An Inventory-Routing Problem with Pickups and Deliveries Arising in the Replenishment of Automated Teller Machines

Roel G. van Anholt, VU University Amsterdam, The Netherlands
Leandro C. Coelho, Université Laval, Canada
Gilbert Laporte, HEC Montréal, Canada
Iris F. A. Vis, University of Groningen, The Netherlands

The purpose of this presentation is to introduce, model and solve a rich multi-period inventory-routing problem with simultaneous pickups and deliveries. Commodities can brought from and to the depot, as well as being exchanged among customers to efficiently manage their inventory shortages and surpluses. A single customer can both provide and receive commodities at different periods, since its demand changes dynamically throughout the planning horizon and can be either positive or negative. This problem arises, for instance, in the replenishment operations of automated teller machines. New technology provides these machines with the additional functionality of receiving deposits and reissuing these to subsequent customers. Motivated by a real case in the Netherlands, we formulate the problem as a mixed-integer linear programing model and we propose an exact branch-and-cut algorithm for its resolution. Given the complexity of the problem, we also propose a flexible clustering heuristic to decompose it. Through extensive computational experiments using real data, we assess the performance of the solution algorithm and of the clustering procedure. The results show that we are able to obtain good lower and upper bounds for this new and challenging practical problem.

Key words: inventory-routing, inventory management, pickup and delivery, branch-and-cut, clustering, exact algorithm, recirculation automated teller machines.