

# **Coursera Capstone Project**

## **Coursera IBM Data Science Certification**

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# **Report Content**

## 1. Introduction Section :

- The “business problem” to be solved by this project and who may be interested

## 2. Data Section:

- Describe Data requirements and Sources needed to solve the problem

## 3. Methodology section:

- Main component of the report
- Execute data processing, describe/discuss any exploratory data analysis and/or inferential statistical testing performed, and/or machine learnings used.

## 4. Results section:

- Discussion of the results and finding of answer

## 5. Discussion section:

- Discussion of observations noted and any recommendations

## 6. Conclusion section:

- Answer chosen and conclusions.

# **1.0 Introduction**

## **1.1 Scenario and Background**

I am currently living and working in Singapore, within walking distance to Town Center with great venues and attractions and restaurants, such as international cuisine, entertainment and shopping and kindergarten for my family. I am current considering a job offer that will obey me to move to New York and I would like to explore if I can find a place to live similar with the one I live now.

## **1.2 Problem to be resolved:**

How to find an apartment in Manhattan with the following conditions:

- Apartment with min 2 bedrooms
- Monthly rent not to exceed US\$7000 / month
- Located within walking distance ( $\leq 1.0$  mile, 1.6 km) from a subway metro station in Manhattan
- Venues and amenities as in my current residence.

## 2.0 Data Section

### 2.1 Data Requirements

- Geodata for current residence in Singapore with venues established using Foursquare.
- List of Manhattan (MH) neighborhoods with clustered venues established via Foursquare (as in Course Lab). [https://en.wikipedia.org/wiki/List\\_of\\_Manhattan\\_neighborhoods#Midtown\\_neighborhoods](https://en.wikipedia.org/wiki/List_of_Manhattan_neighborhoods#Midtown_neighborhoods)
- List of subway metro stations in Manhattan with addresses and geo data (lat,long): [https://en.wikipedia.org/wiki/List\\_of\\_New\\_York\\_City\\_Subway\\_stations\\_in\\_Manhattan](https://en.wikipedia.org/wiki/List_of_New_York_City_Subway_stations_in_Manhattan) , (<https://www.google.com/maps/search/manhattan+subway+metro+stations/@40.7837297,-74.1033043,11z/data=!3m1!4b1>)
- List of apartments for rent in Manhattan area with information on neighborhood location, address, number of beds, area size, monthly rent price and complemented with geo data via Nominatim. <http://www.rentmanhattan.com/index.cfm?page=search&state=results> <https://www.nestpick.com/search?city=new->
- Place to work in Manhattan (Park Avenue and 53rd St) for reference

### 2.2 Data Sources, Data Processing and Tools used

- Singapore data and map is to be created with use of Nominatim , Foursquare and Folium mapping -Manhattan neighborhoods were obtained from Wikipedia and organized by Neighborhoods with geodata via Nominatim for mapping with Folium.
- List of Subway stations was obtained via Wikipedia, NY Transit web site and Google map,
- List of apartments for rent was consolidated from web-scraping real estate sites for MH. The geolocation (lat,long) data was found with algorithm coding and using Nominatim. Folium map was the basis of mapping with various features to consolidate all data in ONE map where one can visualize all details needed to make a selection of apartment

### **3.0 Methodology**

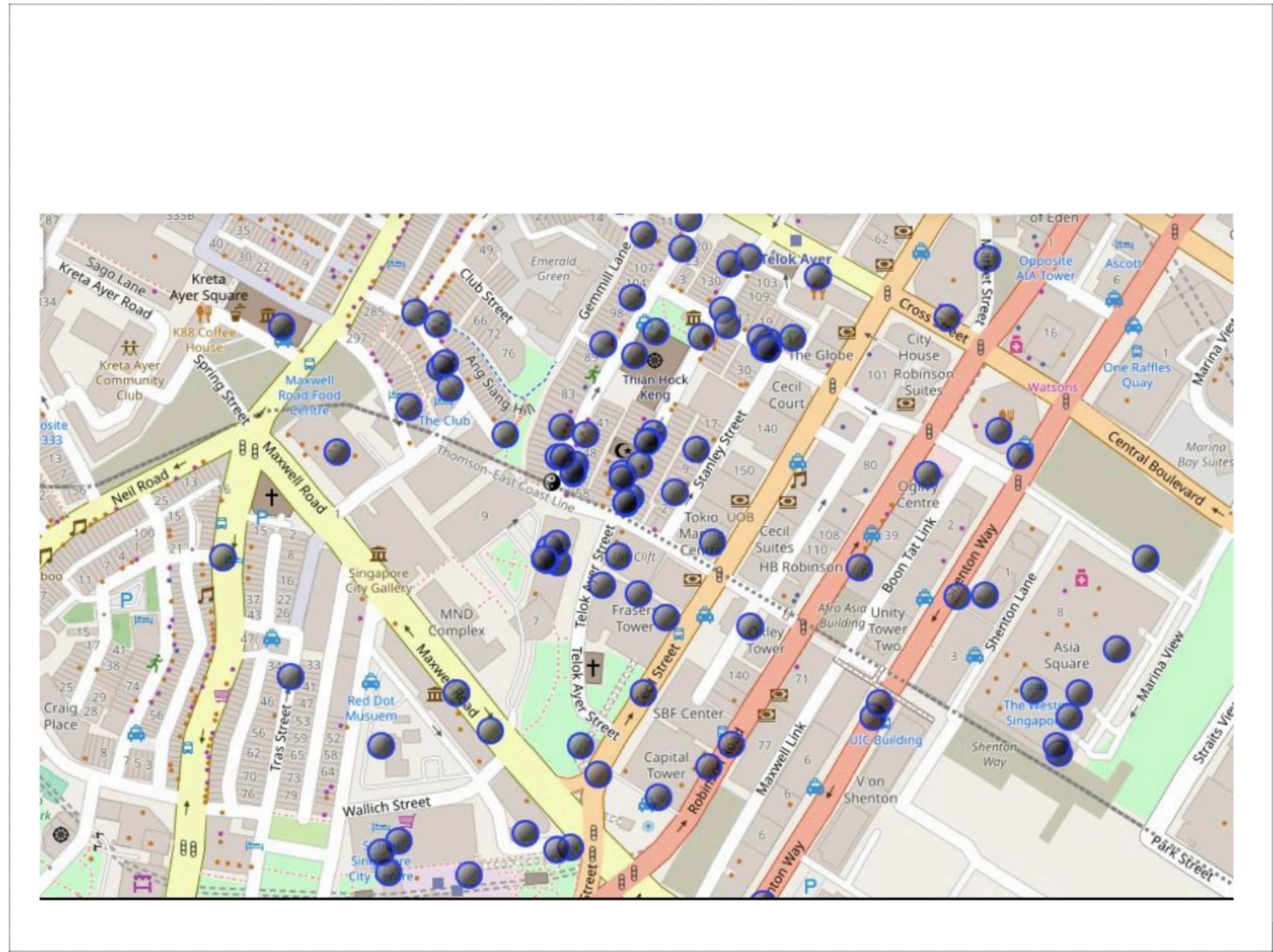
The strategy is based on mapping the described data in section 2.0, in order to facilitate the choice of at least two candidate places for rent. The information will be consolidated in ONE MAP where one can see the details of the apartment, the cluster of venues in the neighborhood and the relative location from a subway station and from work place. A measurement tool icon will also be provided. The popups on the map items will display rent price, location and cluster of venues applicable.

