Manhattan Real Estate Purchase Price correlation to Neighborhoods and surrounding Venues

Introduction /Business problem

New York City (NYC) property cost is known to be highest in the world. The combination of limited confined space for housing with population high density population typically leads to a very high residential property purchase cost. Yet, New York City is an attractive city that pulls in businesses, people and investments.

In addition, NYC has very large of dining venues, shopping opportunities parks and museums. Some people consider it as the best place in the world for fine dining, culture, entertainment and recreation.

However, the neighborhoods in Manhattan have a different content of venues and some neighborhoods offer similar experience for the its residents than others. Yet, the median cost of residential unit varies between one neighborhood to another.

The audience for this work can be an investor or potential residential unit buyer who seeks for a particular lifestyle in a neighborhood with a certain budget for home purchase. Or a home buyer who would like to consider other similar neighborhood with similar venues but a different price point.

In this work the cost of purchase of a residential unit in different neighborhoods of Manhattan will be analyzed based on residential unit type, neighborhood and square feet area. The cost of different types of residence in different neighborhood will be discussed. In addition, this work investigates the correlation between number of venues in a every neighborhood in Manhattan to the cost of purchase of residential unit. Last, this work classifies every neighborhood by its venues content and the median cost of purchase of a residential unit.

Data description:

In this work an open source data of NYC property purchase through 2019 was used. The data is used by NYC tax collector to estimate the taxes per purchase. The data included 16473 property entries of purchases through 2019 in Manhattan only. The dataset included the neighborhood name, borough, building class category, tax class, block, lot, address, zip code, number of residential units under this purchase, number of commercial units under this purchase, total units, land square feet, gross square feet, year built, sale price and sale date.

In addition, Foursquare open source dataset was used for collecting the venues per neighborhood. The venues per neighborhood were limited to 100 venues in the radius of 500 meters from geo-locators of the neighborhood.

The dataset includes both residential commercial, lots, garages and hospitals. For simplicity only the residential properties were considered. In addition, few neighborhoods were consolidated based on the available neighborhood data on Foursquare and the NYC property purchase data.

Fig. 1 shows the top 14 data entries by building class category.

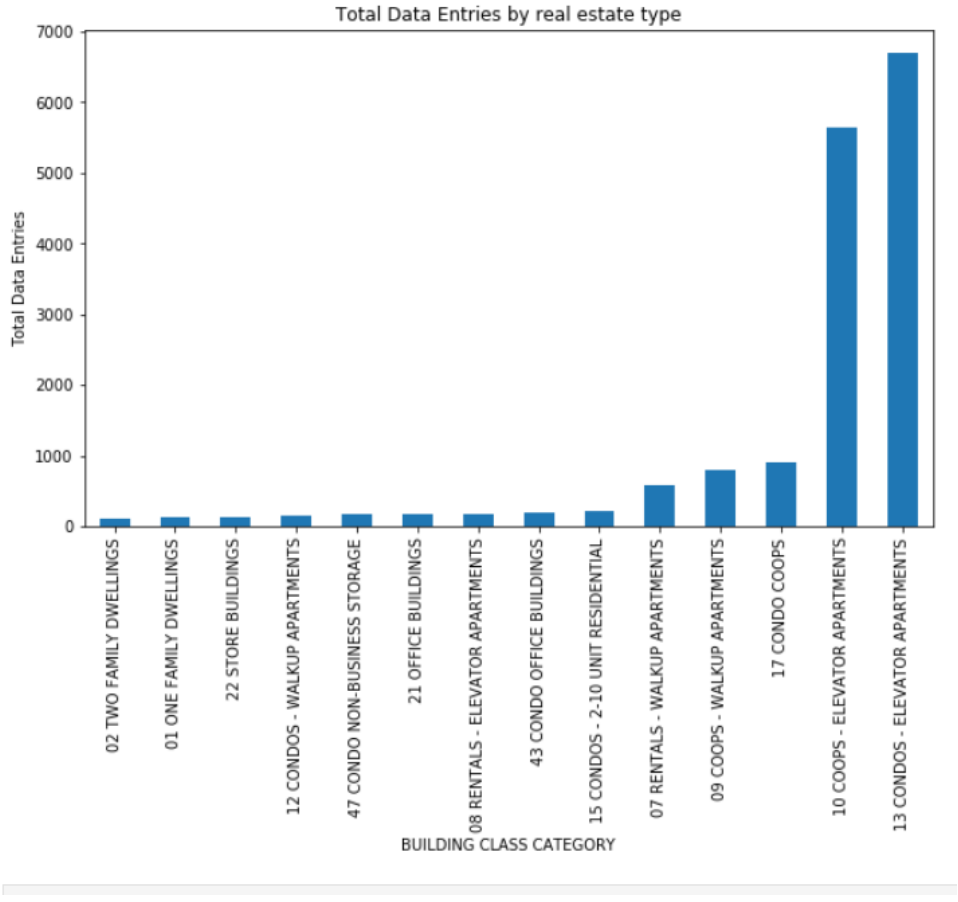


Figure 1 - Total real estate data entries in Manhattan by buliding class category

Figure 2. summarized all the data entries based on building class category for the top 14 building class category. Note the with the borough and hood columns in fact show to total sum of entries in this particular category

	BUILDING CLASS CATEGORY	BOROUGH	Hood	ZIP CODE	TOTAL UNITS	LA
0	01 ONE FAMILY DWELLINGS	132	132	132	132	
1	02 TWO FAMILY DWELLINGS	113	113	113	113	
2	07 RENTALS - WALKUP APARTMENTS	585	585	585	585	
3	08 RENTALS - ELEVATOR APARTMENTS	184	184	184	184	
4	09 COOPS - WALKUP APARTMENTS	789	789	789	0	
5	10 COOPS - ELEVATOR APARTMENTS	5649	5649	5649	0	
6	12 CONDOS - WALKUP APARTMENTS	146	146	146	146	
7	13 CONDOS - ELEVATOR APARTMENTS	6689	6689	6689	6490	
8	15 CONDOS - 2-10 UNIT RESIDENTIAL	216	216	216	215	
9	17 CONDO COOPS	896	896	896	0	
10	21 OFFICE BUILDINGS	177	177	177	177	
11	22 STORE BUILDINGS	140	140	140	140	
12	43 CONDO OFFICE BUILDINGS	194	194	194	194	
13	47 CONDO NON-BUSINESS STORAGE	167	167	167	167	

Figure 2-Top data entries sum by building class

Data clean-up and pre-arrangement:

The dataset was pre-arranged. The columns that are not useful for this work were dropped. Fig. 3 shows a sample the real estate dataset before the columns drop and Fig. s shows the columns after the columns drop.

