Stochastic inventory routing problem with transshipment recourse action

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Extended abstract

Companies, especially large ones, have recognized that globally optimizing supply chain can yield to substantial cost reduction. Vendor managed inventory (VMI) systems seems to be the core of the supply chain leading to more efficient utilization of resources. Inventory routing problem (IRP) constitutes the backbone of the VMI systems, where the coordination of transportation management and inventory control is considered. IRP is determined as a repeated distribution problem of single product from a single facility to a set of N customers over a planning horizon of T. Each day the central supplier which is the vendor makes decisions about which customers to visit and how much to deliver to each of them while keeping in mind that the decision made today impacts what has to be done in the future. IRP key issue is that the proper projection of long term objective to short term planning problem is essential.

Nowadays of unstable global economic conditions the demand of products become highly uncertain in many business areas, therefore considering the stochastic counterpart of IRP seems unavoidable. There are four domains that have been developed related to the IRP under uncertainty recently; the framework of finite rolling horizon, the Markov decision process (MDP) for infinite horizon consideration, the robust IRP as well as the dynamic stochastic IRP. Campbell et al. (1998) set the basis for the rolling horizon approach, while Kleywegt et al.(2002,2004) formulated the stochastic IRP as a MDP over an infinite horizon. In contrast to MDP, Hvattum et al. (2009) presented a framework based on scenario tree and proposed efficient heuristics that set the basis for our stochastic programming approach. On the other hand Solyali et al.(2012) considered the robust optimization approach in the framework of the IRP, while Bertazzi (2013) as well as Coelho (2012) have followed the stochastic IRP as a dynamic program and have solved it by means of hybrid rolling horizon framework.

With respect to the existing literature this paper introduce the stochastic IRP as a two stage stochastic programming model while transshipment is used as the recourse action of second stage decision process. Stochastic programming models try to take advantage of the fact that probability distribution of uncertain parameters is known or can be estimated. The goal is to find the policy that is feasible for almost all possible parameter realization of some function of the decisions and the random variables. Transshipment was introduced in the context of IRP very recent by Coelho and Laporte (2012) however in our work it is treated as a recourse action against shortage situations when the uncertain demand is revealed.

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We have formulated the problem and solved it by developing an L –Shaped decomposition algorithm. In order to evaluate the results we have used the benchmark instances of Arhetti at al. (2007). Computational experiments proved that the L – shaped method converge in a finite number of steps. Results have been evaluated with respect of the expected value of perfect information as well as the value of stochastic solution as a percentage of the best solution cost.

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