

# **Research on Determinants of Rail Transit Ridership**

## **— Taking Fukuoka, Japan as a Study Case —**

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## **0.0 Agenda (dissertation overview)**

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### **■ Introduction**

- Background
- Research questions

### **■ Empirical Work**

- Willingness of Walking Duration to Transit Stations
- Characteristics of Transit Ridership and Land Use
- Influencing Factors on Transit Ridership at Station Level
- Influencing Factors on Transit Ridership at Station-to-Station Level

### **■ Conclusion**

- Findings
- Recommendations

2

# *Chapter 1*

## *Introduction*

### 1.1 Background

#### ■ Beginning



## 1.1 Background

### ■ Rail transit VS Road transportation

			
Capacity	30,000~60,000	2000~5000	Person/h
Speed	30-50	10-15	Km/h
punctuality	On time Not sensitive to the external environment		Not on time sensitive to the external environment

### ■ Importance of rail transit

- Meet the increasing traffic demand
- Promote urban development

## 1.1 Background

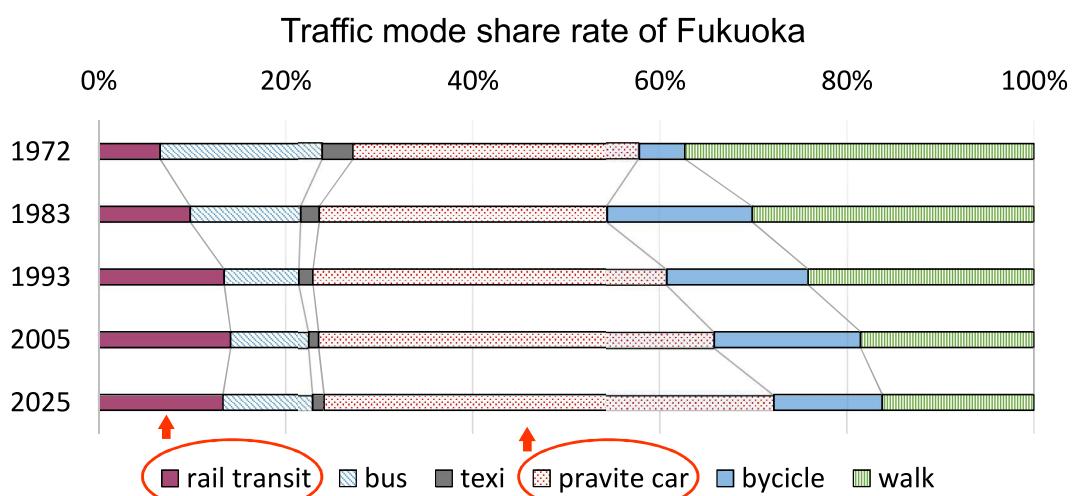
### ■ Problems in Fukuoka

1

Reduction in share rate of public transit

2

Traffic congestion



## 1.1 Background

### ■ Problems in Fukuoka

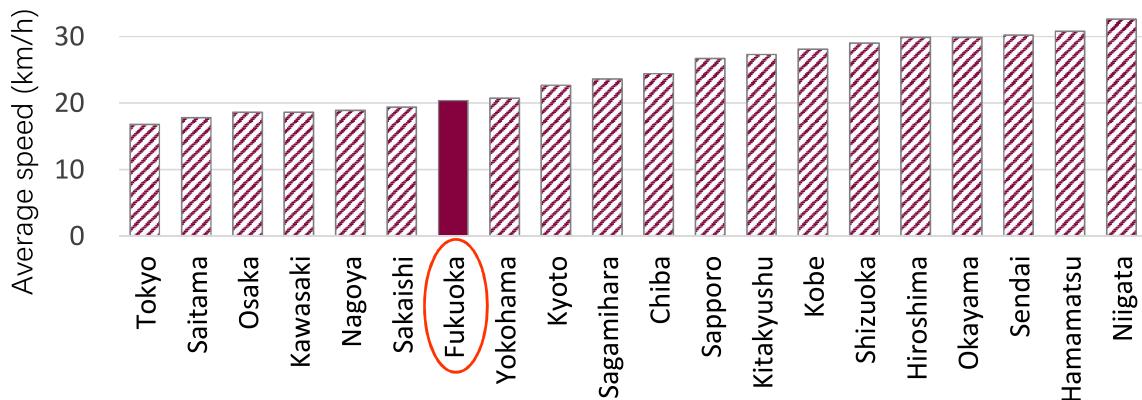
1

Reduction in share  
rate of public transit

2

Traffic congestion

Average travel speed during crowded time in major cities



## 1.2 Research purpose

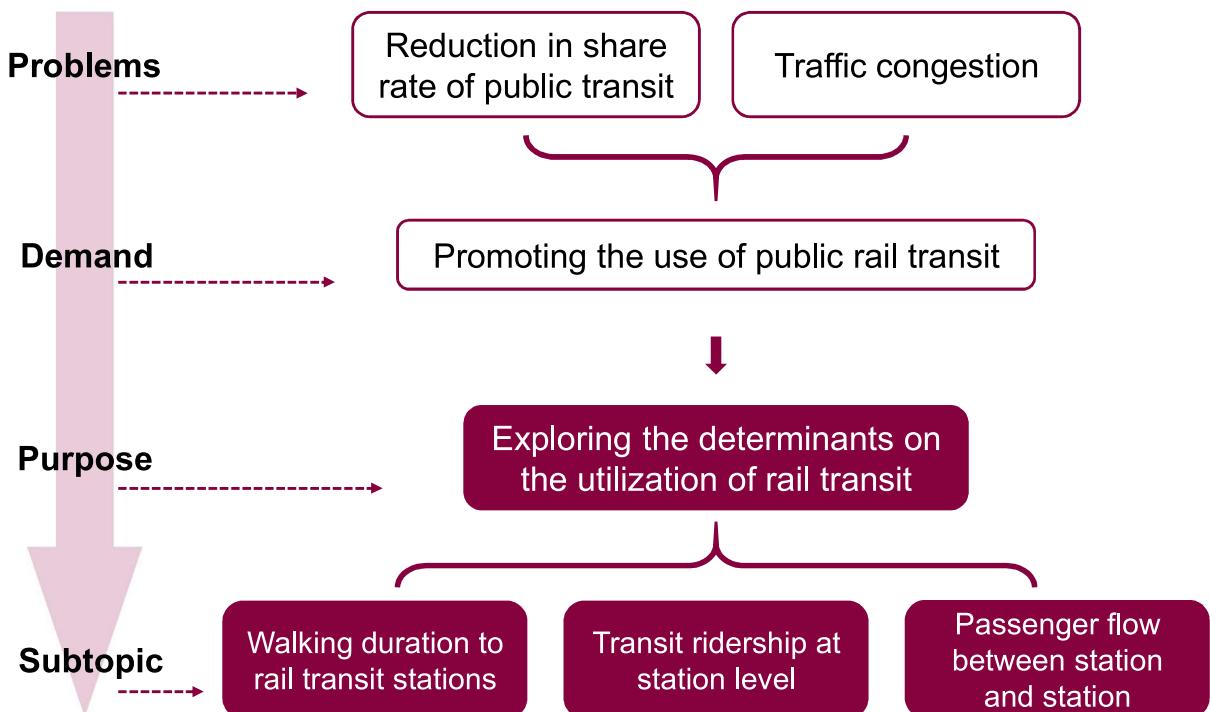
### ■ Main purpose

Exploring the factors influencing rail transit ridership from multiple perspectives and estimating the influence.

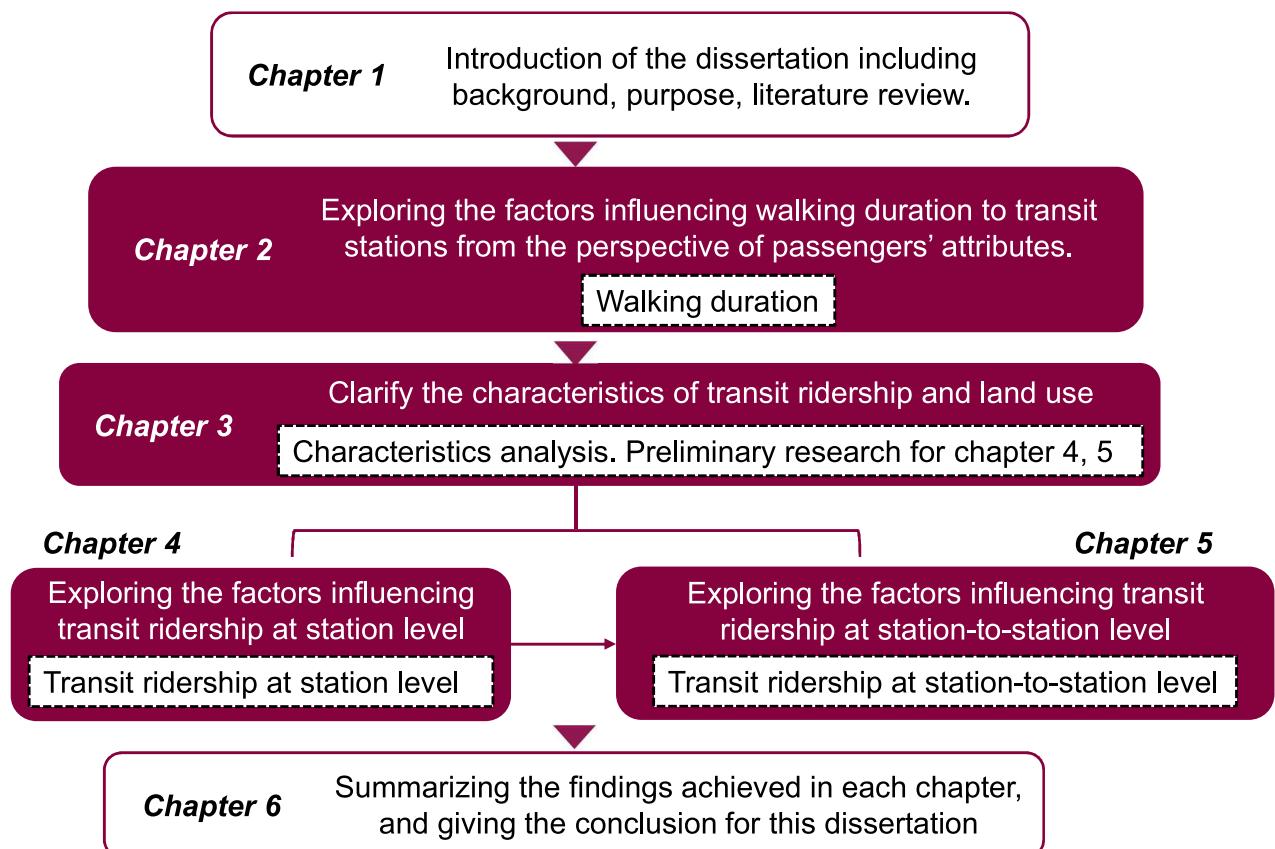
### ■ Specific issues in research

- 1 **Walking** is the most important travel modes in accessing transit stations, also one of the most key determinants on the utilization of rail transit.
- 2 **Rail transit ridership** is considered to be mainly **affected by the factors surrounding the station**.
- 3 The rail transit station is in a network. When the ridership is affected by the environmental factors around the station, **it is also influenced by the environmental factors around the other stations** in the same network.