	BOROUGH	NEIGHBORHOOD	BUILDING CLASS CATEGORY	TAX CLASS AT PRESENT	BLOCK	LOT	EASE-MENT	BUILDING CLASS AT PRESENT	ADDRESS	APARTMENT NUMBER	...	COMMERCIAL UNITS	TOTAL UNITS	LAND SQUARE FEET	GROSS SQUARE FEET	YEAR BUILT
0	1	ALPHABET CITY	01 ONE FAMILY DWELLINGS	1	376	43	NaN	S1	743 EAST 6TH STREET	NaN	...	1.0	2.0	2,090	3,680	1940.0
1	1	ALPHABET CITY	01 ONE FAMILY DWELLINGS	1	390	61	NaN	A4	189 EAST 7TH STREET	NaN	...	0.0	1.0	987	2,183	1860.0
2	1	ALPHABET CITY	02 TWO FAMILY DWELLINGS	1	404	1	NaN	B9	166 AVENUE A	NaN	...	0.0	2.0	1,510	4,520	1900.0
3	1	ALPHABET CITY	03 THREE FAMILY DWELLINGS	1	377	56	NaN	C0	263 EAST 7TH STREET	NaN	...	0.0	3.0	2,430	3,600	1899.0
4	1	ALPHABET CITY	03 THREE FAMILY DWELLINGS	1	393	9	NaN	C0	604 EAST 11TH STREET	NaN	...	0.0	3.0	2,375	5,110	1939.0

Figure 3. Dataset sample before columns drop

	BOROUGH	Hood	BUILDING CLASS CATEGORY	ZIP CODE	TOTAL UNITS	LAND SQUARE FEET	GROSS SQUARE FEET	YEAR BUILT	SALE DATE	SALE PRICE
0	1	East Village	01 ONE FAMILY DWELLINGS	10009	2.0	2,090	3,680	1940.0	7/24/2019	3,200,000
1	1	East Village	01 ONE FAMILY DWELLINGS	10009	1.0	987	2,183	1860.0	9/25/2019	0
2	1	East Village	02 TWO FAMILY DWELLINGS	10009	2.0	1,510	4,520	1900.0	7/22/2019	0
3	1	East Village	03 THREE FAMILY DWELLINGS	10009	3.0	2,430	3,600	1899.0	4/30/2019	6,300,000
4	1	East Village	03 THREE FAMILY DWELLINGS	10009	3.0	2,375	5,110	1939.0	10/24/2019	0

Figure 4. Dataset sample after columns drop

The following actions were done to pre-arrange and clean the dataset:

- Numeric data such as sale price, Land square feet and gross square feet were converted to integers instead of strings and the commas were removed.
- Sale price below 100K$ was dropped
- Non-residential units were not considered – based on building class category
- Sale price was converted into M$
- When number of units was missing – 1 unit was assumed
- Total sale price was divided by number of units to reflect the cost per residential unit. The total price reflects the price of the entire building in a multi-units buildings. The cost of a unit in a co-op reflect 1 unit share in a co-op.
- Square feet (SF) per unit was calculated where square feet data was available.

For simplicity, only residential properties data entries were considered. The following property types are available in the following analysis:

- One family dwelling (single family dwelling)
- Two family dwelling
- Condos – Walkup apartment (no elevator)
- Condos – Elevator apartments
- Condos – 2-10 units
- Condo-Co-op
- Co-ops- Elevator apartment
- Co-op- Walkup apartment
- Rentals (housing purchases for rental purposes) -Elevator
- Rentals (walkup apartments)

As a result of the above actions, the dataset included total of 12,232 entries.

```
TrueSale.shape
```

```
(12232, 10)
```

Methodology:

The Manhattan sale price in M$ by residential category type is shown in the box plot (Fig. 5). The price reflects to total cost per purchase including all the units in the property. As shown below rentals elevator apartment has the highest cost probably due the large amount of residential units under each purchase.

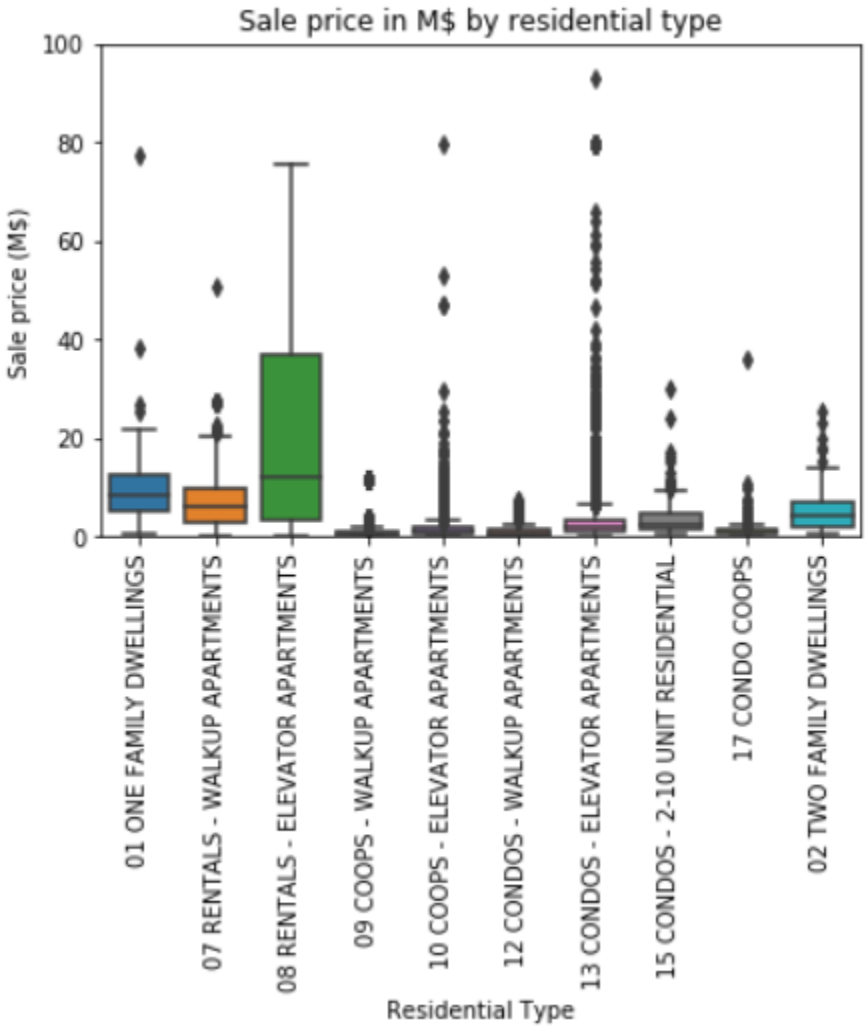


Figure 5 Total sale price by residential category

In order to avoid data biasing, the purchase price per unit is used as a metrics. Fig. 6 shows the cost per residential unit in M$ in Manhattan. Note that as expected- one family house and two family dwelling have the highest cost in Manhattan. These type of properties are extremely rare in Manhattan and very expensive.

