A Preliminary Study of Mobility Patterns in Urban Subway

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Introduction

Natural disasters

Health event

Public safety issue

Accidents

Emergency

Introduction

Abnormal traffic

How to propagate?

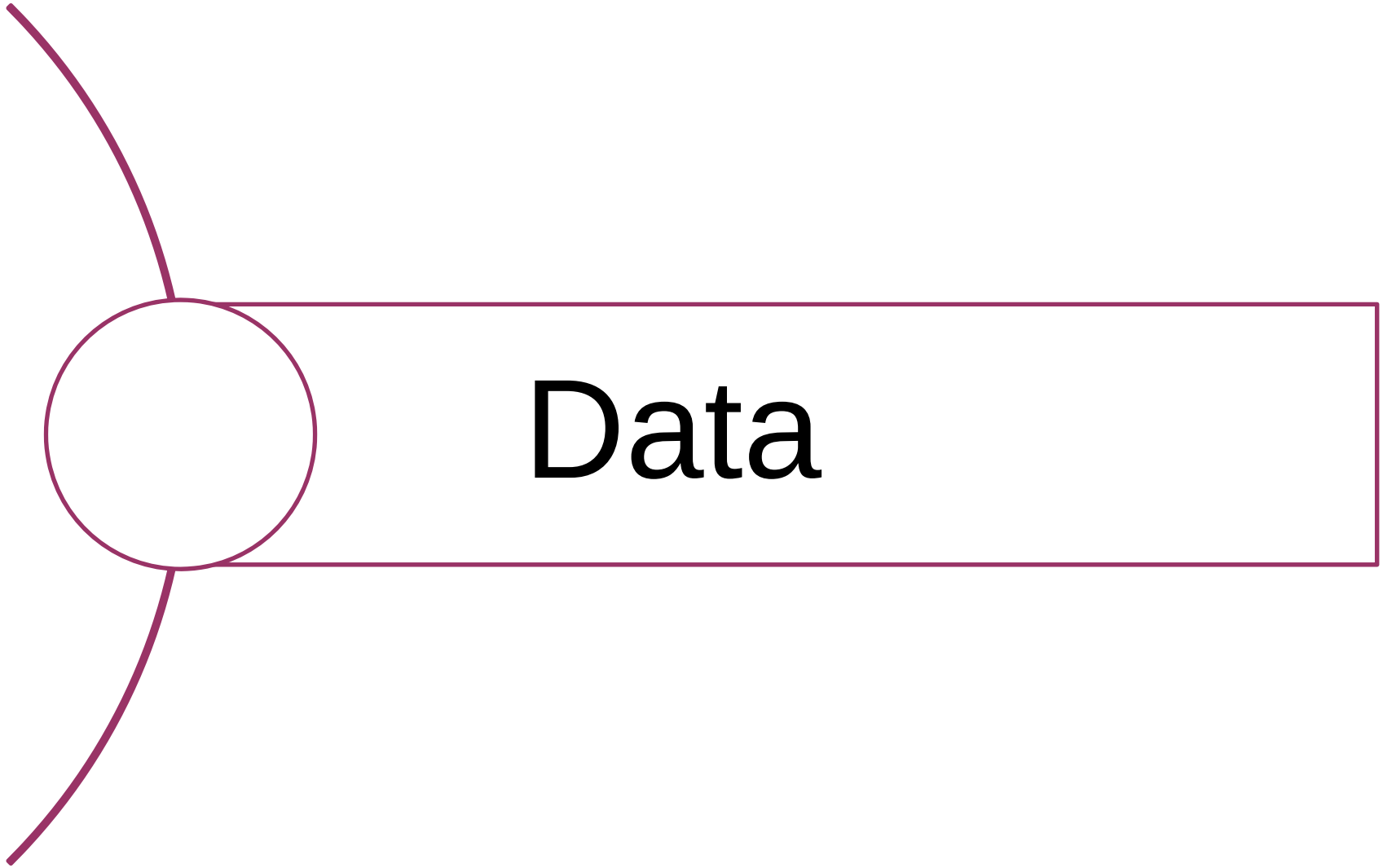
What to do?

Introduction

It’s not about model

But only statistics

Outline



Data

DATA: records from the Auto Fare Collection (AFC) system of Beijing subway.

The total records cover a population of three million trips for a single weekday, and two million trips for a single weekend.

