

# Understanding the Difference in Travel Patterns Between Docked and Dockless Bike-Sharing Systems



## A Case Study in Nanjing, China

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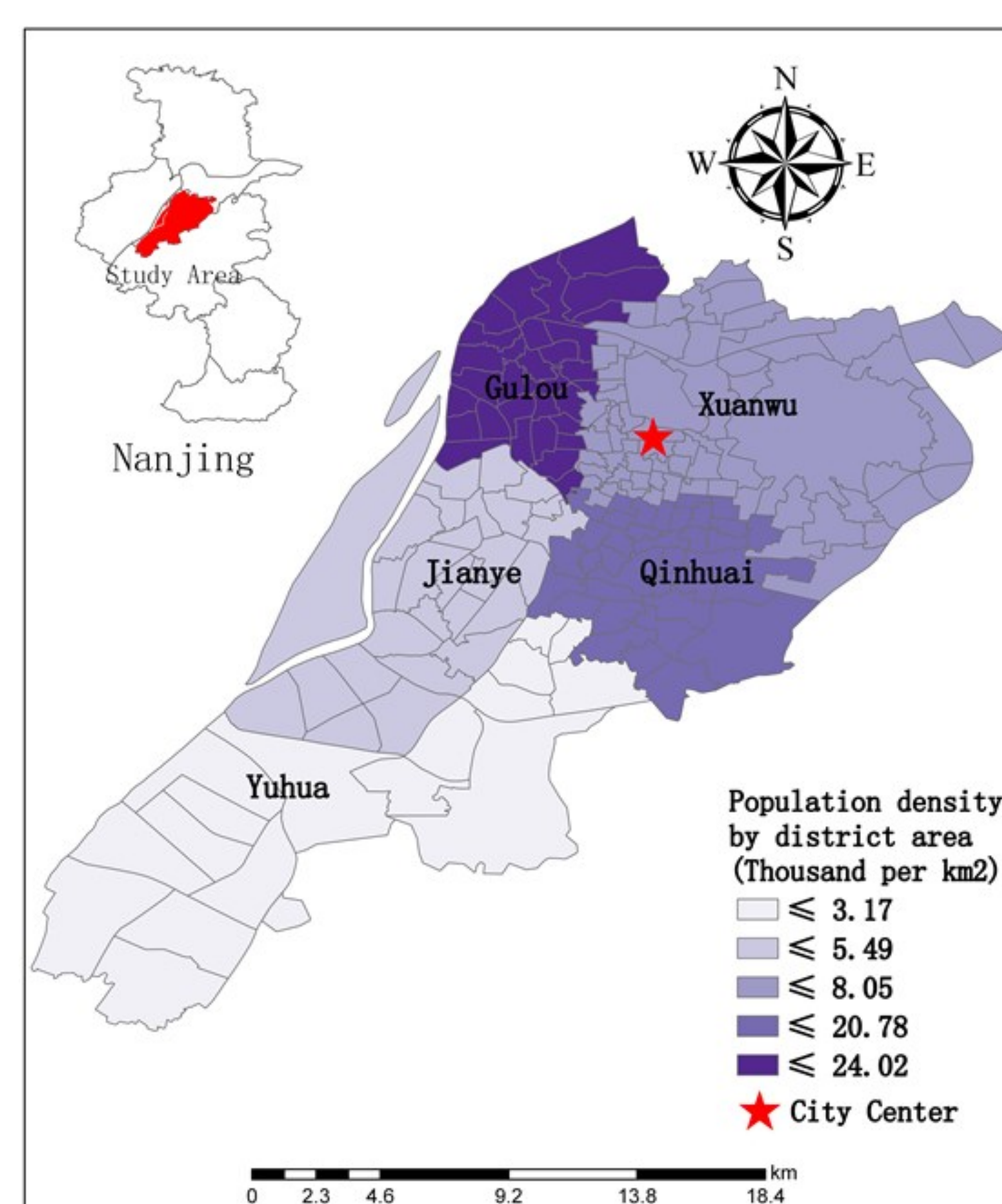
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### Purpose of the Study

