Representative Scenarios Method Report
Annuity Reserves Work Group
American Academy of Actuaries

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The Annuity Reserves Work Group (ARWG) of the American Academy of Actuaries[1] is pleased to provide this report to the National Association of Insurance Commissioners (NAIC) Life Actuarial Task Force (LATF) VM-22 Subgroup to allow the Subgroup to better assess the strengths and weaknesses of the Representative Scenarios Method (RSM).

This report is intended to lay out the potential benefits of the RSM as well as the potential issues in a conceptual manner so that the VM-22 Subgroup can determine the extent to which it could conceptually support RSM as a viable methodology.

This is an educational paper. Accordingly, statements in this paper should not be construed as supporting any particular position.

Issues that arise in the development and implementation of the RSM methodology (e.g., aggregate margins vs. individual margins) will be discussed in this report to the extent that they arise when discussing RSM, but are not intended to be a significant focus of the report.

Background

The ARWG is considering the use of a Representative Scenarios Method (RSM) for the calculation of a component of the VM-22 minimum reserve standard called the Modeled Reserve. The Kansas Insurance Department has been engaged in a field test of an RSM for Fixed Indexed annuities with guaranteed lifetime income benefits (GLIBs) to test the practicality and accuracy of an RSM to right-size the modeled reserve.

[1] The American Academy of Actuaries is an 18,500+ member professional association whose mission is to serve the public and the U.S. actuarial profession. The Academy assists public policymakers on all levels by providing leadership, objective expertise, and actuarial advice on risk and financial security issues. The Academy also sets qualification, practice, and professionalism standards for actuaries in the United States.

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The role of the Modeled Reserve in the calculation of reserves under VM-22 as envisioned by the ARWG was presented to the LATF VM-22 Subgroup in an August 22, 2013, report and corresponding slide presentation. The report, "ARWG Report to LATF's VM-22 Subgroup, Concerning Potential VM-22 Reserve Methodology, Indianapolis, IN – August 22, 2013,"[2] included the following summary of the proposed framework (emphasis has been added to the Modeled Reserve references):

> Our goal for the methodology underlying VM-22 requirements is to propose a sound principle-based reserve standard for annuities other than variable annuities, incorporating:
>
> 1. an appropriate formulaic floor reserve that extends the current [commissioners' annuity reserve valuation method (CARVM)] methodology to reflect its use as a minimum reserve instead of as the primary reserve;
>
> 2. an auditable **modeled reserve** that properly reflects the key risks of today's complex annuity product designs; and
>
> 3. assurance of an adequate reserve standard by exploring possible expansion of asset adequacy analysis requirements, if necessary.
>
> **Minimum Reserve Standard.** Under the VM-22 requirements currently under consideration, the reserve for a given block of business would equal (i) the sum, for all policies in the block, of the larger of the Floor Reserve and the policy cash value, plus (ii) the excess, if any, of the **Modeled Reserve** over (i).

Objective

The objective of statutory reserves as stated in the valuation manual[3] under the Overview Of Reserve Concepts section is:

"Reserve requirements prescribed in the Valuation Manual are intended to support a statutory objective of conservative valuation to provide protection to policyholders and promote solvency of companies against adverse fluctuations in financial condition or operating results pursuant to requirements of the SVL."

"Risks not to be included in reserves are those of a general business nature, those that are not associated with the policies or contracts being valued, or those that are best viewed from the company perspective as opposed to the policy or contract perspective. These risks may involve the need for a liability separate from the reserve, or may be provided for in capital and surplus."

[2] http://www.actuary.org/files/ARWG_VM-22_Methodology_Report_8-22-13.pdf
[3] Valuation Manual, adopted by the National Association of Insurance Commissioners, Dec. 2, 2012, Non-Substantive Revisions through March 31, 2014, page 3.

