

The split delivery vehicle routing problem

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In the vehicle routing problem (VRP) the objective is to find a minimum cost set of routes serving all customers where the demand of each customer is not greater than the vehicle capacity and where each customer is visited exactly once. In the split delivery vehicle routing problem (SDVRP) the restriction that each customer is visited once is removed. Moreover, the demand of each customer can be greater than the capacity of the vehicles. The SDVRP is NP-hard, even under restricted conditions on the costs, when all vehicles have a capacity greater than two, while it is solvable in polynomial time when the vehicles have a maximum capacity of two. The cost saving that can be obtained by allowing split deliveries can be up to 50% of the cost of the optimal solution of the VRP. The variant of the VRP in which the demand of a customer may be greater than the vehicle capacity, but where each customer has to be visited a minimum number of times, will also be considered. The cost saving that can be obtained by allowing more than the minimum number of required visits can be again up to 50%. Simple heuristics that serve the customers with demands greater than the vehicle capacity by full load out-and-back trips until the demands become less than the vehicle capacity may be quite far from the optimal solution. The VRP and the SDVRP solutions will be also compared through a simulation study. Three heuristic methods have been proposed for the solution of the SDVRP: The local search by Dror and Trudeau, a simple and effective tabu search algorithm and a sophisticated heuristic that, using the information collected during the tabu search, builds promising routes and solves MILP models to decide which routes to use and how to serve the customers through those routes. The heuristics are compared on a set of benchmark instances.