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PBR Simplified Methods Project

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Section 2G of Valuation Manual Section 20 (VM-20) states the following: "A company may use simplifications, approximations and modeling efficiency techniques to calculate the net premium reserve (NPR), the deterministic reserve and/or the stochastic reserve required by this section if the company can demonstrate that the use of such techniques does not understate the reserve by a material amount, and the expected value of the reserve calculated using simplifications, approximations and modeling efficiency techniques is not less than the expected value of the reserve calculated that does not use them."

The Society of Actuaries (SOA) funded a research project to explore possible methods of approximating the VM-20 Stochastic Reserve for Principle-Based Reserves (PBR). The PBR Simplified Methods research team consisted of Steve Strommen, Brian Hartman, Chris Davis, Therese DeWitt and myself. The project was designed to provide four deliverables: 1. a multi-risk scenario generator (MRSG) for all material assumptions; 2. objectivity measure(s) for material best estimate assumptions; 3. an actuarial report detailing the results of the project; and 4. recommendations for approximations techniques by product type, together with a sample regulatory demonstration.

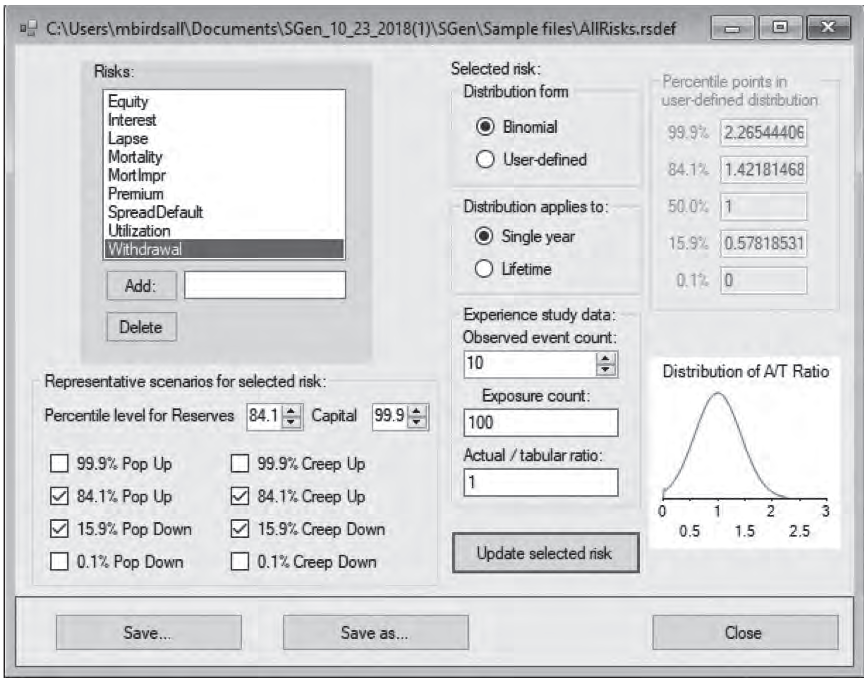
The team has provided these deliverables to the SOA. The project report, including a sample regulatory demonstration, and the MRSG will be available on the SOA website.

This article provides a brief description of deliverables 1, 2 and 4, including testing results with respect to the two recommended approximation methods for a sample universal life with secondary guarantees (ULSG) product.

MULTI-RISK SCENARIO GENERATOR

The MRSG produces actual rates for the equity and interest risks and actual-to-expected (A/E) factors (also called "actual-to-tabular factors" or A/T) for the other material risks. The user first creates a risk definition file.

Figure 1
Defining the Risks



In the upper left-hand corner of Figure 1 (pg. 25), the user starts with the equity and interest risks and adds material risks determined by sensitivity testing, actuarial judgment or other methods. For the equity and interest risks, the scenarios are generated using the SOA/AAA economic scenario generator embedded in the MRSG.

The probability levels for the shocks to the material risks are indicated in the lower left-hand corner, which reflect extreme scenarios that could be used to develop target surplus (e.g., 99.9 percent and 0.1 percent). The 84.1 percent and 15.9 percent scenarios could be used to represent moderately adverse scenarios. Note that the user may input respective percentile levels.

"Pop Up (Down)" and "Creep Up (Down)" are different methods for producing the scenarios at the selected probability levels. For some risks, such as lapses, the adverse direction is not always clear, so deviations in both directions are tested.

