Date: 20th September, 2023

Construction and analysis of eating-out destination choice model

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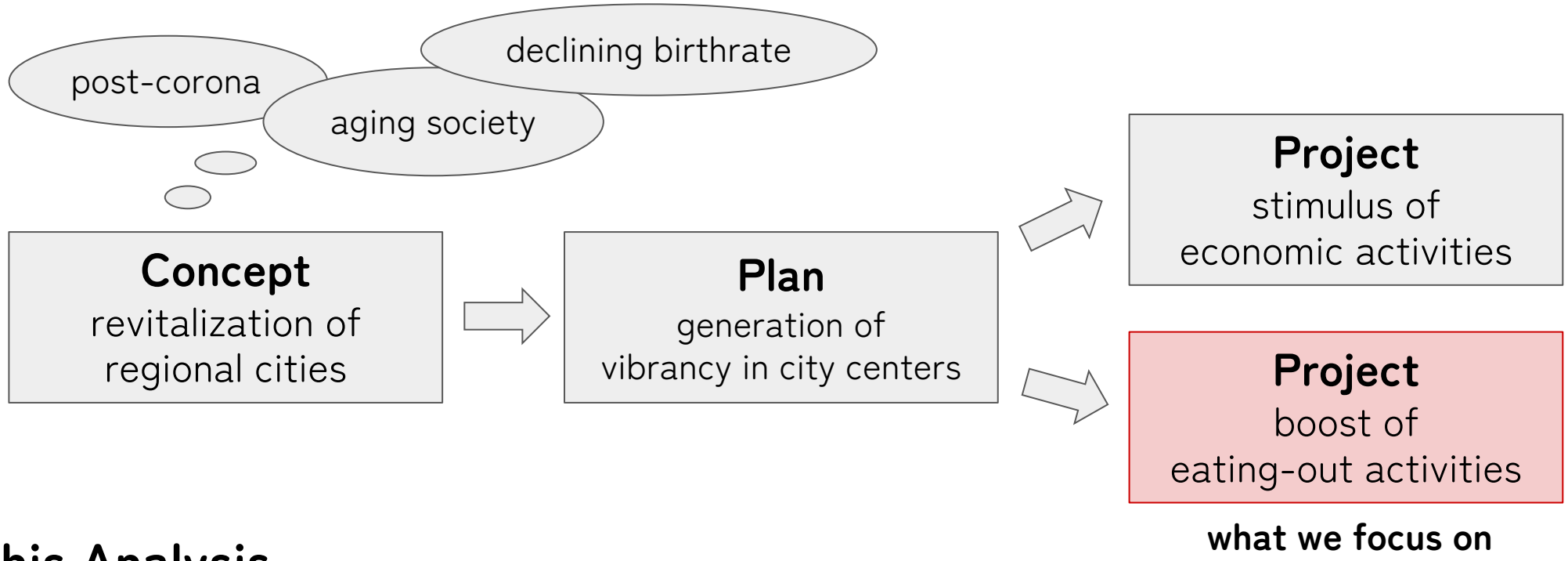
Promote eating out

Background Policy Chart



This Analysis...

- adopts **Destination Choice Model**
- aims to estimate the relations between establishments and options
- will help identify effective components to promote the above policies

Applicable data

Probe Person Data (2021, Shibuya)

- **Purpose**: subjects making destination choice
- **Objects**: residents in Shibuya (236 trips, destinations in Tokyo Pref.)
- **Items**: trip ID, OD location, OD Euclidean distance

Japan MESH3 Boundaries

- **Purpose**: spatial units of aggregating data
- **Objects**: 1km mesh (1274 cells in Tokyo Pref.)
- **Items**: mesh ID

Tabelog Data

- **Purpose**: data characterizing the mesh boundaries
- **Objects**: restaurants (127066 points in Tokyo Pref.)
- **Items**: minimum of budget, rating

Explanatory Variables

Hypothesis

ⅰ. people likely to choose places which have **higher regional attractiveness** (number of restaurants)

ⅱ. low tendency to go eating out **to far away places** (OD trip distanse)

ⅲ. **diversity of restaurants** may have some impacts on choice probabilities (rating average & budgets average and standard deviation)

