risks would then be hedged.

The writer would decide which combinations of guarantees and Greeks to hedge based on the:

- Risk appetite of the VA writer
- Sensitivity of guarantee values to market changes
- Cost of hedging instruments (e.g., futures, swaps, options, swaptions)
- Transaction costs for changing investment positions

To consider these factors more effectively, VA writers need a hedging solution that provides actionable information in a timely manner.

## MoSes VA Hedging Application

Towers Watson has developed a hedging solution that enables VA writers to improve their hedging program by using a full-featured system that they can manage themselves. The MoSes VA Hedging Application is completely transparent, so you can see exactly how the calculations work to give you confidence in the underlying methodology. Because it's a MoSes application, your model administrators can tailor your models to meet any company-specific requirements that might arise. And if you need assistance with your hedging program or software, Towers Watson has a deep bench of hedging experts who can help you achieve your objectives.

The MoSes VA Hedging Application includes a Valuation Module used for the operational aspects of your hedging program and a Projection Module to support strategic decision making.

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**Figure 1. Variable annuity contract guarantees**

<b>GMWB</b>	Guaranteed Minimum Withdrawal Benefit
<b>GMAB</b>	Guaranteed Minimum Accumulation Benefit
<b>GMDB</b>	Guaranteed Minimum Death Benefit
<b>GMIB</b>	Guaranteed Minimum Income Benefit

**Figure 2. The Greeks**

<b>Delta (<math>\Delta</math>)</b>	Derivative of guarantee value with respect to <b>equity price level</b>
<b>Gamma (<math>\Gamma</math>)</b>	Second derivative of guarantee value with respect to equity price level. This describes how much more the guarantee value would change beyond the linear approximation of Delta
<b>Rho (<math>\rho</math>)</b>	Derivative of guarantee value with respect to <b>interest rates</b>
<b>Convexity (C)</b>	Second derivative of guarantee value with respect to interest rates. This describes how much more the guarantee value would change beyond the linear approximation of Rho
<b>Vega (<math>v</math>)</b>	Derivative of guarantee value with respect to <b>equity volatility</b>

## Valuation Module Features

The Valuation Module supports the operational side of a hedging program. It performs a point-in-time calculation of the Greeks selected for a portfolio of VA guarantees. The system allows users to model multiple separate accounts.

Inputs to the Valuation Module typically include economic data from sources such as Bloomberg, policyholder data from your policy administration system, product specifications, projection assumptions and economic scenarios.

It uses an innovative application architecture designed for speed. (We have seen run times 20 to 30 times faster than similar models with conventional application architecture.)

The Module has a built-in economic scenario generator that can calibrate and generate risk-neutral scenarios within the model, or read in economic scenarios from an external source.

It provides a large variety of economic shock projections, leading to production of a wide array of theoretical value calculations and Greeks. Comprehensive hedge reports are also available to support operations, including attribution and risk reports.

## Projection Module Features

The projection module supports the strategic side of a hedging program. It projects the value of VA guarantees forward in time across many economic scenarios while incorporating explicit modeling of dynamic hedging strategies. It lets you perform what-if analyses with a variety of hedging strategies and assess the impact on projected economic profit-and-loss statements, earnings volatility and capital requirements.

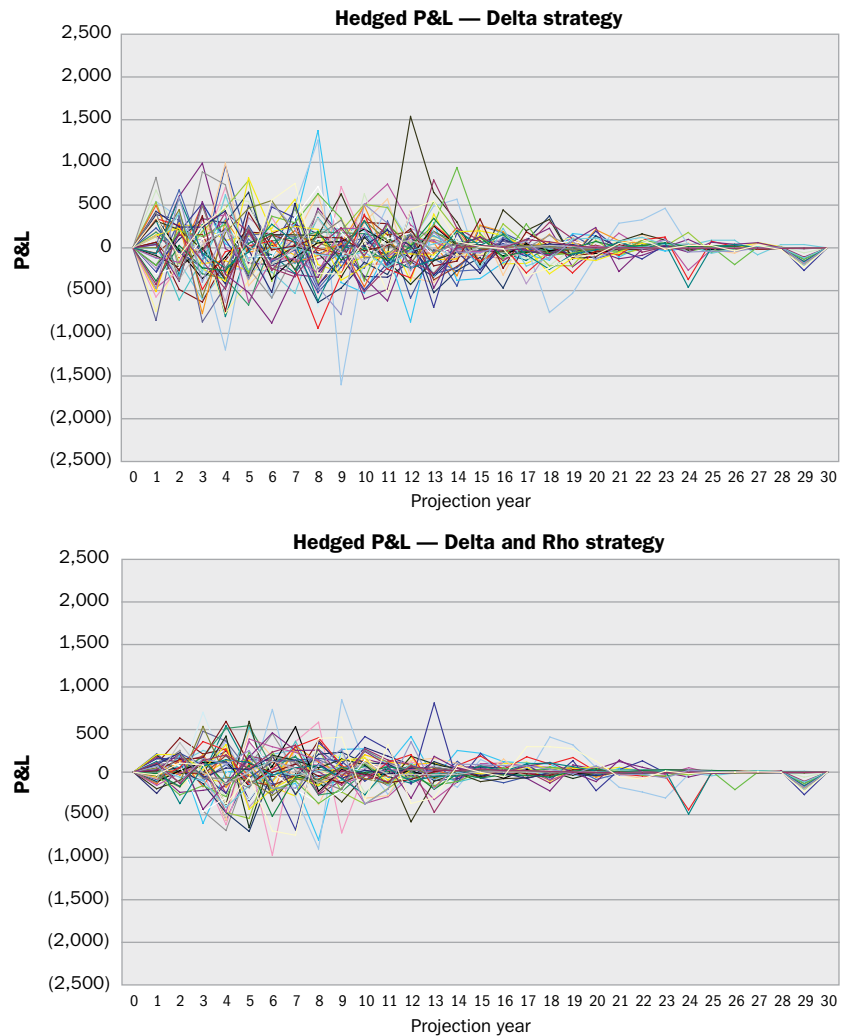
As with the valuation module, the projection module supports all four GMxBs. It can project up to four Greeks in a single projection. Greeks can be recalculated on the fly, and the system supports multiple strategy options for each Greek.

