The Battle of Neighborhoods:

Find the best place to stay in New York City

Applied Data Science Capstone Project

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Introduction: Business Problem

Background

According the latest *NYC&Company* release New York City welcomed about 65.2 million tourists in 2018 year - 51.6 million domestic and 13.5 million international visitors. And these numbers are continuously increasing from year to year [1].

New York City has the largest selection of lodging choices in the country – from the hostels to the luxury hotels. The prices vary from 100$ till several thousand dollars with average price 292 USD per night.

The Hotel Occupancy rate is also high – in 2018 year it was 88% [2].

Visitors prefer short stays that are often over weekends - averaging 2.4 nights [3].

Problem description

In New York City there are almost 300 hotels with over 75,000 hotel rooms and Airbnb has more than 50,000 apartment listings in New York City in 2018 year - it can be hard to find the right fit or know how much you will get with your money.

In this project we will try to find the most optimal neighborhoods on Manhattan where a tourist can rent an accommodation via Airbnb service and have a pleasant stay in NYC and a possibility to attend the most visited attractions like Central Park, Times Square and so on.

Target Audience

This investigation would interest New York City's visitors who prefers short stays (from 1 night) and wants to select the best neighborhoods on Manhattan, New York.

Success Criteria

The success criteria of this project will be a recommendation with the set of apartments clusters have the best score calculated based on

- Accommodation price with fees;
- Location of the accommodation;
- Venues in radius of 1000 meters from the accommodation;
- Crime rate in radius of 100 meters from the accommodation.

Data

Initial datasets

In our investigation we will use the free and public available datasets.
We will try to evaluate available Airbnb 2019-year accommodations on Manhattan, New York and define the most reasonable apartments sets (clusters) for the visitors.

Based on definition of our problem, we suppose that factors that will help us are:

- accommodation's average price per person by the neighborhood;
- number of tourist attractions near the accommodation;
- number of crimes nearby the accommodation.

Airbnb New York City apartment listing
http://data.insideairbnb.com/united-states/ny/new-york-city/2019-12-04/data/listings.csv.gz

It is available below under a *Creative Commons CC0 1.0 Universal (CC0 1.0) "Public Domain Dedication" license.*

Initially data contains 50,599 rows and 106 columns with the information about available accommodations – name, borough, neighborhood, price per night, cleaning fee, minimum nights, guest number and so on.

For our project records were filtered as

- Borough - Manhattan, New York only;
- Number of reviews >= 10;

- Availability >= 10 days/year;
- Last Scraped/Reviewed later than 2019-10-01;
- Minimum nights >= 1;
- Excluded Hostels and Camper/RV;
- Excluded Shared rooms.

After filter was applied, we have 2,356 accommodations in our data set:

id	listing_url	scrape_id	last_scraped	name	summary	space	description	experiences_offered	neighborhood_overview	notes	transit	access
5178	https://www.airbnb.com/rooms/5178	20191204162729	2019-12-05	Large Furnished Room Near B'way	Please don't expect the luxury here just a basic room in the center of Manhattan.	You will use one large, furnished, private room of a two-bedroom apartment and share a bathroom with the host. The apartment is located a few blocks away from Central Park between 8th and 9th Avenue. The closest subway station is Columbus Circle 59th Street. Great restaurants, Broadway and all transportation are easily accessible. The cost of the room is 79pernight.Weeklyrateisavailable.Thereisa 12.00 fee per guest. The apartment also features hardwood floors and a second-floor walk-up. There is a full-sized bed,TV, microwave, and a small refrigerator as well as other appliances. Wired internet, WIFI, TV, electric heat, bed sheets and towels are included. A kitchen is available in the living room. You can come in any time except midnight. Basic check in/out time is 12pm. I am flexible on the schedule so please ask. Please nore that the living room is a private place for the host. Also, because the place is close to the street, there is some traffic noise from ou	Please don't expect the luxury here just a basic room in the center of Manhattan. You will use one large, furnished, private room of a two-bedroom apartment and share a bathroom with the host. The apartment is located a few blocks away from Central Park between 8th and 9th Avenue. The closest subway station is Columbus Circle 59th Street. Great restaurants, Broadway and all transportation are easily accessible. The cost of the room is 79pernight.Weeklyrateisavailable.Thereisa12.00 fee per guest. The apartment also features hardwood floors and a second-floor walk-up. There is a full-sized bed,TV, microwave, and a small refrigerator as well as other appliances. Wired internet, WIFI, TV, electric heat, bed sheets and towels are included. A kitchen is available in the living room. You can come in any time except midnight. Basic check in/out time is 12pm. I am flexible on the schedule so please ask. Please nore that the living room is a private place for the host. A	none	Theater district, many restaurants around here.	Reservation should be made at least a few days before the date of arrival. No reservation for the day will be taken so please do not ask availability for "tonight". Also one night stay is set a higher price per host discretion.	NaN	Bathroom is shared with the host but the kitchen is no i the commor area

Neighborhood Tabulation Areas

https://data.cityofnewyork.us/api/geospatial/cpf4-rkhq?method=export&format=GeoJSON

This dataset contains MultiPolygon GIS data with the coordinates of each NYC neighborhood.
We will use these data for the maps and for the mapping of Airbnb neighborhoods because Airbnb has different neighborhoods structure.

Foursquare API data about venues - food places, museums, galleries, shopping centers, sightseeing attractions, concert halls and so on.
We will check Top-50 venues for the Top-100 Manhattan's Airbnb accommodations in radius of 1000 meters.

New York Police Crime Records

https://data.cityofnewyork.us/api/views/5uac-w243/rows.csv?accessType=DOWNLOAD

We will use this statistic during our apartment evaluation. Originally it contains 461,711 rows and 35 columns.
We filter this dataset by

- Borough – *Manhattan, New York* only;
- Crime type – *FELONY* and *MISDEMEANOR*.

After filtering we have 101,086 crimes records for Manhattan in 2019 year.
This dataset contains NYC Precincts column which is not the same as Neighborhood Tabulation Areas. We need to define the NYC Neighborhood name by the latitude/longitude of each crime record from this dataset.