INFO:

- Card ID: typically corresponding with a passenger
- Entry and exit station code
- Exact time that passenger swipes the card when getting in and out of the subway station.

DATA RANGE: 2014/10/13-2014/10/26 (14 continuous days)

Outline

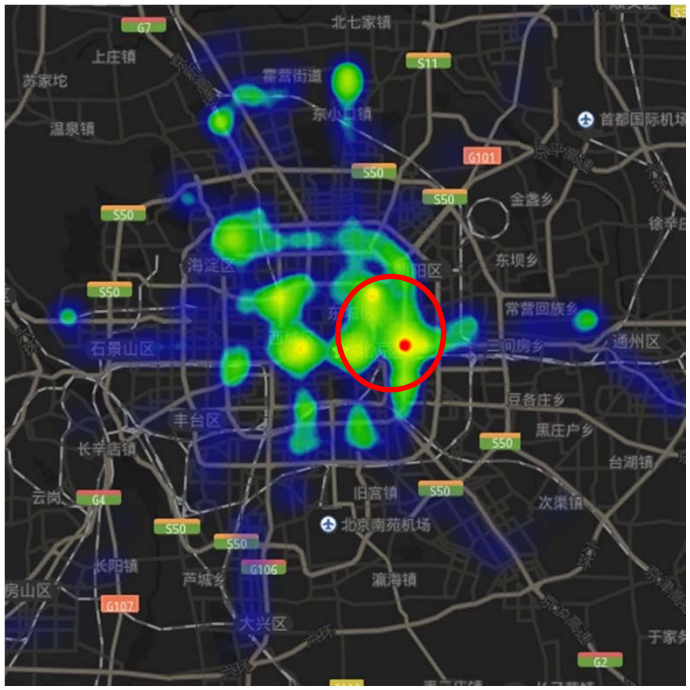
Results

Results

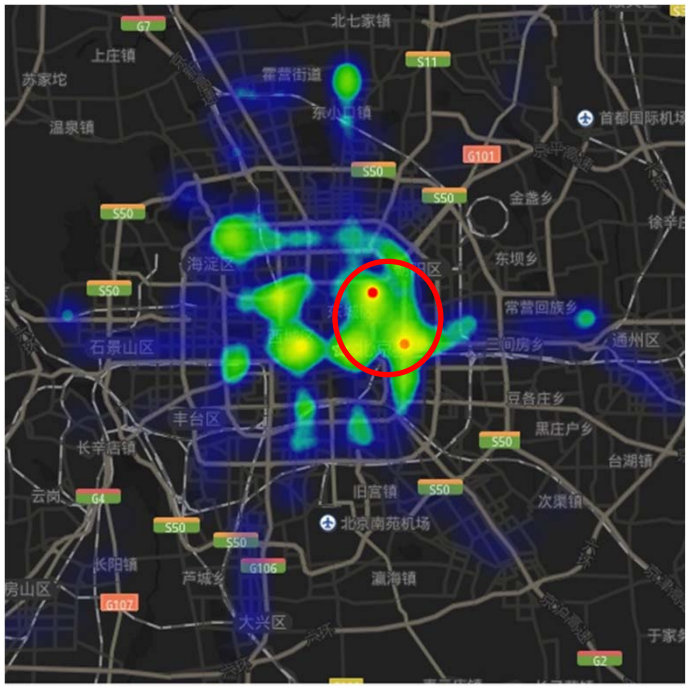
Q1: Where do they come from and go to?