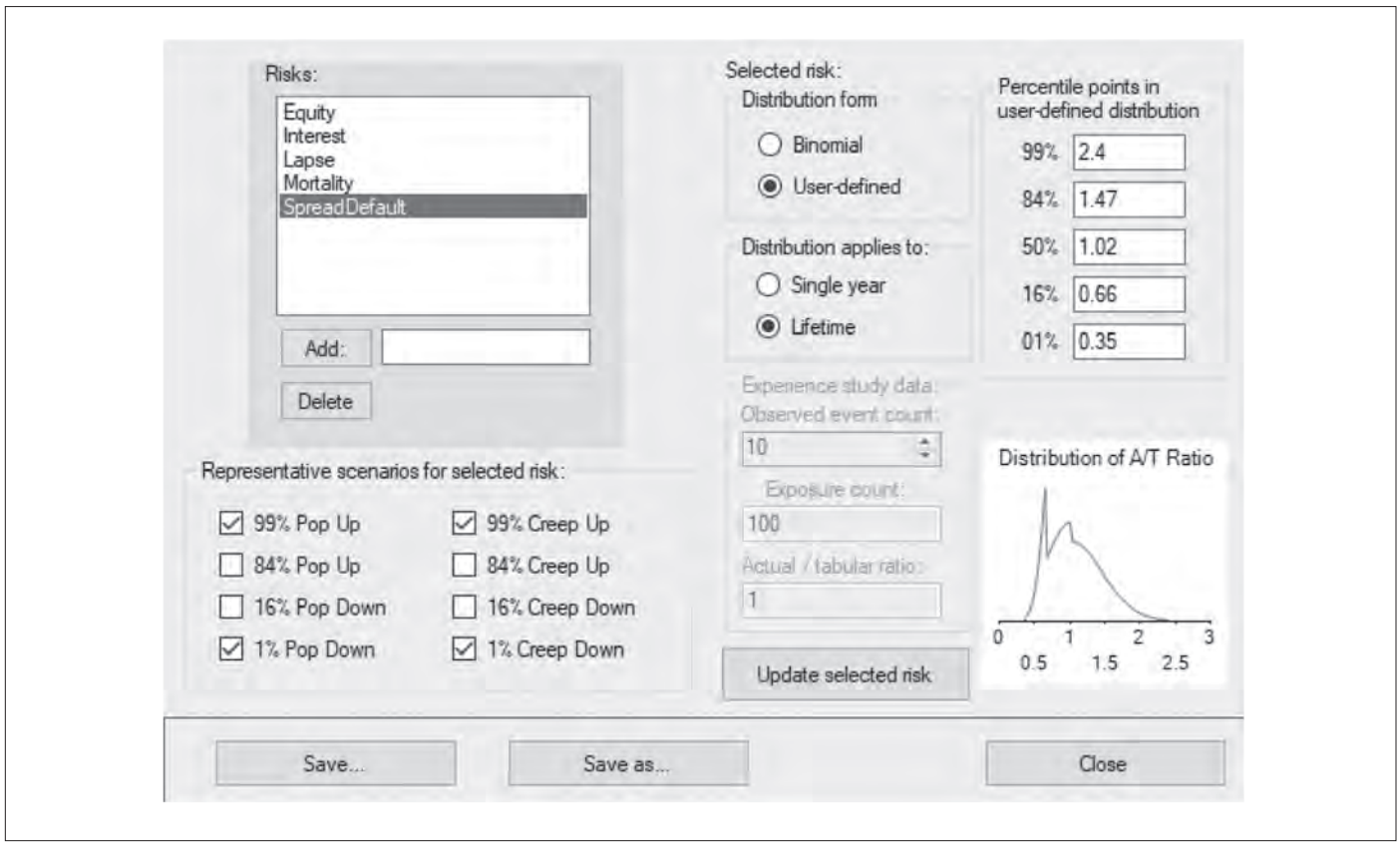
The pop and creep scenarios differ in the pattern of shocks that are used to create them. The PBR Simplified Methods research team defined the severity of a scenario as being measured by the sum of the cumulative shocks. The pop and creep scenarios have the same sum of shocks over the first 20 years (240 months). In the pop scenarios, the shocks are higher initially and then grade off towards zero. In the creep scenarios, the shocks are the same in every month.

The user has the option to select the binomial distribution or to create a user-defined function. In the development of the generator, Brian Hartman developed an approach that permits the use of the binomial distribution for any material risk with a range from zero to one, such as lapse and mortality. The resulting distribution covers both estimation error and adverse deviation, as the valuation manual requires.

A user-defined function could be created when no relevant company or industry experience study is available, but the user has access to other information, such as credit spreads and default rates.

The choice of single-year versus lifetime scenarios impacts the frequency of change of the A/E factors for the specified risk.

Figure 2
Spread Net of Default Risk



In Figure 2 (pg. 26), note that the spread net of default risk employs a user-defined function that provides a single value for the first 20 projection years rather than varying year by year. After 20 years, the value reverts to the 50th percentile value of 1.02. For this situation, pop and creep scenarios do not apply. The percentile points shown in Figure 2 for the user-defined function were based on an American Academy of Actuaries presentation to the NAIC. Note the graph of this distribution is shown in the lower right-hand corner of Figure 2. The distribution of A/E ratios is skewed to the right, as one may expect.

