

Managing Model Risk in Practice

Alan Forrest
Group Risk Analytics Independent Model Validation
RBS Group

Edinburgh University Credit Research Centre,
Credit Scoring and Credit Control XII 24th-26th August 2011

Conference Presentation Version 18th August 2011

Disclaimer

Disclaimer

The opinions expressed in this document are solely the authors' and do not necessarily reflect those of The Royal Bank of Scotland Group or any of its subsidiaries.

Any graphs or tables shown are based on mock data and are for illustrative purposes only.

Overview

- Model Risk assessment is an essential part of Credit Risk model development and validation.
- RBS Independent Model Validation team has developed a Model Risk Framework to guide analysis and codify actions.
- Model Risk can be identified and quantified in practice.
- Actions coming out of Model Risk assessment are effective tools in the post-Crunch management of models and portfolios.

Model Risk

- The risk that a model is built or implemented in a way that turns out to be unfit for purpose.
 - How different could the model have been? How well will it hold up?
- Can be caused by:
 - limitations or bias in the data used to develop the model;
 - changes in the meaning or population of the data over time;
 - assumptions that define the structure of the model;
 - assumptions about the market underlying the portfolio, past and future;
 - uncertainty about model's response to stress or downturn;
 - etc.
- All models have Model Risk.
- Model Risk is not prediction error
 - Bernoulli model of perfect coin toss – no model error, high prediction error.
- In practice, model predictions differ from the actual outcome through a combination of prediction error and model risk.
 - “Precisely wrong” versus “Approximately right”.

Why consider Model Risk? (1)

- Best Practice: “Essentially, all models are wrong, but some are useful.”
 - Recognition and assessment of model risk is professional statistical best practice.
 - Model Risk assesses the credibility of our models in ongoing risk management.
 - Criticism is healthy – assessment of Model Risks gives confidence and focuses improvement.
- Regulation and Basel Rules*
 - Regulations require a deep and clearly documented understanding of uncertainty in our IRB ratings systems, including in the specification and calibration of the model.
 - Regulations also require action to mitigate this risk, specifically conservatism and monitoring.
- The Credit Crunch – Turner review 2009
 - Too great a reliance on models whose best qualification was that they explain the past well.
 - Many pricing and lending decisions paid too little attention to the assumptions and limitations of the pricing models.
 - Model Risk was not communicated adequately to the decision-makers.

* See for example BIPRU 4.3.30, 39A, 48, 74, 88, 89, 128 and 4.4.27

Model Risk Management at RBS

- The Group Risk Analytics Independent Model Validation team has introduced a Model Risk Framework to detect Model Risk and to codify Model Risk actions.
- Scope covers Retail and Wholesale Credit Risk Models.

- A committing project touching all parts of development and review process:
 - Formulating and writing the Model Risk Framework principles and guidance;
 - Communicating the Model Risk Framework and responding to users' concerns;
 - Ensuring the Framework is accepted by all stakeholders and approved at the appropriate level of committee;
 - Teaching the Framework's practices and ensuring they work appropriately in real modelling examples;
 - Monitoring and reviewing the Framework's effectiveness.

Model Risk Framework

- Identification of Model Risks
 - Checklist
 - Review issues and monitoring triggers
- Quantitative assessment
 - Sensitivities
- Assessing the impact
 - Individual Model Risks
 - Combined Model Risks
- Actions
 - Monitoring
 - Conservatism
 - Governance
 - Portfolio Management
 - Data and Model Management

Hypothetical Example: A PD scorecard

- A consumer retail portfolio of 10,000 customers.
- A PD scorecard model uses two factors: Household Income, External Bureau Score.
- In this hypothetical example income has many (36%) missing values...

	Not in default	In default	Total
Income OK	6332	103 (1.60%)	6435
Income missing	3310	255 (7.15%)	3565 (36%)
Total	9642	358 (3.58%)	10000

- Missing income is strongly correlated to default experience.
- Developers approach this by assigning a “missing” category to the classified income factor: 10K-20K, 20K-40K, 40K-60K, 60K+, missing.