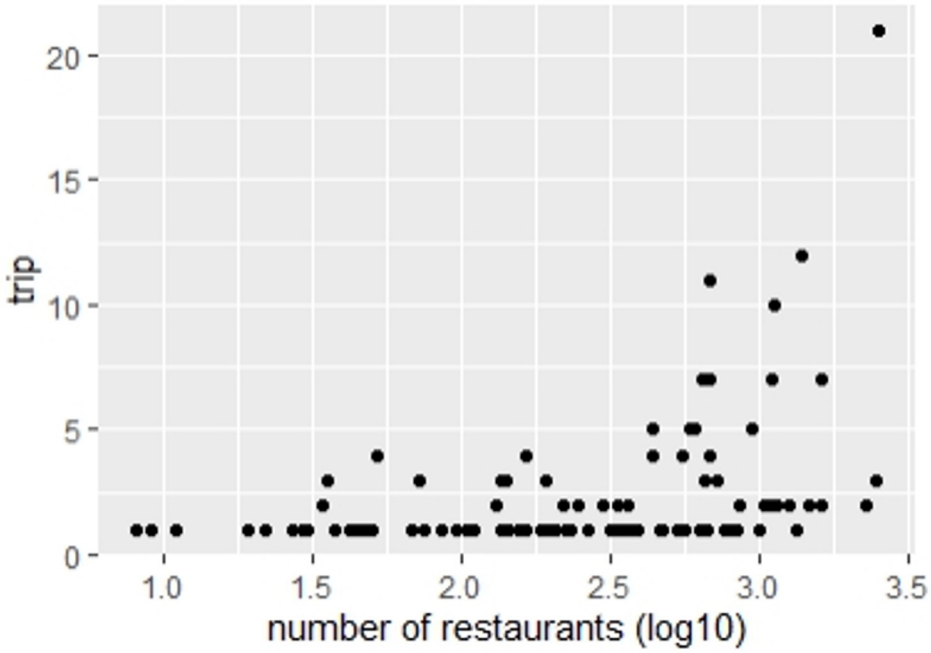
Explanatory Variables

Number of Restaurants (Common Logarithm)

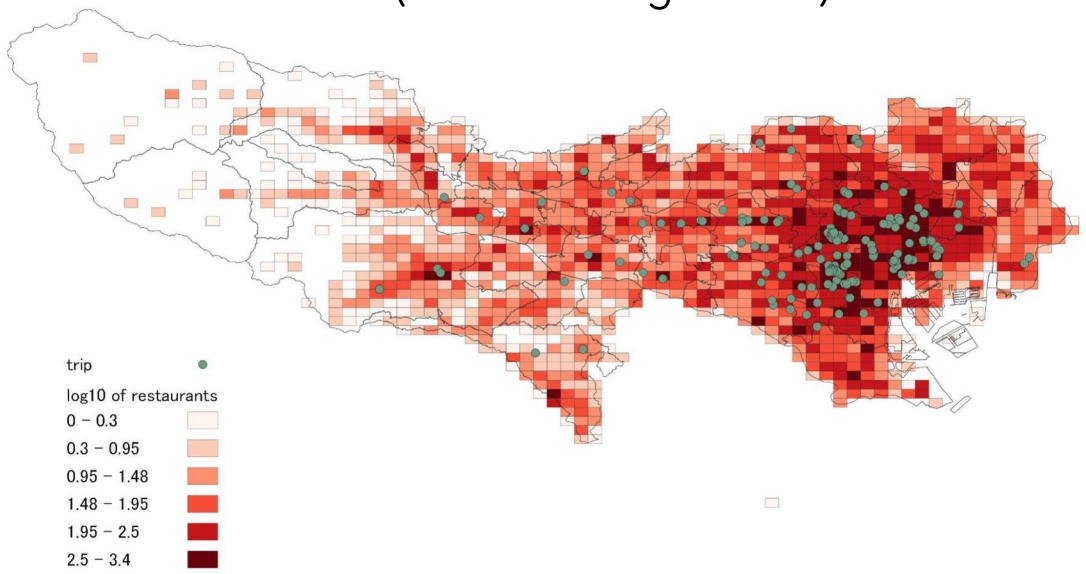
higher values at 23 wards & along railways