The Tools:

Web-scraping of sites is used to consolidate data-frame information which was saved as csv files for convenience and to simplify the report. Geodata was obtained by coding a program to use Nominatim to get latitude and longitude of subway stations and also for each of (144 units) the apartments for rent listed. Geopy\_distance and Nominatim were used to establish relative distances. Seaborn graphic was used for general statistics on rental data. Maps with popups labels allow quick identification of location, price and feature, thus making the selection very easy

## 4.0 Execution and Results

### Current residence Neighborhood in Singapore



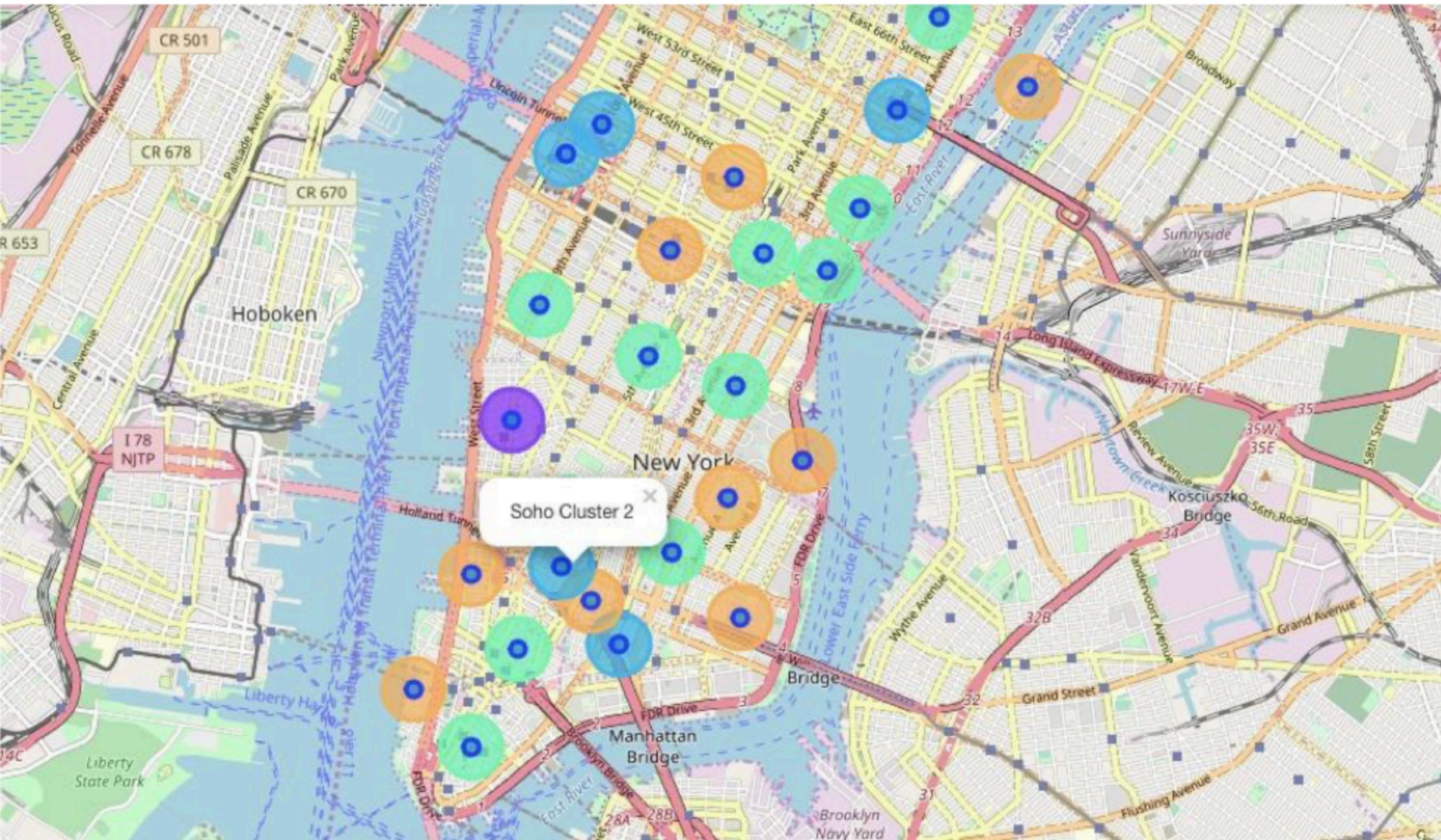
## Venues around Neighborhood

```
: # Venues near current Singapore residence place  
SGnearby_venues.head(10)
```

```
:
```

		name	categories	lat	lng
0		Napoleon Food & Wine Bar	Wine Bar	1.279925	103.847333
1		Park Bench Deli	Deli / Bodega	1.279872	103.847287
2		Native	Cocktail Bar	1.280135	103.846844
3		Muchachos	Burrito Place	1.279175	103.847082
4		Matt's   The Chocolate Shop	Dessert Shop	1.280462	103.846950
5		Freehouse	Beer Garden	1.281254	103.848513
6		PS.Cafe	Café	1.280468	103.846264
7	왕대박 Wang Dae Bak Korean BBQ Restaurant		Korean Restaurant	1.281345	103.847551
8		Ancient Therapy	Massage Studio	1.280413	103.847481
9		Oven & Fried Chicken	Korean Restaurant	1.280479	103.847522

## Manhattan Map - Neighborhoods and Cluster of Venues



## GeoData Manhattan Apartments for rent

```
] : mh_rent=pd.read_csv('MH_rent_latlong.csv')  
mh_rent.head()
```

```
] :  


|   | Address           | Area            | Price_per_ft2 | Rooms | Area-ft2 | Rent_Price | Lat       | Long       |
|---|-------------------|-----------------|---------------|-------|----------|------------|-----------|------------|
| 0 | West 105th Street | Upper West Side | 2.94          | 5.0   | 3400     | 10000      | 40.799771 | -73.966213 |
| 1 | East 97th Street  | Upper East Side | 3.57          | 3.0   | 2100     | 7500       | 40.788585 | -73.955277 |
| 2 | West 105th Street | Upper West Side | 1.89          | 4.0   | 2800     | 5300       | 40.799771 | -73.966213 |
| 3 | CARMINE ST.       | West Village    | 3.03          | 2.0   | 1650     | 5000       | 40.730523 | -74.001873 |
| 4 | 171 W 23RD ST.    | Chelsea         | 3.45          | 2.0   | 1450     | 5000       | 40.744118 | -73.995299 |


