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An Exact Algorithm for Biobjective Mixed Integer Linear Programming Problems

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Abstract

In this study, we develop a new criterion space search algorithm to find the Pareto frontier of biobjective mixed-integer linear programming problems. Our algorithm starts with the solution of an individual objective function and then sequentially finds all Pareto line segments and points, which are the elements of the Pareto frontier, of biobjective mixed-integer linear programming problems. At each iteration of the algorithm, one line segment (or one isolated point) of the Pareto frontier is detected. If there is no new Pareto line segment available, the algorithm ends. We provide numerical examples and present performance results of the algorithm over several test problems.

Keywords: Multi-objective linear programming; biobjective mixed-integer linear programming; ε-constraint methodology; Tabu constraint; Hamming distance.

1. Introduction

Mixed-integer linear programming (MILP) problems involve decision problems where a subset of decision variables is discrete. If there are two objective functions, the problem is called a biobjective mixed-integer linear programming (BOMILP) problem. When all decision variables are restricted to discrete values, the problem is then called a biobjective integer linear programming (BOIP) problem.

A well-known algorithm to solve BOIPs is the ε-constraint methodology [1,2]. This methodology is not only restricted to biobjective problems but can also be efficiently adapted to multi-objective integer linear programming (MOIP) problems [3-7].

The multi-objective MILP literature has recently been active with the contribution of recent studies. Most researchers have focused on developing branch-and-bound (BB) algorithms for the BOMILPs. As in the case of single objective MILP, BB algorithms are suitable for the MOMILPs as well. Mavrotas and Diakoulaki [8] developed one of the first BB algorithms for MOMILPs. In a follow-up study [9], they improved the speed and reliability of their BB algorithm by incorporating new elements. Vincent et al. [10] presented further improvements, in terms of generation of the Pareto

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