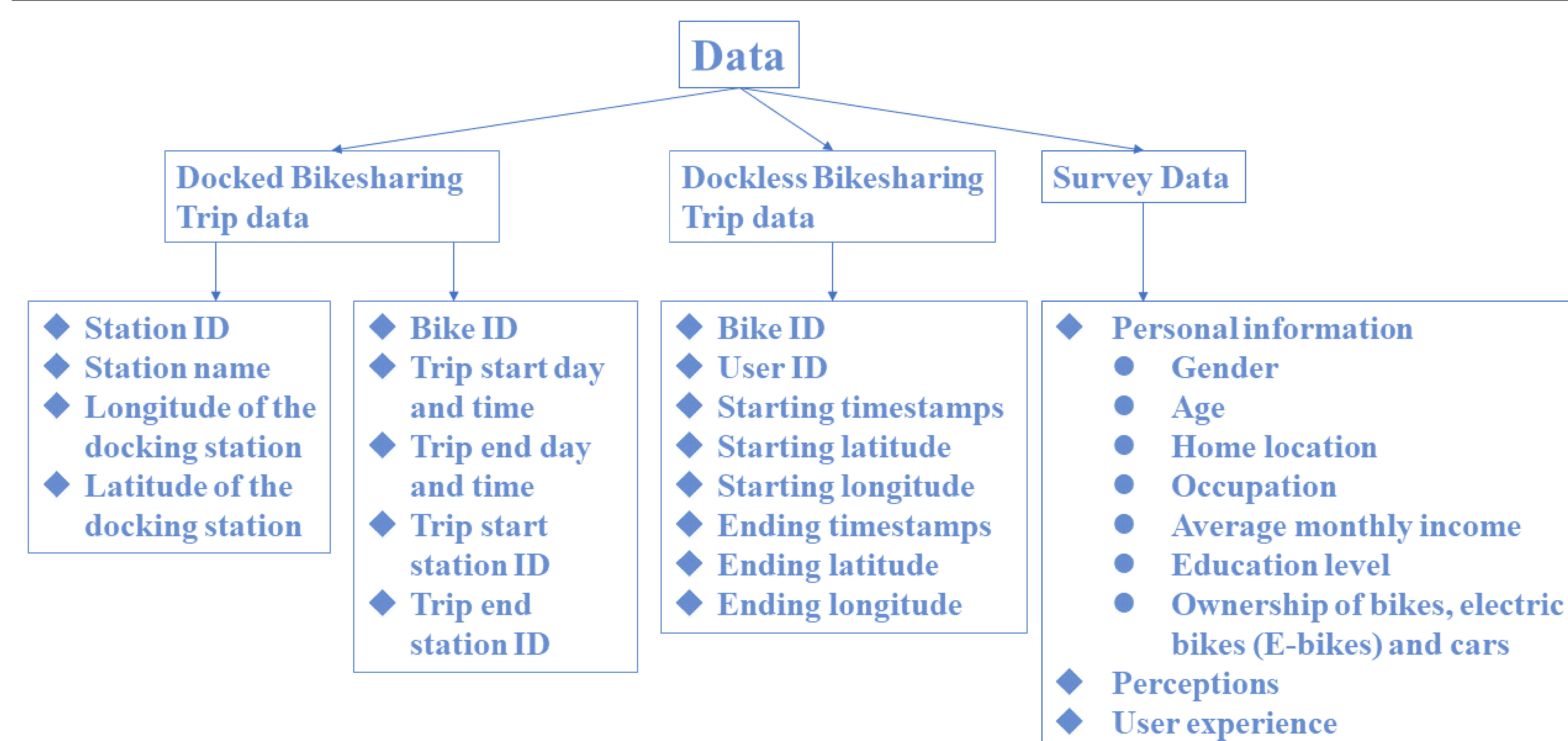
- Revealing the difference in travel characteristics, including travel time, travel distance and other dimensions by mining the GPS data from a dockless bike-sharing scheme and the smart card data from a docked bike-sharing scheme.
- Conducting an intercept survey and establishing a binary logistic model to measure the factors influencing travelers of making a preferred choice between two bike-sharing modes.
- Proposing effective measures to improve the performance of docked and dockless bike-sharing systems.

