Living With Solvency II
An Economic Capital Perspective
From Recent History

IAA Colloquium – 24 June 2013
Agenda

Capital Modelling:
- Some Topical Analysis
- Key Technical Developments
CAPITAL MODELLING
Some Topical Analysis
Historical Capital Analysis

Introduction

Using ECSight™, we have been able to explore the implications for own funds and required capital of some “interesting” recent periods of market history:

- Periods considered were:
  - Q2-Q3 2008: build up to the banking crisis and Lehman collapse
  - Q1-Q2 2009: crisis deepens, AIG reports largest 1/4ly loss in history
  - Q2-Q3 2011: build up to Eurozone sovereign debt crisis

- This analysis required:
  - Daily valuation of 1300+ assets over 360 business days using 5,000 stresses to evaluate the SCR at each point in time
Historical Capital Analysis
Daily Movements In Excess Capital

**Daily Historical SCR and Excess Capital Position**

- SCR uncovered!

<table>
<thead>
<tr>
<th>Month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>1</th>
<th>2</th>
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<td>5.61</td>
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<td>2.00</td>
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<td>1.98</td>
<td>2.05</td>
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<td>5.28</td>
<td>-4.99</td>
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<td>3.57</td>
<td>1.77</td>
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<td>B Spread</td>
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<td>6.58</td>
<td>6.90</td>
<td>8.19</td>
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<td>5.34</td>
<td>5.72</td>
<td>7.54</td>
<td>8.85</td>
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Historical Capital Analysis
Matching Adjustment (MA)
Historical Capital Analysis
Daily Movements In Excess Capital – MA Added

Including mitigation of SCR credit stresses reduces SCR by c15% providing a further boost to excess capital

Volatility in excess capital reduced by c70%
Historical Capital Analysis
Biting Scenario Parameters
Historical Capital Analysis

Individual Scenario Analysis (2)

Scenario 2960 is found to provide a robust proxy for MLC’s solvency position – maximum daily error across the analysis period is £22m
There is some modest pro-cyclicality to the relationship
Historical Capital Analysis
Daily VAR Back-Test

VAR breaches over this period:
Expected = 2 (360 * 0.005)
Observed = 2
CAPITAL MODELLING
Key Technical Developments
### ECSight

#### Key Features

<table>
<thead>
<tr>
<th><strong>Actuarial Aspects</strong></th>
<th><strong>System Aspects</strong></th>
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<tbody>
<tr>
<td><strong>Assets</strong></td>
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<tr>
<td>- Implementation is efficient enough for practical asset-by-asset modeling</td>
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<td>- Extensive existing coverage: fixed income, money market, derivatives, growth</td>
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<td><strong>Liabilities</strong></td>
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<tr>
<td>- “Lite” model implemented using high dimensional spline interpolation. Modular so other approaches can be integrated</td>
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<td>- “Heavy Model” and risk scenario generator agnostic</td>
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<td>- Individual “Lite” models fit to many balance sheet items, allowing granular reporting / analysis</td>
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<td>- Cash flows or other passage of time elements can be incorporated for roll-forward</td>
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<tr>
<td><strong>Risk Taxonomy</strong></td>
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<td><strong>Computing Power</strong></td>
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<tr>
<td>- Cloud enabled: provides high-performance computing &amp; scheduling capabilities in MS Azure</td>
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<td>- Reliable and scalable</td>
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<tr>
<td><strong>Data Management</strong></td>
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<td>- Robust data model in SQL Server providing scalability, versioning and flexible reporting</td>
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<td>- Multiple vendor support for market data</td>
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<td><strong>End User Interaction</strong></td>
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<td>- Via Web UI, no desk-top installation required</td>
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<td>- Multi-site, multi-user, secure access</td>
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Radial Basis Function (RBF) Approach

- Multidimensional spline interpolation
- Interpolate unknown function from calibrating data points to any arbitrary point/scenario
- Individual RBFs can be fit to numerous balance sheet items, allowing for granular reporting and in-depth analysis
- The approach can be used to systematically improve accuracy and evaluate convergence
Radial Basis Functions
Calibration (1)

\[ P_f(z) = w_1 \phi(\|z - x^{(1)}\|) + w_2 \phi(\|z - x^{(2)}\|) + \cdots + w_N \phi(\|z - x^{(N)}\|) \]
Radial Basis Functions

Calibration (2)

- Does not require grid sampling; easy to add new risk factors
- Calibrating scenarios are selected to adequately cover the entire range of possible risk driver values
- By simultaneously sampling each risk driver within the reliable range and using a low discrepancy sampling method, each scenario consists of random like shocks to all risk drivers

Random Sampling:
- Diversified scenarios
- Less points needed than regular grid
- Can leave gaps

Low Discrepancy Sampling
- All benefits of random sampling
- Does not leave gaps
- Speeds up convergence
Radial Basis Functions

Interpolation Error* vs Calibration Sample Size

*Evaluated across 225 out-of-sample observations with an available capital response range of $9bn

- RBF achieves high degree of accuracy
- Able to target a specific error tolerance, optimized to specifications

Here, the RBF model is able to meet a 2% error tolerance threshold with a sample of roughly 375 calibrating nodes.
Cloud enablement can now provide:

- On-demand access to virtually unlimited computing resources
  - An ability to provision resources on-demand to lower operating costs without sacrificing accuracy or granularity
  - Node-monitoring and automatic failover mechanisms to maximize reliability

- 1.8 million market value balance sheet valuations

- Elapsed runtime with 3,000+ CPUs in the cloud was approximately 5.5 hours*

* A real-time daily solvency valuation with the same portfolio, comparable cloud resources and 100,000 SCR stresses takes about 20 minutes to complete
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