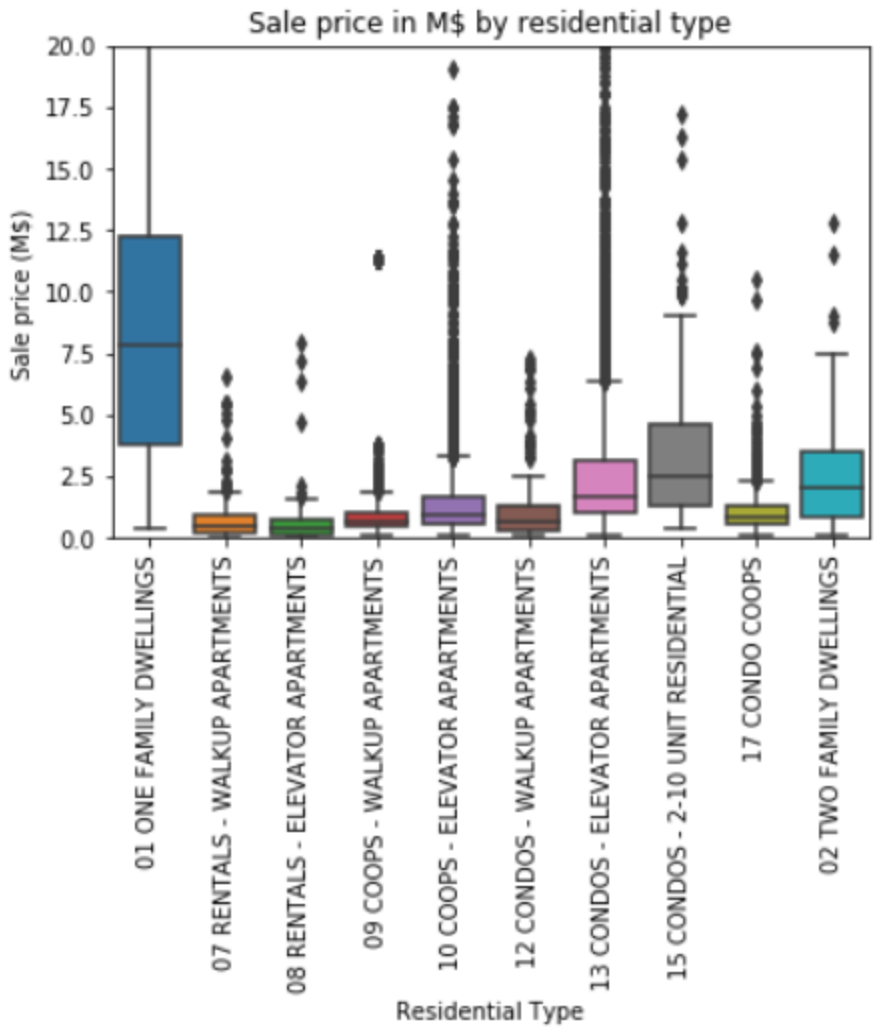


Figure 6. Sale price per residential unit by residential type

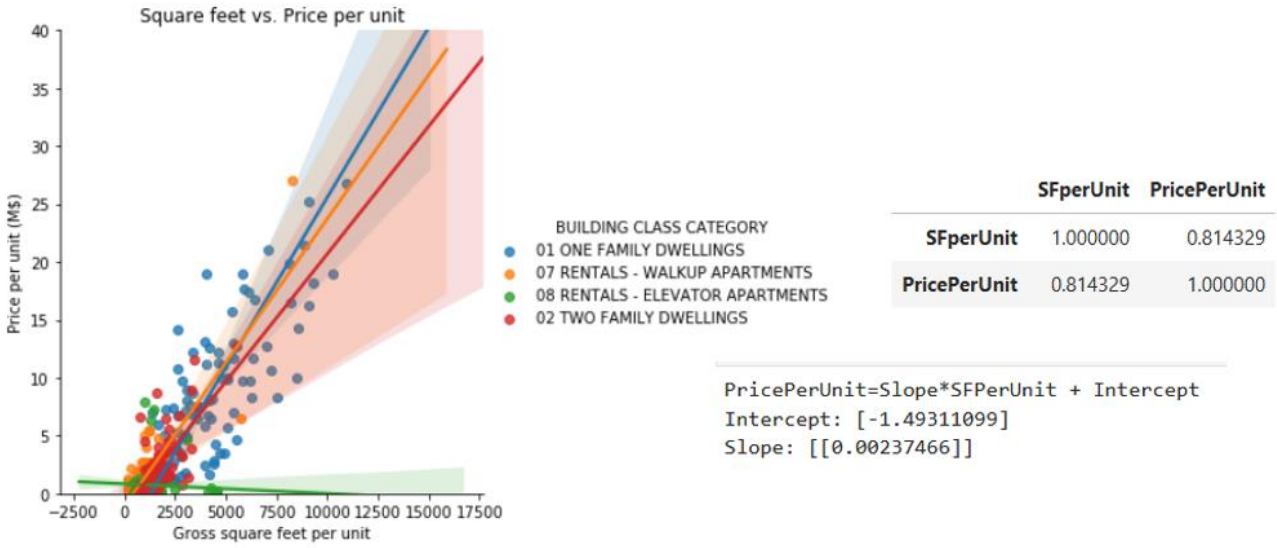
Fig. 7 shows a summary table of the price per unit median by residential type. The data shows the following:

- One family house is more expensive by approximately 4 times than 2 family house
- Elevator co-ops and elevator apartments are signicantly more expensive than non-elevator apartment and co-ops. One can claim that elevator improves the property value. But it is also possible the building with elevators are newer ,modern and larger and therefore more expensive.
- In the case of rental classified properties- walkup apartments are more expensive than elevator apartments.
- Generally speaking – condos are more expensive than co-ops. In condos- the buyer purchases the apartment while co-op the buyer purchases a share in a unit that reflects the size of the apartment in a building – similar to buying a share in the stock market.

