

Robust Optimization with Decision-Dependent Information Discovery

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Robust optimization is a popular paradigm for modeling and solving two-stage decision-making problems affected by uncertainty. Most approaches assume that the uncertain parameters can be observed for free and that the sequence in which they are revealed is independent of the decision-maker's actions. Yet, these assumptions fail to hold in many real-world applications where the time of information discovery is decision-dependent and the uncertain parameters only become observable after an often costly investment. This is the case for example in clinical trial planning, in offshore oilfield exploration, in active preference elicitation, and in R&D project portfolio optimization. To fill this gap in the literature, we consider two-stage robust optimization problems in which (part of) the first stage variables decide on the uncertain parameters that will be observed between the first and the second decision stages. The information available in the second stage is thus decision-dependent and can be discovered (at least in part) by making strategic exploratory investments in the first stage. We propose a novel min-max-min-max formulation of the problem. We prove correctness of this formulation and leverage this new model to provide a solution method inspired from the K-adaptability approximation approach, whereby K candidate strategies are chosen here-and-now and the best of these strategies is selected after the portion of the uncertain parameters that was chosen to be observed is revealed. We reformulate the problem as an MILP solvable with off-the-shelf solvers and demonstrate its effectiveness on several stylized problems. This is joint work with Angelos Georghiou and Han Yu.