	CMPLNT_NUM	ADDR_PCT_CD	BORO_NM	CMPLNT_FR_DT	CMPLNT_FR_TM	CMPLNT_TO_DT	CMPLNT_TO_TM	CRM_ATPT_CPTD_CD	HADEVELOPT	HOUSING_PSA	JURISDICTION_CODE	JURIS_DESC	KY_CD	LAW_CAT_CD	LOC_OF_OCCUR_DESC	OFNS_DESC	PARKS_NM	PATROL_BORO	PD_CD	
1	289837961	25	MANHATTAN	30.12.19	08:30:00 PM	31.12.19	10:00:00 AM	COMPLETED	NaN	NaN	0.0	N.Y. POLICE DEPT	341	MISDEMEANOR	INSIDE	PETIT LARCENY	NaN	PATROL BORO MAN NORTH	338.0	LARCI BUI
4	299841674	18	MANHATTAN	30.12.19	03:30:00 PM	30.12.19	04:50:00 PM	COMPLETED	NaN	NaN	0.0	N.Y. POLICE DEPT	341	MISDEMEANOR	NaN	PETIT LARCENY	NaN	PATROL BORO MAN SOUTH	301.0	LARCI BY A
3	227601821	18	MANHATTAN	29.12.19	12:30:00 PM	29.12.19	01:30:00 PM	COMPLETED	NaN	NaN	0.0	N.Y. POLICE DEPT	233	MISDEMEANOR	NaN	SEX CRIMES	NaN	PATROL BORO MAN SOUTH	175.0	SEXUA
1	754294853	19	MANHATTAN	28.12.19	11:30:00 AM	28.12.19	05:00:00 PM	COMPLETED	NaN	NaN	0.0	N.Y. POLICE DEPT	109	FELONY	INSIDE	GRAND LARCENY	NaN	PATROL BORO MAN NORTH	407.0	LARCEN BY DI
5	365001231	26	MANHATTAN	25.12.19	05:10:00 PM	25.12.19	05:15:00 PM	COMPLETED	NaN	NaN	0.0	N.Y. POLICE DEPT	341	MISDEMEANOR	NaN	PETIT LARCENY	NaN	PATROL BORO MAN NORTH	321.0	LARCI FR

Data Cleaning and Feature Engineering

Airbnb

We do not need all columns from the original dataset so let's create a subset of the needed columns:

- *id* - listing identifier;
- *name* - accommodation's name;
- *last_review* - accommodation's last review date;
- *listing_url* - accommodation's URL;
- *picture_url* - accommodation's picture URL;
- *neighbourhood_group_cleansed* - NYC Borough's name. e.g. Manhattan, Bronx. We will use accommodations only from Manhattan;
- *neighbourhood_cleansed* - Airbnb Neighborhood's name, e.g. Hell's Kitchen. ***These Names are not the same as NYC Neighborhood Tabulation Areas;***
- *review_scores_rating* - accommodation's weighted sum of other scores- *review_scores_location, review_scores_value*
- *latitude* - accommodation's latitude;
- *longitude* - accommodation's longitude;
- *property_type* - accommodation's type e.g. Entire home/Apt, Private Room. ***We exclude Hostels and Camper/RV;***
- *room_type* - accommodation's room type. **We exclude Shared rooms**;
- *accommodates* - number of persons allowed. We use this value to calculate *price_per_person* custom column;
- *bathrooms* - number of bathrooms. Keep it for informative reasons;
- *bedrooms* - number of bedrooms. Keep it for informative reasons;
- *square_feet* - accommodation's size. Keep it for informative reasons;
- *price* - price per night;
- *security_deposit* - security deposit;
- *cleaning_fee* - additional fee. We will use it to calculate **full_price** per night for the accommodation;
- *minimum nights* - minimum nights for rent. We use accommodations with 1 or 2 minimum nights;
- *number_of_reviews_ltm* - number of reviews for the last month. Keep it for informative reasons;
- *reviews_per_month* - average number of reviews per month. Keep it for informative reasons;
- *number_of_reviews_ltm* - overall number of reviews. Keep it for informative reasons;
- *availability_365* - available days/year.

Now we should clean different *Prices* columns:

- fill in empty values;

- convert *String* to *Float*, e.g. $2,100.00 => 2100.00.

id	name	last_review	listing_url	picture_url	neighbourhood_group_cleansed	neighbourhood_cleansed	review_scores_rating	latitude	longitude	property_type	room_type	accommodates	bathrooms	bedrooms	square_feet	price	security_deposit
5178	Large Furnished Room Near B'way	2019-11-21	https://www.airbnb.com/rooms/5178	https://a0.muscache.com/im/pictures/12065/f070997b_original.jpg?aki_policy=large	Manhattan	Hell's Kitchen	84.0	40.76489	-73.98493	Apartment	Private room	2	1	1	0	79.0	0.0
7322	Chelsea Perfect by Doti, an AIRBNB Super Host!	2019-11-16	https://www.airbnb.com/rooms/7322	https://a0.muscache.com/im/pictures/23207/33258e91_original.jpg?aki_policy=large	Manhattan	Chelsea	96.0	40.74192	-73.99501	Apartment	Private room	3	1	1	0	120.0	0.0
9704	Spacious 1 bedroom in luxe building	2019-11-09	https://www.airbnb.com/rooms/9704	https://a0.muscache.com/im/pictures/38418/569b54fd_original.jpg?aki_policy=large	Manhattan	Harlem	98.0	40.81305	-73.95466	Apartment	Private room	2	1	1	900	52.0	150.0
12192	ENJOY Downtown NYC!	2019-11-13	https://www.airbnb.com/rooms/12192	https://a0.muscache.com/im/pictures/93658190/67480448_original.jpg?aki_policy=large	Manhattan	East Village	88.0	40.72290	-73.98199	Apartment	Private room	2	1	1	0	68.0	100.0
15711	2 bedroom - Upper East Side- great for kids	2019-11-24	https://www.airbnb.com/rooms/15711	https://a0.muscache.com/im/pictures/c444be23-6b18-4094-b2c7-cee811c08c9c.jpg?aki_policy=large	Manhattan	Upper East Side	93.0	40.77065	-73.95269	Apartment	Entire home/apt	6	1	2	0	250.0	500.0