	BUILDING CLASS CATEGORY	PricePerUnit
0	01 ONE FAMILY DWELLINGS	7.825000
1	02 TWO FAMILY DWELLINGS	2.032500
2	07 RENTALS - WALKUP APARTMENTS	0.500000
3	08 RENTALS - ELEVATOR APARTMENTS	0.346698
4	09 COOPS - WALKUP APARTMENTS	0.625000
5	10 COOPS - ELEVATOR APARTMENTS	0.880000
6	12 CONDOS - WALKUP APARTMENTS	0.677500
7	13 CONDOS - ELEVATOR APARTMENTS	1.700000
8	15 CONDOS - 2-10 UNIT RESIDENTIAL	2.475000
9	17 CONDO COOPS	0.810000

Figure 7- Median price per unit by residential type

An exploratory correlation between the size of the residential unit measured by square feet per unit vs. the price per unit was made. Some building categories missed the gross square feet data therefore only building categories that had this type of data were considered. Fig. 8 shows the correlation between housing cost and the size of the property. A strong linear correlation was found it price per unit is auto correlated with SF per unit with r^2 =0.814 (1 denotes a perfect linear correlation). The slope of the correlation is 0.002 which means that roughly every square foot in Manhattan cost about $2000. That indicates the very high cost of properties in Manhattan as of 2019.



	SFperUnit	PricePerUnit
SFperUnit	1.000000	0.814329
PricePerUnit	0.814329	1.000000

```
PricePerUnit=Slope*SFPerUnit + Intercept
Intercept: [-1.49311099]
Slope: [[0.00237466]]
```

Figure 8. Gross square feet per unit vs. price per unit

Discussion – By neighborhood analysis – Cost of housing

A summary of price per residential unit by neighborhood is shown in Fig. 9. In this analysis all the residential types were consolidated. One can see that there is a large variation is price based on the neighborhood. For example – A residential unit in Hudson yards- a new developed area with designer sky-scarpers, top-notch shopping centers and new highline gardens – was sold at a median value of 4.66 $M. While Inwood – a low-income working-class neighborhood, the median cost was 0.4 M$.

	Hood	PricePerUnit
0	Central Harlem	0.710000
1	Chelsea	1.195000
2	Chinatown	1.059500
3	Civic Center	2.466200
4	Clinton	0.871500
5	East Harlem	0.701500
6	East Village	0.820000
7	Financial District	1.022250
8	Flatiron	1.675000
9	Gramercy	1.225000
10	Greenwich Village	1.400000
11	Hudson Yards	4.666812
12	Inwood	0.407043
13	Little Italy	2.825000
14	Lower East Side	1.406496
15	Manhattan Valley	0.735000
16	Midtown	0.990000
17	Morningside Heights	0.627500
18	Murray Hill	0.787500
19	Roosevelt Island	1.150000
20	Soho	2.250000
21	Tribeca	2.940000
22	Upper East Side	1.145000
23	Upper West Side	1.225000
24	Washington Heights	0.590147

Figure 9- Median cost per residential unit by neighborhood

Manattan neighborhood in this analysis were plotted using folium the latitude and longitude coordinates were taken from Foursqure database based on the neighborhood name.

Fig. 10 shows a map of Manhattan with the different neighborhood in blue labels.

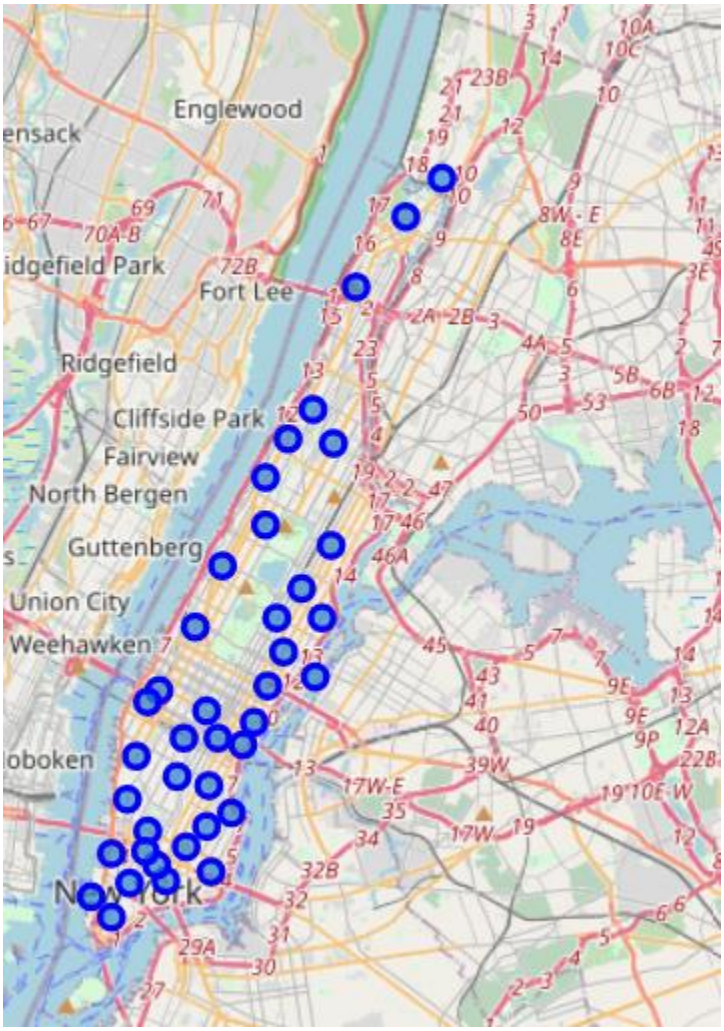
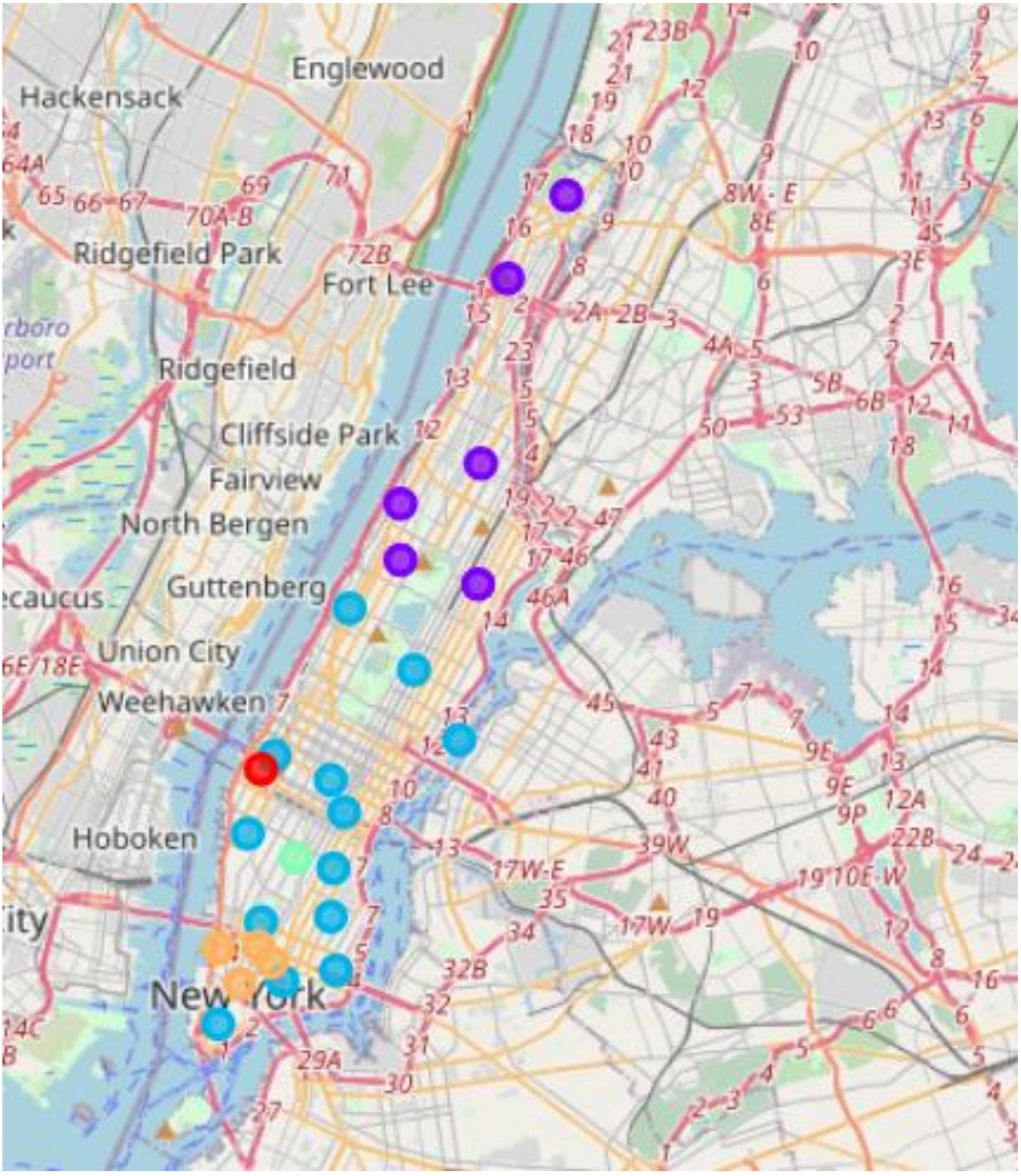


