

Volume 7 | FALL 2017

GETTING THE MOST OUT OF AXIS™

A TOOLKIT FOR MODEL GOVERNANCE AND EFFICIENCY

Editor's words: Welcome to the Fall 2017 edition of our AXIS modeling newsletter. This issue outlines considerations for improving AXIS model runtime and efficiency, and also describes the key components for developing robust and efficient Testware to validate models. You will find helpful tips and tricks for navigating the system and highlights of new features in recent AXIS releases. We hope you enjoy the newsletter.

IN THIS ISSUE

EXECUTIVE CORNER

Balancing Model and Process Timeliness, Accuracy and Cost

IN THE SPOTLIGHT

Turn the Grey Box into a Glass Box

TIPS & TRICKS

WHAT'S NEW IN AXIS

EXECUTIVE CORNER

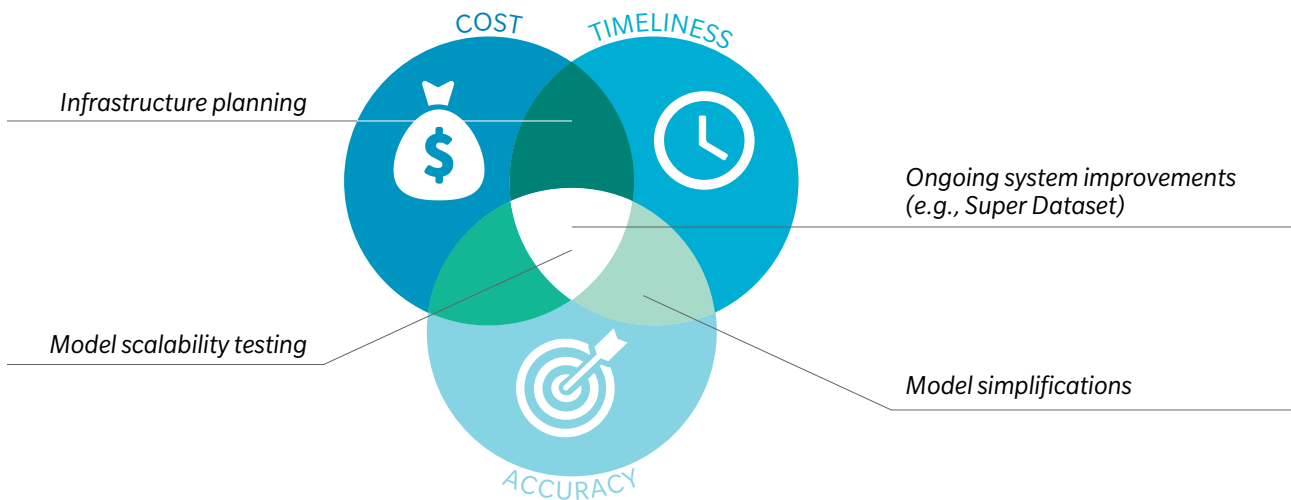
BALANCING MODEL AND PROCESS TIMELINESS, ACCURACY AND COST

Increasingly complex reserve and capital methods combined with stochastic processing requirements have put significant pressure on companies to improve model runtime and efficiency. By optimizing model runtime, companies can improve the timeliness of results and manage their costs; however, a balance must be achieved to ensure continued accuracy of results.

“Increasingly complex reserve and capital methods combined with stochastic processing requirements have put significant pressure on companies to improve model runtime and efficiency”

This article outlines four considerations for improving AXIS model runtime and efficiency, viewed across the dimensions of timeliness, accuracy and cost.

Exhibit 1: Model efficiency considerations



1. MODEL SCALABILITY TESTING

Desired outcome: Identifying the most efficient model setup and runtime environment to maximize timeliness of results

Key consideration: Ideally performed during grid planning and model build

A company should aim to optimize the capacity of its grid infrastructure. Model scalability testing is essential to identify the most efficient model setup and grid core usage. By optimizing runtime, actuaries and stakeholders can benefit from quicker run turnaround by having more time to review and understand result.