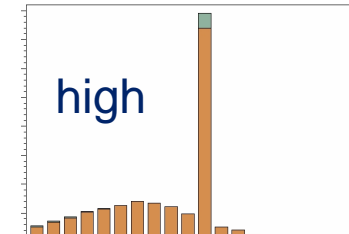
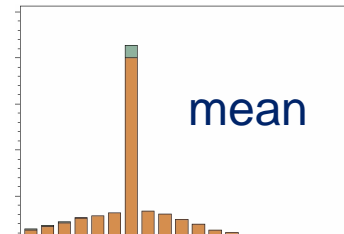
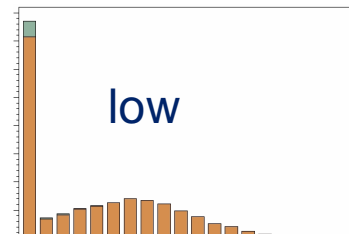
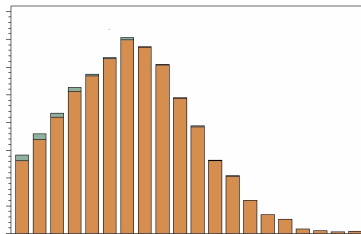
Identifying Model Risks and Sensitivities

- Two Model Risks are associated with missing income data:
- Missing values are not missing at random – this may cause distortions in the model structure and biased parameter choices.
 - Correlation with default event (causes?)
 - Correlation with income itself (lower incomes more likely to be missing?)
 - Hidden correlation of missingness with time (e.g. data collection process improvements over time)
- The modelling solution (classify missings) depends on assumptions of how missingness arises - what other modelling solutions could have been applied?

- Sensitivities: What if ...
 1. The missing data is filled in various plausible or extreme ways?
 2. The income population is really different (expected lower)?
 3. Different modelling methods are used to overcome missingness?

Test 1: fill in the missing values

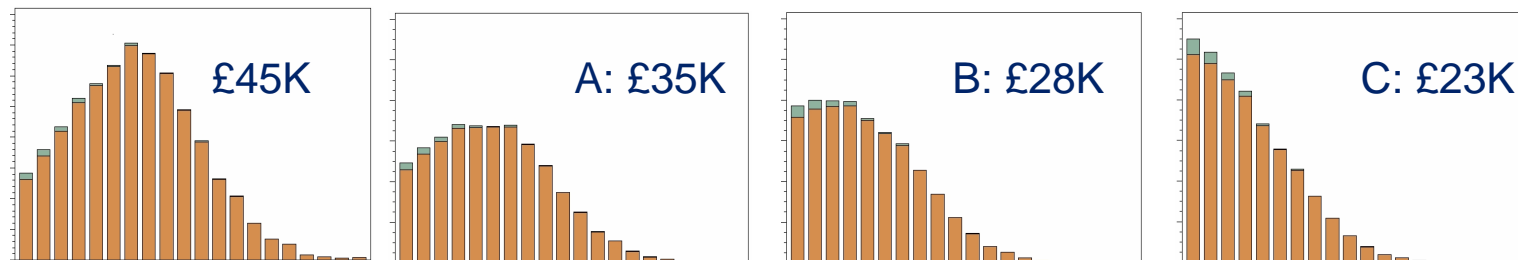
- E.g. Fill in missing income with single special values.



