GIRO 2011 – Navigating Risk: Are actuaries at the helm?
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Douglas Lacoss, FCAS

Capital and Excess of Loss Reinsurance Pricing
13 October 2011
Excess of Loss Reinsurance Pricing:

1. Refresher on Methodologies
2. Survey Results
3. State of Reinsurance Market
1. Refresher on Reinsurance Pricing

- $PV[\text{Premium}] = PV[\text{Losses}] + PV[\text{Expenses}] + \text{Profit}$

- Return on Risk Adjusted Capital (RORAC)
  $= \frac{\text{Profit}}{\text{Capital}}$

- Managing by RORAC, capital is critical.
1. Refresher on Capital Allocation

1. Determine Overall Capital Required for UW risk

2. Allocate Capital to segment/contract
   - Theoretical, not real
   - Define granularity
   - Additivity
   - Create incentives / understand impact
   - Diversification
   - Reflect risk over time
   - Integrated into business
   - On relative “risk” of business
   - What do you care about?
1. Methodologies – Determine Overall Capital

- Variance/Std Dev Load
  - Expected Losses plus Risk Factor × (σ or Variance)
- Value at Risk (VaR)
  - Expected losses at a percentile
- TVaR
  - Expected losses above percentile
- XTVaR
  - Expected losses above percentile: distance from \( \mu \)
1. Methodologies– Determine Overall Capital

Lognormal distribution
Mean 10.0
Standard Deviation 5.0

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>88.0%</td>
<td>15.55</td>
</tr>
<tr>
<td>89.0%</td>
<td>15.95</td>
</tr>
<tr>
<td>90.0%</td>
<td>16.35</td>
</tr>
<tr>
<td>91.0%</td>
<td>16.84</td>
</tr>
<tr>
<td>92.0%</td>
<td>17.34</td>
</tr>
<tr>
<td>93.0%</td>
<td>17.96</td>
</tr>
<tr>
<td>94.0%</td>
<td>18.60</td>
</tr>
<tr>
<td>95.0%</td>
<td>19.43</td>
</tr>
<tr>
<td>96.0%</td>
<td>20.36</td>
</tr>
<tr>
<td>97.0%</td>
<td>21.74</td>
</tr>
<tr>
<td>98.0%</td>
<td>23.47</td>
</tr>
<tr>
<td>99.0%</td>
<td>26.67</td>
</tr>
<tr>
<td>99.5%</td>
<td>29.42</td>
</tr>
<tr>
<td>99.8%</td>
<td>34.53</td>
</tr>
<tr>
<td>99.9%</td>
<td>38.10</td>
</tr>
</tbody>
</table>

Simulated Mean = 10.1

VaR 95%: 19.4

TVaR 90%: 21.7

XTVaR <90%: 5.3>

*typically at mean*
1. Methodologies– Allocate Overall Capital

- Variance/Std Dev
- VaR
- TVaR
- XTVar
- Myers-Read
  - Covariance, additive
- Co-measures (Ruhm – Mango – Kreps)
  - Measures relative risk contribution
1. Methodologies– Allocate Overall Capital

“RMK” (Ruhm – Mango – Kreps)
Allocate capital based on simulated amount of capital required
Example: Threshold = \textbf{20.0}

<table>
<thead>
<tr>
<th>Sim #</th>
<th>Line 1</th>
<th>Line 2</th>
<th>Total</th>
<th>Impact</th>
<th>Cont. 1</th>
<th>Cont. 2</th>
<th>Total Cont.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.6</td>
<td>10.2</td>
<td>15.8</td>
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<tr>
<td>2</td>
<td>8.2</td>
<td>9.6</td>
<td>17.8</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>13.6</td>
<td>7.4</td>
<td>21.0</td>
<td>1.0</td>
<td>3.6</td>
<td>-2.6</td>
<td>1.0</td>
</tr>
<tr>
<td>4</td>
<td>4.3</td>
<td>4.5</td>
<td>8.8</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>6.5</td>
<td>11.3</td>
<td>17.9</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>6</td>
<td>10.8</td>
<td>13.2</td>
<td>24.0</td>
<td>4.0</td>
<td>0.8</td>
<td>3.2</td>
<td>4.0</td>
</tr>
<tr>
<td>7</td>
<td>11.6</td>
<td>9.3</td>
<td>20.9</td>
<td>0.9</td>
<td>1.6</td>
<td>-0.7</td>
<td>0.9</td>
</tr>
<tr>
<td>8</td>
<td>5.4</td>
<td>14.9</td>
<td>20.2</td>
<td>0.2</td>
<td>-4.6</td>
<td>4.9</td>
<td>0.2</td>
</tr>
<tr>
<td>9</td>
<td>5.1</td>
<td>7.3</td>
<td>12.4</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>10</td>
<td>15.0</td>
<td>4.8</td>
<td>19.8</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Average 10.0 10.0 20.0 0.14 0.48 0.61

Allocation: 22.2% 77.8%

This example is illustrative only, 1st 10 iterations of simulation.
1. Methodologies – Allocate Overall Capital

- Vaughn compared the allocation of fixed capital to different classes under various methodologies.