The more restaurants a city accumulate, the more attractive each can be… ?

scatterplot



aggregated number of restaurants (common logarithm)

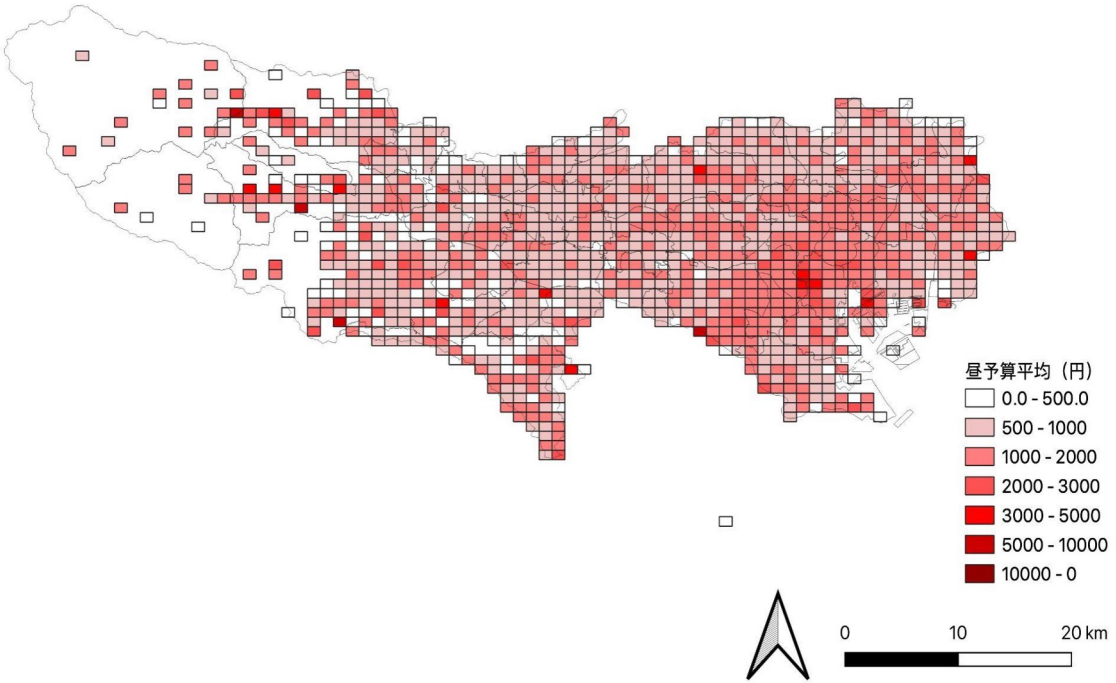


Explanatory Variables

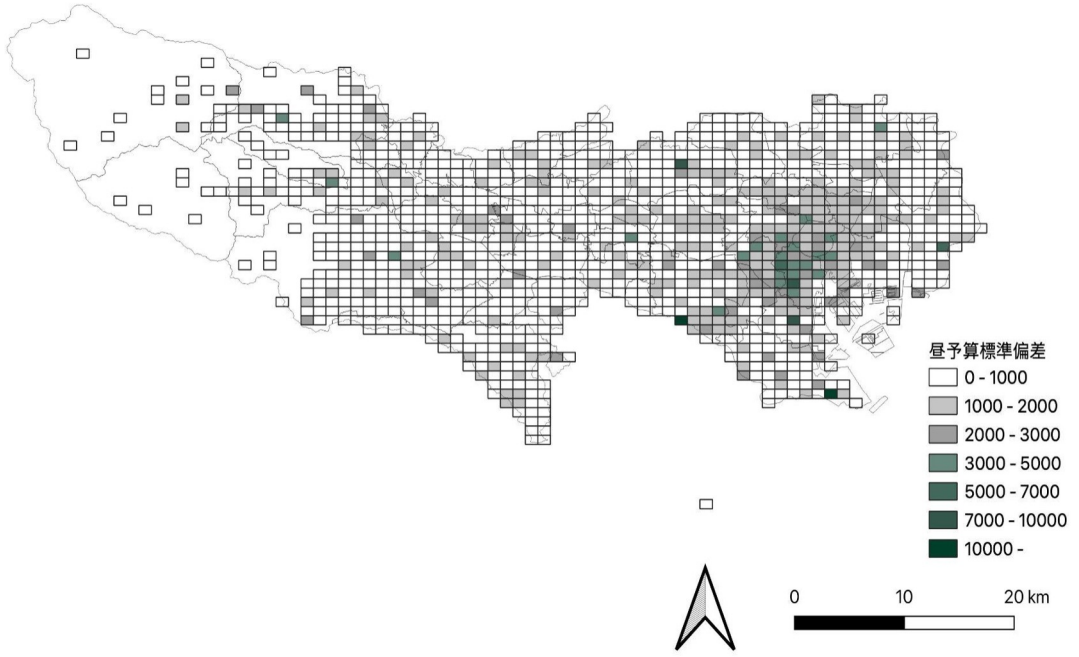
Average & Standard Deviation of Budgets (for Lunch)

