



# Coursera Capstone project

Coursera IBM Data Science Certification

Kshitij Sharma

April, 2020

# 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 in Singapore, within walking distance to Downtown "Telok Ayer MRT metro station". I also enjoy great venues and attractions, such as international cuisine, entertainment and shopping. I have an offer to move to work to Manhattan NY and I would like to move if I can find a place to live similar with similar venues.

### 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.

### 3. Interested Audience

I believe the methodology, tools and strategy used in this project is relevant for a person or entity considering moving to a major city in US, Europe or Asia. Europe, US or Asia, Likewise, it can be helpful approach to explore the opening of a new business. The use of FourSquare data and mapping techniques combined with data analysis will help resolve the key questions arisen. Lastly, this project is a good practical case for a person developing Data Science skills.

# 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 to find the answer:

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.

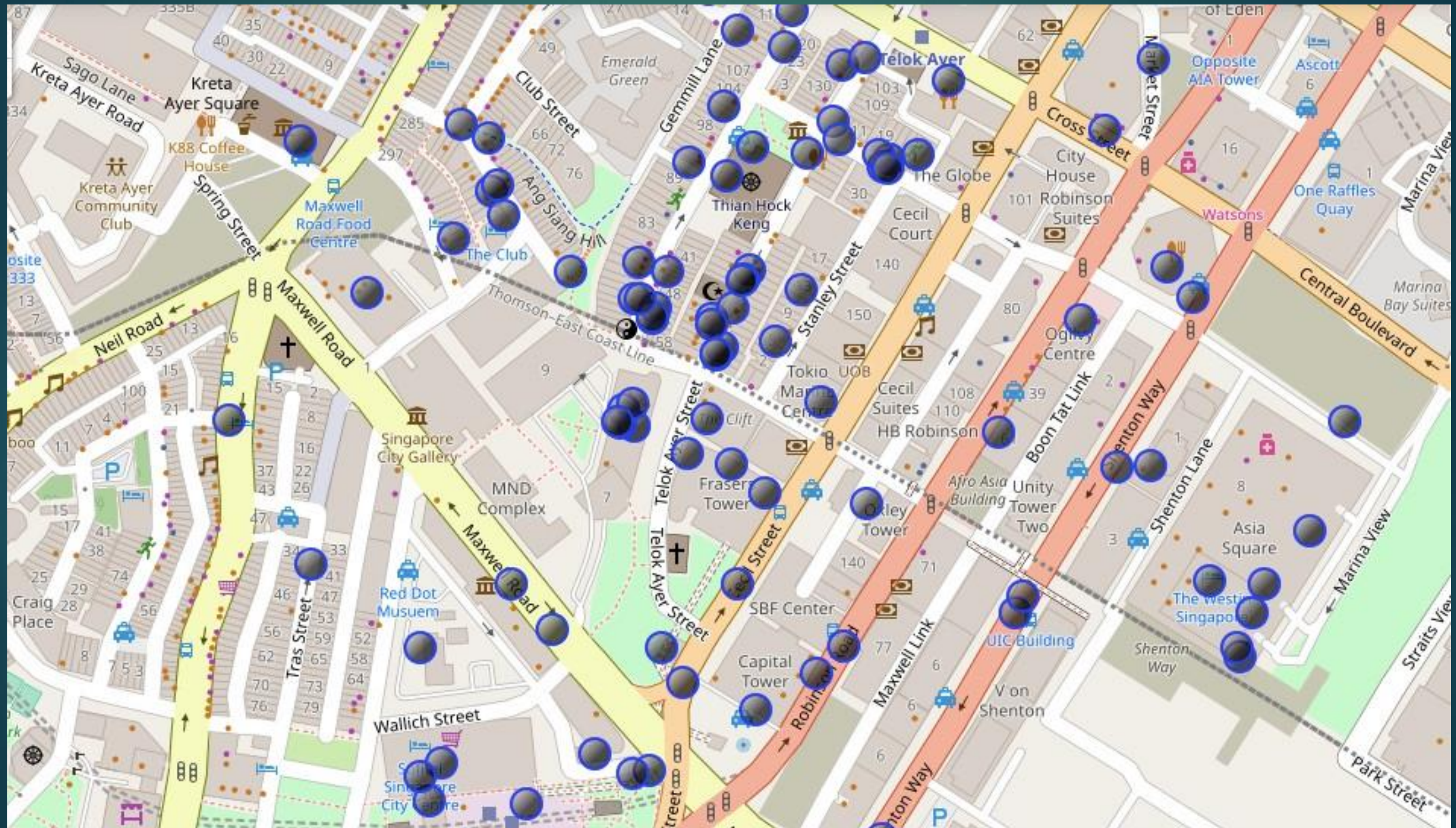
Maps with popups labels allow quick identification of location, price and feature, thus making the selection very easy



