

The Battle of Neighbourhoods

Gopi Kishore

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1. Introduction

1.1 Scenario and Background

Toronto is a wonderful place to live and work. Many people got opportunity to immigrate and enjoy many amenities and venues in the area, such as various international cuisine restaurants, cafes, food shops and entertainment. I have been offered a great opportunity to work for a leader firm in Manhattan, NY. I am very excited and I want to use this opportunity to practice my learnings in Coursera in order to answer relevant questions arisen. The key question is: How can I find a convenient and enjoyable place. Certainly, I can use available real estate apps and Google but the idea is to use and apply myself the learned tools during the course. In order to make a comparison and evaluation of the rental options in Manhattan NY, I must set some basis; therefore the apartment in Manhattan must meet the following demands:

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 current location (See item 2.1)

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 acquisition and cleaning:

2.1 Data of Current Situation

I use Foursquare to identify the venues around the area of residence which are then shown in the Toronto 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: List/Information on neighborhoods form Manhattan with their Geodata (latitude and longitude. List/Information about the subway metro stations in Manhattan with geodata. Listed apartments for rent in Manhattan area with descriptions (how many beds, price, location, address) 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 during 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 compiled in Numbers (Apple excel) and it 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. Details will be shown in the execution of methodology in section 3.0. The subway csv file is

"MH_subway.csv" and the data structure is: mhsb.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=CjwKCAiAjNjgBRAGeIiwAGLlf2hkP3A-cPxjZYkURqQEswOK2jKQEpv_MvKcrIhRWRzNkc_r-

[fGi0lxoCA7cQAvD BwE&type=apartment&display=list https://www.realtor.com/apartments/Manhattan_NY](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. The csv file "nnnn.csv" had the following below structure. An algorithm was used to create all the geodata using Nominatim, as shown in section 3.0. The actual algorithm coding may be shown in 'markdown' mode because it takes time to run. With the use of geolocator = Nominatim() , it was possible to determine the latitude and longitude for the subway metro locations as well as for the geodata for each rental place listed. The loop algorithms used are shown in the execution of data in section 3.0 "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 ammenities 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.

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 Toronto. This visual approach and maps with popups labels allow quick identification of location, price and feature, thus making the selection very easy.

The processing of these DATA and its mapping will allow answering 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? W
- What is the area of Manhattan with best rental pricing that meets criteria established?
- What is the distance from work place (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 trade offs between size and price and location?
- Any other interesting statistical data findings of the real estate and overall data.

METHODOLOGY EXECUTION - Mapping Data

Toronto Map - Current residence and venues in neighborhood for comparison to future Manhattan renting place

neighborhood_latitude=[43.6534817](#)

neighborhood_longitude=[-79.3839347](#)

Dial FourSquare to find venues around current residence in Toronto

	name	categories	lat	lng
0	Downtown Toronto	Neighborhood	43.653232	-79.385296
1	Nathan Phillips Square	Plaza	43.652270	-79.383516
2	Eggspectation Bell Trinity Square	Breakfast Spot	43.653144	-79.381980
3	Japango	Sushi Restaurant	43.655268	-79.385165
4	Indigo	Bookstore	43.653515	-79.380696
5	LUSH	Cosmetics Shop	43.653557	-79.380400
6	Chatime 日出茶太	Bubble Tea Shop	43.655542	-79.384684
7	CF Toronto Eaton Centre	Shopping Mall	43.654540	-79.380677
8	JOEY Eaton Centre	Restaurant	43.655404	-79.381929
9	Noodle King	Asian Restaurant	43.651706	-79.383046

	name	categories	lat	lng
0	Downtown Toronto	Neighborhood	43.653232	-79.385296
1	Nathan Phillips Square	Plaza	43.652270	-79.383516
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5	LUSH	Cosmetics Shop	43.653557	-79.380400
6	Chatime 日出茶太	Bubble Tea Shop	43.655542	-79.384684
7	CF Toronto Eaton Centre	Shopping Mall	43.654540	-79.380677
8	JOEY Eaton Centre	Restaurant	43.655404	-79.381929
9	Noodle King	Asian Restaurant	43.651706	-79.383046

Map of Toronto residence place with venues in Neighborhood - for reference

MANHATTAN NEIGHBORHOODS - DATA AND MAPPING

Cluster neighborhood data was produced with Foursquare during course lab work. A csv file was produced containing the neighborhoods around the 40 Boroughs. Now, the csv file is just read for convenience and consolidation of report.