- Average: mass of data in the city center between 500-2,000 yen
- Standard Deviation: higher value around Minato-ku

aggregated budget average



aggregated budget SD

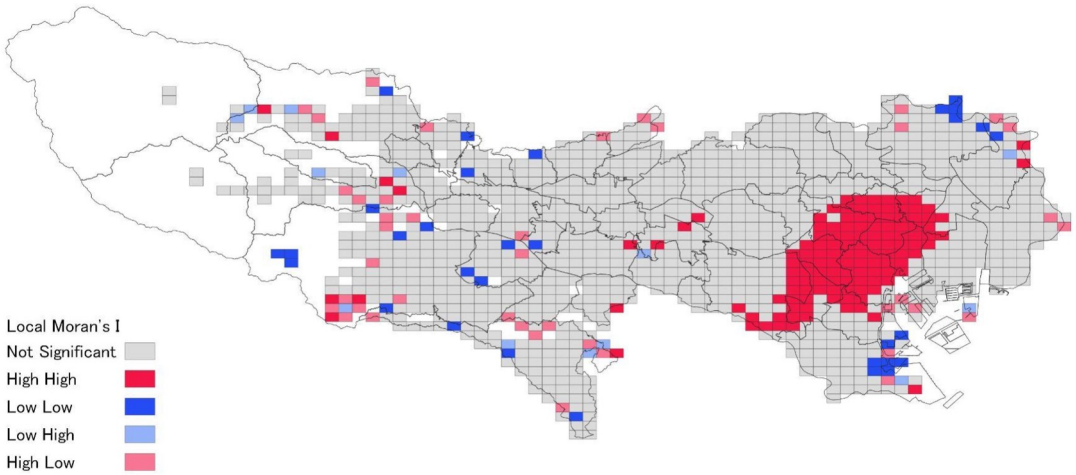


Explanatory Variables

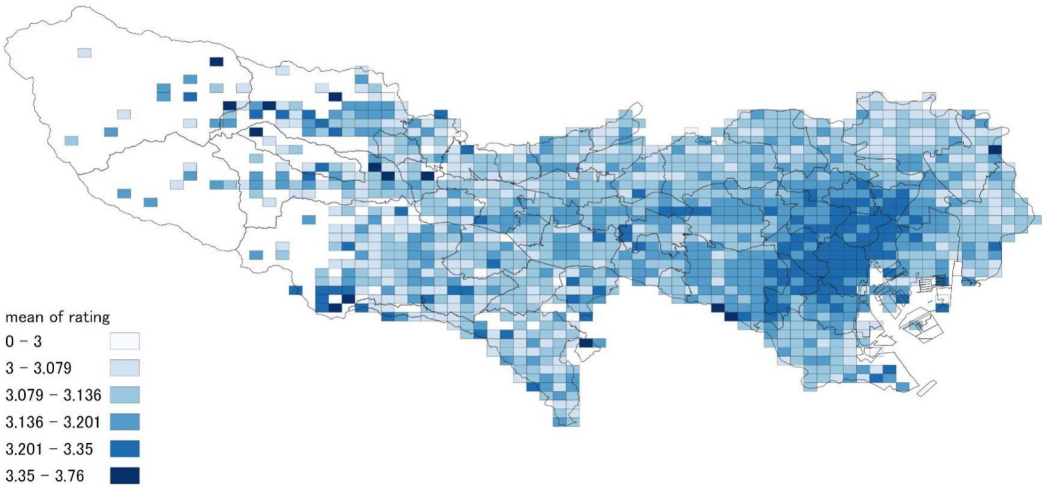
Rating Average

- higher value at regional cells that has few restaurants
- Positive autocorrelation: Minato, Chiyoda, Chuo, Shinjuku & Shibuya

