Coursera Capstone – REPORT

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1. Introduction:

1.1 Scenario and Background

A data scientist currently residing in Downtown Singapore is within walking distance to Downtown "Telok Ayer MRT metro station" therefore he has access to good public transportation to work. Likewise, he enjoys many amenities in the neighborhood, such as international cuisine restaurants, cafes, etc. He has been offered a great opportunity to work in Manhattan, NY. Although, he is very excited about it, he is a bit stress toward the process to secure a comparable place to live in Manhattan. Therefore, I decided to explore ways to make sure my decision is factual and rewarding.

1.2 Problem to be resolved:

The challenge to resolve is being able to find a rental apartment unit in Manhattan NY that offers similar characteristics and benefits to my current situation. Therefore, in order to set a basis for comparison, I want to find a rent a unit subject to the following conditions:

- Apartment with min 2 bedrooms with monthly rent not to exceed US$7000/month
- Unit located within walking distance (<=1.0 mile, 1.6 km) from a subway metro station in Manhattan
- Area with amenities and venues similar to the ones described for the current location

1.3 Interested Audience

I believe this is a relevant project for a person or entity considering moving to a major city in Europe, US or Asia, since the approach and methodologies used here are applicable in all cases. 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 toward the development of Data Science skills.

2. Data:

2.1 Data of Current Situation

The person currently resides in the neighborhood of 'Mccallum Street' in Downtown Singapore. I use Foursquare to identify the venues around the area of residence which are then shown in the Singapore map shown in methodology and execution in section 3.0. It serves as a reference for comparison with the desired future location in Manhattan NY

2.2 Data Required to resolve the problem

In order to make a good choice of a similar apartment in Manhattan NY, the following data is required.

1. List/Information on neighborhoods form Manhattan with their Geodata (latitude and longitude.
2. List/Information about the subway metro stations in Manhattan with geodata. Listed apartments for rent in the Manhattan area with descriptions (how many beds, price, location, address)
3. Venues and amenities in the Manhattan neighborhoods (e.g. top 10)

2.3 Sources and manipulation

The list of Manhattan neighborhoods is worked out during Lab exercise in the course. A csv file was created which will be read in order to create a dataframe and its mapping. The csv file 'mh_neigh_data.csv' has the following below data structure. The file will be directly read to the Jupiter Notebook for convenience and space savings. The clustering of neighborhoods and mapping will be shown however. An algorithm was used to determine the geodata from Nominatim . The actual algorithm coding may be shown in 'markdown' mode because it takes time to run.

mh_neigh_data.tail():

	Borough	Neighborhood	Latitude	Longitude
35	Manhattan	Turtle Bay	40.752042	-73.967708
36	Manhattan	Tudor City	40.746917	-73.971219
37	Manhattan	Stuyvesant Town	40.731000	-73.974052
38	Manhattan	Flatiron	40.739673	-73.990947
39	Manhattan	Hudson Yards	40.756658	-74.000111

A list of Manhattan subway metro stops was complied in Numbers and was complemented with Wikipedia data (https://en.wikipedia.org/wiki/List_of_New_York_City_Subway_stations_in_Manhattan) and information from NY Transit authority and Google maps (https://www.google.com/maps/search/manhattan+subway+metro+stations/@40.7837297,-74.1033043,11z/data=!3m1!4b1) for a final consolidated list of subway stops names and their address. The geolocation was obtained via an algorithm using Nominatim. The subway csv file is ''MH_subway.csv'" and the data structure is: mhsub.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

A list of places for rent was collected by web-browsing real estate companies in Manhattan:
http://www.rentmanhattan.com/index.cfm?page=search&state=results
https://www.nestpick.com/search?city=new-york&page=1&order=relevance&district=manhattan&gclid=CjwKCAiAjNjgBRAgEiwAGLlf2hkP3A-cPxjZYkURqQEswQK2jKQEpv_MvKcrIhRWRzNkc_r-fGi0lxoCA7cQAvD_BwE&type=apartment&display=list https://www.realtor.com/apartments/Manhattan_NY

A csv file was compiled with the rental place that indicated: areas of Manhattan, address, number of beds, area and monthly rental price.Geolocator is used to get lat and long of the places.

"Great_circle" function from geolocator was used to calculate distances between two points, as in the case to calculate average rent price for units around each subway station and at 1.6 km radius.