## 4.0 Execution and Results



# Current residence Neighborhood in Singapore





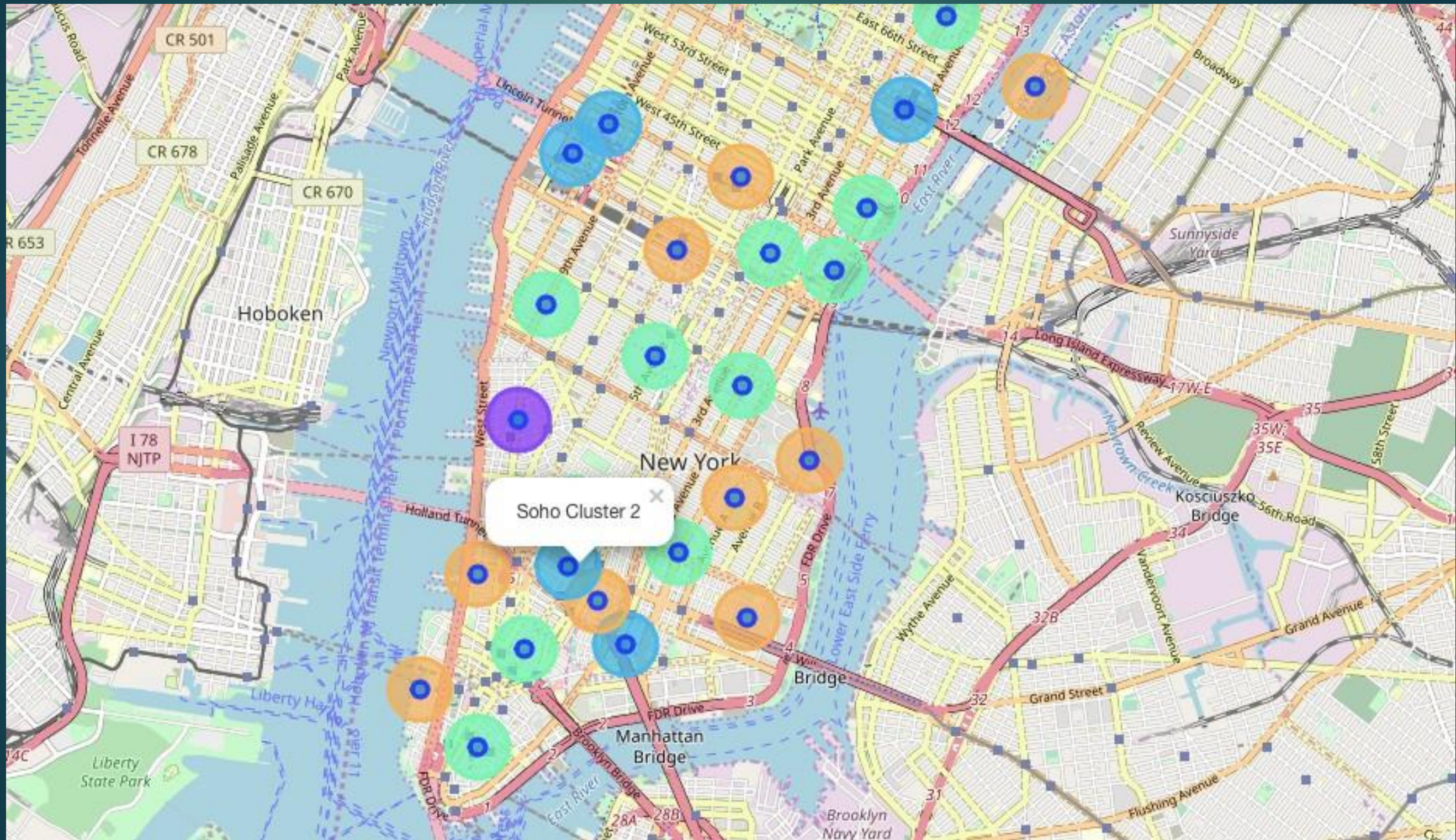
# Venues around Neighborhood in

```
# 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 apts 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()
```

