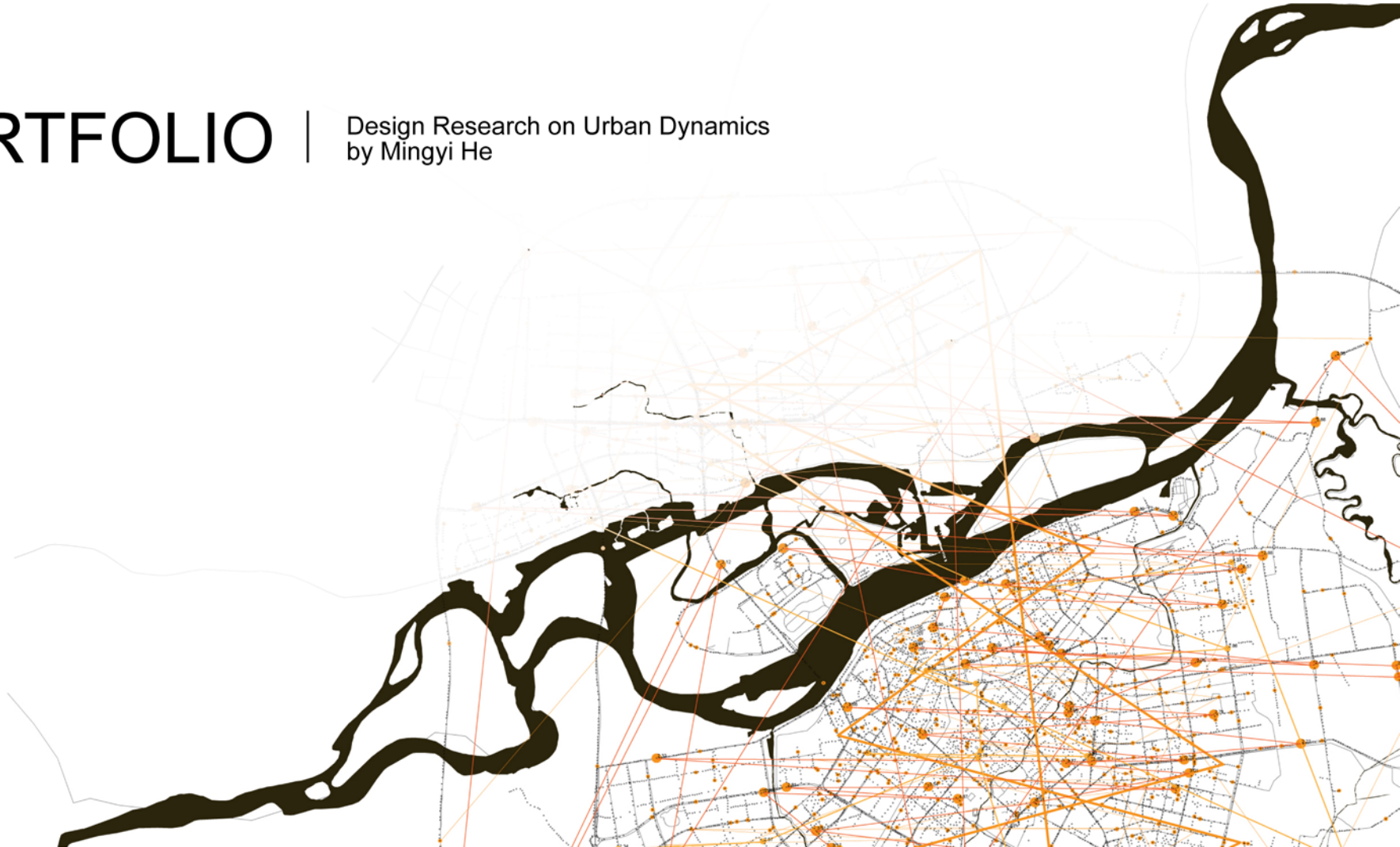
PORTFOLIO

Design Research on Urban Dynamics
by Mingyi He



CONTENTS

Measuring the Enclosure of Urban Street by Color Image Segmentation

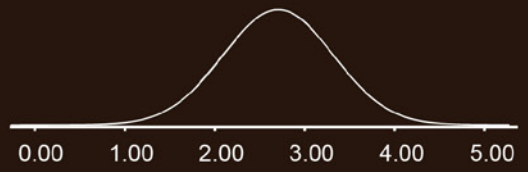
Type: Personal Work

Advisor: Waishan Qiu

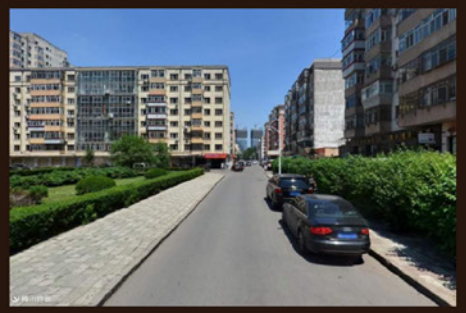
Staerted at MAR. 2017

Segmentation Results & Normal Distribution

Enclosure Degree



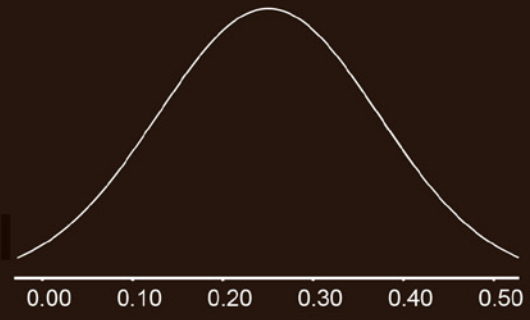
2.035



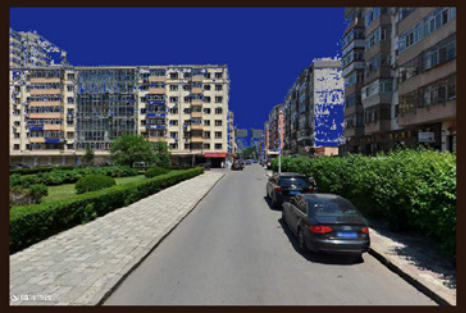
3.154

3.521

Proportion of Sky = $\frac{\text{Area}_{sky}}{\text{Area}_{image}} \times 100\%$



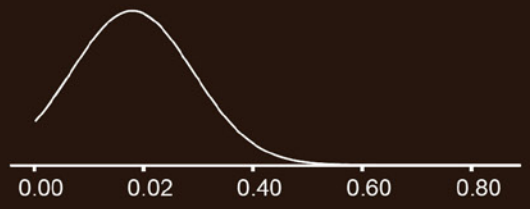
0.383



0.166

0.106

Green View Index = $\frac{\text{Area}_{green}}{\text{Area}_{image}} \times 100\%$



0.071

0.240

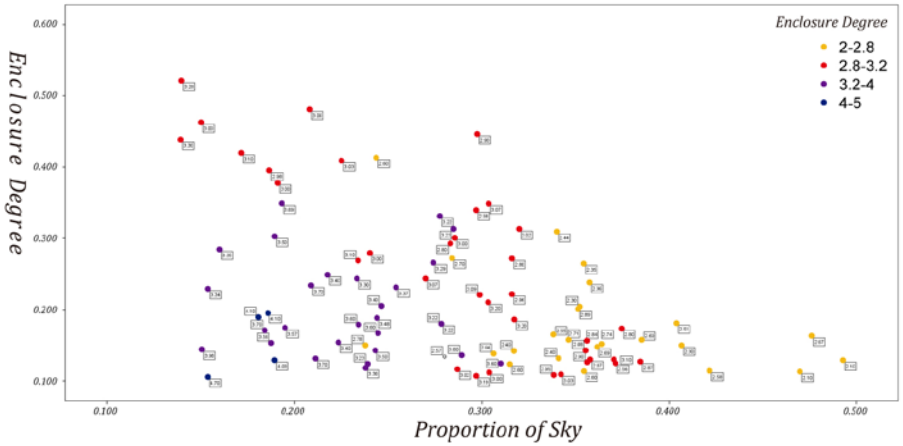
0.002

Model 1:

For this problem, we are using following function to fit our data

$$X_1 = 5.779 - 5.494 \cdot X_2 \text{-} 1.521 e^{X_3}$$

Here, the parameter X_1 represents *Enclosure Degree*, parameter X_2 represents *Proportion of Sky*, X_3 represents *Green View Index*. By fitting our data, we can determineour function as below with R^2=0.651, 6=.000



In this figure, it is obvious that both *Proportion of Sky* and *Green View Index* have positive effect on the *Enclosure Degree*. However when the value of *Green View Index* is larger than 0.278, this variation has a significant influence on the *Enclosure Degree*. Those points' *Enclosure Degree* are alomost marked 3(the best value), much better than other images whose *Proportion of Sky* is at the same level.