Figure 10 Manattan neighborhoods

The median cost of housing per neighborhood was from Fig. 9 was binned and classified into 5 clusters:

- Cluster 1 – Median price per unit < 0.75 M$ (purple)
- Cluster 2 – 0.75< Median price per unit < 1.5 M$ (blue)
- Cluster 3 – 1.5< Median price per unit < 2.25 M$ (cyan)
- Cluster 4 – 2.25< Median price per unit < 3 M$ (orange)
- Cluster 5 – Median price per unit > 3 M$ (red)

Fig. 11 shows Manhattan map with the residential median cost clusters. As pop-up the name of the neighborhood, the cluster and the median cost of residential property is shown.


Englewood
Hackensack
Ridgefield Park
Fort Lee
Ridgefield
Cliffside Park
Fairview
North Bergen
Guttenberg
Union City
Weehawken
Hoboken
New York

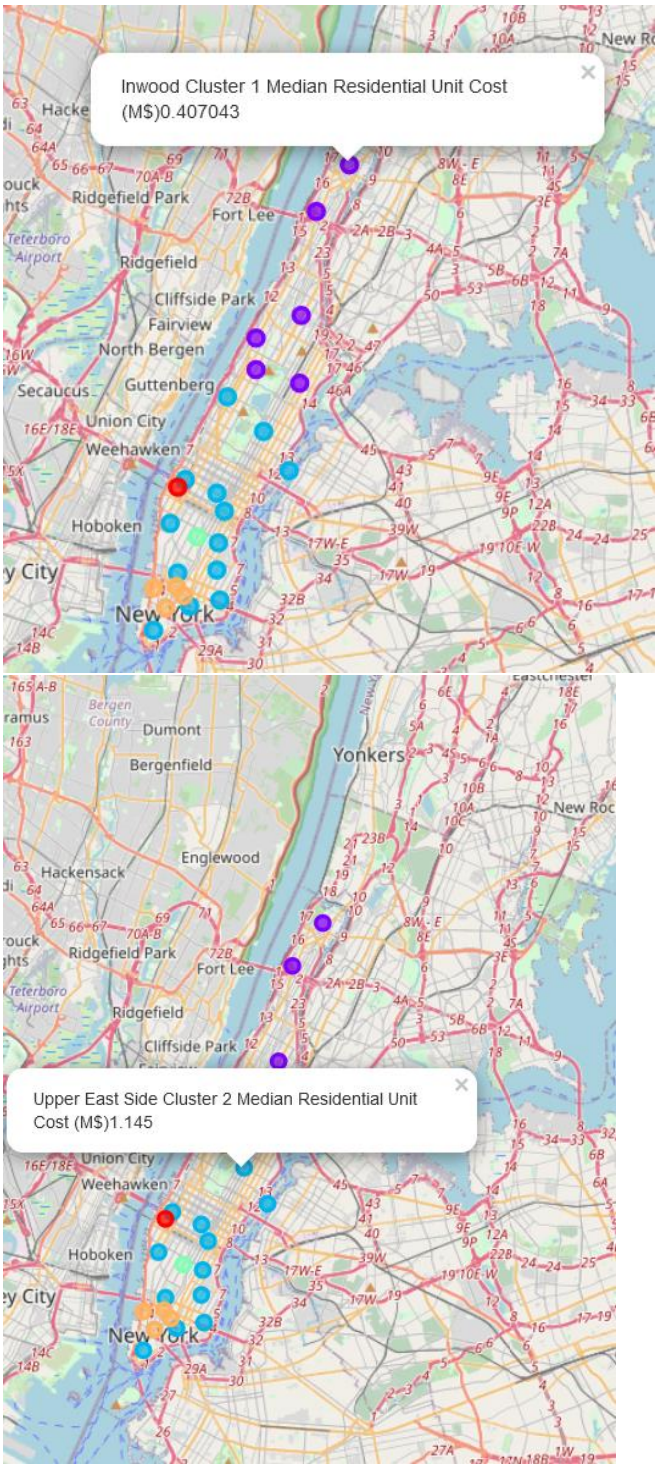


Figure 11 - Manhattan map with median cost per residential unit by neighborhood. 5 clusters represent 5 bins of purchase cost.