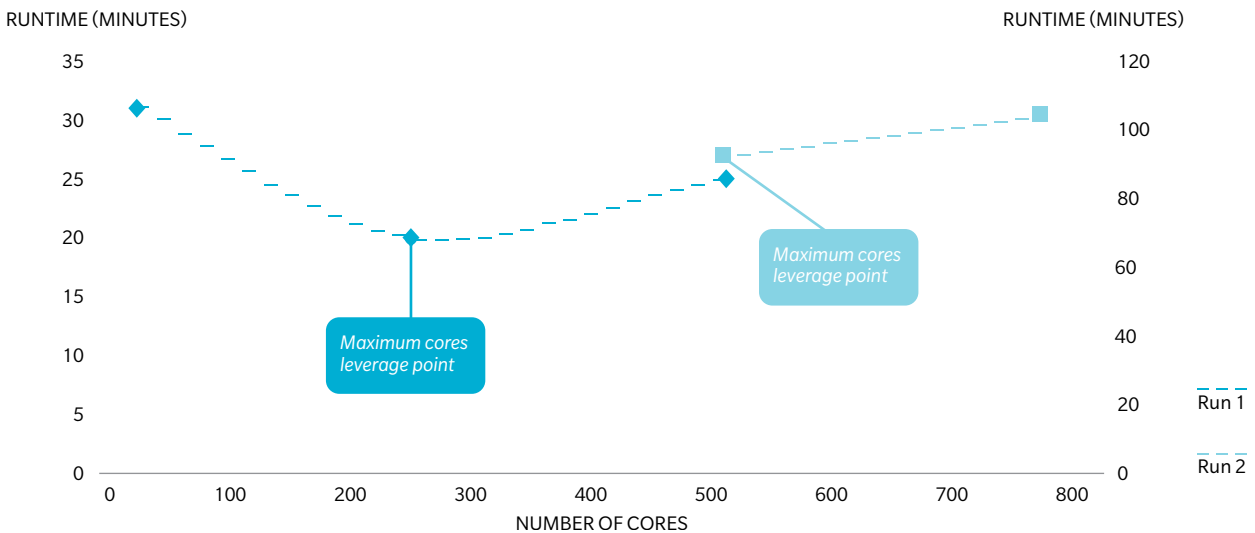
“By optimizing runtime, actuaries and stakeholders can benefit from quicker run turnaround by having more time to review and understand results”

Once model scalability testing is complete, a run and infrastructure plan can be developed to optimize grid capacity at all times and avoid grid bottlenecks.

AXIS runtime estimates are typically scalable up to a certain point; however, some actions performed by AXIS (e.g., DataLink processing) are not scalable. Further, the effort required for the system to consolidate results from multiple processing cores can sometimes outweigh the benefits of distributed processing.

An example of run scalability testing results is shown in Exhibit 2.

Exhibit 2: Run scalability testing



2. INFRASTRUCTURE PLANNING

Desired outcome: Optimizing GridLink structure and capacity to ensure timely results while managing costs

Key consideration: Communication between all GridLink users is crucial

Optimizing GridLink structure and capacity is just as important as optimizing model setup to manage timeliness of results and costs. Without it, there exists potential for grid bottleneck and interruptions. The following is a list of key items to consider when designing a grid infrastructure:

1. Dedicated grid space and queues for different user groups (e.g., split by department, team, function, etc.)
2. Number of concurrent grid users
3. Number of jobs and aggregate total runtime at peak-time
4. Total cores needed
5. Expected Dataset and model output storage requirements

Additionally, AXIS allows the use of cloud services when additional temporary grid capacity is needed. During peak times when the grid is fully utilized, AXIS can “burst onto the cloud” to utilize the cloud’s additional processors, and will release that capacity back after the runs are finished to manage costs. Currently, Moody’s Analytics supports the following cloud environments: GGY Cloud, Microsoft Azure, Amazon EC2, and IBM Softlayer (Bare Metal Only).

3. MODEL SIMPLIFICATIONS

Desired outcome: Compress the number of model points and scenarios to manage runtime while maintaining accuracy of results

Key consideration: Calibration and attribution to the full seriatim model run is required for stakeholders to gain comfort with the approach

AXIS offers two solutions to significantly cut down runtime, namely inforce compression and scenario reduction.

TIPS & TRICKS

Tracking reinvestments

The purchases and sales executed by a Reinvestment Strategy can be difficult to follow. A Reinvestment Report detailing these transactions is available in the Embedded Block by using the Drill Down option.