Model 2:

For this problem, we are using following function to fit our data

$$X_2 = 0.662 - 0.354 \cdot e^{X_3} - 0.118 \cdot \ln(X_4 + 1)$$

Here, the parameter X_2 represents *Proportion of Sky*, parameter X_3 represents *Green View Index,* parameter X_4 represents *Height-to-Width Ratio*. By fitting our data, we can determineour function as below with R^2=0.425, 6=.000

Compares image 2281 and image 14264, under the same H-W Ratio, the *Green View Index* have a great impact on the *Proportion of Sky*. However, compares image 16429 and image 12972, under the same *Green View Index*, *Height-to-Width* does not affect the *Proportion of Sky* a lot. Without vegetation and other obstructions, the *Proportion of Sky* is totally determined by the *Height-to-Width*, even scale varies.

Enclosure Quality Hot Spot Analysis

Quality=2-Abs([Perceived enclosure degree] – 3)

2 marks the highest quality, 0 marks the lowest quality.

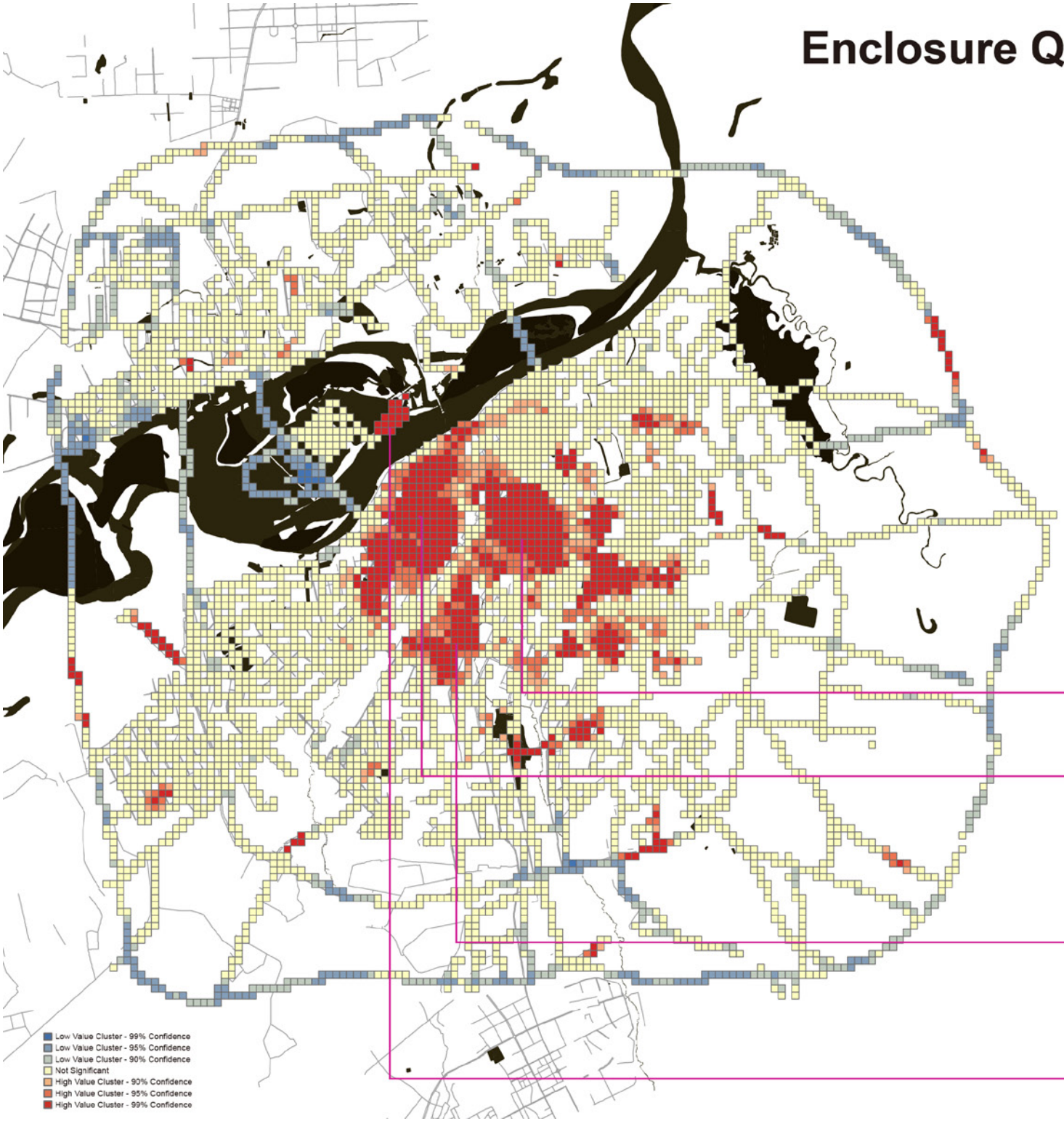
The Hot Spot Analysis tool calculates the Getis-Ord Gi* statistic for each feature in a dataset. The resultant z-scores and p-values define where features with either high or low values cluster spatially.

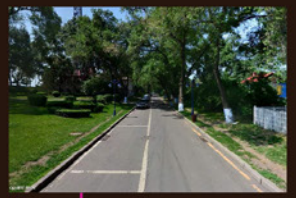
$$G^*_i = \frac{\sum_{j=1}^{n} w_{i,j}x_j - \overline{X}\sum_{j=1}^{n} w_{i,j}}{S\sqrt{\frac{[n\sum_{j=1}^{n} w_{i,j}^2 - (\sum_{j=1}^{n} w_{i,j})^2]}{n-1}}}$$

where x_j is the attribute value for feature j. $w_{i,j}$ is the spatial weight between feature i and j. n is equal to the taotal number of features and:

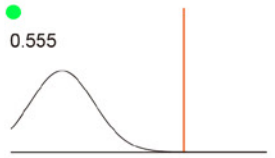
$$\overline{X} = \frac{\sum_{j=1}^{n} x_j}{n}$$

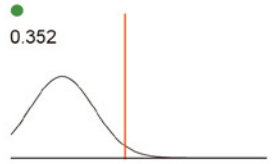
$$S = \sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - \overline{X}^2}$$

