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PASSENGER REACTION IN RIDE-ON-DEMAND SERVICES WITH DYNAMIC PRICING

Suiming Guo, Chao Chen, Yaxiao Liu, Ke Xu, Dah Ming Chiu

Suiming Guo, Chao Chen, Yaxiao Liu, Ke Xu, Dah Ming Chiu, ***Modelling Passengers' Reaction to Dynamic Prices in Ride-on-demand Services: A Search for the Best Fare***, Volume 1, Issue 4, 136:1-136:23, IMWUT

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Outline

data analysis & modelling

Background

dynamic pricing + app-based usage --> new passenger reaction pattern

Data

spatio-temporal distribution of price multipliers

patterns of passenger reaction

Modelling

Numerical Results

What is RoD Service?

- Uber, Lyft,...
- Grab,...
- Didi, Shenzhou UCar, ...
- emerging these years...

What we do?

- real-data, new service, new idea;
- what influence passenger reaction?
- how to model it?

What data?

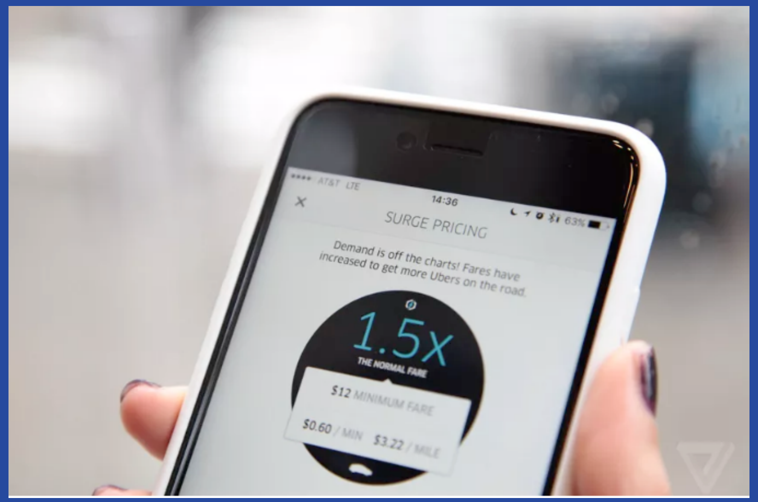
- Event-log data from Shenzhou UCar.
- Beijing
- Late 2015 to Early 2016.

BACKGROUND

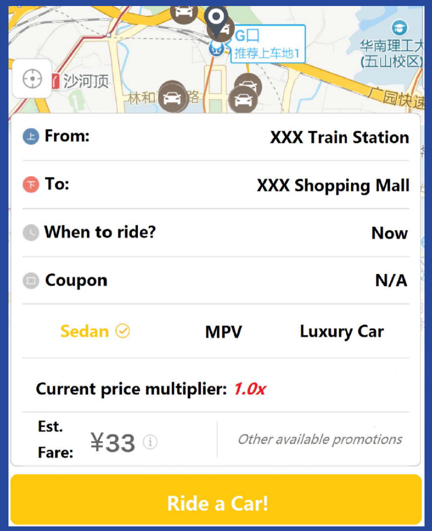
RoD Service: Dynamic Pricing + App-based Usage

Dynamic Pricing

- Taxi: fixed price
- RoD: *dynamic* price multiplier

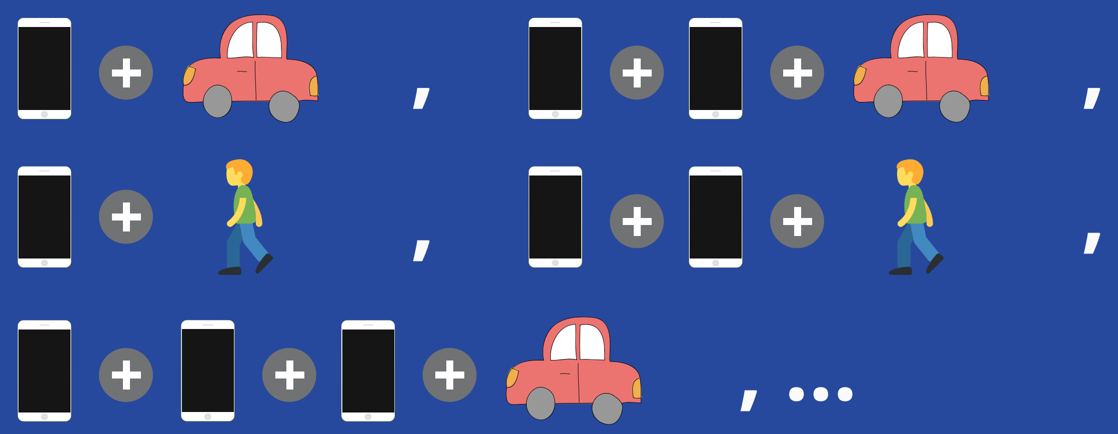


App-based



instead of

New Passenger Reaction Patterns



Estimate the fare for multiple times before giving up or taking a ride

Motivation:

1. Quantify passenger perception & dissipate concerns from outside;
2. Make better and more responsive pricing algorithms.

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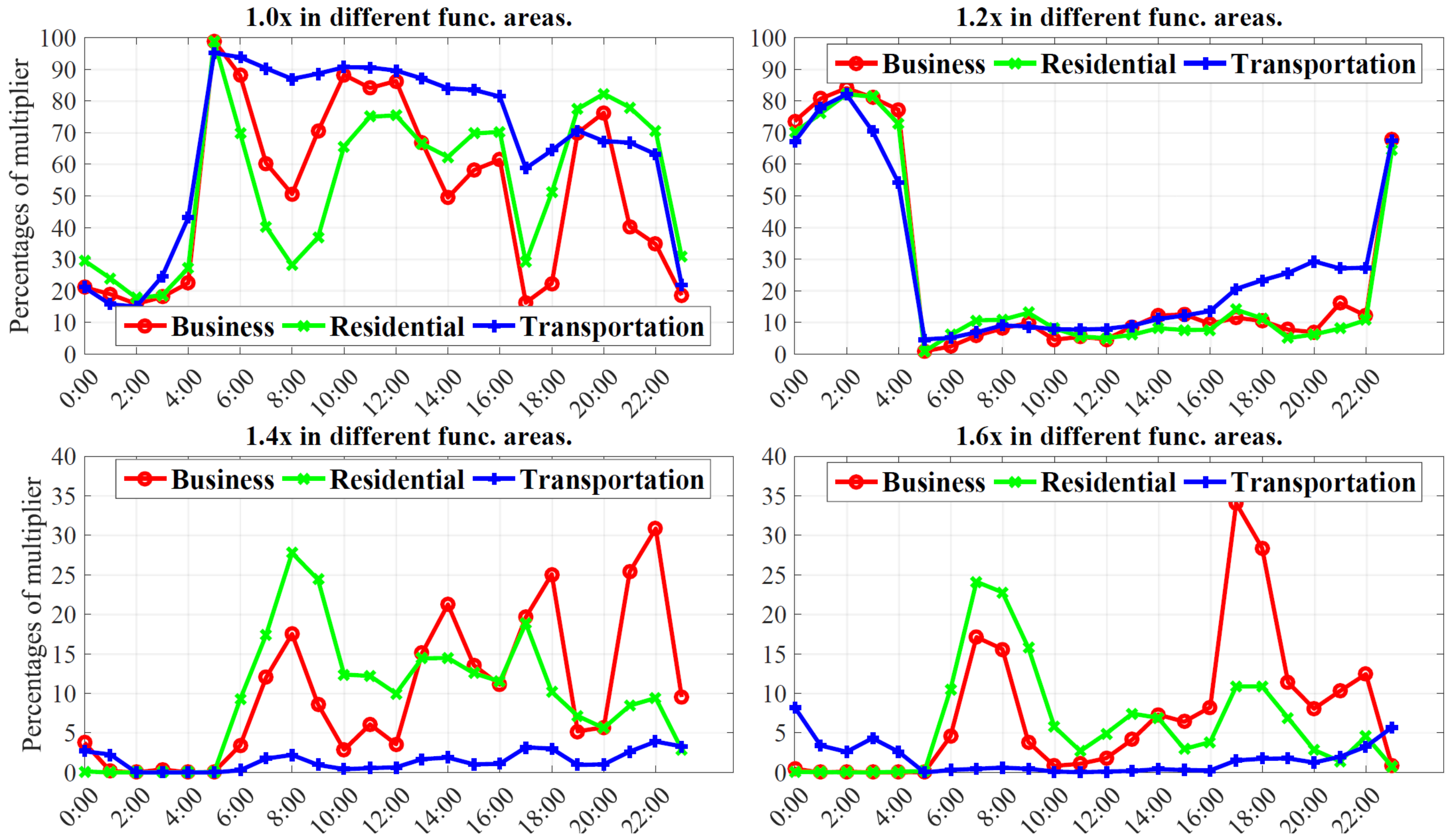
DATA ANALYSIS