## 1.3 Summary



## 1.4 Organization



# *Chapter 2*

## *Analyzing Willingness of Walking Duration to Transit Stations Using Socio-Demographic Characteristics*

### **2.1 Introduction**

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#### **■ Background**

- Walking is the most important travel modes in accessing transit stations.
- Walking duration to transit station is widely accepted to be an important determinants on the utilization of rail transit.

#### **■ Main purpose**

- Exploring the factors influencing walking duration to transit stations from the perspective of passengers' attributes.

## 2.1 Introduction

### ■ Review

	Study	Type 1	Type 2	Type 3	This
Research object	Walking distance	●		●	
	Walking duration		●		●
Method	Statistical description	●			
	Regression		●	●	
	Nonlinear fitting				●
Predictable	No	●	●	●	
	Yes				●
Result		Survey result description	Some factors were found, but prediction and verification were not given	No relationship found	Having relationship with travel purpose, travel time period, age, and occupation

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## 2.1 Introduction

### ■ Research contents

- Problems in previous studies

- Key points

#### Problem 1



#### 1 Function of walking duration

Most studies use qualitative methods. Few quantitative analysis obtained the significant result on estimating walking duration. The reason of that may be in the data processing, the model constructing, also model estimating.

Using probability but not the linear relationship to describe the walking duration preference of passengers with different attributes.

## 2.1 Introduction

### ■ Research contents

- Problems in previous studies

- Key points

#### Problem 2



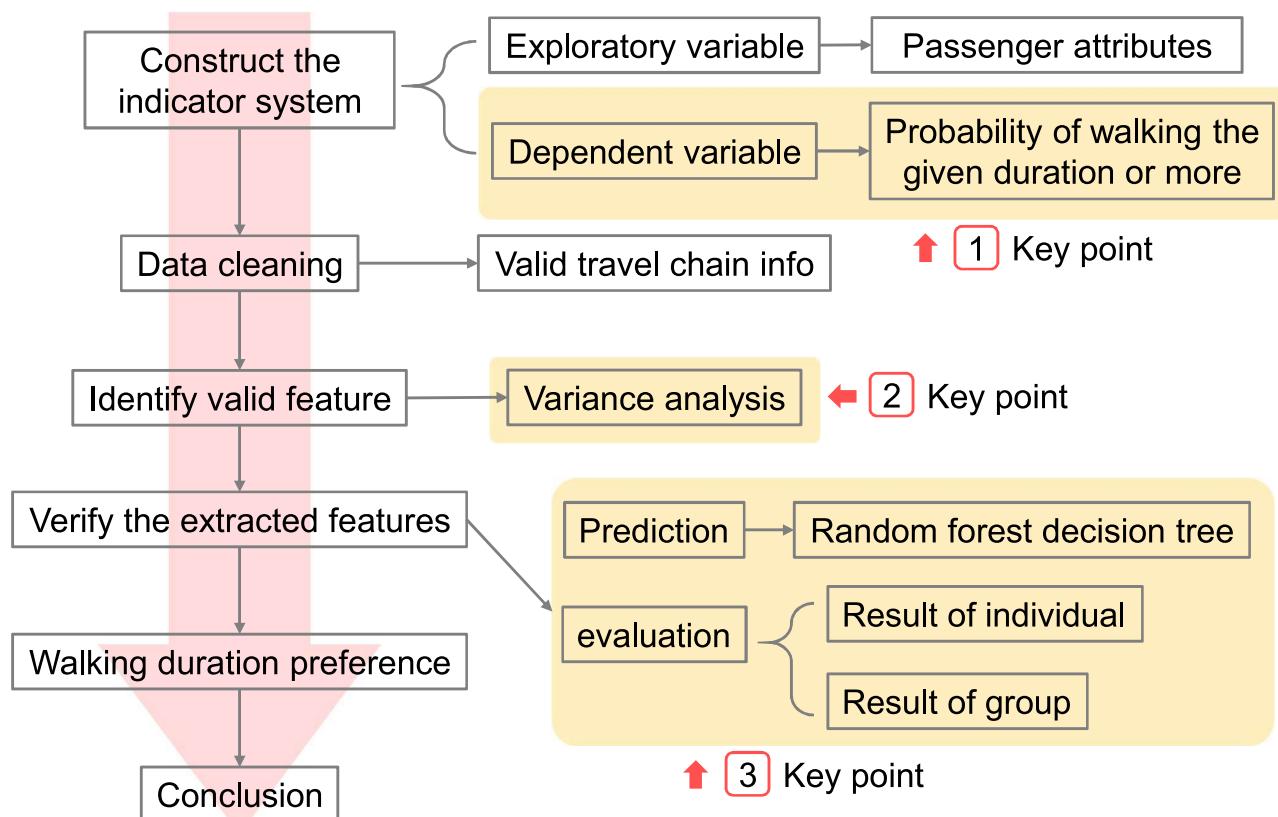
#### 2 Estimation and evaluation

Although many studies have summarized some factors affecting the walking duration through qualitative methods, **none of them quantitatively verified** the effect of the influencing factors.

To estimate the relationship between identified influencing factors and walking duration. Then evaluating the prediction to judge the effectiveness of identified influencing factors.

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## 2.1 Introduction



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## 2.2 Methods

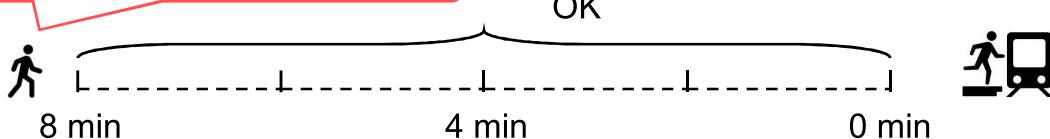
### ■ Problem description

Give an example, for one person who has the attributes:

(Male, 25 years old, student, peak hour, go to school)