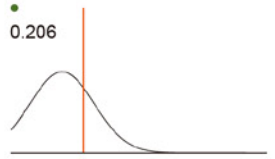


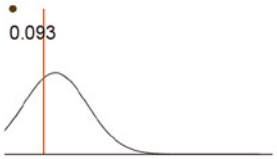


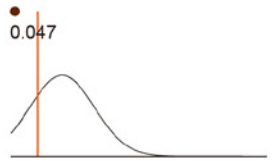
Green View Index Distribution

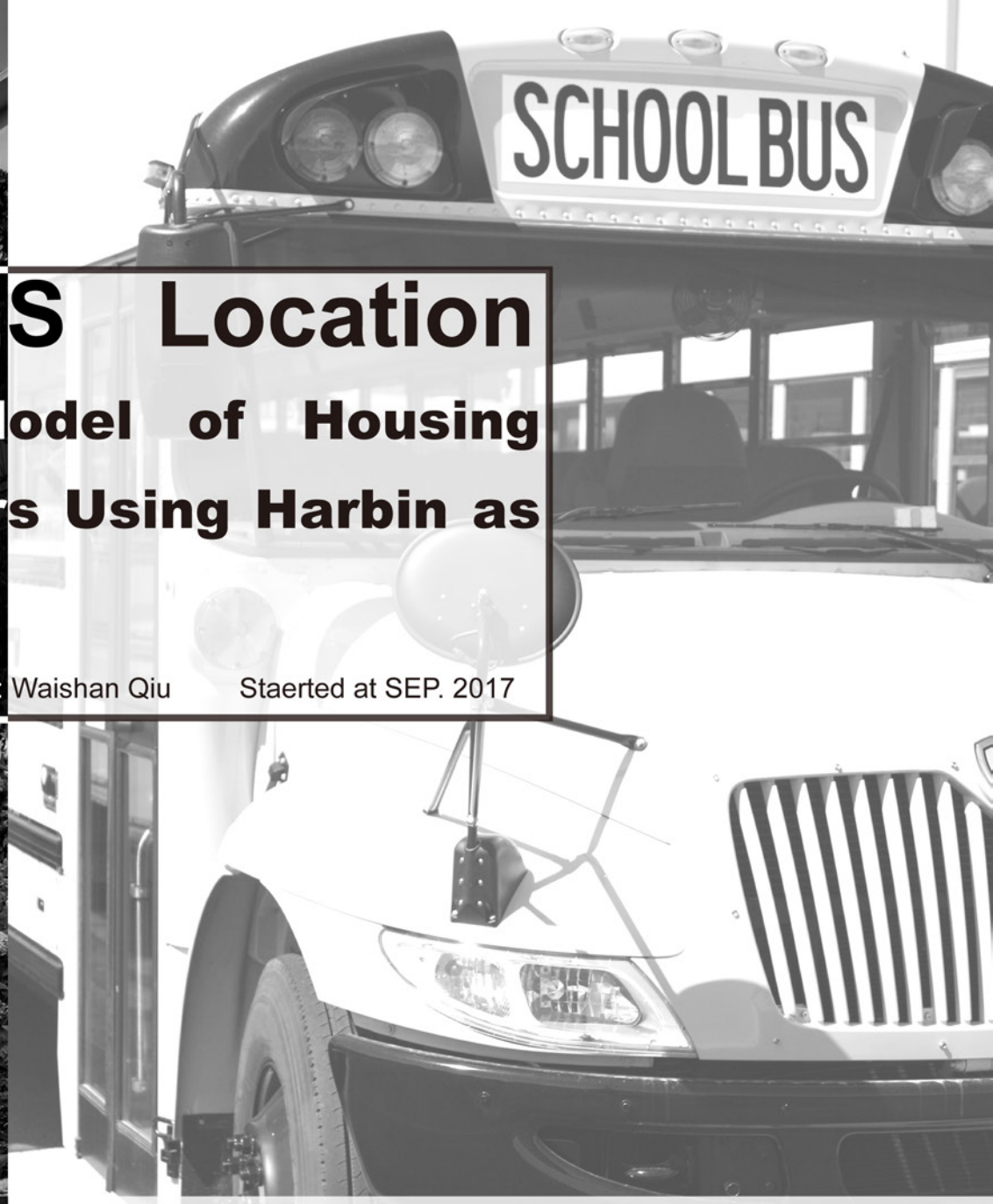












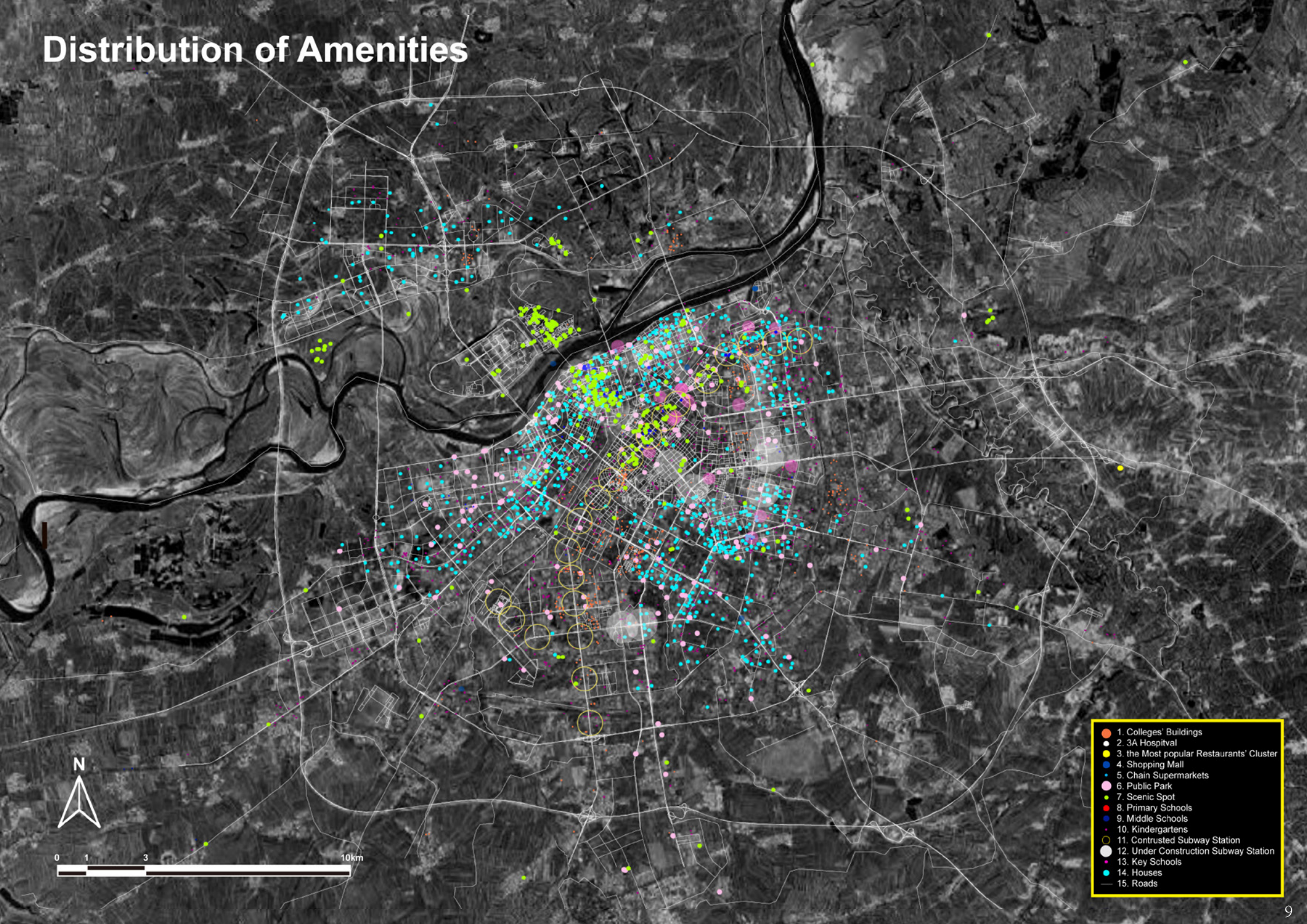
Quality V.S Location

A Hedonic Model of Housing Price Indicators Using Harbin as An Example

Type: Personal Work Advisor: Waishan Qiu Staerted at SEP. 2017

Since Chinese government started to promote compulsory education in 2002, students are required to enter the nearest primary schools and junior high schools. This policy have significantly increased the housing price in certain area. But in 2016, Chinese government published a new policy and led the school district houses became not as valuable as before. This paper develops a theory whether location has the greatest impact on housing price and exploits other variations. We collect our location data from Amap within Harbin, and collect housing price and other attributes of second-hand apartments from Fang.com. As predicted, the quality of community' building environment plays the main role on housing price.

Distribution of Amenities



Variations & Methods

Principal Component Analysis (PCA)

Principal component analysis is a dimension reduction method, it provides a reasonable characterization of the data set. To prevent the correlations between variables which effect the result of regression model significantly, we extracted 8 components from 19 variables.

Location Factors

Component 1: Mainly related to the distance to attractive points

the Distance to Colleges' Buildings	X_2
the Distance to 3A Hospital	X_3
the Distance to the Most popular Restaurants' Cluster	X_4
the Distance to Shopping Mall	X_5
the Distance to Chain Supermarkets	X_6
the Distance to Public Park	X_7
the Distance to Scenic Spot	X_8

Component 2: Mainly related to schools

the amount of middle schools within 1500m	X_{14}
the amount of primary schools within 1000m	X_{16}
located in the key schools' district or not	X_{19}

Component 5: Mainly related to the subway stations

the amount of constructed subway stations within 1000m	X_{18}
the amount of under-construction subway stations within 1000m	X_{17}

