Research on Determinants of Rail Transit Ridership

— Taking Fukuoka, Japan as a Study Case —

CHEN Qi

Graduate School of Human-Environment Studies,
Kyushu University, Japan

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九州大学
KYUSHU UNIVERSITY

0.0 Agenda (dissertation overview)

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

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

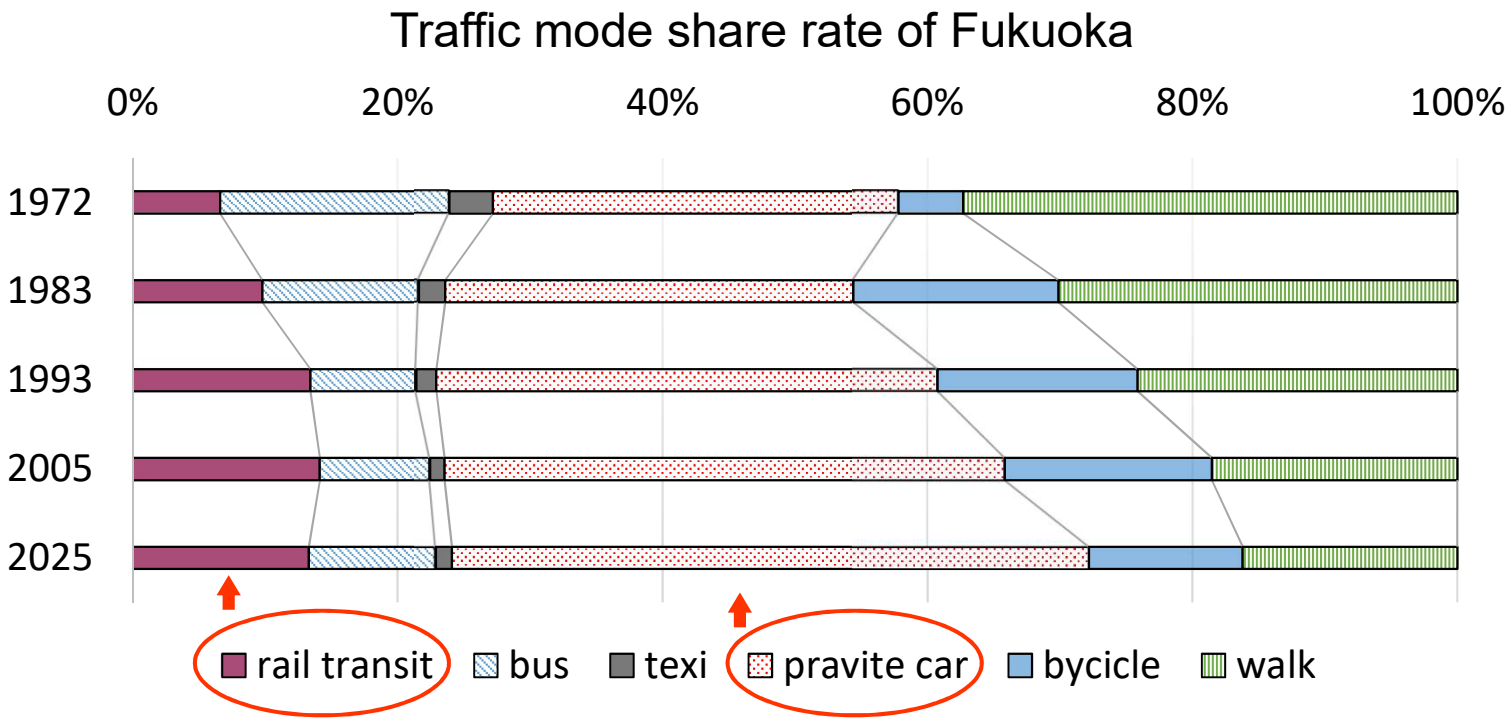
- Meet the increasing traffic demand
- Promote urban development

