Monday, December 13, 2021 | 9:15AM

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"Same-Day Delivery with Fair Customer Service"

Abstract: The demand for same-day delivery (SDD) has increased rapidly in the last few years and has particularly boomed during the COVID-19 pandemic. The fast growth is not without its challenge. In 2016, due to low concentrations of memberships and far distance from the depot, certain minority neighborhoods were excluded from receiving Amazon's SDD service, raising concerns about fairness. In this paper, we study the problem of offering fair SDD-service to customers. The service area is partitioned into different regions. Over the course of a day, customers request for SDD service, and the timing of requests and delivery locations are not known in advance. The dispatcher dynamically assigns vehicles to make deliveries to accepted customers before their delivery deadline. In addition to overall service rate (*utility*), we maximize the minimal regional service rate across all regions (*fairness*). We model the problem as a multi-objective Markov decision process and develop a deep Q-learning solution approach. We introduce a novel transformation of learning from rates to actual services, which creates a stable and efficient learning process. Computational results demonstrate the effectiveness of our approach in alleviating unfairness both spatially and temporally in different customer geographies. We also show this effectiveness is valid with different depot locations, providing businesses with opportunity to achieve better fairness from any location. Further, we consider the impact of ignoring fairness in service, and results show that our policies eventually outperform the utility-driven baseline when customers have a high expectation on service level.

Biosketch: Barry Thomas is the Senior Associate Dean of the Tippie College of Business at the University of Iowa and the Gary C. Fethke Research Professor of Business Analytics. He previously served as the Departmental Executive Officer (Department Head) in the Department of Business Analytics at the University of Iowa. Barry received his PhD and MS in Industrial and Operations Engineering from the University of Michigan and holds BA degrees in both Mathematics and Economics from Grinnell College. He has over 50 peer-reviewed research publications, many focused on the application of machine learning to last-mile logistics problems. His research has been sponsored by the National Science Foundation and private industry. Barry is currently co-Area Editor for the Routing and Logistics Area of the journal Transportation Science. He has previously served as President of the INFORMS Transportation and Logistics Society, an association of over 1000 transportation science researchers, and as a Vice President for INFORMS, the largest association of analytics and operations research professionals in the world. After 15 years, Barry recently retired from the Grinnell College's Board of Trustees. As a Trustee, he had served as Chair of the Audit & Assessment and Governance Committees and had been Vice Chair of the Board.