

## Is Imprecise Probability Let Into the Regulatory Lounge?\*

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**Introduction and Aim** Trust in policy and societal decision making is influenced by the transparency and honesty in the communication of uncertainty [3, 5]. This calls for ways to distinguish and express both direct and indirect uncertainty [7]. Precise probability is a well-established measure for direct uncertainty, with a solid foundation in Bayesian statistics and decision theory. Other measures exist, which depending on the situation may be more appropriate than precise probability. Although many regulatory frameworks face the challenge to take a systematic approach to uncertainty in the first place, there are organizations which acknowledge multiple ways to express uncertainty.

My aim was to find examples of scientific frameworks supporting regulatory decision making which see imprecise probability as a valid quantitative measure for direct uncertainty. This was done by studying a selection of recent regulatory frameworks and guidance documents for the quantification and communication of uncertainty in scientific assessments.

**Results** There are guidance documents or seminal scientific papers pointing at the need to adapt the treatment of uncertainty to its severity, also suggesting that precise probability may not always be the most appropriate measure. Imprecise (bounded or approximate) probability is included in the uncertainty guidance of the European Food Safety Authority (EFSA [1, 2]), but with rather limited support to be applied in practice. The uncertainty guidance of the International Panel of Climate Change (IPCC [4]) mentions imprecise probability as a measure, but it is not included in the recommendations. There are no explicit use of the imprecise probability in the two scientific reports we selected from the US National Research Council (NRC [6]). Instead of suggesting alternative expressions of uncertainty, several instances promote the use of scenario analysis and keeping multiple options when uncertainty is severe.

**Discussion and Conclusion** Better scientific models that help us to understand uncertainty [7] will make it possible to improve the general treatment of uncertainty in regulatory contexts. Precise probability is already well established and efforts are being made to use them well. In general, the promotion of imprecise probability to express uncertainty in scientific assessment are mostly taken place in academic contexts and in certain applications. Although imprecise probability has strong foundations in both statistical inference and decision theory, my conclusion is that imprecise probability is not yet adopted fully by any regulatory organisation.<sup>1</sup> It is likely there is a resistance to work with multiple measures for uncertainty, especially when uncertainty is perceived as something new and complicated and when probability is already seen as a conceptually difficult concept. If imprecise probability can improve and simplify the communication of uncertainty in scientific assessments, it is important to not miss the opportunity to ensure the door is open to let imprecise probability into regulatory frameworks.

### References

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1. I welcome counter examples.