Risk and Investment Conference
Justin Skinner

To boldly go where no ERM has gone before
ERM research that defined the future

Agenda

- ERM
- Risk appetite
- Capital models
- Capital allocation
- Risk measures
- Reserve risk
- Operational risk
- Correlations
CAVEATS

- The following are all personal views.
  - Many might object and/or disagree with my comments
- Reference materials are (mostly) freely available from the internet. Copy/paste has been liberally used from public materials

ERM

ST9

- Gives an excellent foundation knowledge of ERM, without strolling into too much technical detail
  - “Enterprise Risk Management: from incentives to controls”, Lam. Good, insightful, practical examples
  - “Quantitative risk management: concepts, techniques, and tools”, McNeil, Frey, and Embrechts. Too much focus on quantitative analysis that is not used in practice.
  - “Simple tools and techniques for enterprise risk management”, Chapman. Excellent overview of ERM
ERMSolvency II

• Ignoring the detailed implementation requirements…
• The overall principles backing Solvency II cover how an effective insurance company should be run, covering:
  – Corporate governance
  – Risk management
  – Balance sheet management (technical provisions, assets and capital requirements)

Risk appetite

• “Plenary 4: Applications of complexity science”
• Neil Allan and Neil Cantle

• Using systems thinking to give a better understanding of the interactions of risk to aid in setting risk appetite
Capital models

• “A new level of Enterprise Risk Management analysis: Methodology for assessing insurer’s Economic Capital Models”

• Standard and Poor’s

• http://www2.standardandpoors.com/spf/pdf/events/FITconJuly13.pdf

• Probably the best guide to good capital modelling I have seen to date

Capital models

• Standard and Poor’s proposal covers their criteria for analysing ECMs to assess their credibility

• ECMs themselves are part of a strong ERM program, but is only one component of their overall ERM rating

• Based on the output of this, the ECM is given a credibility factor (10% used within their illustrative example) to assess capital alongside the S&P capital model
Capital models

• Some factors may override the model credibility (to zero):
  – No material validation on ECM output
  – Insurer does not have adequate processes to assume a diversification benefit
  – Less than 75% of the insurers business is modelled
  – Unexplained material inconsistencies between actual results and projected results

Capital models

• Requirements are split into two categories:
  – “Indistinct risks” (e.g. capital assessment methodology, pension fund risk, management decisions, diversification and capital fungability)
  – Individual risk groups (e.g. credit, market, insurance and operational risk)

• Scoring is split into three ratings
  – Basic
  – Good
  – Superior
Diversification methodology:
- Basic. Generic high level correlation matrix with little or no empirical justification
- Good. Empirically derived dependency assumptions
- Superior. Copula approach to diversification to capture tail dependencies
Capital models

• Operational risk methodology:
  – Basic. Simple factor based approach
  – Good. Frequency/severity approach
  – Superior. Frequency/severity approach also considering control effectiveness, loss mitigants (e.g. insurance) and basis risk

Capital allocation

• I have yet to see a good quality, practical piece of research on capital allocation
• From what I have seen, existing materials are theoretically elegant, but practically useless
Risk measures

• “Risk Horizon and the Measurement of Economic Capital for General Insurers”
• Stephen Lowe, François Morin and Dean Swallw
• Towers Watson

• Consider the issues around a problem I didn’t think I had

Risk measures

One year balance sheet to balance sheet approach

• Capital based on potential change in the value of assets and liabilities over a single financial year
• Includes a single underwriting year (but only realising the first year of uncertainty around this year)

• Solvency II risk measure
• APRA stated risk measure
Risk measures

Run-off risk horizon

- Capital based on potential change in assets and liabilities as they are run off until ultimate
- Includes a single underwriting year
- Excess assets usually released from the model

- ICA risk measure
- APRA used risk measure
- Lloyd’s risk measure for capital allocation
- General insurance actuaries favourite???
Risk measures

Setting economic capital

- Obviously the run-off approach is the right one…
- … but
  - Solvency is ultimate assessed via balance sheets with market valuations
  - Capital efficiency is maximised by having the capital when it is required, rather than when it might be required
  - Projections of ultimate reserve uncertainty are somewhat uncertain
  - Ultimate approach includes arbitrary periods for different risks (e.g. ultimate for market and credit, one year for underwriting, …)

Reserve risk

- “Bootstrap Estimation of the Predictive Distributions of Reserves Using Paid and Incurred Claims”
- Huijuan Liu and Richard Verrall

- Allows paid and incurred bootstrapping to be carried out, and looks at relationship between the two results
Reserve risk

• The problem with incurred bootstraps…

<table>
<thead>
<tr>
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<th>Dev 10</th>
<th>Dev 11</th>
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<tbody>
<tr>
<td>UW year 1</td>
<td>100</td>
<td>150</td>
</tr>
<tr>
<td>UW year 2</td>
<td>100</td>
<td>99</td>
</tr>
<tr>
<td>UW year 3</td>
<td>100</td>
<td><strong>100</strong> estimate</td>
</tr>
</tbody>
</table>

Dev factor close to 1
Very small expected movement
Pearson residuals \((A - E) / \sqrt{E}\)
blow up
They are not IID across triangle
Normal bootstrapping gives silly results