Foursquare is used to find the avenues at Manhattan neighborhoods in general and a cluster is created to later be able to search for the venues depending of the location shown.

2.4 How the data will be used to solve the problem

The data will be used as follows: Use Foursquare and geopy data to map top 10 venues for all Manhattan neighborhoods and clustered in groups (as per Course LAB) Use foursquare and geopy data to map the location of subway metro stations , separately and on top of the above clustered map in order to be able to identify the venues and amenities near each metro station, or explore each subway location separately Use Foursquare and geopy data to map the location of rental places, in some form, linked to the subway locations. create a map that depicts, for instance, the average rental price per square ft, around a radius of 1.0 mile (1.6 km) around each subway station - or a similar metrics. I will be able to quickly point to the popups to know the relative price per subway area. Addresses from rental locations will be converted to geodata(lat, long) using Geopy-distance and Nominatim. Data will be searched in open data sources if available, from real estate sites if open to reading, libraries or other government agencies such as Metro New York MTA, etc.

2.5 Mapping of Data

The following maps were created to facilitate the analysis and the choice of the palace to live. Manhattan map of Neighborhoods manhattan subway metro locations Manhattan map of places for rent Manhattan map of clustered venues and neighborhoods Combined maps of Manhattan rent places with subway locations Combined maps of Manhattan rent places with subway locations and venues clusters

3. Methodology:

This section represents the main component of the report where the data is gathered, prepared for analysis. The tools described are used here and the Notebook cells indicates the execution of steps.

3.1 The analysis and the strategy:

The strategy is based on mapping the above described data in section 2.0, in order to facilitate the choice of at least two candidate places for rent. The choice is made based on the demands imposed: location near a subway, rental price and similar venues to Singapore. This visual approach and maps with pop ups labels allow quick identification of location, price and features, thus making the selection very easy.

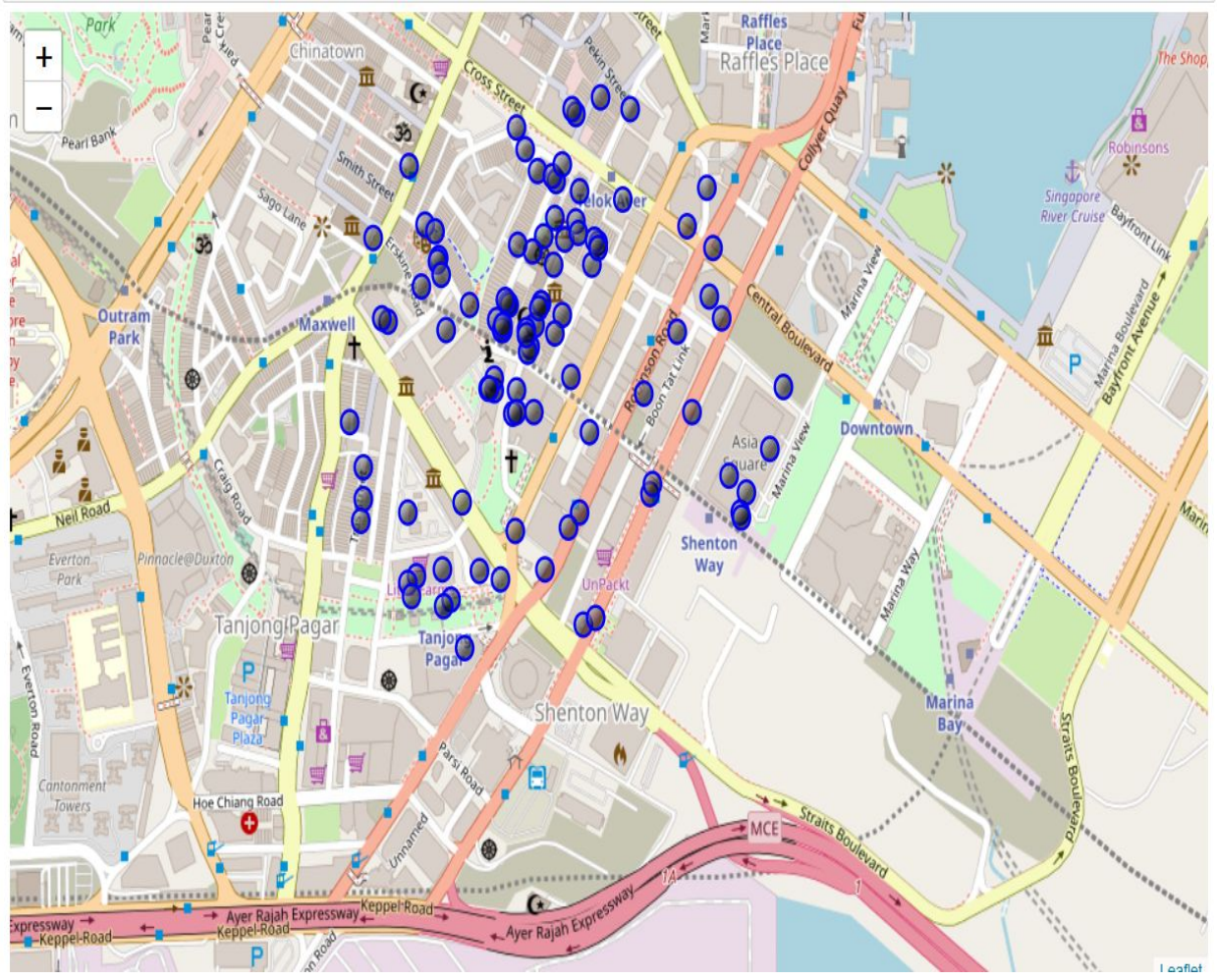
The processing of these DATA and its mapping will allow to answer the key questions to make a decision:

