A generalized formulation and solution approach for stochastic routing problems

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Abstract

We introduce a generalized framework for solving various classes of stochastic vehicle and inventory routing problems as well as other probability-based routing problems with a time-horizon dimension. Demand is assumed to be stochastic and non-stationary, and is forecast using any forecasting model that provides expected demands over the planning horizon, with error terms from any empirical distribution. The optimization methodology is heuristic, based on Adaptive Large Neighborhood Search (ALNS). In this work, we provide a detailed mathematical formulation of the proposed framework, discuss possible conceptual applications, explore in detail several specific problem classes, and demonstrate that probability-based routing problems over a planning horizon can be seen through the lens of stochastic inventory routing. The numerical experiments demonstrate the suitability of our approach and the efficiency of the optimization framework. The optimization results are corroborated by simulation runs.

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