Figure 11 shows that north Manhattan is cheaper to buy a residential unit than in downtown or mid-town. In addition, the financial district sounding neighborhoods are generally more expensive.

Discussion – by neighborhood number of venues vs. cost of residential property per unit

As indicated in the data section – 2 datasets were used in this work. In this section the total number of venues in a neighborhood was considered. Foursquare is limited to max 100 venues per neighborhood. The venue category was also collected in addition to its location and name. Among the venues we can find restaurants, bars, cafes, parks, museums, theatres and more. Figure 12 shows the correlation between the total venues in a neighborhood vs. the median price per residential unit. The data is a little bit biased due to the maximum of 100 venues per neighborhood but one can still observe a slight correlation between the number of venues and the price per residential area.

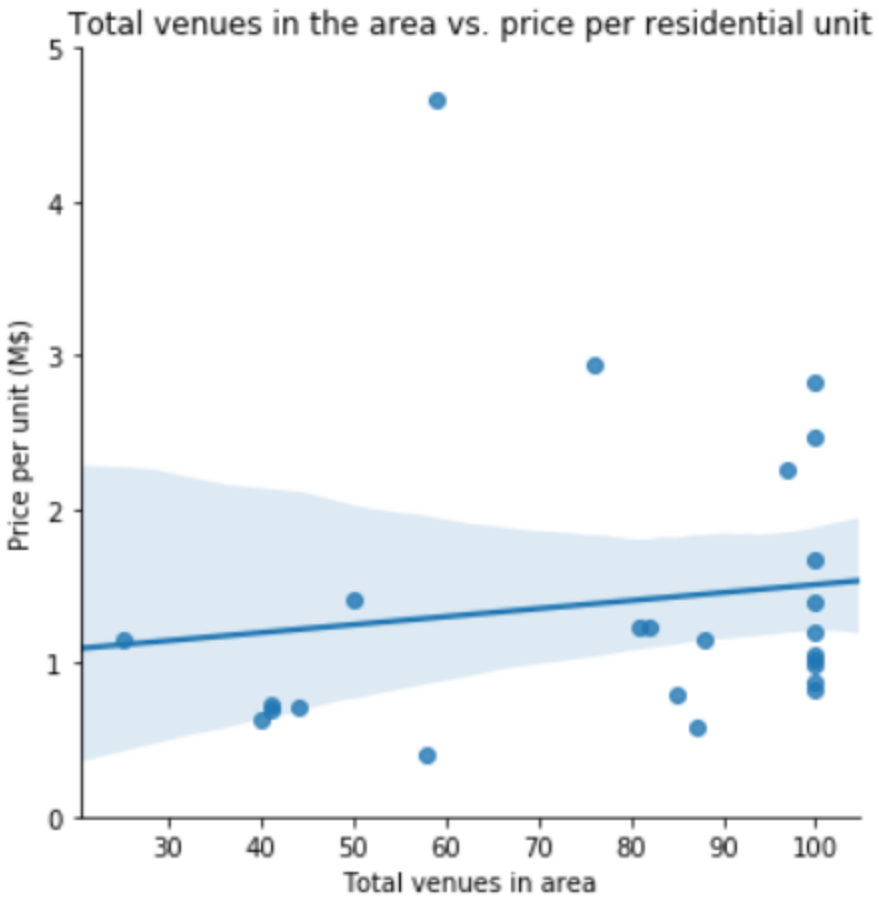


Figure 12 - Total venues in the area vs. price per residential unit

Discussion – by neighborhood type of venues vs. cost of residential property per unit

The venues data from Foursquare was normalized in a way that every entry was categorized by the venue type and given a 1 or 0 to quantify the category type (get dummies).Then the data was grouped

by the neighborhood and the average was taken. As a result if more of a certain venues exist in a certain neighborhood the weighted number (Frequency) will be larger. For example, Fig. 13 shows the most common venues in Central Harlem and in Chelsea. Where African restaurants are the most common venues in Central Harlem while coffee shops and art galleries are most common in Chelsea.

```
----Central Harlem----
                  venue  freq
0    African Restaurant  0.07
1     French Restaurant  0.05
2   American Restaurant  0.05
3  Gym / Fitness Center  0.05
4    Chinese Restaurant  0.05


----Chelsea----
                 venue  freq
0          Coffee Shop  0.08
1          Art Gallery  0.08
2       Ice Cream Shop  0.04
3  American Restaurant  0.03
4                Café  0.03
```

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	Central Harlem	African Restaurant	Chinese Restaurant	French Restaurant	Gym / Fitness Center	Cosmetics Shop
1	Chelsea	Coffee Shop	Art Gallery	Ice Cream Shop	Café	Bakery
2	Chinatown	Chinese Restaurant	Bakery	Cocktail Bar	Optical Shop	Spa
3	Civic Center	Coffee Shop	Hotel	Cocktail Bar	Spa	French Restaurant
4	Clinton	Theater	Coffee Shop	Gym / Fitness Center	Italian Restaurant	Wine Shop

Figure 13. Example of most common venues in certain areas

K-means method was used to cluster the neighborhoods based on the 5 most common venues in each neighborhood. In other words, similar neighborhoods with similar frequencies of venues types will be clustered together while dissimilar neighborhoods will be positioned in a different cluster. The data was combined with the median residential unit purchase cost data frame. Each neighborhood has two types of classification : Median residential purchase price per unit classification (1-5) and venues type cluster (0-4). Fig. 14 shows the data frame after with the 2 different classification of each neighborhood

	Hood	PricePerUnit	Borough	Neighborhood_1	Latitude	Longitude	Price Cluster	Venue	Neighborhood_2	Venue Cluster	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue
0	Central Harlem	0.710000	Manhattan	Central Harlem	40.815976	-73.943211	1	44	Central Harlem	3.0	African Restaurant	Chinese Restaurant	French Restaurant
1	Chelsea	1.195000	Manhattan	Chelsea	40.744035	-74.003116	2	100	Chelsea	3.0	Coffee Shop	Art Gallery	Ice Cream Shop
2	Chinatown	1.059500	Manhattan	Chinatown	40.715618	-73.994279	2	100	Chinatown	3.0	Chinese Restaurant	Bakery	Cocktail Bar
3	Civic Center	2.466200	Manhattan	Civic Center	40.715229	-74.005415	4	100	Civic Center	2.0	Coffee Shop	Hotel	Cocktail Bar
4	Clinton	0.871500	Manhattan	Clinton	40.759101	-73.996119	2	100	Clinton	2.0	Theater	Coffee Shop	Gym / Fitness Center
5	East Harlem	0.701500	Manhattan	East Harlem	40.792249	-73.944182	1	41	East Harlem	0.0	Mexican Restaurant	Bakery	Thai Restaurant
6	East Village	0.820000	Manhattan	East Village	40.727847	-73.982226	2	100	East Village	3.0	Bar	Mexican Restaurant	Coffee Shop
7	Financial District	1.022250	Manhattan	Financial District	40.707107	-74.010665	2	100	Financial District	2.0	Coffee Shop	American Restaurant	Pizza Place
8	Flatiron	1.675000	Manhattan	Flatiron	40.739673	-73.990947	3	100	Flatiron	2.0	Gym / Fitness Center	Café	Italian Restaurant