- what is the cost of available rental places that meet the demands?
- what is the cost of rent around a mile radius from each subway metro station?
- what is the area of Manhattan with best rental pricing that meets criteria established?
- What is the distance from workplace (Park Ave and 53rd St) and the tentative future rental home?
- What are the venues of the two best places to live? How the prices compare?

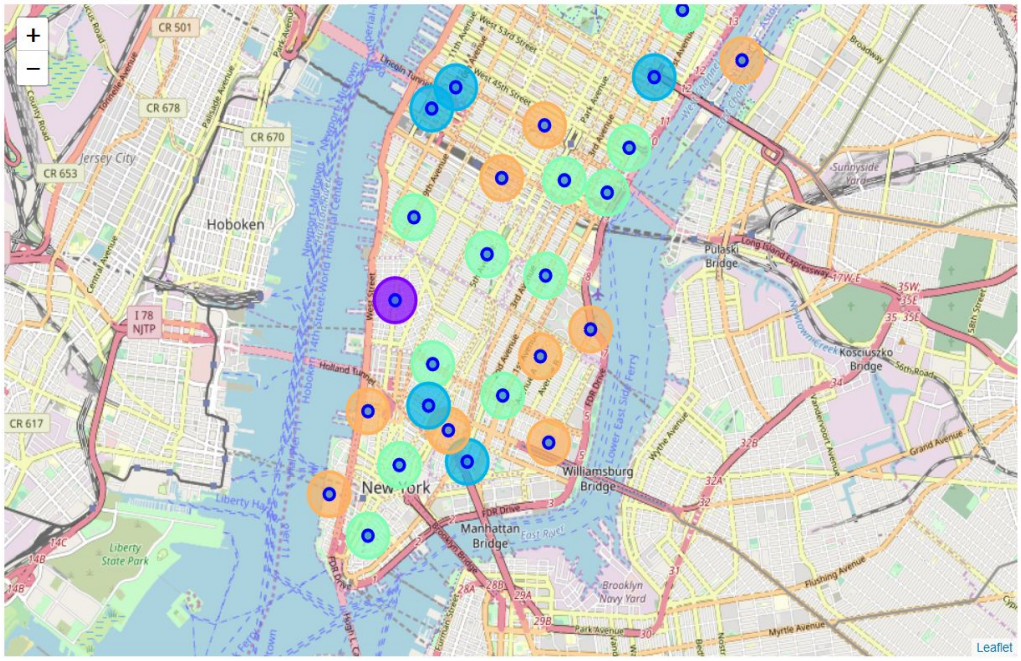
- How venues distribute among Manhattan neighborhoods and around metro stations?
- Are there tradeoffs between size and price and location?
- Any other interesting statistical data findings of the real estate and overall data.

