The Actuarial Profession
making financial sense of the future

The latest issues surrounding catastrophe modelling
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Uncertainty in CAT models

Everything you wanted to know but were afraid to ask

Contents

- Introduction
- Hazard uncertainty
- Vulnerability uncertainty
- User uncertainty
- Correlation
- Conclusions

Introduction

- According to Swiss Re, the natural catastrophe losses in 2010 represented 86% of the total insured losses due to natural catastrophes and man-made disasters.
- Natural catastrophes cost the industry roughly USD 31 billion in 2010.
- The impact of natural catastrophes have increased over the past 40 years.

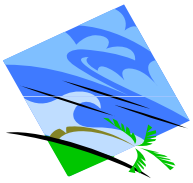
Introduction

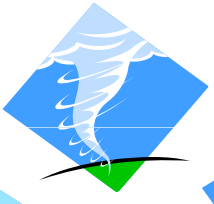
- Companies have to examine a wide range of issues and scenarios and combine various forms of analysis to make sure they are up-to-date as possible when it comes to predict the next major disaster that may hit them.
- The Insurance sector needs to look at as many areas as possible in an effort to spot potential hazards.

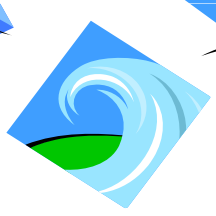
Introduction

In order to buy adequate protection, we need to understand and identify the risk we are taking.

CAT Models



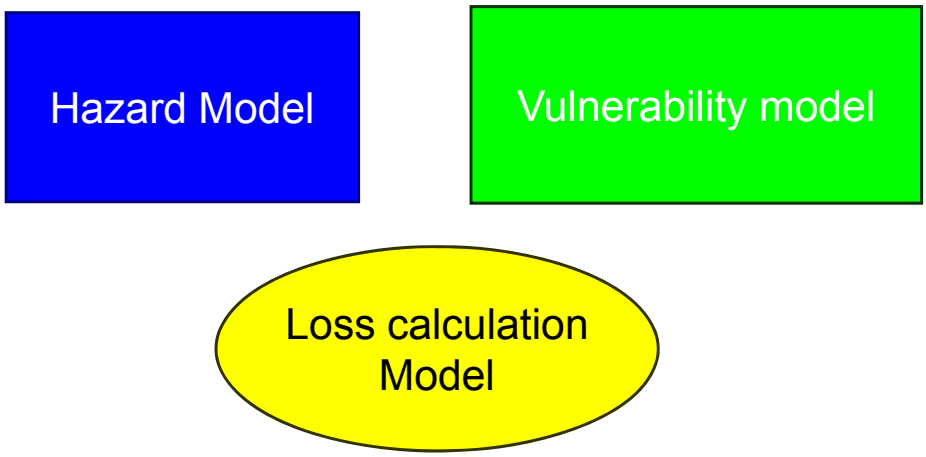




CAT models

- The models are constructed from the random variables which govern hazard event occurrence and severity, as well as the consequent loss potential.
- Only a few variables encountered in the study of natural hazards can be precisely determined through practical observation.

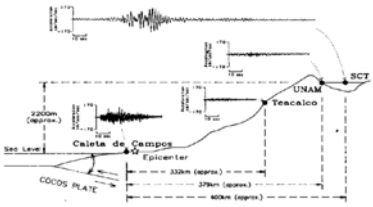
CAT models



Physical model

Information about Earthquakes:

- Location of the earthquake epicenter
- Magnitude
- Earthquake recurrence
- Fault information such as mechanism, direction, dip, etc…
- The depth and size of the rupture
- Attenuation functions
- Soil and local site effects
- Secondary seismic hazard



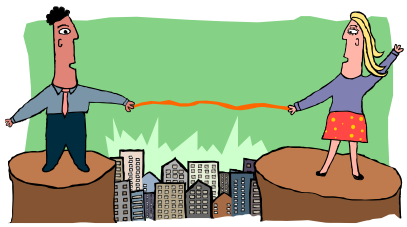
Model assumptions:

- Event grid size
- Time dependency/independency
- Statistical distributions to generate the stochastic event set
- Number of events to be simulated
- Simulation technique
- Validation and calibration techniques

First uncertainty

Hazard

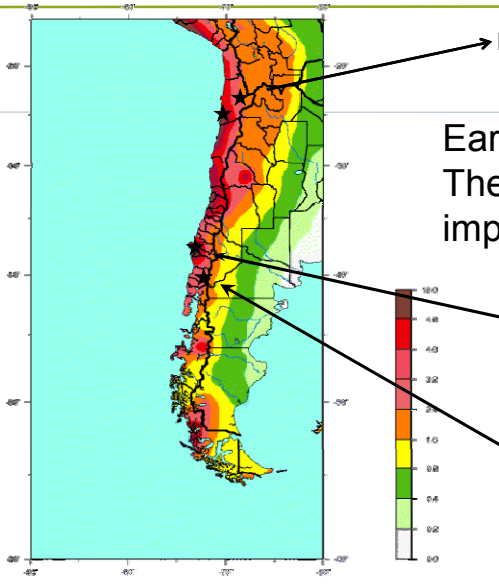
- Uncertainty in time
- Uncertainty in space
- Uncertainty in the event intensity
- Uncertainty in the spatial distribution



Importance of accurate information

LOCATION

Importance of accurate information



Location at the region's centroid

Earthquakes are complex. The type of soil is an important factor.

