# RBS Risk Management
## Assessing Model Risk in Practice

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## Assessing Model Risk in Practice

### Plan for the Talk

- Background to Banking Book Credit Risk Models.
- Principles of Model Risk:
  - Motivation from the recent credit crisis;
  - Motivation from Senior Management and Model Review;
  - Precisely Wrong v Roughly Right;
  - Moonshot v Bridge-building.
- RBS Basel 2 Credit Risk Model Risk Framework:
  - 3 stage approach to quantification;
  - Managing and communicating model risk.



## Assessing Model Risk in Practice

### Background – Banking Book Credit Risk

- The Banking Book
  - Loans and facilities to obligors and customers.
- Default and loss:
  - Driven by the behaviour of each individual entity and the constraints of the contract;
  - Within a latent economy and market environment.
- Banking Book credit loss uncertainties are dominated by
  - Incomplete knowledge of individual obligor circumstances.
  - Uncertainty about how obligors perceive and interact with their environment.

## Assessing Model Risk in Practice

### Background – Obligor-level Models

- Operational Models:
  - Relationship management – acquisition decisions, pricing, limit setting.
- Regulatory Capital Models:
  - PD, EAD and LGD are aggregated from obligor level to portfolio level, with correlations set by the regulator.

- Across the industry, these models tend (with notable exceptions) to have the following features:
  - Data: Detailed obligor-level transactional data, but may span only a few years.
  - Methodologies: Fixed-effects regression modelling dominates.
  - Effects: Model inputs are typically individual obligor characteristics at a point-in-time.
  - Outcomes: Best-estimates are emphasised over variances and distributions.
  - Implementation: Scorecards are common - many obligor-level models are used in operations simply as ranking tools.



## Assessing Model Risk in Practice

### Model Risk and the Credit Crisis: Turner Review – March 2009

- "Misplaced reliance on sophisticated maths."
  - "The very complexity of the mathematics used to measure and manage risk … made it increasingly difficult for top management and boards to assess and exercise judgement over the risks being taken. Mathematical sophistication ended up not containing risk, but providing false assurance that other prima facie indicators of increasing risk … could be safely ignored."

- Reliance on models whose best qualification is that they explain the past well.
- Too many pricing and lending decisions did not take into account the assumptions and limitations of the pricing models.

- Model Risk was not communicated adequately to the decision-makers.

## Assessing Model Risk in Practice

### Questions about Models

- Senior Management
  - How credible and reliable is the model?
  - Should the model override other opinions?
  - How much effort will the model take to maintain?
  - Conservatism.
- Model Review
  - Will the model be fit for purpose in the immediate future?
  - Will the model be fit for purpose in the longer run or under stress?
  - Under what circumstances is the model not fit for purpose?
- All these questions are about Model Risk.



## Assessing Model Risk in Practice

### Principles – Model Risk and Specification Risk

- A (statistical, empirical) model is a description of past data.
- The past data can be described in many ways, but only one model is chosen to make predictions.
- Specification Risk (one part of Model Risk) is the risk that the model chosen is not fit for its intended purpose.
  - Model Risk is also concerned with Implementation Risk and other risks in the use, governance and communication of the model in the business.

## Assessing Model Risk in Practice

### Principles – Precisely Wrong v Roughly Right

- A statistical model falls into two parts.
  1. A deterministic algorithm – to describe the data roughly.
  2. A probability distribution – to describe the error between the algorithm's output and the observed outcomes.

- Model Risk concerns the correctness of both these parts of the model.
- Accuracy (Prediction Risk) concerns the narrowness of the distribution in part 2.

- *Precisely Wrong v Roughly Right.*
  - Tomorrow's weather = today's weather: low prediction error, high model error.
  - Bernoulli model of single coin toss: high prediction error, low model error.



## Assessing Model Risk in Practice

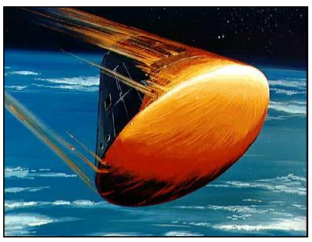
### Principles – Precision, Conservatism and What We Know

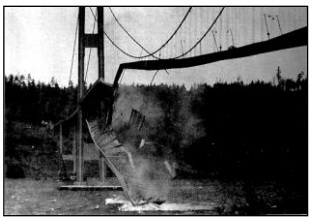
- Model choice and Model Risk depends on its aims.

- Precision – symmetric utility:
  - Operational Scorecards;
  - Expected Loss, Provisions;
  - Apollo re-entry angle.

