Coursera Capstone Project
The Battle of Neighborhoods

SECTION 1: INTRODUCTION

1.1 Background

In this world, crimes are an inseparable part of our lives. Every day we hear about them. Being cautious and improve safety is not a simple instruction anymore. We need to use modern technology and data science techniques to more wisely act against this problem. There are so many records and documentation in the police department that have been gathered during the years, which can be used as a valuable source of data for the data analytics tasks. Applying analytical task to these data bring us valuable information that can be used to increase the safety of our society and lower the crime rate. The average American moves about eleven times in their lifetime. We should always do proper research when planning our next move in life. Safety is a top concern when moving to a new area. If you don't feel safe in your own home, you're not going to be able to enjoy living there.

1.2 Problem

In this project we analyze the New York Crime dataset, which is one of the richest open source data in this area, to get a better understanding about the security status of this city. The crime rates in each borough may have changed over time. The project aims to select the safest areas in each borough in New York based on the lowest crime rates, explore the neighborhoods of that borough to find the 10 most common venues in each neighborhood and finally cluster the neighborhoods using k-mean clustering.

1.3 Interest

People who are considering relocating to New York or the travelers planning to visit this city will be interested to identify the safest borough in NYC and explore its neighborhoods and common venues around each neighborhood.

SECTION 2: DATA DESCRIPTION

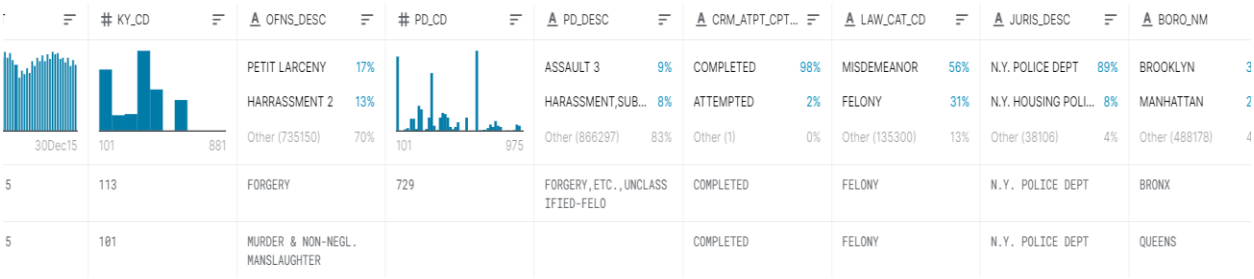
Based on definition of our problem, factors that will influence our decisions are:

- finding the safest borough based on crime statistics
- finding the 10 most common venues
- choosing the right neighborhood within the borough

We will be using the geographical coordinates of New York City to plot neighborhoods in a borough that is safe and in the city's vicinity, and finally cluster our neighborhoods and present our findings.

Following data sources will be needed to extract/generate the required information:

- New York City crimes reported : https://www.kaggle.com/adamschroeder/crimes-new-york-city?select=NYPD_Complaint_Data_Historic.csv
  This dataset consists of the crimes reported in New York city by NYPD. We can get the crimes committed in each borough of NYC and then compare them with each other to find the safest of them.



	KY_CD	OFNS_DESC	PD_CD	PD_DESC	CRM_ATPT_CPT...	LAW_CAT_CD	JURIS_DESC	BORO_NM
	30Dec15 / 101 / 881	PETIT LARCENY 17% HARRASSMENT 2 13% Other (735150) 70%	101 / 975	ASSAULT 3 9% HARASSMENT,SUB... 8% Other (866297) 83%	COMPLETED 98% ATTEMPTED 2% Other (1) 0%	MISDEMEANOR 56% FELONY 31% Other (135300) 13%	N.Y. POLICE DEPT 89% N.Y. HOUSING POLI... 8% Other (38106) 4%	BROOKLYN MANHATTAN Other (488178)
5	113	FORGERY	729	FORGERY,ETC.,UNCLASSIFIED-FELO	COMPLETED	FELONY	N.Y. POLICE DEPT	BRONX
5	101	MURDER & NON-NEGL. MANSLAUGHTER			COMPLETED	FELONY	N.Y. POLICE DEPT	QUEENS

- Population of NYC by Borough: https://www.kaggle.com/adamschroeder/crimes-new-york-city?select=Population_by_Borough_NYC.csv
  Population dataset can be used to analyze the proportion of total crimes to total population in that borough so that the crime rate is calculated without any bias or flaws.

