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DATA-DRIVEN CAPACITY MANAGEMENT AND REVENUE MAXIMIZATION OF RIDE-HAILING SERVICE WITH PRESCRIPTIVE ANALYTICS AND DEEP LEARNING

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Abstract

This paper studies capacity management of ride-hailing service with unstable passenger demand. In existing parametric approaches in the literature, normally a two-stage prediction-then-optimization (PTO) paradigm is used to implement demand prediction, capacity and revenue optimization sequentially, which generally achieves suboptimal performance due to the information loss in demand prediction. To attain optimality, in this study, we integrate these two stages into a prediction & optimization (P&O) paradigm considering both Cobb-Douglas matching function and perfect matching function, and formulate a weighted sample average approximation (WSAA) approach embedded with k-nearest neighbors, kernel regression and decision tree, as well as an innovative deep learning approach that couples decomposition, convolution, and attention together. The WSAA approach was proven to be asymptotically optimal when a sufficient number of samples are collected, while the deep learning approach based on P&O paradigm demonstrated superior performance in capacity management.

Finally, as an extension, we combine WSAA and deep learning approaches to potentially achieve further improvement on optimality.

Keywords

Data Driven Decisions, Ride-Hailing Service, Prescriptive Analytics, Capacity Management, Revenue Maximization, Deep Learning