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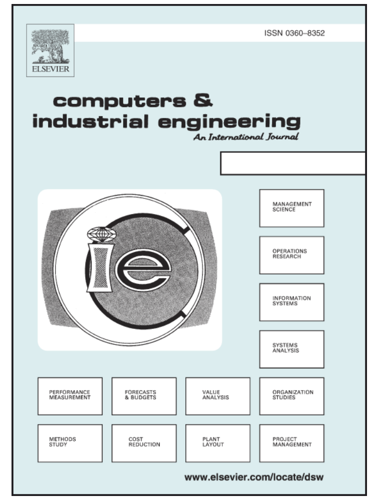

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Exact and Heuristic Algorithms for the Interval Min-Max Regret Generalized Assignment Problem[☆]

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Abstract

We consider the *generalized assignment problem* (GAP) with min-max regret criterion under interval costs. This problem models many real-world applications in which jobs must be assigned to agents but the costs of assignment may vary after the decision has been taken. We computationally examine two heuristic methods: a fixed-scenario approach and a dual substitution algorithm. We also examine exact algorithmic approaches (Benders-like decomposition and branch-and-cut) and further introduce a more sophisticated algorithm that incorporates various methodologies, including Lagrangian relaxation and variable fixing. The resulting Lagrangian-based branch-and-cut algorithm performs satisfactorily on benchmark instances.

Keywords: Combinatorial optimization, Min-max regret generalized assignment problem, Branch-and-cut, Lagrangian relaxation, Variable fixing

1. Introduction

Several optimization problems arising in real world applications do not have accurate estimates of the problem parameters when the optimization decision is taken. Stochastic programming (SP) and robust optimization (RO) are two common approaches for the solution of optimization problems under uncertainty. A decision maker should select a model and a solution approach based on careful examination of the input parameters. In an SP approach, the decision maker has the probability distribution for the random parameters observed in the problem. SP aims to minimize the expected cost, and in most cases it is able to obtain high-quality solutions based on the fact that probability distributions of the parameters are known or can be estimated. However, collecting such distributions can be very time-consuming in many read-world situations, and sometimes they are even unable to obtain. On the other hand, RO aims to minimize the worst-case cost or to minimize the maximum regret without typically requiring any probability distribution of the problem parameters. However, the biggest disadvantage of an RO approach is that a min-max result may be extremely pessimistic. The min-max criterion, known as a typical approach for RO, looks for a solution with the best worst-case value across all scenarios. To deal with the trade-off between robustness and performance, the min-max regret criterion is defined to minimize the worst-case regret, where the *regret* is the difference between the actual cost and the optimal cost that would have been obtained if a different solution had been chosen.

Robust optimization has been one of the hottest topic of the last decade. Buhmann et al. [1] proposed a generic approach based on a measure of similarity of typical scenarios. Snyder and Daskin [2] proposed the stochastic p-robust model in which the object is to minimize the expected cost while bounding the relative regret in each scenario.

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