1.1 Background

Problems in Fukuoka

1 Reduction in share rate of public transit

2 Traffic congestion



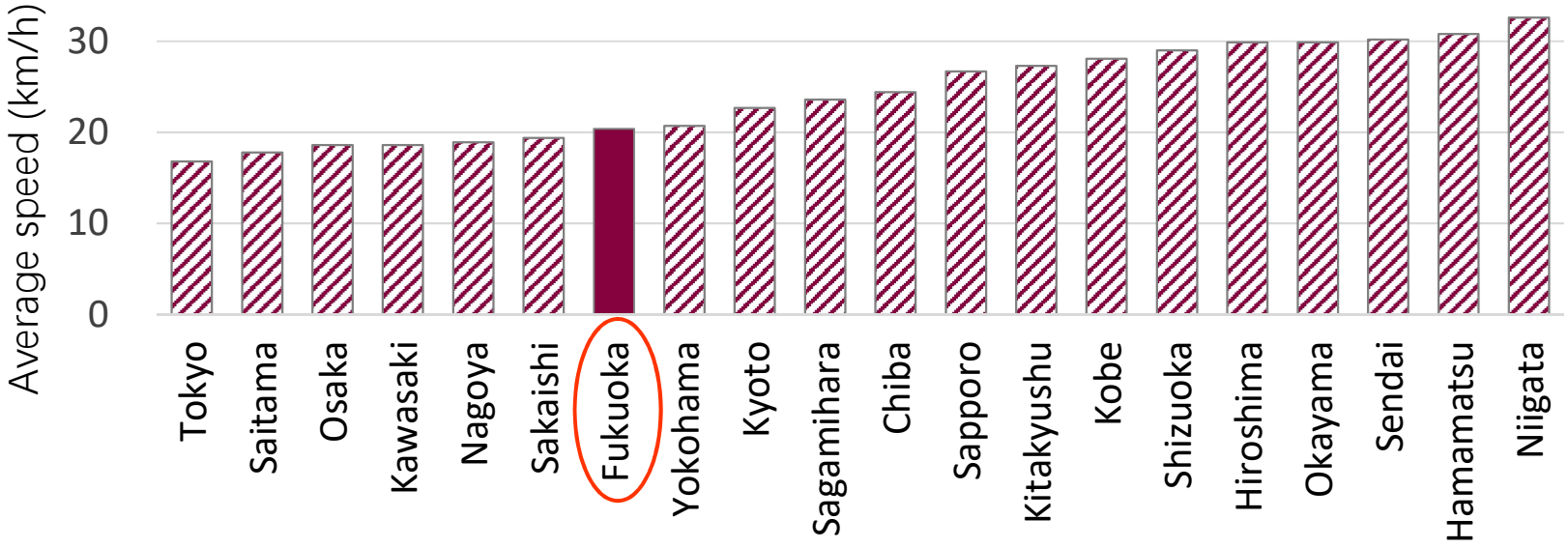
1.1 Background

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

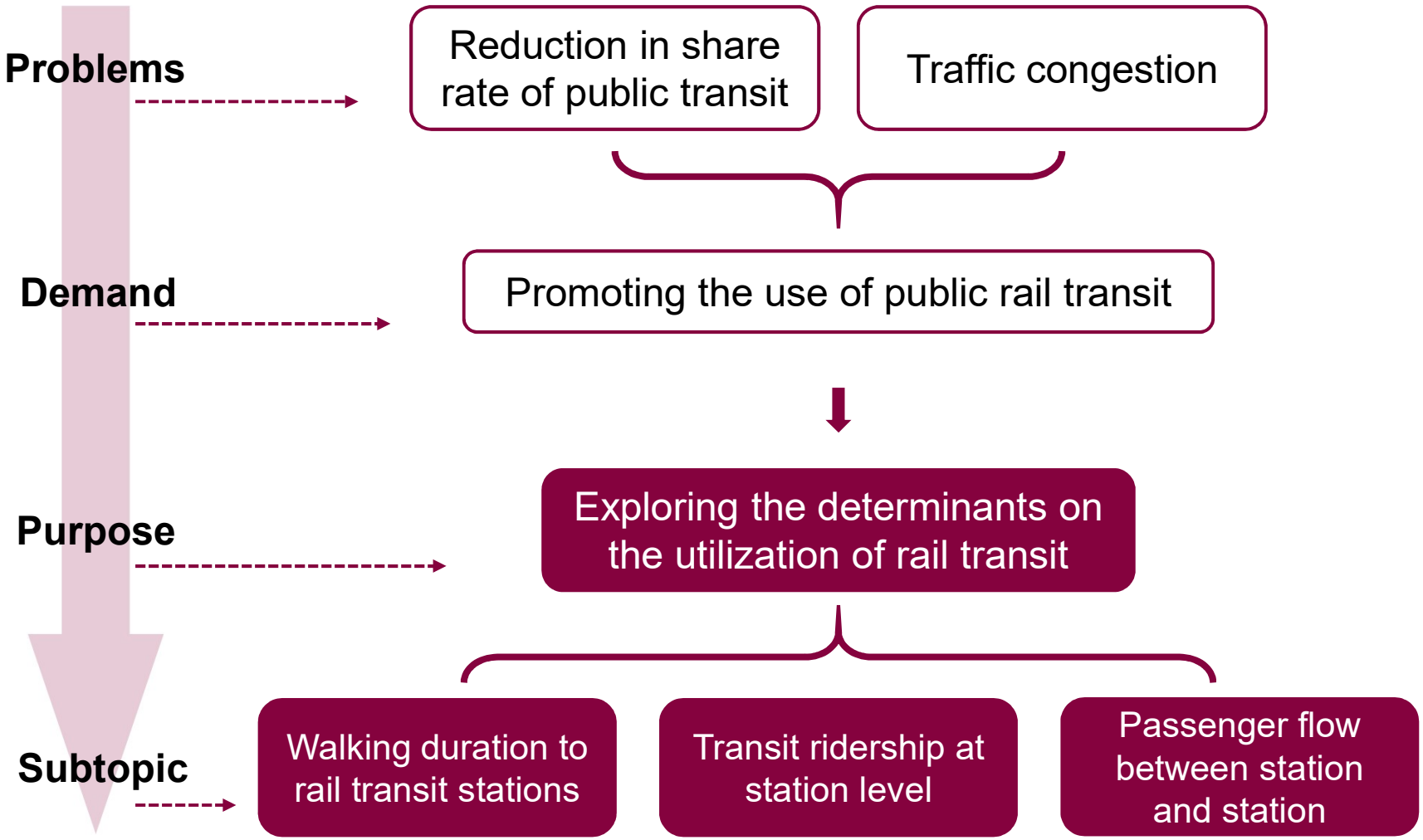
Main purpose

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

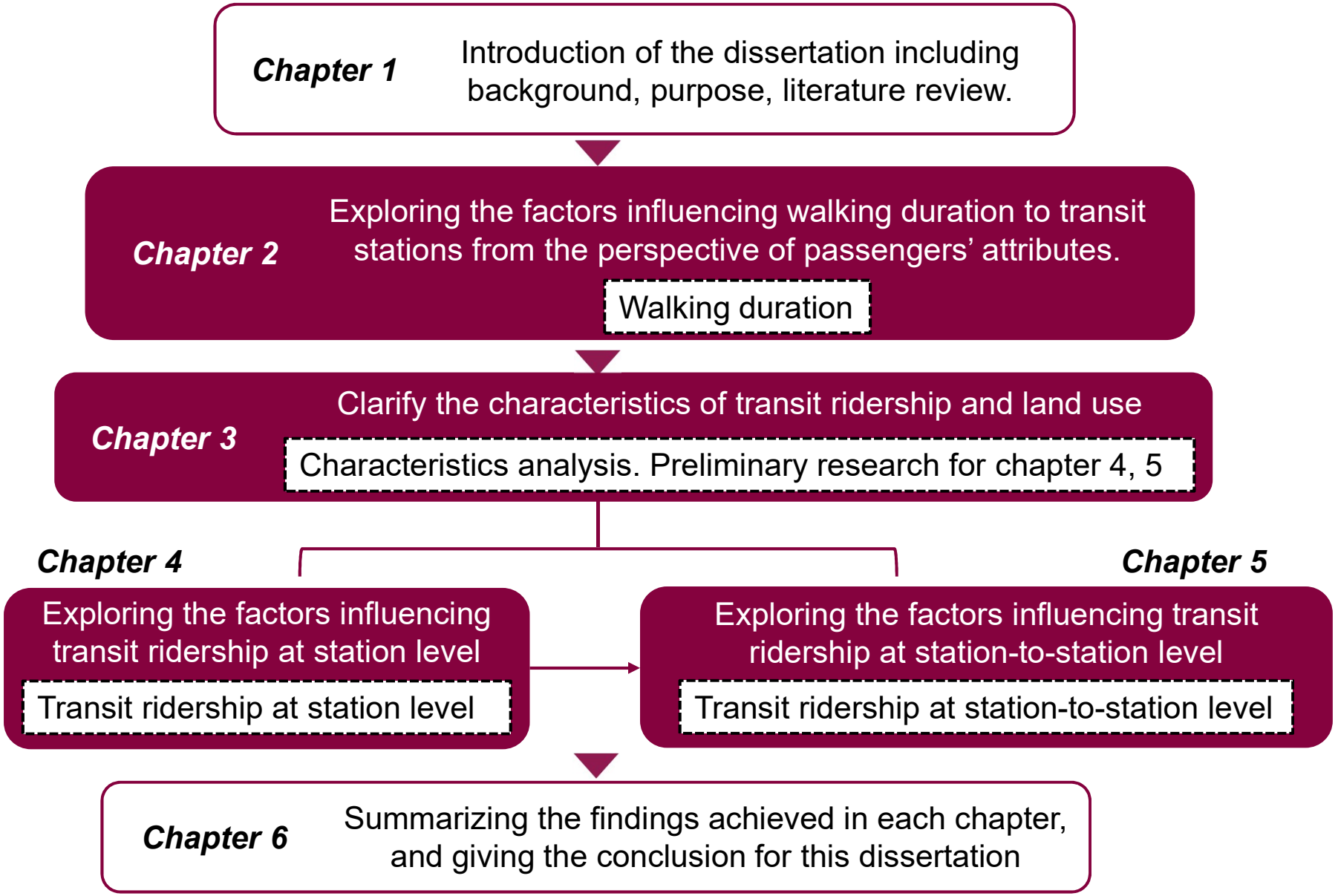
Specific issues in research

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


Problems
Reduction in share rate of public transit
Traffic congestion
Demand
Promoting the use of public rail transit
Purpose
Exploring the determinants on the utilization of rail transit
Subtopic
Walking duration to rail transit stations
Transit ridership at station level
Passenger flow between station and station

1.4 Organization



Chapter 2

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

2.1 Introduction

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

2.1 Introduction

Research contents

- Problems in previous studies

Problem 1

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.

- Key points

1 Function of walking duration

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

Problem 2

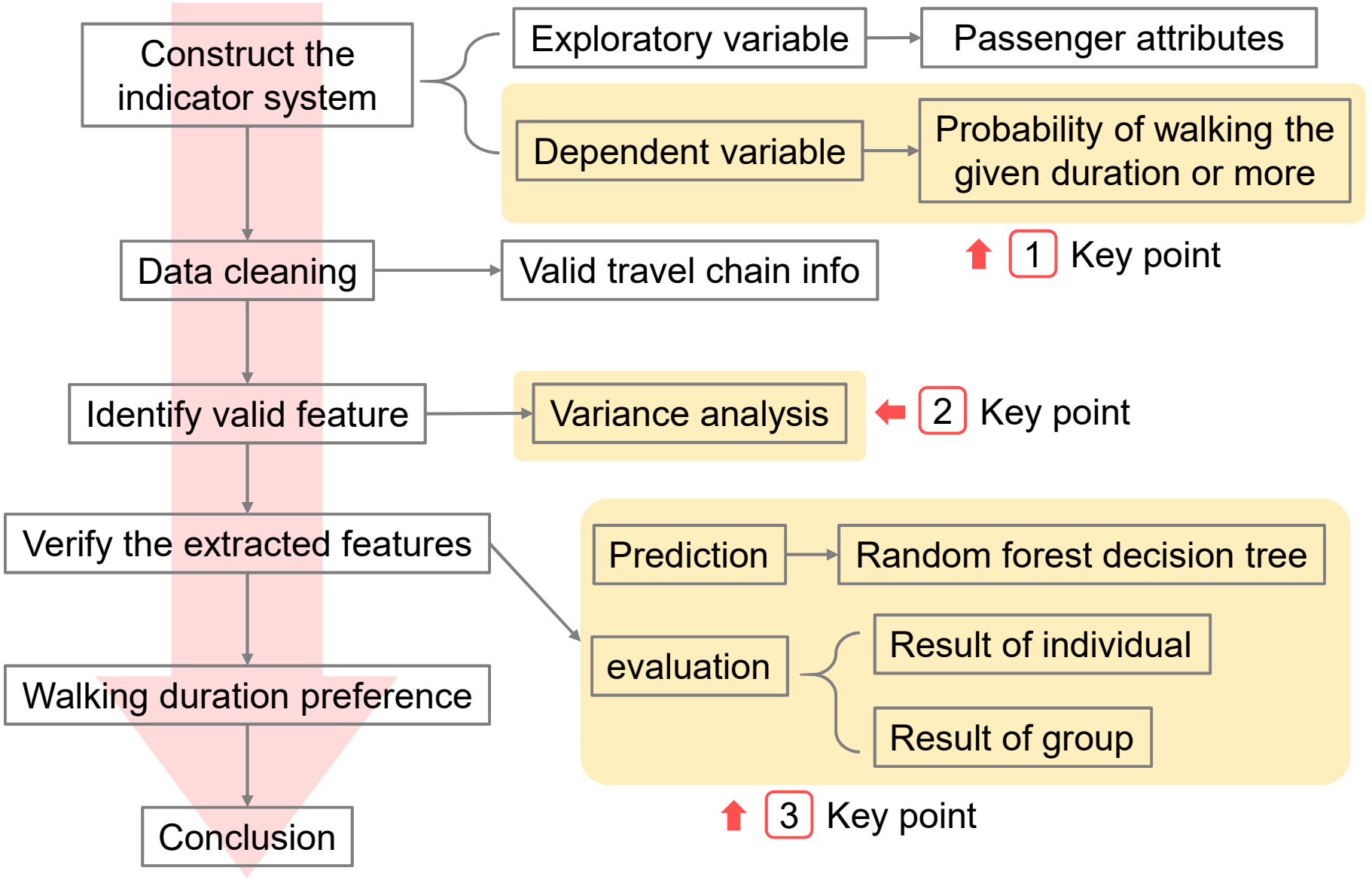
Although many studies have summarized some factors affecting the walking duration through qualitative methods, none of them quantitatively verified the effect of the influencing factors.

- Key points

2 Estimation and evaluation

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

2.1 Introduction



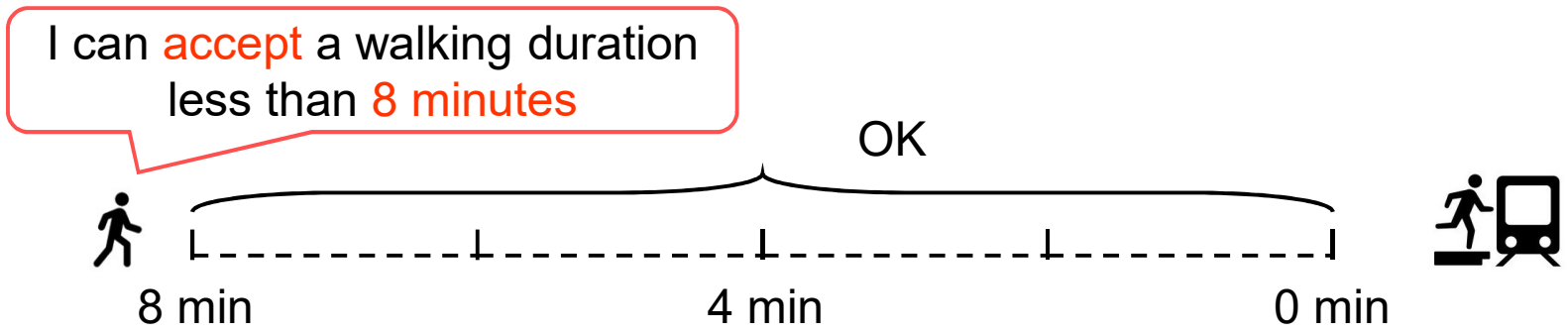
2.2 Methods

Problem description

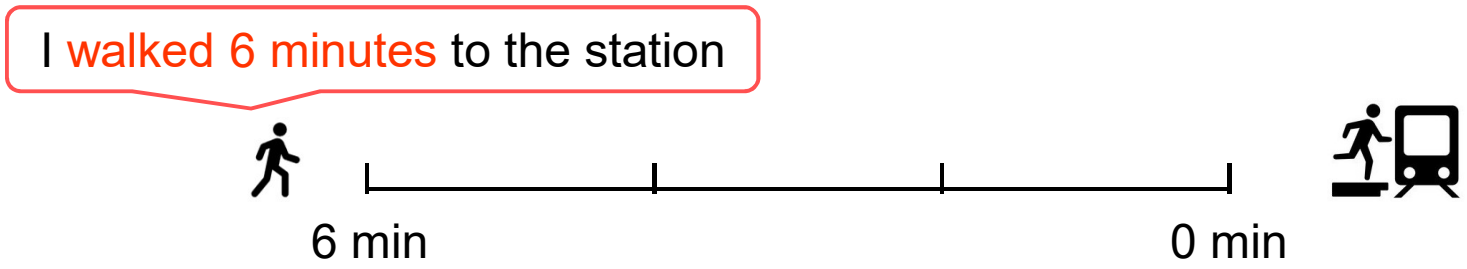
Give an example, for one person who has the attributes:

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

- Realistic issue

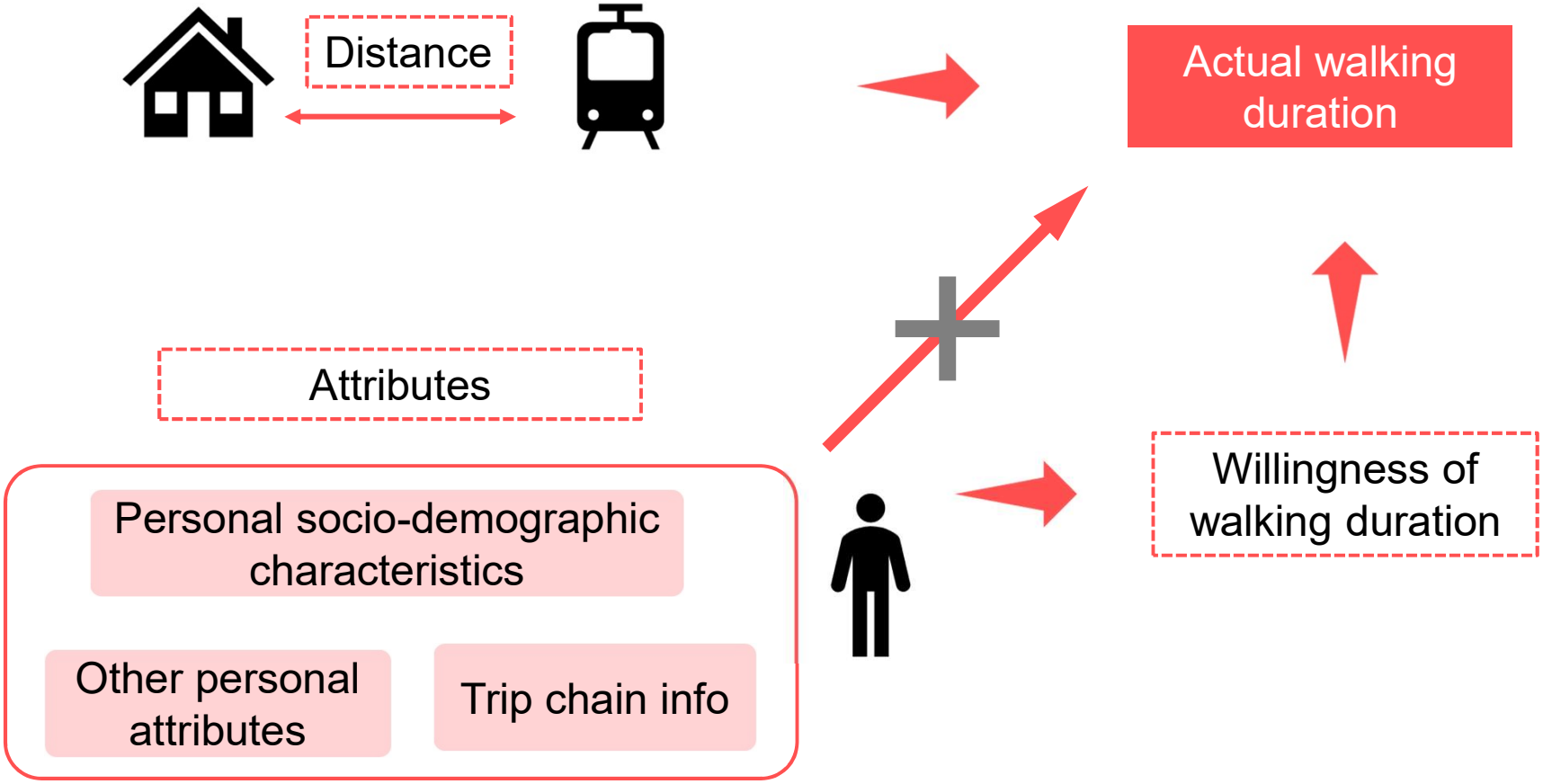


- Reflected in survey



2.2 Methods

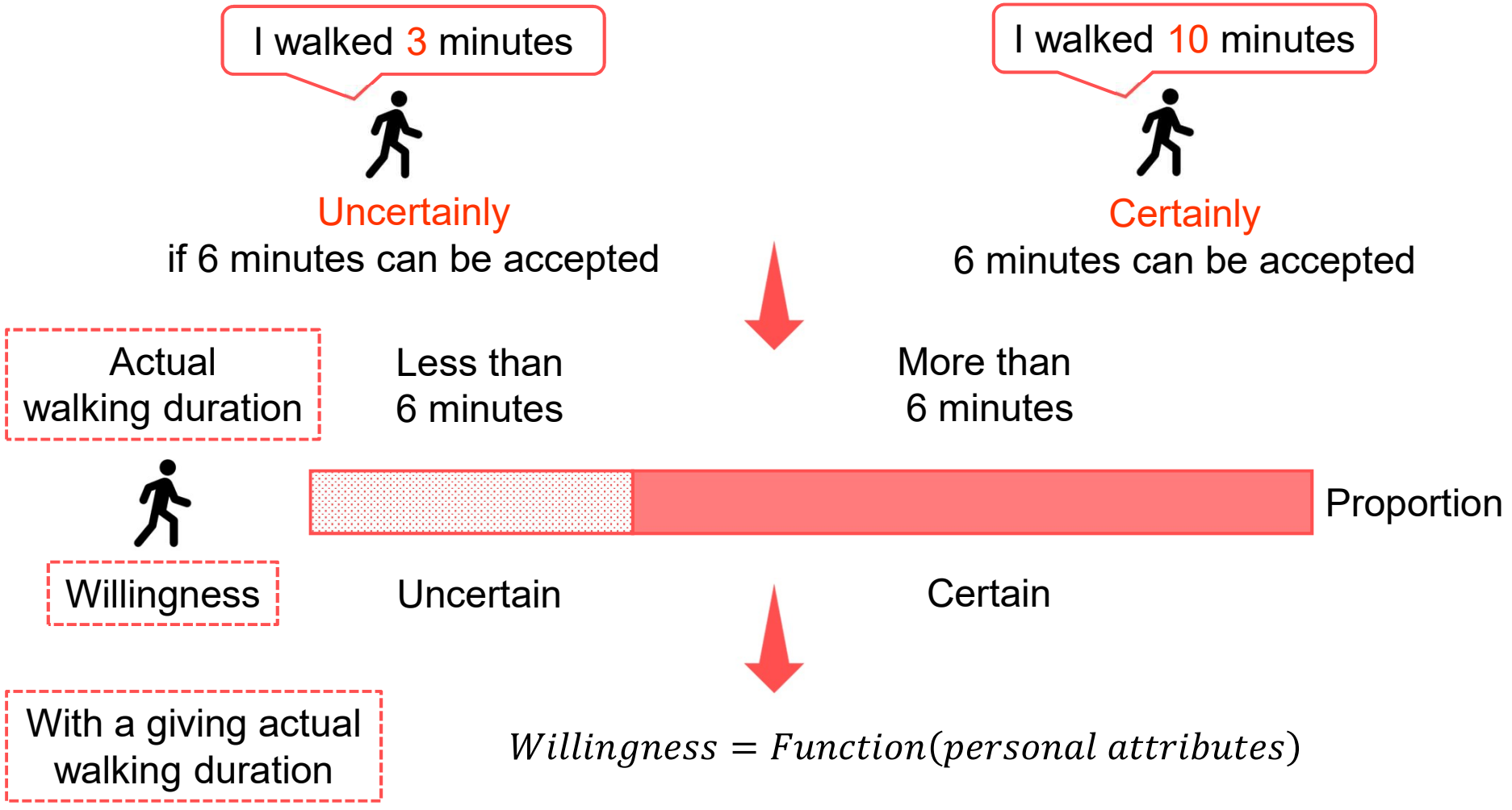
Problem description



2.2 Methods

Model construction

If investigating the 6-minute walking duration



2.3 Data

Indicators

- Dependent variable

  Probability

  Walk longer than the given threshold of walking duration

- Explanatory variables

  Attributes

  Personal socio-demographic characteristics

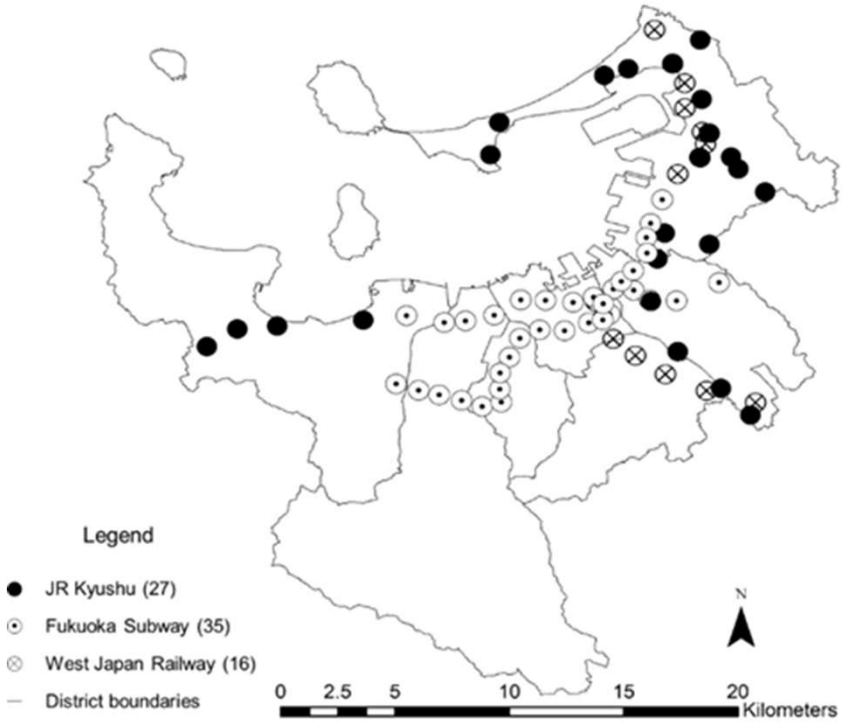
  Other personal attributes

  Trip chain info

2.3 Data

Study case: Fukuoka

- Distribution of the transit stations

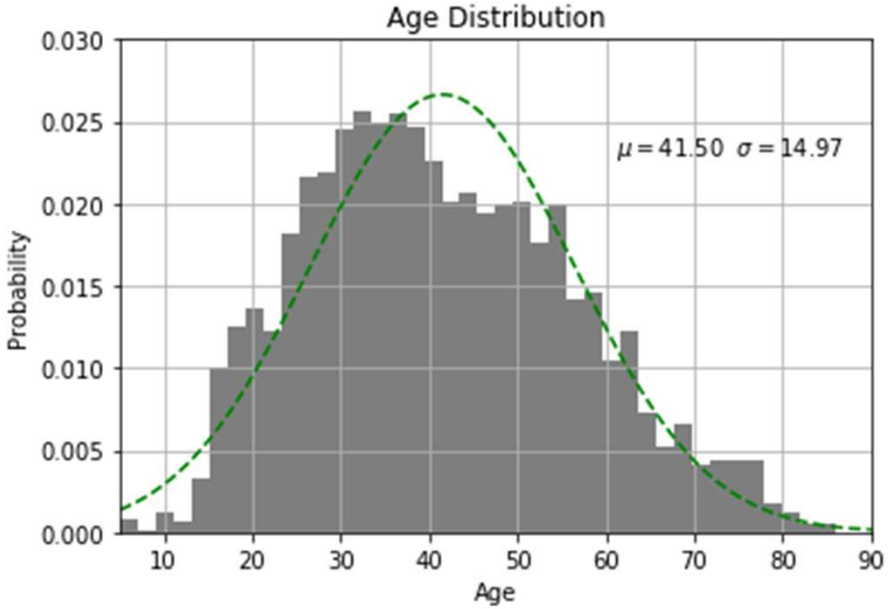


- Data in this study

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

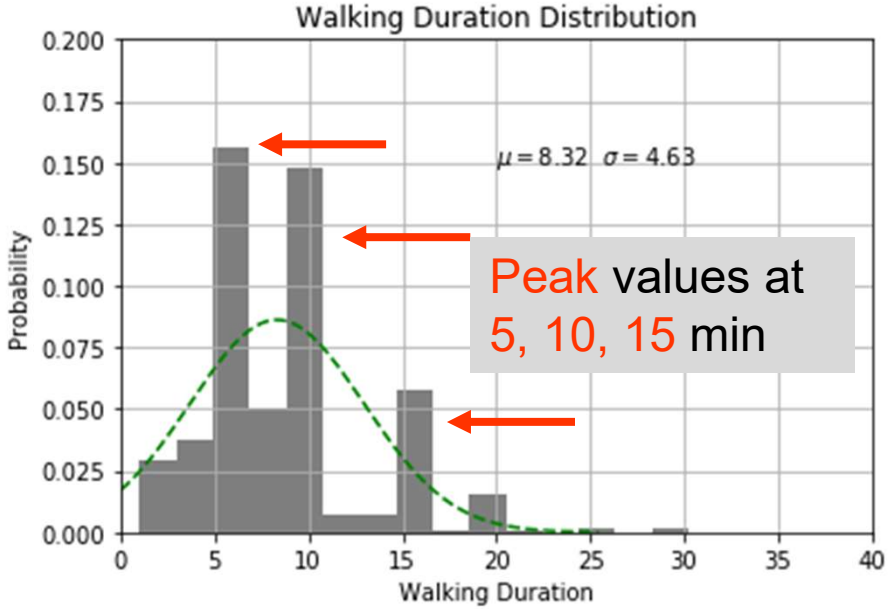
2.3 Data

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.