Component 6: Mainly related to kindergartens

the amount of kindergartens within 500m	X_{15}

Quality Factors

Component 3: Mainly related to the built environment

the age of buildings	X_{10}
the green rate of community	X_{13}

Component 4: Mainly related to the internal quality of community

the floor area rate of community	X_{11}
the property management fee	X_{12}

Component 7: Mainly related to the quality of house decoration

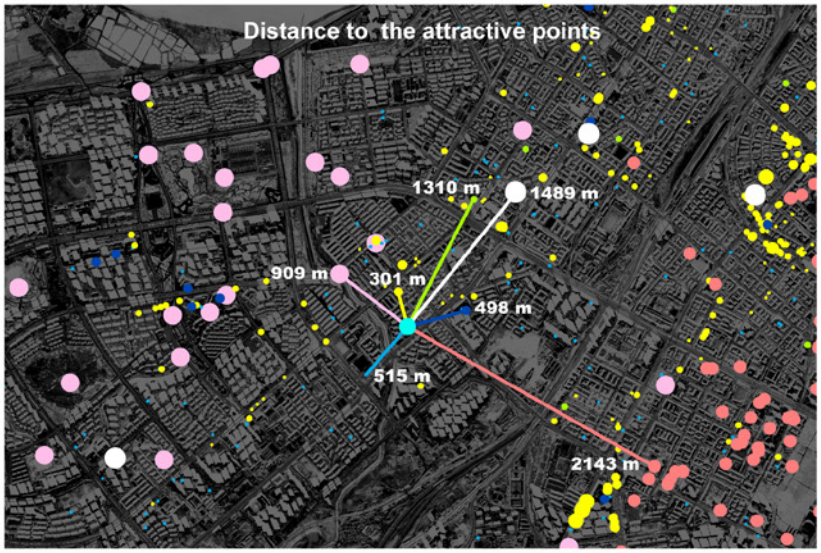
the quality of house decoration	X_1

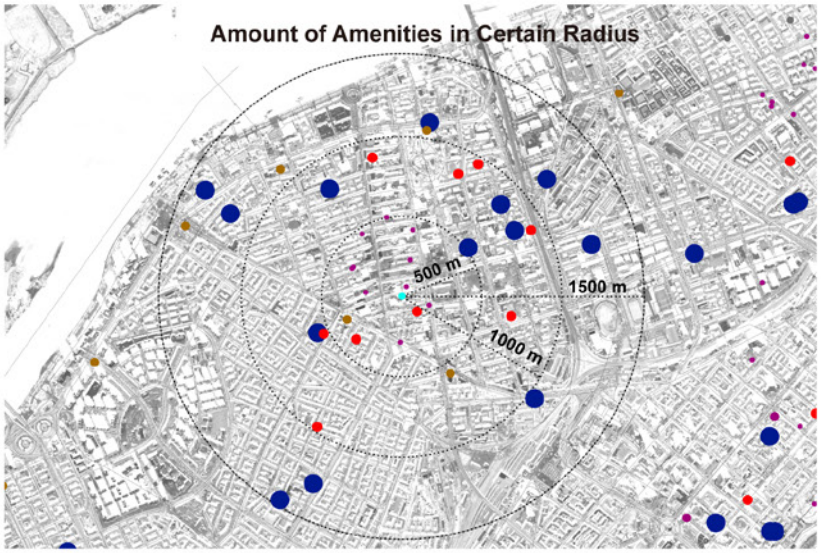
Component 8: Mainly related to the area of house

the area of house	X_9

Hedonic Pricing Method

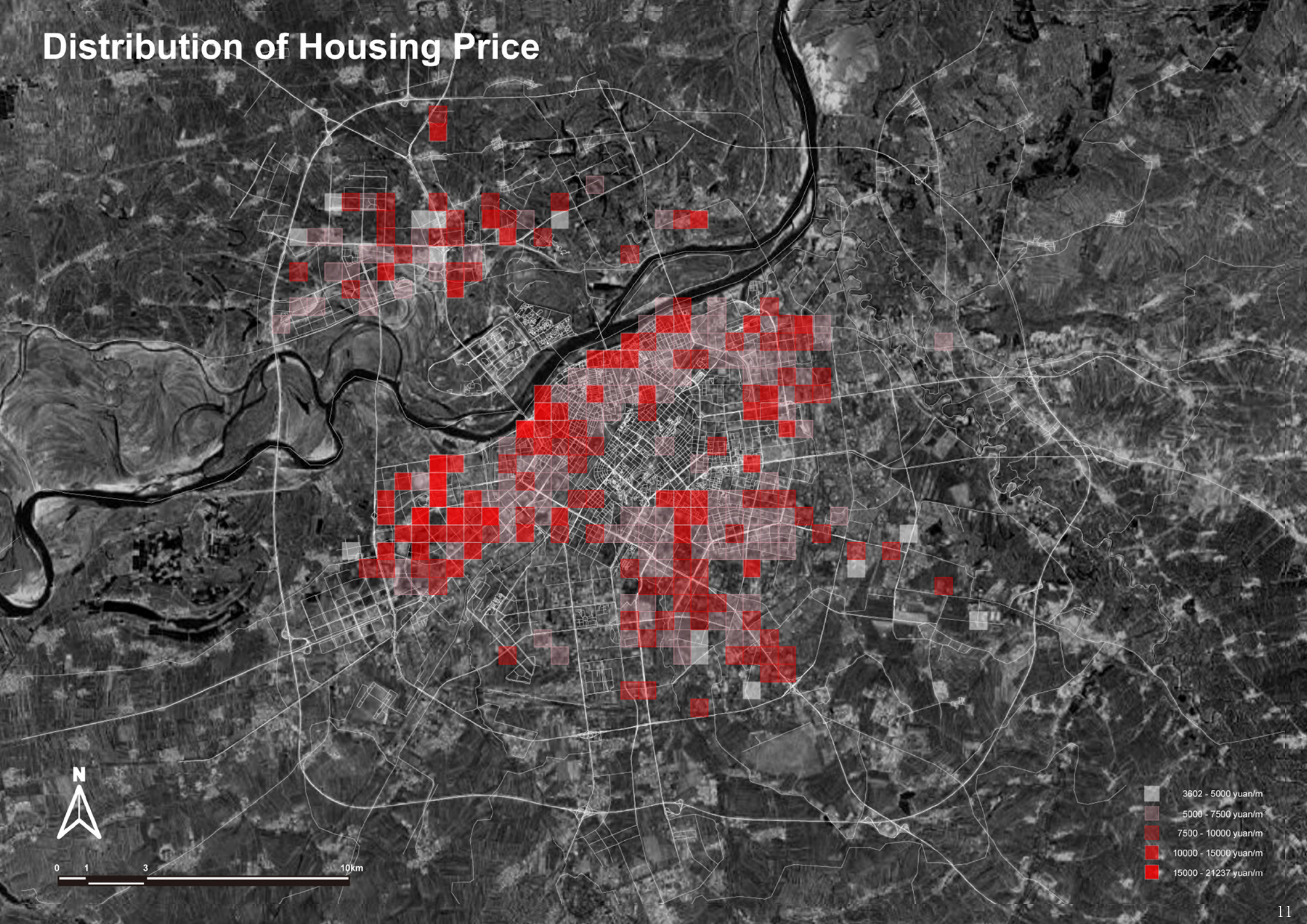
Hedonic price models assume that the price of a product reflects embodied characteristics valued by some implicit or shadow prices. Hedonic price regression models are estimated using secondary data on prices and attributes of different product or service alternatives.





Data Source: Amap API Fang.com

Distribution of Housing Price



Result and Summary

Component Matrix

	α_1	α_2	α_3	α_4	α_5	α_6	α_7	α_8
Decoration Degree: X_1	-0.010	0.020	0.177	0.126	0.837	0.082	-0.463	-0.463	0.156
Dist to the Nearest College: X_2	1.000	0.021	0.011	0.001	0.003	-0.002	0.003	0.003	0.001
Dist to the Nearest 3A Hospital: X_3	1.000	0.020	0.010	0.002	0.002	-0.002	0.002	0.002	0.000
Dist to the Nearest Restaurant Cluster: X_4	1.000	0.020	0.010	0.002	0.004	-0.003	0.002	0.002	-0.001
Dist to the Nearest mall: X_5	1.000	0.016	0.011	0.000	0.001	-0.002	0.003	0.003	0.002
Dist to the Nearest Supermarket: X_6	1.000	0.018	0.011	0.001	0.001	-0.002	0.003	0.003	0.002
Dist to the Nearest Park: X_7	1.000	0.017	0.011	0.001	0.001	-0.001	0.003	0.003	0.002
Dist to the Nearest Scenic Spot: X_8	1.000	0.023	0.011	0.002	0.003	-0.003	0.003	0.003	0.001
Area of House: X_9	-0.002	-0.065	0.245	0.031	0.161	0.858	0.371	0.371	-0.186
Age of House: X_{10}	0.007	0.480	-0.632	-0.048	-0.073	0.142	-0.093	-0.093	0.027
Community Floor Area Ratio: X_{11}	-0.022	0.291	0.582	0.170	-0.198	-0.011	-0.376	-0.376	-0.479
Proper Manage Fee: X_{12}	-0.023	-0.128	0.828	0.018	-0.172	-0.040	0.039	0.039	-0.052
Community Green Rate: X_{13}	-0.018	-0.405	0.528	0.086	0.066	-0.184	0.333	0.333	0.458
Amount of Middle School within 1500m: X_{14}	-0.043	0.770	0.180	0.091	0.046	-0.052	0.164	0.164	0.143
Amount of Kindergarten within 500m: X_{15}	-0.043	0.468	0.006	-0.137	0.412	-0.374	0.403	0.403	-0.463
Amount of Primary School within 1000m: X_{16}	-0.053	0.830	0.185	-0.104	0.048	-0.002	0.089	0.089	0.200
Amount of Constructing Subway Stations within 1000m: X_{17}	-0.030	0.601	0.257	-0.494	-0.059	0.036	0.008	0.008	0.131
Amount of Constructed Subway Stations within 1000m: X_{18}	-0.012	0.162	-0.156	0.870	0.031	-0.115	0.219	0.219	-0.048
within Key School District or Not X_{19}	-0.038	0.693	0.059	0.361	-0.212	0.172	-0.161	-0.161	0.231

