Improving Freeze Risk Modelling

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11th November 1999

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Overview

- Why this project?
- A principled approach.
- Modelling freeze.
- What causes claims.
- Novelty and value of our approach.
- Deliverables.
- A look into the future.

Why This Project?

- Why should insurance companies be interested?
- Provides quantifiable risk.
- Addresses issues: Advanced IT and GIS, Analytical Techniques, Decision Support Tools, Extreme Events, Natural Perils.
- It is a generic technique.
- Why are we interested?
- What is our expertise?
- Why pick UK freeze risk?

A Principled Approach

- Insurance is all about risk: you need costs and probabilities.

- Brokers know this instinctively.

- For freeze we know the hazard varies in space and time:

$$p(f|\boldsymbol{x}, t)$$

- Loss varies with freeze severity, time (?) and house details:

$$p(L|f, t, h)$$

- So the loss at a given location and time, with a given house type:

$$p(L|\boldsymbol{x}, t, h) = \int p(L|f, t, h)\, p(f|\boldsymbol{x}, t) df$$

- The probability distribution of the total loss is:

$$p(L) = \int_{\boldsymbol{x}} \int_{t} \int_{h} p(L|\boldsymbol{x}, t, h)\, p(\boldsymbol{x})\, p(t)\, p(h)\, d\boldsymbol{x}\, dt\, dh$$

Modelling Freeze

- How do we specify $p(f|\boldsymbol{x}, t)$?

- This space-time model for freeze risk can be specified in a Bayesian framework.

- We can use physics:

$$\frac{\partial T}{\partial t} = -\boldsymbol{u} \cdot \nabla T + \frac{1}{c_p}\left(R_n + LE + H\right)$$

Change in temperature = advection + net radiation + latent heat + sensible heat

- Now what is f?

- Current methods use things like the 5 day total minimum temperature.

- But what are the conditions that generate claims?

What Causes Claims?

- We want to choose f so that it is well linked with the loss.
- To do this we need data - this is where you come in!
- If we have enough data we can define the optimal f and the form of $p(L|f,t,h)$.
- This may need non-linear models – neural networks.
- Consider:
  - time period (stationarity)
  - time to claim
  - alternative variables - soil temperatures, wind speeds
  - synoptic (weather pattern) studies

How does this compare with current methods?

- Fully probabilistic and data driven – not based on arbitrary choices.

- Using soil temperature or wind speed may be more realistic than simply air temperatures – it is the integrated heat flux we want.

- Flexible – can be used in other insurance applications: traffic accidents, agriculture, heating degree days.

- Using Bayesian methods will allow us to account for the effect of local measurement errors and our prior knowledge.

Deliverables

- An accurate, quantitative understanding of the relation of loss to freeze.
- Maps of freeze risk (data issues?) through an online GIS interface.
- Workshop – communication is key.
- WWW access to maps, technical reports, papers and software.
- Proof of concept.

A look into the future

- A climatology is essential to make sensible judgements on your risk exposure.
- This method is readily extended into other regions of the globe – would only require extra data.
- Could be implemented in real time – help catching fraud.
- New insurance products?
- Forecasts?