

Operational Risk Models

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Agenda

1. Short history of implementation of Advanced Measurement Approach (AMA) for Operational Risk
2. Background to operational risk and operational risk models
3. First Generation models
 - Two approaches
 - Challenges and lessons learnt from the first models
4. Recent Developments
 - A convergence of approaches?
5. References

1. Short History of AMA: Pre 2008

Pre 2008:

- Circa 2005 APRA took aggressive stance toward Basel II accreditation with major Australian banks required to achieve Basel II Advanced Status in all risk categories before being allowed to use internal models in any single risk class
 - Put Australian banks on a fast track for AMA accreditation
 - All “Big 4” banks plus Macquarie achieved AMA in Jan 2008
- AMA Guidance and Standards open to interpretation
 - i.e. use Internal Losses, External Losses, scenarios and indicators...in a “statistically sound” manner to estimate 99.9th percentile of annual aggregate OpRisk losses
- Available external data and published papers poor/sparse

1. Short History of AMA: Post 2008

Post 2008:

- Globally “First Generation” models built pre 2008
 - Emergence of more literature on back of these developments
 - E.g. “Journal of Operational Risk”
- Emergence of industry organisations and associations sharing data and industry best practice
 - E.g. Operational Risk data eXchange (ORX) and local working groups
- 2008: Bank of International Settlements (BIS) conducted range of practice survey culminating in (References in Section 5):
 - Range of practice document
 - Data benchmarking document
 - June 2011 revised Guidance – still open but certain areas getting more prescriptive
- 2008: GFC Internal and Regulator observation of 1st Generation models during GFC
 - Questions on Adequacy of capital and Sensitivity of models
- Current: Globally many banks revisiting/enhancing 1st Generation models in light of observations on performance, improved literature and greater quality of available external data (ORX)



2. Background: Operational Risk

- Basel II definition of Operational risk
 - *‘the risk of loss resulting from inadequate or failed internal processes, people and systems or external events’*
- As a risk class, and importantly for modelling, it is broad and heterogeneous:
 - Examples: Rogue Traders, Earthquake, Class actions, mis-selling, Internal fraud, External fraud, system failures, terrorism, Regulatory Fines etc.

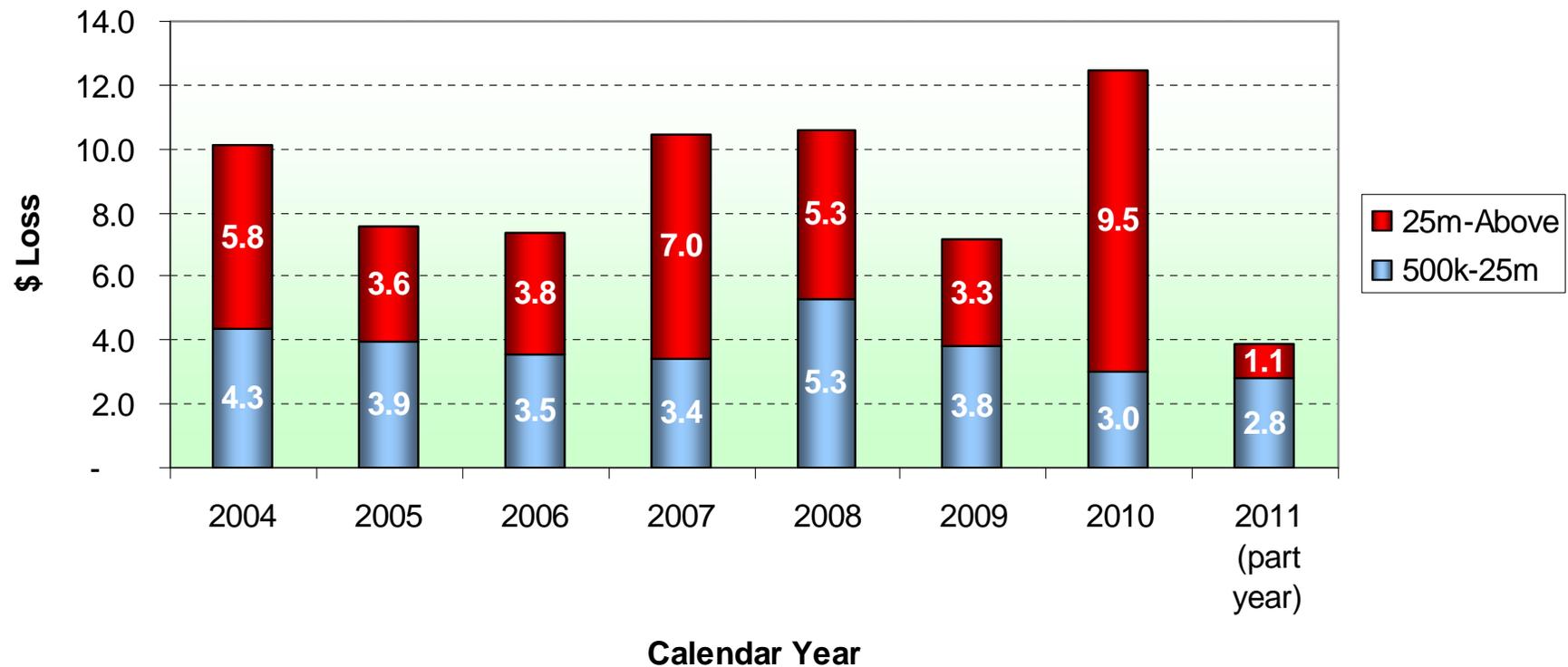
Background: Operational Risk Loss profile

