A SIMPLE BENCHMARK MODEL FOR EUROPEAN WINDSTORM LOSSES

Aspen Reinsurance
5th Windstorm Workshop
Bern, September 1st 2015

Dr. Giovanni Leoncini
Storm Risk Scientist

Aspen Insurance Holdings Limited
• What is reinsurance?
• Risk management
• CAT models
• Exceedance probability
• Benchmark model for EU windstorms
WHAT IS REINSURANCE?

Reinsurance companies

Insurance companies

Insured

Brokers

Modelling companies
WHAT IS REINSURANCE?

Things are not as clear ....

• Brokers provide services for clients
  - e.g. run cat models for them
• Most brokers develop some
  - Some even sell them!
• Many companies have both insurance and reinsurance
• A few develop their own cat models
• Others validate vendor models
• Fewer tag along ....
WHAT IS REINSURANCE?

• Insurance of insurance companies

• Most reinsurance contracts last for a year, they are renegotiated every year. Most insurance contracts last for 1-10 years.

• Most CATtastrophe contracts cover event losses, some cover the sum of all annual losses (aggregate contracts).

• Typically, reinsurance companies care about intense, strong, and rare storms causing significant damage.

• Some type of contracts are designed to provide financial stability

• “Globally operating”
REINSURANCE REQUIREMENTS

- Expected annual average losses
- Expected losses at certain return periods, e.g. 1, 5, 10, 25, 50, 100, 250, 500, 1’000 years.
- Other metrics (eg std) for reserving

Main tool for property is «cat model»
REINSURANCE REQUIREMENTS

- Pricing:
  - The above for a client (the portfolio of one insurance company)
  - Insurance company: loss experience, strategy, etc
  - financial structure of the contract
  - Reinsurance company: expenses, admin cost, etc
Assume that each contract is well reserved,

- how about the REinsurance portfolio?
  - Includes non modelled perils and all lines of business
  - Depends on company “risk appetite” and strategy
  - Regulation: Solvency II

- Regulation, and business, requires “own view of the risk”
- Model validation is becoming increasingly trendy
2 Atmospheric scientists
1 Seismologist
1 Hydrologist
1 Vulnerability expert

Part of “build Aspen’s view of Risk”
- Evaluate Cat models
- Have built
  - Simple model
  - Benchmark model
CAT MODEL CONCEPT

Hazard: 

Vulnerability

Financial module

Event set: $\sim 10^4$
- frequency
- intensity

From wind, flood height, shaking to physical damage (MDR)

Not only single contracts, but “whole” portfolio
Hazard module

- Realistic wind fields with an associated probability

Variety of methods to generate events and very little rules:

- Define “windstorm”
- Intensity vs frequency
- What could "realistically" happen?

- Climatology needs to be well represented
- clustering
Issues, one for all:

- Very large uncertainties
  - Vulnerabilities
  - Frequency and intensity

Experience, judgment calls are important for development and use
CAT MODEL CONCEPT

- Estimate the Exceedance Probability
  - \( F_X(x) = P(X \leq x) \)
  - \( X \) is your choice of peril or loss

- probability associated with at least 1 event exceeding \( x \)
  - \( 1 - F_X(x) \)

- Take frequentist approach and use

\[
return \ period = \frac{1}{prob}
\]
Exceedance Probability for Europe, IED

Graph showing the relationship between Losses / wind and Return Period [yr]. The graph indicates an increase in losses as the return period decreases, with losses reaching 10 at a return period of 0.01 years.
Aggregate Exceedance Probability for Europe (IED)
sum of all losses events occurred during each year

Return Period [yr]

Losses / wind

AHL: NYSE
Aggregate Exceedance Probability for Europe (IED)
sum of all losses events occurred during each year

Losses vs Return Period [yr] graph
Occurrence Exceedance Probability for Europe (IED)

max of yearly losses

Losses vs. Return Period [yr]

AHL: NYSE
Goal

• Provide an independent benchmark to vendor models
• Inform the use of two models

Overview of methodology

• Compute SSI using ERA-I
• Population based index
• Calibration
• Compare with two model
Benchmark model

Use ERA I to

• Define events with SSI (Leckebush et al 2008)
  - Experimented with thresholds and definition:
    \[ SSI = \sum_{t,j} \frac{A_i \left( \frac{v_{i,t}}{v_{\text{th}}} - 1 \right)^k}{A} \]
    
    With and without
    4.5 not so good
    3 is best
    95th, 97.5th, 98th and 99th, 20 m/s
    
    - Rules, minimum size, duration, distance between time frames etc, are all subjective
    - Do not connect features that are not meteorologically related
    - Take as many «small» storms as possible
"OWN VERSION" OF HISTORICAL LOSSES

- Develop population based loss index (Klawa and Ulbrich, 2003)
  - $\text{SSI}_i \times \text{population in the grid box}_i$
  - Calibration: $\log(\text{losses}) \text{ vs } \log(\text{SSI})$

![Correlation Coefficient Graph](chart.png)

- Without duration
- With duration
  - $k=4$
  - $k=5$
Sensitivity of losses to SSI definition

Losses in billions Euro vs. Return Period [yr]

- Red: KU1 98th
- Blue: KU1 99th
- Green: KU2.4 98th
- Cyan: KU2.4 99th
Aggregate Exceedance Probability

The graph illustrates the relationship between losses in billions of Euros and the return period in years. It shows the exceedance probability for different return periods and scenarios, with lines representing the 10th, 50th, and 90th percentiles. The scenarios are denoted with different colors and styles, and the graph is used to analyze the risk of losses over varying periods.
Aggregated Exceedance Probability
Summary of reasoning for blending

On the short return periods
- model A overestimate losses
- There is an issue with benchmark
  - Probably stretching the limits of both SSI and ERA-I

On the long return periods
- Everything seems to be within uncertainties
- A overestimates history
- B slightly underestimate history

This affects the decision of how to “blend” the two models