1. After running a Fund, select “Results” > “Embedded Block Results..” and choose a pivot point
2. In this menu, select “Results” > “Drill Down...”
3. After the Drill Down is complete, select “Results” > “Reinvestment”

The Reinvestment Report by Subfund or Cell can be generated for any pivot date and Block projection.

When running a Fund through a Batch, this report can only be exported using a Batch Valuation Batch. To export this report, select the option to enable the “Drill down report by scenario for primary projection” or “Drill down report by scenario for secondary projection” in Step 5 of the Batch Valuation Wizard, and select an “EB ALM drill down – Reinvestment Report” in Step 12.

Inforce compression allows model points to be grouped together using clustering algorithms. The compression process requires calibration to full seriatim output to choose the most appropriate parameters.

Scenario reduction techniques allow the user to improve either the generation of scenarios or the selection of scenarios from a generated set so that a smaller number are required. For example, a clustering algorithm can be used to compress or group scenarios in a fashion similar to model point compression.

4. ONGOING SYSTEM IMPROVEMENTS

Desired outcome: Leveraging the latest AXIS system capabilities can improve model accuracy but may either increase or decrease runtime

Key consideration: Resources are required to perform model updates and regression testing

There are frequent AXIS system improvements to available functionality and architecture which may positively or negatively impact model efficiency. Depending on the system improvements, all three dimensions (model and process timeliness, accuracy, and cost) might be impacted. Thus, it is beneficial for users to stay up-to-date with the most recent AXIS, EnterpriseLink and GridLink enhancements and version updates to have the option to leverage advantageous system improvements.

AXIS “Super Dataset”:

Moody’s Analytics is working on a potential enhancement to AXIS that would allow users to link multiple Datasets without having to physically consolidate them. This enhancement would (1) make it possible to aggregate results from multiple “lower level” Datasets into a “higher level” Dataset and (2) facilitate post-run processing. This functionality should help improve the efficiency of modeling processes and, thus, the timeliness of results.

For more details visit <https://www.ggy.com/client-content/inside-axis/2017-summer/Innovation.htm>

IN THE SPOTLIGHT

TURN THE GREY BOX INTO A GLASS BOX

INTRODUCTION

AXIS is a comprehensive actuarial modeling system whose source code is not visible to users. We often refer to AXIS as a “grey box” rather than a black box due to the user’s ability to customize certain calculations (e.g., Formula Tables) and the presence of certain detailed reports and help text.

Overall, AXIS users benefit from out-of-the-box actuarial functionality and a user-friendly interface, but sometimes struggle to explain calculations happening “behind the scenes”.

Exhibit 1 lists the major benefits and drawbacks of AXIS’s closed source code design.

Exhibit 1: Tradeoffs of closed source code design

ADVANTAGES	DISADVANTAGES
Code is optimized for runtime and efficiency by professional programmers	There are limited areas users can customize calculations
Strong model governance and controls via locked code which is effectively user acceptance tested by all AXIS licensers	Specific calculations are sometimes opaque
Moody’s Analytics performs thorough developer testing on new functionality and regression testing on version releases	User acceptance testing must be performed by clients for new functionality
Out-of-the-box functionality for complex actuarial calculations	Intermediate calculation steps may not be transparent to users

Independently developed “Testware” enables modelers to validate and understand AXIS calculations. For the purposes of this article, Testware is defined as an Excel replicating spreadsheet developed on a first-principles basis and based on information available from external sources (e.g., assumption memoranda, valuation extracts and policy forms) independent of the model.

“Testware should be part of any robust risk management and model governance framework...”