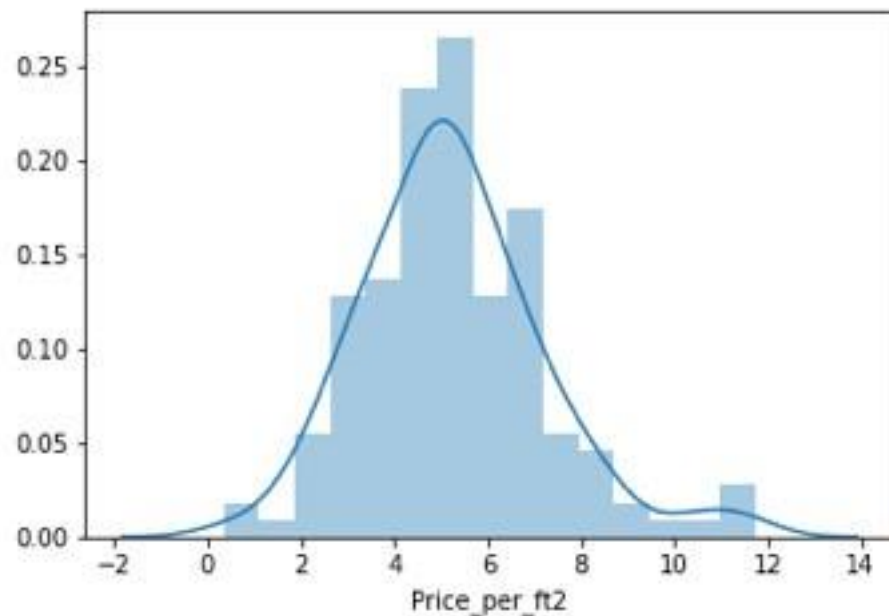
```
] :
```

|     | 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 |

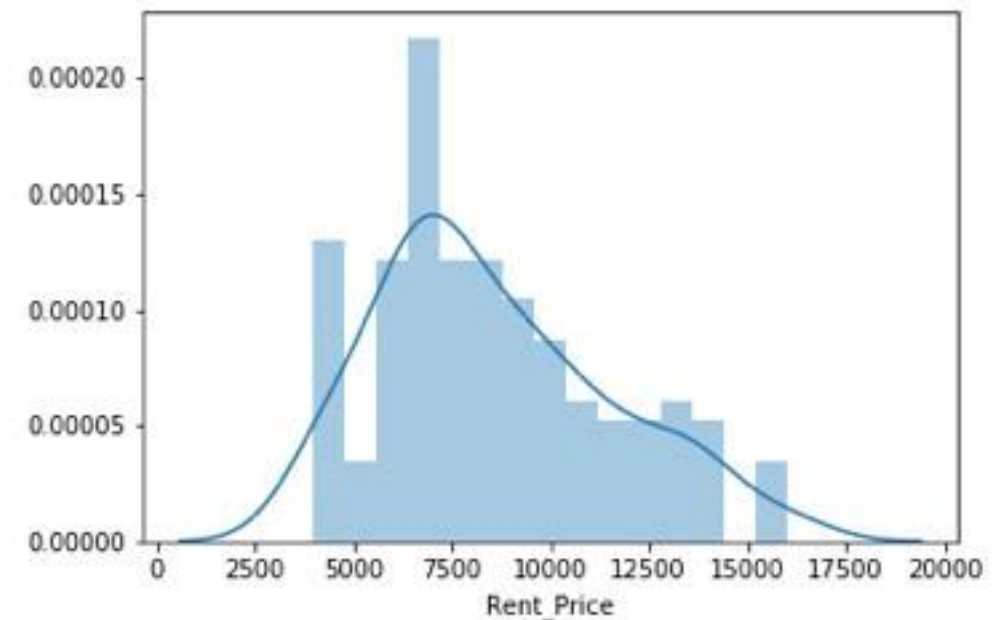
# Rental Price Statistics MH Apartments

