



1. Motivation

Probabilistic seismic hazard analysis (PSHA) aims at the determination of annual exceedance rates for different levels of ground shaking for a particular site of interest. One of the largest sources of uncertainty in this context is the selection and judgement of appropriate ground motion models.

- The logic tree framework is a popular tool to quantify this uncertainty (epistemic uncertainty).
- The degree-of-belief of seismic hazard analysts in a particular set of models is expressed in form of so-called branch weights.
- Hazard curves are calculated using these weights as subjective probabilities.



A logic tree describing model uncertainty.

2. De Finetti Game

Aim: To determine logically consistent weights, which meet Kolmogorov's axioms.

- 1. We use **de Finetti betting games** to illustrate subjective probabilities, e.g.: Given a chance, like, a hundred dollar bet. Preference for throwing the die implies that event A has a subjective probability less than $\frac{1}{6}$.
- 2. We include the precision of the assessment of subjective probabilities into a probability distribution.

3. Graphical Tool to Assess Weights

<u>Goal</u>: Obtain weights for n models (e.g. n = 8), which are logically consistent and represent the expert's degree-of-belief, that a particular model is the one that should be used.

• Suppose you as a hazard analyst have to define weights on models and now consider model 3. Suppose the model, that should be used, is known and will be revealed tomorrow. A de Finetti game can consist in answering following question:

Would you bet on model 3 being "the one" or grab into the left urn?

• Preference for betting on model 3 implies that you give it a greater subjective probability than is represented by the urn. The right urn gives visual feedback about the overall degrees-of-beliefs in the models judged so far.

Quantification of Expert Knowledge for PSHA Using Graphical Tools

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11		
	weight 1	
12	weight 2	
l N -1	weight N -1	
1 N	weight N	

The generation of weights, which are logically consistent and follow the rules of probability calculus (Kolmogorov's axioms) is a major challenge for any analyst. [Scherbaum and Kühn. (2011)]

Human judgement under uncertainty is affected by a multitude of heuristics and biases, which can lead to systematic errors or cognitive biases.

Would you bet on event A or on throwing a "6" on a fair die?





	5. Open Issues
ight left for M3 : 0.564	 Find test cases and try the tools with Average precision was included thropsoches to incorporate each single
7}	 Correlation between categories wat tion?
15 M3 17 M3 M3 M3 M3 M5 15 M5 M5 M3 M5 M5	 Bayesian approaches use prior proba priors with observations. Concepts fo jective priors with data.
1 M3 M3	F. Scherbaum and N. M. Kühn: Logic tree branch weights an revision for publication in Earthquake Spectra. 2011. All graphical tools are developed in Mathematica 8.