Location-allocation and load assignment problem for a package delivery company

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Abstract

We study a location-allocation and load assignment problem for a package delivery company where order requests from customers are not known beforehand, as they are revealed dynamically throughout the day. The objective of the study is to generate, for each courier, a daily master plan and a detailed schedule to efficiently satisfy a random demand over time and to rapidly adjust to meet the sporadic, tightly constrained, delivery requests.

We propose to solve the problem through a two-phase method. The first phase is modeled as a two-stage stochastic programming problem where first-stage decisions correspond to the allocation of daily shifts to couriers and to the assignment of available couriers to geographic zones at each time period. Second-stage decisions (recourse actions) correspond to the allocation of a volume of packages to deliver at each time period, at each area by each courier and to the utilization of an external resource to cover unsatisfied demand. The second phase is modeled as an assignment problem where delivery patterns are generated and assigned to couriers in a dynamic way according to the master plan and the partial demand realization. Preliminary computational experiments on real and randomly generated instances show that the use of our method prevents from incurring additional costs when compared with a deterministic approach.

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