Dynamic Pricing and Matching in Ride-Sharing

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Ride-sharing platforms like Uber, Lyft, and Ola are transforming urban mobility by connecting riders with drivers via the sharing economy. These platforms have achieved explosive growth, by dramatically improving the efficiency of matching, and by calibrating the balance of supply and demand through dynamic pricing[1]. We review the publicly available literature on the data-driven marketplace technologies at the core of ride-sharing technology.

The dynamic adjustment of prices ensures a reliable service for riders, and incentivizes drivers to provide rides at peak times and locations[2]. Dynamic pricing is particulary important for ride-sharing platforms, because pricing too low creates the "wild goose chase" phenomenon: demand outstrips supply, and pickup ETAs get very long. Drivers then spend too much time en-route to pickups, so their time on-trip drops, and few rides are created. Ride requests also frequently go unfulfilled, yielding a negative experience for both riders and drivers. Dynamic pricing prevents the wild goose chase; when dynamic pricing is disallowed by regulatory authorities, the welfare-maximizing fixed price is close to the highest price from the dynamic pricing scenario, and fewer trips are generated[3].

The pricing and matching decisions rely on several key inputs that are estimated from data. These include predictions of demand, supply, and driving time in the road network[4]. For example, demand prediction is used for dynamic pricing, and can be based on historical demand patterns, real-time information, and signals like events, weather, and points of interest[5]. Prediction of the driving time between given locations is used in matching decisions. This prediction is based in large part on geolocation information from vehicles in the road network[6].

Despite their benefits, the current dynamic pricing algorithms can fluctuate considerably in reaction to short-term supply and demand conditions. This suppresses demand and makes it harder for drivers to relocate to areas of higher price, since the prices may drop by the time they arrive[7]. Novel market designs that provide a stabler price have the potential to increase volume of trips and improve geographic alignment of supply and demand. For example, one could take into account destination in pricing decisions, to correct for geographic imbalances in demand flows. Demand tends to be high from residential areas to commercial areas during the morning commute, and vice versa during the evening

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commute; to incentivize relocation of cars to areas where they are needed most, riders could be given a discount on counter-flow trips[8].

Ride-sharing platforms enable efficient on-demand mobility and flexible work, made possible by marketplace technologies like dynamic pricing and matching. Dynamic pricing helps avoid the "wild goose chase" phenomenon, although there is still considerable headroom in improving geographic alignment of supply and demand and in creating more predictable price mechanisms. Academic-industrial collaboration and product development teams that incorporate talent in economics, revenue management, and forecasting are needed to address these continuing challenges[9].

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