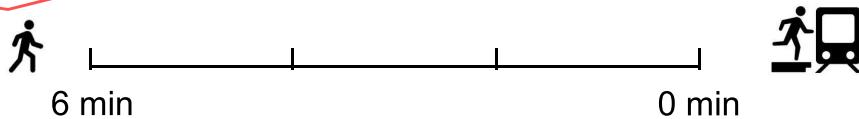
- Realistic issue

I can accept a walking duration less than 8 minutes



- Reflected in survey

I walked 6 minutes to the station



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## 2.2 Methods

### ■ Problem description



Distance



Actual walking duration

Attributes

Personal socio-demographic characteristics

Other personal attributes

Trip chain info

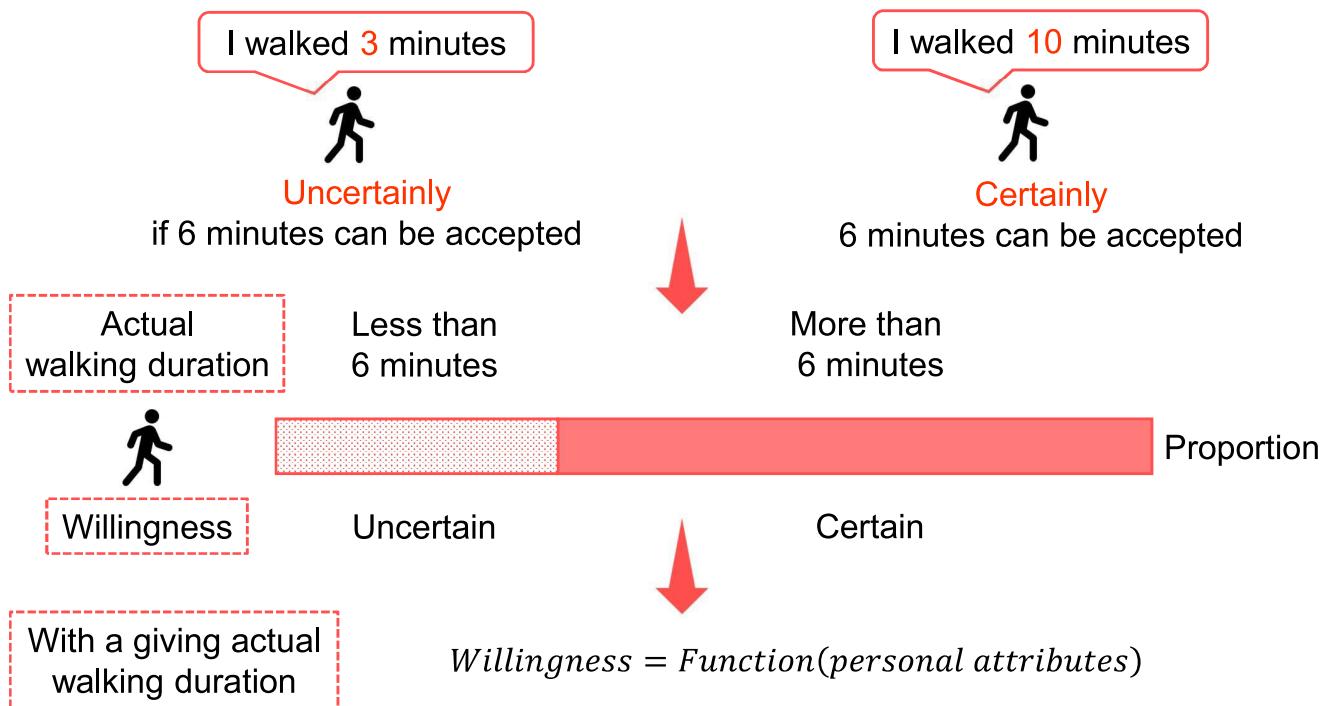
Willingness of walking duration

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## 2.2 Methods

### ■ Model construction

If investigating the **6-minute walking duration**



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## 2.3 Data

### ■ Indicators

- Dependent variable

Probability

Walk longer than the **given threshold** of walking duration

- Explanatory variables

Attributes

Personal socio-demographic characteristics

Other personal attributes

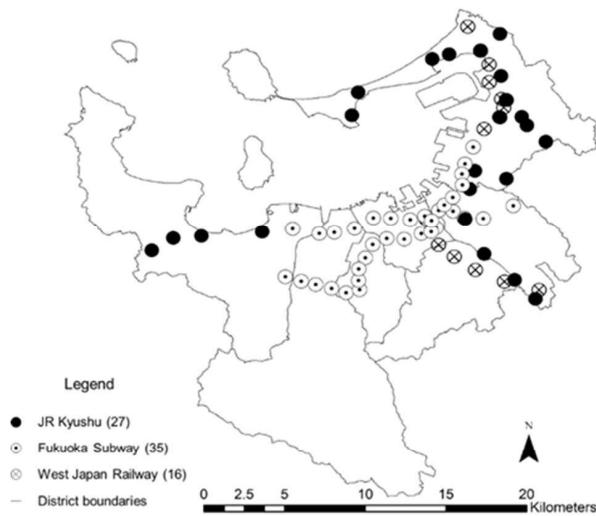
Trip chain info

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## 2.3 Data

### ■ Study case: Fukuoka

- Distribution of the transit stations



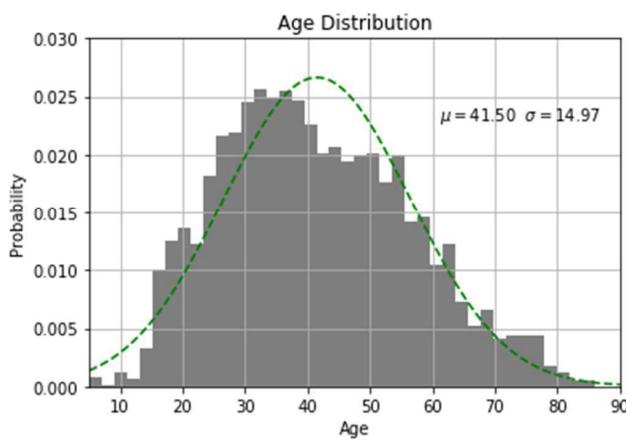
- Data in this study

Category	Feature
Trip chaining behavior	Departure location
	Departure time
	Destination location
	Arrival time
	Transport modes
	Time spent for each mode
Socio-demographic attributes	Location of bus stop or rail transit station
	Age
	Sex
	Occupation
	Trip purpose
	Vehicle/License holding
	Address

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## 2.3 Data

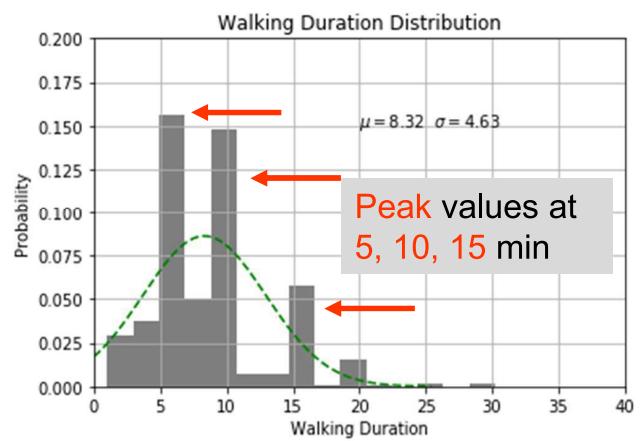
### ■ Distribution characteristics



- The age distribution of passengers



The passengers aged between 25-55 who are still at production age account for the majority



- Distribution of walking duration



People tend to reply a looser answer when they are being asked some questions about details.

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## 2.4 Selection of valid features

### ■ Selection of thresholds

- According to the distribution of walking duration in Fukuoka, the acceptable walking duration mainly range from **5 – 13 minutes**.
- In this study, the average walking duration is about **8 minutes**.

The thresholds selected in this study is **5, 8, 13 minutes**.

### ■ Identification of valid features (analysis of variance)

- 5 minutes

Age over 65  
Peak hour  
No occupation  
purpose of work  
purpose of business  
purpose of entertainment  
purpose of going home

- 8 minutes

Female  
Age from 25 to 44  
Peak hour  
Purpose of work  
Purpose of business  
Purpose of entertainment  
Purpose of going home

- 13 minutes

Age from 45-64  
Peak hour  
purpose of work  
purpose of entertainment

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## 2.5 Prediction and evaluation

### ■ Decision tree and forest random

- Reason for choosing decision tree

Used as an **exploratory method** for the dataset **with unknown feature distribution**

- Reason for adding forest random

**Reduce the possibility of over-fitting** of data which is easily occurred in the decision tree model.

### ■ Flow

Input    50% training set

50% testing set

Train the model

Get the rule

Verify the model

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## 2.6 Prediction and evaluation

- Predictive power of individual



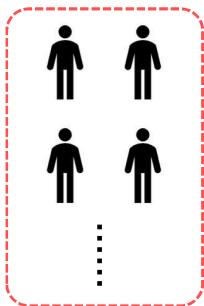
Object: Individual

Index: Kappa indicator

Range



- Predictive power of group trends



Object: Group of 200 individuals

Index: Coefficient of determination

Range



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## 2.6 Prediction and evaluation

5 minutes

8 minutes

13 minutes

- Predictive power of individual

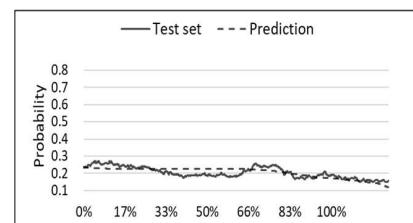
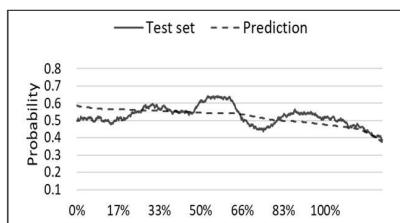
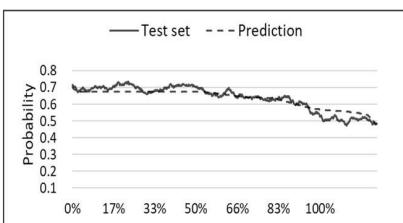
Kappa index

0.142

0.016

0.060

- Predictive power of group trends



Coefficient of determination

0.843

0.221

0.426

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## 2.7 Conclusion

### ■ Findings

#### Prediction

- 5 minutes threshold

Individual: 0.142

Group trend: 0.843

#### Walk more

- Business purpose
- Private purpose
- Going home purpose
- Older than 65
- No occupation

#### Walk less

- Peak hour
- Commuting to work

- 8 minutes threshold

Individual: 0.016

Group trend: 0.221

- Business purpose
- Private purpose
- Going home purpose

- Age between 25-44
- Female
- Peak hour
- Commuting to work

- 13 minutes threshold

Individual: 0.060

Group trend: 0.426

- Private purpose

- Age between 45-64
- Peak hour
- Commuting to work

## 2.7 Conclusion

### ■ Summary

#### ● Problems

- 1 Little quantitative relationship between walking duration and passengers' attributes was found.

#### ● Achievements

Describe passengers' walking duration preferences using the **probability** of walking longer than a given threshold.

- 2 Few of the existing studies quantitatively verified the effect of influencing factors

The effect of influencing factors is **predicted**, the results are **evaluated** from the view of **both individual and group**.

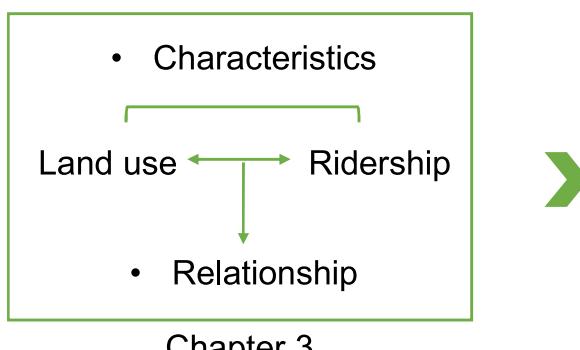
# *Chapter 3*

## *Analysis on the Characteristics of Transit Ridership and Land Use*

### 3.1 Introduction

#### ■ Research position

- Preliminary study
- Ridership Estimation



- Station level
- Station-to-station

→ Chapter 4  
→ Chapter 5

#### ■ Purpose

To **grasp** the **characteristics** of transit stations in terms of both transit ridership and land use in Fukuoka.

## 3.1 Introduction

### ● Problems

#### Problem 1

The characteristics of rail transit ridership and land use in Fukuoka needs to be clarified.

### ● Key points

#### → 1 Characteristics of transit ridership

Summary the characteristics of rail transit ridership in spatial and temporal distribution

#### → 2 Characteristics of land use

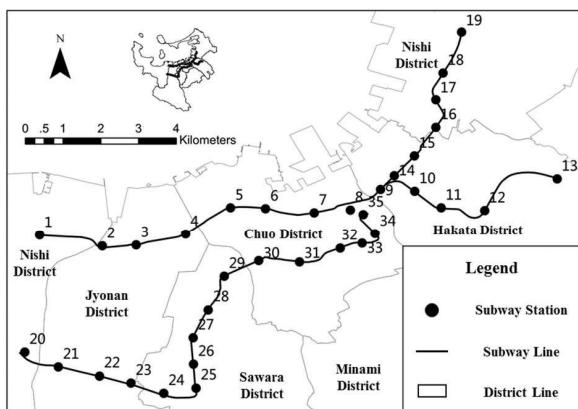
Analyze the characteristics of land use around the subway in terms of the type of land use

#### → 3 Relationship between rail transit ridership and land use

Preliminary explore the relationship between rail transit ridership and land use

## 3.2 Data

### ■ Study case



- Fukuoka subway
- 35 subway stations
- 3 operating subway lines
- 29.8 km operating mileage
- 20% share of motorized travel

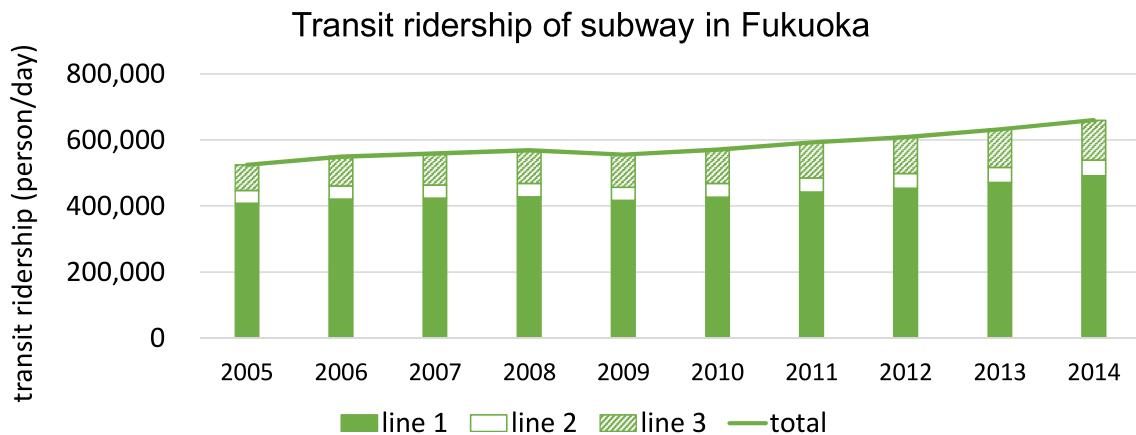
### ■ Data source

Item	Source	Data accuracy	Time point
Subway transit ridership	Fukuoka Traffic Bureau	Station	2005-2014
Population	Resident Basic Account	Town-chome	2005-2014
Land use	Urban Planning Basic Survey	Building	2003, 2008, 2012