Reference:

## 1. Methodologies – Allocate Overall Capital

<table>
<thead>
<tr>
<th>Line of Business</th>
<th>Standard Deviation Load</th>
<th>TVaR at 99%</th>
<th>Risk to Reward</th>
<th>RMK with Capital Consumption</th>
<th>Variance Load</th>
<th>Mango Capital Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Auto</td>
<td>4.8%</td>
<td>1.4%</td>
<td>8.0%</td>
<td>7.0%</td>
<td>0.7%</td>
<td>2.9%</td>
</tr>
<tr>
<td>Commercial Multi-Peril</td>
<td>11.5%</td>
<td>3.7%</td>
<td>20.2%</td>
<td>25.1%</td>
<td>3.2%</td>
<td>8.7%</td>
</tr>
<tr>
<td><strong>Homeowners</strong></td>
<td><strong>59.4%</strong></td>
<td><strong>84.6%</strong></td>
<td><strong>28.6%</strong></td>
<td><strong>8.6%</strong></td>
<td><strong>88.9%</strong></td>
<td><strong>67.7%</strong></td>
</tr>
<tr>
<td>Private Passenger Auto</td>
<td>14.5%</td>
<td>8.0%</td>
<td>26.2%</td>
<td>40.3%</td>
<td>4.8%</td>
<td>13.7%</td>
</tr>
<tr>
<td>Workers Compensation</td>
<td>9.8%</td>
<td>2.4%</td>
<td>17.0%</td>
<td>19.0%</td>
<td>2.4%</td>
<td>7.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

Source: Vaughn – “Comparison of Risk Allocation Methods”
1. Methodologies – Allocate Overall Capital Example

Example: Pricing of contracts using Std Dev Loading

<table>
<thead>
<tr>
<th>Inwards</th>
<th>Loss Cost</th>
<th>Coef. Of Variation</th>
<th>Std Dev Pricing</th>
</tr>
</thead>
<tbody>
<tr>
<td>HO</td>
<td>10.00</td>
<td>68%</td>
<td>1.36</td>
</tr>
<tr>
<td>PPA</td>
<td>40.00</td>
<td>10%</td>
<td>0.77</td>
</tr>
<tr>
<td>Total</td>
<td>50.00</td>
<td></td>
<td>2.13</td>
</tr>
</tbody>
</table>

20%
## 1. Methodologies – Allocate Overall Capital Example

### Example: Pricing of contracts using T-VaR 95% Allocation

<table>
<thead>
<tr>
<th></th>
<th>Inwards Loss Cost</th>
<th>Capital VaR 99.5%</th>
<th>VaR 99.5% Capital</th>
<th>T-VaR 95% Allocation</th>
<th>15% CoC Loading for T-VaR 95% Capital Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HO</td>
<td>10.00</td>
<td>206%</td>
<td>10.58</td>
<td>43.1%</td>
<td>15%</td>
</tr>
<tr>
<td>PPA</td>
<td>40.00</td>
<td>128%</td>
<td>11.05</td>
<td>56.9%</td>
<td>15%</td>
</tr>
<tr>
<td>Total</td>
<td>50.00</td>
<td></td>
<td>17.10</td>
<td></td>
<td>2.57</td>
</tr>
</tbody>
</table>

*Diversification Benefit* 4.53
1. Methodologies – Allocate Overall Capital Example

Example: Comparison of the two pricing methods

<table>
<thead>
<tr>
<th></th>
<th>20% Loading</th>
<th>15% Loading</th>
<th>Price Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inwards</td>
<td>Std Dev</td>
<td>Capital</td>
</tr>
<tr>
<td>Loss Cost</td>
<td>Pricing</td>
<td>Allocation</td>
<td>Pricing</td>
</tr>
<tr>
<td>HO</td>
<td>10.00</td>
<td>1.36</td>
<td>1.10</td>
</tr>
<tr>
<td>PPA</td>
<td>40.00</td>
<td>0.77</td>
<td>1.46</td>
</tr>
<tr>
<td>Total</td>
<td>50.00</td>
<td>2.13</td>
<td>2.57</td>
</tr>
</tbody>
</table>
2. Survey
2. Survey

At what granularity do you allocate capital?