Regression Table

	Unstandardized coefficients	Standardized coefficients
(Constant)	8.994*** (8556.465)	
Component 1	-0.002* (-2.111)	-0.007
Component 2	0.096*** (90.964)	0.300
Component 3	0.066*** (62.937)	0.207
Component 4	0.116*** (110.261)	0.363
Component 5	-0.028*** (-26.573)	-0.088
Component 6	0.009*** (8.450)	0.028
Component 7	0.029*** (27.553)	0.091
Component 8	-0.030*** (-28.790)	-0.095
Observations	88423	
R^2	0.29	

dependent variable: ln(price)
t statistics in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.0001

Initial Eigenvalues

Component	λ	Culmulative %
1	7.006	36.875
2	2.871	51.984
3	1.954	62.271
4	1.227	68.730
5	1.028	74.142
6	0.989	79.349
7	0.886	84.009
8	0.849	88.477

Result

$$Component_i = \sum_{i=1}^{19} ZX_i \times \alpha_i \times \sqrt{\lambda_i}$$

$$ZX_i = (X_i - \mu_i)/\partial_i$$

$$\ln(price) = \beta_0 + \sum_{i=1}^{8} \beta_i \times Component_i + \xi$$

Model Interpretation

Location Related Components

Component 1: Mainly related to the distance to attractive points
the Distance to Colleges' Buildings
the Distance to 3A Hospital
the Distance to the Most popular Restaurants' Cluster
the Distance to Shopping Mall
the Distance to Chain Supermarkets
the Distance to Public Park
the Distance to Scenic Spot
has negative effect on housing price, which means keep other vaiations constant, the closer to those attrctive points, the higher housing price is, as people prefer to live close to those urban amenities.

Component 2: Mainly related to schools
the amount of middle schools within 1500m
the amount of primary schools within 1000m
located in the key schools' district or not
has positive effect on housing price, which means keep other vaiations constant, the more schools in certain radius, the higher housing price is.

Component 5: Mainly related to the subway stations
the amount of constructed subway stations within 1000m
the amount of under-construction subway stations within 1000m
has positive effect on housing price, which means keep other vaiations constant, the more subway stations in certain radius, the higher housing price is. Subway stations usually means a more convenient transportation.

Component 6: Mainly related to kindergartens
the amount of kindergartens within 500m
has positive effect on housing price, which means keep other variations constant, the more kindergartens in certain radius, the higher housing price is.

Quality Related Components

Component 3: Mainly related to the built environment
the age of buildings
the green rate of community
has positive effect on housing price, which means keep other variations constant, the the better built envrionment is, the higher housing price is. Furthermore, the new building, or the high green rate of community usually improve the housing price.

Component 4: Mainly related to the internal quality of community
the floor area rate of community
the property management fee
has positive effect on housing price, which means keep other variations constant, the the better internal quality of community is, the higher housing price is. The high floor area rate, densify but also bring a well-established community. High property management fee mostly related to a careful and outstanding service.

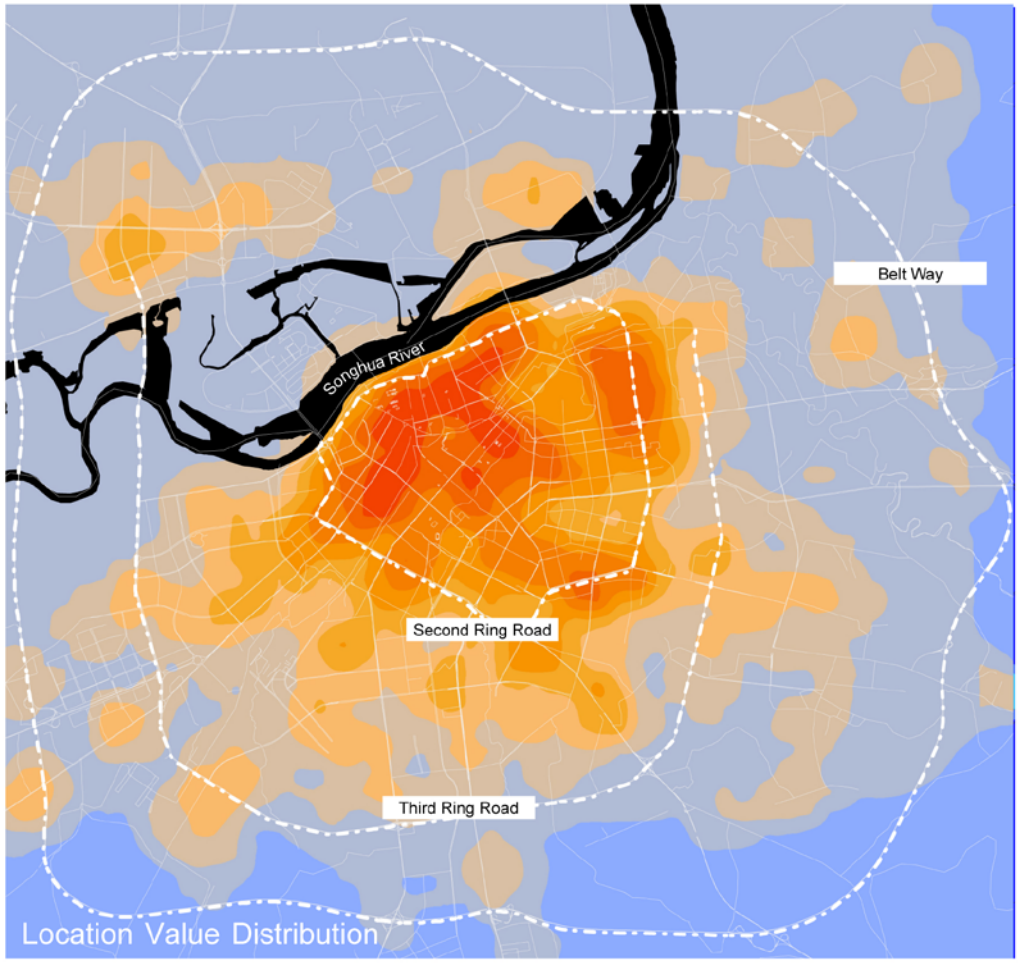
Component 7: Mainly related to the quality of house decoration
the quality of house decoration
has positive effect on housing price, which means keep other vaiations constant, the better decoration is, the higher housing price is.

Component 8: Mainly related to the area of house
the area of house
has negative effect on housing price, which means keep other vaiations constant, the larger area is, the lower housing price for per square meter is.

Summary

According to standardized coefficients in regression model, comparing the sum of the absolute value of location related components' coefficients and quality related components' coefficients, the latter has a greater impact on the housing price.

