NAIC Economic Scenario Generator (ESG)
Questions and Answers (Q&A)
Last Modified: 2/5/2021

This document provides a summary of questions and answers relating to the development of the new ESG to be used for statutory reporting purposes. This ESG will produce real-world interest and equity scenarios to be prescribed for use in calculations of life and annuity Statutory reserves according to the Valuation Manual (e.g. VM-20, VM-21) and capital under the NAIC RBC requirements (e.g. C3 Phase 1, C3 Phase 2). This is a living document. As additional questions are received, this document will be expanded. Please email Reggie Mazyck, rmazyck@naic.org, with additional questions or any requests for clarification relating to this document.

Section A: Treasury Model

Q1: Does the GEMS Treasury model require the initial state variables to be non-negative? If so, what happens if the initial Yields produce a negative state variable?

A: Since the states' volatility in the GEMS Treasury model is proportional to its level, the initial state variables must be non-negative. There are several components of the GEMS' fitting procedure which ensure that the initial state variables will meet this condition. First, when performing the search algorithm for the best 3 Pivot Points (see slide 5 of the 12/3/20 Treasury Model Presentation), the process will reject any combination that produces one or more invalid state variables. Second, in the very unlikely case that the algorithm is unable to find a valid combination, the process will:
1. pick a combination of Pivot Points
2. convert the initial yield curve into the implied starting states using the inversion process*.
3. shift the invalid state variables to 0.0001
4. calculate the discrepancy curve of the resulting implied Yield curve

*Documentation on the inversion process will be available shortly.

Q2: Are there any boundary conditions on the projected state variables? If so, how does the GEMS model ensure that those boundaries are not violated?

A: Yes, there is a boundary condition requiring that each of the state variables must be non-negative.

There are several components of the formulation that ensure that this condition is met. First, as with the Cox-Ingersoll-Ross model that is the original basis of the GEMS Treasury Model, the projected volatility of each state variable is proportional to its square root. As a result, as a state gets closer to 0, its volatility will drop to zero, which makes it harder to breach zero. Second, a valid calibration of this model requires both the mean reversion level and the mean reversion speed to be positive. Mathematically, this means **Theta** + **Lambda0** > 0 and **Kappa** – **Lambda1** > 0 for each of the state variables. These conditions ensure that any state variable which gets close to zero will have enough mean reversion so that the simulated values are very unlikely to breach zero. Finally, in the very unlikely scenario that the model does produce a negative state value in the simulation,

the procedure will floor the actual value at 0.0001 similar to what the current Academy Interest Rate Generator does for Yields.

Section B: Equity Model

Q1: How are the international fund returns expressed: hedged or unhedged?

A: The international funds are in USD and are presented on an unhedged basis. The AAA ESG also expresses international fund returns on an unhedged basis.

Section C: Corporate Model

Q1: Why are bond funds assumed to only invest in industrials (not financials)?

A: One of the goals of the bond funds was to make them consistent with the data being included in the Robust Data set. Since that data set is only going to include one set of Corporate Yields, which will be for industrials, we are suggesting only using these bonds for the bond fund returns.

Q2: Do BBB bonds in the U.S. Investment Grade Corporate bond fund returns reflect a selected BBB bond, a universe of BBB+ / BBB / BBB- bonds, or some other blend of bonds?

A: For any of the Corporate ratings, the bonds will be issued exactly at that rating (i.e. only BBB bonds in this case). The returns will reflect a broadly diversified set of bonds of the selected rating and maturity.

Section D: ESG Ancillary Tools

Q1: What is the purpose of the Scenario Reduction Tool referenced in item #9 of the ESG Implementation Timeline?

A: Conning will deliver a full set of 10,000 economic scenarios on a monthly basis along with scenario subsets produced using the Scenario Reduction Tool that is eventually adopted. The purpose of the Scenario Reduction Tool is to select subsets from the full set of 10,000 that are representative of the full set. A proposal to follow the American Academy of Actuaries' scenario picking methodology has been exposed for public comment through March 7th, 2021. See the link below for more details.

