UNIVERSITY OF BRESCIA

DEPARTMENT OF ECONOMICS AND MANAGEMENT

SEMINAR

Optimizing dynamic decision-making processes under uncertainty. An application in last-mile logistics: uncertain pickup and delivery with in-store shoppers and lockers

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Whereas deterministic optimization enjoys an almost universally accepted canonical form, stochastic optimization is a jungle of competing notational systems and algorithmic strategies. This is especially problematic in the context of sequential (multistage) stochastic optimization problems. In the first part of the presentation, we focus on a specific methodology called Approximate Dynamic Programming (ADP) which addresses uncertainty in decision-making processes. ADP is based on the Markov Decision Process (MDP) framework for modeling dynamic systems. ADP has many applications in fields such as economics, telecommunications, engineering and ecology. The second part of the presentation deals with a last-mile logistics system that integrates in-store shoppers and lockerbased solutions to enhance last-mile delivery efficiency, in order to meet growing demands for faster, more sustainable, and cost-effective delivery services. Nowadays physical retail store has a critical role because it acts as central hub for preparing and fulfilling uncertain online orders. The opportunity of utilizing in-store shoppers to pick up them directly from the store's inventory should accelerate order processing and improve the operational efficiency but also reduces delivery costs. The usage of smart lockers provides a secure and accessible solution for customers to pick up their parcels at their convenience leading to lower transportation costs and improved delivery speed. The problem is designed as a same-day pickup and delivery problem in which online orders and in-store shoppers appear dynamically and stochastically during the working day. Considering the dynamism the problem is modelled using a MDP framework in which we want to decide the best assignment of requests to vehicles and the best routing for them in order to minimize the total service cost composed by transportation cost, remuneration cost for the in-store shoppers and penalty cost for requests fulfilled after the end of the working day. Finding the best policy to solve the problem is not possible due to the well known curse of dimensionality, and to reduce the action space we propose a policy where the assignment decision is taken leveraging off-line computation to predict the expectation value for a request to be served by an in-store, while the routing decision is computed heuristically.

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