Local Moran's I ($p < 0.05$)



Aggregated Rating Average



Explanatory Variables

Mesh Variables

- the number of restaurants
- budgets average
- budgets standard deviation
- rating average

Individual Variables

- Euclidean distance

Multinomial Logit Model

$$V = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5$$

X1 .....log of number of restaurants
X2 .....rating average of restaurants
X3 .....budget average of restaurants (lunch)
X4 .....standard deviation of budget restaurants
X5 .....OD euclidean distance

spatial unit is 1km mesh

Multinomial Logit Model

Result

Explanatory Variables	Parameter	t-statistic		Aggregated elasticity
log of number of restaurants	1.164	16.05	***	1.163
standard deviation of budget restaurants	0.019	0.17		0.016
budget average of restaurants	0.136	0.55		0.143
rating average of restaurants	0.591	0.30		1.847
OD Euclidean distance	-0.0256	-2.37	**	-0.509
Sample size	236			
Initial log likelihood	-1687.38			
Final log likelihood	-1298.34			
Corrected ρ^2	0.23			

Multinomial Logit Model

Result(significance)

- Log of number of restaurants and OD distance are statistically significant.
- The others are not statistically significant.

Multinomial Logit Model

Direct Elastisity

$$E_{x_{ink}}^{P(i)} = \frac{\partial P_n(i)}{\partial x_{ink}} \cdot \frac{x_{ink}}{P_n(i)} = [1 - P_n(i)] x_{ink}\, \beta_k$$

Aggregate Direct Elastisity

$$E_{x_{ink}}^{\overline{P(i)}} = \frac{\sum_{n=1}^{N} \hat{P}_n(i) E_{x_{ink}}^{P(i)}}{\sum_{n=1}^{N} \hat{P}_n(i)}$$

Sample direct elasticity

Multinomial Logit Model

Aggregate Direct Elastisity

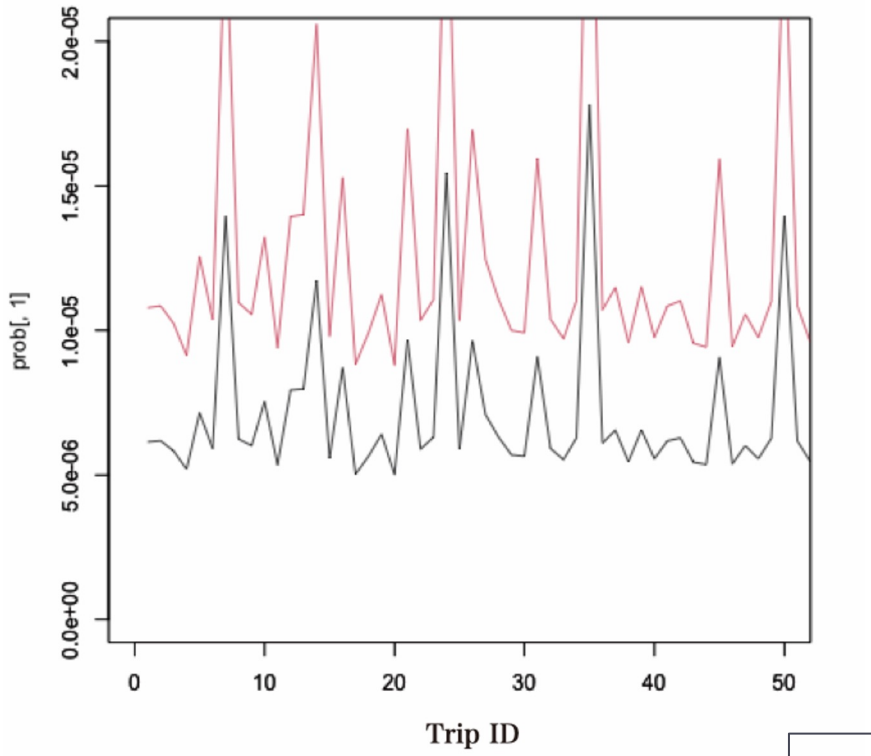
X1 (log of number of restaurants) 1.16
X2 (standard deviation of budget restaurants) 0.02
X3 (budget average of restaurants) 0.14
X4 (rating average of restaurants) ...1.85
X5 (OD euclidean distance) ...-0.51