	Borough	Neighborhood	Latitude	Longitude	Cluster Labels
0	Manhattan	Marble Hill	40.876551	-73.910660	2

	Borough	Neighborhood	Latitude	Longitude	Cluster Labels
1	Manhattan	Chinatown	40.715618	-73.994279	2
2	Manhattan	Washington Heights	40.851903	-73.936900	4
3	Manhattan	Inwood	40.867684	-73.921210	3
4	Manhattan	Hamilton Heights	40.823604	-73.949688	0

manhattan_data.tail:

	Borough	Neighborhood	Latitude	Longitude	Cluster Labels
35	Manhattan	Turtle Bay	40.752042	-73.967708	3
36	Manhattan	Tudor City	40.746917	-73.971219	3
37	Manhattan	Stuyvesant Town	40.731000	-73.974052	4
38	Manhattan	Flatiron	40.739673	-73.990947	3
39	Manhattan	Hudson Yards	40.756658	-74.000111	2

Manhattan Borough neighborhoods - data with top 10 clustered venues

Borough	Neighborhood	Latitude	Longitude	Cluster Labels	1st Most Common Venues	2nd Most Common Venues	3rd Most Common Venues	4th Most Common Venues	5th Most Common Venues	6th Most Common Venues	7th Most Common Venues	8th Most Common Venues	9th Most Common Venues	10th Most Common Venues
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	Bo ro ugh	Neig hbor hood	La tit ude	Lo ngi tud e	Cl us ter La bel s	1st Mo st Co m mo n Ve nu e	2nd Mo st Co m mo n Ve nu e	3rd Mo st Co m mo n Ve nu e	4th Mo st Co m mo n Ve nu e	5th Mo st Co m mo n Ve nue	6th Mo st Co m mo n Ve nue	7th Mo st Co m mo n Ve nu e	8th Mo st Co m mo n Ve nu e	9th Mo st Co m mo n Ve nu e	10th Mo st Co m mo n Ve nu e
0	Ma nha tta n	Mar ble Hill	40. 87 65 51	- 73. 910 660	2	Co ffe e Sh op	Di sco unt Sto re	Yo ga Stu dio	Ste akh ous e	Sup ple ment Sho p	Ten nis Sta diu m	Sh oe Sto re	Gy m	Ba nk	Sea foo d Re sta ura nt
1	Ma nha tta n	Chin atown	40. 71 56 18	- 73. 994 279	2	Chi nes e Re sta ura nt	Co ckt ail Ba r	Di m Su m Re sta ura nt	Amer ican Res tau rant	Vie tna mes e Res taur ant	Sal on / Bar ber sho p	No odl e Ho use	Ba ker y	Bu bbl e Tea Sh op	Ice Cre am Sh op
2	Ma nha tta n	Was hingt on Heig hts	40. 85 19 03	- 73. 936 900	4	Caf é	Ba ker y	Mo bil e Ph one Sh op	Piz za Pla ce	San dwi ch Pla ce	Par k	Gy m	Lat in A me ric an Re sta ura nt	Ta pas Re sta ura nt	Me xic an Re sta ura nt
3	Ma nha tta n	Inwo od	40. 86 76 84	- 73. 921 210	3	Me xic an Re sta	Lo un ge	Piz za Pla ce	Caf é	Wi ne Bar	Ba ker y	A me ric an Re	Par k	Fro zen Yo gur t	Sp ani sh Re sta