Spatial-temporal Distribution of Price Multipliers

low **(1.0x),** ***avg*** **(1.2x) and** ***high*** **(1.4 & 1.6x) price multipliers**



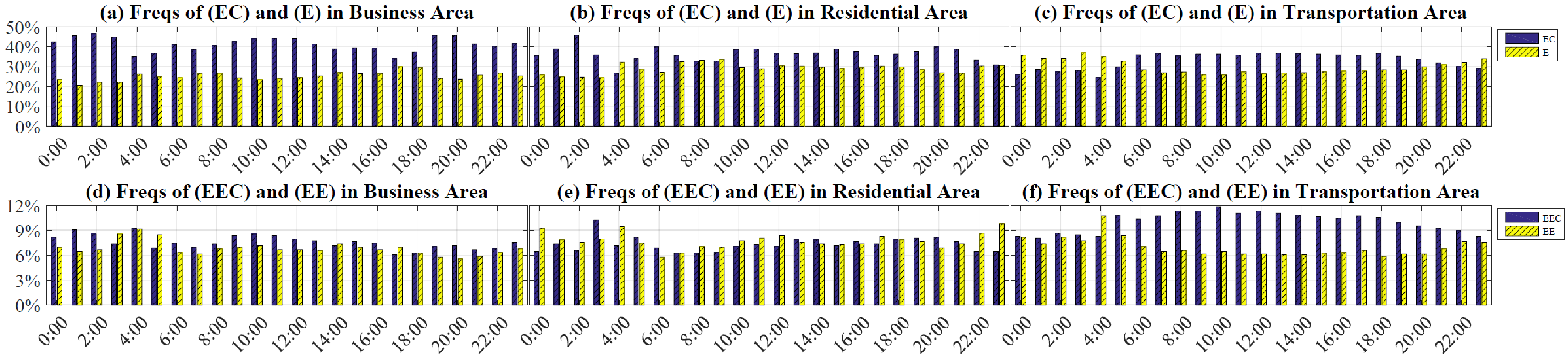
- **clear time-of-day pattern**:
- -- transportation area: more stable
- -- business/residential: going-to-work or -back-home patterns.

The distribution varies according to the price multiplier, time, location, etc.

DATA ANALYSIS

Patterns of Passenger Reaction to Dynamic Prices

→ E, → C, → "nothing happens".



Most don't hesitate long

(EC and E are the most common patterns)

business area:

Most eager to get a car, & highest demand

transportation area:

Not that eager, and can wait longer

business/residential area:

During rush hour, more are inclined to estimate once and give up -- too high price.

Distribution of Price Multipliers + Patterns of Passenger Reaction

Both the *dynamic prices* & *passenger demand elasticity* influence their reaction in RoD service.

This inspires our modelling.

Modelling

Technical details referred to the paper, not shown here.

Distribution of Price Multipliers
Passenger Demand Elasticity / Search Cost
Passenger Reaction

↓

Any two decide the other one

a search = estimate fare for once
search cost = passenger demand elasticity

A SEARCH THEORY MODEL

- Just like buying things at stores: *comparing prices*, *repeating many times*, *buying or giving up*.
- We adopt and extend a search theory model to model passenger reaction.
- Basically, *"every search incurs a search cost; and as long as the expected price decrease is smaller than the search cost, you should stop."*
- **Resulting stopping strategy**:
- (a) If the search cost is large enough, you should "only search once and take the ride.
- (b) Otherwise, stop searching as long as you get a price multiplier <= a multiplier threshold.
- **What can the model be used for?**
- (a) *learning the search cost*: to understand passenger demand elasticity;
- (b) *predicting passenger reaction*: based on the learned search cost and the distribution of price multipliers.