### 3.3 Characteristics of transit ridership and land use

#### ■ Transit ridership characteristics

- Trends of variation in transit ridership

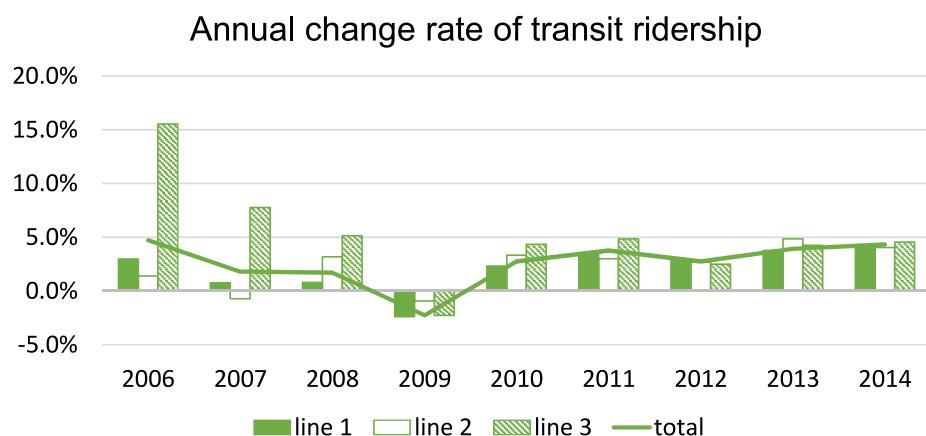


- Growth trend.
- More than 600,000 passengers per day.
- Significant difference in ridership among the three lines.

### 3.3 Characteristics of transit ridership and land use

#### ■ Transit ridership characteristics

- Annual growth rate of transit ridership

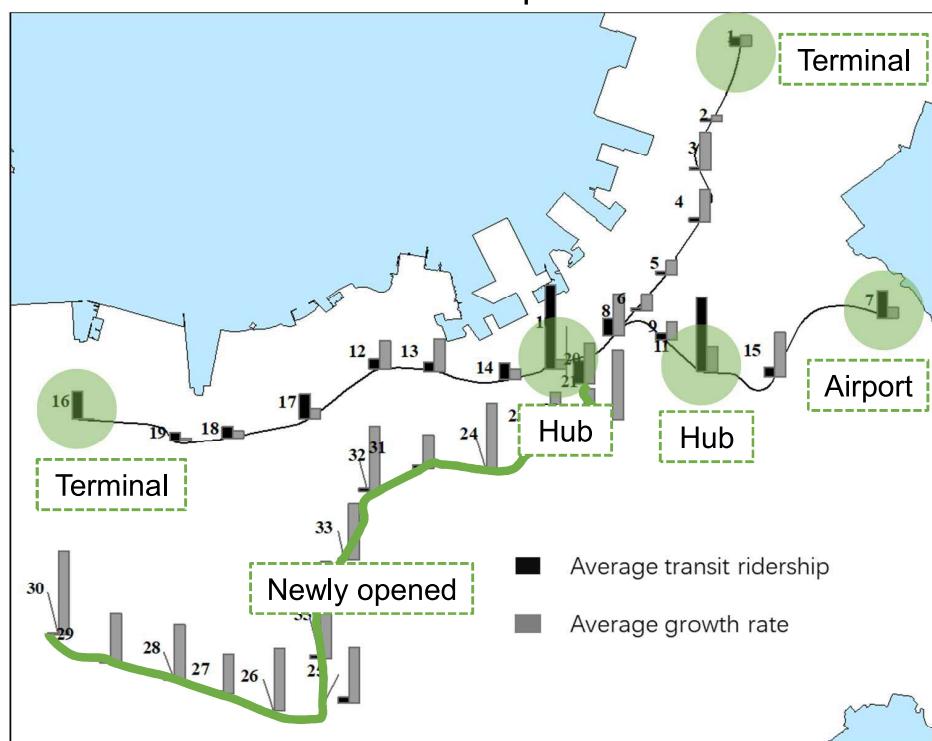


- Line 3 had a much higher growth rate at the first few years of the opening
- The growth rate of three lines tend to be stable after the year of 2009

### 3.3 Characteristics of transit ridership and land use

#### ■ Transit ridership characteristics

- Spatial distribution of transit ridership



### 3.3 Characteristics of transit ridership and land use

#### ■ Transit ridership characteristics

- Classification based on transit ridership

Transit ridership	Total	Line 1	Line 2	Line 3
Hub	2	2	0	0
Large	4	3	0	1
Medium	11	8	1	2
Small	18	0	4	4

#### Line 1

- Large scale
- Low growth rate

#### Line 2

- Small scale
- Low growth rate

#### Line 3

- Small scale
- High growth rate

Growth rate	Total	Line 1	Line 2	Line 3
0-2.5	12	8	4	0
2.5-4.5	11	5	2	4
4.5-6.0	6	0	0	6
6.0-	6	0	0	6

### 3.3 Characteristics of transit ridership and land use

#### ■ Land use characteristics

- Correlation analysis for indicators

Indicator	1	2	3	4	5	6	7	8	9	10
1. Business	1.000	0.848	0.987	0.775	-0.385	0.378	0.848	0.615	0.006	0.656
2. Commerce	0.848	1.000	0.828	0.765	-0.293	0.345	0.734	0.645	0.065	0.530
3. Hotel	0.987	0.828	1.000	0.716	-0.361	0.382	0.815	0.585	0.000	0.619
4. Entertainment	0.775	0.765	0.716	1.000	-0.322	0.281	0.663	0.439	-0.018	0.552
5. Residence	-0.385	-0.293	-0.361	-0.322	1.000	0.205	-0.287	-0.164	-0.175	-0.063
6. Apartment house	0.378	0.345	0.382	0.281	0.205	1.000	0.649	0.408	0.087	0.729
7. Dwelling with shop	0.848	0.734	0.815	0.663	-0.287	0.649	1.000	0.641	0.038	0.808
8. Government	0.615	0.645	0.585	0.439	-0.164	0.408	0.641	1.000	0.395	0.549
9. Education	0.006	0.065	0.000	-0.018	-0.175	0.087	0.038	0.395	1.000	-0.012
10. Culture	0.656	0.530	0.619	0.552	-0.063	0.729	0.808	0.549	-0.012	1.000



High correlation ( $>0.7$ )

### 3.3 Characteristics of transit ridership and land use

#### ■ Land use characteristics

- Factor extraction

Indicator	Component Matrix		
	Component		
	1	2	3
Office	0.962	0.122	0.060
Hotel	0.934	0.123	0.050
Commerce	0.878	0.105	0.131
Entertainment	0.850	0.044	-0.030
Dwelling with shop	0.834	0.417	0.125
Apartment house	0.301	0.860	0.134
Residence	-0.521	0.620	-0.234
Education	-0.066	-0.039	0.958
Culture	0.627	0.644	0.057
Government	0.570	0.305	0.582

#### Factor 1: Office & commerce

- Office
- Hotel
- Commerce
- Entertainment
- Dwelling with shop
- Culture

#### Factor 2: Residence

- Apartment house
- Residence
- Culture

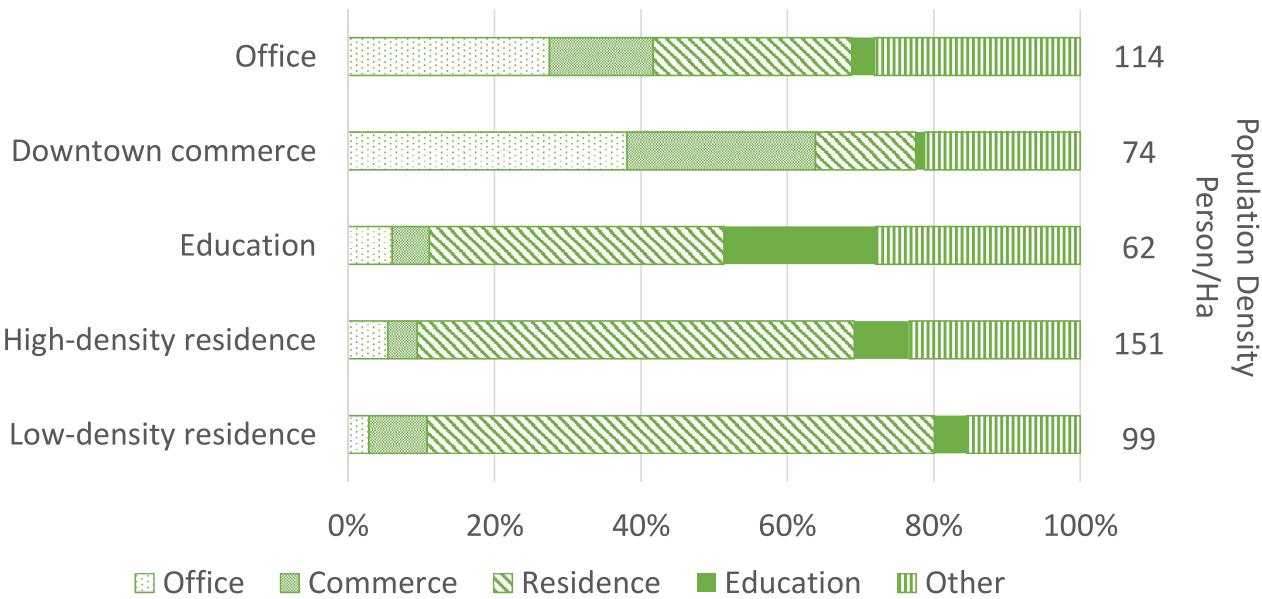
#### Factor 3: Education

- Education
- Government

## 3.4 Characteristics of transit ridership and land use

### ■ Land use characteristics

- Station classification based on land use



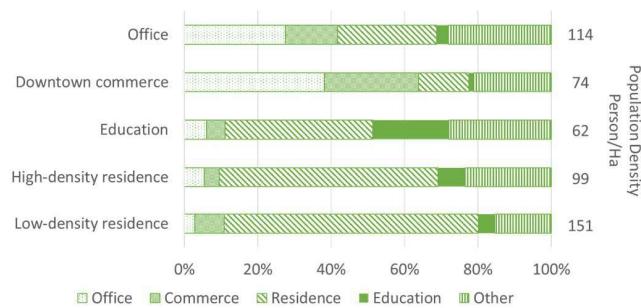
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## 3.4 Exploration the influence on transit ridership

### ■ General relationship

Type	Hub	Large-scale	Medium-scale	Small-scale
Low-density residence	0	0	0	9
High-density residence	0	2	4	3
Education	0	0	1	5
Downtown commerce	2	1	2	0
Office	0	0	3	2



- Transit ridership



- Land use

- Characteristics

- Large differences in different types
- Low density = Low ridership
- Commercial center = High ridership