ESG Scenario Picker Tool

Q2: What is the GEMS® API?

A: The GEMS® API (Application Programming Interface) will offer companies an alternative way to generate data in either the Basic or Robust Data Sets. The API code can be incorporated directly into third-party software to allow for faster processing of the data and a more tailored workflow. This will allow users more flexibility in the number of scenarios and projection length in their simulation process. The GEMS® API is available for a fee from Conning.

Q3: Does the API accept a starting Yield Curve or is it fed the initial state variables?

A: Right now, the API starts with the initial state variables. An enhancement to the API to accept the starting yield curve as input is planned.

Section E: ESG Field Test

Q1: Our company would like to volunteer to participate in the field test. How can we sign up?

A: Companies wishing to participate in the field test should contact Reggie Mazyck by March 1st, 2021 at rmazyck@naic.org and provide the following information:
- Company name
- NAIC company code
- Names and email addresses of company contacts
- A list of the product types the company intends to include in the field test

More information is provided in this document:
ESG Field Test Request

Q2: What is the scope of the ESG field test? For both Variable Annuity (VM-21 and C3P2) and Life (VM-20) business, it seems that the new ESG directly replaces the existing prescribed AIRG parameterization. However, for fixed annuities (C3P1) there will be additional methodology considerations as the new ESG will not necessarily act as a direct substitute for the one that is currently prescribed. For example:
- **C3P1 currently uses a special 12 or 50 scenario subset designed to approximate 95%-tile interest rate risk. Would new subsets be developed, or would Conning's 200 scenario set be used directly?**
- **C3P1 currently prescribes only the interest rate scenarios. Would prescribing GEMS mean that equity scenarios also become prescribed? This would expand the scope of C3P1 to both interest rate and market risk.**
    - **Some companies currently use a deterministic equity scenario with the prescribed C3P1 interest rates scenarios.**
    - **If C3P1 were expanded to cover market and interest rate risk, it seems like we'd need to split the total, similarly to how C3P2 needs to be split.**
    - **In addition, if stochastic equity returns were applied to inforce general account assets (e.g., alternative assets like hedge funds and private equity), would there be a double count with asset risks covered by C-1?**

A: The scope is expected to include VA (VM-21 and C3P2), and Life (VM-20), with the new ESG directly replacing the existing prescribed AIRG parameterization. For C3P1, the methodology needs to be considered, along with field test timing, given the developments on VM-22. For now, please assume C3P1 is in scope for field testing. This will give regulators an indication of the level of participation for companies with products subject to C3P1.

Section F: Scenario File Form and Format

Q1: Once the new ESG is in production, how will scenario files be accessed?

A: Conning will produce scenarios from the Basic Data Set as of each month-end and post them to the ESG landing page on Conning's website by 4:00 PM Central Time on the first business day of the following month. The ESG landing page on Conning's website can be accessed by clicking the link in the "Economic Scenarios" section of the NAIC's PBR webpage. This will be different than the prior process employed by the American Academy of Actuaries, where an excel tool was made available for users to generate scenarios on demand.

Q2: The scenario file is very large and doesn't have the same format as the Academy scenarios. Can this be changed?

A: Yes. Please provide feedback with specifics on how you would like the output to be provided.

Q3: The 12/18/20 exposure only includes 30 projected years of economic scenario data. Is it possible to produce economic scenario files with a longer projection period?

A: Yes. Please provide feedback on the projection period desired for the scenario data.

Q4: The International Diversified Equity (MSCI EAFE) and Aggressive Foreign Equity (MSCI Emerging Market) do not have Income Returns in the sample data set. Will this be split between price and income in the future?

A: The model only projected total returns for these indices. Conning is developing an alternative calibration for these two indices which will split their total returns into Price and Income.

Section G: Calibration and Parameter Updates

Q1: How often will the parameters of the model be updated?

A: This is to be determined and is included as item #8 on the ESG timeline.

Section H: Documentation

Q1: What is the plan for releasing additional documentation on the Treasury, Equity, and Corporate models?