1. Contract layer
2. Programme
3. Line of Business
4. Other
5. We don’t.
2. Survey

Which method do you use to allocate capital?

1. Standard deviation loading
2. VaR
3. TVaR
4. RMK
5. Other
6. We don’t.
2. Survey

Is market price above/below technical price?

1. Market price is above technical price
2. Market price is about the same as technical
3. Market price is below technical price
4. We don’t know what the technical price is.
2. Survey Results

• Survey sent to 45 large reinsurers

• 21 reinsurers responded

• The results include 6 out of the top 10 reinsurers (GWP 2008, Wikipedia)
2. Survey Results

Q1: In which countries do you price the most reinsurance excess of loss reinsurance contracts (top 3 countries)?

- Japan, 5
- UK, 11
- US, 11
- Germany, 3
- France, 3
- Ireland, 2
- Korea, 1
- Bermuda, 1
- Worldwide, 1
- China, 1
- Israel, 1
- Australia, 3

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2. Survey Results

Q2: In which countries do you price the most reinsurance excess of loss reinsurance contracts (top country)?

- US, 10
- UK, 6
- Bermuda, 1
- Korea, 1
- Worldwide, 1
- Japan, 1
2. Survey Results

Q3: For what classes of business do you usually price excess of loss reinsurance contracts (All)?

- Property - commercial, 14
- Property - residential, 5
- Marine, 8
- Motor third party, 12
- Other general liability, 8
- Professional indemnity, 6
- Employers liability, 6
- Motor (other), 5
- Aviation, 2
- Surety, agriculture, umbrella, 1
- Property cat, 15
2. Survey Results

Q4: For what classes of business do you usually price excess of loss reinsurance contracts?

Top class
- Marine, 1
- Property cat, 5
- All, 2
- Property - commercial, 2
- Motor third party, 6

Second class
- Property cat, 1
- Property - residentia l, 1
- Employer's liability, 2
- Other general liability, 4
- Motor third party, 2

Third class
- Marine, 1
- Professional indemnity, 2
- Property cat, 2

Fourth class
- Property cat, 1
- Other general liability, 1
- Property - commercial, 2

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2. Survey Results

Q5: Are pricing methodologies prescribed by a pricing policy?

- 1: No, it is up to the judgement of the actuary to use the most appropriate pricing methodology, in line with high-level management guidelines.
- 6: Pricing methodologies are prescribed for some classes, and it is up to the judgement of the actuary for other classes.
- 5: Yes, the company pricing policy sets out the pricing methodology that needs to be used by class and type of reinsurance contract.
- 9: No reply
2. Survey Results

Q6: What QIS 5 assumptions do you use as your pricing assumptions?

- Cost of capital, 4
- Volatility of loss ratios by class, 3
- Credibility of historical LR, 3
- Discount factors, 3
- Correlation between countries, 0
- Correlation between classes, 0

None, 11
2. Survey Results

Q7: In your opinion, do you think that market price is

- Often above technical price, 1
- Roughly the same as technical price, 1
- Sometimes a lot more and sometimes a lot less than technical price, 7
- Often below technical price, 11
### 2. Survey Results

**Q8: What pricing methodologies do you use to price Excess of Loss contracts?**

<table>
<thead>
<tr>
<th>LoB</th>
<th>Std Dev loading</th>
<th>T-VaR</th>
<th>VaR</th>
<th>Internal P/L Target</th>
<th>Increm. Capital</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property cat</td>
<td>6</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td>Property - commercial</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td>Motor third party</td>
<td>5</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>Other general liability</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Marine</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>All</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Employers liability</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Property - residential</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Professional indemnity</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>19</strong></td>
<td><strong>8</strong></td>
<td><strong>2</strong></td>
<td><strong>3</strong></td>
<td><strong>1</strong></td>
<td><strong>33</strong></td>
</tr>
</tbody>
</table>
2. Survey Results

Q9: At what level do you allocate capital?

- By entity: 3
- By contract: 8
- By line of business: 2

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2. Survey Results

Q10: What capital do you allocate at this level?

- Underwriting risk only, 7
- Underwriting risk and reserve risk, 1
- Capital of the whole company, 3
- Underwriting + Market risk, 1
2. Survey Results

Q11: What methodology do you use to allocate capital?