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	8 minutes	13 minutes
Age over 65	Female	Age from 45-64
Peak hour	Age from 25 to 44	Peak hour
No occupation	Peak hour	purpose of work
purpose of work	Purpose of work	purpose of entertainment
purpose of business	Purpose of business	
purpose of entertainment	Purpose of entertainment	
purpose of going home	Purpose of going home	

2.5 Prediction and evaluation

Decision tree and forest random

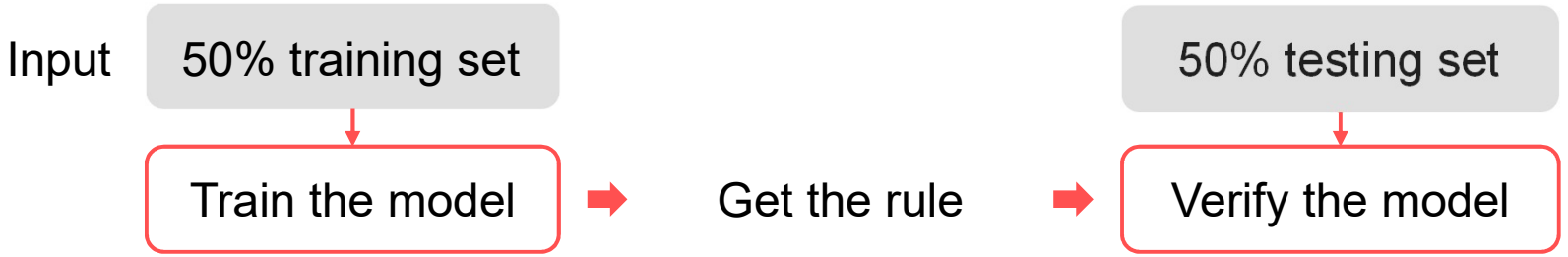
- Reason for choosing decision tree

  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



2.6 Prediction and evaluation

- Predictive power of individual

Object: Individual

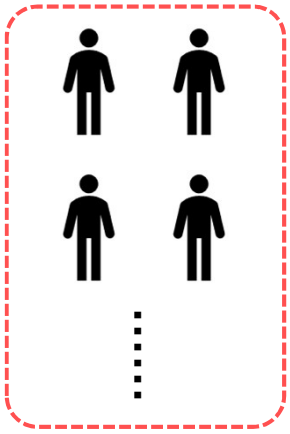
Index: Kappa indicator

Range

-1 — 1

Worse — Predictive power — Better

- Predictive power of group trends



Object: Group of 200 individuals

Index: Coefficient of determination

Range

0 — 1

Worse — Predictive power — Better

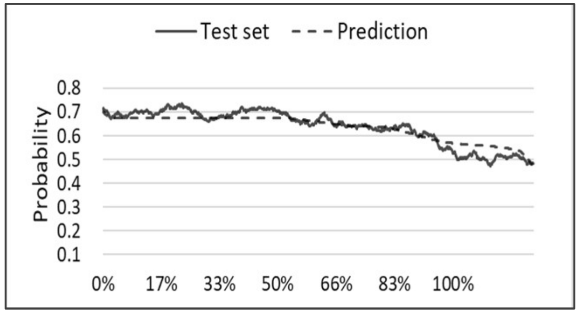
2.6 Prediction and evaluation

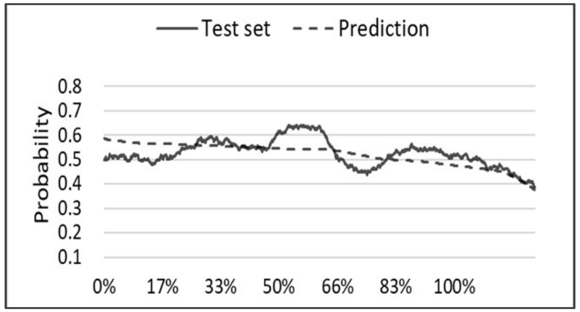
5 minutes	8 minutes	13 minutes

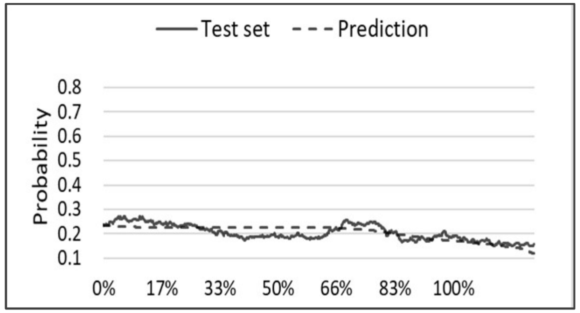
- Predictive power of individual

Kappa index		
0.142	0.016	0.060

- Predictive power of group trends







Coefficient of determination		
0.843	0.221	0.426

2.7 Conclusion

Findings

Prediction	Walk more	Walk less
● 5 minutes threshold Individual: 0.142 Group trend: 0.843	➢ Business purpose ➢ Private purpose ➢ Going home purpose ➢ Older than 65 ➢ No occupation	➢ 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
- Achievements

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

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

2 Few of the existing studies quantitative 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

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

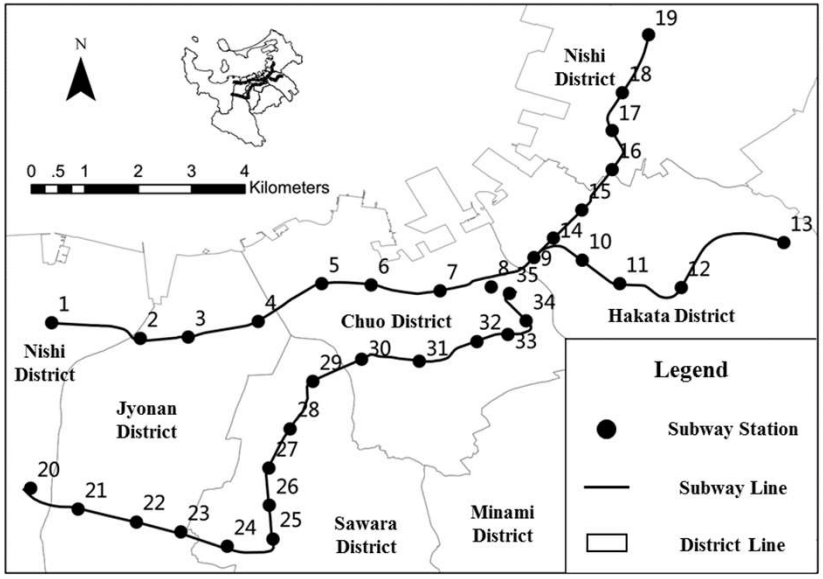
Analyze the characteristics of land use around the subway in terms of the type of land use

➡ 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

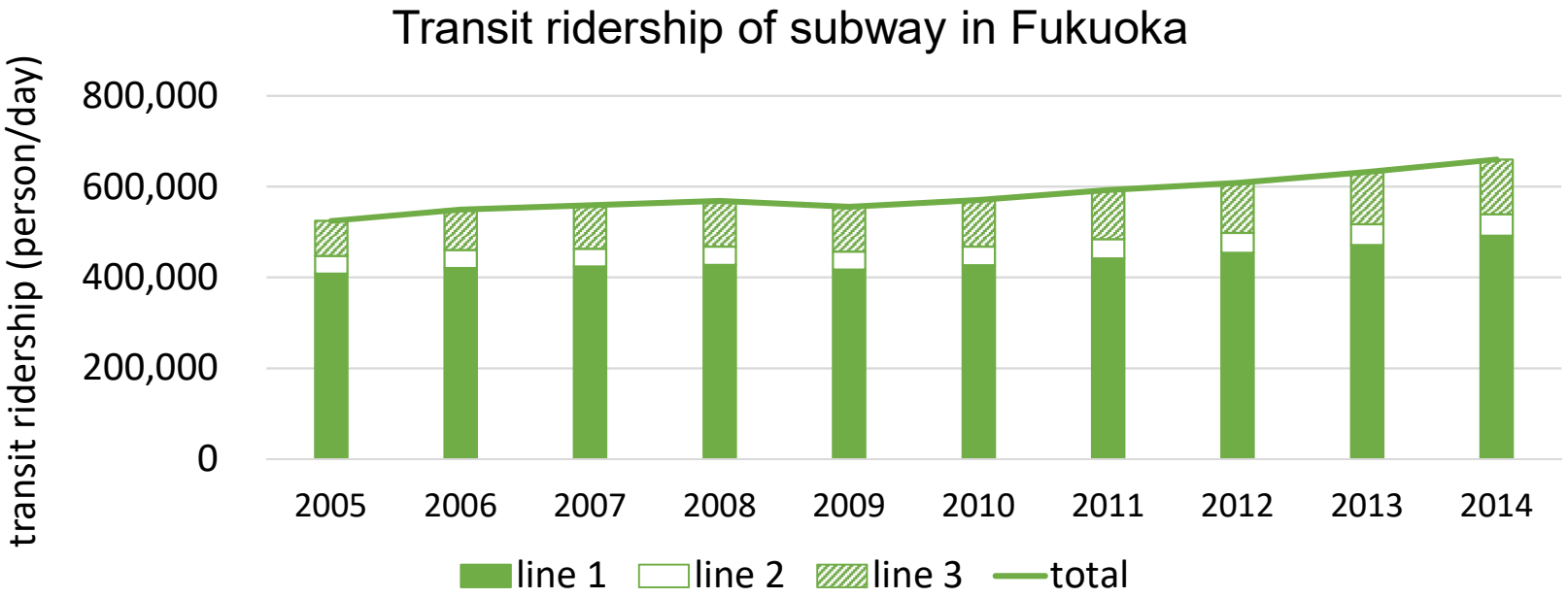
Data source

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

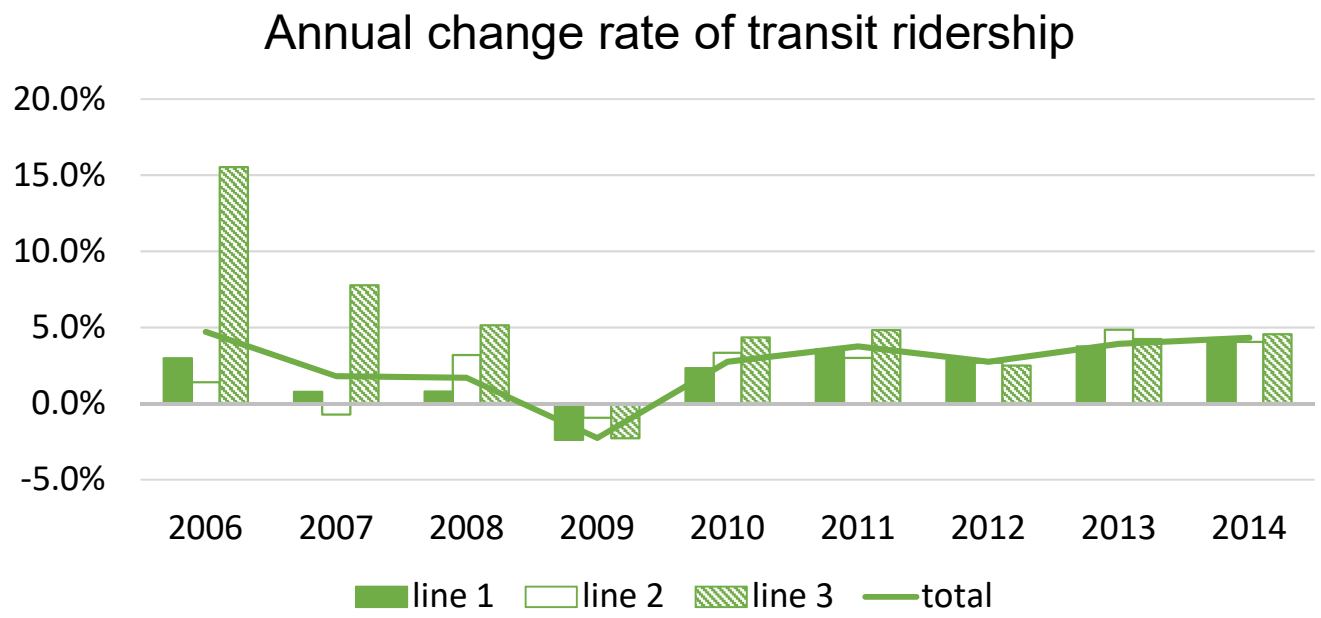


- Growth trend.
- More than 600,000 passengers per day.
- Significant difference in ridership among the three lines.