Age Group Population group, usually classifies y age ranges, here the data it's general	Borough	1950 1950 Census population	1950 - Boro shar...	1960 1960 Census population	1960 - Boro shar...
1 unique value	6 unique values	6 total values	6 unique values	6 total values	6 unique values
Total Population	NYC Total	7,891,957	100%	7,781,984	100%
Total Population	Bronx	1,451,277	18.39%	1,424,815	18.31%
Total Population	Brooklyn	2,738,175	34.7%	2,627,319	33.76%
Total Population	Manhattan	1,960,101	24.84%	1,698,281	21.82%
Total Population	Queens	1,550,849	19.65%	1,809,578	23.25%
Total Population	Staten Island	191,555	2.43%	221,991	2.85%

- Scraping additional information of the different Boroughs in NYC from a Wikipedia page.: Boroughs of New York City

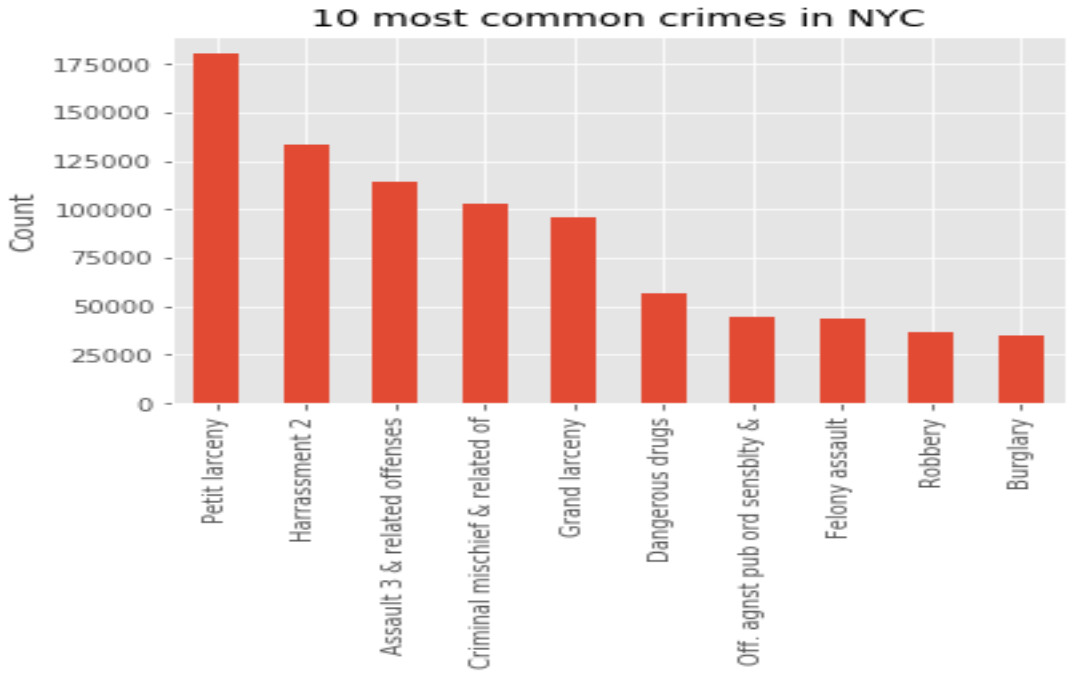
Borough	County	Estimate (2019)[3]	billions (US$)[4]	per capita (US$)	square miles	square km	persons / sq. mi	persons / km^2
The Bronx	Bronx	1,418,207	42.695	30,100	42.10	109.04	33,867	13,006
Brooklyn	Kings	2,559,903	91.559	35,800	70.82	183.42	36,147	13,957
Manhattan	New York	1,628,706	600.244	368,500	22.83	59.13	71,341	27,544
Queens	Queens	2,253,858	93.310	41,400	108.53	281.09	20,767	8,018
Staten Island	Richmond	476,143	14.514	30,500	58.37	151.18	8,157	3,150
City of New York		**8,336,817**	**842.343**	**101,000**	**302.64**	**783.83**	**27,547**	**10,636**
State of New York		19,453,561	1,731.910	89,000	47,214	122,284	412	159

