Model Risk – Illuminating the Black Box

Working Party paper due to be published and presented to the Institute and Faculty in Edinburgh on 29 June 2017.

Contents:
- Model Risk – Daring to Open the Black Box and Case Studies
- Model Risk Communication
- Practical Implementation of a Model Risk Management Framework
- Model Risk – Lessons Learned from Other Industries
- Practical Applications of Model Risk Management in Actuarial Fields
Today’s Agenda

• Practical Implementation of a Model Risk Management Framework
  – Central Inventory of Core Models
  – Assigning Key Model Roles
  – Third Party Model Software
  – Independent Review and Frequency
  – The Culture Challenge
  – Model Risk Assessment / Quantification

• Model Risk – Lessons Learned from Other Industries

• Practical Applications of Model Risk Management in Actuarial Fields

Central Inventory of Core Models

Identification of models
• Include models relying on approximations, simplifications, judgement
• Exclude calculator models such as data manipulation or validation checks

Basic information
• ID, name, version
• Location
• Model owner
• Categorisation
• When last reviewed and by whom

Link to documentation
• User
• Model testing
• Model specification
• Model methodology review
### Assigning Key Model Roles

<table>
<thead>
<tr>
<th>Role</th>
<th>Main responsibilities</th>
<th>Main risks / mitigating actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chief Risk Officers</td>
<td>Ensuring all models are identified and recorded in the model inventory, and have Key Model Roles assigned</td>
<td>• inventories • Gaining agreement on Model Owners</td>
</tr>
<tr>
<td>Model user</td>
<td>Model being used appropriately and only using the model after approval by the Model Approver</td>
<td>• Training, governance • Reducing key person dependencies</td>
</tr>
<tr>
<td>Model owner(s)</td>
<td>Maintenance of information in model inventory system, model risk prioritisation, compliance with model risk control standards, sign-off of model developments, model monitoring, liaising with the Model Reviewer and Auditors</td>
<td>• Ensuring models in inventory are accurate and up-to-date. • Needs sufficient authority / seniority</td>
</tr>
<tr>
<td>Model reviewer</td>
<td>Performing independent validation and reviews of models</td>
<td>• Technical competence • Access to key staff</td>
</tr>
<tr>
<td>Model approver</td>
<td>Reviewing residual risk assessments and approving the use (or limited use) of the model</td>
<td>• Managing if models are at various stages of change. • Difficulty in not approving a model for use</td>
</tr>
<tr>
<td>Internal auditor</td>
<td>Checking due process has been followed when using models</td>
<td>• Timely, recording of audit • Ensuring audit trails</td>
</tr>
<tr>
<td>External auditor</td>
<td>Independent review of process, methodology, assumptions, limitations, results</td>
<td>• As for internal. • Focus on exceptions and deviation from process</td>
</tr>
</tbody>
</table>

### Third Party Model Software

- “Another team, in a separate room”
- Due diligence critical
- Include 3rd party models in your inventory
- Ensure suitably qualified personnel
- Keep your software up to date
- Test new versions
- Keep documentation up to date
Independent Review and Frequency

- Independent review – defined as validation by people who have no involvement in the design and operations of the model being validated
- Evidence and record review

<table>
<thead>
<tr>
<th>Review contents:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model review date; the model and version being reviewed</td>
</tr>
<tr>
<td>Is purpose clear and has it been used for that purpose?</td>
</tr>
<tr>
<td>Review of documentation; could it be followed by a technically competent third party?</td>
</tr>
<tr>
<td>Evidence of requirements, testing documentation and recent model sign off</td>
</tr>
<tr>
<td>Action points and agreed completion dates</td>
</tr>
</tbody>
</table>

The Culture Challenge

Daring to Open the Black Box

- Successful governance requires reflection of the different cultures of model user

Illuminating the Black Box

- Opening up the model
- Social pressures
- Balancing model change and innovation
Model Risk Assessment / Quantification

Meta data → Scheduled run data → Test run data

Increased triage accuracy but increased effort

Today’s Agenda

• Practical Implementation of a Model Risk Management Framework
• Model Risk – Lessons Learned from Other Industries
  – Weather Forecasting
  – Aerospace
  – Software development
  – Auditors
• Practical Applications of Model Risk Management in Actuarial Fields
Weather Forecasting

• Errors noticeable – “Michael Fish” moments
• Making progress
  – RMS error statistic forecast vs naïve forecast
  – Numerical Weather Prediction Index
• Monitoring progress
  – User satisfaction measures
• Considerations for actuarial Models
  – Could we better assess and communicate progress in our forecasting skill?
  – Box ticking vs true progress

Aerospace

Consequences of Model risk materialising may be extremely serious

Areas considered:
  – Computational fluid dynamics
  – Flight control systems
  – Incident investigation by independent investigators

Considerations for actuarial Models
  – It is useful to understand what caused Models to go “wrong”!
Software Development

- Conceptual Model vs Software Implementation
- Test Driven Design (TDD) vs Behaviour Driven Design (BDD)
- The use of Meta Data in Software development

Auditors

- Third line of defence
  - Supplement “first line” – day to day users and “second line” – risk function
- Internal and external
- Highlight importance of
  - Controls and process completed in real time and evidenced
  - Clear lineage from initial model specification, test plans, test evidence, and model sign-off
  - Ability to evidence checks and process with documentation
Today’s Agenda

• Practical Implementation of a Model Risk Management Framework
• Model Risk – Lessons Learned from Other Industries
• Practical Applications of Model Risk Management in Actuarial Fields
  – Life Office
  – Banking
  – Pensions
  – Links to TAS-100

Life Office

• Overview of Model risk mitigation techniques:
  – Central inventory
  – Model development process
    • Change controls – central and local
    • Practicalities – prioritisation
  – Training and controls
  – Automation improves efficiency – eg with VBA
  – Inline code comments
  – Model simplification and removal where justifiable
  – Robust organised filing system
Banking

- PRA outlined expectations in area of Model Risk November 2015
  - Board must understand 5 key areas
- “Models” vary from simple checks to complex Models driving the business
- Models are risk rated and more significant / complex fall under framework
- Independent review required at regular intervals
- Regulatory review required in some cases
- Performance monitoring of KPIs usually conducted quarterly
- Senior management reporting

Pensions

- High reliance on model results
- Regulatory environment
  - Requirement for reporting of key numbers
  - Introduction of IORP II
- Key stakeholders: scheme actuary, trustees, employers, regulator
- Model uses: valuation, risk transfers, longevity projections
- Considerations for actuarial models
  - Increased focus on risk management expected moving forwards
  - Long term nature of the business presents challenges
Links to TAS-100

• New technical actuarial standard in force from 1 July 2017
• Aim to promote high quality actuarial work
• Key principles for Models include:
  – Models must be fit for purpose and this documented along with the model calculations
  – Controls and tests must be documented
  – Communications shall include methods, measures, rationale, changes, and limitations
• Framework set out by Model Risk Working Party consistent with TAS-100

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