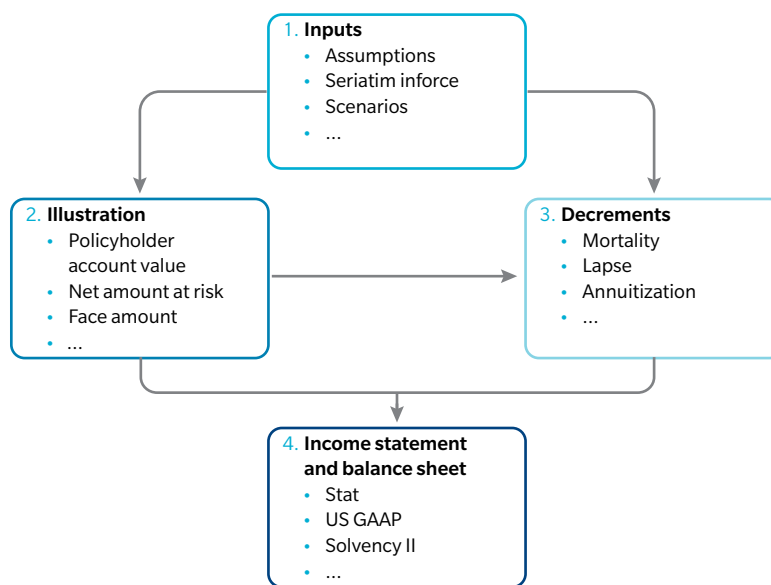
Testware should be part of any robust risk management and model governance framework, and used to validate model output and improve transparency. Further, Testware can be conveniently leveraged for other purposes, such as decoding AXIS calculations into smaller and simpler components, User Acceptance Testing (UAT) and new user training. Testware further helps satisfy the increasing demands of external parties, such as auditors and regulators.

This article describes four key components of well-designed Testware and further outlines major considerations for Testware development.

TESTWARE COMPONENTS

Exhibit 2 illustrates the key components of typical seriatim-level Testware, with a focus on liability-side model validation. (A discussion of asset-side model validation is outside the scope of this article.)

Exhibit 2: Typical Testware components



1. Inputs

Common sources of inputs include assumption memoranda, valuation extracts and policy forms. It is best practice to use a common source of inputs for both AXIS and the Testware. Frequently, assumption, product and seriatim databases are created and used to source the inputs. Utilizing an independent source for inputs provides an extra level of model validation as compared to taking inputs directly from AXIS.

2. Illustration

The Testware should create a policy or contract illustration from the model start date to the end of the projection period or policy maturity. This is especially relevant for account-based products, such as variable annuity and universal life products. The projection incorporates policyholder information (e.g., gender, issue age, risk class, etc.), product features (e.g., premiums, fees and charges, withdrawal bases, etc.), and the projected economic environment. Policy decrements are not part of the illustration.

The illustration forms the chassis of any experience basis and reserve projections and therefore should be flexible enough to handle modeling differences across scenarios and/or reserve bases. For example, when calculating deterministic/stochastic reserves for an indexed universal life product under VM-20, different premium payment patterns may emerge for the same contract under different scenarios. For formulaic reserves, it may be necessary to illustrate under multiple sets of charges (e.g., current, guaranteed, shadow fund).

3. Decrements

Decrement rates for deaths, lapses, annuitizations, and other transactions, are calculated separately and then combined to determine the inforce movement (i.e., persistency).

Decrements such as lapses and annuitizations are often modeled dynamically, using outputs from the illustration. Understanding the timing of fund movement and benefit amounts is critical to properly calculating in-the-moneyness (ITM) components of dynamic policyholder behavior.

Dynamic decrement calculations often become complicated. Therefore, it is important to structure Excel calculations efficiently and logically. Modularizing and following the same logic flow as AXIS source code and Formula Table code is an effective way to ensure complex calculations can be tracked and easily understood.

Finally, the decrement section should be flexible enough to model assumptions that vary by reserve type, including reflecting margins on top of best estimate assumptions and modeling prescribed assumptions.

4. Income statement and balance sheet

The income statement section pulls the decrements and illustration together to derive decremented cash flows. It also layers on investment income, expenses, taxes, change in reserves and other components impacting reserve balances.

TIPS & TRICKS

Searching Formula Tables

A text search can be performed on Formula Table code. This can help determine how a particular inforce field is used in the model. To search Formula Table code:

1. Go to "View" > "Table" > "All Tables"
2. Select "All Formula Tables" from the drop-down menu
3. Then search the selected tables by selecting "Actions" > "Advanced" > "Search Formula Text" > "Search All Tables", and input the text to search, e.g., variable name UserDefOptFld1