The projection module supports various options for dealing with residual exposures. Rebalance frequency and trading tolerances can be set by the user.

The projection module can leverage the embedded scenario generator to calibrate and generate risk-neutral scenarios on the fly within the projection.

Using these capabilities, the system provides hedged and unhedged projected financials calculated on an economic basis, tracking all associated hedge

Figure 3. Projected P&L comparing delta-only hedging with delta-and-rho hedging



cash flows to support capital and reserve valuations and analysis of earnings volatility (Figure 3). The application can also help you with the pricing of VA guarantees to help you design your VA products.

## MoSes Financial Modeling Platform

The MoSes VA Hedging Application is a special application that runs on the MoSes platform. MoSes applications are completely transparent. This openness gives you increased confidence that comes from understanding exactly how the applications model your business.

The MoSes software platform provides unmatched flexibility to tailor sophisticated financial models to your business. MoSes is ideal for addressing current and future modeling needs. Authorized users can fully customize the application code to reflect product designs, modeling assumptions and methodologies.

The comprehensive functionality of the VA Hedging Application, combined with the flexibility and transparency of the MoSes platform, enable your company to achieve self-reliance with a fully featured, state-of-the-art hedging system.

## MoSes High-Performance Computing

As with other MoSes applications, you can run the VA Hedging Application on MoSes High-Performance Computing (HPC). This enables you to perform the calculations in a distributed processing environment across many compute nodes (e.g., a grid). By splitting the run into smaller jobs and running them in parallel across a distributed processing cluster, projections finish in much less time, giving you actionable results faster.

## RiskAgility

Because it's a MoSes application, you have the option of running the VA Hedging Application on RiskAgility, Towers Watson's enterprise financial modeling software platform for insurance companies. The RiskAgility platform enables data management, scheduling, distributed processing and audit capabilities in a controlled technology environment. RiskAgility will improve management of your MoSes models to make running projections more efficient, controlled, reliable and easily repeatable — ideal attributes for an operational hedging program production environment.

## Our Hedging Credentials

Towers Watson offers services to implement a hedging program, and to review and support existing programs. These hedging services draw upon our expertise in capital markets, financial modeling and insurance advisory services.

We advise more than three-quarters of the world's leading insurers. We have more actuaries and more chartered enterprise risk analyst (CERA) designations serving the insurance industry than any other professional services company. Our hedging experts are well versed in derivative instrument valuation and trading floor operations used by insurers to manage risk. We act as a trusted advisor offering a variety of hedging program services, from third-party methodology review to end-to-end implementation of a full-featured hedging program.

## Highlights of the MoSes VA Hedging Application

- Comprehensive functionality to model GMxB riders
- Measures risk sensitivities for a broad range of Greeks
- Application is transparent — no black box
- Models are fully customizable
- Functionality, transparency and flexibility help your company achieve self-reliance in your hedging program
- Designed for speed
- Can run on HPC and RiskAgility for enterprise scalability and control
- Backed by Towers Watson, a worldwide leader in insurance consulting and actuarial software

Towers Watson has more than 40 years of experience in developing actuarial software, and we've provided actuarial software solutions to insurers for a quarter century.

Drawing on these comprehensive capabilities, Towers Watson can help your company establish or improve your hedging operation to help achieve self-reliance in managing risk and optimizing return.

## About Towers Watson

Towers Watson is a leading global professional services company that helps organizations improve performance through effective people, risk and financial management. With 14,000 associates around the world, we offer solutions in the areas of employee benefits, talent management, rewards, and risk and capital management.

Towers Watson is the world's largest provider of actuarial software. We combine the systems expertise of our software professionals with the actuarial knowledge and thought leadership of our insurance consulting business to develop solutions that help clients measure value, manage risk and safeguard solvency.

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