### Study Area



- Five urban districts (Xuanwu, Qinhuai, Gulou, Jianye and Yuhua) in Nanjing, where both docked and dockless bike-sharing systems are well developed were selected as the case study.
- Nanjing launched the docked and dockless bike-sharing programs in January, 2013 and January, 2017 respectively.

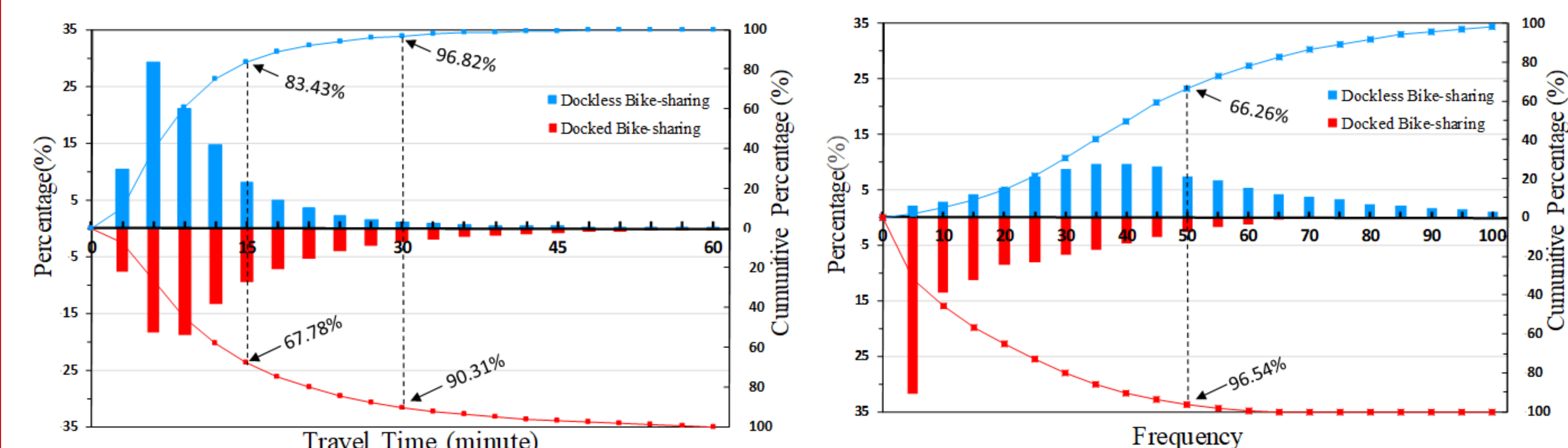
### Study Data Description



### Regression Model and Survey Overview

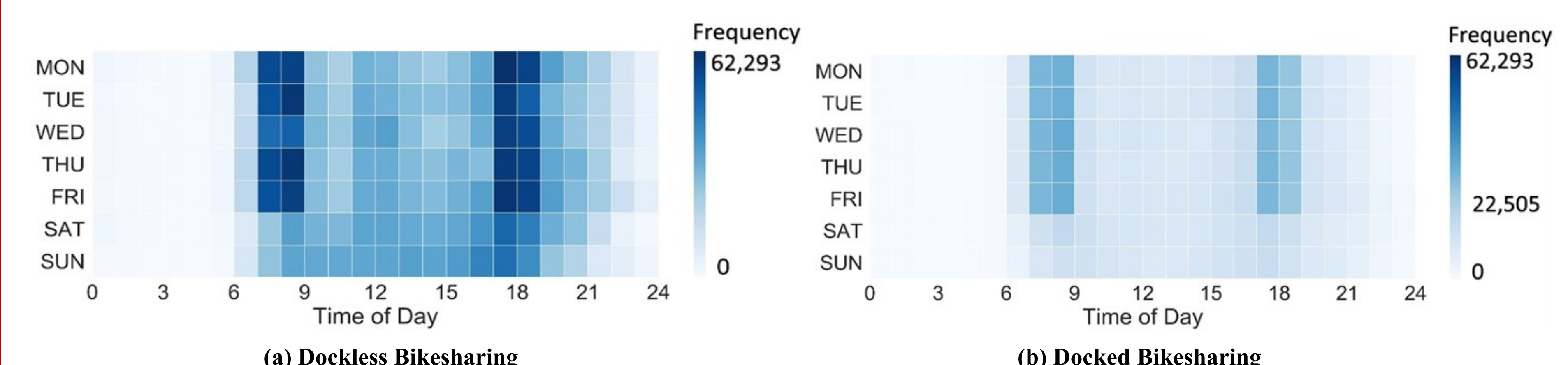
- A binary logistic model is applied to explore the influencing factors of bike-sharing mode choice. The dependent variable for the choice of bike-sharing is binary: docked bike-sharing or dockless bike-sharing as their preferred choice. Three groups of independent variables include personal information, user perceptions towards dockless/docked bike-sharing and their experience of dockless/docked bike-sharing. Only those who have used both dockless and docked bike-sharing services were selected as the respondents. Five interviewers were deployed to conduct the survey in the Nanjing study area in July 2018. A total of 384 questionnaires were collected, of which 362 questionnaires were valid.