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Motivation for RSM

In the early development of the principle-based approach to reserves, it was widely recognized that the ultimate methodology could be a stochastic multivariate distribution thereby enabling the appropriate modeling of each random assumption variable. However, some felt that such models would be beyond the capabilities of companies within the timeframes allowed for statutory financial reporting until significantly greater computing capability could be brought to bear on the process. Additionally, questions were raised by the ARWG regarding the time to run and audit such a large number of scenarios and companies' abilities to mathematically integrate the large number of key risk drivers in a multivariate stochastic distribution. Since an RSM is intended to approximate the result that would be obtained using a stochastic distribution method in a less calculation-intensive manner, it is being considered by the ARWG for possible use as an approach to calculate the modeled reserve component of principle-based reserving for non-variable annuities.

RSM versus Stochastic Modeling

The difference between modeling using RSM and stochastic modeling is in the generation of the scenarios. For stochastic modeling, a large number of scenarios are randomly generated based on a predefined probability distribution. The number of occurrences of a scenario dictates the probability of that scenario, which is consistent with the underlying probability distribution. In using an RSM, a small number of specific scenarios are generated from a predefined probability distribution. Each scenario is assigned a probability based on the underlying probability distribution.

Evaluation of RSM

The integrity of the RSM calculation will be evaluated by the ARWG based on a field test performed by the Kansas Insurance Department. This evaluation will be done by comparing the reserve calculated using RSM against other types of reserve calculations. The following methods are included in the comparison: (a) current CARVM, (b) multivariate stochastic modeling of all key risk drivers, (c) grid scenarios (i.e., a cross-product reserve using all possible combinations of the RSM scenarios), and (d) application of VM-20 to non-variable annuities.

As RSM is being evaluated by comparing the results against stochastic modeling, the outstanding question is how close the RSM results should be relative to the stochastic results to determine that the method is acceptable.

RSM Process Example

The following outlines the process of using RSM in a multivariate application.

Step 1 – Identify the Key Risk Drivers (KRD)

The first step in implementing the RSM is to identify the key risk drivers (KRD), which are those assumptions whose variability can significantly affect the cost of fulfilling the contract. Depending on the contract type, such assumptions could include future investment returns, claim

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costs, lapse rates, expenses, mortality, longevity, and policyholder behavior. Guidance is needed as to how to determine if a risk driver is included or excluded in the reserve calculations. For this example, the assumptions for future investment returns, lapse rates, and longevity could be the block's KRDs.

Step 2 – Determine distribution of assumption values for each KRD

The next step is to determine the assumed distribution of values for each KRD.[4] Standard statistical techniques can then be used to determine the distribution of the variable, although it may be desirable to identify which statistical technique should be recommended for certain types of assumptions.[5]

When setting assumptions, it is appropriate to start with company experience when available and then look to industry experience. This process seeks to produce the best estimate reserve and thus, no margins would be incorporated in the assumptions.

Step 3 – Generate scenarios for each KRD

Now that the distributions for the KRDs are determined, scenarios are generated for each KRD. A small number of scenarios (five in this example) for each KRD at specified percentile levels in the distribution are generated. For example, it may be appropriate to choose the five scenarios as the median, +/- 1 standard deviation and +/- 3 standard deviations. Each of these scenarios is referred to as a "representative scenario." In each representative scenario for a given risk, the values for all other assumptions are held at the median level.[6]

The total number of representative scenarios is equal to:

1 (i.e., the baseline scenario with median values for all variables) + (number of KRDs) x (number of scenarios per KRD – 1)

As the example includes 3 KRDs (future investment returns, lapse rates, and longevity) and 5 scenarios per KRD the total number would be 1 + 3 * (5-1) = 13.

Step 4 – Project asset and liability cash flows

[4] Three primary sources of uncertainty in assumption values have been identified as follows: (1) the true mean is not known, (2) limited experience data sample sizes may have statistical variation around the mean, and (3) there may be undefined random variance in the relationship between the variable and the external environment. To simplify the development, the ARWG is assuming – for now – that there is no undefined randomness in the relationship between the variable and the external environment. The randomness can be revisited as the methodology is further developed.