3.2 Exploratory data analysis.

Map of Singapore residence with venues in Neighborhood - for reference



Map of Manhattan neighborhoods with top 10 clustered venues

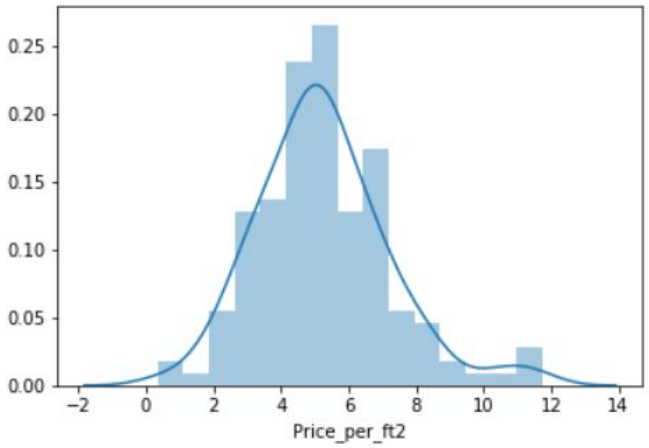


Manhattan apartment rent price statistics

Relationship between rent and square feet

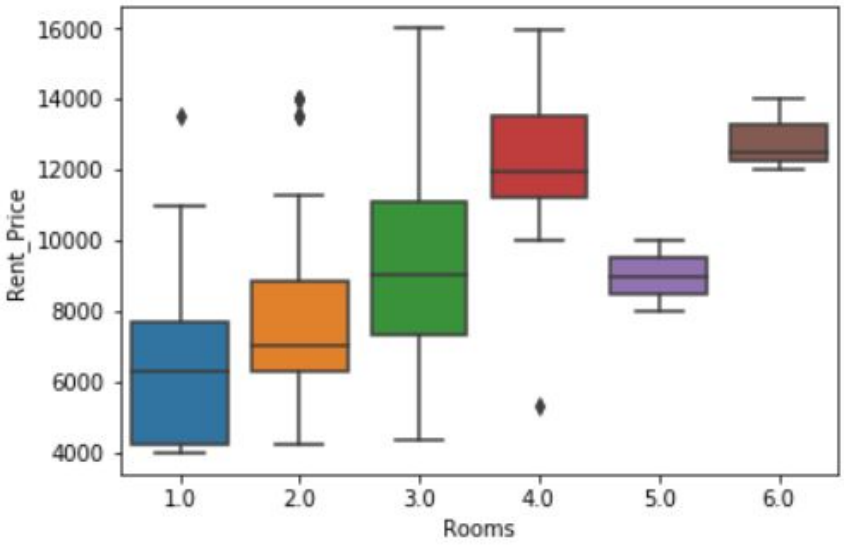
```
: import seaborn as sns
  sns.distplot(mh_rent['Price_per_ft2'],bins=15)
```

```
36]: <matplotlib.axes._subplots.AxesSubplot at 0x19a407d8240>
```