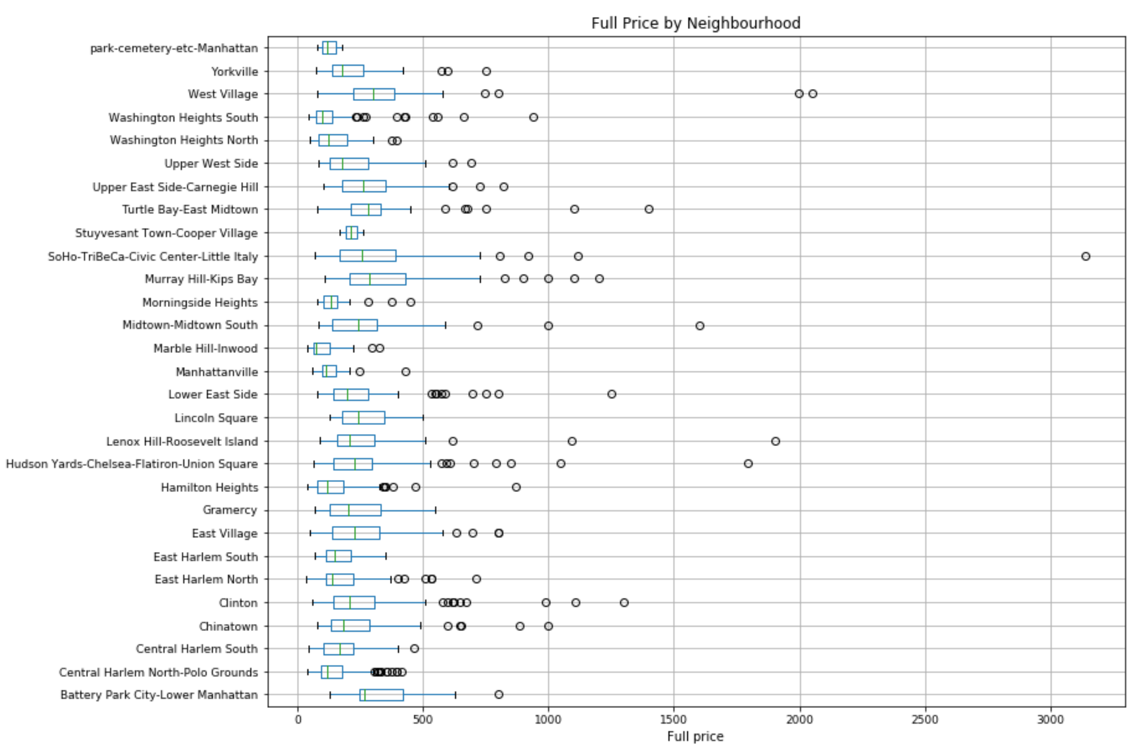
Airbnb Features Engineering

Now we are going to add some new features (columns) to our Airbnb dataset:

- **full_price** - *price* + *cleaning_fee*. Airbnb *price* column could be misleading because it does not include mandatory cleaning fee price;
- **price_per_person** - (price + cleaning_fee)/accommodates;
- **tab_area** from *New York Area Tabulation Name* dataset to our *Airbnb* data set because Neighborhoods' names are quite different in these data sets. We use custom *define_tab_area* function which returns *New York Area Tabulation Name* for each Airbnb accommodation's latitude/longitude pair;
- **crimes** - calculate the number of crimes in radius of 100 meters from each accommodation. This calculation takes 25-50 munities in Python.

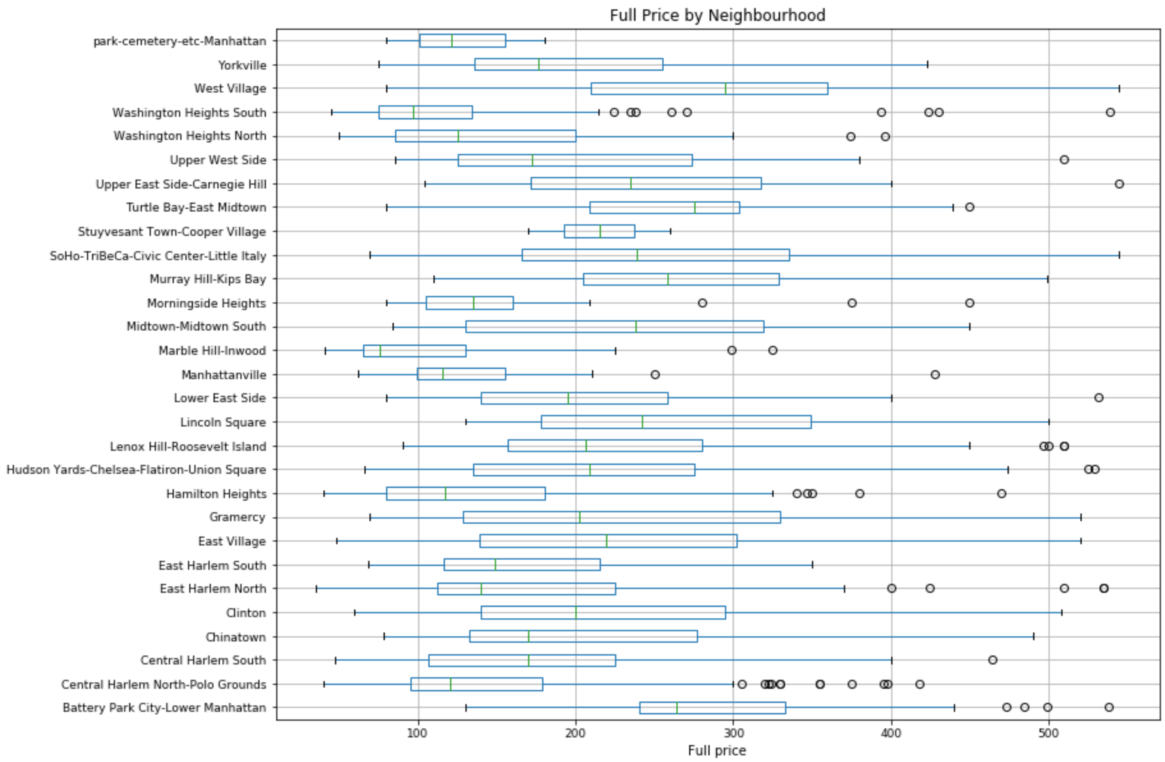
Airbnb Outliers

Check for outliers for the *Full price* column:



In the chart above we can see some outliers - observation points that are distant from other observations.
In our case they are the indication of variance in the data. Let’s remove these outliers via IQR method.

After removing the outliers, a new Barchart looks like this



So finally, we got 2,252 rows and 28 columns for the Airbnb dataset.

Neighborhood Tabulation Areas

'Neighborhood Tabulation Areas.geojson' file contains only polygon area coordinates for each Neighborhoods. So, we need to

- remove neighborhoods outside Manhattan;
- calculate Centroid points ('latitude', 'longitude') for each Neighborhood.

For used **Nominatim** service to detect Centroid points for each Neighborhood and then made some manual correction because Nominatim service is not quite accurate.

Neighborhood	Latitude	Longitude
Manhattanville	40.815778	-73.951554
Clinton	40.764423	-73.992392
Chinatown	40.715100	-73.995500
Battery Park City-Lower Manhattan	40.706784	-74.010147
Lincoln Square	40.772319	-73.984401

New York Police Crime Records

We are interested in crimes only for Manhattan and types are 'Felony' or 'Misdemeanor'. After filtering we have 101,086 crimes records for Manhattan in 2019 year.

