

MODEL RISK A PRIMER

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What is a model?

Narrow

A tool that uses economic, financial and/or mathematical theories to transform input data into output data

Examples:

1. PD, LGD, EAD models
2. Derivative pricing models
3. Statistical learning algorithms
4. Portfolio pricing and optimisation

Broad

A tool that transforms input data into output data

Examples:

1. Narrow plus...
2. Heuristic decision trees
3. Dynamic LVRs
4. Standardised regulatory calculations (e.g. LCR, NSFR, SA-CCR)

Narrow

What is model risk?

- **The risk of incorrect model outcomes due to either:**
 - Inadequacies or errors in its methodology, implementation or data inputs given a particular domain; or
 - The application of a fundamentally sound model to an ill-suited domain
- **High profile examples:**
 - NAB FX options models (~A\$400m, 2004)
 - JP Morgan's synthetic credit portfolio risk models (~US\$6bn, 2012)

What is model risk management?

- **Model validation**
 - Conceptual challenge
 - Implementation integrity
 - Data accuracy, completeness
 - Use
 - Performance monitoring framework and outcomes
 - Challenger models
- **Model risk management vs model validation**
 - Risk assessments including quantification
 - Control framework

How to quantify model risk?

A Novel Approach to Quantification of Model Risk for Practitioners (2017):

Our proposal is to define quantification of model risk as a calculation of the norm of some appropriate function that belongs to a Banach space, defined over a weighted Riemannian manifold endowed with the Fisher–Rao metric. The aim of the present contribution is twofold: Introduce a sufficiently general and sound mathematical framework to cover the aforementioned points and illustrate how a practitioner may identify the relevant abstract concepts and put them to work.

How to quantify model risk?

- **Individual models:**
 - Inherent vs residual model materiality
 - More granular scorecard approach by source of model risk
- **Aggregate:**
 - Heuristic
 - Scorecard
- **High degree of subjectivity**

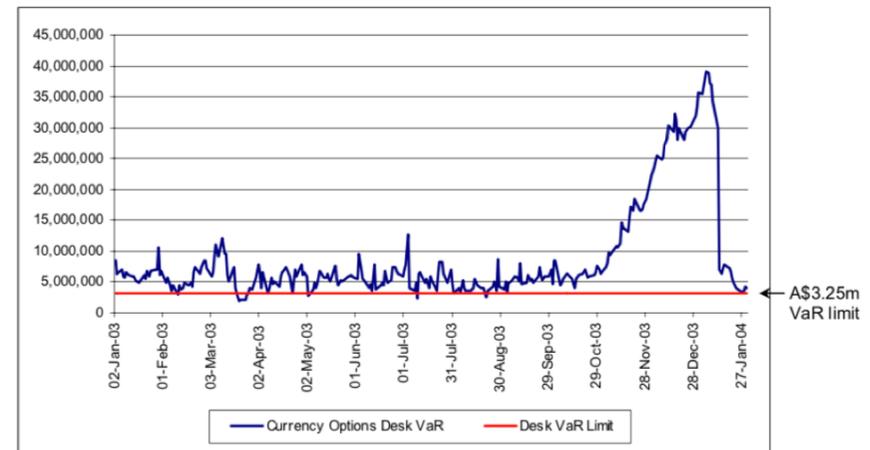
Case study 1: NAB FX options (2004)

Key issues

- **Based on publicly available information**
- **Valuation models: washing non-independent rates through external “independent” rates provider**
- **Risk models: known limitation in VaR model (no smile) had undermined credibility to such an extent that continuous and significant breaches of VaR limit by FXO desk were unable to be effectively challenged**
- **Compounded by non-modelling issues of course (e.g. fake trades, continuous breaches of structural limits)**
- **A\$400m lost**