	Bo ro ugh	Neig hbor hood	La tit ude	Lo ngi tud e	Cl us ter La bel	1st Mo st Com mon Venu e	2nd Most Com mon Venu e	3rd Most Com mon Venu e	4th Most Com mon Venu e	5th Most Com mon Venu e	6th Most Com mon Venu e	7th Most Com mon Venu e	8th Most Com mon Venu e	9th Most Com mon Venu e	10th Most Com mon Venu e
						ura nt						sta ura nt		Sh op	ura nt
4	Ma nha ttan	Ham ilton Heig hts	40. 82 36 04	- 73. 949 688	0	Me xic an Re sta ura nt	Co ffe e Sh op	Caf é	Del i/ Bo deg a	Piz za Pla ce	Liq uor Sto re	Ind ian Re sta ura nt	Sus hi Re sta ura nt	Sa nd wic h Pla ce	Yo ga Stu dio

Map of Manhattan neighborhoods with top 10 clustered venues

Pop us allow to identify each neighborhood and the cluster of venues around it in order to proceed to examine in more detail in the next cell

Examine a paticular Cluster - print venues

After examining several cluster data , I concluded that cluster # 2 resembles closer the Singapore place, therefore providing guidance as to where to look for the future appartment.

	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

	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
26	Morningside Heights	Coffee Shop	American Restaurant	Park	Book store	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

Map of Manhattan places for rent

Several Manhattan real estate webs were webscrapped to collect rental data, as mentioned in section 2.0 . The result was summarized in a csv file for direct reading, in order to consolidate the process.

	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	NaN	NaN
1	East 97th Street	Upper East Side	3.57	3.0	2100	7500	NaN	NaN

	Address	Area	Price_per_ft2	Rooms	Area-ft2	Rent_Price	Lat	Long
2	West 105th Street	Upper West Side	1.89	4.0	2800	5300	NaN	NaN
3	CARMINE ST.	West Village	3.03	2.0	1650	5000	NaN	NaN
4	171 W 23RD ST.	Chelsea	3.45	2.0	1450	5000	NaN	NaN

	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	NaN	NaN
140	50 Murray Street	No fee rental in Tribeca	7.11	2.0	1223	8700	NaN	NaN
141	300 East 56th Street	No fee rental in Midtown East	3.87	3.0	2100	8118	NaN	NaN
142	1930 Broadway	No fee rental in Central Park West	5.06	2.0	1600	8095	NaN	NaN
143	33 West 9th Street	Rental in Greenwich Village	6.67	2.0	1500	10000	NaN	NaN

Obtain geodata (lat,long) for each rental place in Manhattan with Nominatim

Data was stored in a csv file for simplifaction report purposes and saving code processing time in future. This coding section was 'markdown' for the report because its execution takes few minutes . Terefore, the csv saved will be be just read directly in the following cell