We keep all columns, but it's needed to convert Latitude and Longitude columns from *String* to *Float.*

We added **tab_area** column (New York Area Tabulation Name) to NYC Manhattan Crimes data set because we need to display **Crime Rate** Information on the New York Area Tabulation Map.

And removed *'Not defined'* values for *tab_area* column as they do not belong to Manhattan.

Methodology

In this project we are trying to detect Manhattan's Neighborhoods that have accommodations for rent with positive reviews, reasonable prices, low number of crimes and tourists' attractions nearby.

In the first step we have collected the following data:

- Airbnb Accommodations with their NYC Tabulation Area (official neighborhood names);
- Airbnb Accommodation's number of crimes nearby;
- Defined NYC Tabulation Area (official neighborhood name) for each Manhattan's crime case.

The second step in our analysis will be a calculation and exploration different neighborhoods of Manhattan. We will explore the following characteristics:

- number of crimes in the area;
- average price per person;
- number of accommodations available.

In the third and final step we will

- select Top-100 Airbnb accommodations based on summary rating, number of crimes and price per person, and
- invoke Foursquare API to find Top accommodations' nearby venues
- create and investigate clusters (using k-means clustering) for our accommodations to make some recommendations to our tourists.

Analysis

In this section, we will explore the cleansed data and visualize them.
Then, we will conduct cluster analysis to try to classify Manhattan's NYC Airbnb Neighborhoods.

Average Price per Person Neighborhoods

Calculate **average price_per_person**, **average crimes rate** and **number of accommodations** for each Airbnb neighborhoods.

Top-5 Neighborhoods with Highest average *Price per Person* in 2019 year:

- West Village - 112.85 USD - 88 accommodations
- Lincoln Square - 112.51 USD - 20 accommodations
- Stuyvesant Town-Cooper Village - 107.5 USD - 2 accommodations
- SoHo-TriBeCa-Civic Center-Little Italy - 105.38 USD - 81 accommodations
- Upper East Side-Carnegie Hill - 96.98 USD - 24 accommodations

Top-5 Neighborhoods with Lowest average *Price per Person* in 2019 year:

- Marble Hill-Inwood - 45.48 USD - 25 accommodations
- Washington Heights South - 46.79 USD - 82 accommodations
- Washington Heights North - 54.74 USD - 53 accommodations
- Central Harlem North-Polo Grounds - 57 USD - 132 accommodations
- Manhattanville - 59.75 USD - 25 accommodations

Crime Rate Neighborhoods

Top-5 Neighborhoods with the Highest Crime level in 2019 year:

- Midtown-Midtown South - 10,397
- Hudson Yards-Chelsea-Flatiron-Union Square - 7,788
- East Harlem North - 6,221
- Central Harlem North-Polo Grounds - 5,186
- SoHo-TriBeCa-Civic Center-Little Italy - 4,789

Top-5 Neighborhoods with the Lowest Crime level in 2019 year:

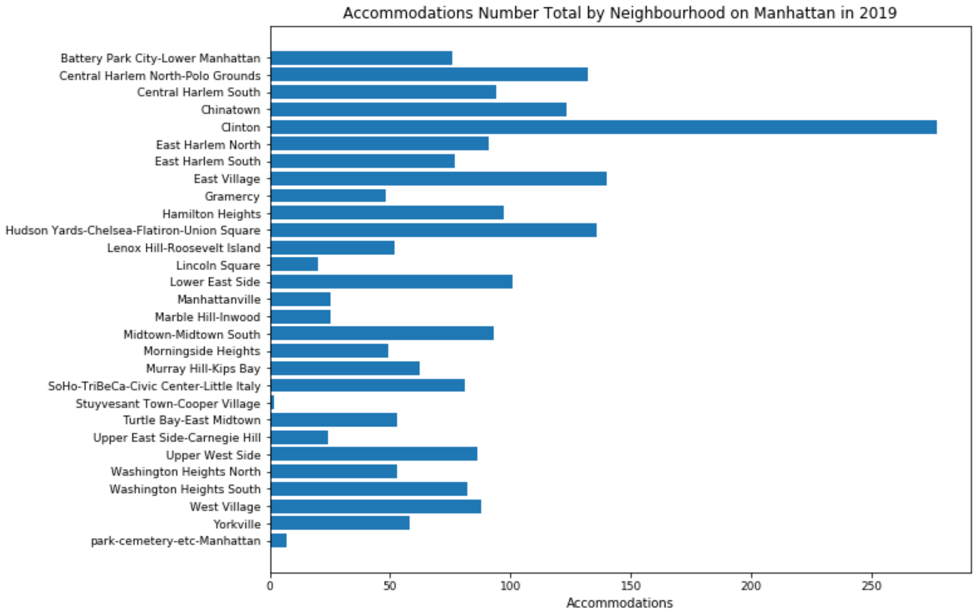
- Stuyvesant Town-Cooper Village - 145
- park-cemetery-etc-Manhattan - - 1,213
- Lenox Hill-Roosevelt Island - 1,604
- Manhattanville - 1,832
- Yorkville - 1,898