3.3 Characteristics of transit ridership and land use

Transit ridership characteristics

- Annual growth rate of transit ridership

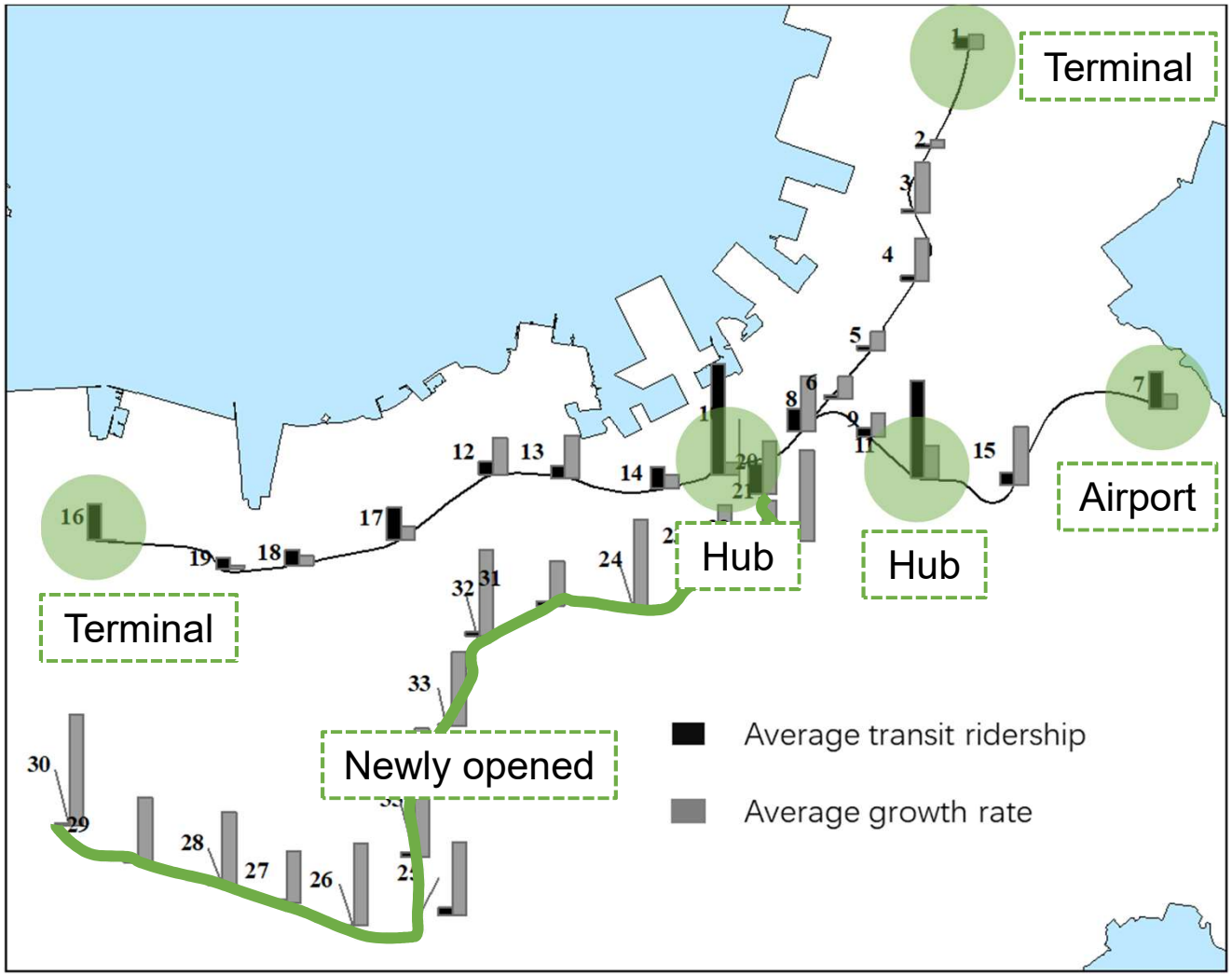


- Line 3 had a much higher growth rate at the first few years of the opening
- The growth rate of three lines tend to be stable after the year of 2009

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

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

Line 1

- Large scale
- Low growth rate

Line 2

- Small scale
- Low growth rate

Line 3

- Small scale
- High growth rate

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	-.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

Component Matrix

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

Factor 2: Residence

- Apartment house
- Culture
- Residence

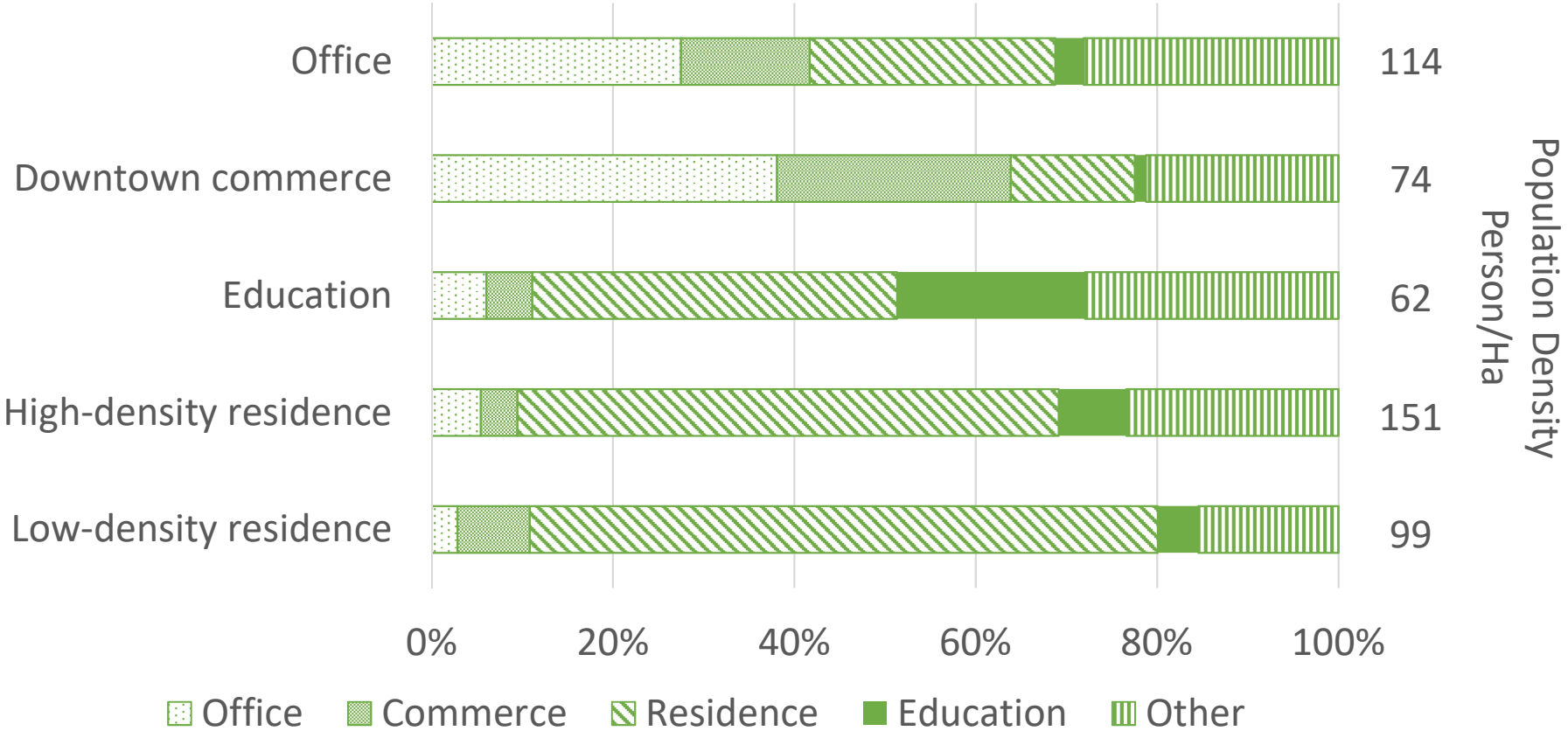
Factor 3: Education

- Education
- Government

3.4 Characteristics of transit ridership and land use

Land use characteristics

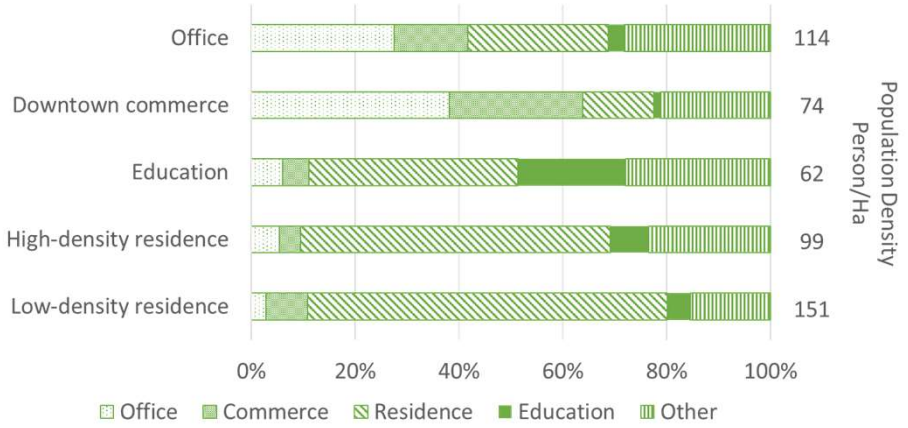
- Station classification based on land use



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

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	13004 13.84%
	40-80	13	2283	
	80-120	8	164	
	120-160	8	-2481	
	160-	3	-8360	
Commerce & Office (m^2)	0-100,000	16	-6249	43288 46.07%
	100,000-400,000	9	-6617	
	400,000-1,000,000	5	-4765	
	1,000,000-	5	36671	
Residence (m^2)	0-300,000	4	-1450	16240 17.28%
	300,000-800,000	20	-5575	
	800,000-	11	10664	
Government (m^2)	0-1,000	13	-2957	12267 13.06%
	1,000-10,000	9	-5501	
	10,000-	13	6766	
Education (m^2)	0-10,000	5	4842	9159 9.75%
	10,000-50,000	11	993	
	50,000-100,000	11	-4317	
	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	0.0265 28.44%
	40-80	13	0.0020	
	80-120	8	-0.0001	
	120-160	8	-0.0110	
	160-	3	0.0056	
Commerce & Office (m^2)	0-100,000	16	-0.0016	0.0097 10.44%
	100,000-400,000	9	0.0006	
	400,000-1,000,000	5	0.0069	
	1,000,000-	5	-0.0028	
Residence (m^2)	0-300,000	4	-0.0183	0.0226 24.31%
	300,000-800,000	20	0.0043	
	800,000-	11	-0.0012	
Government (m^2)	0-1,000	13	0.0111	0.0228 24.54%
	1,000-10,000	9	0.0008	
	10,000-	13	-0.0117	
Education (m^2)	0-10,000	5	-0.0078	0.0114 12.27%
	10,000-50,000	11	-0.0025	
	50,000-100,000	11	0.0034	
	100,000-	8	0.0036	
Independent variable		Sample size		35
Growth rate of transit ridership		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