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## 3.4 Exploration the influence on transit ridership

### ■ Statistical relationship - quantification method I

#### ● Part 1

Factor category	Category	Number	Score	Range
population density (person/ha)	0-40	3	4644	
	40-80	13	2283	
	80-120	8	164	13004
	120-160	8	-2481	13.84%
	160-	3	-8360	
Commerce & Office (m <sup>2</sup> )	0-100,000	16	-6249	
	100,000-400,000	9	-6617	43288
	400,000-1,000,000	5	-4765	46.07%
	1,000,000-	5	36671	
Residence (m <sup>2</sup> )	0-300,000	4	-1450	
	300,000-800,000	20	-5575	16240
	800,000-	11	10664	17.28%
Government (m <sup>2</sup> )	0-1,000	13	-2957	
	1,000-10,000	9	-5501	12267
	10,000-	13	6766	13.06%
Education (m <sup>2</sup> )	0-10,000	5	4842	
	10,000-50,000	11	993	9159
	50,000-100,000	11	-4317	9.75%
	100,000-	8	1544	
Independent variable Transit ridership		Sample size	35	
		Coefficient of determination	0.513	

#### Dependent variable

- Transit ridership per day

#### Explanatory variables

- Population density
- Commerce & office
- Residence
- Education

#### Coefficient of determination

- 0.513

#### Key factors

- Commerce area
- Office area

## 3.4 Exploration the influence on transit ridership

### ■ Statistical relationship - quantification method I

#### ● Part 2

Factor category	Category	Number	Score	Range
population density (person/ha)	0-40	3	0.0155	
	40-80	13	0.0020	
	80-120	8	-0.0001	0.0265
	120-160	8	-0.0110	28.44%
	160-	3	0.0056	
Commerce & Office (m <sup>2</sup> )	0-100,000	16	-0.0016	
	100,000-400,000	9	0.0006	0.0097
	400,000-1,000,000	5	0.0069	10.44%
	1,000,000-	5	-0.0028	
Residence (m <sup>2</sup> )	0-300,000	4	-0.0183	
	300,000-800,000	20	0.0043	0.0226
	800,000-	11	-0.0012	24.31%
Government (m <sup>2</sup> )	0-1,000	13	0.0111	
	1,000-10,000	9	0.0008	0.0228
	10,000-	13	-0.0117	24.54%
Education (m <sup>2</sup> )	0-10,000	5	-0.0078	
	10,000-50,000	11	-0.0025	0.0114
	50,000-100,000	11	0.0034	12.27%
	100,000-	8	0.0036	
Independent variable Growth rate of transit ridership		Sample size	35	
		Coefficient of determination	0.537	

#### Dependent variable

- Growth rate of transit ridership

#### Explanatory variables

- Population density
- Commerce & office
- Residence
- Government
- Education

#### Coefficient of determination

- 0.537

#### Key factors

- Population density

## 3.5 Conclusion

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- Summary

- Through the summary and analysis, we got a **comprehensive understanding** of rail transit utilization and land use status in the case of Fukuoka City.
- **Provided foundation and references** for the further exploration on the determinants on transit ridership

- Implications

- **Pedestrian area** should be considered.
- **Explanatory variables** should be enriched.
- **Model** should be improved.
- The approach of dealing with **small sample case** should be considered.

## *Chapter 4*

### *Influencing Factors on Transit Ridership at Station Level*

## 4.1 Introduction

### ■ Background

- Rail transit ridership is considered to be mainly **affected by the environmental factors surrounding the station**.
- The influencing factors are different in cities with different urban form and travel preference. **Few studies focus on such a city like Fukuoka with only tens rail transit stations.**

### ■ Main purpose

- Explore and explain the factors influencing subway ridership **at station level** using a **small sample case**

## 4.1 Introduction

### ■ Review

Study type		Type 1	Type 2	Type 3	This
Sample size	Tens				●
	Hundreds	●	●	●	
Method	Linear regression	●	●	●	
	Spatial regression				●
Catchment area	Circle buffer	●	●		
	Walking distance			●	●
Indicators	Land use		●	●	●
	Transit-relation	●	●	●	●
	Demographic-relation	●			●

## 4.1 Introduction

### ■ Research contents

- Problems in previous studies

- Key points

#### Problem 1

Index system need to be enriched

#### 1 Improve index system

Propose and reconstruct indicators to improve the index system

#### Problem 2

Few studies work on the selection of valid indicators using small sample case.

#### 2 Identify valid indicators

Propose effective index screening method for small samples

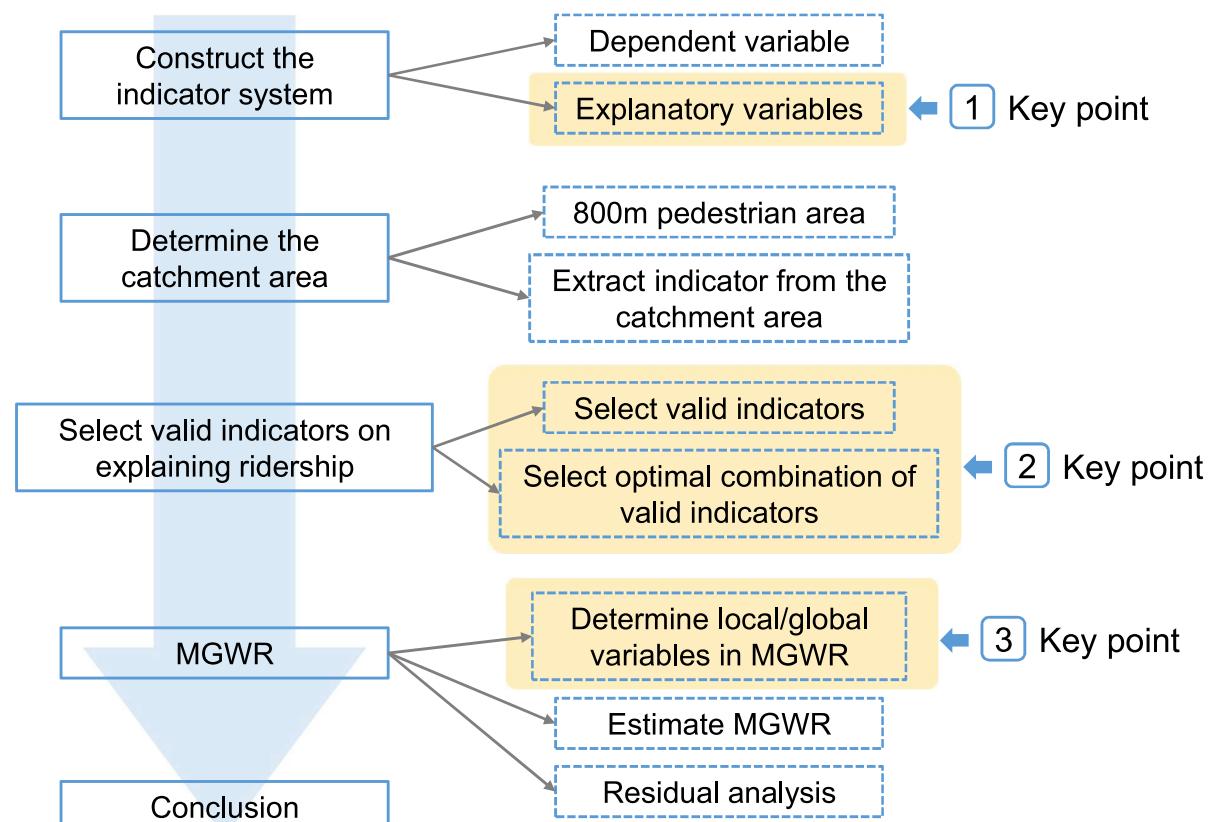
#### Problem 3

The consideration of spatial correlation among the explanatory variables is inadequate.

#### 3 Improve accuracy in estimation

Consider the different spatial distribution of indicators in the spatial regression model by identifying global/local variables.

## 4.1 Introduction



## 4.2 Indicators

### ■ Variable summary

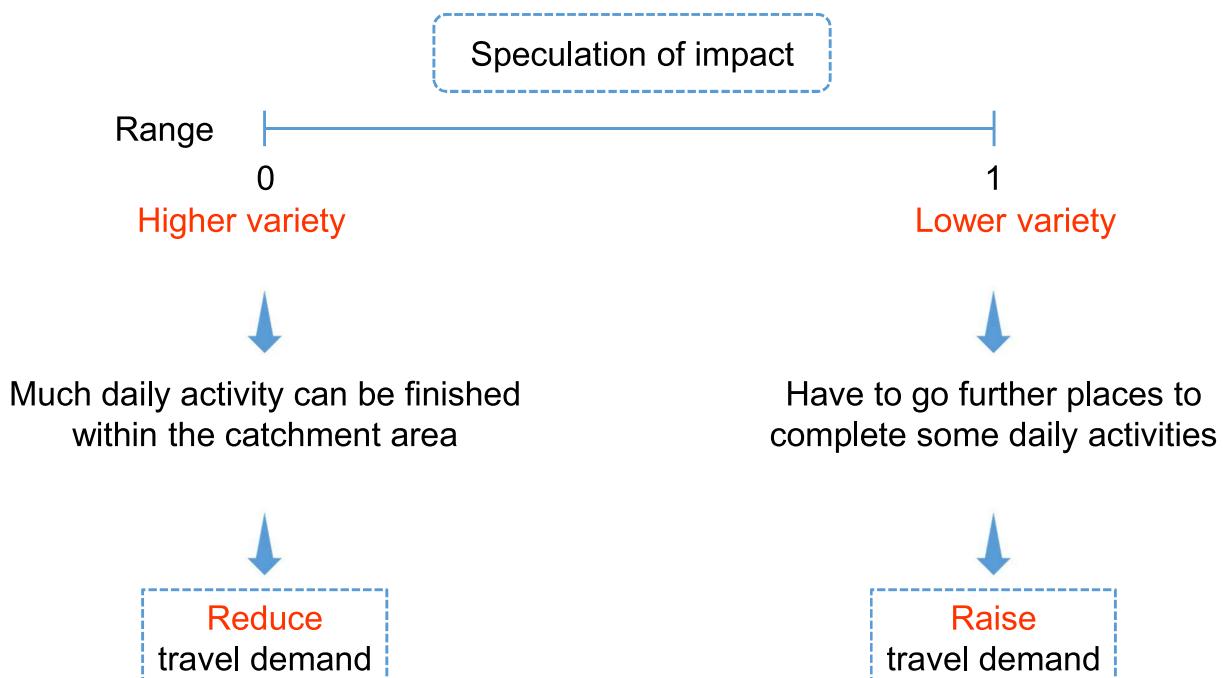
Category	Variable	Expected sign	Min Value	Max Value	Average	Unit
Built environment	Commerce	+	2,921	811,281	114,353	m <sup>2</sup>
	Office	+	2,614	839,956	167,088	m <sup>2</sup>
	Residence	+	110,748	1,067,523	528,533	m <sup>2</sup>
	Education	+	294	305,559	59,691	m <sup>2</sup>
	Government	+	-	128,471	20,878	m <sup>2</sup>
	Transportation Facility Area	+	197	132,777	21,204	m <sup>2</sup>
Transportation Accessibility	Land use Aggregation	+	0.09	0.75	0.31	-
	Transfer Dummy	+	1	4	1.34	-
	Bicycle Parking	Unknown	64	4,375	778	-
	Bus Capacity	Unknown	3	260	58.48	-
Demographic and Socioeconomic Environment	Bus Accessibility	Unknown	4	455	89.71	-
	Road Density	-	191	479	299	m/ha <sup>2</sup>
	Population	+	1,908	19,393	9,813	-
	House Member	-	1.86	2.79	2.18	-
Demographic and Socioeconomic Environment	Population/Job Balance	Unknown	1.27	2.61	1.80	-
	Tenant Proportion	-	0.15	0.65	0.43	%

