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Solving the team orienteering problem with time windows and mandatory visits by multi-start simulated annealing

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Abstract

This study investigates the team orienteering problem with time windows and mandatory visits (TOPTW-MV), a new variant of the well-known team orienteering problem with time windows. In TOPTW-MV, some customers are important customers that must be visited. The other customers are called optional customers. Each customer carries a positive score. The goal is to determine a given number of paths to maximize the total score collected at visited nodes, while observing side constraints such as mandatory visits and time window constraints.

We constructed a mathematical programming model and designed a multi-start simulated annealing (MSA) heuristic for TOPTW-MV. Computational study showed that MSA outperforms Gurobi on solving small-scale benchmark instances. Among the 72 small TOPTW-MV instances, MSA obtained better solutions than Gurobi for 13 instances and the same solutions as those obtained by Gurobi for the remaining instances. Moreover, the average computational time of MSA is shorter than that of Gurobi. In addition, computational study based on 168 TOPTW-MV benchmark instances adapted from existing TOPTW benchmark instances indicated that MSA significantly improves the performance of basic

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