Session 8D: The Future of Model Management and Governance

Emily Cassidy, Hans Harris, Chris Murphy & Joy Chen

October 28, 2020
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With you today

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**Director, KPMG LLP**

Emily is a Director in the Actuarial practice of KPMG LLP. She specializes in US GAAP and statutory financial reporting, actuarial accounting change, model risk management, and model validation.

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**Senior Associate, KPMG LLP**

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**Consultant, Oliver Wyman**

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Today's Topic

1. KPMG Introduction
   Part 1: Consistency within Model Risk Management
   Emily Cassidy

2. OWG Emerging Topics
   Part 2: Emerging topics in actuarial model validation
   Joy Chen

3. KPMG Model Sustainability
   Part 3: Making model changes sustainable
   Hans Harris

4. OWG Assumption Governance
   Part 4: Optimizing the assumption governance process
   Christopher Murphy
History of actuarial models

The core pillars of actuarial models – decrements and discounting cash flows – has not changed since the earliest models. However, the sophistication, computing power, and complexity has advanced significantly in the last two decades. Monitoring, governance, and validation of actuarial models must evolve to keep pace with the industry.

**1600s**
**Actuarial Tables**
Convert raw data from bills of mortality into Life Tables

**1900s**
**Actuarial Modeling Software**
Stochastic modeling for more intensive workload

**2000s**
**Modern Infrastructure**
Integration of softwares, task/workflow automation, cloud computing, machine learning

**2020**
Model risk management program

Model development and model risk management (MRM) should work together to support an integrated, comprehensive solution and provides a practical approach for mitigating model risk.
MRM and ASOP 56

Enhanced definition of a model in ASOP 56 (Section 2.8)

"A simplified representation of relationships among real world variables, entities, or events using statistical, financial, economic, mathematical, non-quantitative, or scientific concepts and equations. A model consists of three components: an information input component, which delivers data and assumptions to the model; a processing component, which transforms input into output; and a results component, which translates the output into useful business information."

ASOP 56 applies

- When using a model developed by others
- When model output materially affects intended user

ASOP 56 does not apply

- To parts of model outside an actuary’s responsibilities
- When performing individual pension benefit calculations
Drivers of change

**Models and Data**
General growth in the number of models and data sources

**Complexity**
Structure growing in complexity and the implementation of tools for consolidation

**Accuracy**
Desire for accurate earning forecast for business strategy and planning

**Technology**
Increased use of advanced technology and big data, e.g., predictive models for underwriting; machine learning tools

**Regulatory**
Regulatory changes such as moving away from LIBOR, LDTI, PBR, are necessitating MRM changes

**Board**
Desire for accurate earning forecast for business strategy and planning
Future of model validation

Models continue to get more sophisticated, with worldwide spending on cognitive and artificial intelligence (AI) systems is expected to reach almost $58 billion by 2021.

**Integrity**
Track the lineage and provenance of all data, model experiments, and ongoing changes made by SMP's.

**Explainability**
Models that can explain learning, decisions in business terms and allow interpretation based on their explanation.

**Free from bias**
Models that must be free of bias, are inclusive and avoid unfair treatment of certain protected groups and comply with regulation or policy.

**Agile and robust**
Models are interoperable between various runtimes, providers, or frameworks. The models, ground truth and feedback are safe and secure from harm or adversarial attacks.
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CONTENTS

1  Recent regulatory developments impacting modeling

2  Sample model validation techniques

3  Case studies

4  Key takeaways
Engage Model Risk and Governance early in the planning phase to establish a robust validation plan.
Effective model validation program applies validation techniques tailored to model risk and materiality
CASE STUDY #1 – INPUT VALIDATION

Adam is validating the assumption input process for a new LDTI model. He has received an approved assumption memo from the assumption owner and confirmed that the model owner correctly coded the approved assumptions in the model by spot checking assumption tables in the model.

Select the key risks that are presented in Adam’s validation from the list below.

**Risks**

- Results look reasonable on aggregate level but not at a more granular level
- Misinterpretation of assumption inputs
- Manual input process may introduce errors that spot check does not capture
- Model correctly calculates time-zero reserves but projects future reserves incorrectly
- Downstream adjustments not applied correctly
- Assumptions maybe overwritten during/after model runs
- Business is dropped during data handoffs from downstream spreadsheet to the ledger
- Model produces unintuitive results under alternative assumptions or market conditions
- Multiple model errors having offsetting impacts
- Inadvertent changes made to spreadsheet model
Adam is validating the assumption input process for a new LDTI model. He has received an approved assumption memo from the assumption owner and confirmed that the model owner correctly coded the approved assumptions in the model by spot checking assumption tables in the model.

