Balancing Fairness and Profit in Rideshare

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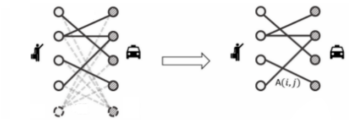
Background

Dispatch policies are algorithms that match drivers with riders for rideshare companies

Dispatch policies use Markov Decision Policies, which model matching riders and drivers as actions that change the "state" of the rideshare system

State Space: Rider and Driver Locations

Action Space: All combinations of riders, drivers
Dispatch policies determine action that maximizes objective function

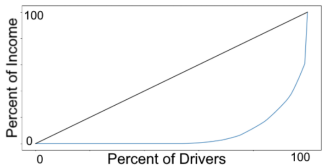


There are many combinations of drivers and riders, so dispatch policies need to quickly sort through the combinations and find the best ones
Image taken from Xu et al. paper in KDD 2018

Fairness in Rideshare

Dispatch policies typically optimize for profit, which causes inequality for both drivers and riders

Driver Inequality: Unequal pay amongst drivers
Quantify using a Lorenz Curve

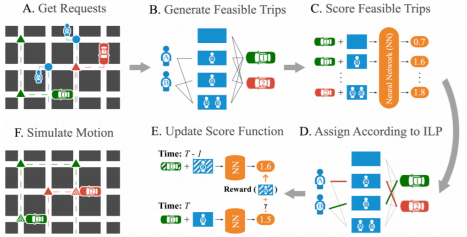


The closer the curve is to a striaght line, the more even the income distro is.

Passenger Inequality: Passengers from certain areas get picked up less

Quantify using difference in distribution between which drivers request rides, and which get picked up

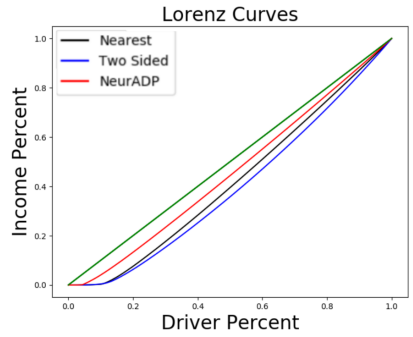
Rideshare Simulator

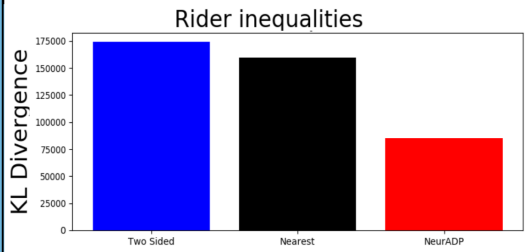


We use an Integer Linear Program (ILP) and score function to simulate data, which is used to evaluate different policies. Different policies vary in score function, ILP constraints. Picture from Shah et. al paper.

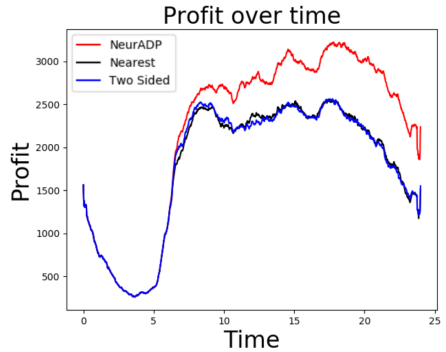
Experiments

Run preliminary experiments comparing existing dipsatch policies on fairness and profit





Experiments



We see the NeurADP policy perfoms best in profit and inequality, While two sided performs worst in all three

Future Directions

We have baseline performance from policies

So we know what to compare our policies to

Next step is to find policies that outperform in fairness using different objective functions, such as entropy

Another method is to enforce fairness constraints when matching in the ILP

References

1. Shah, Sanket, Meghna Lowalekar, and Pradeep Varakantham. "Neural Approximate Dynamic Programming for On-Demand Ride-Pooling." arXiv preprint arXiv:1911.08842 (2019).
2. Sühr, Tom, et al. "Two-sided fairness for repeated matchings in two-sided markets: A case study of a ride-hailing platform." Proceedings of the 25th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining. ACM, 2019.
3. Xu, Zhe, et al. "Large-scale order dispatch in on-demand ride-hailing platforms: A learning and planning approach." Proceedings of the 24th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining. 2018.