```

```
] : mh_rent.tail()
```

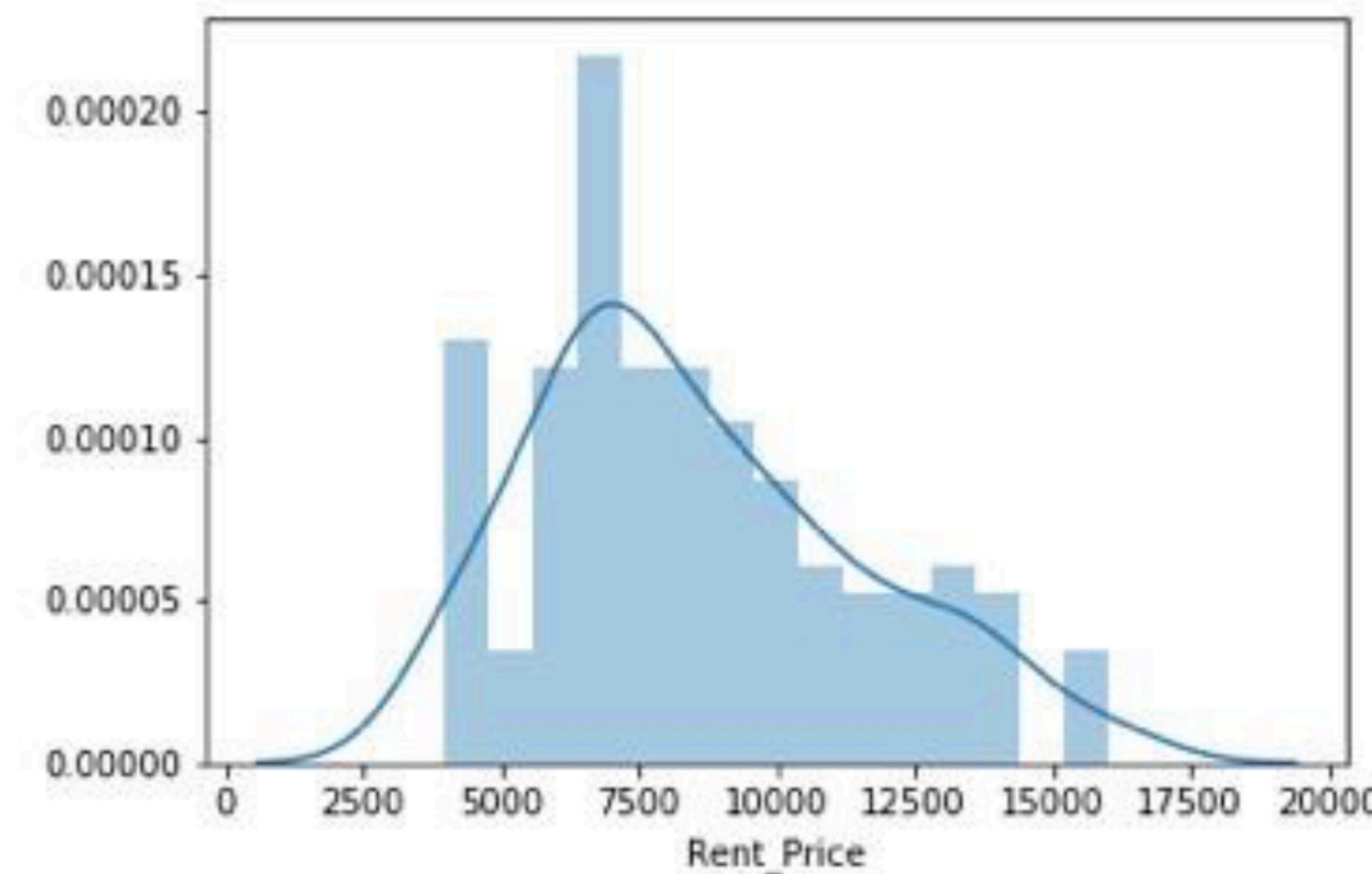
```
] :  


|     | Address              | Area                               | Price_per_ft2 | Rooms | Area-ft2 | Rent_Price | Lat       | Long       |
|-----|----------------------|------------------------------------|---------------|-------|----------|------------|-----------|------------|
| 139 | 200 East 72nd Street | Rental in Lenox Hill               | 5.15          | 3.0   | 1700     | 8750       | 40.769465 | -73.960339 |
| 140 | 50 Murray Street     | No fee rental in Tribeca           | 7.11          | 2.0   | 1223     | 8700       | 40.714051 | -74.009608 |
| 141 | 300 East 56th Street | No fee rental in Midtown East      | 3.87          | 3.0   | 2100     | 8118       | 40.758216 | -73.965190 |
| 142 | 1930 Broadway        | No fee rental in Central Park West | 5.06          | 2.0   | 1600     | 8095       | 40.772474 | -73.981901 |
| 143 | 33 West 9th Street   | Rental in Greenwich Village        | 6.67          | 2.0   | 1500     | 10000      | 40.733691 | -73.997323 |

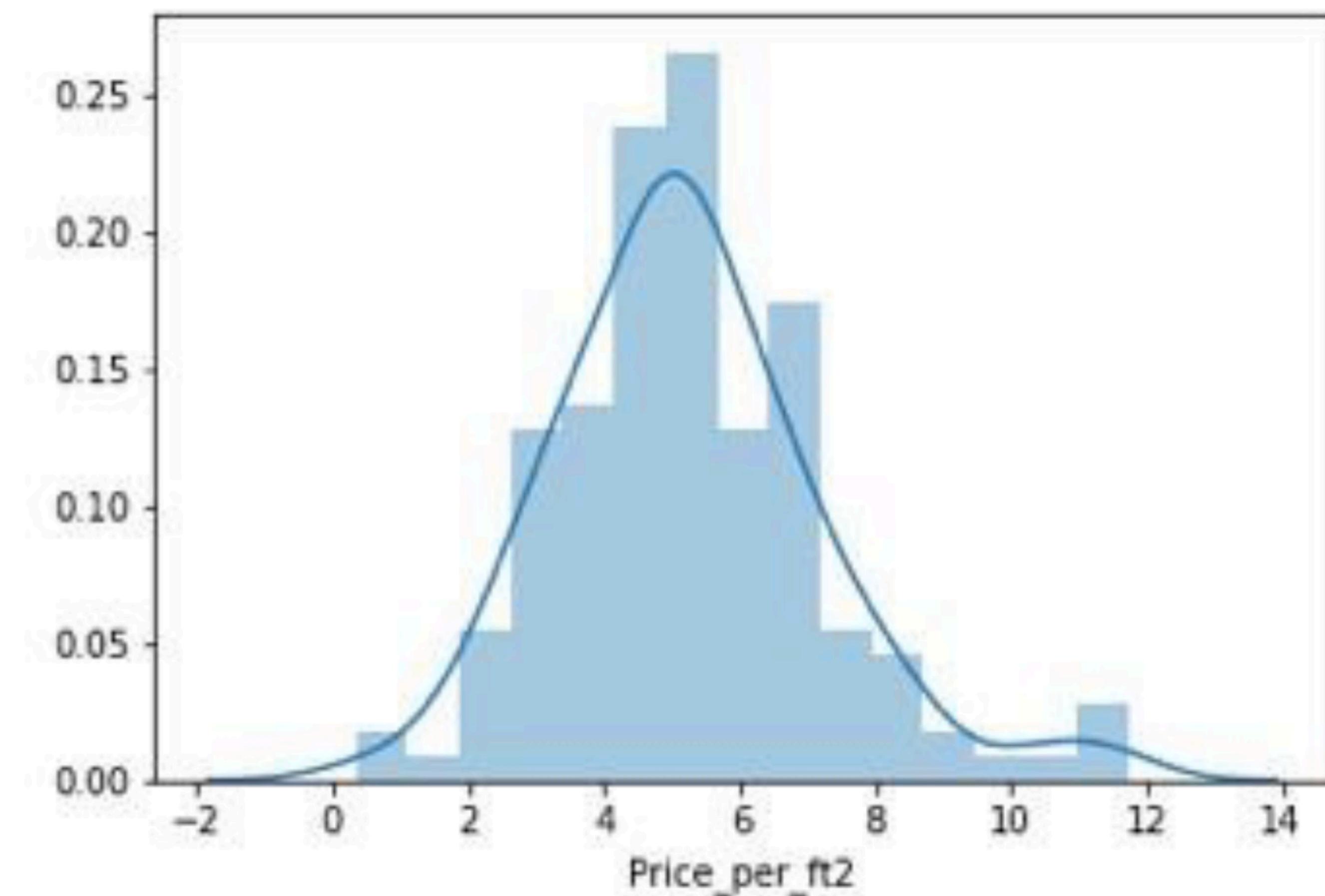