High coincidence of in-flux and out-flux

In flux



Out flux



O Hot spots

Average of 14 continuous days

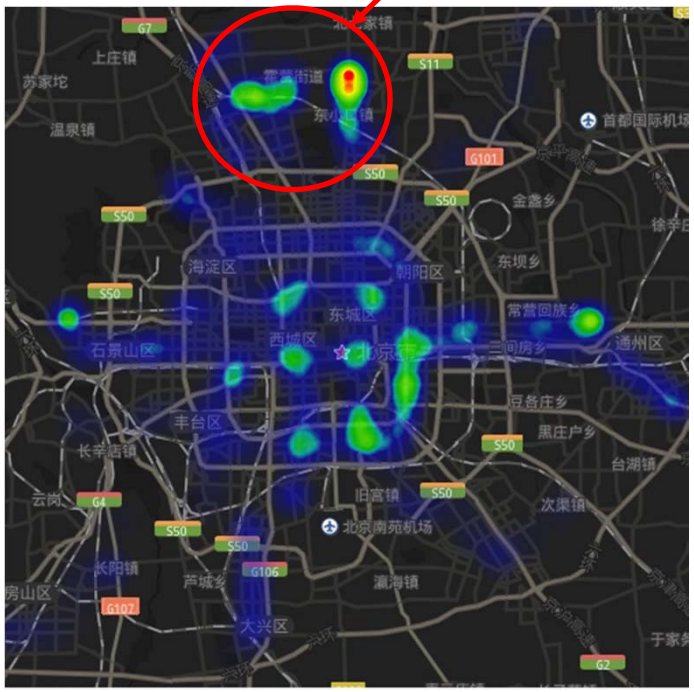
Results

Q1: Where do they come from and go to?

