

# **Recommending the best location for opening new restaurants in Tokyo now**

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## **1. Introduction**

### **1.1 Background**

Today, all people see and face this pandemic which is caused by Covid-19. Almost all the industries have got financial damages. Among those, I believe restaurants business have got the biggest damages. While learning about data science, I was thinking how data science can be helpful for them. This project is completely my original idea and I selected my original methodologies. It is because I could not find similar cases for my project. Although in human histories, we experienced pandemics, this is first time that so many people just move and interact each other. That is why we did not need to change lifestyle much.

### **1.2 Problem**

Problem is for running restaurant business now, take out service should be the most profitable source of income. It is because people cannot be a cluster. I mean people cannot be together in same place. Thus, take out service is the key for running restaurant business.

### **1.3 Target cities**

The targeted cities are Shinjuku city, Shibuya city, Chiyoda city and Minato city. Shinjuku city is a typical city for office workers and there are so many companies. Shibuya is a young and energetic city and there are many tech and venture companies. Chiyoda city is a traditional city and most of bureaucrats and politicians work there. Minato city is an entertaining city and great places for young people.

### **1.4 Methodology**

First, I will use foursquare API for collecting data of parks and restaurants in each city. I will clean the data and compare it. I select the best city from the four cities and then I find

the best location in the city for owners who want to open new restaurants.

## 2. Data acquisition and cleaning

### 2.1 Data source

I used foursquare API and obtained data. I summarized the numbers of parks and restaurants as tables.

Shinjuku city: Data table of park

	name	categories	id	lat	lng
0	新宿遊歩道公園 四季の路	[{'id': '4bf58dd8d48988d1f9931735', 'name': 'R...	4bcc021a937ca593e685aa92	35.694562	139.704569
1	Kashiwagi Park (柏木公園)	[{'id': '4bf58dd8d48988d163941735', 'name': 'P...	4b5fbf2df964a52019cb29e3	35.694847	139.697556
2	公益財団法人 東京都公園協会	[{'id': '4bf58dd8d48988d124941735', 'name': 'O...	504457a2e4b037986897f270	35.696246	139.701062
3	歌舞伎町公園	[{'id': '4bf58dd8d48988d163941735', 'name': 'P...	532e9e27498ee94a23dfc6f3	35.694381	139.702346
4	Okubo Park (大久保公園)	[{'id': '4bf58dd8d48988d163941735', 'name': 'P...	4c36f1ed93db0f471be01e92	35.697397	139.701264
5	新宿遊歩道公園 公衆トイレ	[{'id': '5744ccdf4b0c0459246b4c4', 'name': 'P...	59e87f1a6eda025b69af0cf9	35.693918	139.704307
6	東大久保公園	[{'id': '4bf58dd8d48988d1e7941735', 'name': 'P...	4ed71e362c5b95fea16e59f7	35.694859	139.709118
7	大久保公園 喫煙所	[{'id': '56aa371be4b08b9a8d57356a', 'name': 'O...	59f67e353b83077c09425620	35.697089	139.701684
8	Kabukicho Intersection (歌舞伎町交差点)	[{'id': '52f2ab2ebcbc57f1066b8b4c', 'name': 'I...	4db83d02cda105154123c4c4	35.693529	139.701265
9	アイン薬局 大久保店	[{'id': '4bf58dd8d48988d10f951735', 'name': 'P...	56480e07498ee13b454ceaaa	35.697252	139.701859

