Solution Approaches for the Consistent Stochastic Inventory Routing Problem

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Abstract

In the last decades, companies developed a growing interest in dealing with problems that occur in different levels of the supply chain. Among all research directions within the supply chain, the Inventory Routing Problem (IRP) is recently one of the most studied in the literature. In this paper, we present an IRP that aims to minimize the total cost of elaborating efficient replenishment and delivery plans considering several characteristics. We introduce the Consistent Stochastic Inventory Routing Problem with Time Windows (CSIRPTW). Each period over a finite planning horizon, customers face a stochastic demand given by a probability distribution. Moreover demands present continuous consumption rates within the periods that, in the later, create the possibility of incurring in stock out situations within the periods. Customers can also demand consistency in delivery times in order to anticipate the deliveries and present different time windows related to opening times. After formulating the CSIRPTW we propose three different solution approaches for the problem. The first solution approach consist on a matheuristic solution approach that integrates an ALNS with a Sample Average Estimator, in order to evaluate the efficiency of the algorithm. The second solution approach is an adaptation of the Branch-and-Regret heuristic for stochastic and dynamic vehicle routing problems. The last method is a multiple scenario approach that evaluates different demand realizations and creates efficient routes to minimize average costs. In the last step, we present computational comparisons between the proposed methods and managerial insights using an adapted benchmark set of instances.

Keywords: IRP, Time Windows, Consistency, Stochastic

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