- Creating a new consolidated dataset of the Neighborhoods, boroughs, and the most common venues and the respective Neighborhood along with co-ordinates.: This data will be fetched using Four Square API to explore the neighborhood venues and to apply machine learning algorithm to cluster the neighborhoods and present the findings by plotting it on maps using Folium.

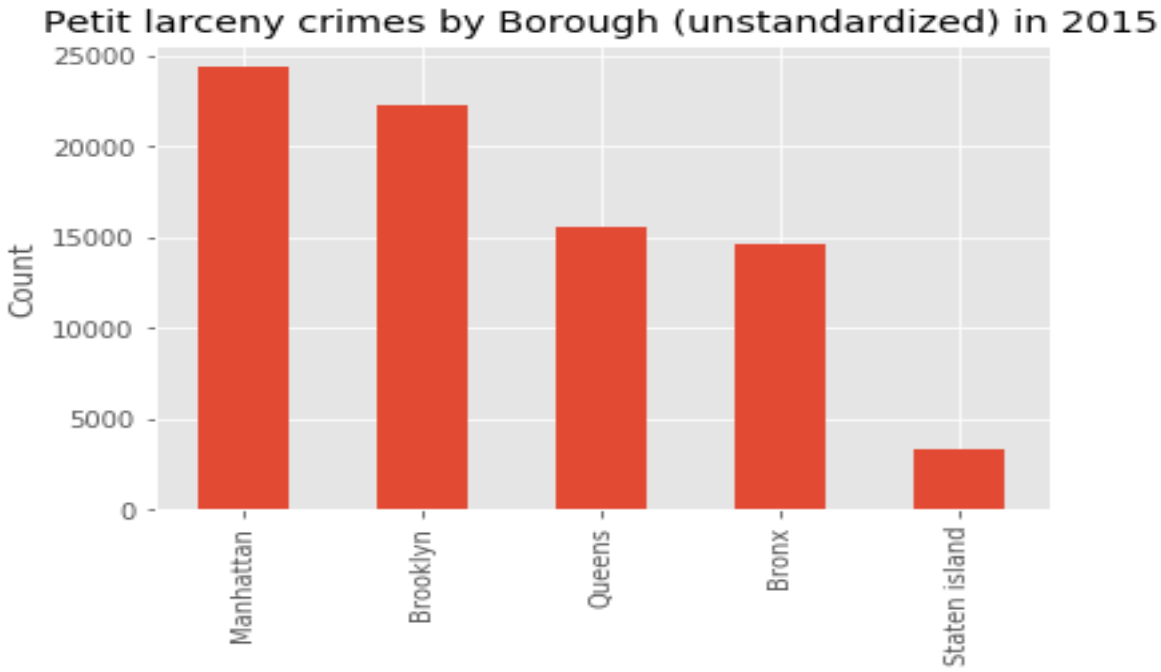
SECTION 3: METHODOLOGY

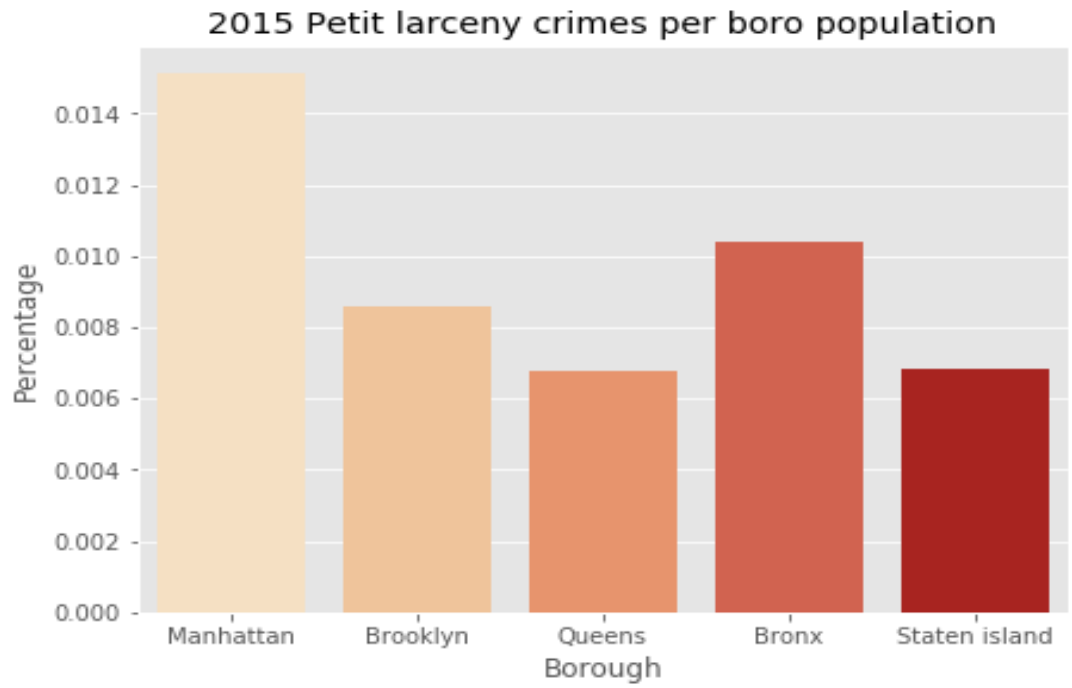
3.1 Exploratory Data Analysis

- 10 Most Common Crimes in NYC – Sums the number of crimes per category and plot it against the total number of crimes resulting in Top 10 most common crimes in the New York City. 'Petit larceny' is the highest reported crime and 'Burglary' is the lowest recorded Crime. This helps the target audience know which crime has higher chance occurrence.