OBJECTIVITY OF ASSUMPTIONS

Using the MRSG, the probability distributions of material assumptions are objectively defined for economic scenarios and for mortality and lapses based on company experience studies, relevant industry experience studies, and other relevant information sources.

In measuring assumption objectivity, the concept of central estimate assumptions is used. Central estimate assumptions refer to assumptions for the material risks to develop baseline assumptions for modeling those material risks in cash flow projection models. Where relevant company experience for a material risk is 100 percent credible, the relevant company experience for that material risk would be the central estimate assumption, including consideration of possible trends in the experience. When there is less than 100 percent credibility, the relevant company experience could be credibility blended with relevant industry experience to establish the central estimate assumptions for a material risk, including consideration of possible trends in both relevant company and relevant industry experience. The central estimate assumptions should be updated regularly to not miss trends and provide a standard of comparison for the actual base assumptions used in the cash flow projection model. Four assumption objectivity measures are defined here.

Measure 1: Actual to Expected Ratios for the Material Assumptions

The central estimate assumptions provide the denominators for A/E ratios for the material assumptions for ULSG. The actual modeling assumptions (without margins) used as the basis for the cash flow projections provide the numerators in the A/E calculations. If the anticipated experience assumptions are set equal to the central estimate assumptions, the A/E ratios for all the material risks equal one. The A/E ratio provides a measure of the deviation of modeling assumptions to the central estimate assumptions for each material risk.

Measures 2, 3: Margin Impact, Percent Statutory Margin Impact

An anticipated experience reserve is defined as a deterministic reserve from the cash flow projection model using the anticipated experience assumptions. Similarly, a central estimate assumption reserve is defined for this demonstration as a deterministic reserve using the central estimate assumptions.

The anticipated experience reserve minus the central estimate assumption reserve for a block of business equals the margin impact. For this purpose, the statutory margin equals the reported statutory reserve for a block of business minus the anticipated experience reserve. The percent statutory margin impact equals the margin impact divided by the statutory margin.

If the anticipated experience assumptions equal the central estimate assumptions, the margin impact equals $0 and the percent statutory margin impact equals 0 percent. Otherwise, these measures provide the combined impact of using modeling assumptions different than the central estimate assumptions. In a sense, these measures can be considered as measuring the degree to which the margin has been reduced to cover the use of other modeling assumptions.

Measure 4: Percent Aggregate Reserve Margin Impact

Using the MRSG to produce deterministic scenarios for each material risk at the 84th percentile of the distribution for that risk, an aggregate reserve margin is calculated, including a covariance adjustment, using either a square root formula

(like the statutory life risk-based capital formula) or a covariance matrix. The percent aggregate margin impact equals the margin impact divided by the aggregate reserve margin. If the anticipated experience assumptions equal the central estimate assumptions, the percent aggregate reserve margin impact equals 0 percent. Otherwise, this measure provides the combined impact of using modeling assumptions different than the central estimate assumptions. As above, this measure quantifies the reduction in margin due to using other modeling assumptions for one or more material risks.

APPROXIMATION METHODS FOR THE VM-20 STOCHASTIC RESERVE

Four products were tested for this project: level term, ULSG, accumulation UL, and par whole life. Using the MRSG, the research team developed what we called "fully stochastic scenarios," with all material risks varying according to the distributions defined in the risk definition file. The regulatory guardrail against mortality improvement was observed. The conditional tail expectation (CTE) 70 reserve based on 1,000 fully stochastic scenarios was the standard of comparison for the approximation methods. Two methods of approximating the PBR stochastic reserve for these products provided useful estimates that remained stable over three successive valuation years.

Method 1: Limited Number of Fully Stochastic Reserves plus CTE 70 Standard Deviation

The CTE 70 standard deviation is based on a 2005 article by John Manistre and Geoffrey Hancock in the North American Actuarial Journal titled "Variance of the CTE Estimator." We refer to the sum of the CTE 70 stochastic reserve and the CTE error adjustment (i.e., standard deviation) as the "adjusted stochastic reserve." For all four products, the adjusted stochastic reserve was greater than the CTE 70 stochastic reserve based on 1,000 fully stochastic scenarios for each of the numbers of scenarios run (30, 50, 100 and 200) and for each of the three successive valuation dates tested. The degree of conservatism in the adjusted stochastic reserve over the stochastic reserve based on 1,000 scenarios varied based on the number of scenarios.