Budget US7000/month is around the mean

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

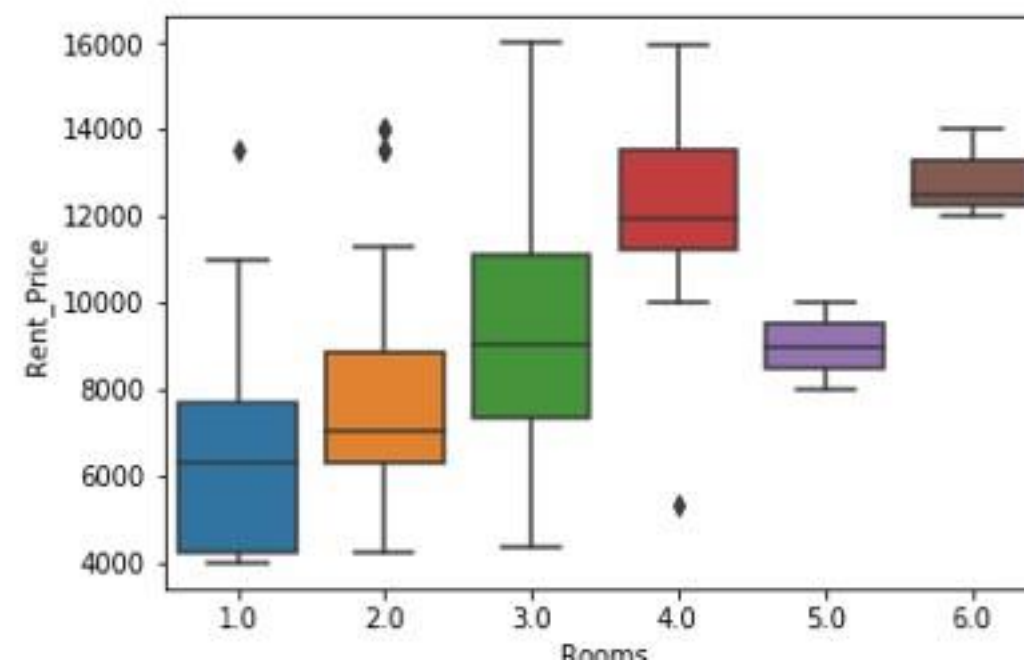


```
<matplotlib.axes._subplots.AxesSubplot at 0x1a25dd8400>
```



