

## ACTUARIAL INSIGHTS

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# Integrating Scenario Generation and Actuarial Models to accelerate the modeling process

There is increasing pressure on actuarial modeling teams to produce results in ever decreasing timescales. For example, IFRS 17 has created a requirement for fast, up-front delivery of stochastic scenarios to feed into more time-consuming downstream accounting calculations. Therefore, the ability to streamline the modeling process has become a high priority for many insurers.

Moody's Analytics offers a set of modeling and analytics capabilities to support all aspects of the process, and as a result can support greater streamlining through tight integration between the tools used for each stage.

This paper sets out how Moody's Analytics has integrated our Scenario Generation and Actuarial Modeling tools, to deliver a solution that allows insurers to run both models, without the need for manual intervention or file conversions. This reduces the operational risk that insurers are otherwise exposed to and the overall runtime of the modeling process; which increases the efficiency and flexibility of the modeling team.

## The Solutions

The AXIS™ actuarial modeling software from Moody's Analytics is a robust, vendor-maintained system that is ready to use immediately. Offering a single integrated actuarial software solution for modeling of insurance and annuity products, the AXIS system has unparalleled flexibility. It is widely used by life insurers, reinsurers, and consulting firms around the globe for pricing, reserving, asset and liability management (ALM), financial modeling, capital calculations, and hedging. With more than 30 software releases per year, the AXIS solution is regularly enhanced to exploit new technology and meet evolving regulatory standards and client needs.

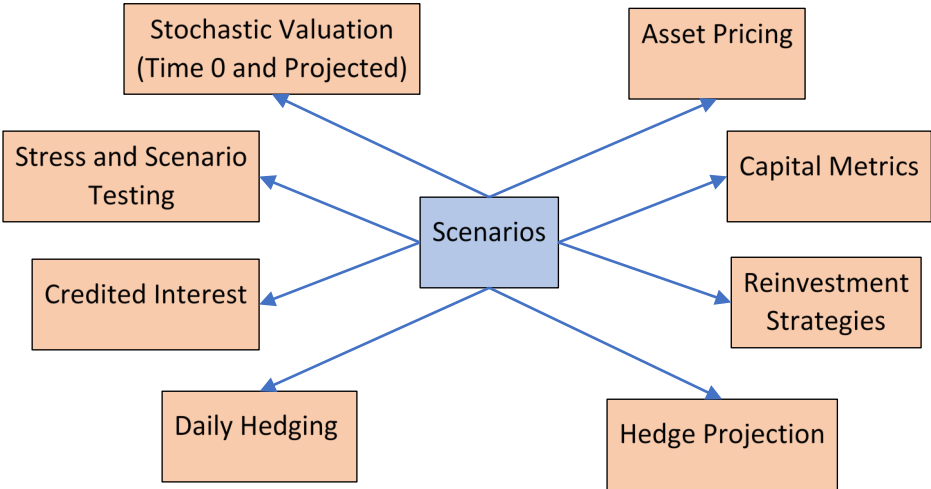
Moody's Analytics Scenario Generation solutions are compiled from a suite of leading-edge stochastic models, software modules, and services that allow insurers and other financial institutions to undertake a range of risk management activities.

Integrated functionality

The AXIS models make thorough use of scenarios generated by the Scenario Generator to enable economic and other variables to be reflected consistently throughout a range of possible applications. For example, Interest rates and crediting rates in investment products and funds; Investment and reinvestment asset performance; Calculations of asset values; and Insurance and annuity product reserves. Our AXIS models can perform both deterministic and stochastic analysis, based on sets of pre-generated or dynamically generated scenarios. The projections can incorporate hedging strategies and pricing of derivatives at multiple future dates. In addition, reserves or capital calculations using embedded stochastic calculations will reflect the projected economic environment at a future reporting date.

Figure 1 illustrates the range of AXIS system processes and objects that are supported by scenarios.

Figure 1 Uses for Scenarios in AXIS



The AXIS system supports the use of static scenario sets. This means scenarios can be generated in advance and imported into the system, for example if a separate team to the AXIS modeling process owns the scenario generation process. Alternatively, dynamic scenario sets are generated on an on-demand basis using a scenario generator.

Full integration exists between the Moody’s Analytics AXIS system and Scenario Generator solutions, with the flexibility to either:

- » Dynamically generate scenarios within the AXIS system using the Scenario Generator API (application programming interface)
- » Generate scenarios within the Scenario Generator and automatically export them to the AXIS system in the required format.