Figure 14- Example of table of Manhattan neighborhoods by property purchase median cost and venues types clusters

Last, Fig. 15 shows the total number of units in a neighborhood vs. the median residential price per unit in Manhattan's neighborhood, clustered by the venues cluster. Neighborhoods with similar venues share the same cluster. Fig. 16 shows a summary table of venue cluster, price per residential unit purchase in M$ and the average number of venues in that cluster.

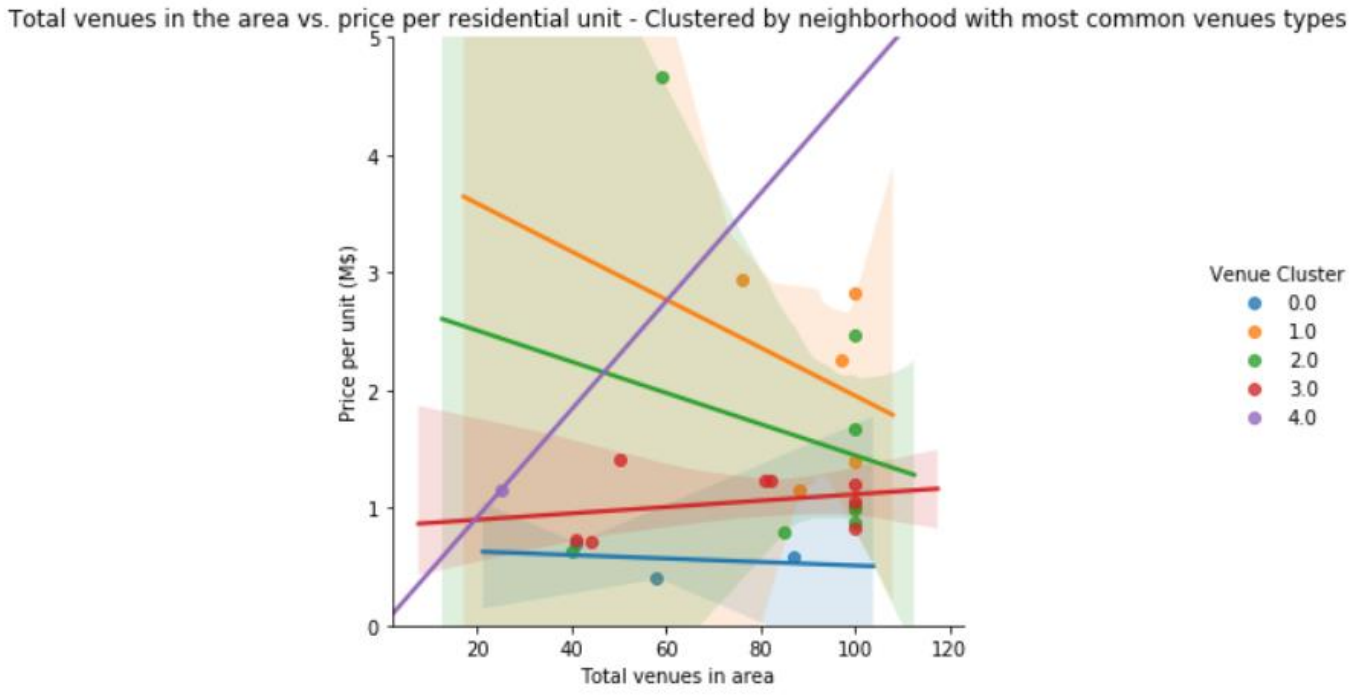


Figure 15 total venues in area vs. price per residential unit grouped by venues types clusters

[249]:

	Venue Cluster	PricePerUnit	Latitude	Longitude	Price Cluster	Venue
0	0.0	0.566230	40.837279	-73.934098	1.000	62.00
1	1.0	2.112000	40.733120	-73.993813	3.200	92.20
2	2.0	1.638345	40.748595	-73.990894	2.625	85.50
3	3.0	1.046999	40.755432	-73.978306	1.750	74.75
4	4.0	1.150000	40.762160	-73.949168	2.000	25.00

Figure 16 Summary table by venue cluster - average price per unit and average total number of venues in that cluster

We can identify few trends in the data –

- Neighborhoods with venue Cluster 0 typically has low end housing which are cheaper to buy. Indeed the cluster 0 neighborhood are located in north Manhattan which has more affordable housing and typically has low-income families.
- Neighborhoods with venue Cluster 3 has mid-range housing that are a little bit pricier than cluster 0. Yet we see that the all offer similar types of venues in a similar price-point.
- Neighborhoods with venue cluster 2 larger price variation across the neighborhoods . In other words, if someone is interested in venues types that cluster 2 has to offer, one can choose to buy an apartment in a cheaper area that offers similar types of venues.
- Venue Cluster 1 neighborhood are high-end neighborhoods that is reflected in high-cost housing with a median cost of 2.11 M$

248]:

	Hood	PricePerUnit	Borough	Neighborhood_1	Latitude	Longitude	Price Cluster	Venue	Neighborhood_2	Venue Cluster	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
5	East Harlem	0.701500	Manhattan	East Harlem	40.792249	-73.944182	1	41	East Harlem	0.0	Mexican Restaurant	Bakery	Thai Restaurant	Deli / Bodega	Latin American Restaurant
12	Inwood	0.407043	Manhattan	Inwood	40.867684	-73.921210	1	58	Inwood	0.0	Mexican Restaurant	Lounge	Restaurant	Bakery	Café
24	Washington Heights	0.590147	Manhattan	Washington Heights	40.851903	-73.936900	1	87	Washington Heights	0.0	Café	Deli / Bodega	Bakery	Mobile Phone Shop	Latin American Restaurant

Let's checkout the mean of price per unit by neighborhood cluster type

Figure 17. Venue Cluster 0 neighborhoods

[250]:

