LOSS MODELLING FRAMEWORK

SCOR
The Art & Science of Risk

Given the inevitable uncertainty of vulnerability functions, how would you recommend that end users mitigate against this problem?

16.11.2017

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End users make important risk decisions based on the outputs of catastrophe models. In this article, we explain how we can use open platforms to reveal the inherent uncertainty of vulnerability functions. Revealing uncertainty to inform decision-making is, in our view, the best treatment to mitigate the risk of unpleasant surprises.

Revealing Uncertainty – the business case

Brexit, OGDEN, H.I.M, California wildfires, terrorist bombings, Debbie (remember Cyclone Debbie?), an impending increasing interest rate cycle?

Recent events remind us of the many risks we face as a (re)insurance industry. We use models to estimate risk to help end users make better decisions about risk acceptance, risk mitigation and investment management. Much effort goes into producing these wonderful estimates. The more precise, the better. The less uncertain, the better. Much less effort however, goes into quantifying the uncertainty underlying these estimates.

In the absence of clear signalling of uncertainty to end users, we fall prey to the biases of delusional exactitude, or far worse, perfect model syndrome. Are decision-makers to believe that with great computing power and more complex models, uncertainty is somehow reduced? As recent experience shows, catastrophe risk remains a major source of uncertainty despite the sophisticated models available and the comprehensive catastrophe reinsurance purchased.

Illustrating uncertainty should be a **fundamental** element of any catastrophe model. With more uncertainty revealed, decision-making is made more robust as we reduce the chance of unexpected surprises.

Let’s consider the case of vulnerability modelling for instance. There are multiple levels of uncertainty involved.

Revealing Uncertainty – vulnerability case study

Typically, claims data and hazard data are used to calibrate vulnerability curves. Those curves are often rooted in academic research and building design codes that are focused more on damage and public safety than on loss prediction. The observational data are key in reconciling prediction of damage and the financial loss outcome. However, such reconciliation is fraught with difficulty, primarily due to lack of such data. For instance, beyond certain levels of hazard intensity no data exists, so requiring expert elicitation from experienced engineers. For many permutations of occupancy, construction, etc. no data exists anywhere along the vulnerability curve, requiring judgement to relate damage from one group of curves to another. So-called secondary uncertainty attempts to reflect the likely range of damage given a certain level of intensity. However, judgement is required here to ensure confidence bounds are reasonable and whichever uncertainty distribution you use, there will be limitations.

Quantifying the range of possible modelled results through sensitivity testing is a useful tool to communicate uncertainty. Existing vendor models offer some, but limited, functionality to reveal the true range of uncertainty.

I was asked recently what sensitivity test functionality we'd consider developing for models we plan to deploy in OASIS. I list a few examples and practical applications based on insights from recent events, more to illustrate the point.

1. Hurricane Maria illustrates the uncertainty related to business interruption losses. Such losses and coverage can be extremely difficult to get right in a model. If in Oasis we can change PD/BI damage or loss mix, or perhaps add 90 days in time-element loss, we could play it through the financial model and reveal impacts. This could be applied for a particular sector / portfolio of interest (e.g., Pharmaceutical only or all Commercial/Industrial). In this way we could reveal uncertainty in loss estimates and adjust our estimates as more information emerges.
2. The recent earthquakes in Mexico illustrate how variations in design-codes and code enforcement can drive variations in damage. One could encode construction-specific modifying factors to vulnerability curves based on available data on local design practices and views on enforcement. These factors would correspond to some high / low bound on uncertainty. Once sensitivities are computed for a number of region-perils, we could compare loss ranges across region-perils or across regions within countries covering a very large domain (e.g., US or China).This could better inform where to peg reinsurance limits in the context of multiple views of what the 1:250 OEP loss could be.
3. We also saw a high proportion of the collapsed buildings either had 'soft' ground storeys (e.g. with walls removed for ground storey car parks) or were on the corners of blocks. Here we can apply relevant secondary modifiers to quantify the impacts of these more vulnerable buildings. As these modifiers are not always added, this could inform standard adjustments where exposure data is not coded appropriately.
4. As we saw recently with the implementation of the FEMA P-58[1] methodology in the new US earthquake models, we gained greater insight into what drives vulnerability at lower versus higher ground motion intensities. One useful sensitivity would be to change the damage contribution from key building components to reveal to users which components are most critical and how this changes with hazard intensity. This not only informs understanding, but with open development, encourages diversity in how we implement engineering judgement.
5. Varying the impact of deductibles and limits on loss estimates from a model can be a useful sensitivity test that can be compared to claims data. This may reveal deductible credits higher than observed suggesting perhaps that vulnerability curves are too conservative at low intensities. Sensitivity testing here reveals model performance.

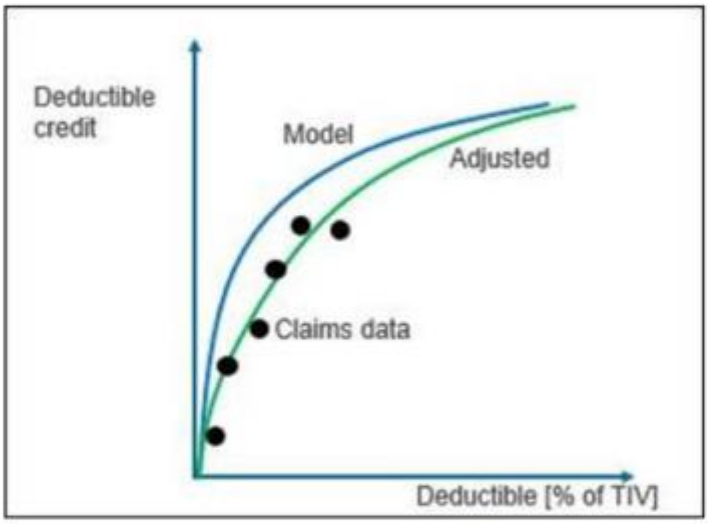

Figure 1: illustrative example of deductible sensitivity testing

6. In the 2016 Taiwan EQ we saw use of cooking oil cans in the building foundation. Such corrupt building practices can lead to much higher potential for collapse. We don't know which buildings have corrupt building practices but we could randomly sample a percentage of buildings from the exposure profile and apply more conservative vulnerability functions to examine (and possibly implement) this particular aspect of uncertainty.

Figure 2: Oil cans used to fill spaces in beams (Taiwan earthquake, Feb. 2016)

These examples serve to illustrate how lessons learnt from recent events could serve as a basis to carry out sensitivity analysis in a vulnerability model. While current vendor models allow some (possibly illusory?) view of uncertainty, an open platform provides more dials to reveal more of the underlying uncertainty.

With choice, modellers have the freedom to reveal and disclose what they believe to be the true level of uncertainty. Surely this can't be a bad thing?