```

**Rental Price Statistics MH Apartments**  
**Budget US7000/month is around the mean**

<matplotlib.axes.\_subplots.AxesSubplot at 0x1a25dd8400>

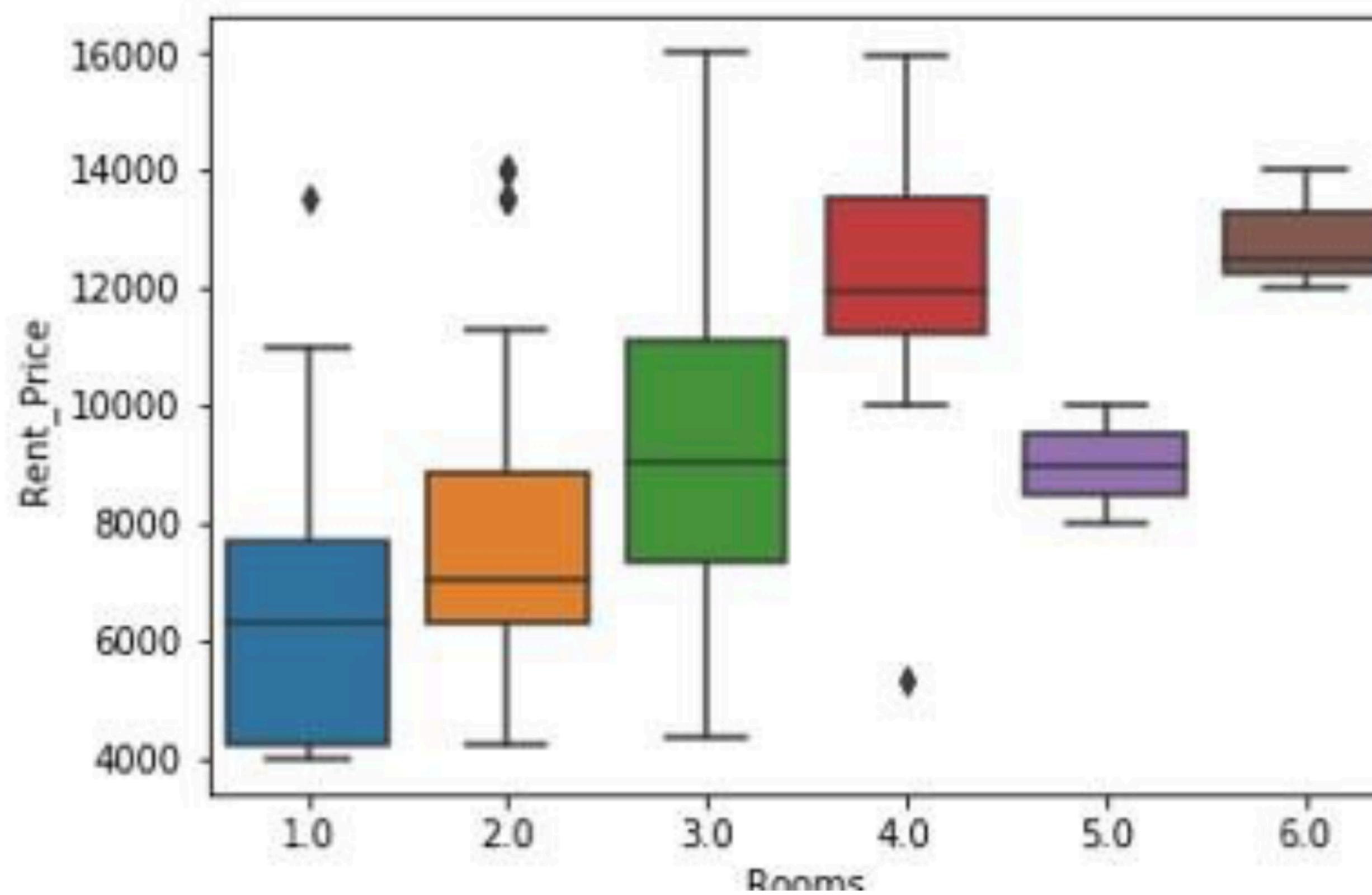


<matplotlib.axes.\_subplots.AxesSubplot at 0x1a2415fc18>