All data

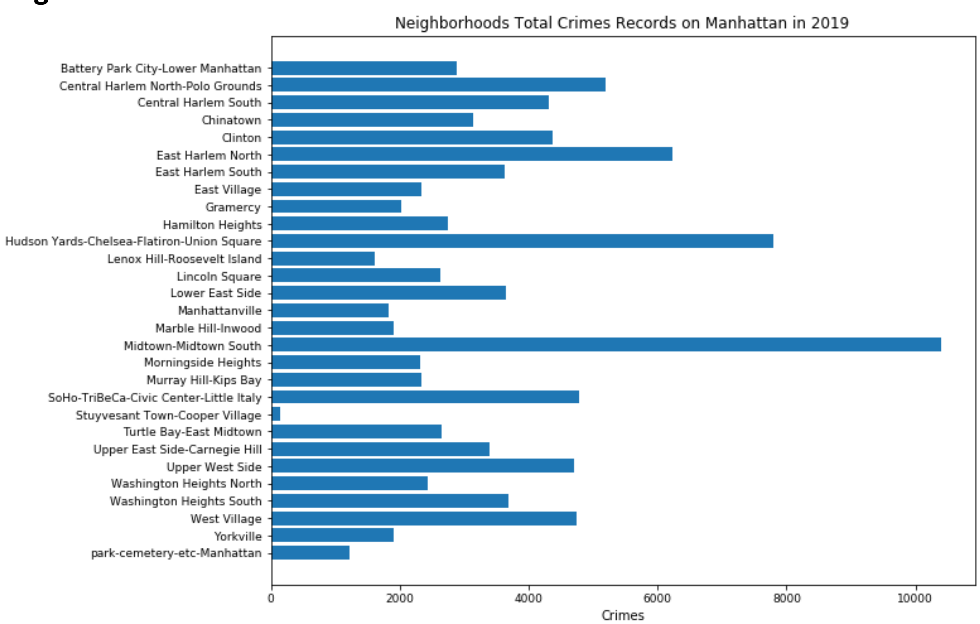
tab_area	mean_price_per_person	accommodates	mean_crimes
Marble Hill-Inwood	45.475238	25	54.440000
Washington Heights South	46.793172	82	57.682927
Washington Heights North	54.738050	53	50.886792
Central Harlem North-Polo Grounds	57.038497	132	73.265152
Manhattanville	59.746667	25	70.520000
Hamilton Heights	60.069404	97	66.206186
park-cemetery-etc-Manhattan	61.404762	7	13.428571
East Harlem North	62.275497	91	104.824176
East Harlem South	64.950000	77	90.051948
Central Harlem South	67.000823	94	87.148936
Morningside Heights	71.386054	49	56.204082
Upper West Side	78.127907	86	57.813953
Midtown-Midtown South	81.491705	93	139.000000
Battery Park City-Lower Manhattan	82.133130	76	90.394737
Chinatown	82.362703	123	93.081301
Clinton	84.308819	277	84.314079
East Village	84.842758	140	74.385714
Lower East Side	88.452617	101	72.415842
Hudson Yards-Chelsea-Flatiron-Union Square	88.591179	136	77.816176
Yorkville	89.692529	58	65.000000
Murray Hill-Kips Bay	90.410167	62	48.016129
Gramercy	94.364931	48	84.791667
Turtle Bay-East Midtown	94.817296	53	60.509434
Lenox Hill-Roosevelt Island	96.636218	52	45.019231
Upper East Side-Carnegie Hill	96.988889	24	62.833333
SoHo-TriBeCa-Civic Center-Little Italy	105.384002	81	71.962963
Stuyvesant Town-Cooper Village	107.500000	2	47.000000
Lincoln Square	112.514286	20	87.300000
West Village	112.854167	88	99.863636

NYC Manhattan's Neighborhoods Analysis Charts

Apartments Total by Neighborhood Chart



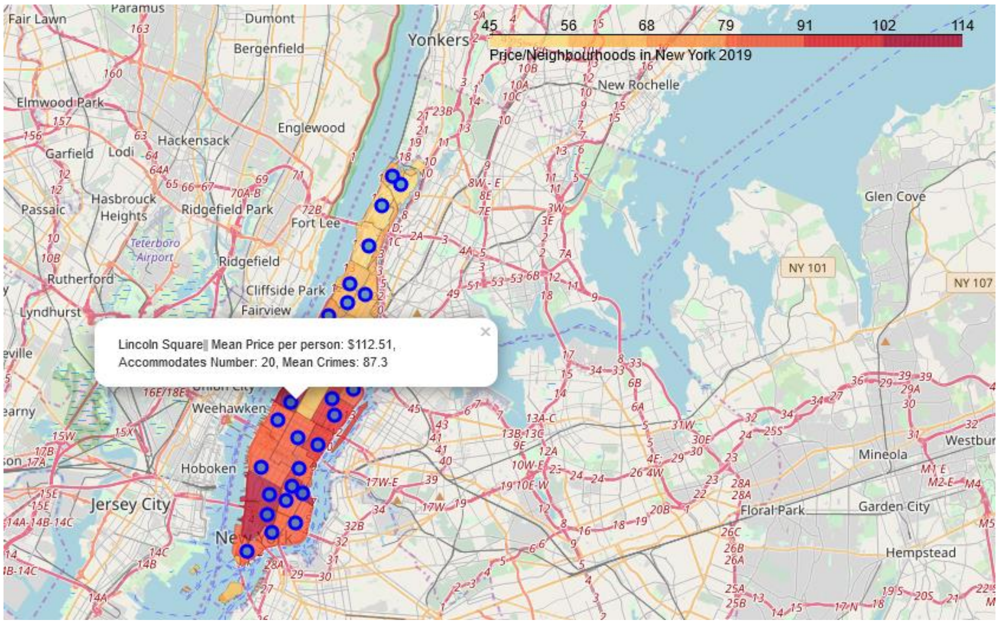
Neighborhoods Crimes Records Chart



NYC Manhattan's Neighborhoods Analysis Maps

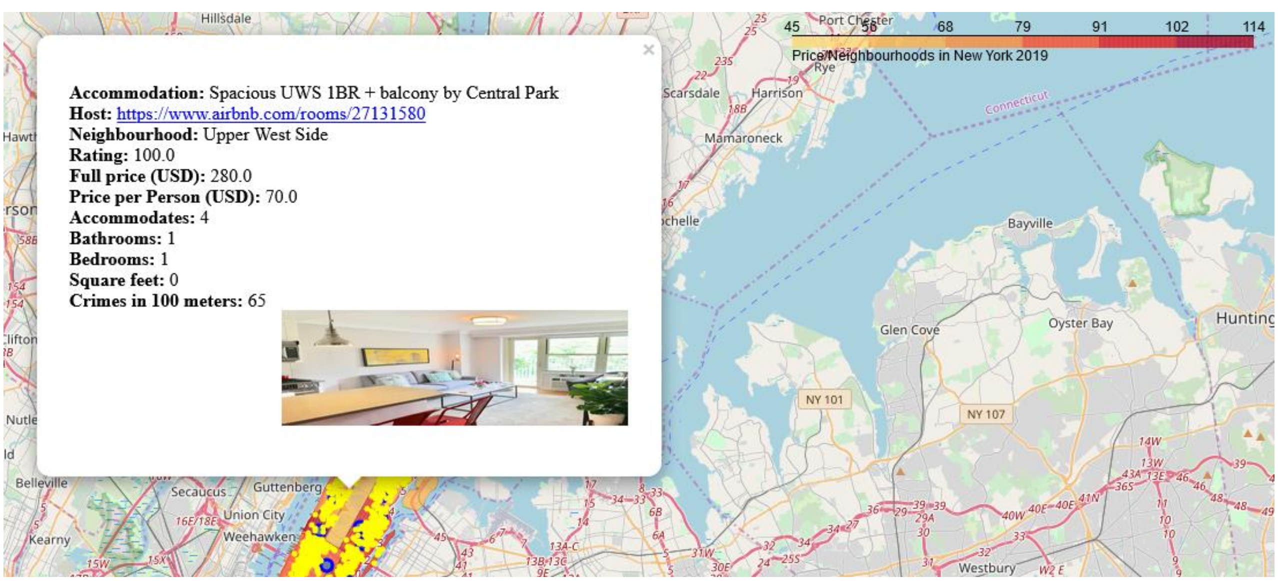
We created several maps to visualize our results and help the user select needed lodges.