Shinjuku city: Data table of restaurants

	name	categories	id	lat	lng
0	Robot Restaurant (ロボットレストラン)	[{"id": '56aa371be4b08b9a8d573538', 'name': 'T...'}]	5053222fe4b055f81ad14a41	35.694319	139.702843
1	レストランはやしや	[{"id": '55a59bace4b013909087cb36', 'name': 'Y...'}]	4c7e2ce510916dcb636f2b96	35.693436	139.701892
2	Bakery Restaurant Saint Marc (ベーカリーレストラン サンマルク)	[{"id": '4bf58dd8d48988d1c4941735', 'name': 'R...'}]	4d12cc1dffa1224b3a1a9cad	35.692443	139.698503
3	J'z (フレンチバル&レストラン ジェイズ)	[{"id": '4bf58dd8d48988d10c941735', 'name': 'F...'}]	50160a5ee4b0ad6ab3763d4b	35.693103	139.704352
4	タイレストラン ヤカ	[{"id": '4bf58dd8d48988d149941735', 'name': 'T...'}]	4dee19867d8bb2167432e890	35.694872	139.705330

### Shibuya city: Data table of park

	name	categories	id	lat	lng
0	Kashiwagi Park (柏木公園)	[{"id": '4bf58dd8d48988d163941735', 'name': 'P...'}]	4b5fbf2df964a52019cb29e3	35.694847	139.697556
1	新宿遊歩道公園 四季の路	[{"id": '4bf58dd8d48988d1f9931735', 'name': 'R...'}]	4bcc021a937ca593e685aa92	35.694562	139.704569
2	公益財団法人 東京都公園協会	[{"id": '4bf58dd8d48988d124941735', 'name': 'O...'}]	504457a2e4b037986897f270	35.696246	139.701062
3	Okubo Park (大久保公園)	[{"id": '4bf58dd8d48988d163941735', 'name': 'P...'}]	4c36f1ed93db0f471be01e92	35.697397	139.701264
4	歌舞伎町公園	[{"id": '4bf58dd8d48988d163941735', 'name': 'P...'}]	532e9e27498ee94a23dfc6f3	35.694381	139.702346
5	大久保公園 喫煙所	[{"id": '56aa371be4b08b9a8d57356a', 'name': 'O...'}]	59f67e353b83077c09425620	35.697089	139.701684
6	Little Park Bridge (公園小橋)	[{"id": '4bf58dd8d48988d1df941735', 'name': 'B...'}]	4c0adddb2ffb8c9b63e626c61	35.691905	139.693951
7	野方第一公園	[{"id": '4bf58dd8d48988d163941735', 'name': 'P...'}]	502ee77de4b047ef9a394038	35.692125	139.694241
8	新宿遊歩道公園 公衆トイレ	[{"id": '5744ccdfe4b0c0459246b4c4', 'name': 'P...'}]	59e87f1a6eda025b69af0cf9	35.693918	139.704307
9	Kabukicho Intersection (歌舞伎町交差点)	[{"id": '52f2ab2ebcb57f1066b8b4c', 'name': 'I...'}]	4db83d02cda105154123c4c4	35.693529	139.701265
10	FamilyMart (ファミリーマート 西新宿柏木公園前店)	[{"id": '4d954b0ea243a5684a65b473', 'name': 'C...'}]	59491b41002f4c4e852da1ad	35.695538	139.696870
11	アイン薬局 大久保店	[{"id": '4bf58dd8d48988d10f951735', 'name': 'P...'}]	56480e07498ee13b454ceea	35.697252	139.701859

### Shibuya city: Data table of restaurants

	name	categories	id	lat	lng
0	Bakery Restaurant Saint Marc (ベーカリーレストラン サンマルク)	[{"id": "4bf58dd8d48988d1c4941735", "name": "R..."}]	4d12cc1dffa1224b3a1a9cad	35.692443	139.698503
1	レストランはやしや	[{"id": "55a59bace4b013909087cb36", "name": "Y..."}]	4c7e2ce510916dcb636f2b96	35.693436	139.701892
2	Robot Restaurant (ロボットレストラン)	[{"id": "56aa371be4b08b9a8d573538", "name": "T..."}]	5053222fe4b055f81ad14a41	35.694319	139.702843
3	Beer Restaurant Lion (ビヤレストラン ライオン)	[{"id": "4bf58dd8d48988d155941735", "name": "G..."}]	5952448cbcd4834674282fc3	35.691105	139.702500
4	Jz (フレンチバル&レストラン ジェイズ)	[{"id": "4bf58dd8d48988d10c941735", "name": "F..."}]	50160a5ee4b0ad6ab3763d4b	35.693103	139.704352