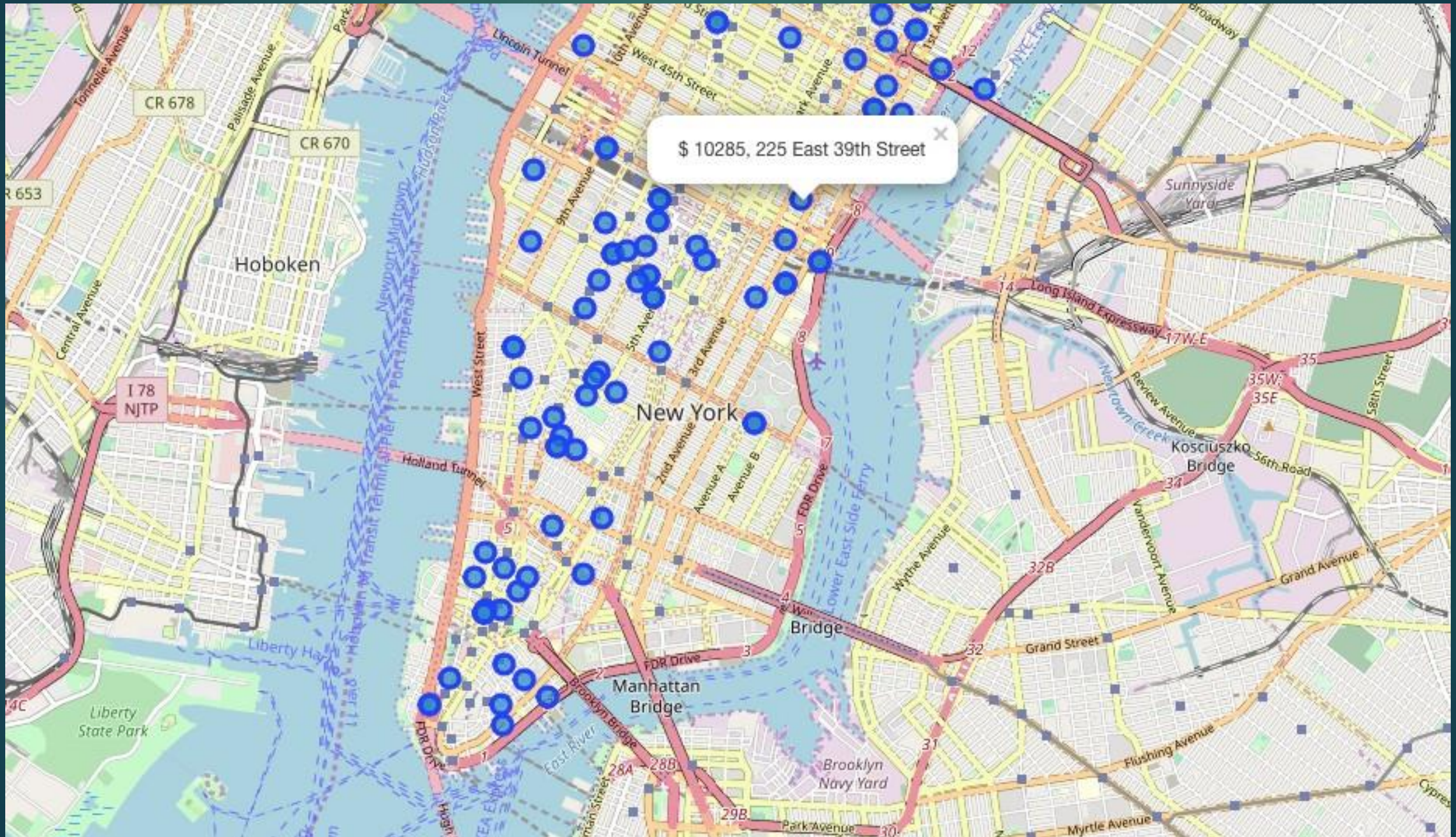
```
sns.boxplot(x='Rooms', y='Rent_Price', data=mh_rent)
```