- Conservatism – asymmetric utility:
  - Regulatory Capital;
  - Bridge building.

- Even with best available knowledge, conservatism and regulatory compliance can't guard against every Model Risk.





## Assessing Model Risk in Practice

### Assessing Model Risk "Bottom-up"

- The RBS Model Risk Framework aims to assess and manage Model Risk in all RBS Credit Risk IRB Pillar 1 Models
  - Compliance – regulations (BIPRU 4.3.88), regulatory guidance, professional best practice.
  - Communication – senior managers want to understand model risks.
  - Analysis – consistent, transparent, proportionate.

- The Framework works "bottom-up" in 3 stages:
  - Identify Model Risks.
  - Quantify Model Risks and their combinations.
  - Action to Mitigate and Manage.

- The Model Risk Framework works closely with the model approval process, but takes a different point of view.
  - Assumes that the model is approvable and proposes model risk management.



## Assessing Model Risk in Practice

### Hypothetical Example

- A Probability of Default (PD) model is proposed for a growing secured lending portfolio in a non-UK region.
- Modellers manage each model risk separately at first.

- Model Risk 1 - Default count
- Identify:
  - The model's parameters are fitted using only a small number of local defaults.
- Quantify:
  - Flex the fitted model parameters separately by their model standard error: what impact does this have on model output?
  - Explore bootstrap variations, etc.
    - *This shows a possible (1 sd) scalar change in PD of 0.95-1.10.*
- Action:
  - For capital purposes, propose a conservative uplift factor 1.1 to PD (this may be modified by other model risks investigated).
  - Agree to schedule model reweight in 1 year when number of cases is expected to be significantly higher.

## Assessing Model Risk in Practice

### Hypothetical Example continued

- Model Risk 2 – Model Choice:
- Identify:
  - Because of limited regional data, the model's structure and factors are preset to be the same as another model developed on UK data, although the local model parameters are tuned using regional data.
- Quantify:
  - Add in as many additional local factors as can be found quickly; check univariate whether these other factors are as influential as the ones chosen in the model.
  - Build a rough model with local data and see what structure emerges.
    - *This suggests that one UK-chosen factor, X, may be replaced by another local factor, Y.*
  - To test the impact of this choice, flex X and Y (correlated) over a reasonable range and see what influence it could have on PD, as determined by their respective models.
    - *Variation observed happens not to be materially different.*
- Action:
  - No immediate changes to the model proposed: data volume and expected impact small.
  - Although the impact appears immaterial now, it may not stay that way. Therefore set up monitoring so that, if the population of Y changes enough, the model will be re-validated.



## Assessing Model Risk in Practice

### Sensitivity Analysis

- Model Risk assessment asks "What if…?"
  - …the missing data were filled in? and filled in differently?
  - …different factors were to be used?
  - …the experts took at different view of the immediate economy?
- Therefore Model Risk quantification has sensitivity analysis at its core.

- The work required has to be proportionate and justified, so use filtered levels of detail:
  - Rough, quick, using ready data - could the Model Risk have large impact?
  - More detailed sensitivity analysis – is the model really sensitive to this risk?
  - Explore realistic sensitivities and scenarios, and come to a final view about materiality and size of the Model Risk impact on the model.
  - Explore interactions with other material Model Risks.
- Plans for Model Risk assessment could affect the data extract specification or the choice of model structure.

- Warning! Model Risks that are immaterial now could blow up in the future.

## Assessing Model Risk in Practice

### Communicating the Impact of Model Risk

- Senior Management and Reviewers need answers to their Model Risk questions:
  - Model credibility;
  - Robustness against development assumptions; and
  - Robustness against future changes and stress conditions.
- The Model Risk Framework generates judicious combinations of sensitivity analysis and impact analysis, aiming to answer these questions quantitatively.
- Model Risk Actions – conservatism, monitoring, governance, process improvement.
- Model Risk Monitoring



## Assessing Model Risk in Practice

### Summary

- Model Risk is important to Senior Managers' and Reviewers' understanding of models, covering:
  - Model credibility and on-going fitness for purpose – cf. Turner Review;
  - Model governance and maintenance.
- For the last 18 months, RBS has managed Model Risk in its IRB Credit Risk models following an approved Model Risk Framework.
  - The MRF assesses Model Risk impact quantitatively, bottom-up.
  - Model Risk assessment centres on sensitivity analysis.
  - The MRF stipulates actions to remove, mitigate and monitor Model Risk.