### Chiyoda city: Data table of park

	name	categories	id	lat	lng
0	神保町愛全公園	[{"id": "4bf58dd8d48988d163941735", "name": "P..."}]	4b6c1461f964a520c2222ce3	35.696979	139.756293
1	Nishi-Kanda Park (西神田公園)	[{"id": "4bf58dd8d48988d163941735", "name": "P..."}]	4c1c8b8c63750f472bc0b667	35.698519	139.754722
2	A2-03.Nishikanda Park(West side) - Tokyo Chiy...	[{"id": "4e4c9077bd41f78e849722f9", "name": "B..."}]	5636eee7498eaf29d53306f0	35.698277	139.754840
3	九段坂公園	[{"id": "4bf58dd8d48988d163941735", "name": "P..."}]	51a98ec1498ec63158095450	35.694738	139.748725
4	Tayasu-mon Gate Intersection (田安門交差点)	[{"id": "52f2ab2ebcbcc57f1066b8b4c", "name": "I..."}]	4d64ee49072a6ea89c2ff74d	35.694969	139.748672
5	俎橋児童遊園	[{"id": "4bf58dd8d48988d163941735", "name": "P..."}]	4e1400a86284431b53535c3b	35.695833	139.752495
6	堀留南児童遊園	[{"id": "4bf58dd8d48988d163941735", "name": "P..."}]	4de4af6cc65b7a3e214f18b2	35.697918	139.752113

### Chiyoda city: Data table of restaurants

	name	categories	id	lat	lng
0	オークラ カフェ&レストラン メディコ	[{"id": "4bf58dd8d48988d1c4941735", "name": "R..."}]	59e59dccb3d8e257351c3822	35.693775	139.752140
1	PARK RESTAURANT (パークレストラン)	[{"id": "4bf58dd8d48988d128941735", "name": "C..."}]	53c1fd1a498eb88f6affefe2	35.691426	139.752939
2	Restaurant Alaska (レストラン アラスカ)	[{"id": "4bf58dd8d48988d10c941735", "name": "F..."}]	4cbbbdda90c9a143bd3097d6	35.691104	139.757134
3	レストラン 鳴海	[{"id": "4bf58dd8d48988d1c4941735", "name": "R..."}]	4b621897f964a52027352ae3	35.697248	139.755422
4	Restaurant Budo (レストラン 武道)	[{"id": "4bf58dd8d48988d16d941735", "name": "C..."}]	4ccfcd1448b837044c22eede	35.692881	139.750045

### Minato city: Data table of park

	name	categories	id	lat	lng
0	Kamezuka Park (亀塚公園)	[{"id": "4bf58dd8d48988d163941735", "name": "P..."}	4b56a3cef964a520611728e3	35.643334	139.740522
1	港区立高浜公園	[{"id": "4bf58dd8d48988d163941735", "name": "P..."}	4de3637245dd180ae55cbda8	35.638101	139.743379
2	三田台公園	[{"id": "4bf58dd8d48988d163941735", "name": "P..."}	4b5a5610f964a52030be28e3	35.642481	139.739210
3	三田台公園 ピオトープ	[{"id": "52e81612bcbc57f1066b7a13", "name": "N..."}	5732ef89498e7f7dfe676cd9	35.642350	139.739750
4	港区立高松くすのき公園	[{"id": "4bf58dd8d48988d163941735", "name": "P..."}	4d143bf11356a0939a73c782	35.643025	139.735990
5	大庭城址公園	[]	4dbe5e19fa8cee72737dd5d3	35.643475	139.744786
6	車町児童遊園	[{"id": "4bf58dd8d48988d1e7941735", "name": "P..."}	4c19ace5d4d9c9282b6cf129	35.637119	139.739737
7	白高児童遊園	[{"id": "4bf58dd8d48988d1e7941735", "name": "P..."}	4c0982ccffb8c9b66c0f6a61	35.644718	139.734824