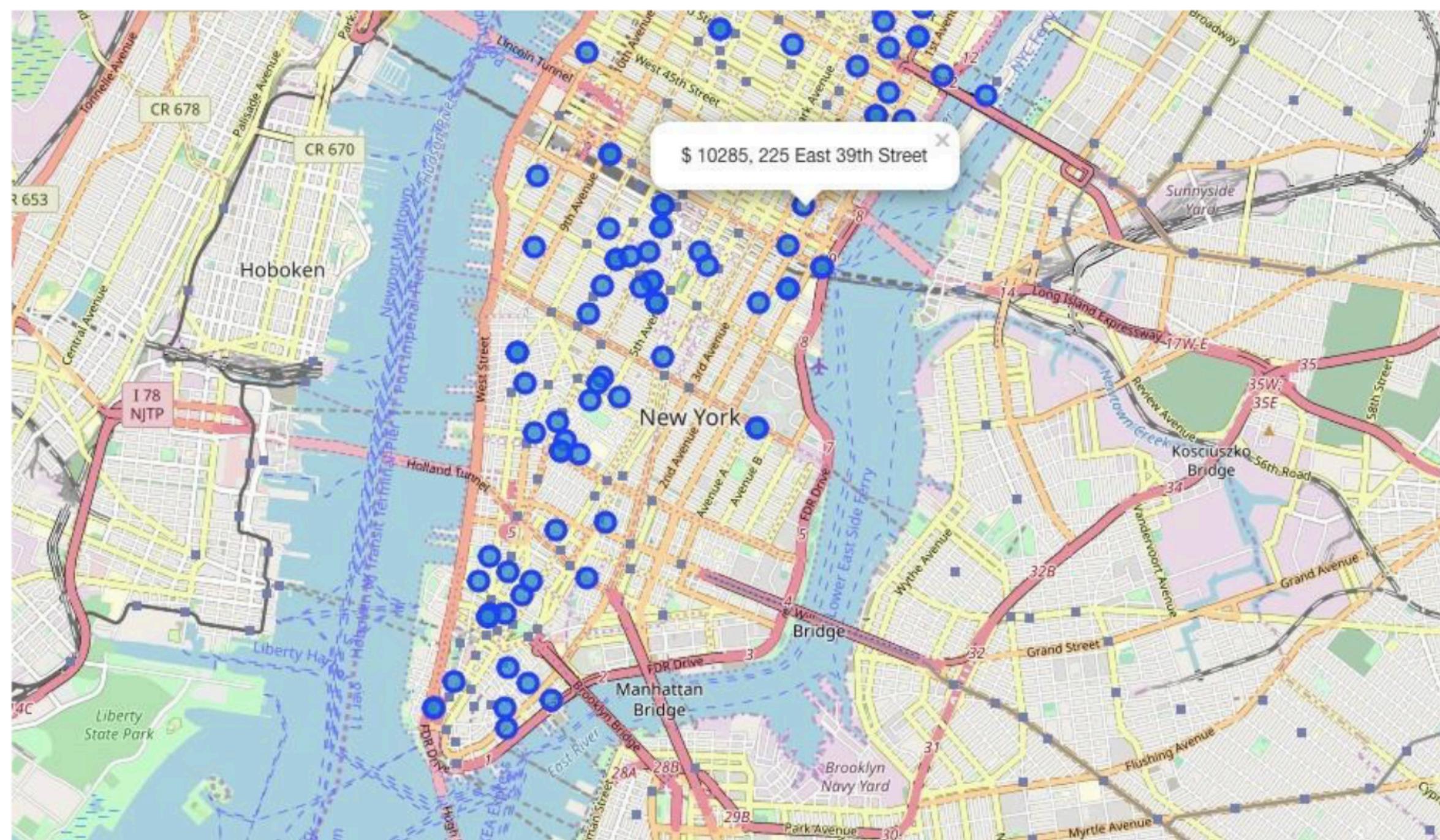


```
sns.boxplot(x='Rooms', y= 'Rent_Price', data=mh_rent)
```

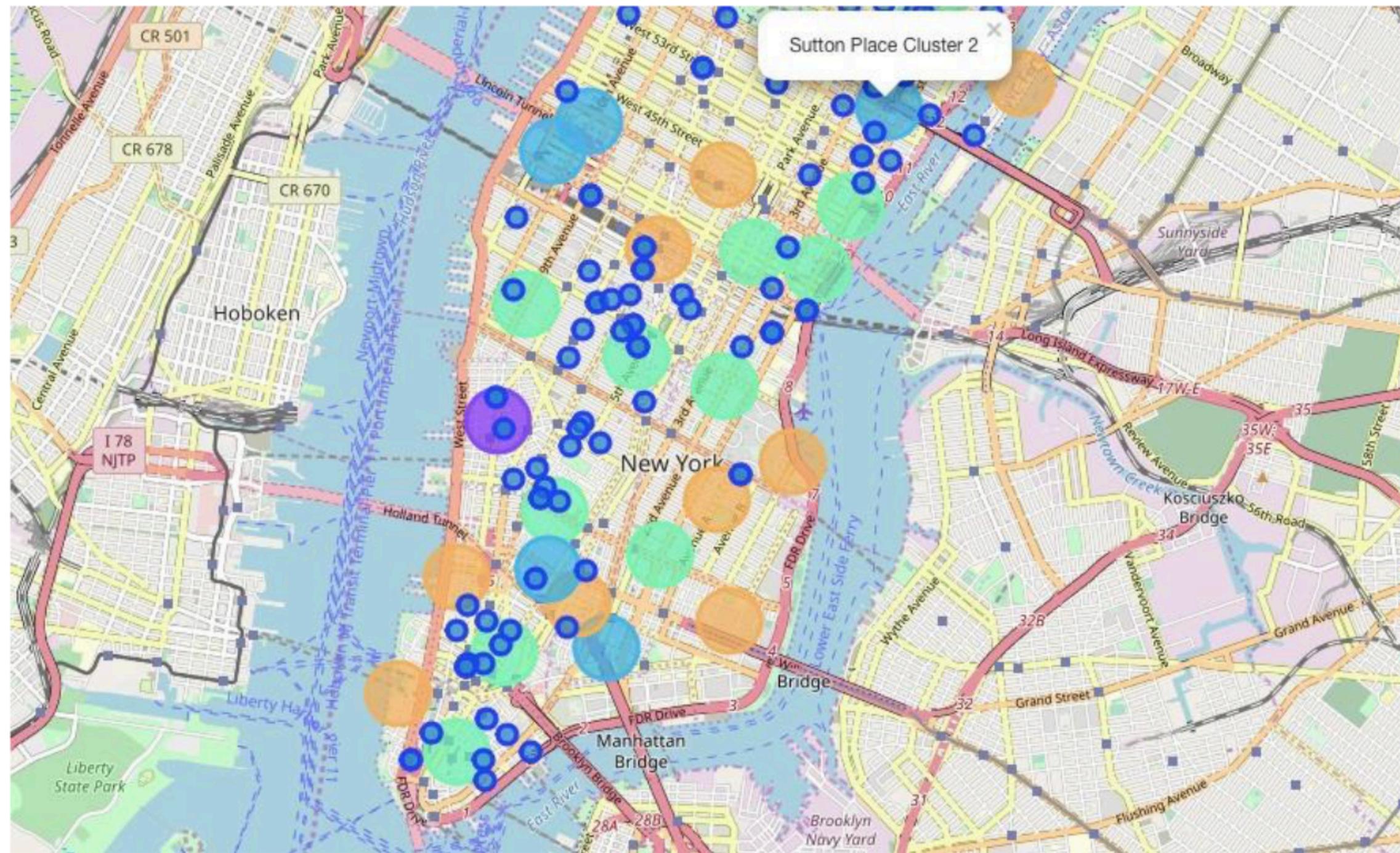
```
<matplotlib.axes._subplots.AxesSubplot at 0x1a25f2a2b0>
```