- **Capital Allocation by Percentile Layer - Bodoff**, 1
- **Target RoE**, 1
- **Co-Tvar**, 1
- **Expected shortfall**, 1
- **E[Results] + loading x stddev[Results]**, 1
- **S&P Risk Based Capital**, 1
- **T-VaR at 1%**, 2
- **VaR at 1 in 200**, 3
- **Covariance Principle**, 1

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3. State of Reinsurance Market

- Worldwide reinsurance profitability

![Loss and Expense Ratios (2003 – 2009)](image)

Source: IAIS
3. State of Reinsurance Market

Reinsurance Premiums Assumed by Class of Business and Contract Type (US$ millions)

Source: IAIS
3. State of Reinsurance Market

![Insurer Capital Change Graph]

Source: Individual Company Reports, Aon Benfield Analytics

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3. State of Reinsurance Market

Global Reinsurer Capital

USD (billions)

- FY 2007: 411
- FY 2008: 342 (-17%)
- FY 2009: 402 (18%)
- FY 2010: 470 (17%)
- 1H 2011: 445 (-5%)

Source: Company reports, Aon Benfield Analytics
3. State of Reinsurance Market

“Reinsurers will again have capacity in excess of demand from insurers in every region” (Aon Benfield Reinsurance Market Outlook, September 2011)
3. State of Reinsurance Market

- Gearing ratio = \( \frac{\text{Expected losses on business written}}{\text{Available Capital}} \)

![Gearing Ratios (2004 – 2009)]

Source: IAIS
3. Diversity in Market Quotes - Property

- Comparison of modelled RoL (20% stdev + 15% expense loading) to market quotes
- LOB: Property
- Territory: Continental Europe

<table>
<thead>
<tr>
<th>Layer</th>
<th>Modelled RoL</th>
<th>Quoted RoL</th>
<th>Relative to Modelled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>RI 1</td>
<td>RI 2</td>
</tr>
<tr>
<td>Layer 1</td>
<td>60.98%</td>
<td>80.00%</td>
<td>93.50%</td>
</tr>
<tr>
<td>Layer 2</td>
<td>11.50%</td>
<td>14.35%</td>
<td>10.85%</td>
</tr>
<tr>
<td>Layer 3</td>
<td>1.72%</td>
<td>2.24%</td>
<td>3.50%</td>
</tr>
</tbody>
</table>
3. Diversity in Market Quotes - Property

- Comparison of modelled RoL (20% stdev + 15% expense loading) to market quotes
- LOB: Property
- Territory: Continental Europe
3. Diversity in Market Quotes - MTPL

- Comparison of modelled Rate (25% stdev + 15% expense loading) to market quotes
- LOB: MTPL
- Territory: Continental Europe

<table>
<thead>
<tr>
<th>Layer</th>
<th>Modelled Rate</th>
<th>RI 1</th>
<th>RI 2</th>
<th>RI 3</th>
<th>RI 4</th>
<th>RI 5</th>
<th>RI 1</th>
<th>RI 2</th>
<th>RI 3</th>
<th>RI 4</th>
<th>RI 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer 1</td>
<td>0.156%</td>
<td>0.130%</td>
<td>0.103%</td>
<td>0.110%</td>
<td>0.050%</td>
<td></td>
<td>-17%</td>
<td>-34%</td>
<td>-29%</td>
<td>-68%</td>
<td></td>
</tr>
<tr>
<td>Layer 2</td>
<td>0.077%</td>
<td>0.170%</td>
<td>0.121%</td>
<td>0.190%</td>
<td>0.160%</td>
<td>0.110%</td>
<td>121%</td>
<td>58%</td>
<td>147%</td>
<td>108%</td>
<td>43%</td>
</tr>
<tr>
<td>Layer 3</td>
<td>0.004%</td>
<td>0.090%</td>
<td>0.053%</td>
<td>0.110%</td>
<td>0.050%</td>
<td>0.065%</td>
<td>2166%</td>
<td>1235%</td>
<td>2670%</td>
<td>1159%</td>
<td>1537%</td>
</tr>
</tbody>
</table>
3. Diversity in Market Quotes - MTPL

- Comparison of modelled Rate (25% stdev + 15% expense loading) to market quotes
- LOB: MTPL
- Territory: Continental Europe
3. State of Reinsurance Market

Solvency II

- Solvency II captures diversification
- Reinsurers are more diversified by LoB and geographical area
- Demand for reinsurance is likely to increase
Summary

• What are you worried about?
• Capital allocation is a key factor in reinsurance pricing
• Survey says: Disconnect between pricing & capital allocation
• Availability of capital very strong
• Demand for reinsurance likely to increase.
Questions or comments?

Expressions of individual views by members of The Actuarial Profession and its staff are encouraged.

The views expressed in this presentation are those of the presenter.