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## **An integrated approach for robust inventory routing problem in a three-echelon distribution system**

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**Abstract:** This paper introduces the robust inventory routing problem with finite time horizon in three-level distribution systems considering uncertain demand and transportation cost. The vendor is responsible for replenishing distribution centres and distribution centres replenish geographically scattered customers. The products are distributed by capacitated vehicles and, depending on the decision variables, multiple vehicles are assigned to each distribution centre. The inventories are kept both in distribution centres and customer sites. The objective is to find a combined transportation and inventory strategy and minimise system cost while meeting the demand of each customer without shortage and ensuring feasibility regardless of the realised demands and transportation cost. The proposed system is integrated by a mixed integer linear programming (MILP) formulation for deterministic case of the problem. Moreover, the corresponding robust counterpart is formulated with regard to three different techniques of box, polyhedral and interval-polyhedral and analysed using adjustable uncertainty parameters on a test bed. Finally, to cope with intractability of large size problems, an imperialist competitive algorithm is developed by genetic algorithm operators.