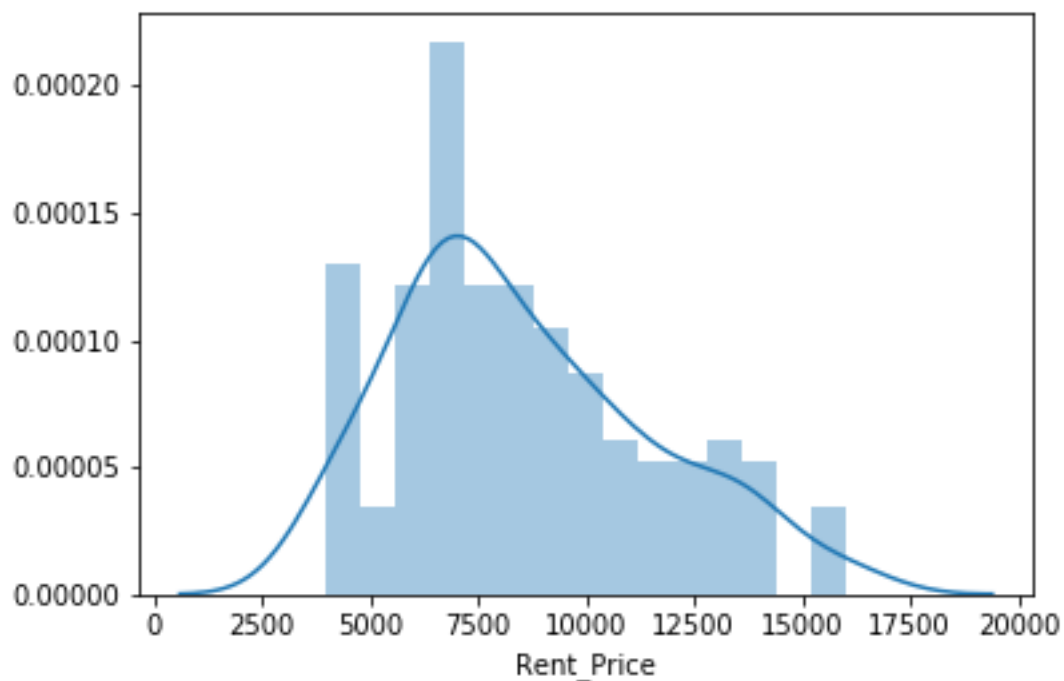
	Address	Area	Price_per_ft2	Rooms	Area-ft2	Rent_Price	Lat	Long
0	West 105th Street	Upper West Side	2.94	5.0	3400	10000	40.799771	-73.966213
1	East 97th Street	Upper East Side	3.57	3.0	2100	7500	40.788585	-73.955277
2	West 105th Street	Upper West Side	1.89	4.0	2800	5300	40.799771	-73.966213
3	CARMIN E 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

