



AMERICAN ACADEMY *of* ACTUARIES

**Report from the
American Academy of Actuaries
Standards for Stochastic Methods Work Group**

**Presented to the
National Association of Insurance Commissioners
Life and Health Actuarial Task Force
Life Risk-Based Capital Working Group**

St. Louis, MO – September 2006

The American Academy of Actuaries is a national organization formed in 1965 to bring together, in a single entity, actuaries of all specializations within the United States. A major purpose of the Academy is to act as a public information organization for the profession. Academy committees, task forces and work groups regularly prepare testimony and provide information to Congress and senior federal policy-makers, comment on proposed federal and state regulations, and work closely with the National Association of Insurance Commissioners and state officials on issues related to insurance, pensions and other forms of risk financing. The Academy establishes qualification standards for the actuarial profession in the United States and supports two independent boards. The Actuarial Standards Board promulgates standards of practice for the profession, and the Actuarial Board for Counseling and Discipline helps to ensure high standards of professional conduct are met. The Academy also supports the Joint Committee for the Code of Professional Conduct, which develops standards of conduct for the U.S. actuarial profession.

Standards for Stochastic Methods Work Group

Nancy Bennett, F.S.A., M.A.A.A., Chair

Philip Barlow, F.S.A., M.A.A.A.
Larry Bruning, F.S.A., M.A.A.A.
Tom Campbell, F.S.A., M.A.A.A.
Larry Gorski, F.S.A., M.A.A.A.
Jim Lamson, F.S.A., M.A.A.A.

Andy Rallis, F.S.A., M.A.A.A.
Max Rudolph, F.S.A., M.A.A.A.
Bill Schwegler, F.S.A., M.A.A.A.
Steve Strommen, F.S.A., M.A.A.A.
Mike Ward, F.S.A., M.A.A.A.

Standards for Stochastic Methods Work Group Report

With the movement toward the increased use of principles-based approaches in the calculation of reserves and capital, the Standards for Stochastic Methods Work Group (SSMWG) was formed to develop standards to be applied across the various types of stochastic calculations, such as risk-based capital calculations, life, annuity, and long-term care reserves. The recommendations of this group may also provide a basis for stochastic calculations for other types of insurance. In the following report, the SSMWG has outlined the group's charge and recommendations.

SSMWG Charge:

The charge of the SSMWG is as follows:

Recommend the most appropriate method for supporting the use of stochastic interest rate and equity generators for the purpose of calculating capital charges (C3 Phases 1 - 4) and reserves using a stochastic methodology (i.e., principles-based life and annuity reserves.)

The operating principle of the SSMWG is that a consistent stochastic methodology should be used for the purpose of calculating RBC and reserves, assuming the method is appropriate for a given line of business.

In addressing the charge, the SSMWG considered certain issues:

- Should the AAA Economic Scenario Work Group provide predetermined scenarios similar to those originally developed for C-3 Phase I or calibration criteria similar to those in C-3 Phase II for the purpose of calculating RBC and reserves?
- How should consistency be applied when using stochastic methods to calculate reserves and capital?
- Should the AAA Economic Scenario Work Group participate in updating the pre-packaged scenarios or the calibration criteria on an ongoing basis?

Background:

At various times during the past decade, actuaries have been using stochastic methods in the calculation of capital and reserves, notably in the calculation of C3 Phase 1 and C3 Phase 2 charges and in the calculation of statutory reserves for variable annuities. Consider how stochastic methods have been used in these examples:

- **C3 Phase 1 Scenarios**
 - Predetermined scenario sets (12 or 50 scenarios) and weights were provided to calculate the C3 capital charge for those products within the C3 Phase 1 scope.
 - The scenario sets were selected from a larger set and are a biased sample in order to calculate required capital. The scenario sets were not selected by a random sample of 200 stochastically generated scenarios.
 - The C3P1 scenario sets were provided to assist the industry in calculating RBC.
 - An Enhanced C3P1 generator was released in January 2006. The enhanced generator will produce a set of interest rate scenarios based on a specified yield curve and the same model parameters underlying the original C3P1 generator.
- **C3 Phase 2 Scenarios**
 - 10,000 prepackaged scenarios were developed to calculate the C3 capital charge for those products within the C3 Phase 2 scope.
 - The scenarios are a representative sample generated from an equity return generator parameterized for various fund types.

SSMWG Principles:

The SSMWG consisted of representatives from several AAA work groups, including the Life Reserves Work Group, Annuity Reserves Work Group, Variable Annuity Reserves Work Group, Life Capital Adequacy Subcommittee, and the Economic Scenario Work Group (LRWG, ARWG, VARWG, LCAS, ESWG) and regulators. The SSMWG developed its recommendations based on the following principles:

- Reserve and capital work groups want to provide users with a number of alternative methods for generating stochastic scenarios rather than requiring one method.
- The SSMWG recommendations have been made in the spirit of principles-based approaches for the determination of reserves and capital.