Method 1: Dynamic Scenario Generation within the AXIS system

To generate scenarios within the AXIS system, clients can upload a simulation file configured in the Scenario Generator application. This file contains the models required to produce the scenarios for use within the AXIS system and is calibrated to the appropriate valuation date being modeled. The AXIS system will parse the simulation file to identify the models contained within it. This allows clients to map the models from the simulation file into the markets required for modeling the assets and liabilities within the AXIS dataset.

Figure 2 Mapping Scenario Generator models in the AXIS system

The screenshot shows a dialog box titled "AXIS Market-SG Model Dialog". It contains the following fields and controls:

- Market:** A text box containing the word "Interest".
- Moody's Simulation File:** A text box containing "[3] AXISSimulation.bhs" and a browse button "...".
- Moody's SG Model:** A dropdown menu showing "ESG.Economies.GBP.NominalYieldCurves.NominalYieldCurve".
- Credit Class:** A dropdown menu showing "Govt".
- Seniority:** A dropdown menu showing "3".
- Buttons:** "OK" and "Cancel" buttons at the bottom right.

The AXIS system also contains functionality to adjust the calibration of the Scenario Generator simulation. For example, the initial yield curve used within the simulation can be updated to reflect the input yield curve. This can be performed for all scenarios or only for scenarios which start at points other than the valuation date, as may be necessary if performing stochastic analysis at a future projected timestep.

Figure 3 Scenario Generator Market Model Screen

The screenshot shows a window titled "Moody's Analytics SG Model". It contains a table with the following rows:

ESG simulation file	AXISSimulation.bhs
ESG data dictionary	SG Data Dictionary
Markets to generate	0 - Exclude markets not in dictionary
Initial yield curve choice	0 - Use Moody's simulation file yield curve
Equity models use Moody's simulation file equity volatility curve	

Clients can specify the number of scenarios to create in the AXIS system. It is also possible to specify the time format of the scenarios, and the scenario naming convention as shown in figure 4. These parameters redefine the output file properties to ensure that the scenarios are produced in the correct format for use within the AXIS dataset.

Figure 4 Scenario Format Options Screen

The screenshot shows a window titled "Scenario Format Options". It contains the following fields and controls:

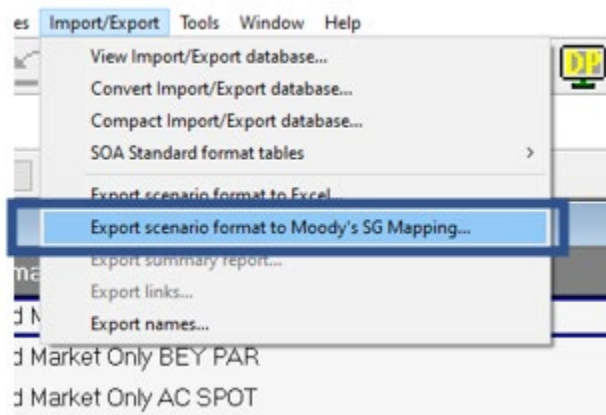
- Time Format:** A section with four input boxes: "Months" (0), "Quarters" (0), "Years" (10), and "Num to Generate" (10).
- Scenario Name:** A section with a text box labeled "Prefix for generated scenario name" containing "Moody's SG".
- Buttons:** "Help", "Go to", "Cancel", "< Back", "Next >", and "Finish" buttons at the bottom.

The AXIS system populates the required scenarios from the Scenario Generator through an API. This means that the Scenario Generator works dynamically and passes scenarios to the AXIS system in memory without the need to manually configure or interact with the separate application.