Basel Risk Event Types (Level 1) – aggregated across Business Lines
Business Disruption & System Failure
Clients, Products & Business Practices
Employment Practices & Workplace Safety
Execution, Delivery & Process Management
External Fraud
Internal Fraud

- Table is colour coded to denote areas where largest losses occur (ORX data)
 - CP&BP: misselling, PPI
 - Internal Fraud: rogue trading
- These “spikes” in loss profile are largest contributors to capital

Profile of Operational Risk Losses

Loss per \$1000 Income: ORX data



- Large losses (>\$25m) dominate the loss profile by value
 - By volume these are less than 0.1% of total losses
 - Note these results are averaged across 60 member institutions

Summary: OpRisk and modelling challenges

- Broad definition of Risk:
 - Heterogeneity
- Losses in bad year dominated by single large loss
 - Fat tailed distributions
 - Low volumes of data in the tail “where it matters”

Virtually all operational risk models use compound models familiar to actuaries. i.e. separate modelling of:

- Frequency of losses: how often losses occur; and
- Severity of loss: how large is a loss *given* it has occurred
 - Generally “sub-exponential/fat tailed” distributions
- Assumption of independence between frequency and severity

Operational Risk Models @ NAB End to End Process Flow



Frequency
How often operational risk events occur

Severity
Size of loss when an event occurs

Scenario Analysts (SA)

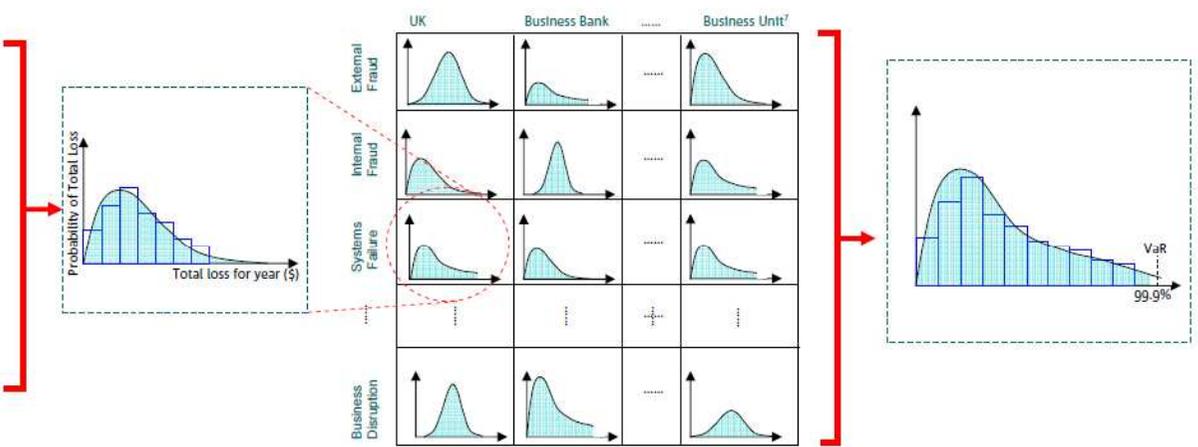
	Likelihood	Impact
SF*	1/20	\$32m
SF	1/25	\$170m
SF	1/80	\$188m