### Minato city: Data table of restaurants

	name	categories	id	lat	lng
0	レストラン クラウン	[{"id": "4bf58dd8d48988d143941735", "name": "B..."}	4c47b974417b20a171bcdea9	35.641460	139.741545
1	レストランカフェ グレース	[{"id": "4bf58dd8d48988d16d941735", "name": "C..."}	4bee2b1c767dc9b67424d4e9	35.647321	139.740043
2	レストラン 菊	[{"id": "4bf58dd8d48988d1c4941735", "name": "R..."}	4c3fd7fbcc410f47efdea861	35.642179	139.742463
3	レストラン 榎ノ木	[{"id": "4bf58dd8d48988d1c4941735", "name": "R..."}	4fe53520e4b0ef8f177786db	35.638876	139.738311
4	プール&レストランバー フォンポイント	[{"id": "4bf58dd8d48988d147941735", "name": "D..."}	4be2467421d5a593fd581611	35.644856	139.743815

### Sums of parks

Name of city	Shinjuku	Shibuya	Chiyoda	Minato
Number of Parks	9	11	7	8

### Sums of restaurants

Name of city	Shinjuku	Shibuya	Chiyoda	Minato
Number of Restaurants	9	11	7	8

## 2.2 Data cleaning

I found parks of Shinjuku and Shibuya had wrong data. I searched they included such as toilets and convenience store of parks. I assume somebody put element of park to those

ones as mistake. I cleaned the data.

#### Shinjuku city: Cleaned Data table of park

	name	categories	id	lat	lng
0	新宿遊歩道公園 四季の路	[{"id": "4bf58dd8d48988d1f9931735", "name": "R..."}	4bcc021a937ca593e685aa92	35.694562	139.704569
1	Kashiwagi Park (柏木公園)	[{"id": "4bf58dd8d48988d163941735", "name": "P..."}	4b5fbf2df964a52019cb29e3	35.694847	139.697556
2	公益財団法人 東京都公園協会	[{"id": "4bf58dd8d48988d124941735", "name": "O..."}	504457a2e4b037986897f270	35.696246	139.701062
3	歌舞伎町公園	[{"id": "4bf58dd8d48988d163941735", "name": "P..."}	532e9e27498ee94a23dfc6f3	35.694381	139.702346
4	Okubo Park (大久保公園)	[{"id": "4bf58dd8d48988d163941735", "name": "P..."}	4c36f1ed93db0f471be01e92	35.697397	139.701264
5	東大久保公園	[{"id": "4bf58dd8d48988d1e7941735", "name": "P..."}	4ed71e362c5b95fea16e59f7	35.694859	139.709118
6	Kabukicho Intersection (歌舞伎町交差点)	[{"id": "52f2ab2ebcbc57f1066b8b4c", "name": "I..."}	4db83d02cda105154123c4c4	35.693529	139.701265

