UNIVERSITY OF BRESCIA

DEPARTMENT OF ECONOMICS AND MANAGEMENT

SEMINAR

Incentivizing In-Store Customers for Last Mile Delivery: A Dynamic Compensation Framework

Prof. Rouven Schur
Universität Duisburg-Essen, Germany

Chair: Prof. Claudia Archetti
University of Brescia

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Room A2, C.da S. Chiara 50

Last-mile delivery remains one of the most challenging and cost-intensive components of modern retail logistics. A promising approach to address these challenges is to crowdsource deliveries to in-store customers who, after completing their own shopping, may be willing to transport goods along their homeward routes. These occasional drivers (ODs) can serve as a flexible and cost-efficient supplement to traditional delivery fleets. However, their successful integration into delivery operations hinges on overcoming two challenges: the uncertainty of ODs' availability and their voluntary decision to accept delivery tasks.
We address these challenges through the application of dynamic pricing, using monetary incentives to influence OD behavior in real time. The retailer's decision problem is modeled as a finite-horizon Markov decision process, where compensation offers are dynamically adapted to the current system state – specifically, the set of remaining delivery locations and the time left to attract ODs before tasks must be fulfilled by dedicated drivers. In contrast to prior work, our model does not assume certainty of ODs' destinations or guaranteed participation. Instead, it captures the stochasticity in both OD availability and willingness to accept tasks.
We examine two scenarios: one in which partial information about potential OD destinations is available, and one in which no such information can be observed. Each setting requires distinct modeling and solution approaches. For both, we derive analytical results in selected cases and identify structural properties of the optimal policy. These insights serve as the foundation for the development of heuristic solution methods applicable in more general cases. Through simulation studies, we demonstrate the benefits of a dynamic, state-dependent compensation scheme in effectively engaging in-store customers for last-mile delivery.

Via S. Faustino 74/B, 25122 Brescia (BS), Italy
Tel +39 030 2988896
commissionericerca.dem@unibs.it