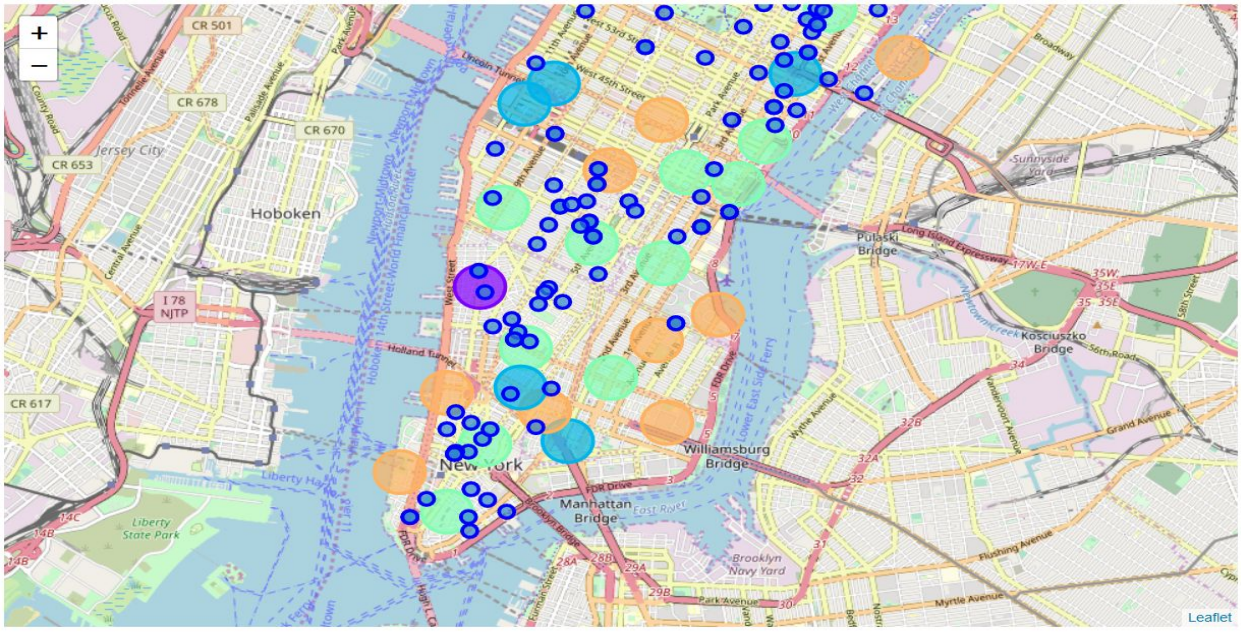


Relationship between rent and number of rooms

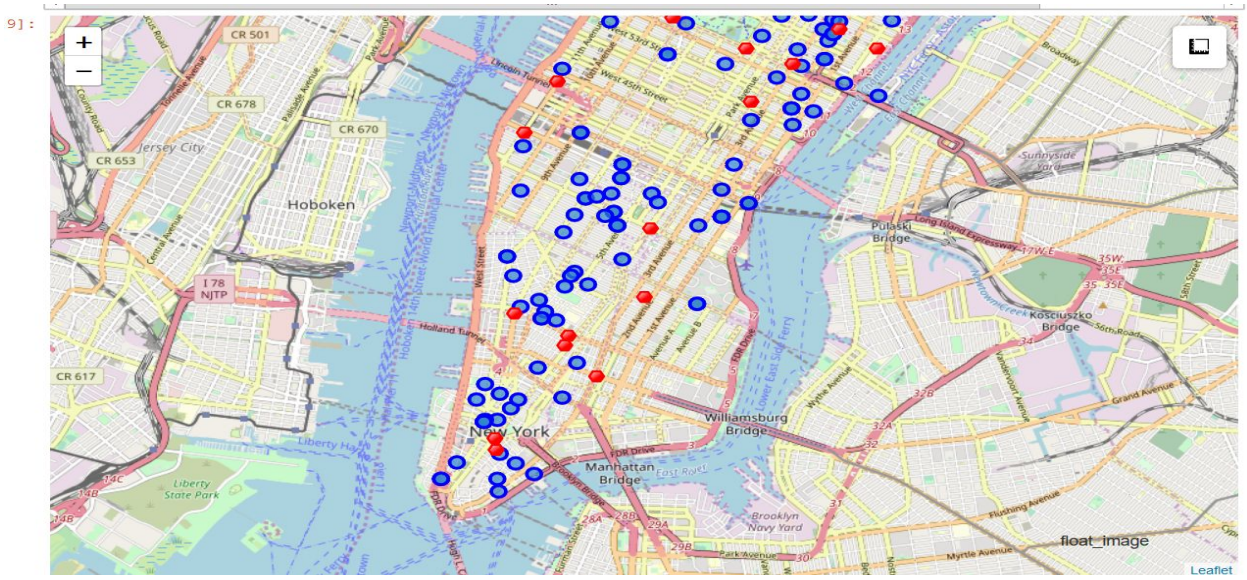
```
]:  sns.boxplot(x='Rooms', y= 'Rent_Price', data=mh_rent)
[37]: <matplotlib.axes._subplots.AxesSubplot at 0x19a408619e8>
```