### Comparative Analysis of Usage Patterns



Distribution of the travel times of dockless and docked bike-sharing (left) and Distribution of usage frequency of dockless and docked shared bikes in a week (right).

- Over 60% trips of both dockless bike-sharing and docked bike-sharing users last less than 15 minutes, and trips within 30 minutes take up 96.82% and 90.31% of all trips respectively.
- More than 30% of docked shared bikes are used less than 5 times in a week, and 96.54% used less than 50 times.
- For dockless bike-sharing, usage frequency reaches its peak at 30-35 times and concentrates between 20 and 80 times during one week.



Dockless (a) and Docked (b) bike-sharing usage with aggregation levels of 1 hour for dimension time and one calendar day for dimension date.

- Both dockless and docked bike-sharing show obvious two transfer peaks from Monday to Friday, which are 7:00-9:00 and 17:00-19:00. A small peak of dockless bike-sharing is observed between 11:00 and 13:00. During off-peak hours, the number of docked bike-sharing users is lower than that of dockless bike-sharing users. On weekends, there are no significant peak hours and the transfer volume is significantly lower than that on weekdays.

### Model Results

Variables	Coef.	Odds Ratio	P> z
<b>Personal Information</b>			
Age group: older than 60	-4.450	0.012	0.000***
Occupation: Corporation employee	-3.645	0.026	0.000***
Average monthly income: over 20,000 (yuan: 1 yuan= US\$ 0.1487)	3.650	38.483	0.000***
E-bike ownership: Yes	-1.177	0.308	0.012**
<b>Perceptions Towards Dockless/Docked Bike-sharing</b>			
Two hours for free use: Reasonable	-2.645	0.071	0.000***
Preferred way of unlocking a shared bike: Mobile phone App	1.559	4.752	0.001***
Impact of discounts on your use of dockless bike-sharing: Attractive	2.878	17.775	0.000***
People using dockless bike-sharing around you affect your use of the service: Agree	2.072	7.937	0.000***
<b>Use Experience of Dockless/Docked Bike-sharing</b>			
Complexity of registering the dockless bike-sharing: Complex	2.328	10.260	0.005**
Frequency of unlocking broken dockless shared bikes: Always	-2.318	0.098	0.000***

N = 362  
 LR chi2 = 240.7  
 Pseudo R<sup>2</sup> = 0.4982  
 \*\*\*for p-value less than 0.01  
 \*\*for p-value between 0.01 and 0.05

### Conclusion and Recommendation

- More than 90% bike-sharing users return their bikes within 30 min, demonstrating that it is desirable to limit the free hiring time of docked bike-sharing to a period within 0.5 to 1 hour.
- Both docked and dockless bike-sharing trips on workdays are apparently more frequent than those on weekends, especially during the morning and evening rush. This result indicates that most of the bike-sharing trips are for commuting purposes.
- Retirees are less likely to use docked sharing-bikes than dockless bike-sharing. It is suggested that dockless bike-sharing firms would develop specialized mobile Apps and offer discounted deposit and rental price for them.
- It is suggested that docked bike-sharing firms would design and promote a mobile App to simplify the registration process to attract the high-income travelers, those who prefer unlocking the shared bikes with the smartphone app and those who complain about the complicated registering procedure.