Violent shaking

Strong shaking

Peak Ground Acceleration (m/s²) with 10% Probability of Exceedance in 50 Years

Vulnerability Model

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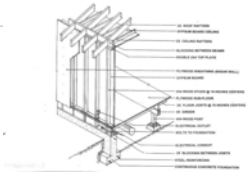
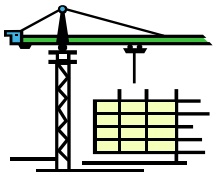
Damage to structures depends on

- Construction materials
- Construction techniques
- Quality of labor
- Location of the structure
- Efficiency of inspection
- Financial affordability
- Environment
- Occupancy
- Height
- Floor Plan
- Age
- Maintenance
- Occupancy



Information used

- Historically observed damage
- Experimental research
- Engineering principles
- Claims data from all major events
- Demand surge
- Difference in construction techniques by country



But…what about

- Liquefaction?
- Landslides?
- Fire following earthquake?
- Business Interruption (BI)?
- Contingency Business Interruption (CBI) ?

Second uncertainty

Damage Calculation

Importance of accurate information

Risk characteristics:

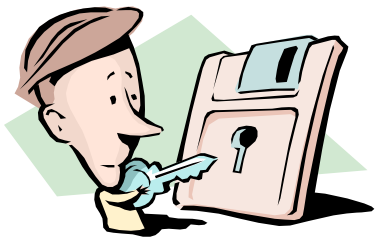
- Structure type
- Occupancy
- Type of risk

Modeling

Representation of the exposure for simulation

Modeling decisions and available information

- Site level
- Policy level
- Aggregate information
- Detailed information



Insured values

Premium

Limits

Deductibles

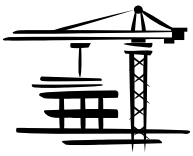
Understanding the tool.

Third uncertainty

Use of the tool

Importance of accurate information

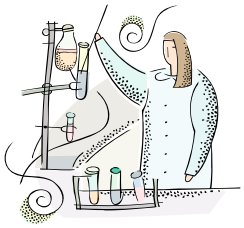
- Insured values
- Risk distribution
- Coverage
- Deductibles
- Limits



- Communication with the modelers and the underwriters
- Understand the company needs and strategy

Sensitivity Testing

- Data quality
- Structural types and occupancies
- Application of deductibles and limits
- Comparison of Historical losses when available



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Correlation

How EQECAT takes into account the uncertainties.

- **Spatial** - Hazard: where and how
- **Temporal** – Hazard: when and how many
- **Loss response** - as a function of distance, occupancy, construction class

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Correlation Model – 2G

- A 150,000 year simulation set to provide stable loss metrics
- Recurrence models to capture clustering of events
- EQECAT's simulation methodology enables the capture of intra-event partial correlation within geographic clusters, occupancies, and design methods

Correlation Model

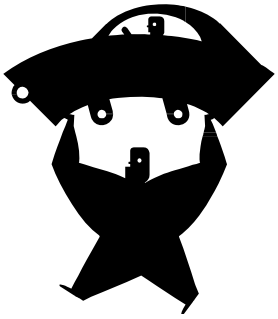
- It provides more robust modelling of phenomena
- It represents complex distributions more precisely

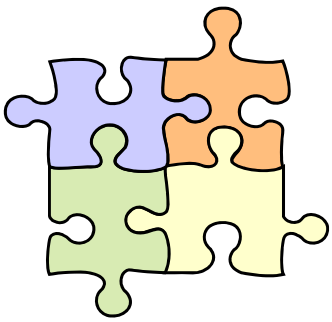
But

- Complexity and directionality of calculations precludes aggregation / disaggregation outside of the model

Correlation Model – 3G

- ✓ Will employ the robustness of 2G approach
- ✓ And the ease of use of 1G approach





Conclusion

- The process of estimating losses after a catastrophic event is a complicated task but a necessary one to prepare for the inevitable.
- No one takes a risk knowing one will loose, but one can take a measured risk.
- Decisions are made on the basis of available data and CAT models provide the best estimation we have.
- It is important to have a clear understanding of the assumptions used to construct the CAT models and their inherent uncertainties.

"*It is one thing to set up a up a mathematical model that appears to explain everything. But when we face the struggle of life, of constant trial and error, the ambiguity of the facts as well as the power of the human heartbeat can obliterate the model in short order.*"

"Our lives teem with numbers, but we sometimes forget that numbers are only tools. They have no soul; they may indeed become fetishes."

"Different people have different information; each of us tends to color the information we have in our own fashion. Even the most rational among us will often disagree about what the facts mean."

"We are never certain; we are always ignorant to some degree."

Peter L. Bernstein

Against the Gods, the remarkable story of Risk

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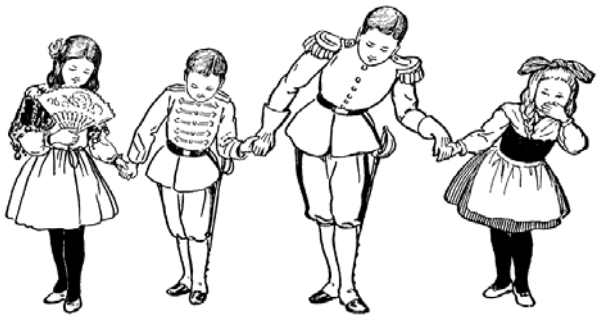
Thank you for your attention



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