NYC Tabulation Area Neighborhoods Average Prices per Person on Manhattan in 2019 Map



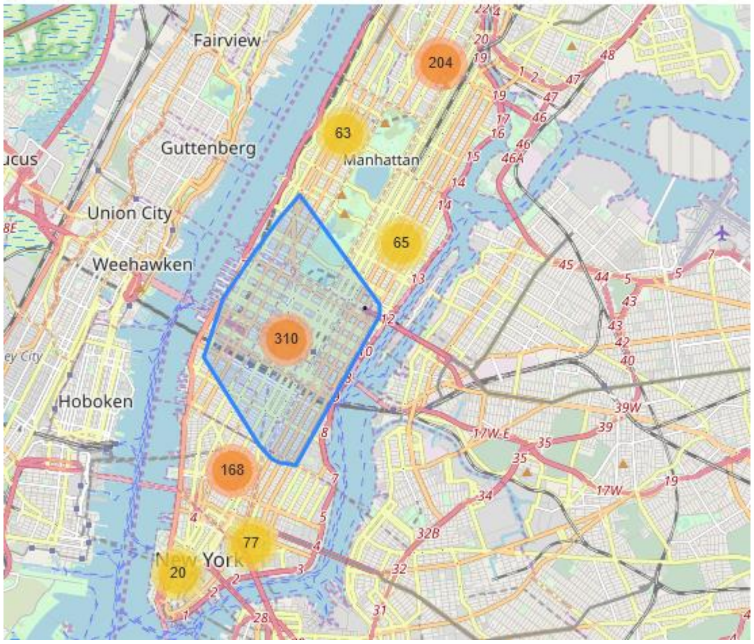
Accommodations Detailed Info Map

We put all our Airbnb accommodations on the Map - so the user can easily review them.



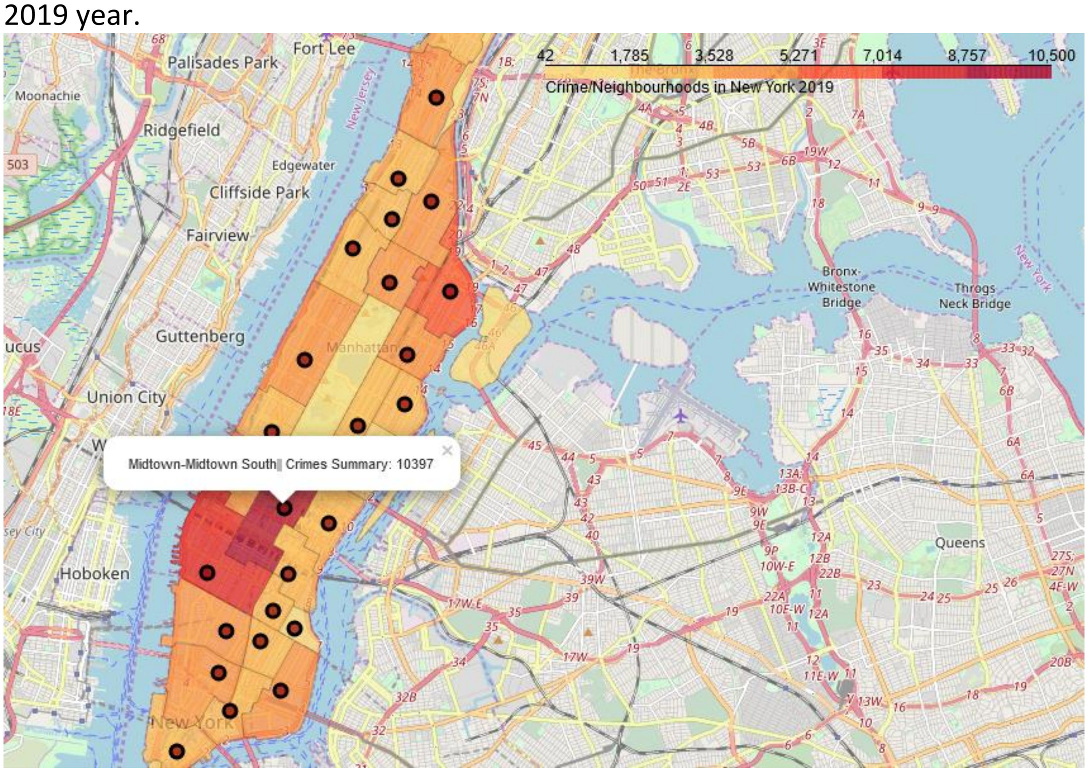
Crimes Cluster Map

Cluster Map of **1000 crimes** by Neighborhood from *New York Police Crime* data set.



Summary Crimes by Neighborhoods Map

In this map we depict the summary number of crimes for each neighborhood on Manhattan for 2019 year.



Foursquare API Neighborhoods Analysis

Because of the Foursquare API limitations for free usage lets analyze Top-100 Accommodations from the Airbnb data set.
We define Top-3 Venue Categories for each accommodation in radius of 1000 meters.
Then we will try to define the 3 clusters for these accommodations.

Let’s choose Top Accommodations by

- review_scores_rating - overall accommodations rating - from maximum 100 to lower values
- full_price - from lower price to higher
- price_per_person - from lower price to higher
- crimes - from lower number to higher

name	tab_area	neighbourhood_cleansed	latitude	longitude	review_scores_rating	property_type	room_type	accommodates	full_price	price_per_person	crimes	listing_url	picture_url	bathrooms	bedrooms	square_feet
Private Bedroom in Cozy Hamilton Heights Apartment	Hamilton Heights	Harlem	40.82749	-73.94461	100.0	Apartment	Private room	2	54.0	27.0	34	https://www.airbnb.com /rooms/34770173	https://a0.muscache.com/im/pictures/aff6d2a3-b6f6-491f-84b3-1e6d2ff35115.jpg?aki_policy=large	1	1	0
Mr. B - Room Apartment in NYC	Washington Heights South	Washington Heights	40.84377	-73.94094	100.0	Apartment	Private room	1	67.0	67.0	32	https://www.airbnb.com /rooms/32589616	https://a0.muscache.com/im/pictures/88aec7e7-eb04-417d-9c42-43a33d4b9426.jpg?aki_policy=large	1	1	0
roll output; double click to hide master bedroom/NYC/The Heights	Washington Heights North	Washington Heights	40.84911	-73.93097	100.0	Apartment	Private room	2	74.0	37.0	78	https://www.airbnb.com /rooms/26303788	https://a0.muscache.com/im/pictures/fcc9077f-fab7-4c8f-a62c-1b7340fcaa30.jpg?aki_policy=large	1	1	0
Little Safe Haven	Hamilton Heights	Harlem	40.82494	-73.94280	100.0	Apartment	Private room	1	80.0	80.0	43	https://www.airbnb.com /rooms/29205817	https://a0.muscache.com/im/pictures/97143bde-79c7-4112-8bfa-fb219529c4e6.jpg?aki_policy=large	1	1	0
One cozy private BR close to the mecca of shopping	Turtle Bay-East Midtown	Midtown	40.76026	-73.96590	100.0	Apartment	Private room	1	80.0	80.0	64	https://www.airbnb.com /rooms/13246804	https://a0.muscache.com/im/pictures/b4722160-be37-4701-a2e5-36cfe38f7a27.jpg?aki_policy=large	1	2	0