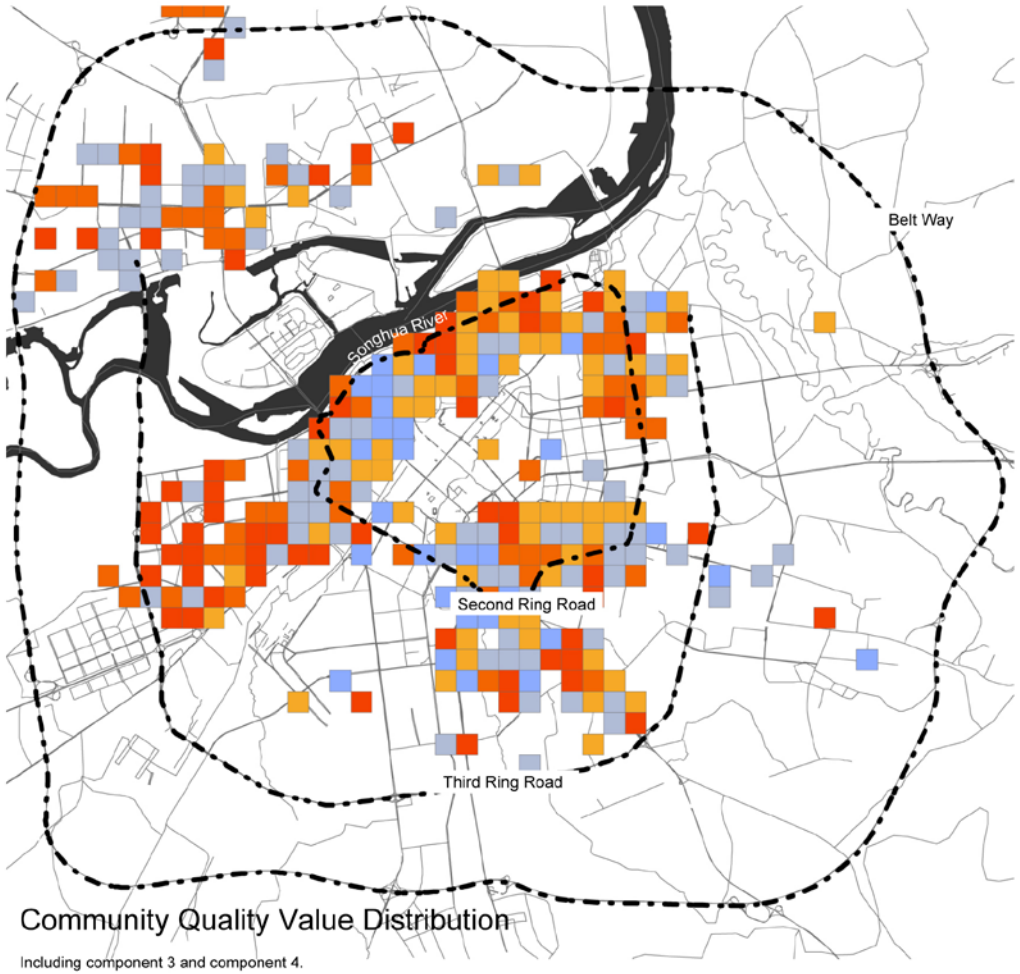
Distribution of Location Value and Housing Quality



Creat 600m fishnet, calculate each pane center's location value, use Kriging interpolation to predict whole city, including component 1, component 2, component 5 and component 6.

the highest location value

the lowest location value



Including component 3 and component 4.

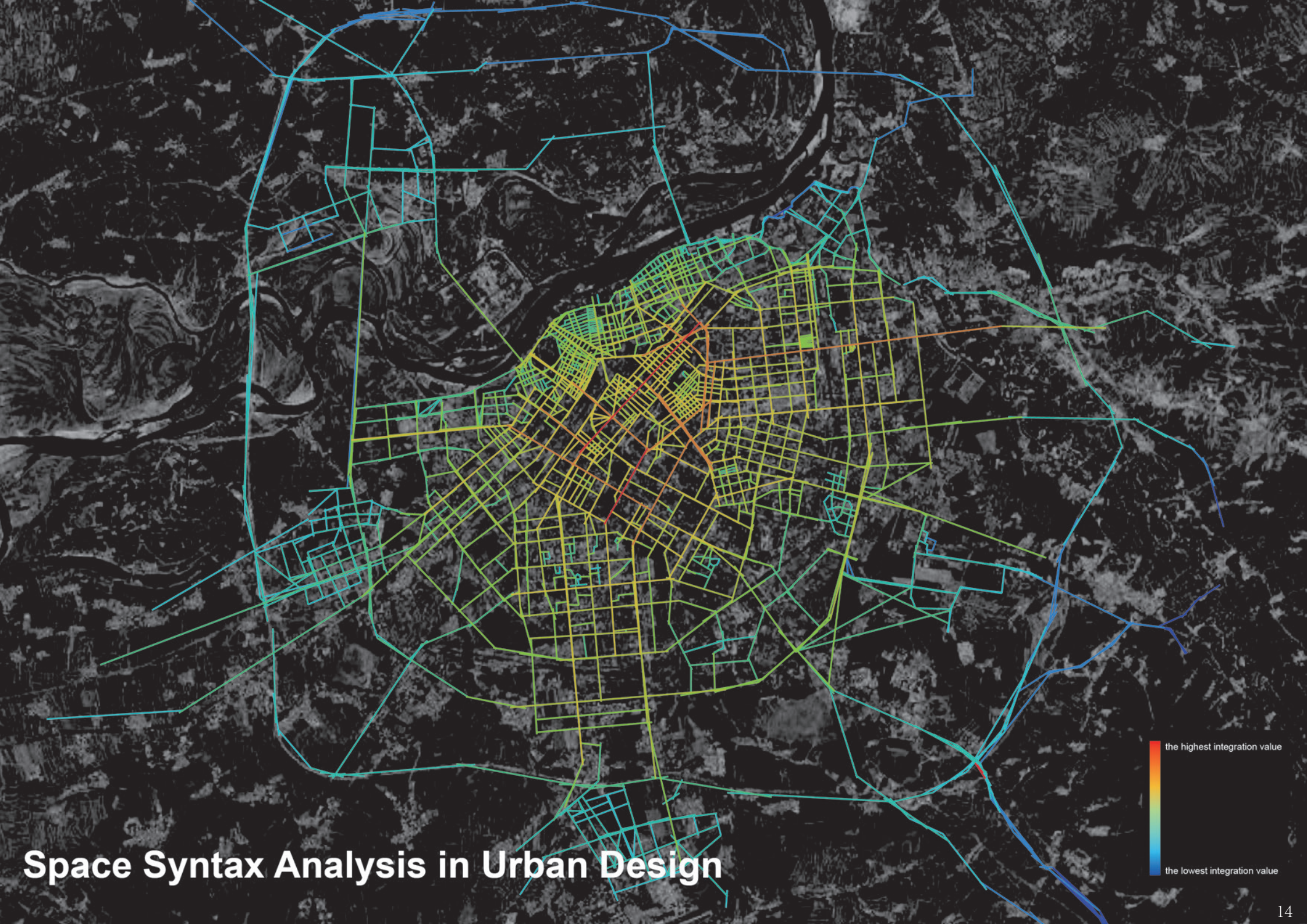
the highest quality value

the sub-highest quality value

the medium quality value

the sub-lowest quality value

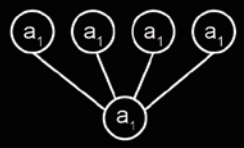
the lowest quality value



Space Syntax Analysis in Urban Design

Space Syntax Analysis

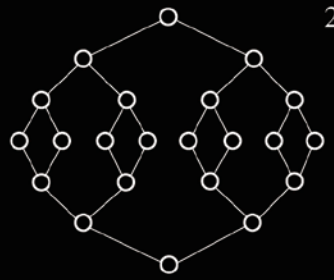
Integration measures how many turns have to be made from a street segment to reach all other street segments in the network, using shortest paths. The street segments that require the fewest turns to reach all other streets are called 'most integrated'.



$$Total\ Depth(a_1) = 1+1+1+1+4$$

$$Mean\ Depth(a_1) = \frac{Total\ Depth(a_1)}{N_A} = \frac{4}{3}$$

$$Relativized\ Asymmetry = \frac{Mean\ Depth(a_1)-1}{\frac{N_A}{2}-1}$$

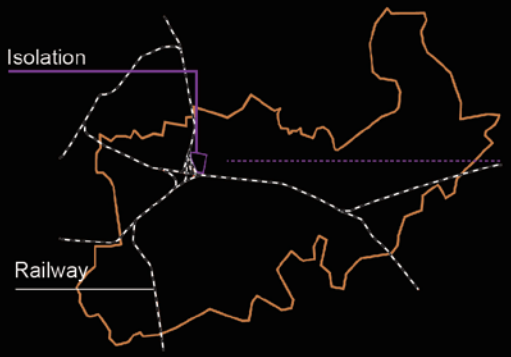


Diamond Shape
Each element has the same mean depth

$$Relativized\ Asymmetry' = \frac{N\left\{\log_2\left(\frac{N}{3}\right)-1\right\}+1}{\frac{(N-1)(N-2)}{2}}$$

$$Integration(b_1) = \frac{Relativized\ Asymmetry'}{Relativized\ Asymmetry(b_1)}$$

Method



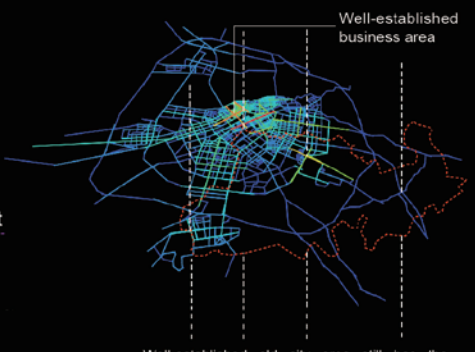
Consequence

The northern road of the field has a relative high integration value, but not the highest part in this district.

The eastern road's integration rises significantly, and the northern road becomes the most intergrated road in this district.

Densify the road system, and revitalize the surronding area.