■ Dependent variable: average daily subway ridership

## 4.2 Indicators

### ■ Variable interpretation

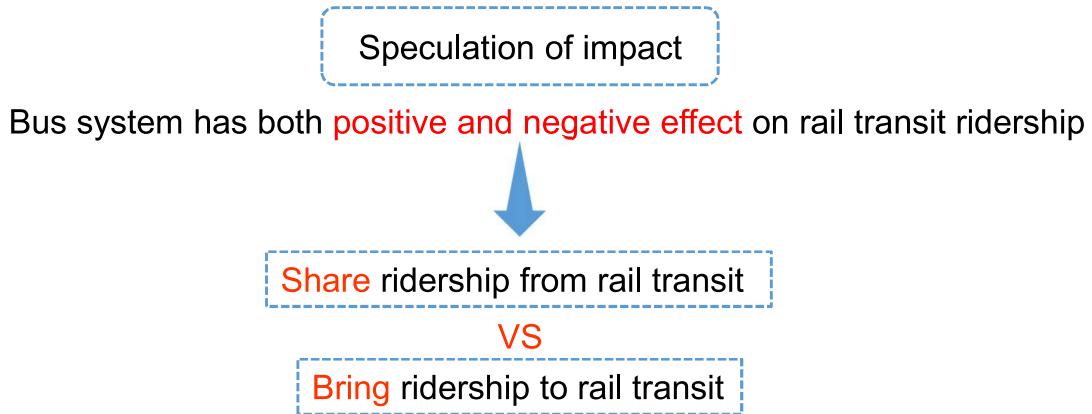
- Land-use Aggregation



## 4.2 Indicators

### ■ Variable interpretation

- Indicators of bus system



- Bus capacity

Share passengers from rail transit. **Negative effect** on rail transit ridership

- Bus Accessibility

Bring passengers to rail transit. **Positive effect** on rail transit ridership

## 4.3 Catchment area

### ■ Walking distance

- In general

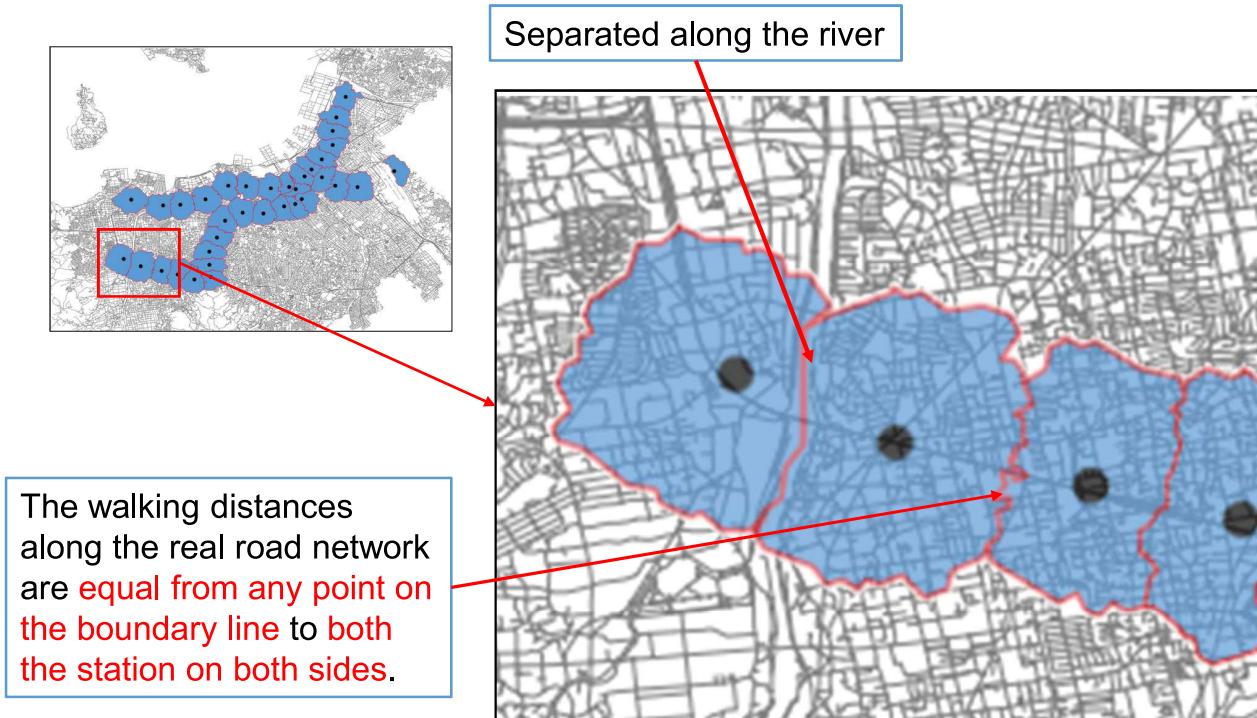
- Catchment area: walking distance accessing the subway station.  
(Pedestrian Catchment Area, PCA)
- Pedestrian area range: **400m ~ 1000m**
- Most adopted: **800m**

- In the case of Fukuoka

- Walking speed: about **4.8km/h**
- **Average** walking distance: **about 600m**
- **85%** of passengers walk to stations

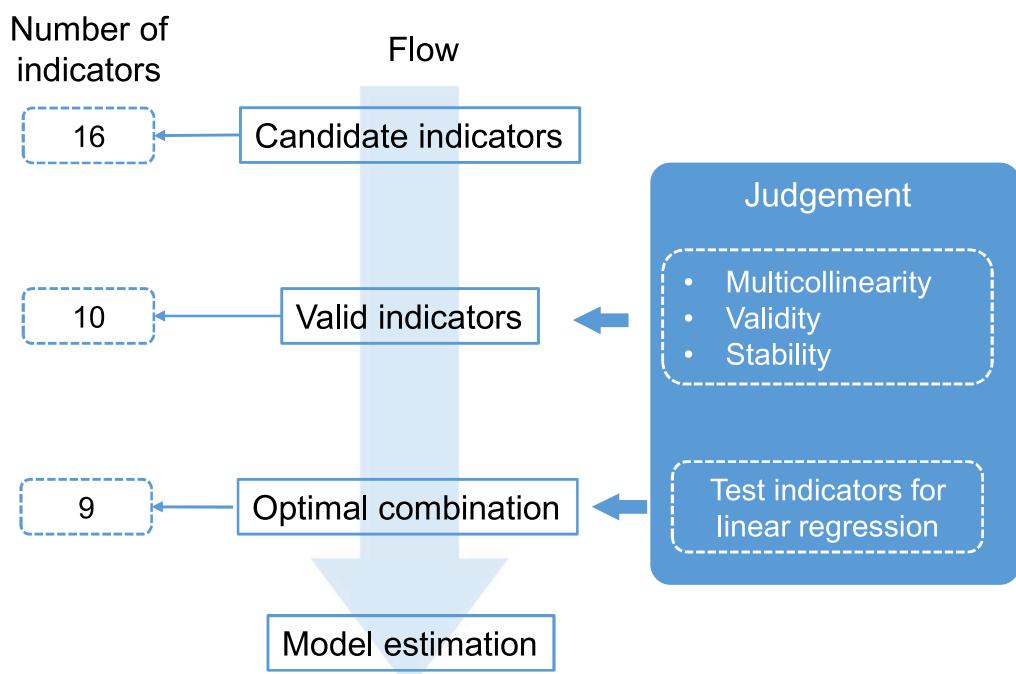
Use **800m** pedestrian area as the catchment area of rail transit.

## 4.3 Catchment area



## 4.4 Identification of valid factors

### ■ Flowchart of screening valid factors with small sample



## 4.5 Model estimation

### ■ Identification for global/local variable

Variable	Moran's Index	P-value*			Pattern	Type
Government Area	0.04	0.51			Random	Global
Transportation Facility	0.29	0.00			Clustered	Local
Land use Aggregation	-0.01	0.84			Random	Global
Transfer Dummy	0.13	0.12			Random	Global
Bicycle Parking	-0.12	0.36			Random	Global
Bus Capacity	0.70	0.00	P > 0.05	Pattern: Random Type: Global	Clustered	Local
Bus Accessibility	0.45	0.00			Clustered	Local
Population/Job Balance	0.77	0.00			Clustered	Local
Tenant Proportion	0.24	0.01	P ≤ 0.05	Pattern: Clustered Type: Local	Clustered	Local

## 4.5 Model estimation

### ■ Estimation of Mix Geographically Weighted Regression

Variable	Unit	Type	MGWR model	
			B	t
Government Area	m <sup>2</sup>	Global	0.05	2.59
Land Use Aggregation	coef (0-1)	Global	13,384.34	2.48
Transfer Dummy	dummy	Global	5,968.65	4.98
Bicycle Parking	count	Global	7.72	8.59
Transport Area	m <sup>2</sup>	Local	0.10	-
Bus Capacity	coef	Local	-55.14	-
Bus Accessibility	coef	Local	48.61	-
Population/Job Balance	coef	Local	-2,411.17	-
Tenant Proportion	%	Local	-10,304.66	-

## 4.6 Conclusion

### ■ Summary

- Problems

- 1 Indicator system need to be enriched



Reorganized the indicator system.  
Proposed the indicators of **land use variety, bus capacity and bus accessibility.**

- 2 Selection of effective indicators under small sample



To reduce the first and second type of statistical error in small sample case, use **exploratory regression to screen effective indicators** and the most metric combinations.