#### Shibuya city: Cleaned Data table of park

	name	categories	id	lat	lng
0	Kashiwagi Park (柏木公園)	[{"id": "4bf58dd8d48988d163941735", "name": "P..."}	4b5fbf2df964a52019cb29e3	35.694847	139.697556
1	新宿遊歩道公園 四季の路	[{"id": "4bf58dd8d48988d1f9931735", "name": "R..."}	4bcc021a937ca593e685aa92	35.694562	139.704569
2	公益財団法人 東京都公園協会	[{"id": "4bf58dd8d48988d124941735", "name": "O..."}	504457a2e4b037986897f270	35.696246	139.701062
3	Okubo Park (大久保公園)	[{"id": "4bf58dd8d48988d163941735", "name": "P..."}	4c36f1ed93db0f471be01e92	35.697397	139.701264
4	歌舞伎町公園	[{"id": "4bf58dd8d48988d163941735", "name": "P..."}	532e9e27498ee94a23dfc6f3	35.694381	139.702346
5	Little Park Bridge (公園小橋)	[{"id": "4bf58dd8d48988d1df941735", "name": "B..."}	4c0addb2ffb8c9b63e626c61	35.691905	139.693951
6	野方第一公園	[{"id": "4bf58dd8d48988d163941735", "name": "P..."}	502ee77de4b047ef9a394038	35.692125	139.694241
7	Kabukicho Intersection (歌舞伎町交差点)	[{"id": "52f2ab2ebcbc57f1066b8b4c", "name": "I..."}	4db83d02cda105154123c4c4	35.693529	139.701265

#### Sums of parks

Name of city	Shinjuku	Shibuya	Chiyoda	Minato
Number of Parks	7	8	7	8

#### Sums of restaurants

Name of city	Shinjuku	Shibuya	Chiyoda	Minato
Number of Restaurants	31	31	15	8

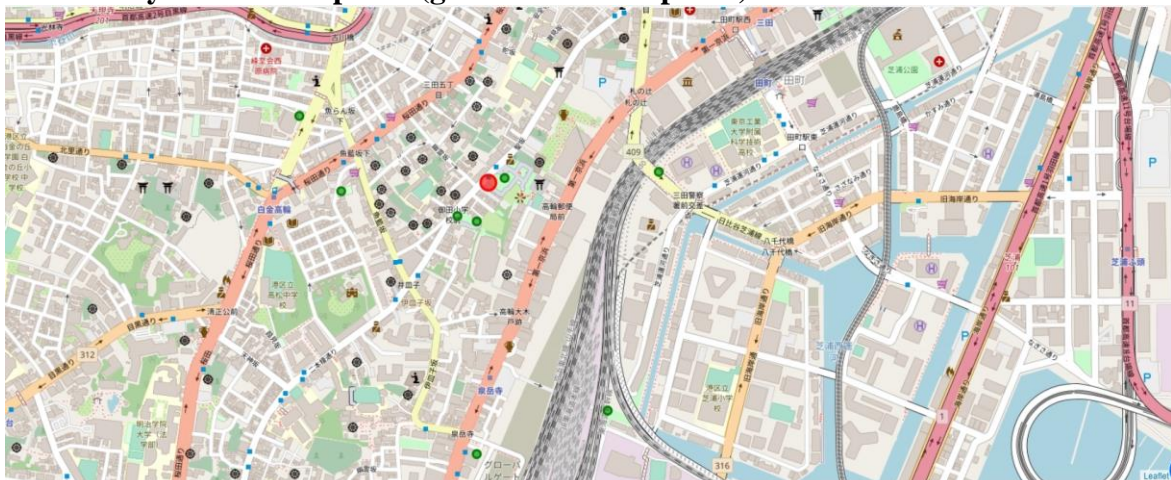
### 3. Exploratory Data Analysis

#### 3.1 Comparing Data and select the most desired city for the case

From the cleaned data, I can see Minato city has 8 parks and only 8 restaurants. I can select Minato city for the recommending city.

#### 3,2 Use graphical data and find the best location

Minato city: location of parks (green marks are parks)



Minato city: location of restaurants (blue marks are restaurants)



Minato city: location of parks (green marks are parks and blue marks are



restaurants)



In the red circle which are surrounded by 3 parks and no restaurants. The location's latitude is around 35.64 and around longitude is 139.74. The location looks idealistic.

I found the great location for owners who want to open new restaurants in Tokyo.

The place's latitude is around 35.6432274 and longitude is around 139.7400553.

However, I need to collect mathematical result for more persuasive recommendation

I continue to use the data and find the best location.