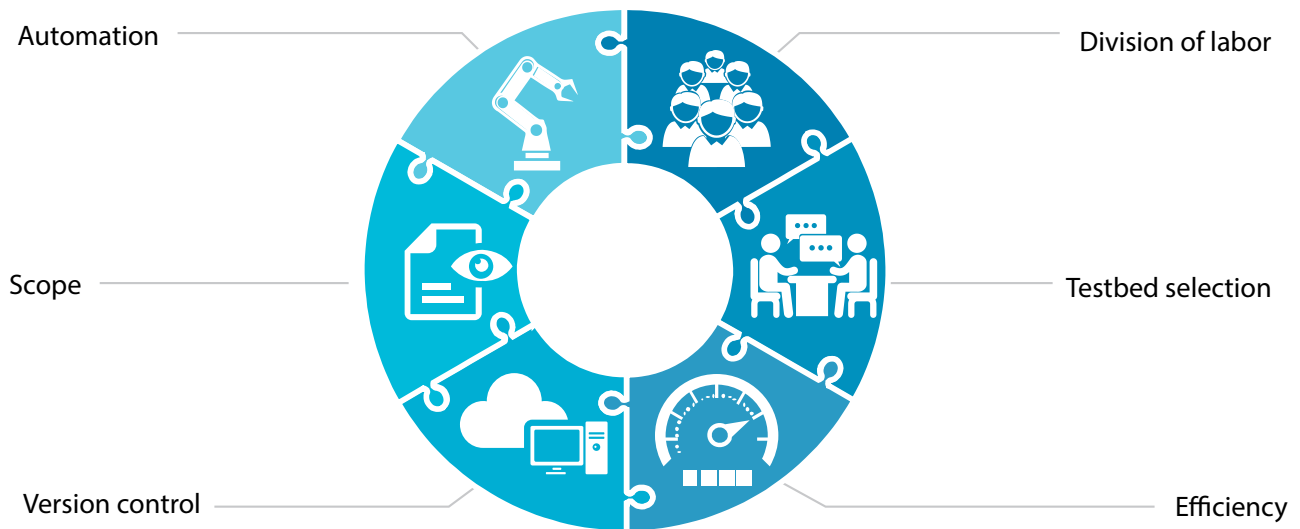
The balance sheet section performs calculations under multiple reserve bases and required capital frameworks as of the valuation date and at selected future revaluation points by utilizing balances and cash flows produced by other Testware sections. The final metrics to be validated are typically housed in a summary section.

Testware can clearly present results in a standardized income statement and balance sheet format, as well as calculate other reported metrics consistent with the AXIS model purpose and output. This provides a tool that a wide-ranging audience can understand and utilize.

CONSIDERATIONS FOR TESTWARE DEVELOPMENT AND GOVERNANCE

Developing robust and efficient Testware requires substantial initial planning and subsequent implementation time and effort. Considerations are dependent on an organization's model governance framework, testing requirements and validation thresholds. (In a robust model governance framework, the Testware itself may be considered a model, requiring a threshold level of model governance and controls.) Some key considerations are listed in Exhibit 3 below.

Exhibit 3: Key considerations for Testware development and governance



SCOPE

The scope should be clearly defined when designing the Testware and should be reflective of its intended usage. Model validation and increased transparency are generally the primary goals of Testware; thus, two questions should be considered when defining the scope.

1. Will the Testware be capable of producing results for a representative sample testbed within a reasonable timeframe?
2. Will the Testware improve stakeholders' understanding of and confidence in the AXIS model?

It is important to strike a balance between functionality and practicality. Exhibit 4 demonstrates three examples of functionality that is difficult to build directly into Testware and possible alternative implementation options.

“It is important to strike a balance between functionality and practicality”

Exhibit 4: Practical considerations for Testware development

FUNCTIONALITY	CONSIDERATION	ALTERNATIVE IMPLEMENTATION
Full stochastic calculations	Significantly increased calculation time and use of macros	Select a subset of sample scenarios covering a range of potential outcomes
Assets, reinvestments and hedging	Increased complexity due to the need for asset calculations and results consolidation	Build a separate module or tool to validate asset, reinvestment and hedging calculations; consider leveraging liability balances and cash flows directly from AXIS (or other Testware modules or sections) as inputs
Disability income, long-term care or similar products with recurring cash flows and multiple statuses (active, on claim) and decrements (incidence, recovery, termination)	Large and complex calculation and cash flow structure due to state dependency	Reduce calculation frequency, leverage macros (result may be decreased Testware transparency)

AUTOMATION

Model validation can be expected to take place regularly for financial reporting purposes and even more frequently during active model development. Due to the repetitive nature of testing processes, as well as the multiple user groups that may make use of the Testware, an automated process is typically a “must have”. Exhibit 5 below illustrates the automation process.