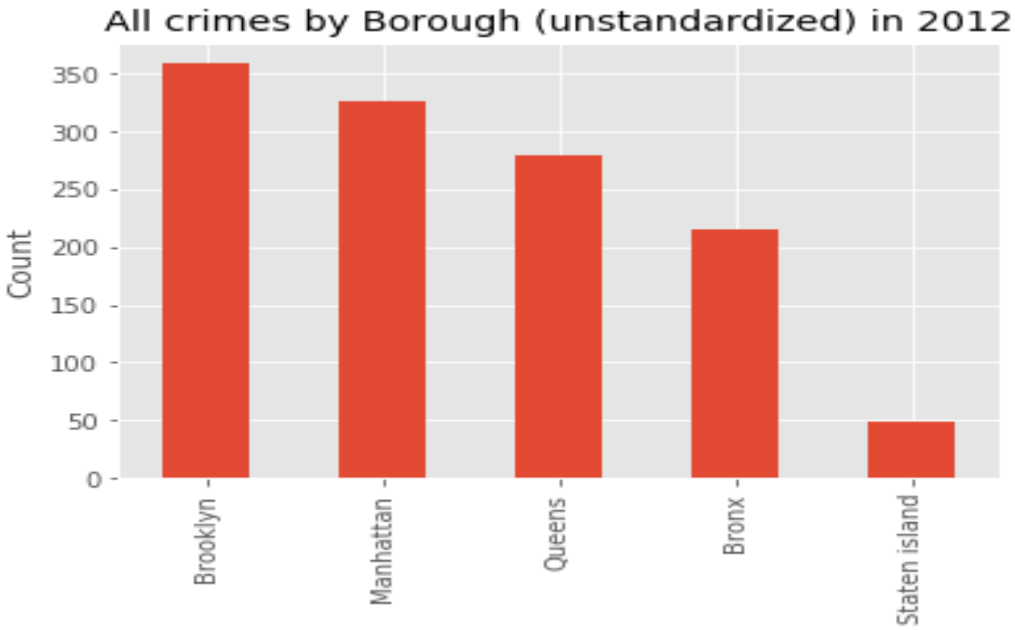


- Petit larceny Crimes per Borough in the Year 2015 (Standardized and Unstandardized):
  This crime is the topmost reported crime in the New York City. We further explore the number of petit larceny crimes in each borough. Comparison results in the safest borough in terms of Petit larceny – Staten Island. Standardized plot shows different results since the output is given based on the population of that particular borough.