- 3 Insufficient consideration of spatial relevance of indicators



**Identified global/local indicator** in MGWR using the spatial autocorrelation of indicators.

## Chapter 5

*Impact of Land Use Types on Transit Ridership  
between Stations and Stations*

## 5.1 Introduction

### ■ Background

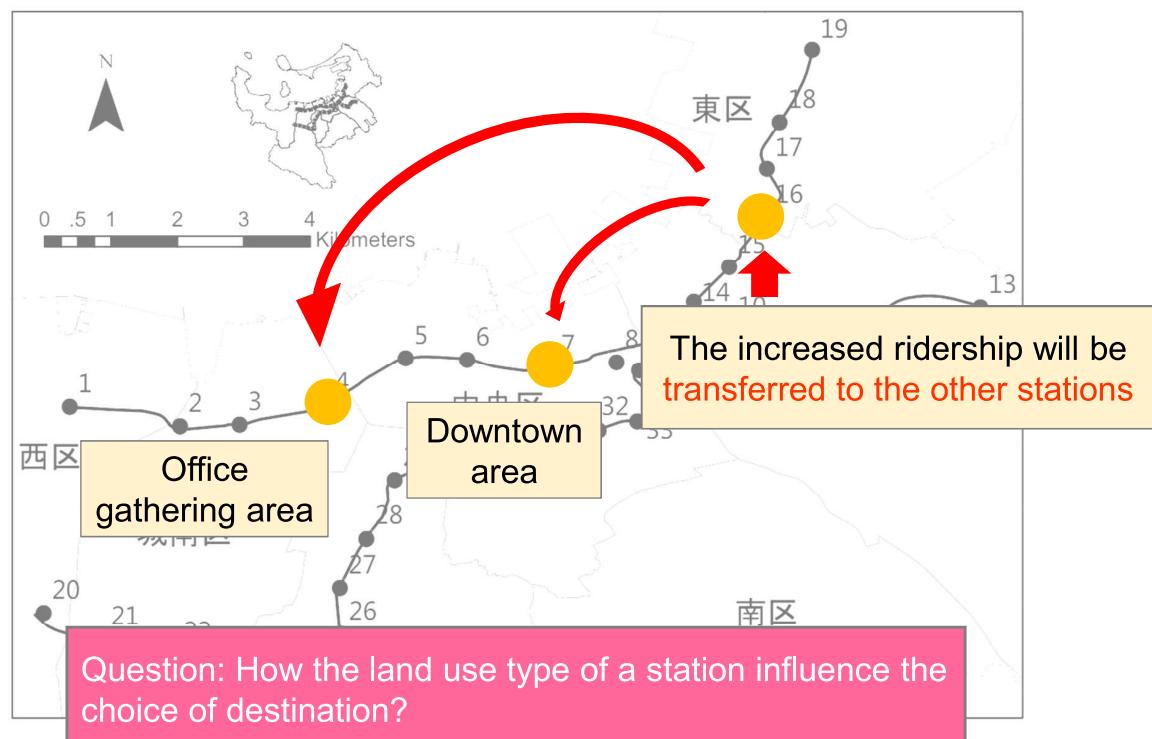
- The rail transit station is in a network. When the ridership is affected by the environmental factors around the station, it is **also influenced by the environmental factors around the other stations** in the same network.
- Land use determines travel purpose in some extent. The variation in the **land use of departure station** can affect the **choice of travel destination**.

### ■ Main purpose

- Explore the impact of land use on the choice of destination station.

## 5.1 Introduction

### ■ Background



## 5.1 Introduction

### ■ Review

- Differences with station-level

	Type 1	Type 2	This
Scale	Station-level	Station-to-station level	Station-to-station level
Research object	Transit ridership of a single station	Transit ridership between station and station	Probability of choosing the a specific station as the destination
Functional relationship	Linear relationship	Linear relationship	Probability relationship (Binary choice)

## 5.1 Introduction

### ■ Research contents

- Problems in previous studies

Problem 1

How to describe and **define the passenger flow** between station and station?



1

Describe the passenger flow between station and station using the **probability of choosing a specific station as the destination**.

- Key points

Problem 2



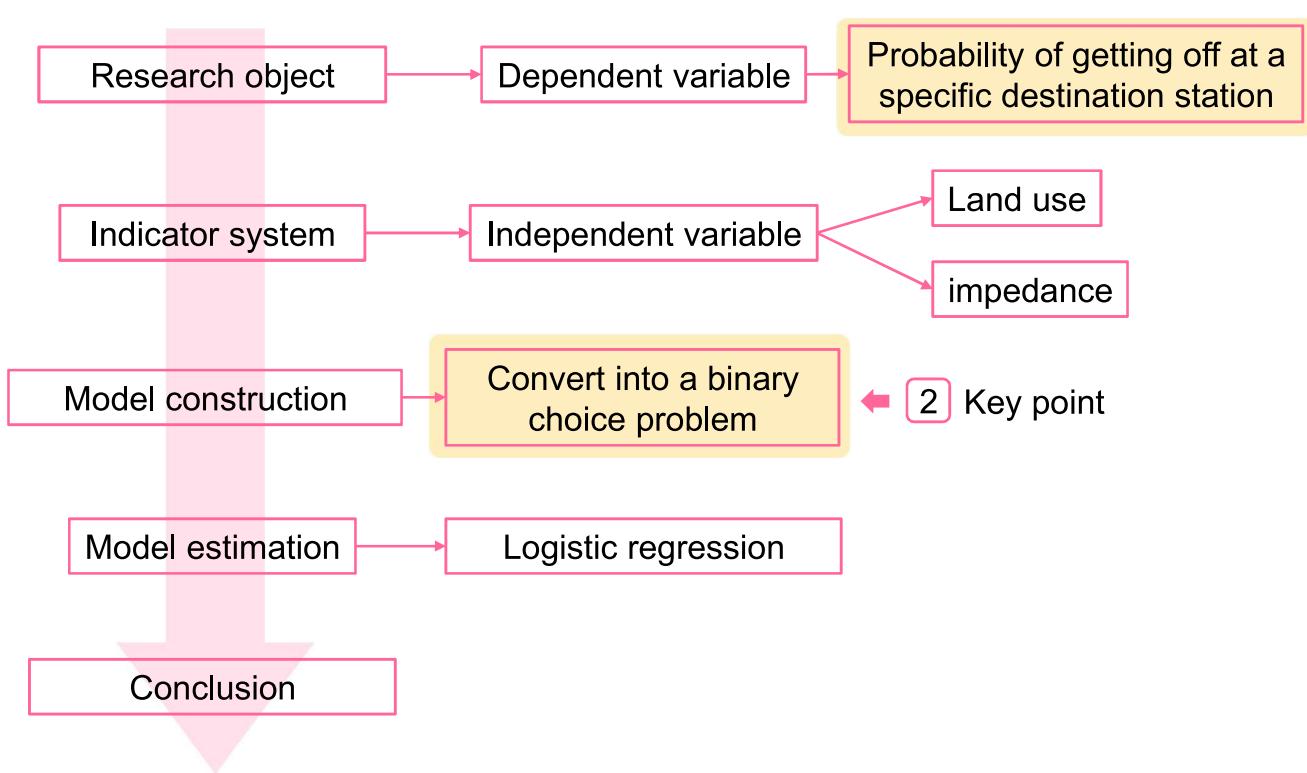
2

How to establish the **functional relationship** between the passenger flow and land use?

Convert the problem of passenger flow to a **binary choice problem**, then estimate the influence of land use on the choice of destination.

## 5.1 Introduction

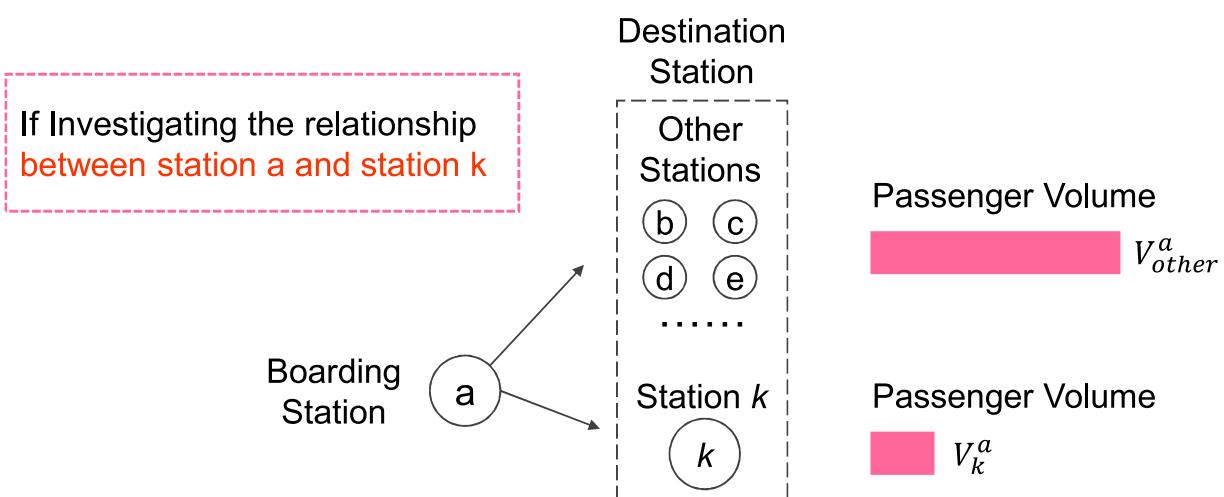
### ■ Flowchart



## 5.2 Research object

### ■ Dependent variable

- Probability of choosing the destination



Expression

$$P_k^a = \frac{V_k^a}{V_{other}^a + V_k^a}$$

## 5.3 Indicator system

### ■ Explanatory variables

- Land use

- Residence proportion
- Office proportion
- Land-use aggregation
- Commerce proportion
- Education proportion