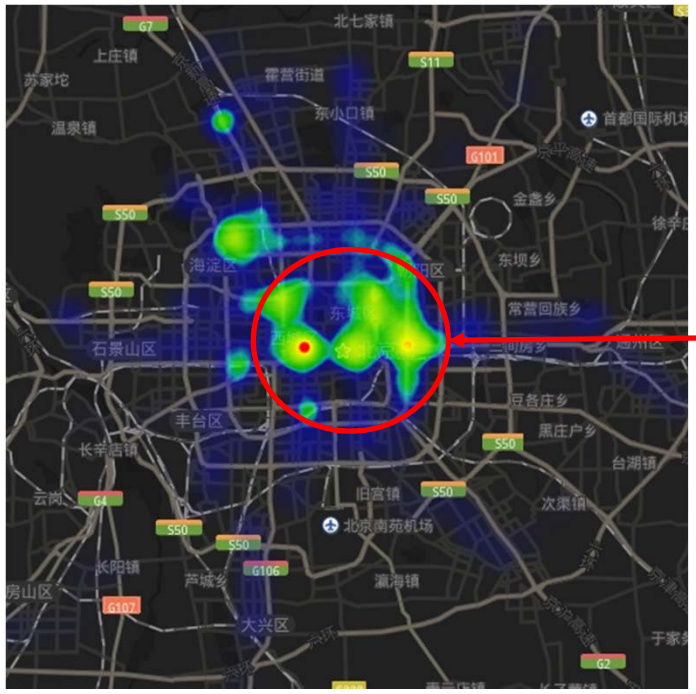
Living quarters and Work areas

Living quarters

In flux-before 12pm



In flux-after 12pm



Work areas

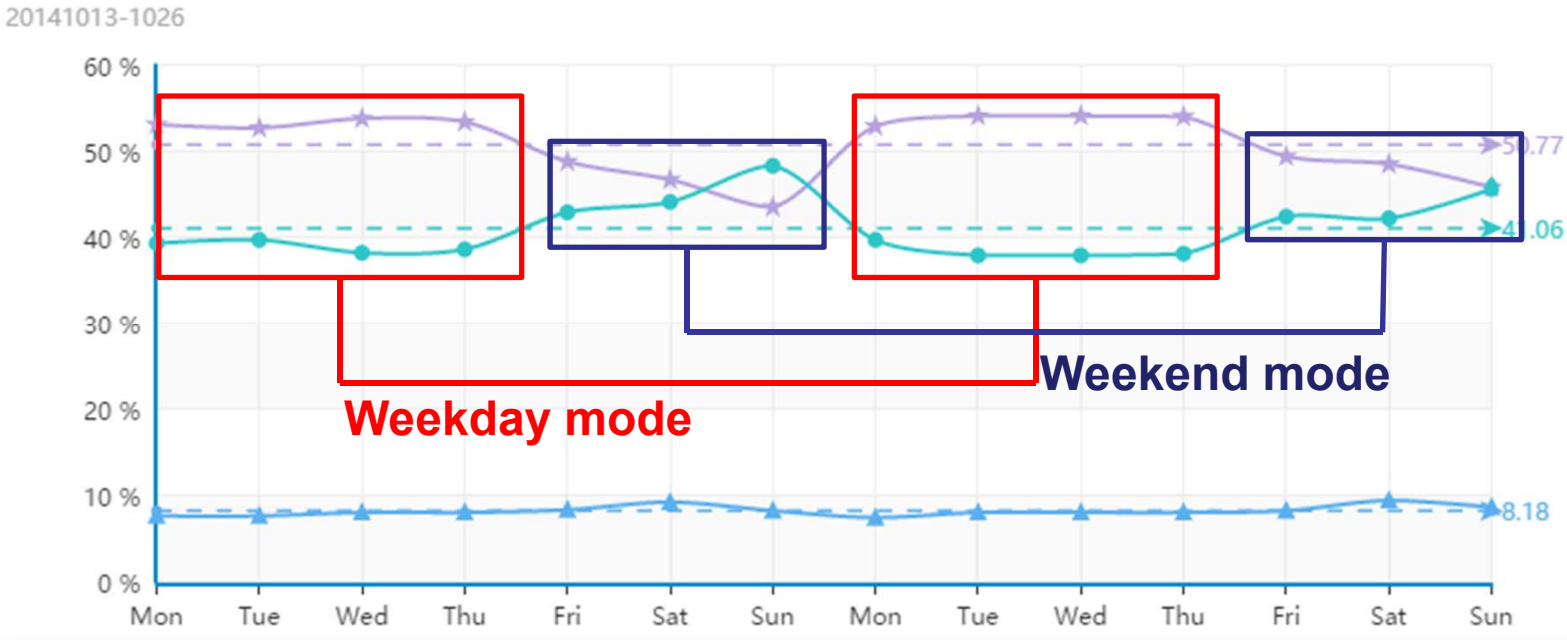
Average of 14 continuous days

Results

Q2: What's the travel frequency of passengers?

Daily travel frequency
- **Once a day**
- **Twice a day**
- **Three times or more**

Significant difference between weekdays and weekends



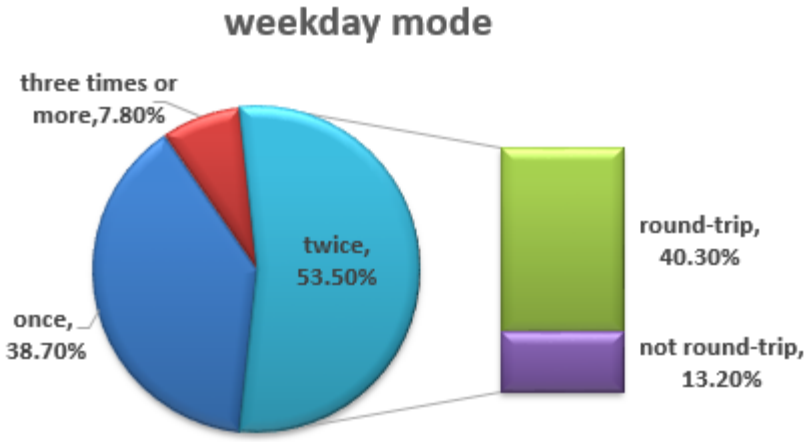
Results

Q2: What's the travel frequency of passengers?