Exhibit 5: Illustrative Testware automation process



EFFICIENCY

Efficiency is critical for Testware to be useful; transparent Testware with inferior runtime may not serve its purpose if the required testbed cannot be run in a reasonable amount of time. Techniques to improve efficiency should be employed where appropriate. Runtime and file size should be kept in mind throughout both design and development. Exhibit 6 below describes two representative design decisions that will impact efficiency.

Exhibit 6: Examples of Testware design decisions

DESIGN DECISION	APPROACHES CONSIDERED
Input location and storage	<ol style="list-style-type: none"> 1. Store and lookup policyholder information, product features, actuarial assumptions and economic scenarios in the Testware (e.g., input tab) 2. Link the Testware to information stored in external sources (e.g., flat files, database or data warehouse)
Calculation engine	<ol style="list-style-type: none"> 1. Excel formula-driven 2. VBA macro-driven 3. Generally utilize formulas to promote transparency but utilize macros for specific modules or calculations (e.g., prescribed assumptions unlocking under AG48)

Both examples presented on the previous page involve a tradeoff between runtime and Testware file size. The appropriate decision varies from situation to situation. Optimizing runtime subject to a maximum file size is an effective way to strike a balance; the maximum file size chosen should allow for uninterrupted operation of the Testware given the current hardware infrastructure. Generally speaking, an Excel file size of less than 100MB serves as a good benchmark.

TESTBED SELECTION

The sample testbed should be selected intelligently in light of breadth and depth of material policyholder demographics, policy status, product features, assumptions, risks and potential economic outcomes. From an efficiency perspective, the selection process should aim for a minimally-defined sample testbed which is representative of the entire block of business being modeled.

Sample selection is not solely limited to seriatim policies. Strategic selection of sample scenarios, assumption bases and sensitivity or stress tests all serve to increase the robustness of the Testware.

DIVISION OF LABOR

Testware development should be independent of model development. The Testware developer should have sufficient product background and will also benefit from knowledge of data and logic flows within AXIS. The Testware developer and AXIS model developer should engage in active communication related to model enhancements and testbed selection but should otherwise remain at arms-length. Typically, having robust, pre-defined business and model requirements promotes independence of Testware and model developers.

“...having robust, pre-defined business and model requirements promotes independence of Testware and model developers”

The development of Testware is an iterative process. Building the Testware in parallel with the AXIS model provides real-time feedback with respect to errors or bugs. The efficiency of the model development and validation cycle is thus optimized.

VERSION CONTROL

AXIS model and Testware development is a complex process which involves many iterations. Wisely versioning the intermediate steps is key for effective risk management and model governance. It is best practice to align AXIS models with the corresponding Testware via consistent versioning. Combined with model documentation, version control effectively transforms historical versions of Testware into an accessible model log.

CONCLUSION

AXIS model users and stakeholders can enjoy many benefits of building sound Testware, including an effective risk management and model governance infrastructure, adherence to external stakeholder expectations and highly leverageable tools for various testing and training purposes. Following the framework described in this article promotes the development of robust and efficient Testware that is adaptive to future model enhancements.

TIPS & TRICKS

Logging custom messages

It is possible to output custom messages to the System Log, which can be useful when debugging code or attempting to identify bad data. An example of the syntax to execute this in DataLink is as follows.

```
Do Case
  Case [Mode_Inforce] = "Annual"
    [Premium_Mode] = 1
  Case [Mode_Inforce] = "Semi-Annual"
    [Premium_Mode] = 2
  Case [Mode_Inforce] = "Quarterly"
    [Premium_Mode] = 3
  Case [Mode_Inforce] = "Monthly"
    [Premium_Mode] = 4
  Otherwise
    [Premium_Mode] = 1
  =LOGMSG("Invalid premium mode: ", [Mode_Inforce], ". Policy ID: ", [Policy_ID], "
  premium mode set to 'annual'.")
EndCase
```

WHAT'S NEW IN AXIS

NAIC PREMIUM REFUND AND NONDEDUCTION RESERVES

Description

- For the Par module, new functionality has been added to the Reserve Method objects:
 - A new “Nondeduction reserve” switch to calculate additional reserves when valuation premium is annual, but policy premium is paid more frequently (applies for both US GAAP and NAIC methods)
 - A new “Premium refund reserve” switch to calculate additional reserves when there is a return of unearned premium on decrements (applies for both US GAAP and NAIC methods)
 - The existing “Return of UE premium” switch is extended for US GAAP methods (FAS60, FAS97, FAS120)

