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Evolutionary Adaptive Policies for the Stochastic Dynamic Inventory-Routing Problem

The stochastic dynamic inventory-routing problem (SDIRP) integrates inventory management and vehicle routing under uncertainty, where customer demands are revealed progressively over time.
This research aims to provide new insights into resolving an SDIRP, focusing on a central warehouse that periodically distributes homogeneous goods to a set of geographically dispersed customers.
Decision-making involves a three-step policy: calculating a delivery priority for each customer, determining delivery quantities based on an (s, S) inventory rule, and computing a vehicle route via an exact method.
A simulator was developed to replicate the problem's dynamics and enable policy training and evaluation across multiple scenarios.
The priority rule is obtained as a combination of key features extracted from the problem instances, relying on two evolutionary methods: Genetic Programming and Genetic Algorithms.
Our policies were evaluated on problem instances with up to 50 customers and 20 periods, considering multiple demand uncertainties, holding and shortage costs, and vehicle capacities. The obtained results highlight a competitive performance in total cost reduction compared to several myopic and direct lookahead benchmarks, enhancing stock balance and minimizing travel distances.

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