  When standardized, Staten Island and Queens turn out to be at the same level of safety when it comes to the Petit larceny crimes.





- All NYC Crimes reported per Borough in 2012
  Plot results in Brooklyn being the worst crime-affected Borough and Staten Island being the lease crime-affected Borough



3.2 Data Modelling

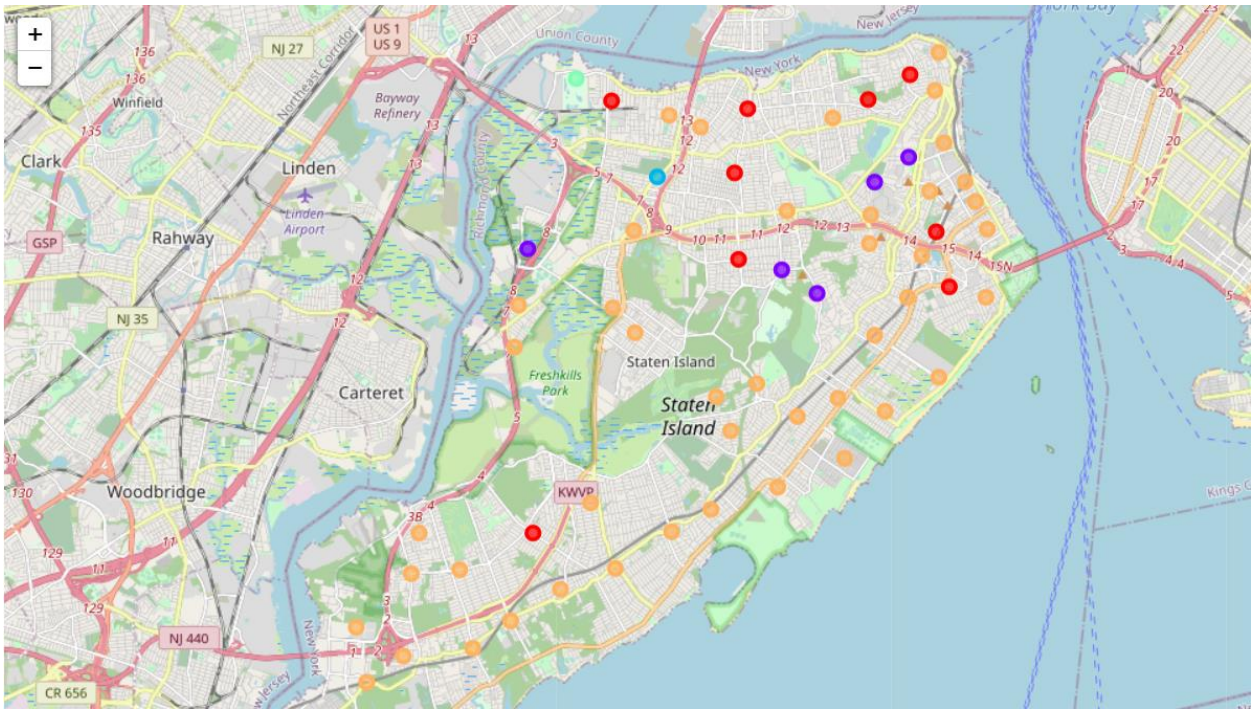
Using the final dataset containing the neighborhoods in Staten along with the latitude and longitude, we can find all the venues within a 1000-meter radius of each neighborhood by connecting to the Foursquare API.