Map of Manhattan showing the places for rent and the cluster of venues

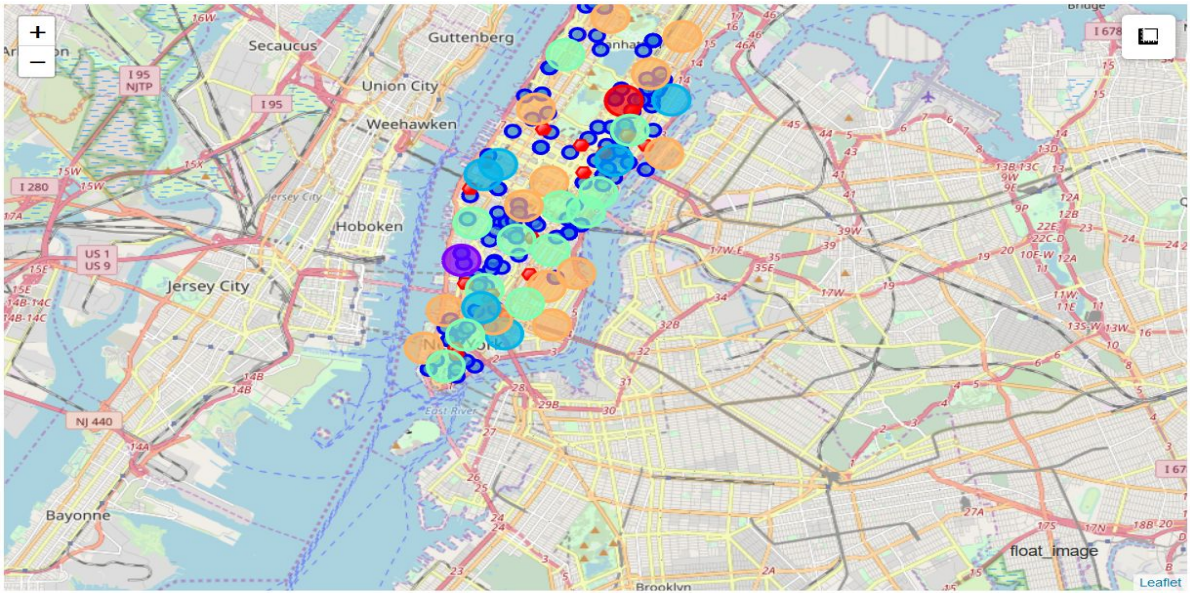


Map of Manhattan showing places for rent and the subway locations nearby



5. Results

Consolidated map of Manhattan with rental places, subway locations and a cluster of venues



Red dots are Subway stations, Blue dots are apartments available for rent, Bubbles are the clusters of venues

5. Discussion

After examining, I have chosen two locations that meet the requirements which will assess to make a choice.

1. Apartment 1: 305 East 63rd Street in the Sutton Place Neighborhood and near 'subway 59th Street' station, Cluster # 2 Monthly rent : 7500 Dollars

2. Apartment 2: 19 Dutch Street in the Financial District Neighborhood and near 'Fulton Street Subway' station, Cluster # 3 Monthly rent : 6935 Dollars

Venues for Apartment 1 - Cluster 2

	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

Venues for Apartment 2 - Cluster 3

	Neighborhood	Common Venue	Common Venue	Common Venue	Common Venue	Common Venue	Common Venue	Common Venue	Common Venue	Common Venue	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
32	Civic Center	Gym / Fitness Center	Bakery	Italian Restaurant	Cocktail Bar	French Restaurant	Sandwich Place	Coffee Shop	Gym	Yoga Studio	Park
35	Turtle Bay	Italian Restaurant	Coffee Shop	Steakhouse	Wine Bar	Sushi Restaurant	Hotel	Noodle House	Indian Restaurant	Japanese Restaurant	French Restaurant
36	Tudor City	Café	Park	Pizza Place	Mexican Restaurant	Greek Restaurant	Sushi Restaurant	Hotel	Deli / Bodega	Diner	Dog Run
15d9f6528b1e68f450af10		Italian Restaurant	American Restaurant	Gym	Gym / Fitness Center	Yoga Studio	Vegetarian / Vegan	Bakery	Clothing Store	Cosmetics Shop	Cycle Studio

Apartment 1 rent cost is US7500 slightly above the US7000 budget. Apt 1 is located 400 meters from the subway station at 59th Street and workplace (Park Ave and 53rd) is another 600 meters way. I can walk to work and use the 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 the 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.

6. Conclusion

In this study, I analyzed how rent for an apartment varies based on the number of rooms, area of the building , amenities located nearby etc. I used k-means clustering algorithm to find an apartment in my price range satisfying the conditions that I set up. This idea can be developed further to include broader conditions like apartment with ares having less noise pollution, less traffic, less crime rate etc so that it satisfies the user from finding an apartment that he/she likes.