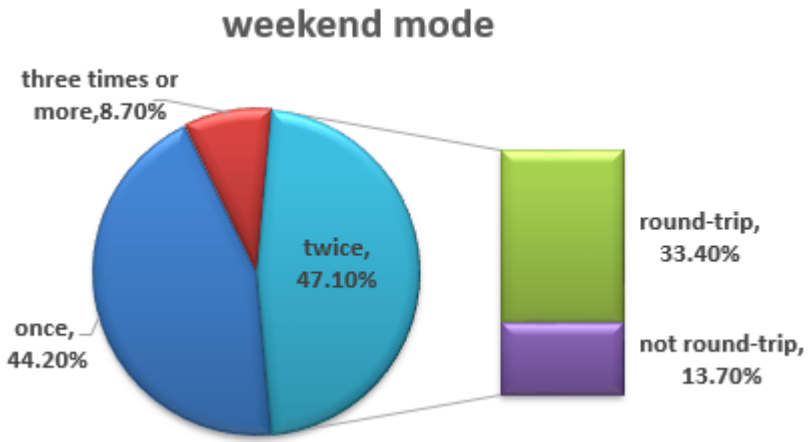
Travel twice a day

- **Round-trip**
- **Not round-trip**

High return rate



Weekday mode average



Weekend mode average

Results

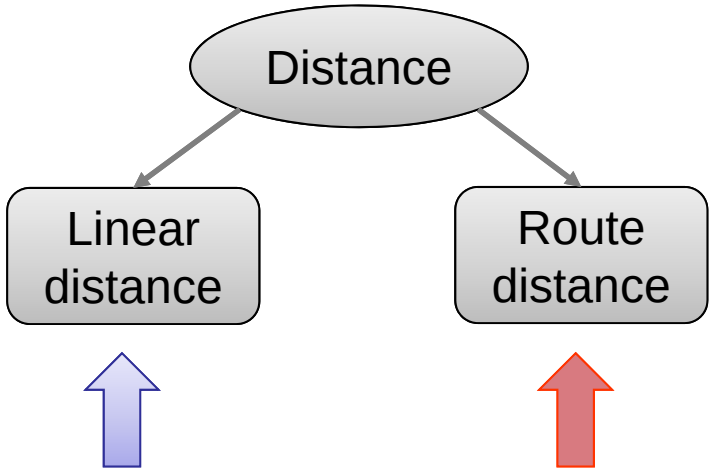
Q3: What's the trip distance?

Ideal linear path:

from *NATIONAL LIBRARY* to *DAZHONGSI* directly

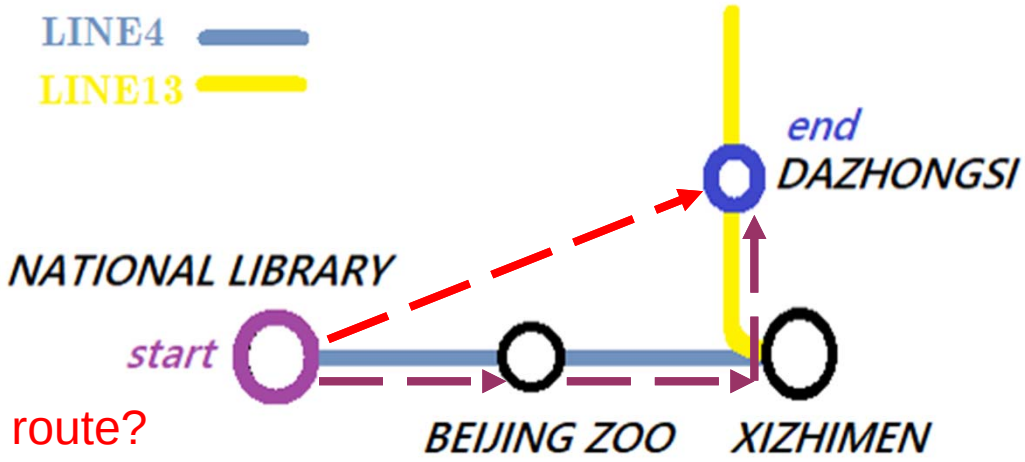
Actual path:

NATIONAL LIBRARY ⇨ *BEIJING ZOO* ⇨ *XIZHIMEN* ⇨ *DAZHONGSI*



longitude and latitude

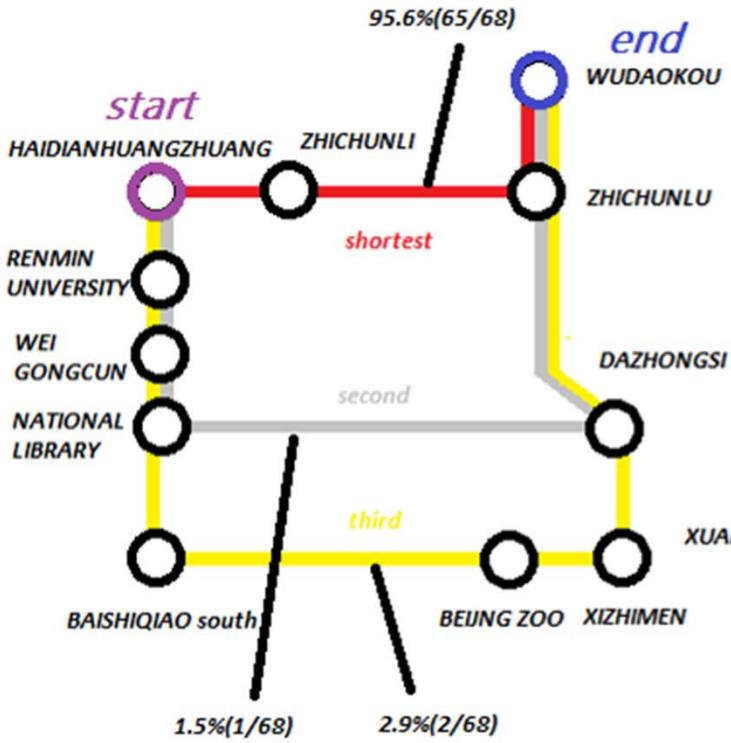
How to get the route?