## Apartments for Rent in MH



## MH Apartments for rent with venue clusters



## Venues of cluster 3

<pre><code>## kk is the cluster number to explore kk = 3 manhattan_merged.loc[manhattan_merged['Cluster Labels'] == kk, manhattan_merged.columns[[1] + list(range(5, manhattan_m</code></pre>											
	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
3	Inwood	Mexican Restaurant	Lounge	Pizza Place	Café	Wine Bar	Bakery	American Restaurant	Park	Frozen Yogurt Shop	Spanish Restaurant
5	Manhattanville	Deli / Bodega	Italian Restaurant	Seafood Restaurant	Mexican Restaurant	Sushi Restaurant	Beer Garden	Coffee Shop	Falafel Restaurant	Bike Trail	Other Nightlife
10	Lenox Hill	Sushi Restaurant	Italian Restaurant	Coffee Shop	Gym / Fitness Center	Pizza Place	Burger Joint	Deli / Bodega	Gym	Sporting Goods Shop	Thai Restaurant
12	Upper West Side	Italian Restaurant	Bar	Bakery	Vegetarian / Vegan Restaurant	Indian Restaurant	Coffee Shop	Cosmetics Shop	Wine Bar	Mexican Restaurant	Sushi Restaurant
16	Murray Hill	Sandwich Place	Hotel	Japanese Restaurant	Gym / Fitness Center	Coffee Shop	Salon / Barbershop	Burger Joint	French Restaurant	Bar	Italian Restaurant
17	Chelsea	Coffee Shop	Italian Restaurant	Ice Cream Shop	Bakery	Nightclub	Theater	Art Gallery	Seafood Restaurant	American Restaurant	Hotel
18	Greenwich Village	Italian Restaurant	Sushi Restaurant	French Restaurant	Clothing Store	Chinese Restaurant	Café	Indian Restaurant	Bakery	Seafood Restaurant	Electronics Store
27	Gramercy	Italian Restaurant	Restaurant	Thrift / Vintage Store	Cocktail Bar	Bagel Shop	Coffee Shop	Pizza Place	Mexican Restaurant	Grocery Store	Wine Shop
29	Financial District	Coffee Shop	Hotel	Gym	Wine Shop	Steakhouse	Bar	Italian Restaurant	Pizza Place	Park	Gym / Fitness Center
31	Noho	Italian Restaurant	French Restaurant	Cocktail Bar	Gift Shop	Bookstore	Grocery Store	Mexican Restaurant	Hotel	Sushi Restaurant	Coffee Shop

## Manhattan subway stations geo data

click to scroll output; double click to hide				
		sub_address	lat	long
0	Dyckman Street Subway Station	170 Nagle Ave, New York, NY 10034, USA	40.861857	-73.924509
1	57 Street Subway Station	New York, NY 10106, USA	40.764250	-73.954525
2	Broad St	New York, NY 10005, USA	40.730862	-73.987156
3	175 Street Station	807 W 177th St, New York, NY 10033, USA	40.847991	-73.939785
4	5 Av and 53 St	New York, NY 10022, USA	40.764250	-73.954525

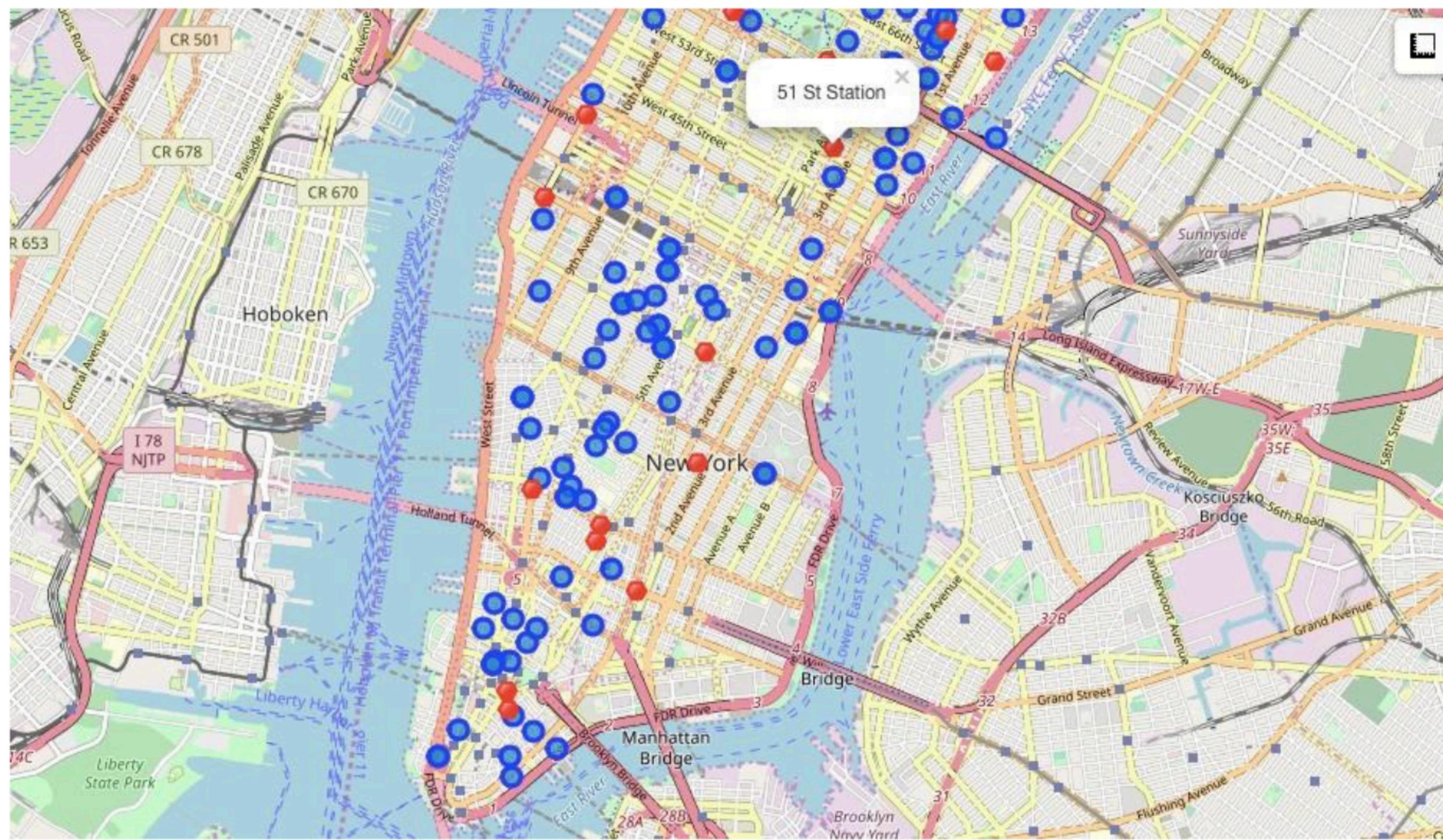
```
# removing duplicate rows and creating new set mhsub1
mhsub1=mh.drop_duplicates(subset=['lat','long'], keep="last").reset_index(drop=True)
mhsub1.shape
```

```
(22, 4)
```

```
: mhsub1.tail()
```

