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Efficient Formulations for Dynamic Warehouse Location under Discrete Transportation Costs

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Abstract

A Mixed-integer Linear Programming model is proposed to determine the optimal number, location and capacity of the warehouses required to support a long-term forecast with seasonal demand. Discrete transportation costs, dynamic warehouse contracting, and the handling of safety stock are the three main distinctive features of the problem. Four alternatives for addressing discrete transportation costs are compared. The most efficient formulation is obtained using integer variables to account for the number of units used of each transportation mode. Contracting policies constraints are derived to ensure use of warehouses for continuous periods. Similar constraints are included for the case when a warehouse is closed. Safety stock with risk-pooling effect is considered using a piecewise-linear representation. To solve large-scale problems, tightening constraints, and simplified formulations are proposed. These formulations are based on single-sourcing assumptions and yield near-optimal results with large reduction in the solution time.

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