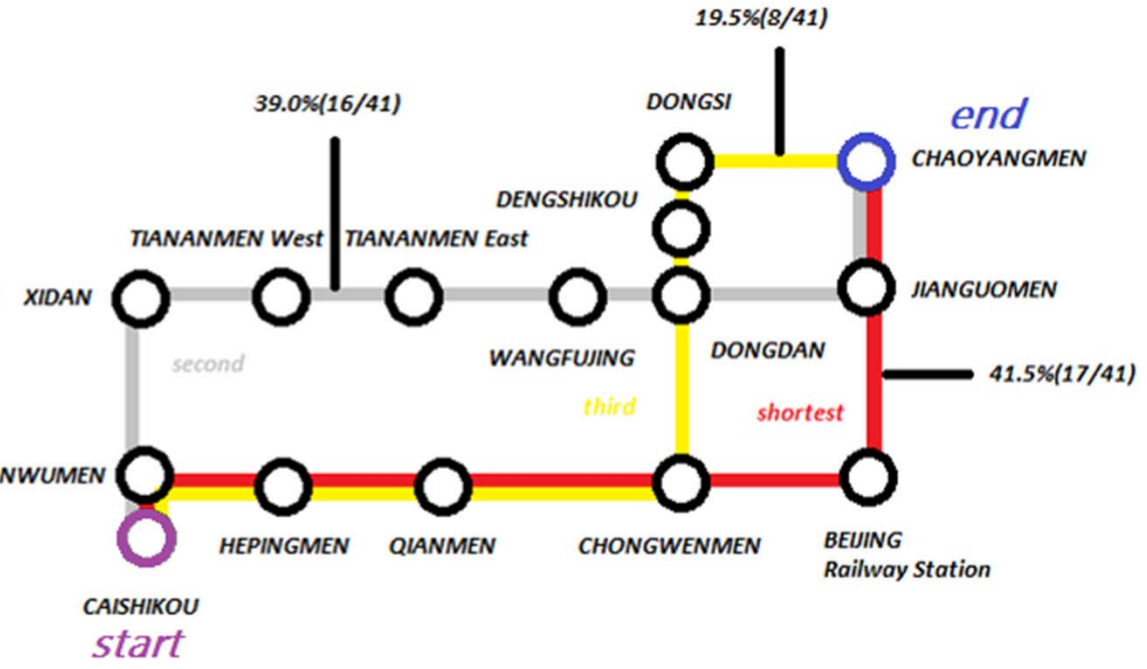
Method

How to get the **actual route** of each pair of origin-destination?

1.Obvious shortest route:



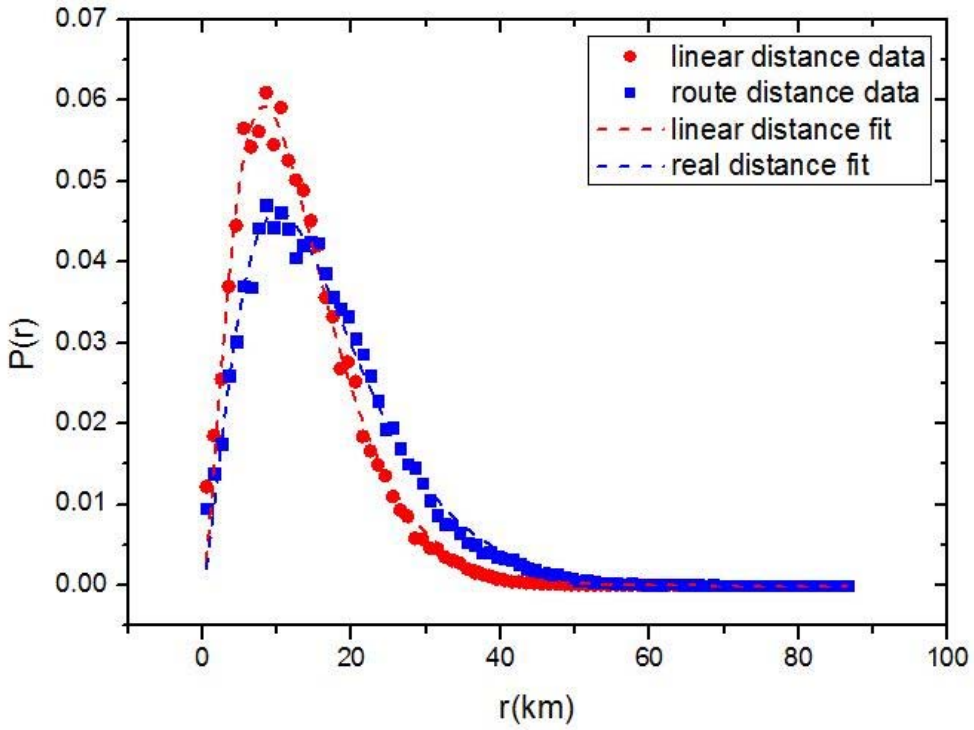
2.Competitive route:
judge by actual transit time



