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Sensitivity Measures for Continuous Actions

The value of information (VOI) is a decision sensitivity measure that quantifies the expected improvement in decision quality when uncertainty in selected inputs is removed. Unlike many other sensitivity measures, the VOI provides not only a relative ranking of factors but also an absolute metric of decision quality. Despite this, its use has been limited, particularly to decision problems with discrete alternatives. Our work addresses this gap by developing an approach for settings with continuous decisions, which arise in various fields, including medicine (e.g., determining dosage intensity), environmental management (e.g., setting water release levels in reservoir management), and engineering design (e.g., choosing dimensions of structural elements). In such contexts, instead of selecting among a small number of discrete alternatives, decision makers must determine an action that varies over a continuous domain. Since the optimal decision depends on uncertain inputs, the VOI indicates which uncertainties are most valuable to reduce. To address the computational challenges of computing the VOI for continuous actions, we develop a method based on smoothing techniques that approximate optimal decisions from a set of samples. Overall, our results in engineering test cases show good performance for the problems investigated. The main remaining challenges for practical use are selecting appropriate hyperparameters and the relatively high number of samples required.

Special/ Invited session

Sensitivity analysis

Classification

Both methodology and application

Keywords

Value of information; decision sensitivity; smoothing techniques

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