Weighted Average = \$105m

Business Environment Internal Control Factors (BEICFs) External Loss Data (ELD)

Second Tail Metric

*SF – Systems Failure



A. Data: There are four data elements mandated by Regulators:

Historic Experience (backward looking data)

- Internal loss data
- External loss industry data

Risk Profiling (forward looking data)

- Scenario Analysis data
- Business Environment Internal Control Factors

All of above need to be combined in a statistically sound manner in the capital model.

Value for NAB lies in making better use of forward looking data BUT extracting this value is heavily reliant on quality of this information.

B. Distributions: The Building blocks of an operational risk model are:

- The Frequency model:** How often operational events occur.
 - Driven by Internal Loss Data as sourced from ORECS.
- The Severity Model:** The size of loss when an event occurs, incorporating the;
 - Body (small value losses) informed by our internal loss data
 - "Tail" (large value losses) informed by our scenarios and external loss data, as sourced from ORX.
- Use of "mixture distribution" enabling a clearer linkage between scenarios and capital.

For both frequency and severity it is the profile of large losses that is most relevant for capital.

C. Monte Carlo Simulation: A purely mechanical step to aggregate frequency and severity distributions to generate a total loss distribution for the coming year for that cell in the model.

D. Granularity: Modelling groups of risks together which have a similar statistical profile.

E. Correlation: The final step occurs when dependencies between risks are incorporated to generate a total loss distribution for the Group.

F. Capital: is the 99.9th VaR point of the aggregate distribution. Capital is then allocated to business lines, based on internal loss data and scenario analysis data

Key model assumptions/decisions

1. Level of granularity
 - Trade off between availability of data and homogeneity of risk
2. How to model the tail?
 - Use scenarios directly in model; or
 - Purely loss data driven – Internal and/or External;
 - Either way challenge of how to blend the data elements.
3. Approaches to Correlation/aggregation
 - At aggregate level or via frequency of occurrence?



Two approaches to tackling the modelling challenges

Lack of large value losses in internal loss databases is a key challenge in developing robust operational risk capital models (at 99.9% confidence!):

•Operational risk regulations recognise this challenge and respond by requiring banks to develop solutions that incorporate one or both of the following:

- External Losses: Incorporate losses from other institutions into modelling databases
 - NB: capital outcomes not reflective of or sensitive to the organisations own risk profile
- Scenario Analysis: Incorporate data from internal risk profiling processes such as scenario analysis into the modelling databases
 - Relies on management to accurately quantify exposures to extreme losses
 - Sensitivity of model dependent on sensitivity of scenario estimates

•Scenario Based Approaches: NAB uses a combination of these approaches, as do other Australian and many European banks

•Data Driven Approaches: US banks focussed on developing approaches only using Internal and External losses

Data driven approaches: Lessons Learnt and current challenges

- Pure data approaches to the modelling have had to deal with a number of highly technical challenges:
 - Fitting distributions
 - Low value collection threshold has a strong influence on outcome and may give non-intuitive sensitivities
 - Stability of estimation techniques – use of robust estimators
 - Spliced distributions
 - Extreme Value Theory
 - Mixing the data

Whatever choices made above...