### 3.3 Euclidean distance formula

For keeping this research, I use Euclidean distance formula for analyzing the desirable location.

$$d(p, q) = d(q, p) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2 + \dots + (q_n - p_n)^2} = \sqrt{\sum_{i=1}^n (q_i - p_i)^2}$$

New restaurants should be next to park. Thus, I attempt to the best park's location for opening new restaurants. If the park is closer to other parks, it is better because customers can take foods there as well. If the park is far from restaurants, owners can attract customers more easily.

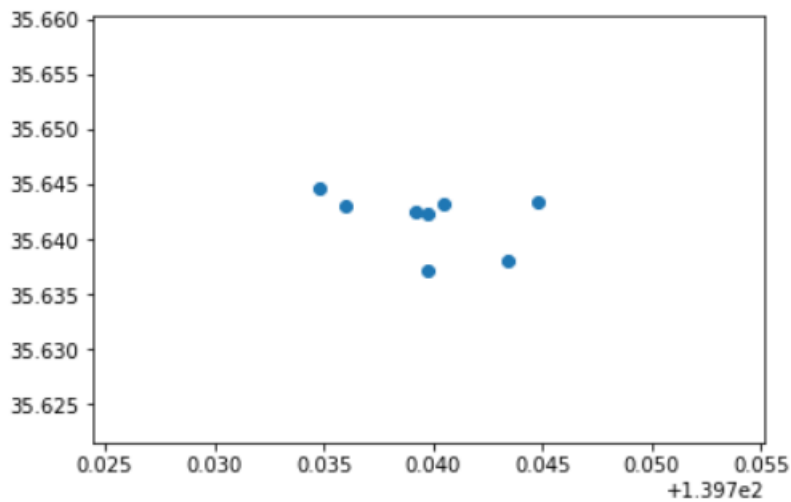
### 3.4 Applying Euclidean distance formula for this case

Firstly, I organize the data by making graphs.

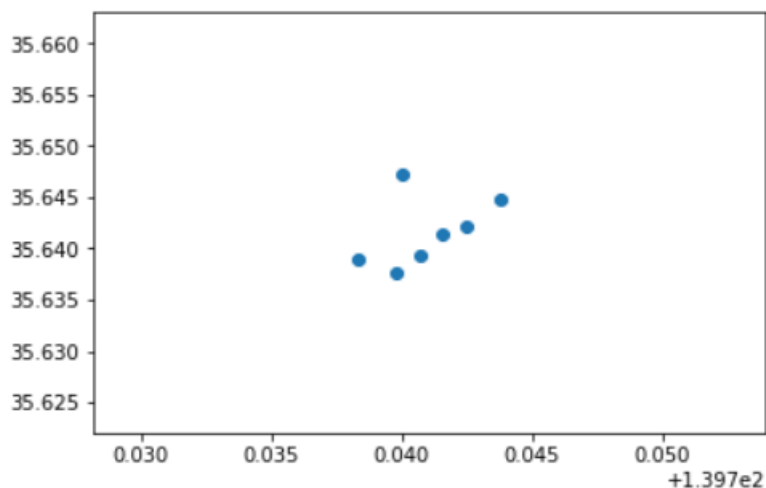
#### Location of parks

(Latitude: y, Longitude x)





### Location of restaurants (Latitude: y, Longitude x)



Next, I obtain Euclidean distance of each parks to other parks and restaurants. After that, I sum up for all parks in Minato city, total Euclidean distance to each park and restaurants. I still need to use this result for finding the best location. For the best location, total distance to parks should be the least and total distance to restaurants should be the biggest. It means distance to parks is negative and distance to restaurants is positive. I made the data table for organizing data.