	sub_station	sub_address	lat	long
17	190 Street Subway Station	Bennett Ave, New York, NY 10040, USA	40.858113	-73.932983
18	59 St-Lexington Av Station	E 60th St, New York, NY 10065, USA	40.762259	-73.966271
19	57 Street Station	New York, NY 10019, United States	40.764250	-73.954525
20	14 Street / 8 Av	New York, NY 10014, United States	40.730862	-73.987156
21	MTA New York City	525 11th Ave, New York, NY 10018, USA	40.759809	-73.999282

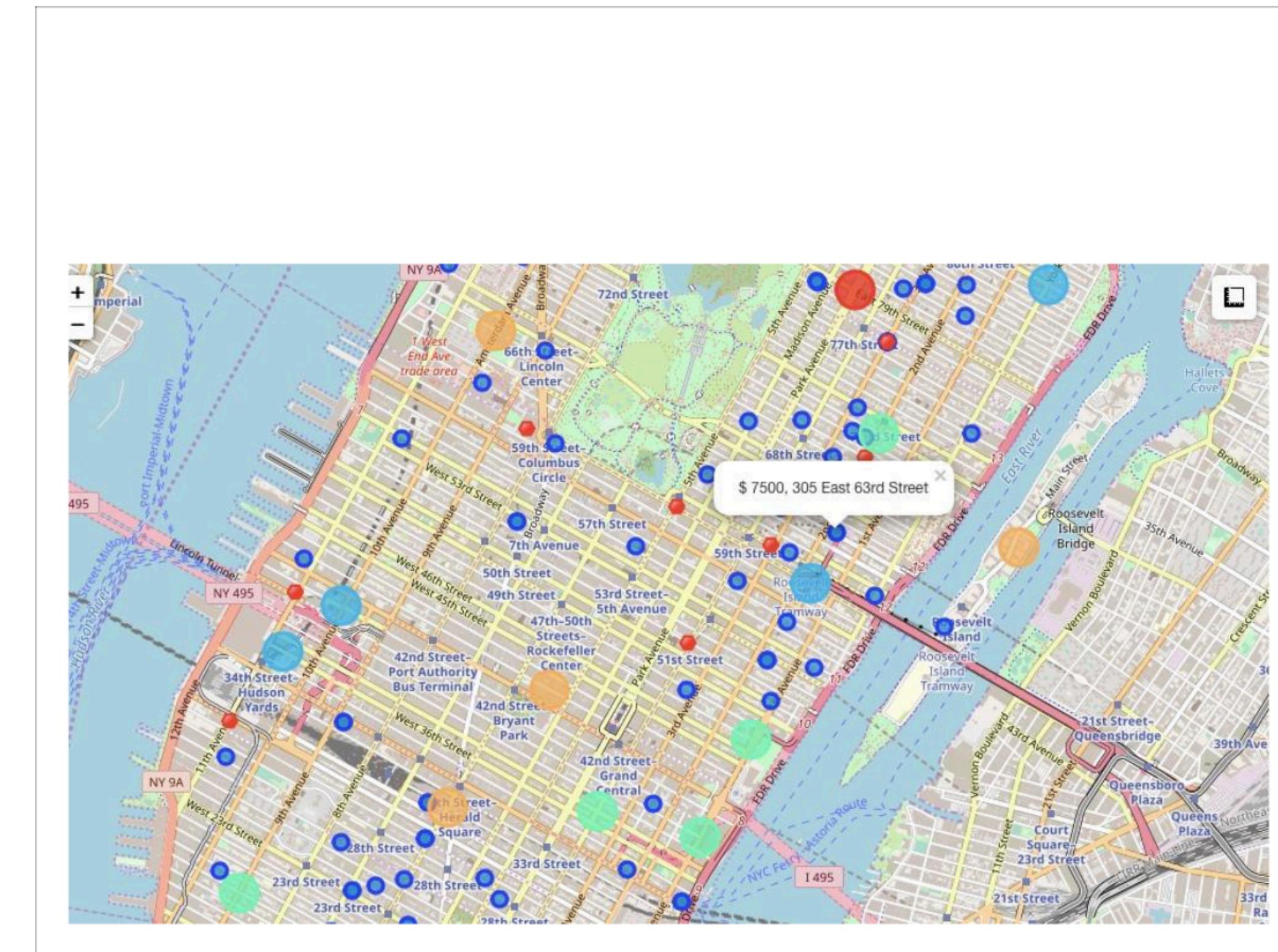
## Apts for rent (blue) and subway stations (red)



## Selected Apartment

The ONE consolidated map shows all information for decision:

Apartments address, price, neighborhood, cluster of venues and subway station nearby. Blue dots=apts , Red dots=Subway station, Bubbles=Cluster of Venues



## **Final Result: Apartment Selection**

Using the "one map" above, I was able to explore all possibilities since the popups provide the information needed for a good decision.

