

# The Probabilistic Pickup and Delivery Problem

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**Abstract:** The Pickup and Delivery Problem is a routing problem in which the vehicle have to satisfy a set of customer orders where each order involves the transportation of an item from a given origin to a given destination. In the Probabilistic Pickup and Delivery Problem (PPDP), for each order there is a given probability that it is withdrawn by the customer at the time the route is performed. This means that a route has to be designed for all the orders, but in the realization of the route the visits to the points corresponding to the removed orders will be skipped. The objective is to design the route with the minimum expected length.

In this work we address the case where all the orders are independent and have the same probability of being removed. We propose two integer linear formulations of the problem. The first formulation is a compact one, that is, the number of variables and constraints is polynomial in the number of requests, while the second one contains an exponential number of constraints and is used as the basis of a branch- and-cut algorithm. The performance of the proposed solution methods is evaluated through an extensive computational study using instances of different types that were created by adapting existing benchmark instances.

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