This returns a json file containing all the venues in each neighborhood which is converted to a pandas dataframe. This data frame contains all the venues along with their coordinates and category. One hot encoding is done on the venues data.

One hot encoding is a process by which categorical variables are converted into a form that could be provided to ML algorithms to do a better job in prediction). The Venues data is then grouped by the Neighborhood and the mean of the venues are calculated, finally the 5 common venues are calculated for each of the neighborhoods. To help people find similar neighborhoods in the safest borough we will be clustering similar neighborhoods using K - means clustering which is a form of unsupervised machine learning algorithm that clusters data based on predefined cluster size. We will use a cluster size of 5 for this project that will cluster the neighborhoods into 5 clusters. The reason to conduct a K- means clustering is to cluster neighborhoods with similar venues together so that people can shortlist the area of their interests based on the venues/amenities around each neighborhood.

SECTION 4: RESULTS

After doing the Exploratory Data Analysis, we conclude that Staten Island has the lowest crime rate in NYC followed by Queens. Applying K-means clustering we can access each cluster created to see which neighborhoods were assigned to each of the five clusters. (see fig 4.1)



The cluster four is the biggest cluster with more than 15 neighborhoods in the borough Staten Island. Upon closely examining these neighborhoods we can see that the most common venues in these neighborhoods are Restaurants, Pubs, Cafe, Supermarkets, and stores. Looking into the neighborhoods in the second, third and fifth clusters, we can see these clusters have only one or two neighborhoods each. This is because of the unique venues in each of the neighborhoods, hence they couldn't be clustered into similar neighborhoods.

The second cluster has one neighborhood which consists of Venues such as Restaurants, Yoga Studio and Parks. The second cluster has one neighborhood which consists of Venues such as Grocery Store, Yoga Studio. The third cluster has one neighborhood which consists of Venues such as Grocery shops, Bars, Restaurants, Furniture shops, and Department stores. We will look into the neighborhoods in the fourth cluster. The fifth cluster has two neighborhoods in it, these neighborhoods have common venues such as Parks, Gym/Fitness centers, Bus Stops, Restaurants, Electronics Stores and Soccer fields etc. Visualizing the clustered neighborhoods on a map using the folium library cluster is color coded for the ease of presentation, we can see that majority of the neighborhood falls in the orange cluster which is the first cluster. The red cluster consists of two neighborhoods which is the 4th cluster.

SECTION 5. DISCUSSION

The aim of this project is to help people who want to relocate to the safest borough in New York, expats can choose the neighborhoods to which they want to relocate based on the most common venues in it. For example, if a person is looking for a neighborhood with good connectivity and public transportation, we can see that Clusters 4 and 5 have Train stations and Bus stops as the most common venues. If a person is looking for a neighborhood with stores and restaurants in a close proximity, then the neighborhoods in the third cluster is suitable.

For a family I feel that the neighborhoods in Cluster 4 are more suitable dues to the common venues in that cluster, these neighborhoods have common venues such as Parks, Gym/Fitness centers, Bus Stops, Restaurants, Electronics Stores and Soccer fields which is ideal for a family. The choices of neighborhoods may vary from person to person.

SECTION 6. CONCLUSION

This project helps a person get a better understanding of the neighborhoods with respect to the most common venues in that neighborhood. It is always helpful to make use of technology to stay one step ahead i.e. finding out more about places before moving into a neighborhood. We have just taken safety as a primary concern to shortlist the safest borough of New York. The future of this project includes taking other factors such as cost of living in the areas into consideration to shortlist the borough, such as filtering areas based on a predefined budget.