Results

Q3: What's the trip distance?

Characteristics of travel radius (CTR) for subway in Beijing



$$p(r) = \alpha \cdot \exp(\beta r) \cdot r^{\gamma}$$

linear	route
α=0.010	α=0.006
β=-0.198	β=-0.149
γ=1.619	γ=1.503

$$r_0 = \left| \gamma / \beta \right|$$

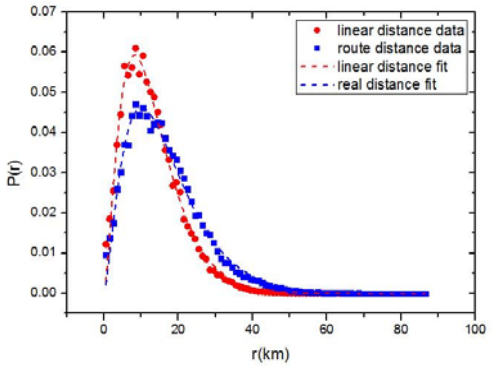
Average of 14 continuous days

Outline

Discussion

Discussion

Quite of the passengers make detours relative to the linear path when traveling by subway.

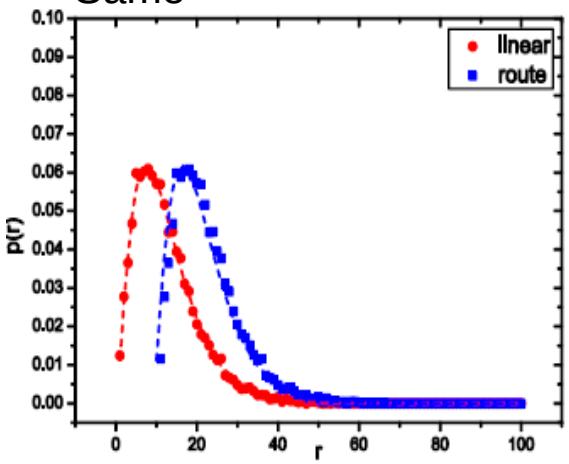


Does more distance takes more detours or less detours?