A: Conning has produced initial documentation for the Treasury, Equity, and Corporate models. This documentation can be accessed by clicking the link under the "Economic Scenarios" section of the NAIC's PBR Webpage. More information will be added to the documentation throughout the project as it evolves. Specific requests for additional items to cover in the documentation can be made to Reggie Mazyck at the NAIC.

Section I: 12/17/20 LATF Equity and Corporate Model Presentation

Link to 12/17/20 Equity and Corporate Model Presentation

Q1: On page 13, are the 2 year and 30 year "columns" annualized returns?

A: No, those are summaries of the total return over the associated year. For example, the values in the second column reflect a summary of the 10,000 total returns from Sept 2021 through Sept 2022 from the current AIRG model.

Q2: On page 18, are the 34 negative thirty year returns for GEMS, and 3 for the AIRG, out of 10,000 scenarios? One would expect about 50 negative returns for the AIRG, if it is for 10,000 scenarios. There have been no negative 30-year periods for the S&P 500, even if you include the Great Depression. There are some good reasons to exclude the Great Depression from consideration for S&P 500 returns. The S&P did not become 500 stocks until 1957, being only 90 stocks from 1929 until 1957. SEC rules and other governance and advances in understanding of economics provide greater information and protection for investors than existed in the 1920's and 1930's. Comparisons to those periods might be more appropriate for some of the smaller and less well diversified indices in the scenarios.

A: Yes, both of those counts are out of 10,000 scenarios. These were scenarios selected where the cumulative return was below 0 for all 30 years of the simulation. So, it is a subset of the ones that end the simulation below zero.

Q3: How are the correlations on page 22 being computed?

A: For those correlations, we first sorted the relevant scenarios (i.e. rolling 12-month periods for the historical data, the 10,000 scenarios for the first year for the simulations) based on the US Large Cap (i.e. S&P 500) total return. Next, we broke that data down into 5 equal quintiles. So, for the GEMS scenarios, the ones in the 1st quintile reflect the 2000 scenarios with the smallest US Large Cap total returns. Finally, the bars reflect the correlation between the US Large Cap and US Small Cap (i.e. Russell 2000) within these quintiles.

Section J: 12/18/20 LATF Exposure

[Link to 12/18/20 Exposure](#)

Q1: Scenarios were provided as of 12/31/19. Can they be provided as of 9/30/20 or 12/31/20? This would be useful given lower starting rates than 12/31/19, and the scenarios could use the 3.25% 20-year mean reversion target for UST.

A: Yes. However, we expect to improve the model calibration and provide a new set of scenarios based on comments received on the 12/18/20 exposure. We propose to wait until then to provide scenarios as of different dates.

Q2: In the target formulas shown in the Targeting Example.xlsx file included in the 12/18/20 exposure, it looks like Theta and Lambda0 get added together in the targets. Why are there two separate parameters?

A: For the Long-Term State value targets (i.e. Column J of the **Model Parameters** tab of **Targeting Example.xlsx** file), the formula does add together **Theta and Lambda0**. A similar manipulation

happens with the **Kappa** and **Lambda1** parameters: those same formulas use the difference between these two parameters. Both **Lambda0** and **Lambda1** are risk premium parameters. Specifically, they are the ones which allow the long-term reversion levels for Yields to differ from those implied by the initial Yield curve. Whenever the model needs to price a set of cash flows (e.g. determining a particular Spot Rate), it does NOT use these risk premiums. That is why all of the formulas on the **Auxiliary Functions** tab of that spreadsheet, which are used to determine spot rates at different tenors, only reference parameters from the **Theta**, **Kappa,** and **Sigma** columns. This is also why there are two separate parameters: one that gets used for pricing (i.e. Theta and Kappa) and one that gets used as a risk premium (i.e. Lambda0 and Lambda1).

For more information, see the Treasury Model documentation.

Q3: Do the mean reversion level and speed in the Risk-Neutral model impact the scenarios in the Real-World model?

A: No, the Real-World model only relies on the mean reversion characteristics of the Real-World model, just like the current Academy generator.