### Key risks presented in Adam’s validation

- Manual input process may introduce errors that spot check does not capture
- Misinterpretation of assumptions
- Assumptions maybe overwritten during/after model runs

### Potential solutions

- Full reconciliation against input source
- Confirming model interpretation is consistent with assumption memo
- Use implied rates / single policy testing to validate key assumptions
CASE STUDY #2 – CALCULATION VALIDATION

Eric is validating the reserves from a new LDTI model. He compared the post-LDTI reserves to the current GAAP reserves in aggregate and by cohort and performed unit testing on a few policies. In addition he reviewed implied rates of key assumptions for reasonability.

Select the key risks that are presented in Eric’s validation from the list below.

**Risks**

- Results look reasonable on aggregate level but not at a more granular level
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CASE STUDY #2 – CALCULATION VALIDATION

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<th>Key risks presented in Eric’s validation</th>
<th>Potential solutions</th>
</tr>
</thead>
<tbody>
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<td>• Results look reasonable on aggregate level but not at a more granular level</td>
<td>• Establish robust policy-level validation tool that independently replicates cashflows and reserves calculations</td>
</tr>
<tr>
<td>• Multiple model errors having offsetting impacts</td>
<td>• Identify key impact drivers through change attribution analysis</td>
</tr>
<tr>
<td>• Model correctly calculates time-zero reserves but projects future reserves incorrectly</td>
<td>• Perform dynamic validation</td>
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<tr>
<td>• Model produces unintuitive results under alternative assumptions or market conditions</td>
<td>• Shock assumptions under a reasonable range of outcomes</td>
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Tina is validating the downstream spreadsheet changes to incorporate the LDTI model outputs. The model projects undiscounted cashflows at contract level, which are then brought into the spreadsheet model for discounting, aggregation and topside adjustments before being fed into the ledger. Tina reconciled time-zero policy counts and account value in the downstream spreadsheet to the model, validated that the discount rates used are correct, and the contract level data is aggregated to the reporting cohort appropriately.

Select the key risks that are presented in Tina’s validation from the list below.

**Risks**

- Results look reasonable on aggregate level but not at a more granular level
- Manual input process may introduce errors that spot check does not capture
- Downstream adjustments not applied correctly
- Business is dropped during data handoffs from downstream spreadsheet to the ledger
- Multiple model errors having offsetting impacts
- Misinterpretation of assumption inputs
- Model correctly calculates time-zero reserves but projects future reserves incorrectly
- Assumptions maybe overwritten during/after model runs
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- Inadvertent changes made to spreadsheet model
Tina is validating the downstream spreadsheet changes to incorporate the LDTI model outputs. The model projects undiscounted cashflows at contract level, which are then brought into the spreadsheet model for discounting, aggregation and topside adjustments before being fed into the ledger. Tina reconciled time-zero policy counts and account value in the downstream spreadsheet to the model, validated that the discount rates used are correct, and the contract level data is aggregated to the reporting cohort appropriately.

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<td>• Downstream adjustments not applied correctly</td>
<td>• Perform independently replication of downstream process</td>
</tr>
<tr>
<td>• Business is dropped during data handoffs from downstream spreadsheet to the ledger</td>
<td>• Perform static validation at every data handoff between the model and the ledger</td>
</tr>
<tr>
<td>• Inadvertent changes made to spreadsheet model</td>
<td>• Regression test to confirm no impact to existing use cases</td>
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KEY TAKEAWAYS

Model validation techniques should address the key risks of the model (or model changes)

The level of rigor applied in validation should be commensurate with risk and complexity of the model (or model changes)

A well-designed model architecture can reduce ongoing efforts related to model maintenance and validation
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“Happiness is the smell of a new car, but what if it fades?”
Sustainable model management framework

1. Maintain Data and Assumption
   Maintain data processes and employ proper assumption management techniques

2. Testing and Controls
   Premodeling data controls as well as testing intermediary outputs

3. Maintain Model
   Standardization of a model change and subsequent model testing processes

4. Empower People
   Human aspect of model management, arguably the most important aspect.
Empower people

Utilize **best-suited** personnel and embed knowledge transfer.