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



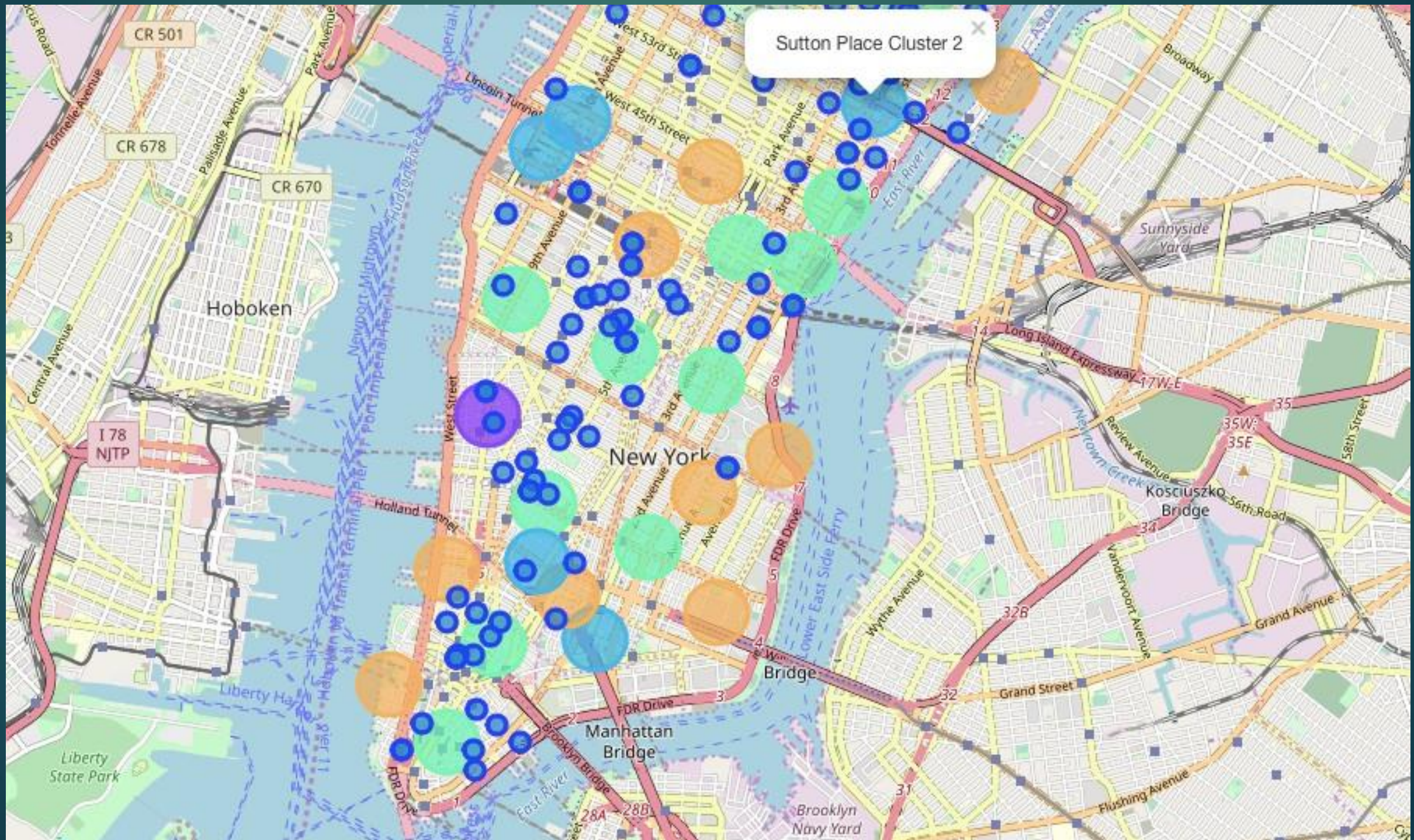


# Apartments for Rent in MH





# MH apts for rent with venue clusters





# Venues of cluster 3



```
## 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
```