	Score weights					Bureau score	EL	RWA
	Offset	£ Income (missing=0)						
		10K-20K	20K-40K	40K-60K	60K+			
Model	229	24	156	248	280	1.62	2.71%	13.30%
Low	234		151	243	275	1.62	2.70%	13.30%
Mean	244		7	225	257	1.65	2.83%	14.21%
High	260		132	4	256	1.59	3.43%	16.60%

Test 2: weight population to lower incomes

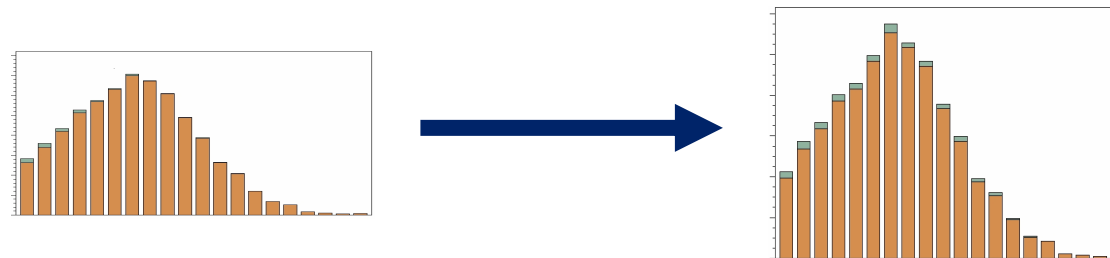
- Income distribution shifted down.



	Score weights					Bureau score	EL	RWA
	Offset	£ Income (missing=0)						
		10K-20K	20K-40K	40K-60K	60K+			
Model	229	24	156	248	280	1.62	2.71%	13.30%
A	223	21	153	242	281	1.64	2.73%	13.32%
B	217	18	150	239	283	1.67	2.76%	13.34%
C	211	14	147	236	284	1.68	2.78%	13.37%

Test 3: try alternative modelling solutions

- E.g. Income distribution imputed (e.g. hot-decking).



	Score weights					Bureau score	EL	RWA
	Offset	£ Income (missing=0)						
		10K-20K	20K-40K	40K-60K	60K+			
Model	229	24	156	248	280	1.62	2.71%	13.30%
Hotdeck	231		63	94	62	1.65	3.45%	17.94%

Sensitivity and Impact

- The impact of uncertainties in the possible values of the missing data is generally small
 - The largest impact is caused by infilling a high income value, a possibility that is unlikely to apply.
- Never-the-less the observed movements in EL and RWA are all increases, so a conservative adjustment should be considered.
 - Reasonable assessment for the isolated impact of uncertainty due to the missing income data : EL = 2.8% and RWA = 14%
 - This corresponds to a scaling of PDs by a factor 1.05 approx.
- The EL and RWA outcomes are highly sensitive to the choice of modelling solution to the missing value problem.
 - Some alternative approaches correspond to a scaling of PD by a factor of 1.5.
- Note that other Model Risks and sensitivities would be listed and mixed in to a final conclusion.

Model Risk Actions

- **Conservatism**
 - Put a conservative adjustment of 1.2 on PD (a level over 1.05, and an agreed value looking over various alternative imputation methods).
- **Governance and Review**
 - Require alternative methods to deal with missing income to be evaluated in first annual review.
 - Propose reduction in conservatism if annual review evidences lower variations as a result of model choice.
- **Monitoring**
 - Monitor population shifts in income – triggers set to flag up when the 1.05 conservatism level would be breached.
- **Model and Portfolio Management**
 - Improve or implement income data quality process.
 - Review in 1 year to consider any proposal for the reduction in conservatism.

Why Consider Model Risk? (2)

- Manage model improvement
 - Model Risk assessment focuses model development strategy.
 - Reduce conservatism in direct response to model risk mitigation.
 - “Model development is a journey and Model Risk defines the terrain.”
- Manage portfolio risk - Post-crunch
 - Model Risk assessment lets us know which deals and which sectors are open to most uncertainty in our quantification of risk, and modifies prices accordingly.
 - “Avoid this sector, we don’t believe we can estimate its risks accurately.”
 - “We’re uncertain about this risk therefore the price is high.”
 - “We can show we understand and estimate the risk in this sector better now, and therefore can reduce the price.”