- Each stochastic method has positive and negative implications, depending on the frame of reference.
 - Level of reserves and capital
 - Flexibility for the company user
 - Ease (or difficulty) of implementation for a company user
 - Ease (or difficulty) of implementation for the AAA work groups
 - Consequences for aggregation across lines of business
 - Implications for the future (e.g., maintaining and updating the stochastic methods)

SSMWG Recommendations:

The recommendations of the SSMWG fall into two areas:

- Alternative methods for generating stochastic scenarios
- Use of Scenario Generators

With respect to alternative methods for generating stochastic scenarios, the SSMWG is recommending that each AAA work group allow two methods for generating stochastic scenarios. The objective of each method is to produce a consistent level of either reserves or capital, regardless of the method used to generate scenarios. A company could choose to use different methods for different products, since the underlying methodology produces consistent results.

The AAA's Economic Scenario Work Group will be responsible for providing the technical guidance for the implementation of stochastic methods. The AAA's Economic Scenario Work Group will periodically update the calibration criteria and parameters to be used in the stochastic generator.

Alternative methods for generating stochastic scenarios:

- Prescribed Generator
The AAA Economic Scenario Work Group (ESWG) will provide an economic generator. This generator would contain updated parameters and would satisfy the calibration criteria developed by the AAA's Economic Scenario Work Group. The C3 Phase 2 generator is an example of a prescribed generator.
- Proprietary Generator
A company could develop its own economic generator. This generator would satisfy the calibration criteria developed by the AAA's Economic Scenario Work Group.

In recommending the use of either an AAA (ESWG) prescribed generator or a proprietary generator, the SSMWG has consciously excluded the use of the current C3 Phase 1 generator, or rather, the C3P1 generator that underlies the C3P1 worksheet. This C3P1 generator and resulting scenario set is based on a generic set of products and asset portfolios. The SSMWG believes that the development (and use) of pre-selected scenario sets is inconsistent with the principles based approach for determining reserves and capital. These particular pre-selected scenarios were developed more than ten years ago when C3P1 was introduced. The pre-selected scenarios were a necessary and practical tool to provide at that time.

The SSMWG has considered the case of companies that may not currently be in a position to implement robust stochastic models of assets and liabilities, but believes the options available for the uses of scenarios, as discussed in the remainder of this report, present these companies with adequate options to address the dilemma. Furthermore, maintaining pre-selected scenarios is a very time-consuming process for the AAA LPC given the many product designs and asset classes maintained throughout the industry. Most importantly, the SSMWG feels that the risk created by those products subject to the C3P1 requirements justifies a more robust calculation of capital charges.

Use of Scenario Generators:

Each AAA work group should recommend how the scenarios are to be used in the ongoing calculation of reserves and/or capital. In specifying how the scenarios should be used in the stochastic calculations, each work group should consider how much flexibility to give the user and how results should be aggregated. In addition, each group should consider how the peer review and/or certification process will address the use of scenarios.

The AAA's Economic Scenario Work Group will provide the generator/parameters and calibration criteria for developing stochastic scenarios. In using a generator (proprietary or prescribed), an actuary would have the option of generating a large number of scenarios OR a company could generate scenarios and apply variance reduction techniques to use a smaller number of scenarios in the reserve or capital calculations.

In the first example, a company could generate a large number of scenarios as is done for the AAA LPC C3 Phase 2 generator. In this example, the company would generate 10,000 scenarios and weight the results projected for each of the 10,000 scenarios. In the second example, a company could use a smaller number of scenarios in the event that the company has a block of business with little or no material tail risk.

The application of variance reduction techniques, resulting in fewer scenarios, is only allowed, provided the company can robustly demonstrate that using fewer scenarios results in a reserve or capital charge that is at least as great as the result obtained when using a scenario set and model that has not been reduced for calculation expediency. The actuary must be able to document and demonstrate the robustness of the model and the variance reduction techniques in terms of the reserve or capital charge, relative to the reserve or capital charge generated from the larger number of scenarios.

In using the generated scenarios, the actuary will need to determine the appropriate number of scenarios to be used for the calculation and the relative weight placed on the result from each individual scenario. There is a *presumption* that simulation with a large number of stochastic scenarios, using either the prescribed generator or a company generator that, ex ante, satisfies calibration requirements, will result in convergence to an unbiased estimation of the metric used to evaluate capital or reserve adequacy. A variety of variance reduction techniques may be used if the actuary can demonstrate, ex post, with respect to that metric a) convergence within a prescribed tolerance is preserved, and b) that any estimators (i.e., results) remain unbiased.

A guiding principle underlying these stochastic methods is that of consistent results between methods. Therefore, if a company is using a smaller set of scenarios, the actuary must demonstrate that the resulting reserve and/or capital charge is at least as great as the reserves calculated using the large number of scenarios. Testing of the scenarios must be sufficiently robust so that the results would hold up under changing conditions. In addition, the rationale and demonstration for using a smaller set of scenarios, a compressed model, and all model assumptions and parameters would be subject to peer review.

The SSMWG is fully cognizant of the potential burden being placed on companies with blocks of low risk business (i.e. business without significant tail risk). The SSMWG believes that it is acceptable to allow the option of using a smaller number of scenarios and weights in the reserve and capital calculations, as long as the company can demonstrate that the results are consistent with a more robust, stochastic calculation of reserves and/or capital.