Prioritising efforts to reduce uncertainty in a third-party cat model through Global Sensitivity Analysis

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The challenge

Catastrophe models used in re/insurance firms are often developed by third-party model vendors. These models, due to their proprietary nature, have some components that cannot be modified by model users. This in turn can limit the ability of users to explore the full range of uncertainties impacting the estimated losses. It is therefore essential for model users to understand the impact on model predictions of the uncertainty of the inputs they have control over, such as exposure data.

What was achieved

By collaborating with AXA XL we investigated the input factors related to the exposure data (i.e. primary modifiers and the spatial resolution of the exposure data) which mostly control the uncertainty of the losses for a third party cat model by applying Global Sensitivity Analysis (GSA). The aim was to prioritise efforts to reduce the uncertainty of the Average Annual Losses (AAL). For example, in this particular case, GSA results show that the construction type is by far the most influential input factor, whereas higher resolution exposure data only have a limited influence on the uncertainty of the losses.

This type of analysis enables model users to better understand which inputs drive the uncertainty of the estimated losses, and therefore where the acquisition of new data is going to be most useful.
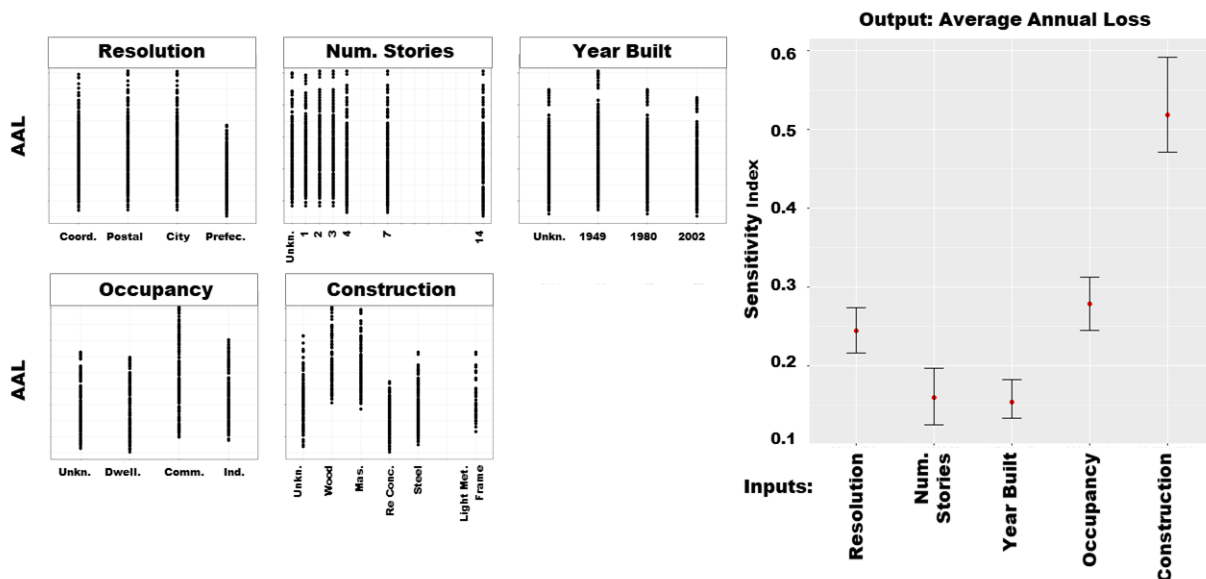
This means that having more granular data is not crucial for this particular peril and region, whereas better information on construction types would mostly improve the estimation of the losses.

Identifying the most influential input factors on the uncertainty of AAL

How we did it

We used the SAFE toolbox (Pianosi et al. 2015) to apply Global Sensitivity Analysis to a third-party wind peril model. We varied the uncertain inputs of interest (i.e. the primary modifiers and the spatial resolution) to understand where investments to reduce uncertainty should focus (Noacco et al. 2019). The uncertainty associated with the event generation process was first filtered out, by estimating the AAL for the event set considered when only the input factors are varied.

This allowed to estimate the impact of the exposure data on the uncertainty of the losses.

References

Pianosi F, Sarrazin F, Wagener T. 2015. A Matlab toolbox for Global Sensitivity Analysis. *Environ. Model. Software* 70. 80–85 DOI: 10.1016/j.envsoft.2015.04.009

Noacco V, Sarrazin F, Pianosi F, Wagener T. 2019. Matlab/R workflows to assess critical choices in Global Sensitivity Analysis using the SAFE toolbox. *MethodsX* 6. 2258–2280 DOI: 10.1016/j.mex.2019.09.033

"This collaboration on the SAFE project has been extremely useful to AXA XL in developing a systematic framework for assessing sensitivity to model data inputs. We plan to use SAFE further in the future to better understand input variables into catastrophe risk models with the aim of prioritising efforts to improve data quality. We also intend to share the knowledge and insight we have gained with other departments internally, as to assess additional use cases outside the catastrophe risk modelling space." Catherine Pigott (Head of Science & Natural Perils at AXA XL)

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