	Hood	PricePerUnit	Borough	Neighborhood_1	Latitude	Longitude	Price Cluster	Venue	Neighborhood_2	Venue Cluster	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
10	Greenwich Village	1.400	Manhattan	Greenwich Village	40.726933	-73.999914	2	100	Greenwich Village	1.0	Italian Restaurant	Café	Sushi Restaurant	Gym	Comedy Club
13	Little Italy	2.825	Manhattan	Little Italy	40.719324	-73.997305	4	100	Little Italy	1.0	Italian Restaurant	Bakery	Mediterranean Restaurant	Spa	Pizza Place
20	Soho	2.250	Manhattan	Soho	40.722184	-74.000657	4	97	Soho	1.0	Italian Restaurant	Sandwich Place	Mediterranean Restaurant	Clothing Store	Coffee Shop
21	Tribeca	2.940	Manhattan	Tribeca	40.721522	-74.010683	4	76	Tribeca	1.0	Italian Restaurant	American Restaurant	Park	Wine Bar	Greek Restaurant
22	Upper East Side	1.145	Manhattan	Upper East Side	40.775639	-73.960508	2	88	Upper East Side	1.0	Italian Restaurant	Coffee Shop	Bakery	Gym / Fitness Center	Yoga Studio

Figure 18. Venue Cluster 1 neighborhoods

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	Hood	PricePerUnit	Borough	Neighborhood_1	Latitude	Longitude	Price Cluster	Venue	Neighborhood_2	Venue Cluster	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
3	Civic Center	2.466200	Manhattan	Civic Center	40.715229	-74.005415	4	100	Civic Center	2.0	Coffee Shop	Hotel	Cocktail Bar	Spa	French Restaurant
4	Clinton	0.871500	Manhattan	Clinton	40.759101	-73.996119	2	100	Clinton	2.0	Theater	Coffee Shop	Gym / Fitness Center	Italian Restaurant	Wine Shop
7	Financial District	1.022250	Manhattan	Financial District	40.707107	-74.010665	2	100	Financial District	2.0	Coffee Shop	American Restaurant	Pizza Place	Café	Italian Restaurant
8	Flatiron	1.675000	Manhattan	Flatiron	40.739673	-73.990947	3	100	Flatiron	2.0	Gym / Fitness Center	Café	Italian Restaurant	Mediterranean Restaurant	Gym
11	Hudson Yards	4.666812	Manhattan	Hudson Yards	40.756658	-74.000111	5	59	Hudson Yards	2.0	Hotel	Italian Restaurant	Gym / Fitness Center	American Restaurant	Coffee Shop
16	Midtown	0.990000	Manhattan	Midtown	40.754691	-73.981669	2	100	Midtown	2.0	Hotel	Coffee Shop	Bakery	Theater	Cuban Restaurant
17	Morningside Heights	0.627500	Manhattan	Morningside Heights	40.808000	-73.963896	1	40	Morningside Heights	2.0	Park	American Restaurant	Coffee Shop	Bookstore	Sandwich Place
18	Murray Hill	0.787500	Manhattan	Murray Hill	40.748303	-73.978332	2	85	Murray Hill	2.0	Hotel	Sandwich Place	Coffee Shop	Gym / Fitness Center	Japanese Restaurant

Figure 19 . Venue Cluster 2 neighborhoods

[252]:

	Hood	PricePerUnit	Borough	Neighborhood_1	Latitude	Longitude	Price Cluster	Venue	Neighborhood_2	Venue Cluster	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	Central Harlem	0.710000	Manhattan	Central Harlem	40.815976	-73.943211	1	44	Central Harlem	3.0	African Restaurant	Chinese Restaurant	French Restaurant	Gym / Fitness Center	Cosmetics Shop
1	Chelsea	1.195000	Manhattan	Chelsea	40.744035	-74.003116	2	100	Chelsea	3.0	Coffee Shop	Art Gallery	Ice Cream Shop	Café	Bakery
2	Chinatown	1.059500	Manhattan	Chinatown	40.715618	-73.994279	2	100	Chinatown	3.0	Chinese Restaurant	Bakery	Cocktail Bar	Optical Shop	Spa
6	East Village	0.820000	Manhattan	East Village	40.727847	-73.982226	2	100	East Village	3.0	Bar	Mexican Restaurant	Coffee Shop	Cocktail Bar	Pizza Place
9	Gramercy	1.225000	Manhattan	Gramercy	40.737210	-73.981376	2	82	Gramercy	3.0	Bagel Shop	Coffee Shop	Bar	Pizza Place	American Restaurant
14	Lower East Side	1.406496	Manhattan	Lower East Side	40.717807	-73.980890	2	50	Lower East Side	3.0	Chinese Restaurant	Art Gallery	Pharmacy	Café	Cocktail Bar
15	Manhattan Valley	0.735000	Manhattan	Manhattan Valley	40.797307	-73.964286	1	41	Manhattan Valley	3.0	Coffee Shop	Yoga Studio	Mexican Restaurant	Bar	Pizza Place
23	Upper West Side	1.225000	Manhattan	Upper West Side	40.787658	-73.977059	2	81	Upper West Side	3.0	Italian Restaurant	Bar	Dessert Shop	Indian Restaurant	Wine Bar

Figure 20 . Venue Cluster 3 neighborhoods

[253]:

	Hood	PricePerUnit	Borough	Neighborhood_1	Latitude	Longitude	Price Cluster	Venue	Neighborhood_2	Venue Cluster	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
19	Roosevelt Island	1.15	Manhattan	Roosevelt Island	40.76216	-73.949168	2	25	Roosevelt Island	4.0	Park	Plaza	School	Gym	Greek Restaurant

Figure 21. Venue Cluster 4 neighborhoods

Conclusions

In this work I investigated the correlation between residential real estate median cost per unit vs. the type of venues that are located in the neighborhoods of Manhattan.

First, I showed the impact of different residential properties types on the median purchase point and I also showed correlation between the size of the real estate to its cost. I found that in Manhattan every square feet of residential unit cost roughly 2000$. I also showed the impact of an elevator on the cost of real-estate value and the difference in price between co-op and condo.

Second, I analyzed the neighborhoods by their median residential real-estate cost, and I showed that north Manhattan is cheaper than mid-town or down-town. I also showed that the new developing area of Hudson yards has the highest cost of purchase.

Third, I showed a possible connection between the number of venues in neighborhood to the cost of its housing costs and I classified the neighborhoods by their venue's types.

Last, I made suggestions based on neighborhoods most common venue types and the price point of housing. In other words, if someone would like to live in an area with certain venues this person can decide based on the price point. I showed that some clusters such as cluster 2 has high variation in prices which means one can find cheaper houses and yet get similar surrounding venues experience. Another conclusion was made also on the high end and low end housing neighborhoods where each one of them proposes different types of venues that are more suitable for its residents.