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Robust Inverse Optimization

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Abstract

Given an observation of a decision-maker's uncertain behavior, we develop a robust inverse optimization model for imputing an objective function that is robust against misspecifications of the behavior. We characterize the inversely optimized cost vectors for uncertainty sets that may or may not intersect the feasible region, and propose tractable solution methods for special cases. We demonstrate the proposed model in the context of diet recommendation.

Keywords: Inverse optimization, Robust optimization, Dietary recommendation

1. Introduction

Given an observation as input, the inverse optimization problem determines objective function parameters of an (forward) optimization problem that make the observation an (often approximately) optimal solution for the forward problem. Inverse optimization has been applied in diverse areas, ranging from finance [1] and electricity markets [2] to medical decision-making [3, 4]. It has been studied in various optimization frameworks including network and linear [5], combinatorial [6], conic [7], integer and mixed-integer [8, 9, 10], variational inequality [11], and countably infinite linear [12] problems. Recently, there has been a growing interest in inverse optimization with multiple solutions as input [11, 13, 14, 15, 16, 17]. While it is unlikely that multiple solutions can be simultaneously optimal, the above studies aim to render the solutions nearly optimal by minimizing some function of residuals with respect to optimality of the solutions.

In this study, instead of considering multiple data points, we consider an uncertainty set that encapsulates all possible realizations of the input data. We adopt this idea from robust optimization, which has been widely used for solving (forward) optimization problems with

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