- 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

Problem 1

Index system need to be enriched

Problem 2

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

Problem 3

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

- Key points

1 Improve index system

Propose and reconstruct indicators to improve the index system

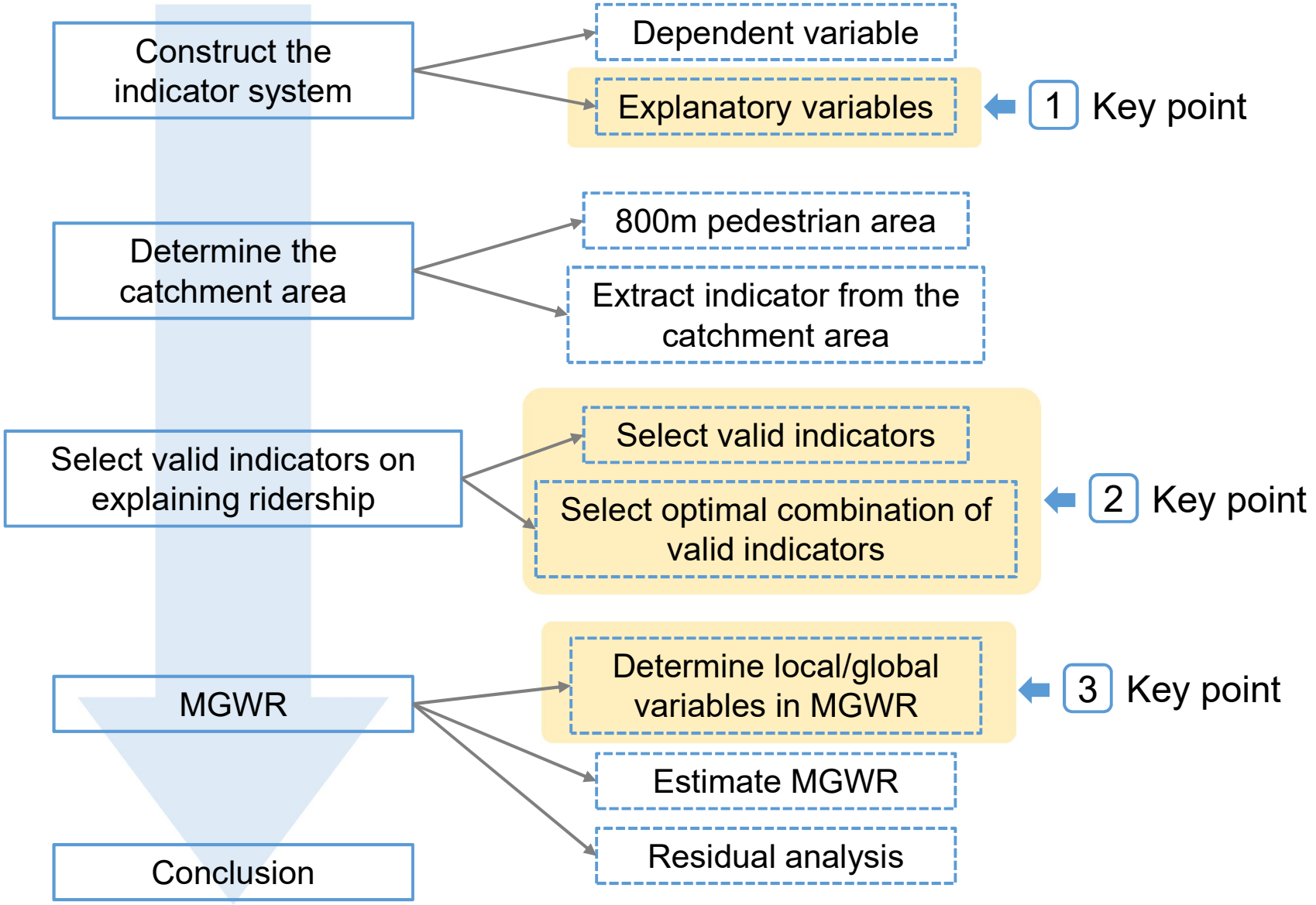
2 Identify valid indicators

Propose effective index screening method for small samples

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

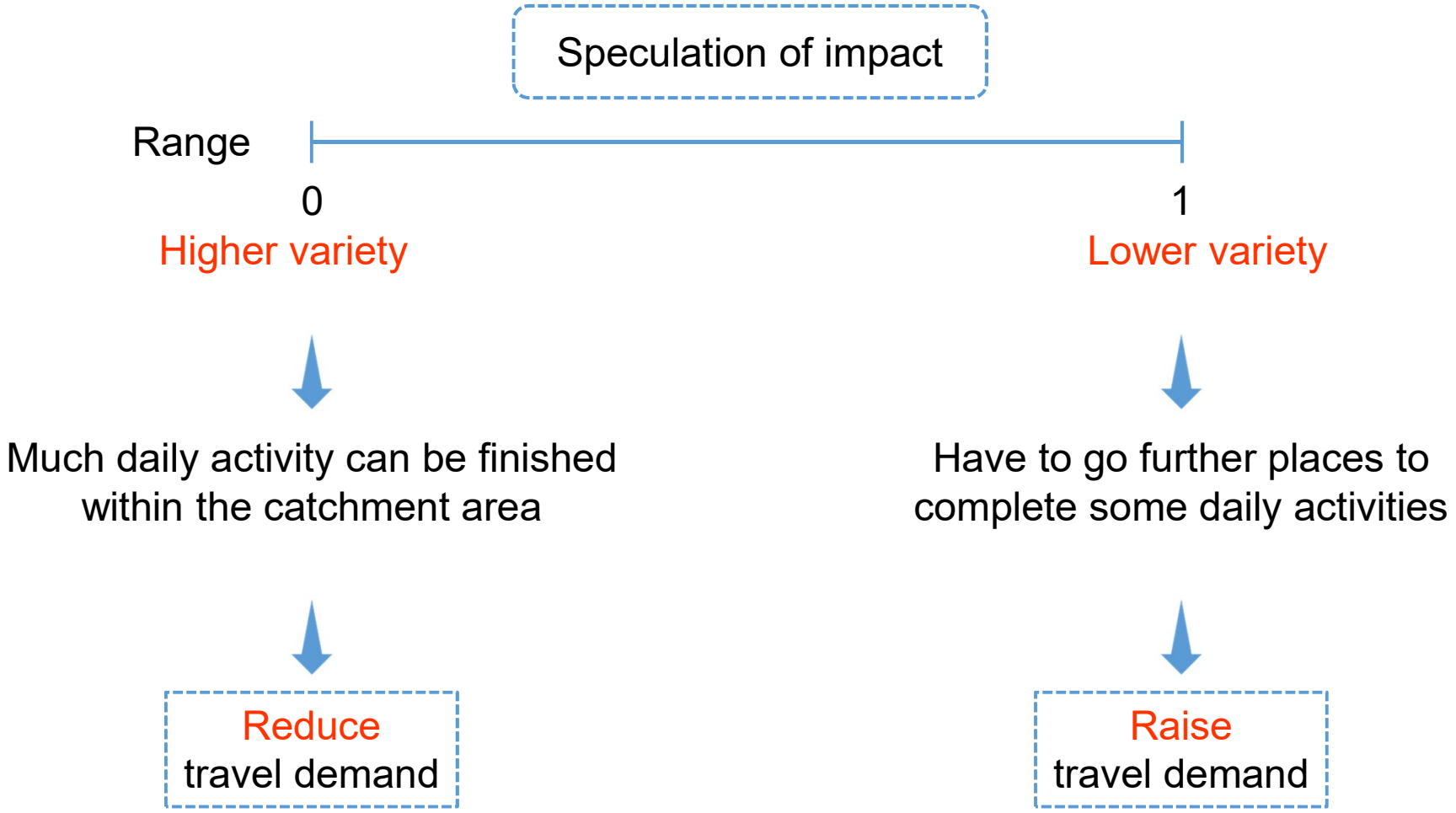
Category	Variable	Expected sign	Min Value	Max Value	Average	Unit
Built environment	Commerce	+	2,921	811,281	114,353	m^2
	Office	+	2,614	839,956	167,088	m^2
	Residence	+	110,748	1,067,523	528,533	m^2
	Education	+	294	305,559	59,691	m^2
	Government	+	-	128,471	20,878	m^2
	Transportation Facility Area	+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

Speculation of impact

Bus system has both positive and negative effect on rail transit ridership

Share ridership from rail transit

VS

Bring ridership to rail transit

- 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.

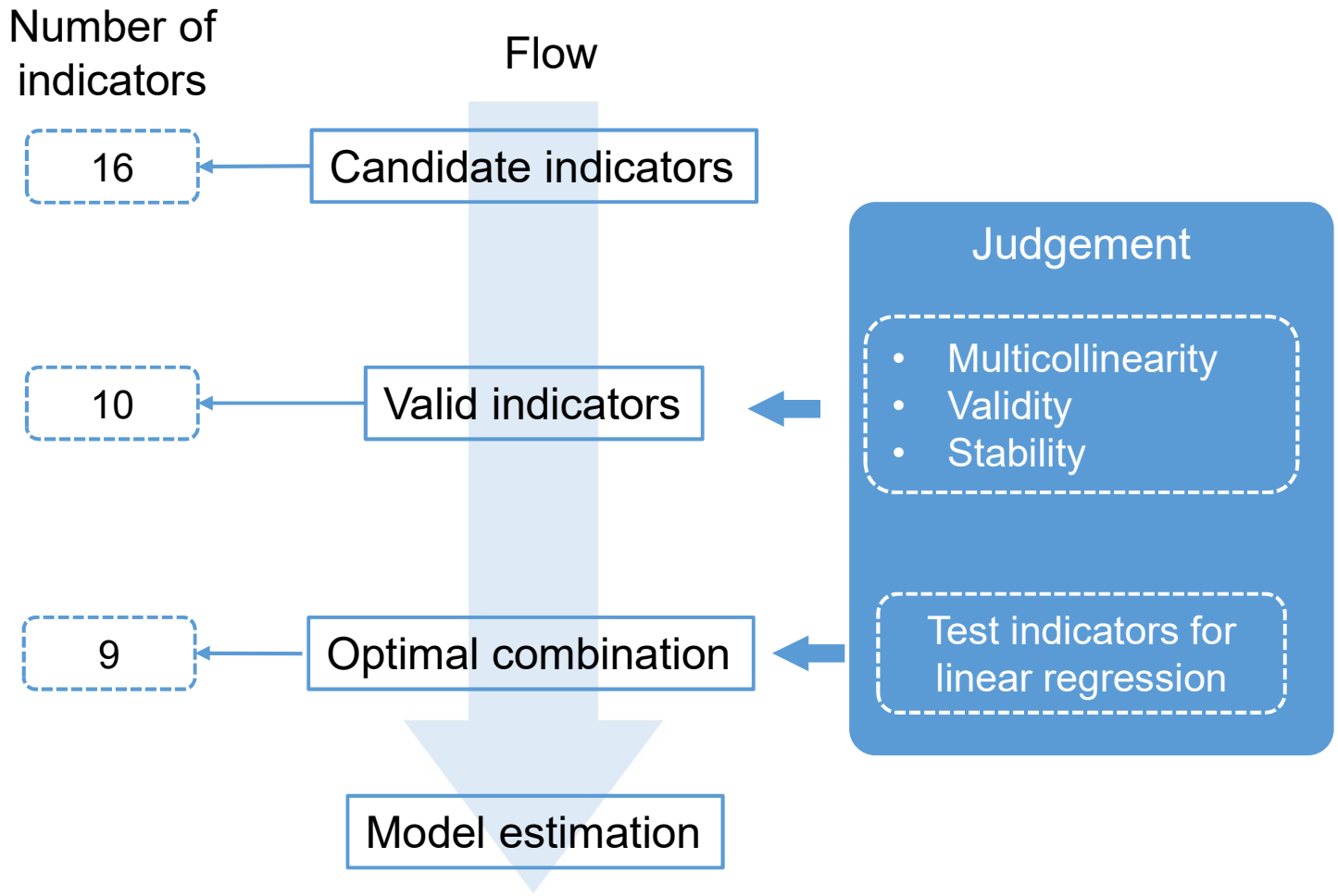
4.3 Catchment area

Separated along the river

The walking distances along the real road network are equal from any point on the boundary line to both the station on both sides.

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*
Government Area	0.04	0.51
Transportation Facility	0.29	0.00
Land use Aggregation	-0.01	0.84
Transfer Dummy	0.13	0.12
Bicycle Parking	-0.12	0.36
Bus Capacity	0.70	0.00
Bus Accessibility	0.45	0.00
Population/Job Balance	0.77	0.00
Tenant Proportion	0.24	0.01

$P > 0.05$

Pattern: Random
Type: Global

$P \leq 0.05$

Pattern: Clustered
Type: Local

Pattern	Type
Random	Global
Clustered	Local
Random	Global
Random	Global
Random	Global
Clustered	Local
Clustered	Local
Clustered	Local
Clustered	Local

4.5 Model estimation

Estimation of Mix Geographically Weighted Regression

Variable	Unit	Type	MGWR model	
			B	t
Government Area	m^2	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^2	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
- Achievements

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.