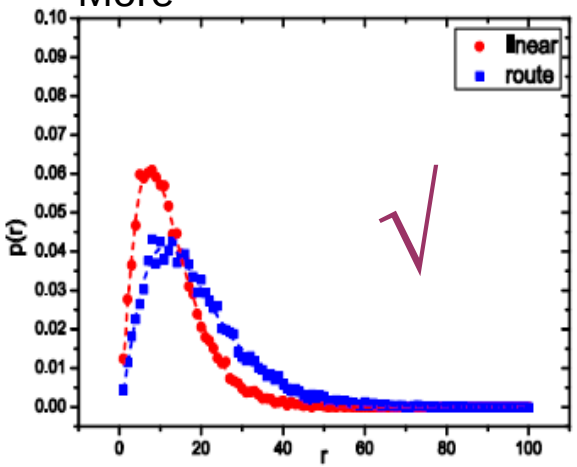
$$r_{ir} = r_{il} + \Delta r_i$$

Monte Carlo Simulation

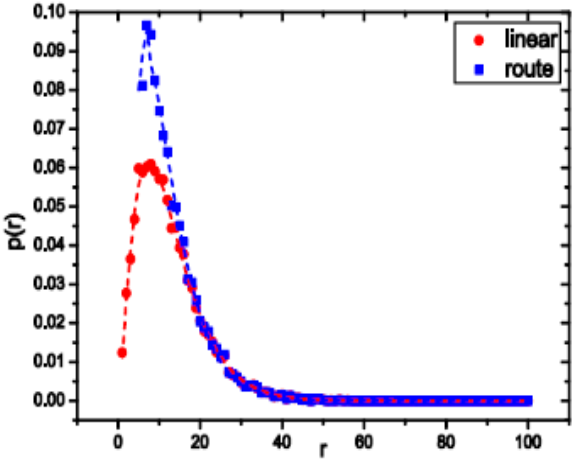
Same



More



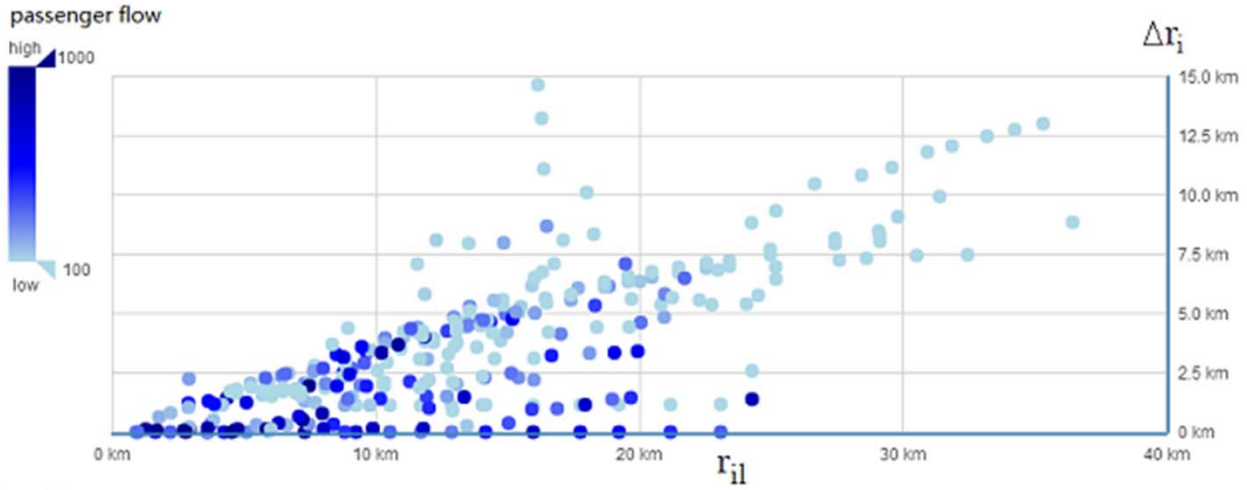
Less

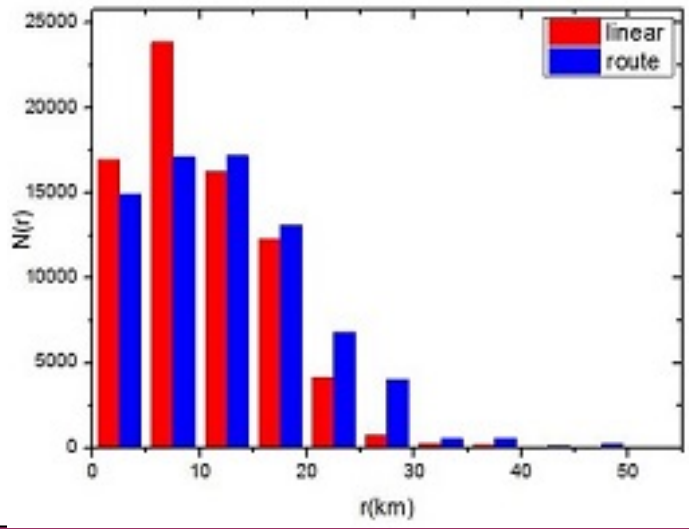


Discussion

Statistics case: GUOMAO station

Take the records of 20141015 (Wednesday) with a total of 74589 trips starting from GUOMAO station.





To some extent, with the increase of r_{il}, there exists a growing trend of Δr_i

It is speculated that in Beijing subway, the more distance it takes, the more detours it makes.

Conclusion

#1 Hot spots of in-flux and out-flux have a high coincidence in Beijing subway.

#2 More than 30% of the passengers in Beijing make round-trip in a day by subway. The proportion is even higher on weekdays.

#3 The characteristics of travel radius (CTR) for subway trip in Beijing is about 10 *km*.

#4 The distributions of linear distance and actual route distance are not the same. Quite of the passengers make detours when traveling by subway.

Thanks for your attention!