### Data table of Euclidean distance for each park

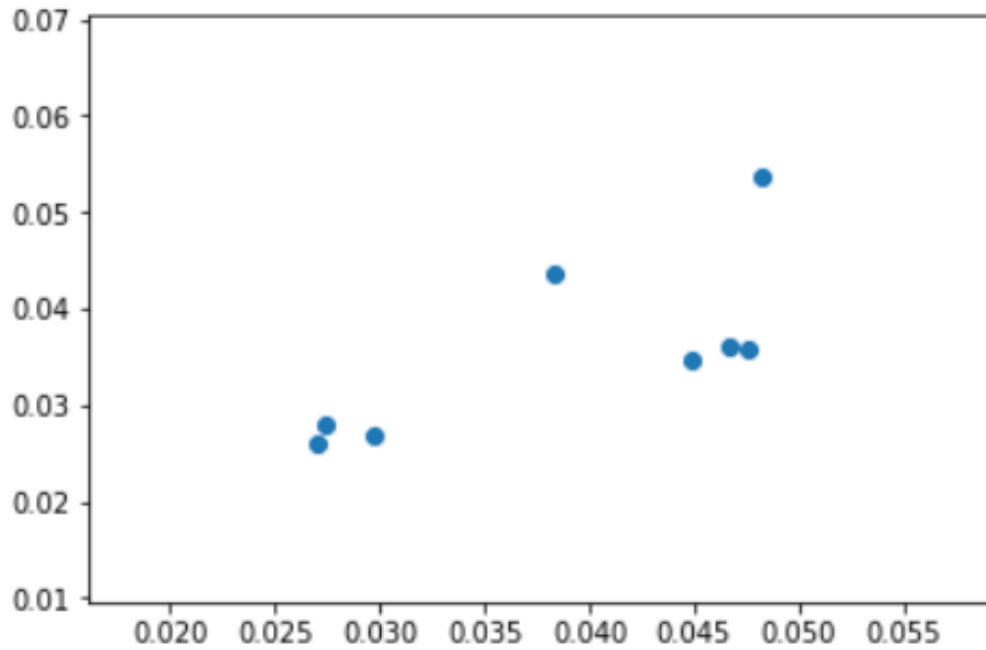
	Distance_parks	Distance_restaurants
<b>0</b>	0.029714	0.026777
<b>1</b>	0.046621	0.036199
<b>2</b>	0.027409	0.028009
<b>3</b>	0.027072	0.026134
<b>4</b>	0.038365	0.043599
<b>5</b>	0.047611	0.035693
<b>6</b>	0.044816	0.034613
<b>7</b>	0.048215	0.053797

The distance to parks is negative and the distance to restaurants is positive. I calculate distance to restaurants minus total distance to parks and obtain this result. Thus, 6<sup>th</sup> (No.5) park is the best from calculation. The data table and graph show about it clearly.

#### **Data table of the most desirable park(location)**

	the_best_park
<b>0</b>	0.002937
<b>1</b>	0.010422
<b>2</b>	-0.000599
<b>3</b>	0.000937
<b>4</b>	-0.005234
<b>5</b>	0.011918
<b>6</b>	0.010203
<b>7</b>	-0.005582

**Graph for the best location**



**Graphical map for the best location**



I found the best location for opening new restaurants. I am going to recommend to owners about it. The location is which the latitude is 35.643475 and the longitude is 139.744786.

#### **4 Conclusion**

I found the great location for owners who want to open new restaurants in Tokyo. The latitude is 35.6432274 and longitude is 139.7400553. However, after I did use mathematical methods, I found the best location. The location is far from other restaurants and close to other parks. I will recommend to open new restaurant at the location which the latitude is 35.643475 and the longitude is 139.744786. I could not get this result if I did not calculate. I understand just looking map is not enough to give recommendations.

#### **5 Future direction**

To be honest, it is all about my idea that opening new restaurant next to parks because people can enjoy opened places for eating foods and chat with their friends or family. In at least 1 year later, we can really know which locations will be the best for restaurants owners. However, before the data will be showed, I wanted to do something with now's data and conclude something for business owners who are in the severest situation. I really love eating delicious foods and I do not want many restaurants owners give up to continue their business anymore. I will keep finding the best advices for them. This project is my first step for that.