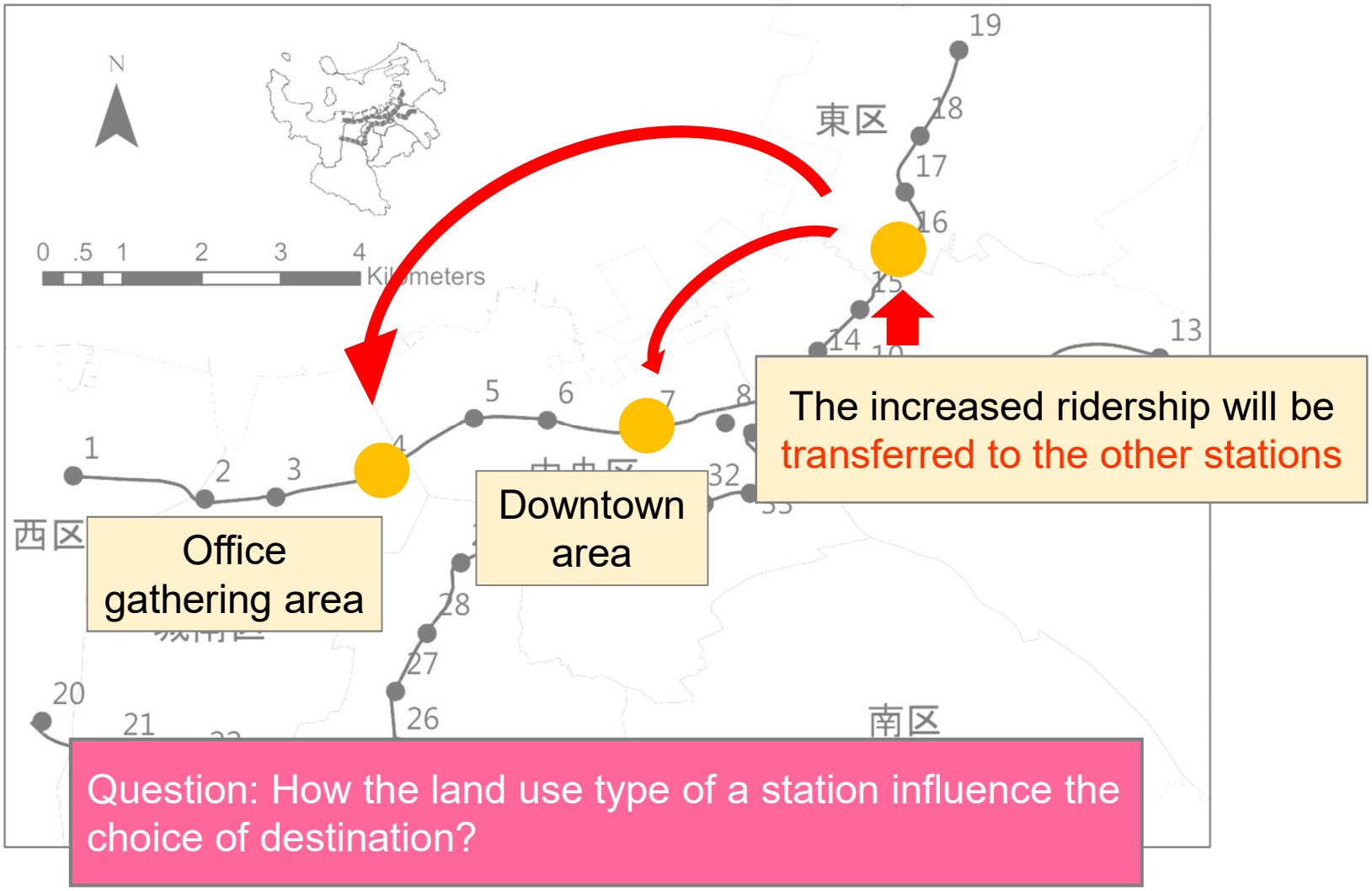
- Land use determines travel purpose in some extent. The variation in the land use of departure station can affect the choice of travel destination.

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?

Problem 2

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

- Key points

1

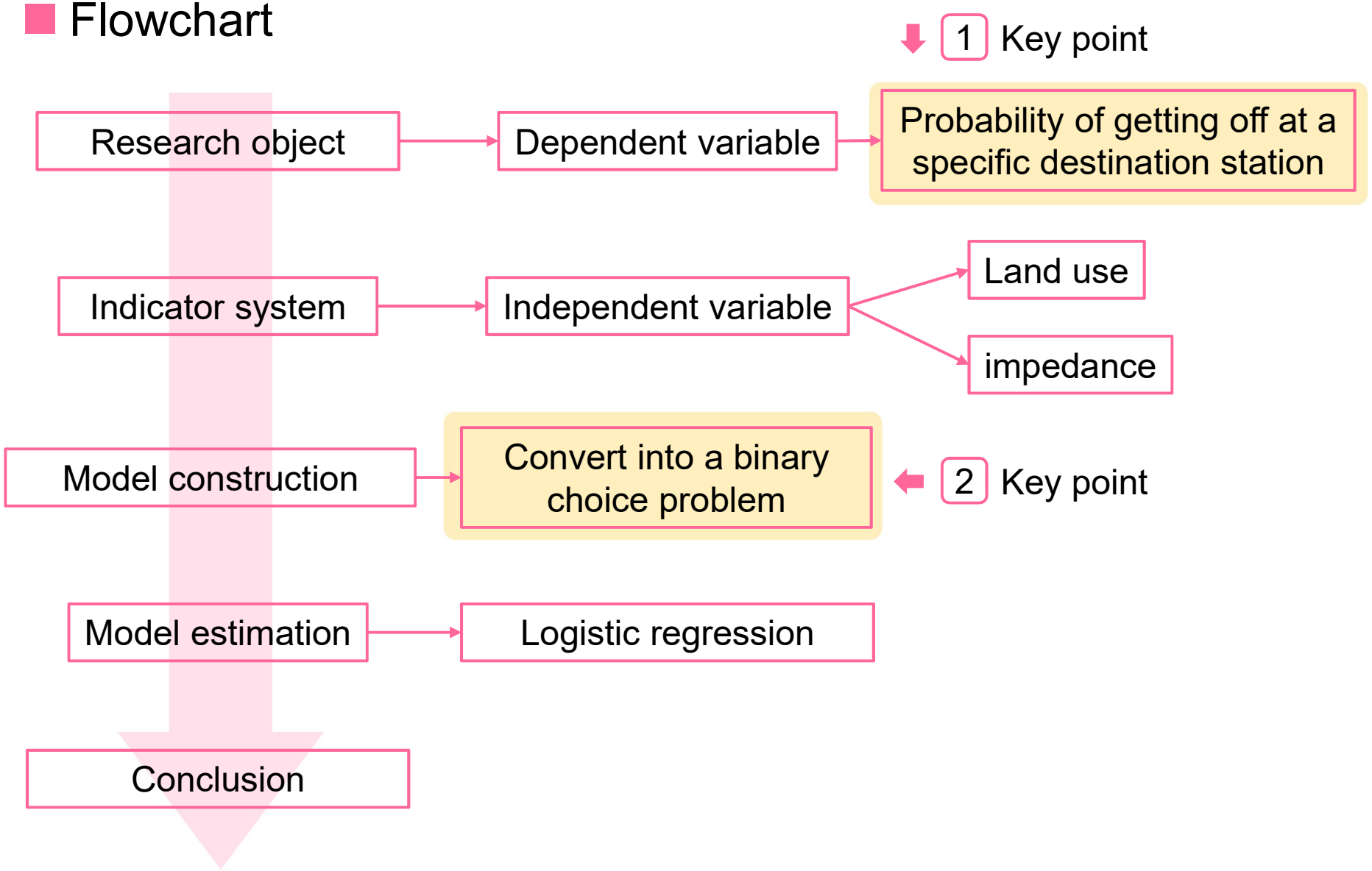
Describe the passenger flow between station and station using the probability of choosing a specific station as the destination.