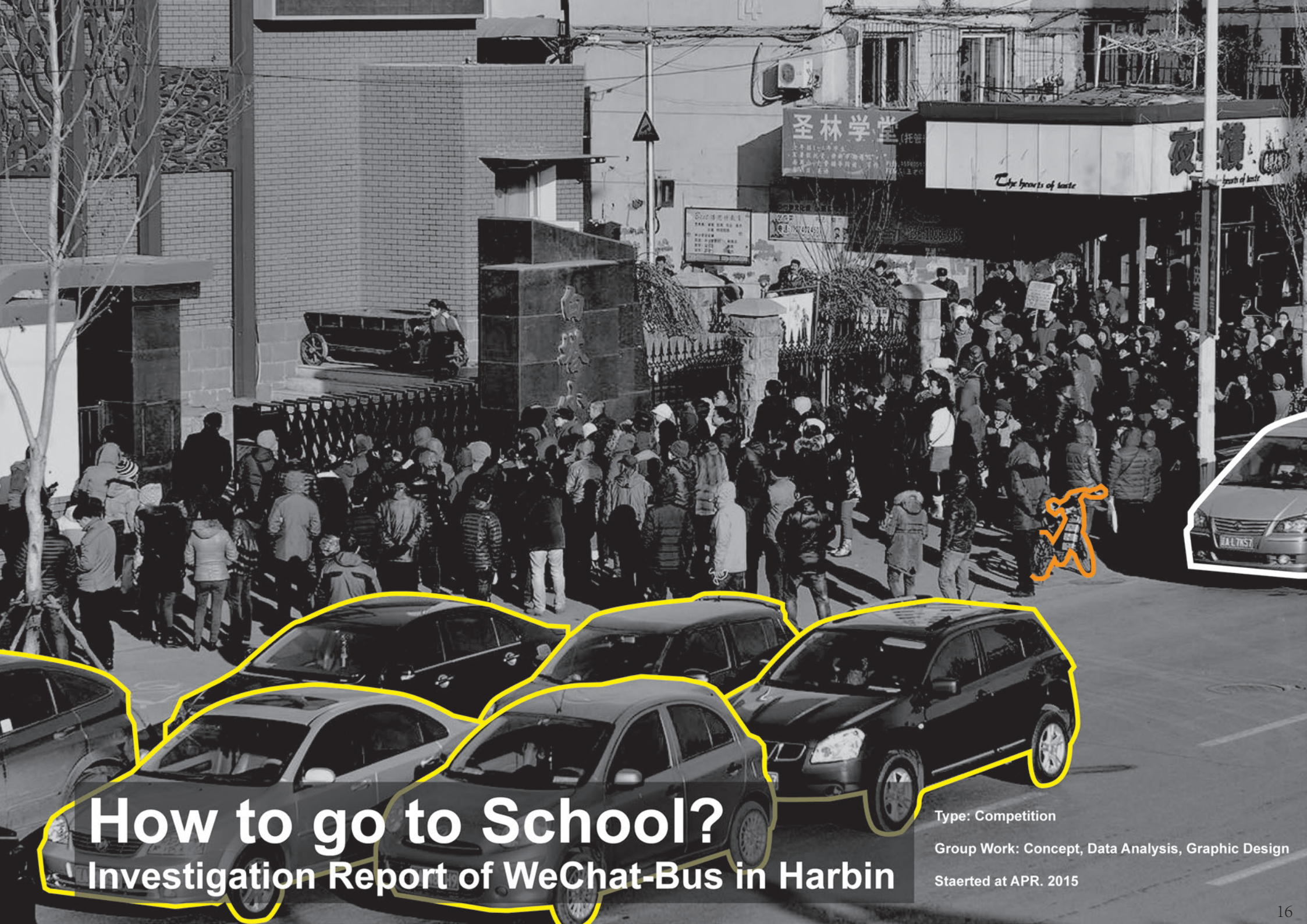
In Whole City



Well-established old city area still has the dominative integration.

Far from downtown area, won't exsit negative competition.

Might take the place of current distriction center.



How to go to School?

Investigation Report of WeChat-Bus in Harbin

Type: Competition

Group Work: Concept, Data Analysis, Graphic Design

Staerted at APR. 2015

Investigation Report of Wechat Bus

[Abstract] “Wechat bus" platform, based on Wechat APP, is committed to unit every school bus company in Harbin. It transforms the competition between companies to cooperation, aims at improve the user experience through this platform, and facilitates the government management. This investigation through questionnaires pubilshed on the platform and collaboration with the Wechat Bus company for investigation and analysis, affirming that the "Wechat Bus" have eased the pressure on urban traffic and provided a higher quality service to costumers.

1. Research Background

1.1 School Buses is the best choice

Most buses are not on time; can be really crowded in peak period; uncomfortable ride.

Expensive; not enviromental friendly; hard to take one in peak period, especially in winter.

Only one subway route in Harbin, for most people, it is unavailable,

1.1 Problems in School Buses Industry

Too many school bus companies
There are 31 companies in total, but 7 of them are unqualified.

Lacking in school bus management
The vihecle models vary between companies, Only 11% buses meet the standard published by government.

Exsting route coincidence
Companies don’t share their resource, causing a large amount of waste.

Hard to organize
Costumers scatterd widely, it is hard for one company to plan a new route.

2. Brief Introduction of Wecha Bus

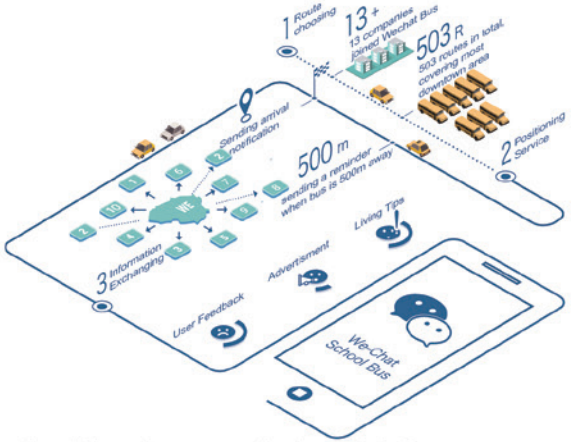


Figure 1. The working process and functions of Wechat Bus

2.1 Cooperative Companies

There are 31 school bus companies in Harbin, **13** of them cooperate with Wechat Bus, occupying **50%** market.

2.2 User Statistics

in 5195 questionnaires

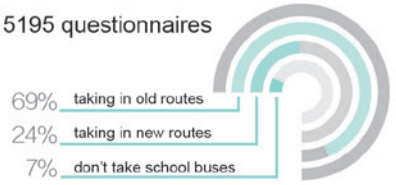
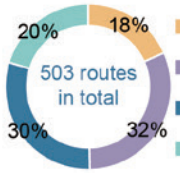


Figure 2. User structure

2.3 Route Statistics



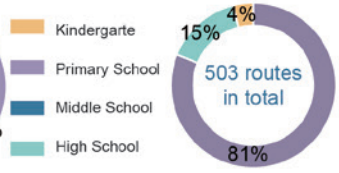


Figure 3. Route destination statistics

Figure 4. Route classafication statistics

Table 1. Route lenth statistics

Route Lenth	Amount
16-22km	98
12-16km	207
10-12km	136
7-10km	47
5-7km	15

The average route lenth is 9.3km

Table 2. Route time statistics

Time	Go to school	Back from school
30-min	36	0
30-50min	277	171
50-70min	183	235
70-90min	7	86
90+min	0	11

The average time for go to school is 31 minutes, for back from school is 62 minutes.