We define our custom Top-Level categories for Venues

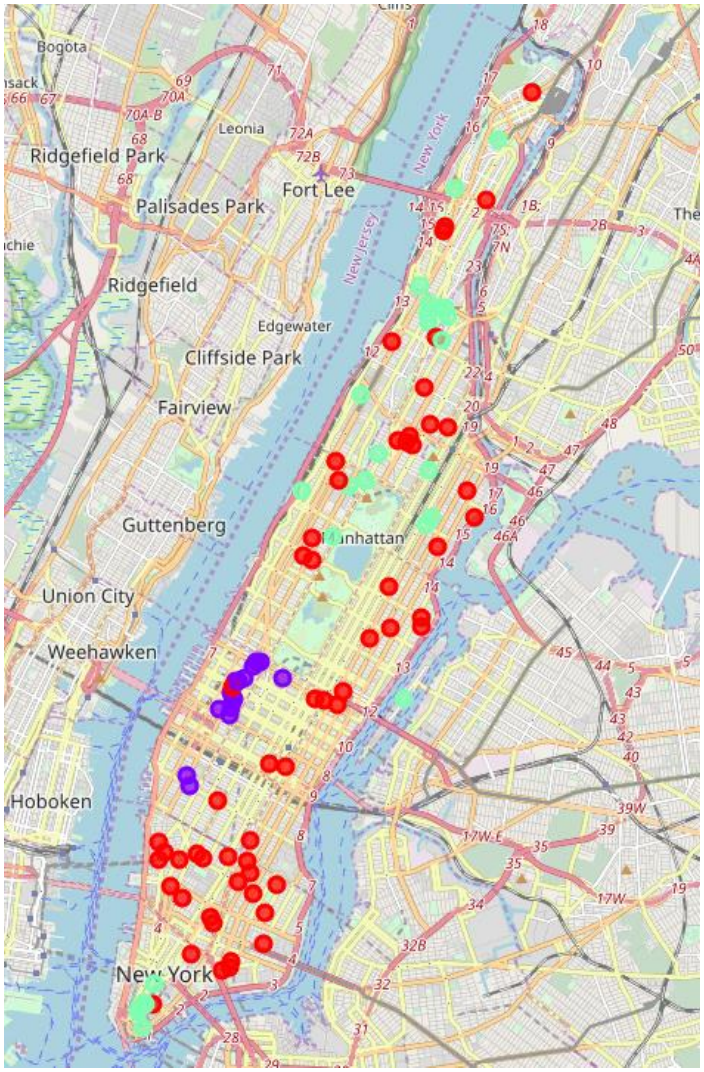
```
fine_art_cat = ['Art','Arts','Museum', 'Library','Exhibit','Gallery']
eat_place_cat = ['Restaurant','Steakhouse']
shopping_cat = ['Shopping Mall','Market','Boutique']
outdoor_cat = ['Sculpture Garden','Scenic Lookout','Roof Deck','Outdoor Sculpture','Monument / Landmark',
              'Memorial Site','Lighthouse','Historic Site','Harbor / Marina','Fountain','Event Space','Bridge',
              'Waterfront','Church','Building','Garden','Historic Site','Lake','Park',
              'Pier','Rest Area','River','Synagogue','Field']
entertainment_cat = ['Nightclub','Circus','Club', 'Stadium', 'Karaoke Bar', 'Pub','Theater','Opera', 'Concert', 'Zoo']

#Join all categories' values in one
tourists_categories = fine_art_cat + eat_place_cat + shopping_cat + outdoor_cat +entertainment_cat
```

Calculate the Top-3 Venues Categories for each accommodation.

Then run k-means to cluster the neighborhood into 3 clusters.

Cluster Labels	name	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	1st Most Common Venue Share	2nd Most Common Venue Share	3rd Most Common Venue Share
1	**Stylish, Quiet, Centrally Located (9th & 52nd)	Food Place	Entertainment	Fine Art	0.62	0.35	0.04
2	157-C	Food Place	Sightseeing	Fine Art	0.52	0.29	0.14
2	A neat bedroom in a cozy 3-bedroom apartment	Food Place	Sightseeing	Shopping	0.48	0.41	0.04
0	Art filled peaceful paradise EV Union Square	Food Place	Sightseeing	Shopping	0.71	0.07	0.07
0	Artsy Parisian Apt in Greenwich Village	Food Place	Entertainment	Sightseeing	0.65	0.26	0.09

Now, we can examine each cluster and determine our custom venue categories that distinguish each cluster.



Cluster 0 – Mix (red dots) characteristics:

- average *price_per_person*
- average *crimes* rate
- second top Common Venue Category has a Mix of all kind of Categories
- contains 58% from all top accommodations

	review_scores_rating	accommodates	full_price	price_per_person	crimes	bathrooms	bedrooms	Cluster Labels
count	58.0	58.000000	58.000000	58.000000	58.000000	58.000000	58.000000	58.0
mean	100.0	2.189655	229.068966	109.554023	67.051724	1.051724	1.034483	0.0
std	0.0	0.907220	117.766028	48.078871	57.990750	0.291542	0.417407	0.0
min	100.0	1.000000	67.000000	37.000000	3.000000	0.000000	0.000000	0.0
25%	100.0	2.000000	132.250000	71.250000	37.250000	1.000000	1.000000	0.0
50%	100.0	2.000000	202.500000	99.166667	49.500000	1.000000	1.000000	0.0
75%	100.0	2.750000	301.750000	140.125000	78.000000	1.000000	1.000000	0.0
max	100.0	5.000000	519.000000	259.500000	385.000000	2.000000	2.000000	0.0