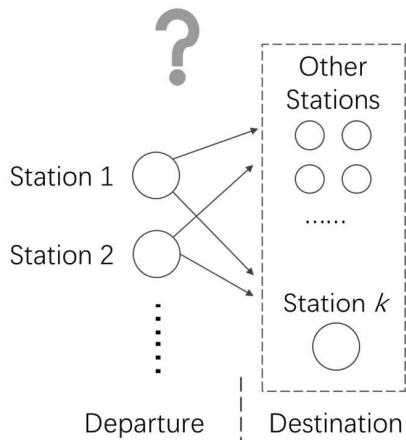
- Impedance

- Bus capacity
- Bus accessibility
- Operation distance of subway

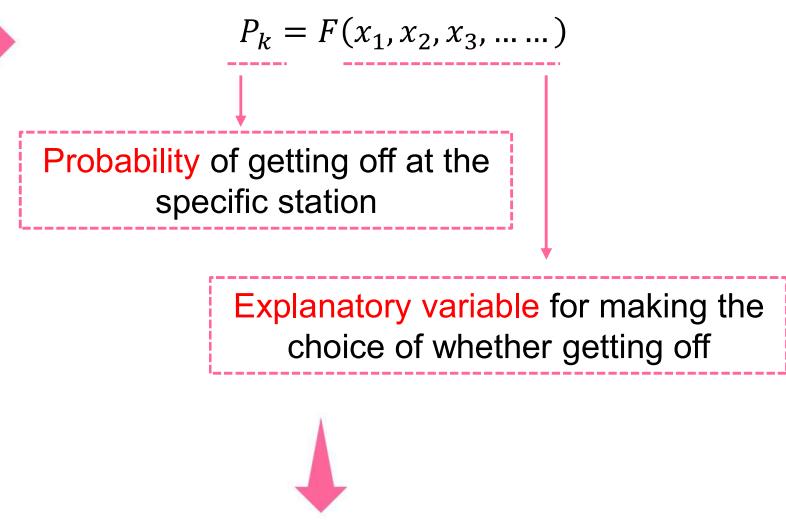
## 5.4 Method

### ■ Mathematical problems

- Passenger flow

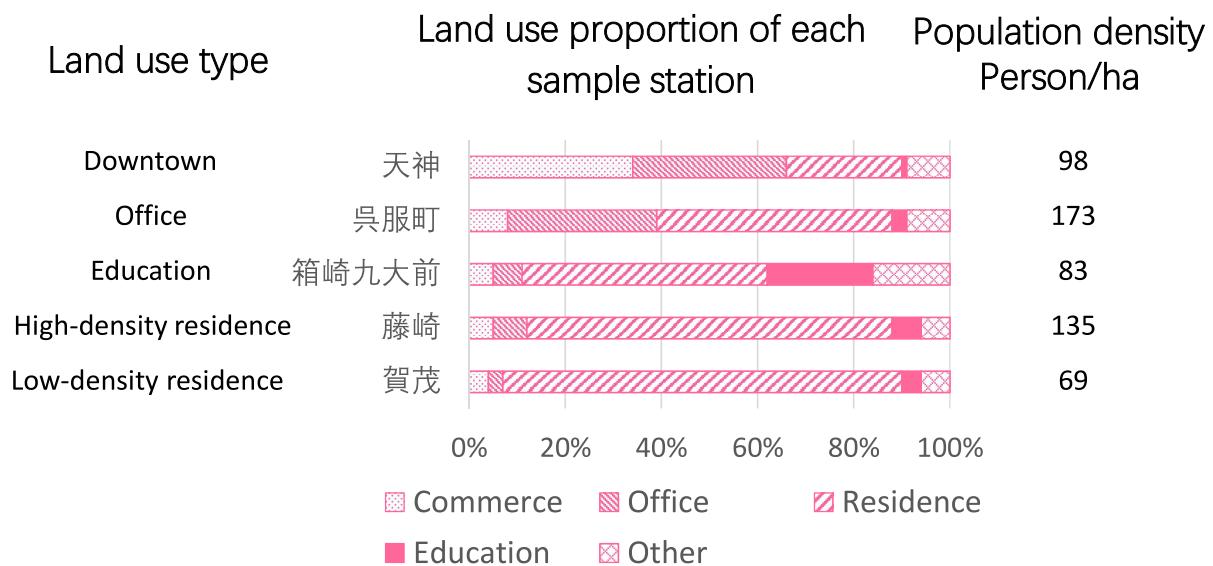


- Binary choice model



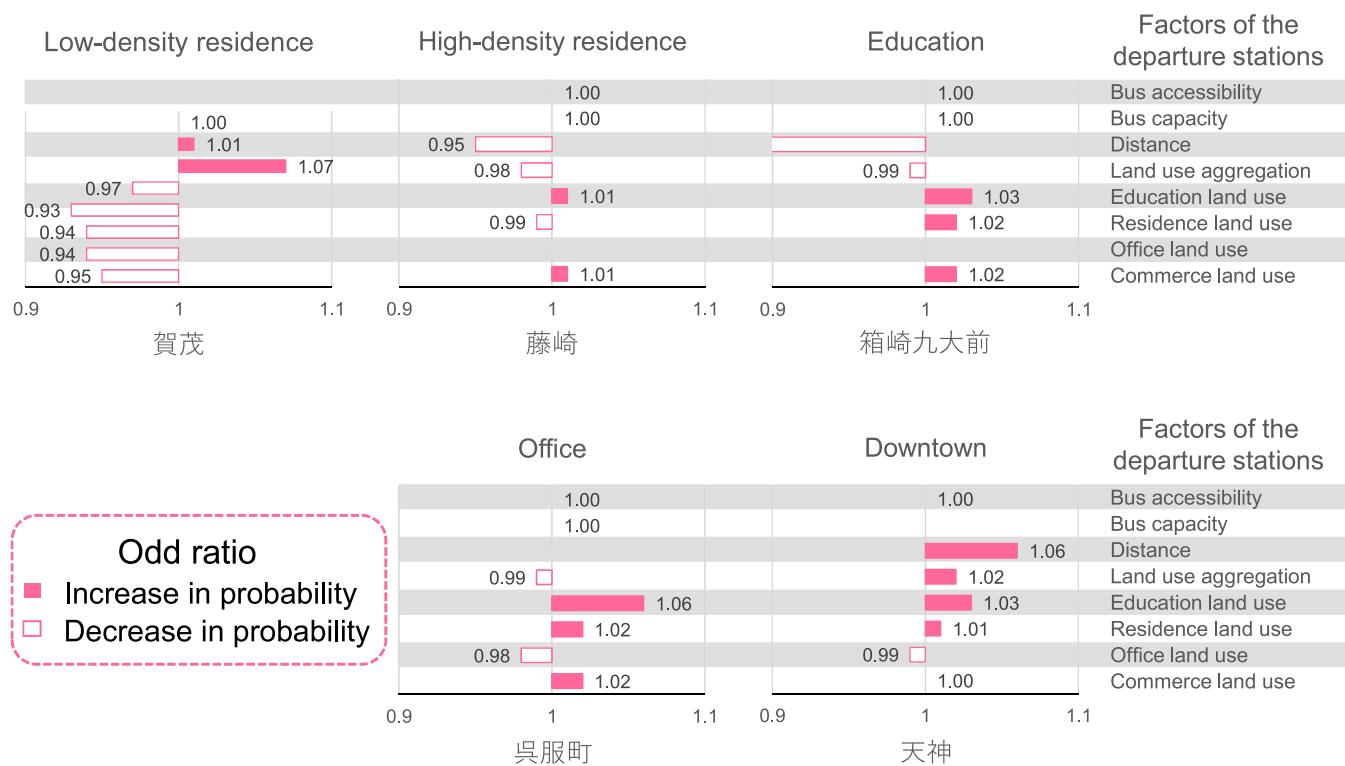
## 5.4 Method

## ■ Selection of sample station



## 5.5 Estimation

- Probability of choosing the station as the destination



## 5.6 Conclusion

### ■ Findings

1. Passengers are **not inclined to choose a destination station which has a similar land use type with that of the departure station.**
2. A station belongs to **low-density residence type** has a **low probability being chosen as the destination** no matter how the land use of departure station varies.
3. For **any type of stations**, the increase in the **education land use** of the departure station can lead to an **increase in the probability of choosing the target station as the destination.**

## 5.5 Conclusion

### ■ Summary

#### ● Problems

- 1 Description for the process of passenger flow needs to be clear.

#### ● Achievements

Described the passenger flow using the **probability of choosing a specific destination station.**

- 2 The model should be able to reflect the influence extent of the indicators.

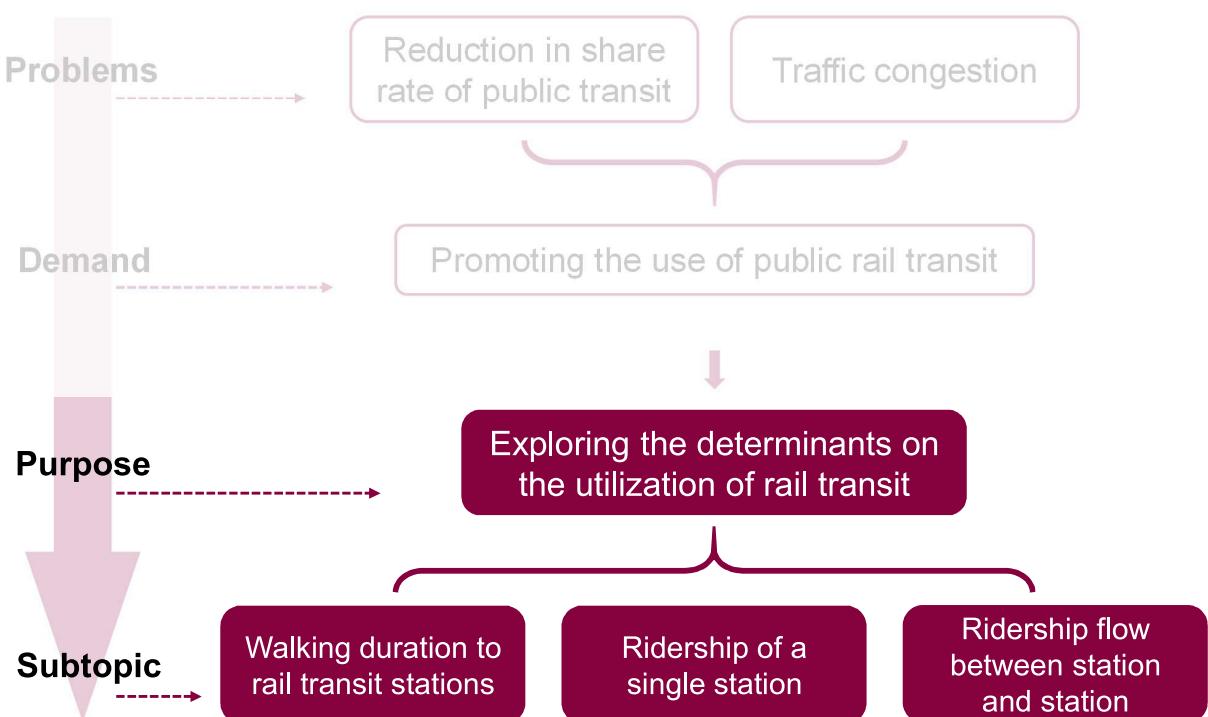
The problem is converted into a **binary choice question**. **Logistic regression** is used to estimate the influence of land use on the choice of destination

# *Chapter 6*

## *Conclusion*

### 6.0 Conclusion

#### ■ Review of the subtopics



## 6.0 Conclusion

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### ■ Walking duration to transit stations

- Described passengers' walking duration preferences by examining the probability of certainly accepting a given threshold of walking duration to transit stations.
- The effect of influencing factors is predicted, the results are evaluated from the view of both individual and group.

## 6.0 Conclusion

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### ■ Influencing factors of transit ridership (station level)

- Reorganized the indicator system. Proposed the indicators of land use variety, bus capacity and bus accessibility.
- To reduce first and second type of statistical error in small samples, use exploratory regression to screen effective indicators and the most metric combinations.
- Identified global/local indicator in MGWR using the spatial autocorrelation of indicators.

## 6.0 Conclusion

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### ■ Influencing factors of transit ridership (station-to-station level)

- Described the passenger flow using the probability of choosing a specific destination station.
- The problem is converted into a binary choice question. Logistic regression is used to estimate the influence of land use on the choice of destination station.

Thanks