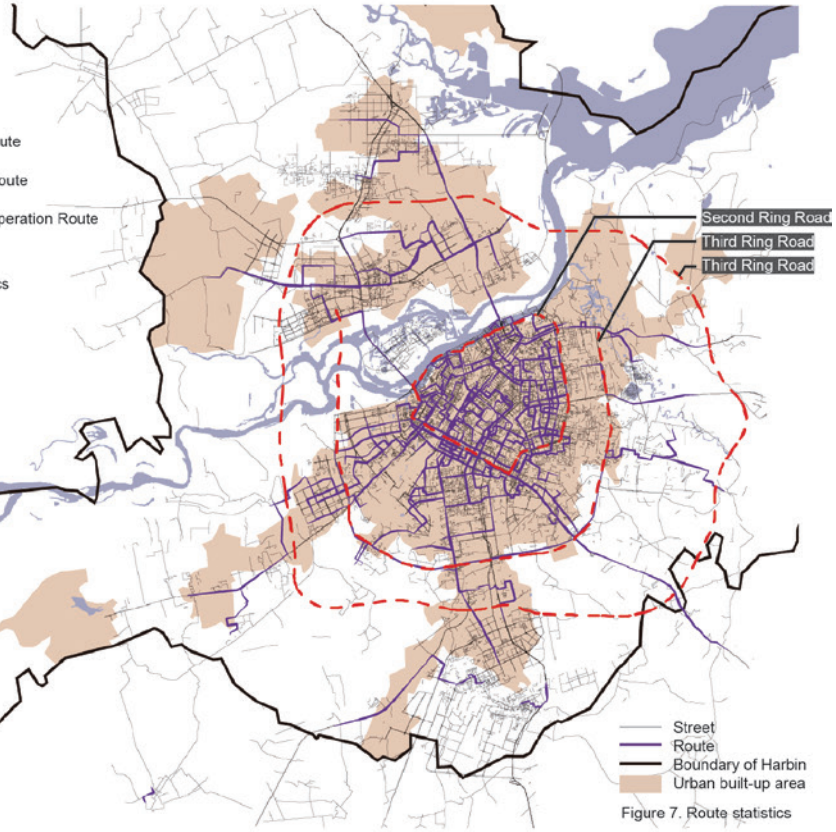


Figure 7. Route statistics

Investigation Report of Wechat Bus

3. Advantage Analysis

3.1 For Companies

3.1.1 Route Optimization

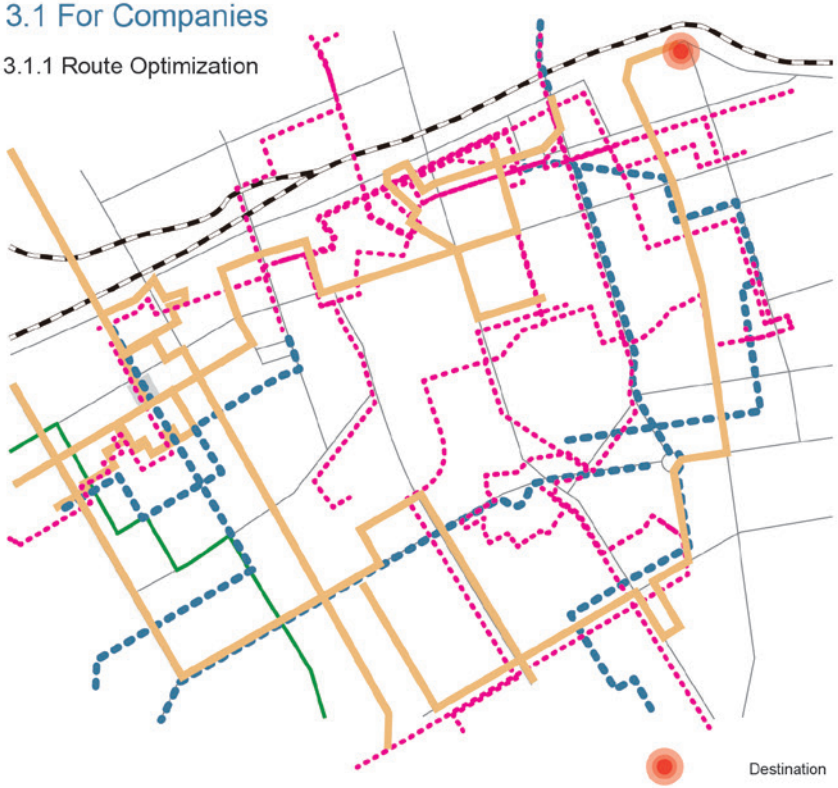


Figure 8. Before cooperation, routes overlapped severely

Table 3. Improvement on original routes

	Before	After
Costumer Amount	3671	3585
Route Amount	454	408
Average Costumer Amount for Per Route	8.1	8.8

Table 3. Comparison between original and new route

	Original Route	New Route
Costumer Amount	3585	1247
Route Amount	408	95
Average Costumer Amount for Per Route	8.8	13.1

Wechat Bus re-organized those original routes and re-arrange costumers for each route, caused a slightly improvement on efficiency.

New routes have siginificantly improved the efficiency of operation, which means also improved the companies' profits.

3.1.2 Costumer Attracting

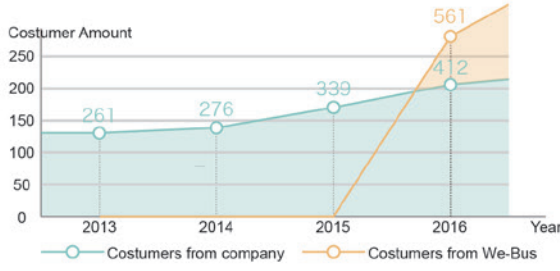


Figure 9. Amount of costomers in a certain company

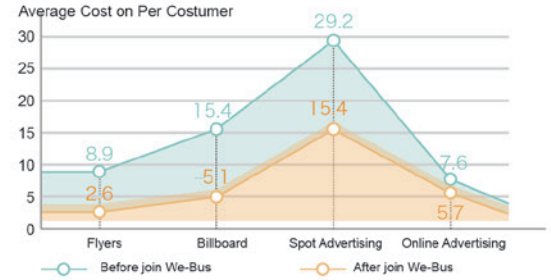


Figure 10. Per capita cost of publicity in a certain company

Wechat Bus is able to attract more costumers and reduce the advertising cost significantly.

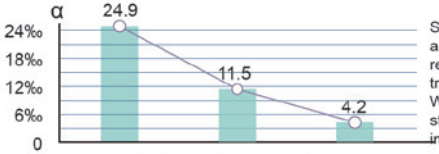
3.2 For Urban Traffic

Table 5. The change of costumers' transportation way and exchanging coefficients of traffic volume

	Before School Bus	Before join We-Bus	After join We-Bus	Vehicle Conversion Factor(PCE)
Motorcycle: X_1	137	22	0	0.4
Private Car: X_2	2743	987	0	0.6
Bus: X_3	2315	340	0	1.2
School Bus: X_4	0	3846	5195	1.2

Data source: 5195 questionnaires
The road system design capcity is 739,000 cars in Harbin.
The average passenger volume of Wechat-Bus is 20 persons.

$$\alpha = \frac{\sum_{i=1}^{4} X_i \cdot PCE_i}{Road\ System\ Design\ Capacity}$$



School buses have a great impact on reducing the urban traffic volume, and Wechat-Bus even strengthen this impact.

Figure 11. The reduction of α

3.2.1 Ruducing parking space occupancy

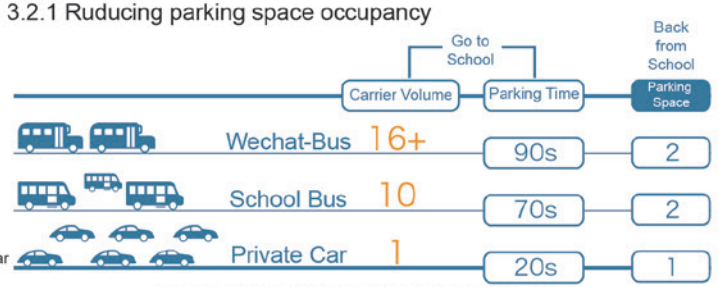
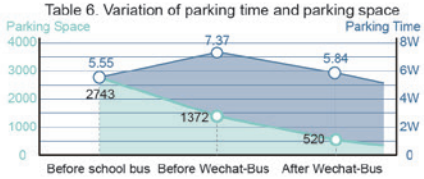


Figure 12. Comparison of parking time and parking space

Table 6. Variation of parking time and parking space



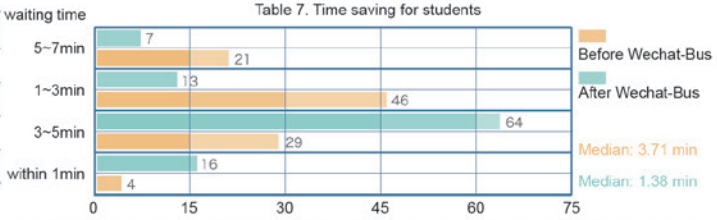
When go to school, both cars and buses don't need parking space, drivers only need to pull up over for a little while. To this extent, the parking time will not decrease. But when back from school, cars and buses drivers have to park while they are waiting for students. As Wechat-Bus's carrier volume is much bigger, the parking space in total has a marked decrease.

3.3 For Costumers

3.1.1 Time Saving

Figure 13. Time saving for parents statistic

Table 7. Time saving for students



Wechat-Bus not only save time for parents as most conventional school buses have already achieved, but also provide positioning service for costumers. Thus, students don't need to wait buses for a too long time. Considering that Harbin is the coldest capital in China, these modification is really important.

3.1.1 Easy to Pay