Using Interval Dominance and Γ-Maximin for Decision Making in Offshore Power Transmission*

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We discuss the application of imprecise probabilities, namely interval dominance and Γ-maximin, in a recently published work [1]. The contributions of this work include the use of imprecise probabilities in a new field, and by doing so we aim to gain a better understanding of how to implement these techniques. We focus on a scenario where a decision maker aims to maximise the economic metric return on investment.

The technical and economic uncertainties surrounding offshore power transmission complicate decision making. We focus on two decisions, the first taken by policy makers regarding which regulatory regime to implement and the second taken by project planners concerning project design specifications. Classical decision making techniques are unable to adequately deal with the identified uncertainties, and since these decisions could have substantial economic consequences, imprecise techniques are utilised.

When applying imprecise probabilities in this context, we encounter a similar problem to [2] in that we have act-state dependence: the set of distributions of the state of nature depends on the decision. The presence of act-state dependence prevents the use of maximality as our decision criterion. Instead, we simulate the best and worst case distributions of the act-state dependent variables, for fixed values of the act-state independent variables. These simulations bound the expectation on the return on investment (conditionally on the act-state independent variables), and can be used with the interval dominance and Γ-maximin decision criteria. To treat the act-state independent variables, we simply investigate how the decision changes as a function of fixed values of these variables. We present our results using a 2-dimensional visualisation where axes represent the act-state independent variables. The visualisation highlights the regions of optimal decisions in a way that is clear to interpret for decision makers in the offshore wind industry. This type of sensitivity analysis allows decision makers to use their own expert knowledge to simply read off the optimal decisions from the visual output, rather than having to specify explicit distributions to input their knowledge into the model.

Overall, we present the benefits of using imprecise probability for decision making in offshore wind, and identify that careful consideration is required when there is act-state dependence. The visualisation approach provides a way to engage with decision makers who are unfamiliar with imprecise probabilities. Finally, the application of imprecise probabilities to offshore power transmission advances current practice, and enables the decision maker to base their selection on outputs that reflect the uncertainties involved.

References

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