

Deep Uncertainty

Complex uncertainties pervade the problems that risk and analysts address. In the case of epistemological and aleatory uncertainties, many believe that no further tools are needed to model uncertainty than subjective probability, augmented by careful sensitivity and robustness analysis. In the case of ambiguity, one might need to discuss and reflect on issues to understand and conceptualise things better. However others have argued differently. Often adopting the language of Knight's 1921 book on *Risk, Uncertainty and Profit*, they have argued that we must address contexts in which there are *deep* (or *strict*) uncertainties such that probabilities cannot be defined. The response in the (Bayesian) risk and decision analysis communities has been to look to the process and discuss how it might cycle to a requisite recommendation. However, recent discussions, lying at the boundaries of sense-making, knowledge management, and risk and decision analysis, have convinced some that there are reasons to discuss deep uncertainties; not perhaps in the sense that there are situations in which the assignment of probabilities to uncertainties is *conceptually* impossible, but in which it is *practically* impossible in the time available before some action is needed. Potential events or unknown quantities may be so uncertain that different experts assign probabilities across the entire 0–1 range. In some cases they may not even agree on what events should be included in the probability space: the (σ -)field of events itself may be a matter of contention. Moreover, there may be no possibility of conducting any empirical or other study that might draw them towards some consensus before a decision must be taken.

Several methods have been suggested as a way forward here, particularly scenario-focused risk and decision analyses in which different scenarios are developed based on fixing the contentious uncertainties at particular 'interesting' values. No attempt is made to assign probabilities to scenarios themselves. However, full quantitative analyses are conducted *within* scenarios, and the decision makers presented with the results of these. In some cases strategies emerge that are robust to the deep uncertainties represented by the different scenarios.

Such scenario-focused analyses may bring problems in eliciting probabilities from experts, since conditioning on each scenario may be akin to conditioning on counterfactual information. Moreover, the cognitive abilities of the experts combined with the deeply conflicting opinions that the set of scenarios is meant to span in some sense may bring constraints on how the scenarios are developed and chosen. There are many issues to be discussed here.

Should you be interested in pursuing these or related questions please contact

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