## Method 2: Generate scenarios within the Scenario Generator and automatically export them to the AXIS system

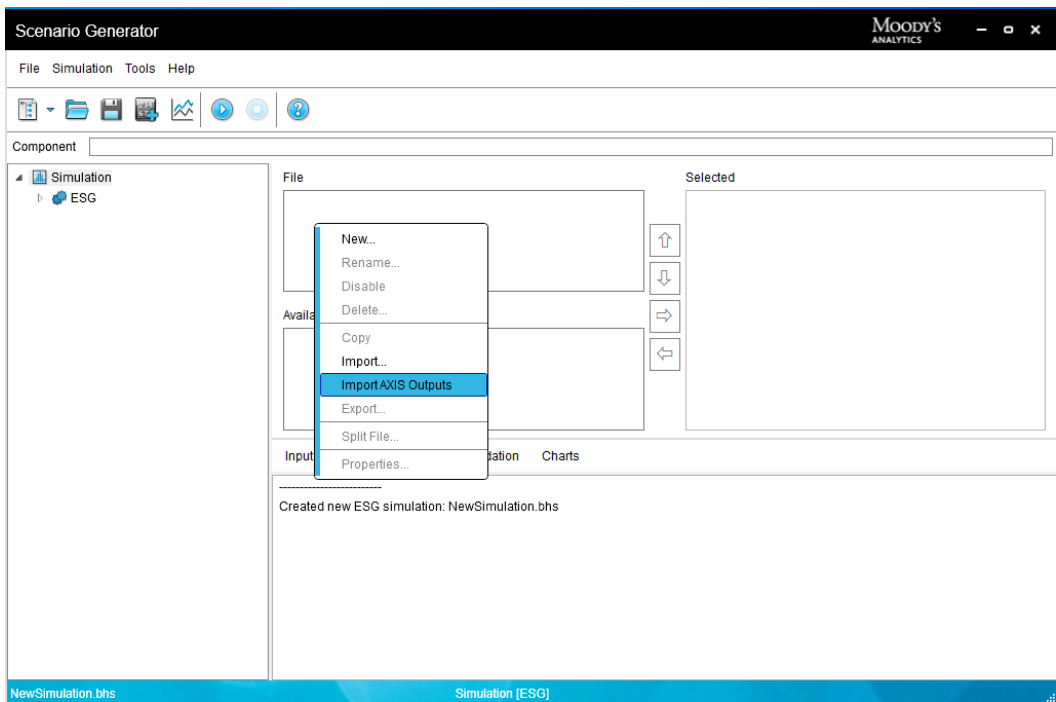
To generate the scenarios for upload, a configured simulation file should be uploaded in the AXIS system as explained in method 1. The models from the simulation file are mapped to the markets required for modeling the assets and liabilities within the AXIS dataset. This then allows clients to export an AXIS mapping file for the required scenario format as shown in figure 5. The mapping file associates each column in an AXIS scenario with a fully qualified output name from the Scenario Generator.

Figure 5 Exporting a Mapping file



The mapping file can then be imported into the Scenario Generator. It will automatically configure all the required outputs and configure the output file to use the format expected by the AXIS system.

Figure 6 Importing an AXIS system mapping file into the Scenario Generator



The Scenario Generator should then be configured to produce the trials and timesteps required by the AXIS dataset and run to produce the scenarios. The Scenario Generator will produce two files for each output file configured to use AXIS outputs. One containing the single trial historic scenario required within the AXIS system, used to define historic trends of interest rates and other economic assumptions. The second output file contains the future scenarios (with values for future timesteps).

The AXIS system contains specific processes to automate the import of the scenarios produced by the Scenario Generator. By using these, it automatically matches the columns in the scenarios files to the markets in the relevant AXIS scenario format. This allows clients to automatically create the required scenarios and upload the scenario data.

Figure 7 Import flexible format scenarios batch

MarketName	To Column	From Field	Value
Interest	3 month bills	InterestIYC_3M	
Interest	6 month bills	InterestIYC_6M	
Interest	12 month bills	InterestIYC_1YR	
Interest	2 year bonds	InterestIYC_2YR	
Interest	3 year bonds	InterestIYC_3YR	
Interest	5 year bonds	InterestIYC_5YR	
Interest	7 year bonds	InterestIYC_7YR	
Interest	10 year bonds	InterestIYC_10YR	
Interest	20 year bonds	InterestIYC_20YR	
Interest	30 year bonds	InterestIYC_30YR	
S&P TSX	Growth rate	S&P TSXIEQ_GROWTH	
S&P TSX	Dividend rate	S&P TSXIEQ_INCOME	
S&P 500	Growth rate	S&P 500IEQ_GROWTH	
S&P 500	Dividend rate	S&P 500IEQ_INCOME	
Inflation	Inflation Rate	InflationINFL_RATE	

29 scenario columns / 15 mapped

Clear entries

Edit field

Match fields

Show mapped scenario columns

☒ Create new scenarios

☐ Remove captured rates

Help

Go to

Cancel

< Back

Next >

Finish

Conclusion

The integration between the AXIS actuarial system and the Scenario Generator greatly simplifies the process of importing generated scenarios into an insurer's actuarial model. This applies whether scenarios are created in advance, or on demand while the model is projecting assets and liabilities through a given scenario path. As a result, actuarial modeling teams can respond more quickly to requests, running full asset liability projections on an integrated and consistent economic basis. This improves performance and efficiency, requires less overall time to prepare and perform the modeling process, and reduced operational risk inherent in manual processes.

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