Risk Assessment Global Case Study: Catastrophe Loss Modelling

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History does not contain a sufficient population of catastrophes from which to derive a stable mean loss

Or address questions like - what loss can we expect once in a hundred years (on average)

So we have to create a richer (‘100,000 year’) set - through generating a large population of virtual catastrophes

- Each event must be credible
- Each event has a probability
- And the whole population has to be a complete representation of the ‘universe of possible events’
- How do we do this?
CREATING THE SYNTHETIC CATALOGUE

Research the best historical catalogue
Understand catastrophe historiography
Thresholds of completeness by period and region
Event prehistory (as from geological evidence)
Recognise that history is only one realisation of the possible
Most synthetic catalogues are some hybrid of:
• Statistical Methods
• Dynamical Methods (physics based models)
Look for independent measures for calibration – such as regional strain rate for earthquakes or river flows as independent of rainfall extremes.
Framework for Earthquake Catastrophe Loss Modelling

1. Generate Stoch. Events
2. Earthquake Ground motion
3. Apply Exposure
4. Calculate Damage
5. Quantify Financial Loss
In Major Catastrophes - Loss does not occur in isolation
Quantifying Catastrophe Risk: the Exceedance Probability (EP) Curve

Exposure = € 1,000 B

<table>
<thead>
<tr>
<th>Event ID</th>
<th>Annual Rate</th>
<th>Loss M</th>
<th>Cumulative Probability</th>
<th>AAL(M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event 1</td>
<td>0.01%</td>
<td>€100</td>
<td>0.01%</td>
<td>€ 0.01</td>
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<tr>
<td>Event 2</td>
<td>0.5%</td>
<td>€ 50</td>
<td>0.51%</td>
<td>€ 0.25</td>
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<tr>
<td>Event 3</td>
<td>0.3%</td>
<td>€ 40</td>
<td>0.81%</td>
<td>€ 0.12</td>
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<tr>
<td>Event 4</td>
<td>0.65%</td>
<td>€ 25</td>
<td>1.46%</td>
<td>€ 0.16</td>
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<tr>
<td>Event 5</td>
<td>0.9%</td>
<td>€ 20</td>
<td>2.36%</td>
<td>€ 0.18</td>
</tr>
<tr>
<td>Event 6</td>
<td>1.0%</td>
<td>€ 15</td>
<td>3.36%</td>
<td>€ 0.18</td>
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<tr>
<td>Event 7</td>
<td>1.5%</td>
<td>€ 12</td>
<td>4.86%</td>
<td>€ 0.18</td>
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</table>

Total € 1.05
Visual Display of EP Curves & Return Period Losses

- The EP curve provides a visual interpretation of loss potential

- Each point of the curve has an associated threshold and probability of exceedance
FLOOD DRIVES 80% OF AAL

Yangtze and Pearl River Delta economic zones are high risk
MANAGING TSUNAMI RISK IN CHINA
CATASTROPHE MODELS DRIVE THE BUSINESS OF CATASTROPHE INSURANCE
THE ‘SECRET SAUCE’ OF CAT MODELLING

• Needs strongly interdisciplinary approach (Science, Engineering, Statistics, Insurance) – RMS employs c 100 PhDs
• High value for global insurance industry based on risk diversification - regulatory reporting requirements and investor disclosure – requires ‘industrial strength’ commercial Cat modelling capability and long term model maintenance
• The insurance industry is collecting key ‘scientific’ data on exposures and loss. However claims data are also proprietary (and represent competitive IP). Working with/for insurance industry – claims and loss data are utilized to improve vulnerabilities and test short RP modeled losses.
• The key to robust catastrophe modelling is multiple rounds of calibration
Optimization of Portfolio Composition

- Each dot represents a portfolio
Mitigating the Risk in a Supply-Chain Network

<table>
<thead>
<tr>
<th></th>
<th>AA EDT</th>
<th>BI EDT</th>
<th>CBI ratio</th>
<th>CBI ratio with Inventories</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 yrs</td>
<td>0.36</td>
<td>8.3</td>
<td>2.89</td>
<td>1.91</td>
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<tr>
<td>500 yrs</td>
<td>0.36</td>
<td>31.5</td>
<td>1.75</td>
<td>2.06</td>
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</tbody>
</table>

Suppliers A
- Engine

Suppliers B
- Body

Suppliers C
- Semiconductor

Inventory 60 days

Facility (General Assembly)
Framework for Probabilistic Earthquake Casualty Modelling

- Generate Stoch. Events
- Ground motion Footprints
- Damage & Collapse
- Human 24 hr Exposure
- Casualties
- Building Stock inventory
Framework for Storm Surge/Tsunami Evacuation Modelling
RMS TIME STEPPING SURGE MODELLING FOR 50,000 EVENTS IN US HURRICANE MODEL

REGIONAL MESH

LOCAL MESH

FLOOD DEPTHS
RISKY BUSINESS 2014
COASTAL US ‘INSURABLE’ LOSS UNTIL 2100

www.riskybusiness.org