Manage and **prioritize** unplanned changes

Restrict access control and change management

Best suited

Prioritize

Restrict
Maintain data and assumptions

Optimize storage and structure
— Streamline data consistency throughout the automated process that retrieve and transfer data

Integrate assumption management
— Facilitate assumption change process and storage of assumptions in a controlled manner
Maintain model

Introduce model change protocols

Allow time for periodic model review or model validation
Emphasize testing and controls

Monitor data quality and control effectiveness
- Optimize monitoring of input data quality through the process of automated controls

Utilize testing-driven development
- To dynamically identify issues with model maintenance and routine change process
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For models that use assumptions as input, the actuary should use, or confirm use of, assumptions that are appropriate given the model’s intended purpose.

ASOP 56, section 3.1.6
A framework should be optimized based on **risk-mindfulness**, rather than fulfilled for compliance only.
01. DEFINING ASSUMPTIONS AND INPUTS

An **assumption** is any static, dynamic, or stochastic value and/or formula developed, in part or wholly, with reliance on expert judgment that affects projected results of actuarial models. An assumption is subject to a level of uncertainty; that is, its true value or form is not presently known.

An **input** is a value that is always both measurable and known (though it may change over time), and is therefore not subject to expert judgment. Not all inputs are assumptions, but assumptions are inputs to models. An example of an input that is not an assumption is product features.

Assumption changes go through assumption and model governance, while input updates only go through model governance.
02. ASSUMPTION REVIEW AND APPROVAL STRUCTURE

Diverse practices have emerged in the industry to address the challenges of complexity, materiality, and scale.
Three levels of review:
1) Peer review of the proposed assumption
2) Working groups challenge the assumption
3) Formal Assumption Governance and Risk Committee approvals

Continual monitoring after approval and implementation
Monitoring will lead to restarting the development process as new data and results emerge

Internal data is gathered, validated, transformed, and experience studies are calculated
External data and experience studies are gathered

Financial impacts are calculated for applicable reporting bases
Sensitivity tests are required to present the full detail of the potential impact
Impacts and sensitivities will lead to an iterative process with rethinking proposal

New assumptions
- New products
- New methodologies / accounting practices
- Better data could allow for new assumptions

Data and experience studies
- Internal data is gathered, validated, transformed, and experience studies are calculated
- External data and experience studies are gathered

Analysis and recommendation
- Recommendation may propose no change, a change, or a range of acceptable options

Committee rejection
03. ASSUMPTION GOVERNANCE CYCLE

Detailed steps

Controls and monitoring
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03. SAMPLE ANNUAL ASSUMPTION DEVELOPMENT TIMELINE

**DATA REQUIREMENTS**
- All data requirements to be finalized in January

**ACTUARIAL ANALYSIS**
- All analyses and initial peer review to be completed between April and June

**ASSUMPTION IMPLEMENTATION**
- Assumption changes to take place in parallel with all other Q3 model changes

**DATA PREPARATION**
- Most data preparation work to take place in Q1
- Some spillover into Q2 due to nature of data (e.g., mortality)

**RECOMMENDATION APPROVAL**
- Governance and approval processes to take place after Q2 earnings release

**PLANNING**
- To begin after Q3 assumptions changes hit financials and completed by year-end

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04. ASSUMPTION PROPOSAL PROCESS AND DOCUMENTATION REQUIREMENTS

Formal documentation and proposal process supports changes that are transparent, fully understood, and hold up to independent scrutiny.

- Providing a template ensures consistent and complete information
- Allow for exceptions that can result from use of actuarial judgment or special circumstances
- Documentation requirements should address all modeling uses relevant to your company
- Control activities (e.g. peer review) must be evidenced in a standardized manner
05. ASSUMPTION MANAGEMENT VIA A MASTER ASSUMPTION INVENTORY

Exhaustively tracking the assumptions via an efficient and practical tool supports meaningful governance

General purpose

• Purpose: inventory all assumptions used in production models, their risk classification, and review history and schedule
• Tracks important information for all assumptions:
  – Ownership
  – Financial segment and type
  – Model(s) impacted
  – Governance status
  – Data sources
  – Supporting documentation
  – Materiality

Design features

• Unique identifier to briefly reference assumptions and grouping by assumption type
• Identification of high priority assumptions based on their potential financial impact
• Capture of financial impacts by legal entity and accounting basis

Central inventory

• According to Oliver Wyman’s recent assumption governance survey, nearly 70% of participants have an inventory of assumptions under governance, and nearly 20% have one in development

A master assumption inventory uses the potential impact and risk assessment of each assumption to determine the level of governance required
Thank you
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