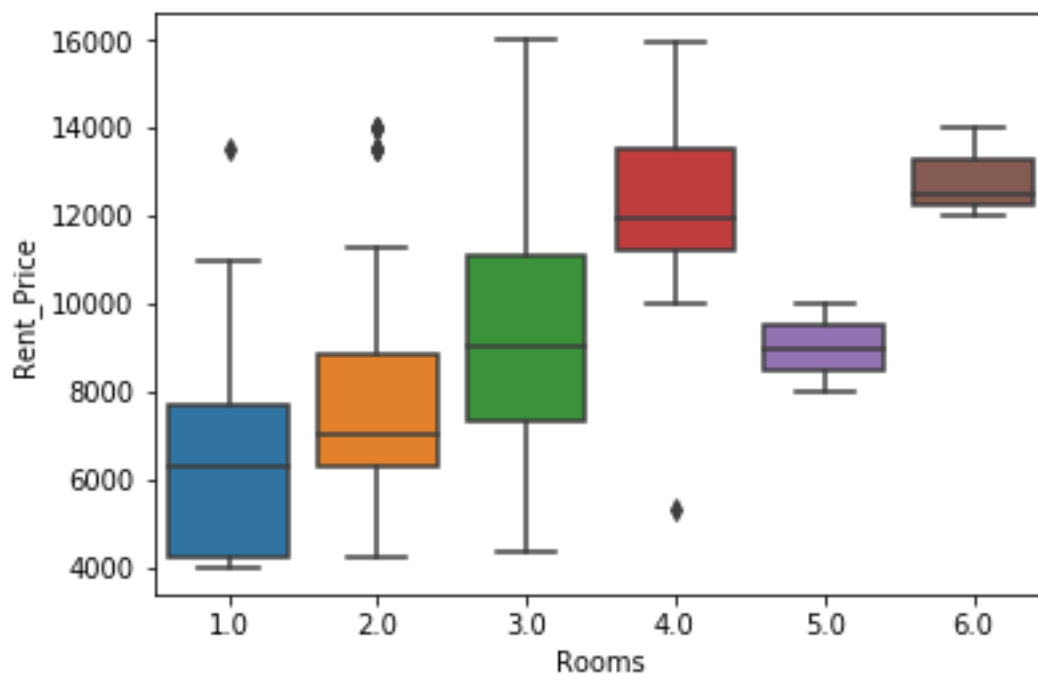
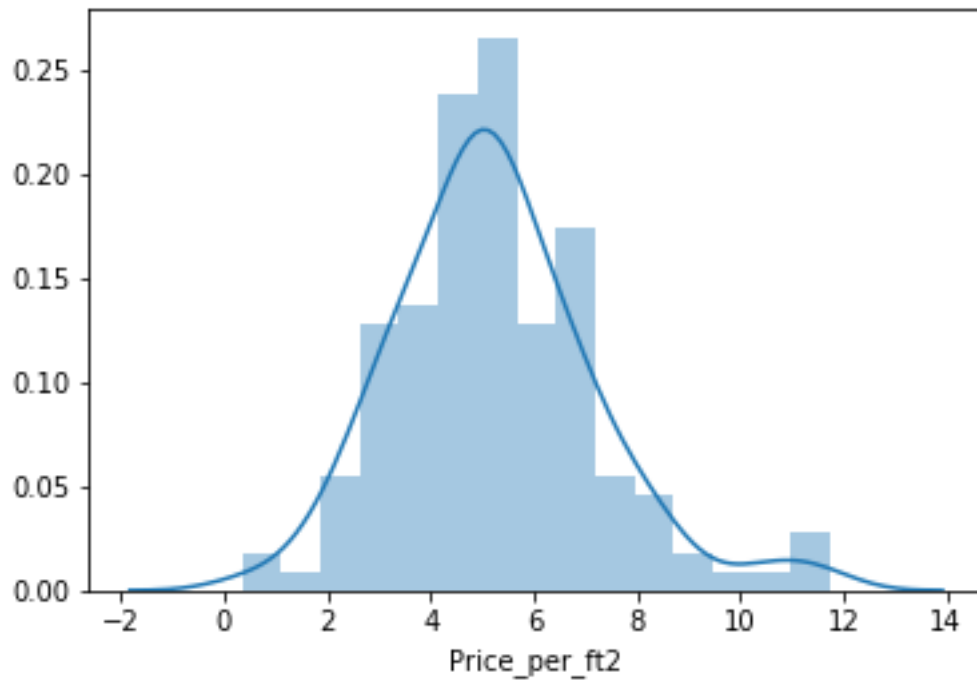
	Address	Area	Price_per_ft2	Rooms	Area-ft2	Rent_Price	Lat	Long
139	200 East 72nd Street	Rental in Lenox Hill	5.15	3.0	1700	8750	40.769465	-73.960339
140	50 Murray Street	No fee rental in Tribeca	7.11	2.0	1223	8700	40.714051	-74.009608

	Address	Area	Price_per_ft2	Rooms	Area-ft2	Rent_Price	Lat	Long
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

Manhattan apartment rent price statistics

A US 7000 Dollar per month rent is actually around the mean value





Map of Manhattan apartments for rent

The popups will indicate the address and the monthly price for rent thus making it convenient to select the target apartment with the price condition estipulate (max USD 7000)



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

Now, one can point to a rental place for price and address location information while knowing the cluster venues around it.

This is an insightful way to explore rental possibilities



Now one can explore a particular rental place and its venues in detail

In the map above, examination of apartments with rental place below 7000/month is straight forward while knowing the venues around it. We could find an apartment with at the right price and in a location with desirable venues. The next step is to see if it is located near a subway metro station, in next cells work.