Cluster 1 – Entertainment (blue dots) characteristics:

- highest average *price_per_person* among all clusters
- highest average *crimes* rate among all clusters
- *Entertainment* is 1st and the 2nd Top Common Venue Categories
- contains 15% from all top accommodations

	review_scores_rating	accommodates	full_price	price_per_person	crimes	bathrooms	bedrooms	Cluster Labels
count	15.0	15.000000	15.000000	15.000000	15.000000	15.0	15.000000	15.0
mean	100.0	2.666667	273.733333	111.403333	102.000000	1.0	0.866667	1.0
std	0.0	1.175139	96.230725	40.353361	64.378346	0.0	0.516398	0.0
min	100.0	1.000000	110.000000	55.000000	23.000000	1.0	0.000000	1.0
25%	100.0	2.000000	210.000000	79.650000	61.000000	1.0	1.000000	1.0
50%	100.0	2.000000	275.000000	105.000000	74.000000	1.0	1.000000	1.0
75%	100.0	4.000000	329.500000	137.500000	130.500000	1.0	1.000000	1.0
max	100.0	5.000000	420.000000	200.000000	257.000000	1.0	2.000000	1.0

Cluster 2 – Sightseeing (light-green dots) characteristics:

- lowest average *price_per_person*
- lowest *crimes* rate among all clusters
- *Sightseeing* is the second top Common Venue Category
- contains 27% from all top accommodations

	review_scores_rating	accommodates	full_price	price_per_person	crimes	bathrooms	bedrooms	Cluster Labels
count	27.000000	27.000000	27.000000	27.000000	27.000000	27.000000	27.000000	27.0
mean	99.925926	3.148148	182.074074	58.638889	65.037037	1.185185	1.111111	2.0
std	0.266880	1.974914	112.167775	17.109439	43.882256	0.483341	0.506370	0.0
min	99.000000	1.000000	54.000000	27.000000	4.000000	1.000000	0.000000	2.0
25%	100.000000	2.000000	88.500000	46.000000	33.000000	1.000000	1.000000	2.0
50%	100.000000	2.000000	158.000000	57.000000	62.000000	1.000000	1.000000	2.0
75%	100.000000	4.000000	260.500000	65.125000	82.500000	1.000000	1.000000	2.0
max	100.000000	10.000000	470.000000	100.000000	175.000000	3.000000	3.000000	2.0

Results and Discussion

During the analysis, three clusters were defined.
All clusters have a 'Food Place' category as the First Common Venues. This is what we have in common among our clusters.
But they are distinguished by the other characteristics as

- average **Price per person;**
- average **Crimes Rate;**
- the second Common Venues;
- number of available Airbnb accommodations;
- neighborhoods location.

Cluster 0 – Mix is the most generic cluster - it has a

- average price_per_person - $110;
- average crimes rate - 67 (but very varying - depends on the neighborhood, from 3 to 385 crime cases in radius of 100 meters from the accommodation);
- mix of all Venue Categories (Fine Arts, Shopping, Entertainment);
- contains 58% from all accommodations selected from analysis (Top-100 Airbnb accommodations);
- spreads almost on all Manhattan's areas.

Cluster 1 - Entertainment is the smallest cluster with the following qualities (Nightclub, Stadium, Pub, Theater, Concert and so on):

- highest average *price_per_person* among all clusters - $111;
- highest average *crimes* rate among all clusters – 102;
- *Entertainment* is 1st and the 2nd Top Common Venue Categories;
- contains 15% from all top accommodations (Top-100 Airbnb accommodations);
- spreads on *Chelsea, Hell's Kitchen, and Midtown* Airbnb's Neighborhoods.

Cluster 2 - Sightseeing is the cheapest one with many Sightseeing attractions nearby (Monument/Landmark, Memorial Site, Historic Site, Lake, Park, Pier, and so on)

- lowest average price_per_person - $59;
- lowest crimes rate among all clusters – 65;
- *Sightseeing* is the second top Common Venue Category;
- contains 27% from all top accommodations (Top-100 Airbnb accommodations);
- spreads on *East Harlem, Financial District, Harlem, Inwood, Morningside Heights, Roosevelt Island, Upper West Side, Washington Heights, West Village.*

We identified three clusters from which a visitor could choose an appropriate accommodation based on his/her preferences or needs.

Top Neighborhoods Statistics

Top-5 Neighborhoods with Lowest average *Price per Person* in 2019 year:

- Marble Hill-Inwood - 45.48 USD - 25 accommodations
- Washington Heights South - 46.79 USD - 82 accommodations
- Washington Heights North - 54.74 USD - 53 accommodations
- Central Harlem North-Polo Grounds - 57 USD - 132 accommodations
- Manhattanville - 59.75 USD - 25 accommodations

Top-5 Neighborhoods with the Lowest *Crime level* in 2019 year:

- Stuyvesant Town-Cooper Village - 145
- park-cemetery-etc-Manhattan - - 1,213
- Lenox Hill-Roosevelt Island - 1,604
- Manhattanville - 1,832
- Yorkville - 1,898

Limitations

- We limited our investigation by Manhattan Borough only;
- Foursquare free account has a limitation of 950 calls/day so maybe it's worth to upgrade our free account to analyze Top-1000 Airbnb accommodations instead of Top-100.

Conclusion

To conclude, the basic data analysis was performed to identify Manhattan's Neighborhoods clusters for a short stay visit.
During the analysis, we cleansed and investigated Manhattan Neighborhoods' datasets, found some statistical characteristics and visualize them.

The aim of this project is to help Manhattan visitors select the Airbnb neighborhoods where to stay based on the most common venues, price policy, and safety characteristics:

- if a person is interested in **entertainment** (Nightlife, Pubs, Concerts, Movies) we recommend paying attention for accommodations from the *Cluster 1 - Entertainment*: *Chelsea, Hell's Kitchen, and Midtown* Airbnb's Neighborhoods. But the person should take into the consideration the high prices and crime rate for this location;

- if a person is looking for a neighborhood with **lower prices** and nice views nearby, we recommend looking at *Cluster 2 - Sightseeing*: *Chelsea, Hell's Kitchen, and Midtown Airbnb's Neighborhoods*;

- if a person **does not have any preferences** - investigate proposals from *Cluster 0 - Mix*. It has average prices and spreads over almost all Manhattan's neighborhood.

Areas of improvement

- We could include the other NYC Boroughs - The Bronx, Brooklyn, Queens, and Staten Island;
- We also could utilize other services like Google API to find nearby Venues;
- We have not analyzed the Hotels. It's very big chunk but we have not found any fresh public data sets about hotels accommodations with rating.

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