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Efficient exact and heuristic algorithms for the Inventory Routing

In the last decades, Inventory Routing Problems (IRPs) have been attracting growing attention from the research community, due to the real-world applications, in integrated logistics and supply chain management, and the intellectual challenges that their study poses. The interest in studying IRPs is mainly motivated by the potential benefits coming from combining inventory management and routing decisions. Solving two separate optimization problems for inventory management and routing typically produces sub-optimal solutions to the integrated problem. Tackling directly the integrated problem causes an increase of the computational burden but tends to provide considerably better solutions.

In the IRP the goal is to determine an optimal distribution plan to replenish a set of customers by routing a limited fleet of capacitated vehicles over a discrete planning horizon. Each customer consumes a per period quantity of product and has a maximum inventory capacity. The objective is to minimize the total distribution cost, that includes the routing and the inventory holding costs.

The goal of this talk is to present efficient solution approaches for this extremely challenging problem, both exact and heuristic. As for exact approaches, we analyse different formulations and study their pros and cons. We will mainly focus on compact formulations, focusing on properties and links between formulations with vehicle indices and aggregated formulations. We present a branch-and-cut algorithm and show its performance. As for heuristic approaches, we give an overview of what has been proposed in the literature and a different effective matheuristic based on Kernel Search (KS), which uses one of the formulations presented above. Other ideas for heuristic approaches are sketched as well