		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Neighborhood		Most Common Venue	Most Common Venue	Most Common Venue	Most Common Venue	Most Common Venue	Most Common Venue	Most Common Venue	Most Common Venue	Most Common Venue	Most Common Venue

3	Inwood	Mexican Restaurant	Lounge	Pizza Place	Café	Wine Bar	Bakery	American Restaurant	Park	Frozen Yogurt Shop	Spanish Restaurant
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	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
5	Manhattanville	Deli / Bodega	Italian Restaurant	Seafood Restaurant	Mexican Restaurant	Sushi Restaurant	Beer Garden	Coffee Shop	Falafel Restaurant	Bike Trail	Other Night life
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	Night club	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

	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
27	Gramer cy	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
3	Flatiron	Italian	Ame	Gym	Gym	Yoga	Veget	Bake	Cloth	Cos	Cycle

	1st Most Com mon Ven ue	2nd Most Com mon Ven ue	3rd Most Com mon Venu e	4th Most Com mon Venu e	5th Most Com mon Venu e	6th Most Com mon Venu e	7th Most Com mon Ven ue	8th Most Com mon Ven ue	9th Most Com mon Ven ue	10th Most Com mon Venu e
8	n Resta urant	rican Resta urant		/ Fitne ss Cent er	Studi o	arian / Vega n Resta urant	ry	ing Store	metic s Shop	Studi o

Mapping Manhattan Subway locations

Manhattan subway metro locations (address) was obtained from web scrapping sites such as Wikipedia, Google and NY Metro Transit. For simplification, a csv file was produced from the 'numbers' (Apple excel) so that the reading of this file is the starting point here. The geodata will be obtain via Nominatim using the algorithm below.

	sub_station	sub_address
0	Dyckman Street Subway Station	170 Nagle Ave, New York, NY 10034, USA
1	57 Street Subway Station	New York, NY 10106, USA
2	Broad St	New York, NY 10005, USA
3	175 Street Station	807 W 177th St, New York, NY 10033, USA
4	5 Av and 53 St	New York, NY 10022, USA

Add columns labelled 'lat' and 'long' to be filled with geodata

Algorithm to find latitude and longitude for each subway metro station and add them to dataframe

	sub_station	sub_address	lat	long
0	Dyckman Street Subway Station	170 Nagle Ave, New York, NY 10034, USA	1.162052	- 0.201503
1	57 Street Subway Station	New York, NY 10106, USA	0.281092	0.116987
2	Broad St	New York, NY 10005, USA	- 0.573425	- 0.071091
3	175 Street Station	807 W 177th St, New York, NY 10033, USA	1.071530	1.001606
4	5 Av and 53 St	New York, NY 10022, USA	0.183704	1.485702
	sub_station	sub_address	lat	long
71	50 St Br	New York, NY 10019, United States	- 0.617571	- 2.004014
72	57 Street Station	New York, NY 10019, United States	0.088510	- 0.388182
73	23 Street Station	New York, NY 10010, United States	0.054383	- 0.945154
74	14 Street / 8 Av	New York, NY 10014, United States	- 0.973493	0.488370
75	MTA New York City	525 11th Ave, New York, NY 10018, USA	- 0.338517	- 0.382061

MAP of Manhattan showing the location of subway stations

**Now, we can visualize the desirable rental places and their nearest subway station.
Popups display rental address and monthly rental price and the subway station name.**

Notice that the icon in the top-right corner is a "ruler" that allows to measure the distance from a rental place to an specific subway station

	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



4.0 Results

ONE CONSOLIDATE MAP

Let's consolidate all the required information to make the apartment selection in one map.

Map of Manhattan with rental places, subway locations and cluster of venues

Red dots are Subway stations,

Blue dots are apartments available for rent,

Bubbles are the clusters of venues



Problem Resolution - Select the apartment for rent

The above consolidate map was used to explore options. After examining, I have chosen two locations that meet the requirements which will assess to make a choice.