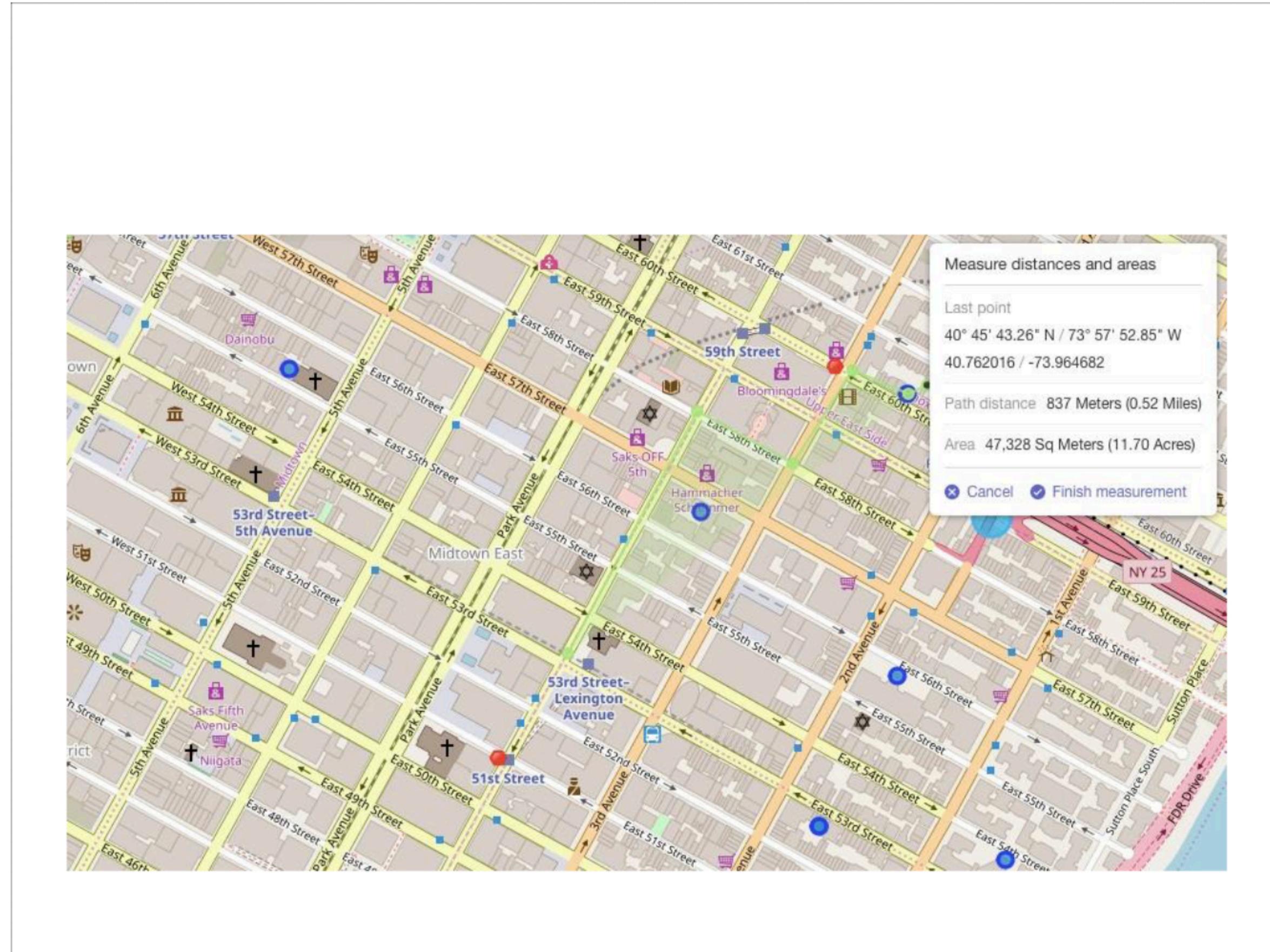
Apartment 1 rent cost is US7500 slightly above the US7000 budget. Apt 1 is located 400 meters from subway station at 59th Street and work place (Park Ave and 53rd) is another 600 meters way. I can walk to work place and use subway for other places around. Venues for this apt are as of Cluster 2 and it is located in a fine district in the East side of Manhattan.

Apartment 2 rent cost is US6935, just under the US7000 budget. Apt 2 is located 60 meters from subway station at Fulton Street, but I will have to ride the subway daily to work , possibly 40-60 min ride. Venues for this apt are as of Cluster 3.

Based on current Singapore venues, I feel that Cluster 2 type of venues is a closer resemblance to my current place. That means that APARTMENT 1 is a better choice since the extra monthly rent is worth the conveniences it provides.

# I will walk to work

## Walk from home to work is less than 1 km



## Venus in Cluster 2 near future home

```
## kk is the cluster number to explore
kk = 2
manhattan_merged.loc[manhattan_merged['Cluster Labels'] == kk, manhattan_merged.columns[[1] + list(range(5, manhattan_mer...
```

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	Marble Hill	Coffee Shop	Discount Store	Yoga Studio	Steakhouse	Supplement Shop	Tennis Stadium	Shoe Store	Gym	Bank	Seafood Restaurant
1	Chinatown	Chinese Restaurant	Cocktail Bar	Dim Sum Restaurant	American Restaurant	Vietnamese Restaurant	Salon / Barbershop	Noodle House	Bakery	Bubble Tea Shop	Ice Cream Shop
6	Central Harlem	African Restaurant	Seafood Restaurant	French Restaurant	American Restaurant	Cosmetics Shop	Chinese Restaurant	Event Space	Liquor Store	Beer Bar	Gym / Fitness Center
9	Yorkville	Coffee Shop	Gym	Bar	Italian Restaurant	Sushi Restaurant	Pizza Place	Mexican Restaurant	Deli / Bodega	Japanese Restaurant	Pub
14	Clinton	Theater	Italian Restaurant	Coffee Shop	American Restaurant	Gym / Fitness Center	Hotel	Wine Shop	Spa	Gym	Indie Theater
23	Soho	Clothing Store	Boutique	Women's Store	Shoe Store	Men's Store	Furniture / Home Store	Italian Restaurant	Mediterranean Restaurant	Art Gallery	Design Studio
26	Morningside Heights	Coffee Shop	American Restaurant	Park	Bookstore	Pizza Place	Sandwich Place	Burger Joint	Café	Deli / Bodega	Tennis Court
34	Sutton Place	Gym / Fitness Center	Italian Restaurant	Furniture / Home Store	Indian Restaurant	Dessert Shop	American Restaurant	Bakery	Juice Bar	Boutique	Sushi Restaurant
39	Hudson Yards	Coffee Shop	Italian Restaurant	Hotel	Theater	American Restaurant	Café	Gym / Fitness Center	Thai Restaurant	Restaurant	Gym

# Thank You