- How make relevant to organisation?
 - Scale data? Weak evidence – in general arbitrary scaling not supported by regulators
- Challenges in satisfying the “use test”:
 - How to explain capital movements to business
 - Both backward looking AND potentially not related to business if movements driven by losses at another institution (or small values losses – c.f. dependence on collection threshold noted above)

Scenario based approaches: Lessons Learnt and current challenges

Scenario based approaches circumvent *some* of the technical challenges of data driven approaches...

- But these challenges are replaced with other issues:
 - How to define the outcomes of the SA process so that they can be used for modelling:
 - Elicit “worst in 1,000 years?”
 - Why build a model if participants can estimate this?
 - Use outcomes of 5x5 risk assessment?
 - Are the outcomes from this robustly defined? E.g. are likelihood and consequence estimates truly independent?
 - How to incorporate the scenario estimates with other sources of data?
 - How to deal with gaming and estimation biases
 - Has a clear linkage to business factors been captured to enable monitoring through time?



Recent Developments: Regulatory

Significant global cooperation between regulators through SIGOR¹ which has released results of:

- International Loss Data Collection Exercises (LDCE)
- International paper on Benchmarking of modelling practices
- BIS released enhanced AMA guidelines 2011, expectation is that these will be reflected in revised regulatory standards
- Regulators using this data/information to reassess minimum capital requirements
 - Constructing models using this data and challenging industry op-risk capitalisation

Regulators questions arising from Global Financial Crisis

- Sensitivity of AMA models during crisis – Why didn't it increase during crisis?
- Concern that the “credit” issues during the GFC were at core due to operational failings
 - Current regulatory standards define these as credit losses for capital purposes
 - Do these “boundary” issues leave a gap in the standards when systemic (e.g. sub-prime, earthquake) failings occur?

1. Standards Implementation Group for Operational Risk: subcommittee of BIS responsible for providing guidelines for operational risk management and modelling

Recent developments: Industry

- Many Banks using either approach are developing “second generation models” building on the observations from first generation models
- Convergence: Structural models
 - Deep dives into key risks & building models around these
 - Scenarios moving away from “workshop” estimates to structured research on drivers of loss and transparency of assumptions underlying loss estimates
 - Workshops used to agree & challenge these assumptions

References

Bank of International Settlements: www.bis.org

- 2006 Original Basel II:
 - www.bis.org/publ/bcbs128.pdf
- “Results of 2008 Data collection exercise” and “Range of practice document”:
 - www.bis.org/publ/bcbs160.htm
- 2011 AMA guidelines:
 - www.bis.org/publ/bcbs196.htm

APRA

- APS 115 Capital Adequacy: Advanced Measurement Approaches to Operational Risk:
www.apra.gov.au/adi/PrudentialFramework/Pages/basel-ii-implementation-in-australia.aspx

Journal of Operational Risk – the main source of quantitative research in modelling operational risk

- www.risk.net/type/journal/source/journal-of-operational-risk
- Aue F., Kalkbrener M. (2006/07). LDA at work: Deutsche Bank’s approach to quantifying operational risk. *Journal of operational risk* **1**(4), 49-93.
 - Seminal paper with thorough introduction into modelling challenges and DB’s approach to handling them
- Cope E. (2012). Combining scenario analysis with loss data in operational risk quantification. *Journal of operational risk* **7**(1), ??
 - Rare paper on using scenarios in models, that gives a well structured theoretical approach for use of scenarios

ORX: www.orx.org

- Active industry group which has a strong relationship with SIGOR and many research sub-groups as well as providing invaluable consortia data to members for modelling. In the process of developing an insurance data consortia and actively looking for global industry participation.

Other regulator sites especially the FSA and the Canadian regulator have good discussion documents such as:

FSA (UK regulator) use test discussion document: www.fsa.gov.uk/pubs/international/orsg_8sep08.pdf

OSFI (Canadian regulator) AMA self assessment templates: www.osfi-bsif.gc.ca/osfi/index_e.aspx?ArticleID=4961&templateID=6