SOME NUMERICAL RESULTS

based on our data and the model

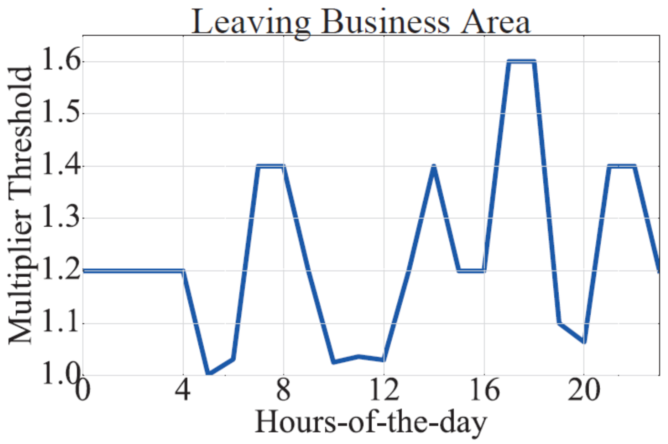


Fig. 11. The multiplier threshold: leaving business area on weekdays.

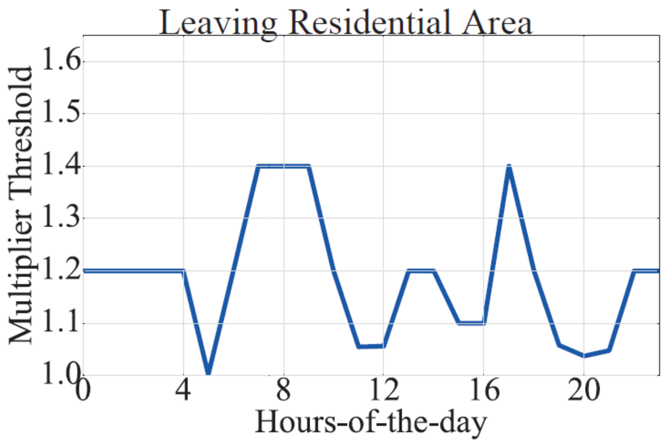


Fig. 12. The multiplier threshold: leaving residential area on weekdays.

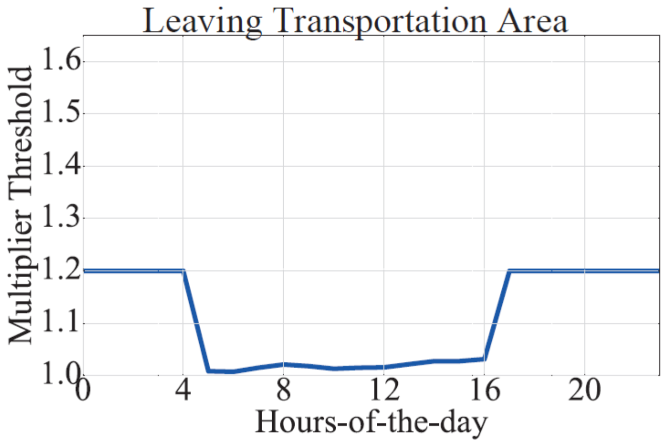


Fig. 13. The multiplier threshold: leaving transportation area on weekdays.

Some quick observations:

- peaks-and-troughs roughly agree that of high price multipliers, but not the same -- joint result of both price multiplier distribution and search cost.
- time-of-day variation of multiplier threshold can be a useful guidance for both passengers and the service provider.

Fig. 14. The search cost: leaving business area on weekdays.

Fig. 15. The search cost: leaving residential area on weekdays.

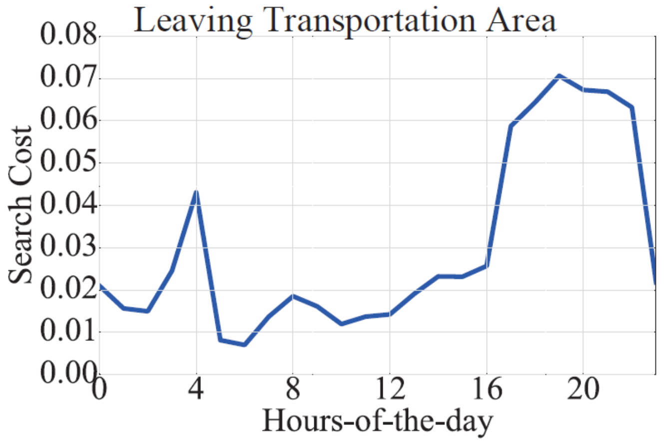


Fig. 16. The search cost: leaving transportation area on weekdays.

- search cost v.s. multiplier threshold: more accurate, with finer granularity
- information obtained is different. Example: when the multiplier threshold is the same (e.g., 1.4x), the search cost is significantly lower in residential area.
- can infer the relationship between the search cost and trip intention.

Thank you for your interest!

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