[5] It will also be necessary to ensure that studies of the underlying experience effectively filter out behavior that is dynamically linked to the environment and can thus be modeled using dynamic assumptions. In addition, considerations may be needed to address the potential impact on minimum reserve standards caused by the wider distributions that smaller companies would be expected to have.

[6] The rationale for this choice (and not to set the value for all other assumptions at the mean level) is that the reserve (before any margin is added) is intended to be the mean. In order for that to happen, the scenarios that are used need to be at defined percentile levels. The median is at a clearly defined percentile level, while the mean is not.

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For each of the generated scenarios, an asset-liability simulation model is used to project future asset and liability cash flows. The minimum scenario reserve is defined as the level of starting assets required to satisfy all liability cash flows until the contracts expire for each scenario. Given the small number of scenarios required using RSM, it may be practical to iteratively solve for the starting asset amount for each scenario.

Step 5 – Combine scenarios to determine the minimum reserve

We assign probability weights to each representative scenario within any key risk that sum to 1 so that we can produce a "mean" value. As we selected our representative scenarios to be at the median of the distribution and at four other points on the distribution, we can use standard probability theory to assign weights to each scenario (e.g., the weight for the median scenario would be the probability between -0.5 and 0.5 standard deviations).

In order to aggregate results for all KRDs, we assign probability weights to each KRD that must sum to 1. The technique that is used for the Kansas field test is to assign weights to each risk based on the variability[7] of results for that risk.

Step 6 – Include an Aggregate Margin

Thus far we have described how to compute an RSM reserve without margins to cover moderately adverse scenarios. At this point the assumption has been that an aggregate margin, using an appropriate method, would be added.

Advantages/Disadvantages and Considerations of RSM

Advantages

- Scenario Requirements: Using an RSM is less calculation-intensive than a stochastic approach because cash flow projections are required for a fewer number of scenarios. This reduces the run-time requirements, enabling fewer system resources and/or the ability to generate results quicker.
- Transparency: All cash flows projections used in the reserve calculation utilizing the RSM could be completely reviewed given the small number of scenarios.

Disadvantages

- Scenario Generation: Where scenario generation is not prescribed by regulation, there will be an increased audit focus on the scenario generation.
- Scenario Distribution Credibility: Actuarial judgment will likely need to be used in determining the probability distribution to generate scenario for key risks where credible experience may not exist.
- Tail Scenarios: The representative scenarios include tail scenarios that are difficult to determine.

[7] The difference between the highest and lowest results for the key risk driver determine the weight used for that key risk driver, i.e., a key risk where the spread of results is great will get more weight.

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Considerations

- Regulatory Prescription: The extent to which it will be necessary to insert regulatory prescription in lieu of the actuary's judgment will need to be considered. One area to consider would be in the probability distributions used for scenario generation.
- Key Risk Driver Selection: Assuming the Key Risk Drivers are determined by the company, guidance is needed as to how to determine if a risk driver is included or excluded in the reserve calculations.
- Skewed Distributions: The Kansas field test has used a normal distribution for all key risks. The RSM should also be evaluated using a skewed distribution.
- Risk Aggregation: The Kansas field test uses a unique approach to aggregating results across risks as described in the example above. It does not use typical techniques that require a correlation assumption between risks. This approach will need to be evaluated to determine whether it is appropriate.
- KRD Probability: The method used for the Kansas field test in assigning KRD probabilities should be evaluated.
- Dynamic Behavior: It will also be necessary to ensure that studies of the underlying experience effectively filter out behavior that is dynamically linked to the environment and can thus be modeled using dynamic assumptions.
- Consistency Across Companies: The methodology may be needed to address the potential impact on minimum reserve standards caused by the wider distributions that smaller companies would be expected to have.
- Median Scenarios: The RSM requires the use of the median scenario rather than mean assumptions. The availability of the median scenario and their associated distributions from industry experience should be considered.

Conclusion

The ARWG will evaluate the use of an RSM in calculating the Modeled Reserve component of the VM-22 minimum reserve standard. The evaluation is dependent on a report expected as part of the Kansas Insurance Department field test. Based on the field test results, the ARWG will determine a position on the use of an RSM.

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