- X1, X4, X5 have strong effect on choice on people.

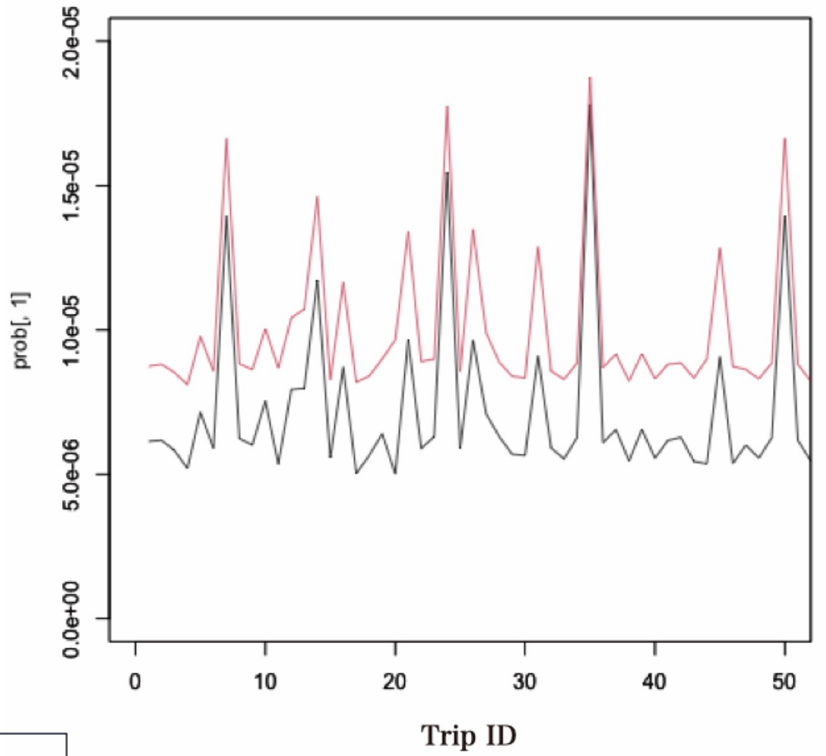
- X4 (rating average of restaurants) is not statistically significant (t_value = 0.3), but has high elasticity, so it may have some implications, but would be so hard to make an inference.
- The range of X4 is very narrow (about3.1~3.7) , so in practical the effect might not be important.

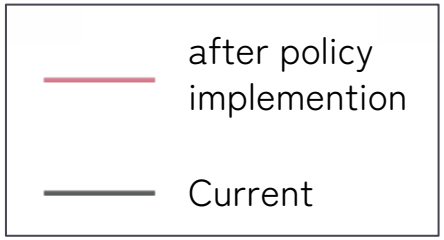
Government policy

Increase the number of restaurants by 20%



Reduce the distance by 50%





Discussion

Hypothesis

ⅰ. people likely to choose places which have **higher regional attractiveness** (number of restaurants)

→it has strong effect and it is significant

ⅱ. low tendency to go eating out **to far away places** (OD trip distanse)

→it is significant , **but the effect is a bit too small**

ⅲ. **diversity of restaurants** may have some impacts on choice probabilities (rating average & budgets average and standard deviation)

→the effect is small and it is not significant

Discussion

Consideration

- budget and rating of restaurants effect may be small and statistically insignificant because of aggregation.
- Do people decide the “area” according to the average budget/rating of restaurants of the area?

Future prospect

- effects may be different when it is analysed by each restaurant, not by each mesh.
- Is it hard to reproduce this model to regional city…?