Reserve risk

• Based around Munich Chain Ladder method
  – Chain ladder factors adjusted to reflect correlations between paid and incurred data
  – Chain ladder factors therefore differ across underwriting and development years
  – Gives closer estimation of paid and incurred projections
• Then uses repeated sampling from the residuals (picking the paid and incurred residuals in the same part of the triangle to maintain the dependency implied by the data)
• Can (fairly easily) be coded into Excel
Reserve risk – Example of well behaved data

Figure 3. Comparison of predictive distributions of overall reserves for CL and MCL reserves for paid and incurred claims

Reserve risk – Example of Lloyd’s syndicate data

Figure 6. Comparison of predictive distributions of CL and MCL reserves predicted on paid and incurred claims
Operational risk

- “A New Approach for Managing Operational Risk”
- OpRisk Advisory and Towers Perrin

Details the new way of managing operation risk. Mirrors many features of banking operational risk management

Operational risk

- The paper summarises traditional operational risk management and modern operational risk management
- Most notably is the move from banded likelihood/impact assessments to frequency/severity simulation assessments
Operational risk

Exhibit 4.3 — Expected Loss and Unexpected Loss

![Diagram of Expected Loss and Unexpected Loss](image)

Operational risk

Exhibit 1.1 — Summary of Differences between Traditional and Modern ORM

<table>
<thead>
<tr>
<th>Traditional ORM</th>
<th>Modern ORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition: Risk is defined primarily as a kind of undesirable incident/event, such as a fraud or a system failure (Operative question: What are your risks?)</td>
<td>Definition: Risk is defined primarily as a measure of exposure to loss from undesirable incidents/events (Operative question: How much risk do you have?)</td>
</tr>
<tr>
<td>Risk Identification Process: Ask managers to identify their major risks. (Risks include risk factors, controllable factors, events and effects; no restriction on overlaps; generally no differentiation made between risks and controls.) Leads to the creation of a large and unmanageable set of risks</td>
<td>Risk Identification Process: First define the “risk” universe, consisting of a finite (comprehensive) set of mutually exclusive (non-overlapping) “risk” classes. Use hard or soft data to reveal where the large losses are taking place (where the largest risks actually exist)</td>
</tr>
<tr>
<td>Risk Assessment/Measurement Method: Calculate risk by multiplying likelihood and impact for each risk type (conditional on one event), one “risk” at a time</td>
<td>Risk Assessment/Measurement Method: Use Monte Carlo simulation and frequency and severity distributions to calculate the cumulative loss potential from multiple events, across all risk classes simultaneously</td>
</tr>
<tr>
<td>Aggregation: Likelihood cannot be aggregated, so results cannot be aggregated</td>
<td>Aggregation: Frequency can be aggregated, so results can be aggregated</td>
</tr>
<tr>
<td>What is measured: Probability weighted loss from one specific incident (the routine loss)</td>
<td>What is measured: Cumulative loss for one or more risk classes: both the expected loss and unexpected loss, which are comparable to the average and “worst case”</td>
</tr>
<tr>
<td>Goal: Day-to-day management of current threats arising from imminent operational failures: loss prevention through tactical intervention</td>
<td>Goal: Management of key risks, specifically the optimization of risk-reward, risk-control and risk-transfer in the context of cost-benefit analysis</td>
</tr>
<tr>
<td>Cost: Generally very resource intensive</td>
<td>Cost: Relatively much less resource intensive</td>
</tr>
</tbody>
</table>

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Correlations

• “Observed Correlations and Dependencies Among Operational Losses in the ORX Consortium Database”
• Eric Cope and Gianluca Antonini
• [Link to the publication]

• Helps resolve an issue external flagged up in a number of regulatory capital reviews I have been involved in

Correlations

• The study is based around 90,000 individual losses (excess 20k Euros) from 41 banks
• There are four main conclusions from the research:
  – Kendall rank correlations are low, typically not exceeding 0.2
  – There is homogeneity amongst correlations measure at different banks (so using a market correlation matrix is appropriate)
  – There is slight evidence of tail dependency between losses
  – There is diversification benefit in the high percentiles of the data, although no accurate estimate is assessed
Correlations – Kendall rank correlations are low

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<tr>
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<th>TIF</th>
<th>EDPM</th>
<th>Malicious damage</th>
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<td>0.04</td>
<td>0.00</td>
<td>0.04</td>
<td>0.21</td>
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<tr>
<td>Health and safety</td>
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<td>0.04</td>
<td>0.07</td>
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<tr>
<td>Disasters and public safety</td>
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<td>0.01</td>
<td>0.24</td>
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<tr>
<td>IT and infrastructure</td>
<td></td>
<td>0.1</td>
<td>0.04</td>
<td></td>
<td>-0.01</td>
</tr>
</tbody>
</table>

Correlations – Different banks have the same correlations

Histogram of Kendall's Tau Severity Corrs
Correlations – Slight evidence of tail dependency

Conclusions

- The pace of ERM research has picked up over the past few years
- There is a wealth of information out there, mostly available at the click of a button
  - Is there any appetite for an ERM library with summaries of papers?
- There are still some notable gaps in current papers