Method 2: ULSG Central Estimate Reserve Plus Aggregate Margin at the 88th Percentile (Enhanced RSM)

The enhanced representative scenarios method (RSM) is a method to approximate the PBR stochastic reserve by projecting cash flows using separate deterministic scenarios for each material risk at a selected probability level (e.g., 88th percentile) to calculate an aggregate margin, which is then added to the central estimate reserve. For ULSG at December 2016, the aggregate margin was about 157.8 percent of the central estimate reserve. This result reflects the number of material risks associated with ULSG, as well as the degree of variability in those risks.

Sensitivity testing at the 88th percentile and the 12th percentile of the economic scenarios demonstrated that enhanced RSM continued to work well as an approximation method as economic conditions change.

REGULATORY DEMONSTRATION

When available, see the project report on the SOA website for a sample regulatory demonstration for ULSG. The regulatory demonstration for level term would contain similar elements.

In the testing for this project, the prevailing CRVM reserves for par whole life and accumulation UL were much higher than any of the modeled reserves calculated. It should be noted that modeled reserves reflect the level of expected profitability of the respective products; the higher the expected profitability of a product, the lower the modeled reserves. The regulatory demonstrations for these products simply need to provide evidence that the modeled reserves are less than the CRVM reserve. The goal is to minimize the extra work of PBR while still providing useful information for a company's risk analysis.

OTHER USES

The PBR Simplified Methods Project has resulted in the development of new tools that can be used not only for approximation methods for the VM-20 stochastic reserves but also for other purposes.

VM-20 requires the development of margins for all material assumptions in both the deterministic and stochastic reserve calculations. The MRSG could be a useful tool for the objective development of individual margins that reflect the amount of relevant experience underlying the specific material assumptions. The process of calculating an aggregate margin reflecting the covariance of the material risks can be used to calibrate the individual margins to avoid the stacking problem of just adding up individual margins.

Migrating asset adequacy analysis into a similar multi-risk modeling structure using the MRSG and assumption objectivity measures would improve the analysis of company risk and the consistency of reserve measures among blocks of business. Since the material risks in the MRSG are user-defined (except for economic scenarios), the generator could be used for the asset adequacy analysis of all long-tailed lines of business. Ranking of insurance risks could then be accomplished on a legal entity basis.

Many smaller companies use a percentage of RBC as a proxy for target surplus that is needed for pricing and capital allocation purposes. There is no theoretical meaning to a multiple of RBC but may simply represent a rule of thumb with respect to rating agency requirements to achieve certain ratings. With the

MRSG, extremely adverse scenarios for each material risk can be selected and the results combined to produce a target surplus level that reflects the company's specific risks rather than an industry-wide average. Free surplus can also be computed consistently, and due to the excessive levels of statutory reserves for some products, the value of free surplus may be larger than previously thought.

GAAP reserve requirements currently require the addition of provisions for adverse deviations. The MRSG could be used to produce those margins on an objective basis at a probability level consistent with GAAP.

The VM-20 stochastic exclusion test (SET) is focused on economic scenarios for interest rate and equity risk. The SET with a threshold of 6 percent may not differentiate well between products with different risk profiles. It may be that the MRSG could be used to refine the SET as part of the NAIC's feedback loop. Regardless, a company could run tests using the MRSG to determine whether stochastic reserves should be calculated, either as part of the PBR reserves or as a part of asset adequacy analysis.

The company's use of the assumption objectivity measures is entirely voluntary. In situations where reviewers (such as independent auditors, regulators or other interested third parties) may need assurance that assumptions used are appropriately set, the voluntary submission of assumption objectivity measures could help minimize time-consuming communications and increase trust for both current and future projects. Rate increase filings for long-term care and state examinations of PBR are two areas that could benefit from using this approach.

CONCLUSION

For level term and ULSG, VM-20 defines an NPR that is generally lower than the prior CRVM reserve for those products. For both products, reduced numbers of fully stochastic scenarios produced a CTE 70 reserve that, when augmented by the standard deviation of the CTE estimator, produced a good approximation of the CTE 70 reserve based on 1,000 fully stochastic scenarios. In addition, the enhanced RSM at the 88th percentile produced good approximations for the CTE 70 reserve based on 1,000 scenarios.

For the par whole life and accumulation UL products, the current definition of CRVM serves as the NPR. This reserve level does not reflect company experience and, for the product designs tested and the assumptions used in the cash flow projections, far exceeds the level of statutory conservatism targeted by the NAIC's Life Actuarial Task Force. For this situation, the incremental work to calculate the modeled reserves for PBR may not be useful. However, using the tools developed in this research project, enhanced work may be accomplished in asset adequacy analysis that could set the stage for future PBR developments, such as revised NPR calculations for these two product types. As noted, less-profitable products would produce modeled reserves that could be higher than the NPR (or CRVM) floor. ■

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