A matheuristic for the multi-vehicle inventory routing problem

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1 Abstract

The interest in the integration of different problems traditionally treated independently is growing in logistics practice and research. Inventory routing problems aim at integrating inventory and transportation planning. Tutorials, with the body of literature available in the area, are available in [3] and [4].

We consider the Inventory Routing Problem (IRP) where customers have to be served over a discrete time horizon by a fleet of capacitated vehicles starting and ending their routes at a depot. The problem is to decide in each time period how much to deliver to each customer and the routes of the vehicles in such a way that the sum of inventory and transportation costs is minimized.

The IRP is related to other classes of vehicle routing problems. Most of these problems, however, assume that the period of service of each customer has been decided, and the task is to optimize the assignment of customers to vehicles and the sequence of customers in each route. The decision on the period of service is considered in the Periodic Vehicle Routing Problem (PVRP), where alternative sequences of periods of visit are given, and the daily demand of each customer is known and must be satisfied in only one visit by exactly one vehicle. The IRP and the PVRP have a different focus and are inspired by different real-world situations. With respect to the

PVRP, the IRP considers a broader decision space, in terms of sequences of visiting periods and in terms of demand served in a visit. Even if in the PVRP all sequences of periods of visits are given as possible, still the two problems are different: In the IRP the demand of a period is not requested to be served in that period but can be served during a previous visit.

The single vehicle version of the IRP was introduced in [2]. The multi-vehicle version of the problem was modeled and solved heuristically in [5]. An in-depth analysis of alternative formulations was carried out in [1].

In this paper we consider the multi-vehicle version of the IRP under the maximum level policy, which means that we are allowed to deliver to any customer any quantity as long as a stock-out situation does not occur and a maximum capacity constraint at the customer is not violated. We present a matheuristic for the solution of the problem based on a tabu search combined with different mathematical programming models. The matheuristic was tested on a large set of benchmark instances and the results prove its effectiveness.

References

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