|    | 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 geodata

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 mhsubl
mhsubl=mh.drop_duplicates(subset=['lat','long'], keep="last").reset_index(drop=True)
mhsubl.shape
```

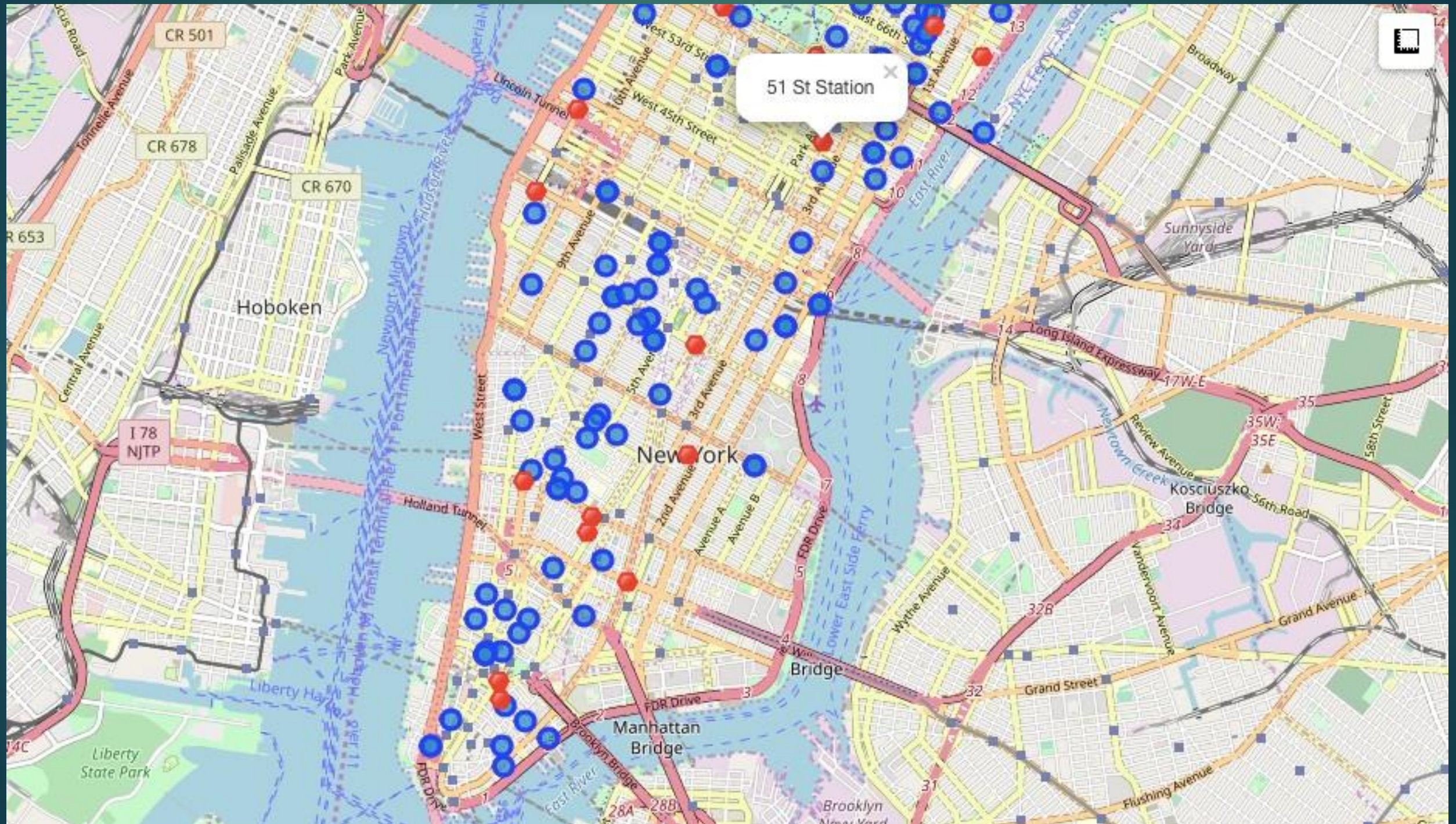
(22, 4)