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

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

		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
	Neighborhood	Most Common Venue	Most Common Venue	Most Common Venue	Most Common Venue	Most Common Venue	Most Common Venue	Most Common Venue	Most Common Venue	Most Common Venue	Most Common Venue
0	Marble Hill	Coffee Shop	Diner Store	Yoga Studio	Steakhouse	Supplement Shop	Tennis Stadium	Shoe Store	Gym	Bank	Seafood Restaurant

	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
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

	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
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	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 Night life
10	Lenox Hill	Sushi Restaurant	Italian Restaurant	Coffee Shop	Gym / Fitness Center	Pizza Place	Burger Joint	Deli / Bodega	Gym	Sporting Goods Shop	Thai Restaurant

	Neigh borho od	1st Most Common Venue	2nd Most Common Venue	3rd Most Commo n Venue	4th Most Commo n Venue	5th Most Comm on Venue	6th Most Comm on Venue	7th Most Comm on Venue	8th Most Com mon Venu e	9th Most Comm on Venue	10th Most Com mon Venu e
12	Upper West Side	Italian Restaurant	Bar	Bakery	Vegetari an / Vegan Restaura nt	Indian Restaur ant	Coffee Shop	Cosme tics Shop	Wine Bar	Mexica n Restau rant	Sushi Resta urant
16	Murray Hill	Sandwich Place	Hotel	Japanese Restaura nt	Gym / Fitness Center	Coffee Shop	Salon / Barber shop	Burger Joint	Frenc h Resta urant	Bar	Italia n Resta urant
17	Chelse a	Coffee Shop	Italian Restaurant	Ice Cream Shop	Bakery	Nightcl ub	Theate r	Art Gallery	Seafoo d Resta urant	Americ an Restau rant	Hotel
18	Green wich Village	Italian Restaurant	Sushi Restaurant	French Restaura nt	Clothing Store	Chines e Restaur ant	Café	Indian Restaur ant	Bake ry	Seafoo d Resta urant	Electr onics Store
27	Gramer cy	Italian Restaurant	Restaurant	Thrift / Vintage Store	Cocktail Bar	Bagel Shop	Coffee Shop	Pizza Place	Mexi can Resta urant	Grocer y Store	Wine Shop
29	Financi al District	Coffee Shop	Hotel	Gym	Wine Shop	Steakh ouse	Bar	Italian Restaur ant	Pizza Place	Park	Gym / Fitnes s Cent er
31	Noho	Italian Restaurant	French Restaurant	Cocktail Bar	Gift Shop	Bookst ore	Grocer y Store	Mexica n Restaur ant	Hotel	Sushi Restau rant	Coffe e Shop
32	Civic Center	Gym / Fitness	Bakery	Italian Restaura	Cocktail Bar	French Restaur	Sandwi ch	Coffee Shop	Gym	Yoga Studio	Park

	Neigh borho od	1st Most Common Venue	2nd Most Common Venue	3rd Most Commo n Venue	4th Most Commo n Venue	5th Most Comm on Venue	6th Most Comm on Venue	7th Most Comm on Venue	8th Most Com mon Venu e	9th Most Comm on Venue	10th Most Com mon Venu e
	Center			nt		ant	Place				
35	Turtle Bay	Italian Restaurant	Coffee Shop	Steakhou se	Wine Bar	Sushi Restaur ant	Hotel	Noodle House	India n Resta urant	Japane se Restau rant	Frenc h Resta urant
36	Tudor City	Café	Park	Pizza Place	Mexican Restaura nt	Greek Restaur ant	Sushi Restau rant	Hotel	Deli / Bode ga	Diner	Dog Run
38	Flatiro n	Italian Restaurant	American Restaurant	Gym	Gym / Fitness Center	Yoga Studio	Vegeta rian / Vegan Restau rant	Bakery	Cloth ing Store	Cosme tics Shop	Cycle Studi o

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 away. I can walk to work place and use subway for other places around. Venues for this apartment 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 the Toronto venues, I feel that Cluster 2 type of venues is a closer resemblance. That means that APARTMENT 1 is a better choice since the extra monthly rent is worth the conveniences it provides.

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. I feel I have acquired a good starting point to become a professional Data Scientist and I will continue exploring to creating examples of practical cases.

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