Details

- Version 20171701

Learn more

- <https://www.ggy.com/client/BugEnhance/UpdateDetail/23582/>

SYNTHETIC GIC - FORMULA TABLE FOR ASSET POOL ALLOCATION

Description

- In the Annuity module, users can now select an “Asset pool” Formula Composite Table in the “Asset pool” field in the Product Features - Accumulation Phase section
 - The availability of this field is only available if “Plan type” is set to “4 - Synthetic GIC”
- The “Asset pool” Formula Table can be used to dynamically select the allocation of a synthetic GIC asset pool to the underlying managed funds

Details

- Version 20171401

Learn more

- <https://www.ggy.com/client/BugEnhance/UpdateDetail/23293/>

DISABILITY MODULE MORTALITY ASSUMPTIONS

Description

- New switches and table fields have been added to the Mortality section of the Actuarial Assumptions in the Disability module
- The new switches added are:
 - “Historic mortality improvement”
 - “Mortality margin definition”
- The new table fields added are:
 - “Mortality margin”
 - “Final mortality MAD”
 - “Mort improve margin”

Details

- Version 20172201

Learn more

- <https://www.ggy.com/client/BugEnhance/UpdateDetail/23850/>

ABOUT OLIVER WYMAN

Oliver Wyman is a global leader in management consulting. With offices in 50+ cities across 26 countries, Oliver Wyman combines deep industry knowledge with specialized expertise in strategy, operations, risk management, and organization transformation. The firm's 3,000 professionals help clients optimize their business, improve their operations and risk profile, and accelerate their organizational performance to seize the most attractive opportunities. Oliver Wyman is a wholly owned subsidiary of Marsh & McLennan Companies [NYSE: MMC], a global team of professional services companies offering clients advice and solutions in the areas of risk, strategy, and human capital. With 52,000 employees worldwide and annual revenue exceeding \$10 billion, Marsh & McLennan Companies is also the parent company of Marsh, a global leader in insurance broking and risk management; Guy Carpenter, a global leader in risk and reinsurance intermediary services; and Mercer, a global leader in human resource consulting and related services.

The Actuarial Practice of Oliver Wyman has life, health and property & casualty actuaries that advise financial institutions, insurance companies, regulators and self-insured entities across a broad spectrum of risk management issues. With more than 200 professionals in 16 offices across North America and the Caribbean, the firm's consulting actuaries provide independent, objective advice, combining a wide range of expertise with specialized knowledge of specific risks.

For more information, please contact:

Dean Kerr, FSA, ACIA, MAAA
Principal
Dean.Kerr@oliverwyman.com
+1 416 868 7061

Scott Houghton, FSA, MAAA
Principal
Scott.Houghton@oliverwyman.com
+1 860 723 5619

Rebecca Rycroft, FSA, FCIA, MAAA
Principal
Rebecca.Rycroft@oliverwyman.com
+1 416 868 2823

David Weinsier, FSA, MAAA
Partner
David.Weinsier@oliverwyman.com
+1 404 239 6431

www.oliverwyman.com

Copyright © 2017 Oliver Wyman

All rights reserved. This report may not be reproduced or redistributed, in whole or in part, without the written permission of Oliver Wyman and Oliver Wyman accepts no liability whatsoever for the actions of third parties in this respect.

The information and opinions in this report were prepared by Oliver Wyman. Moody's Analytics shall have no liability in respect of the views and opinions expressed in this newsletter. This report is not investment advice and should not be relied on for such advice or as a substitute for consultation with professional accountants, tax, legal or financial advisors. Oliver Wyman has made every effort to use reliable, up-to-date and comprehensive information and analysis, but all information is provided without warranty of any kind, express or implied. Oliver Wyman disclaims any responsibility to update the information or conclusions in this report. Oliver Wyman accepts no liability for any loss arising from any action taken or refrained from as a result of information contained in this report or any reports or sources of information referred to herein, or for any consequential, special or similar damages even if advised of the possibility of such damages. The report is not an offer to buy or sell securities or a solicitation of an offer to buy or sell securities. This report may not be sold without the written consent of Oliver Wyman.