```
: mhsubl.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 |



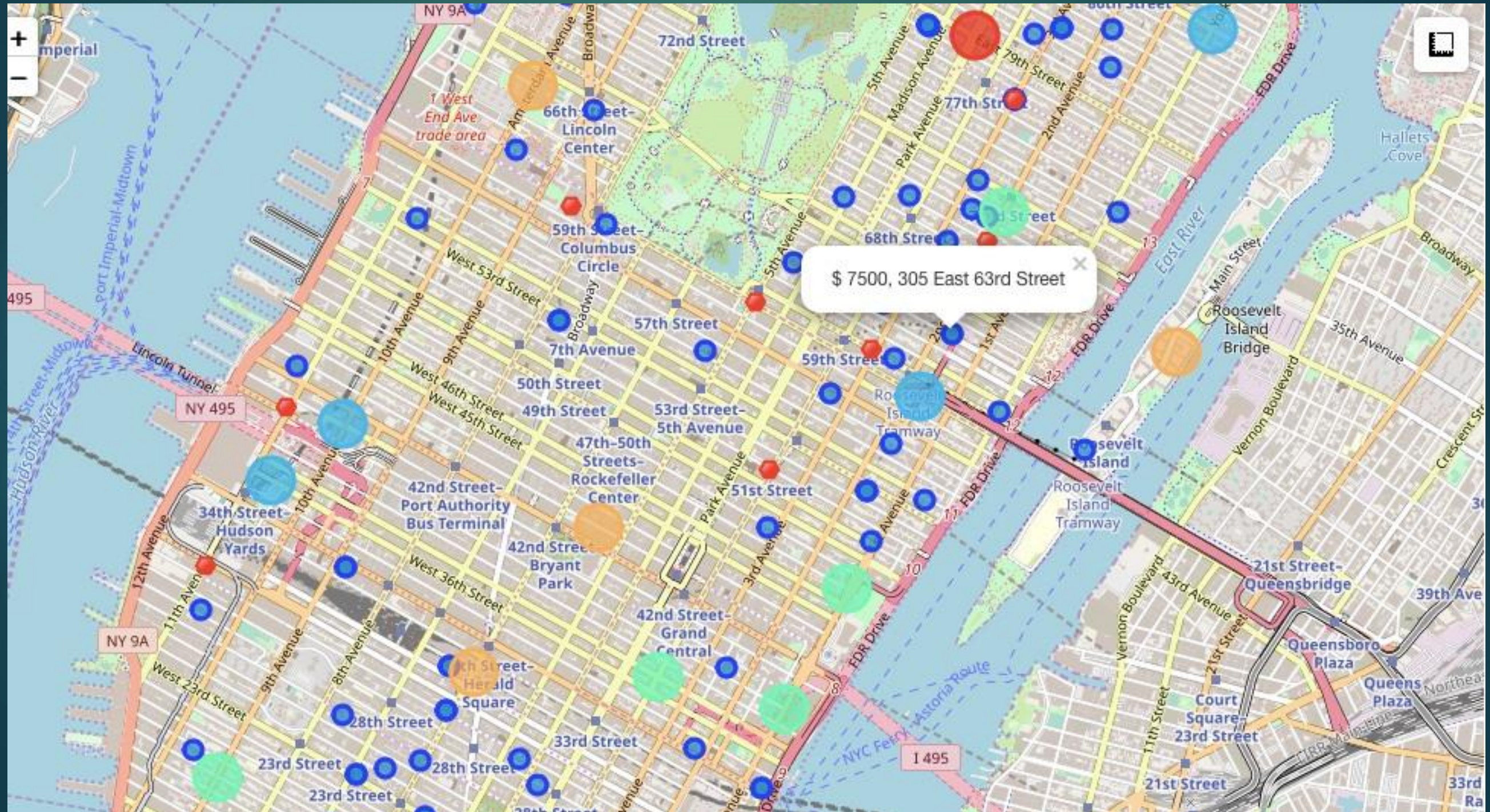
# Apts for rent (blue) and subway stations (red)





# Selected

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





# 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 US\$7500 slightly above the US\$7000 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 US\$6935, just under the US\$7000 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.







# 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_m
```

|    | 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                    |



# 5.0 Discussion

- ← In general, I am positively impressed with the overall organization, content and lab works presented during the Coursera IBM Certification Course
- ← I feel this Capstone project presented me a great opportunity to practice and apply the Data Science tools and methodologies learned.
- ← I have created a good project that I can present as an example to show my potential.

# 6.0 Conclusions

- I feel rewarded with the efforts, time and money spent. I believe this course with all the topics covered is well worthy of appreciation.
- This project has shown me a practical application to resolve a real situation that has impacting personal and financial impact using Data Science tools.
- The mapping with Folium is a very powerful technique to consolidate information and make the analysis and decision thoroughly and with confidence. I would recommend for use in similar situations.
- One must keep abreast of new tools for DS that continue to appear for application in several business fields.