VaR over 2003-2004

Figure 2.5: Currency options daily desk VaR



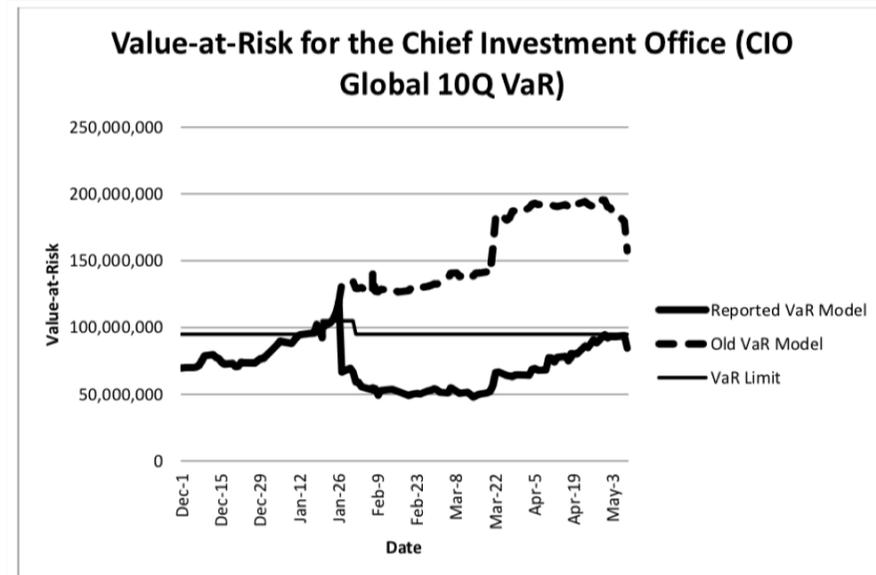
Source: <http://www2.owen.vanderbilt.edu/nick.bollen/themes/pwcreport.pdf>

Case study 2: JPM synthetic credit portfolio (2012)

Key issues

- Based on publicly available information
- Valuation models: using trader marks not the independent marks used by other desks with same positions
- MO models: using models in price testing that were not validated
- Risk models: credibility of original VaR / CRM models were contested; rushed implementation and validation of replacement (significant errors overlooked or downplayed). See next slide for more details.
- Compounded by non-modelling issues of course (e.g. structural and VaR limits not respected and continuously breached, insufficient internal and regulatory challenge, trading that was inconsistent with trading strategy)
- US\$6bn lost

CIO VaR over 2011-2012



Source: <https://www.hsgac.senate.gov/download/report-jpmorgan-chase-whale-trades-a-case-history-of-derivatives-risks-and-abuses-march-15-2013>

Case study 2: JPM synthetic credit portfolio (2012)

The unrespected VaR model issues:

- **No back-testing exceptions over preceding 12m...that is, “the VaR was too high”**

The enabling VaR model issues:

- **Data feed was completely manual and dependent on model developer**
- **Spreadsheet implementation that was error prone**
- **Using a pricing model that was not validated or approved for use**
- **Incorrect historical return calculations**

CRM model issues:

- **Couldn't be calculated for five weeks due to technical issues (+300% over that period)**
- **Changed model scope with RWA outcome in mind**

What is the MRM value proposition?

- **Get our own house in order**
- **Silo-busters**
- **Clarity**
- **Independent subject matter experts**
- **Independent arbiter of model integrity (e.g. not risk modellers, not business)**
- **Reduced risk of capital overlays or P&L risks**

What is it like to work in MRM?

- **Valued for bringing clarity**
- **Rich experience**
- **Independence**

What do regulators think?

- **Global regulators have placed much greater focus on model risk management as a discipline:**
 - US: SR11-7 (2011)
 - Basel: Sound independent validation practices (2016)
 - UK: Stress test model management (2017)
 - EU: Targeted review of internal models (2017)
 - Canada: Enterprise-Wide Model Risk Management for Deposit-Taking Institutions (2017)
 - Australia?

What does the future hold?

- **Pervasive statistical learning and ethical considerations**
- **Democratisation of modelling**
- **What do you think?**

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