2

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

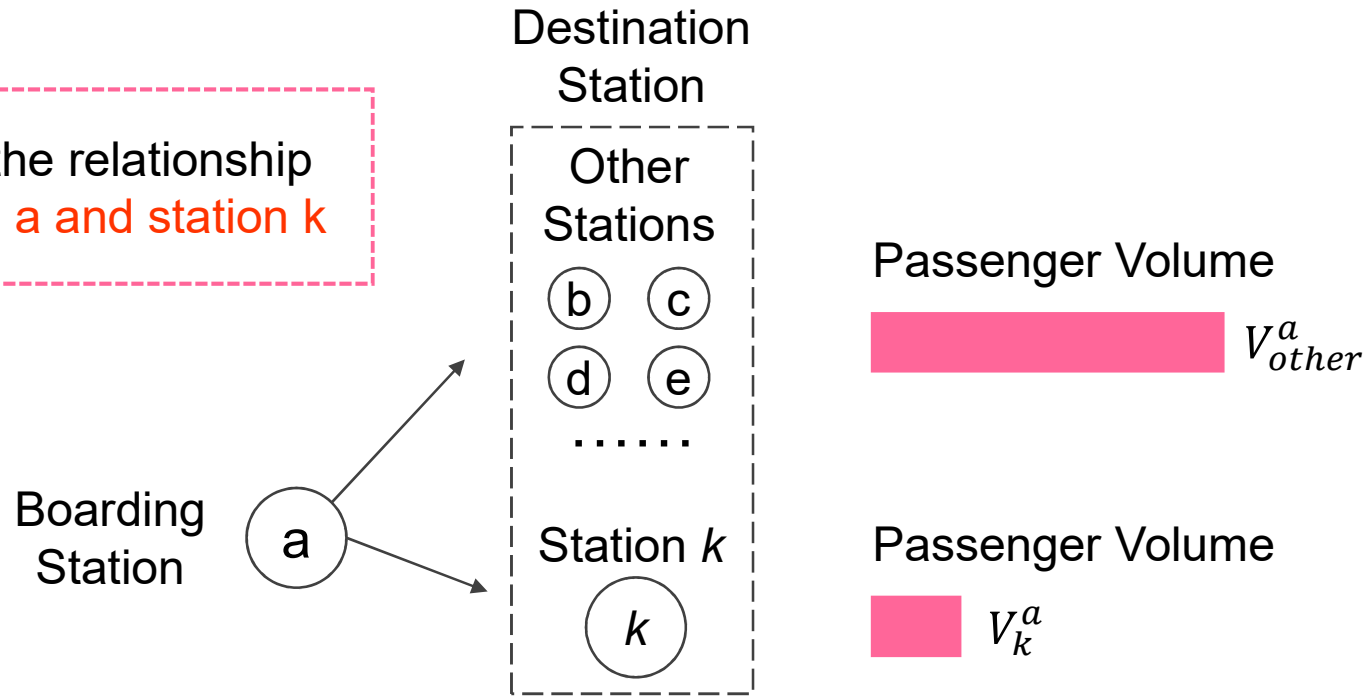


5.2 Research object

Dependent variable

- Probability of choosing the destination

If Investigating the relationship between station a and station k



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

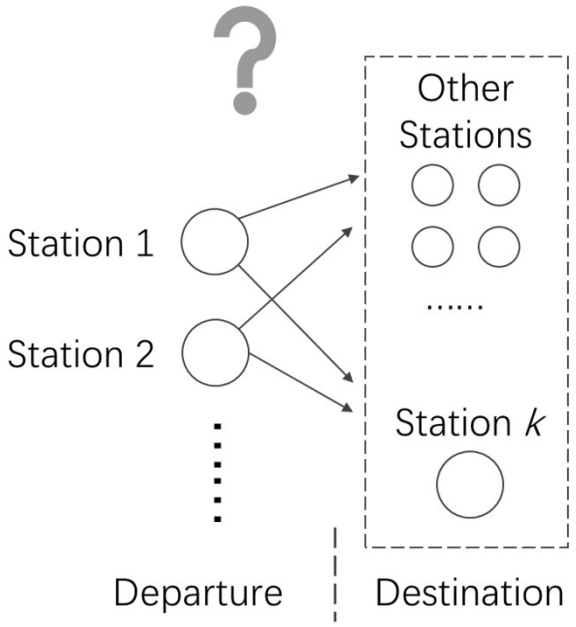
- Impedance

  - Bus capacity
  - Bus accessibility
  - Operation distance of subway

5.4 Method

Mathematical problems

- Passenger flow



- Binary choice model

$$P_k = F(x_1, x_2, x_3, \dots\dots)$$

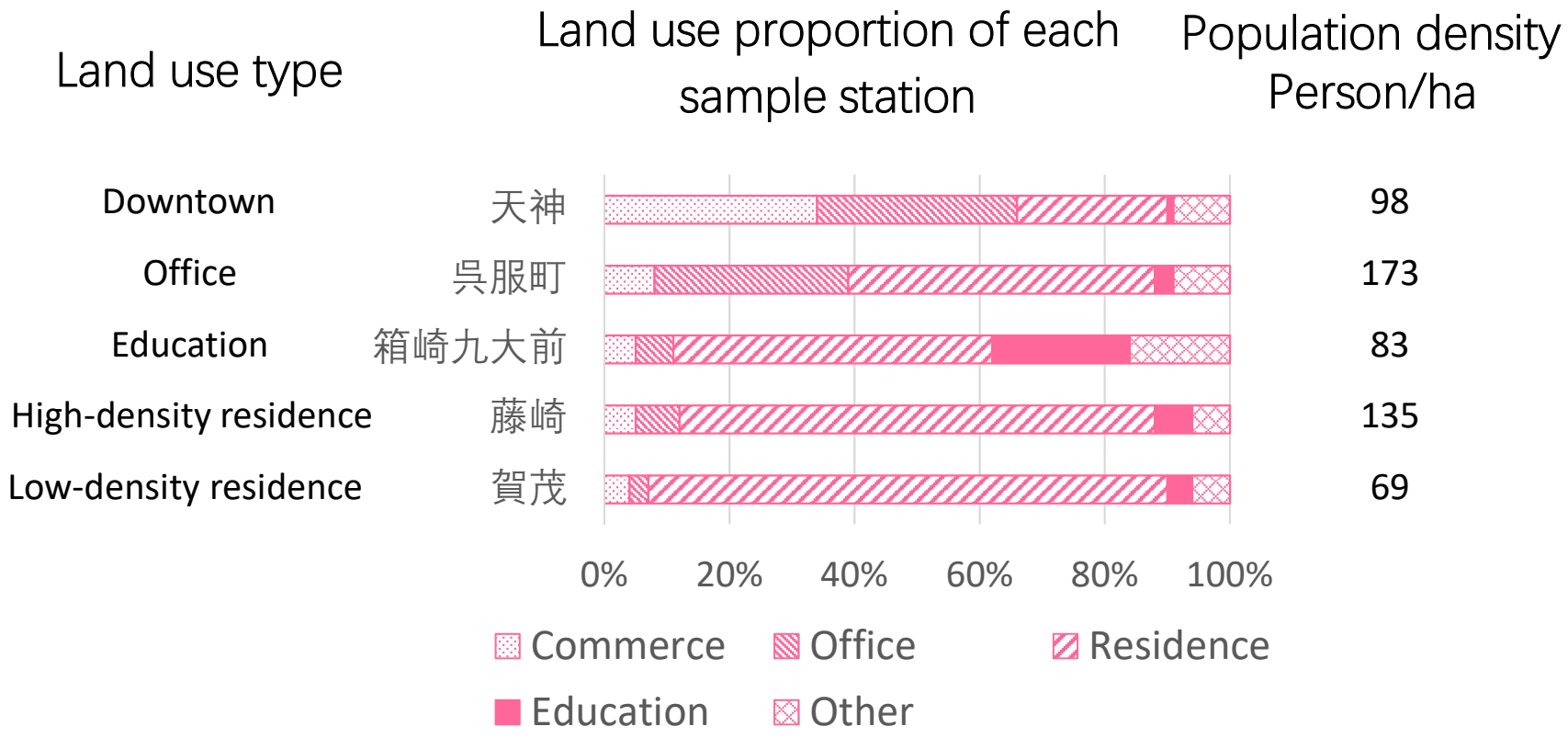
Probability of getting off at the specific station

Explanatory variable for making the choice of whether getting off

- Logistic regression model

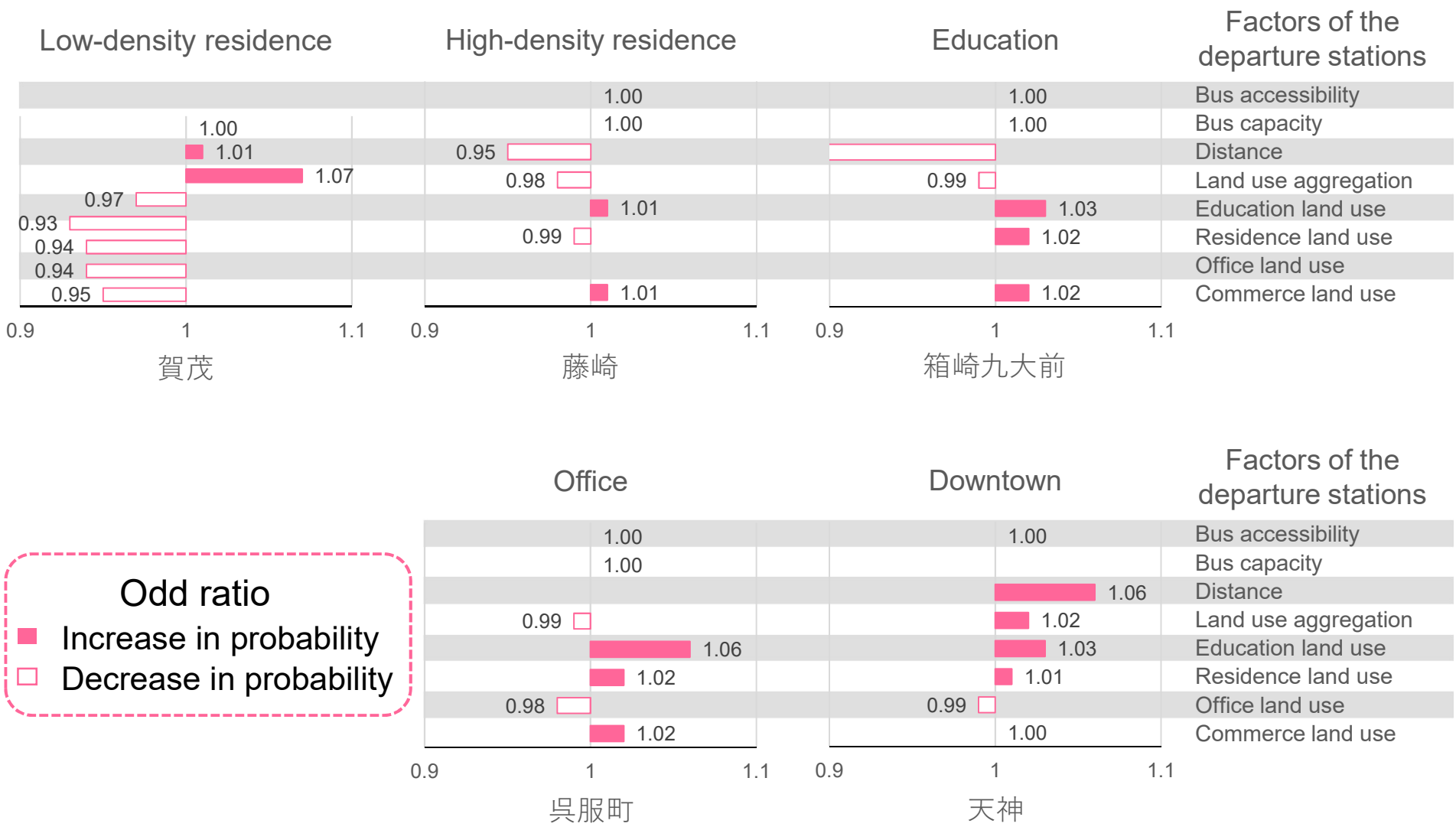
5.4 Method

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
- Achievements

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

→ 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.

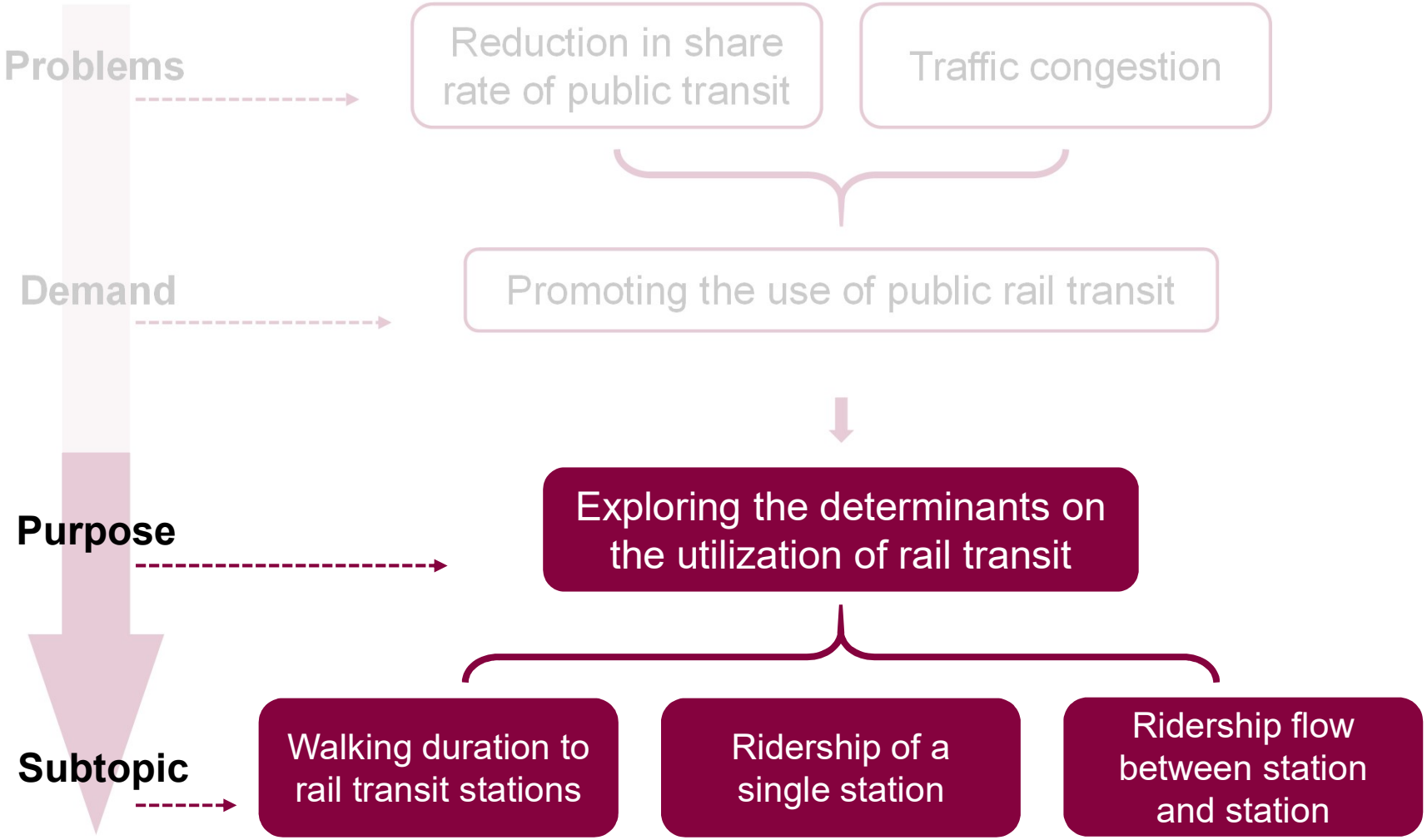
→ The problem is converted into a binary choice question. Logistic regression is used to estimate the influence of land use on the choice of destination

Chapter 6

Conclusion

6.0 Conclusion

- Review of the subtopics



6.0 Conclusion

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

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

- 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