1.Introduction

1.1 Background

New York City is a very diverse city in the United States and has a very high population. In this crowd city, some boroughs/neighborhoods have high crime rates while some are considered relatively very safe. In addition, within 5 borough and more than 30 neighborhood in New York City, restaurant and coffee shop are the top 2 venues. Each year thousands of people looking to open new restaurant in this city. As we all aware, crime rate will affect restaurant business in a negative way so does high concentration of similar restaurants. Therefore, it is advantageous for people to know the crime rate and existing venue while picking locations to open restaurant.

1.2 Problem

Data that might contribute to determining future restaurant profit include location, neighborhood crime rate, nearby existing restaurant type, etc. This project will be finding the best neighborhood in New York City to open a restaurant.

1.3 Interest

Obviously, people who want to open a new restaurant in New York City would be interested in.

2.Data

2.1 Data sources

In this project, there is two data source. First, New York City crime data provided by NYC OpenData(https://data.cityofnewyork.us/Public-Safety/NYPD-Complaint-Data-Historic/qgea-i56i) named NYPD Complaint Data Historic. This dataset includes all valid felony, misdemeanor, and violation crimes reported to the New York City Police Department (NYPD) from 2006 to the end of last year (2017). In total, this dataset contains 35 columns and 7.31M rows each row represents a individual complain. The second data source is the Foursquare API. The Foursquare API is used to explore neighborhoods in New York City.

2.2 Data cleaning

Due to file size, NYPD crime data is per-cleaned before imported to the notebook, only data from 2016-2017 is included and 7relevent columns are kept. No change in the Foursquare API is made.

3.Methodology

## 3.1Exploratory Data Analysis

3.1.1 Crime Rate

Table 1 shows the total number of crime from 2016 to 2017 in 5 different borough in New York City. Brooklyn has the most total crime (26149), while Staten Island has the fewest(4095). In the same table, the last column "Sum" is calculated by weighting felony crime 0.5, misdemeanor crime 0.2 and violation crime 0.3. As the results show, this weight won't change the order of crime rate of this 5 borough.

Graph1 shows three category crime in 5 boroughs. In all 5 borough misdemeanor is the most common crime and violation crime is the least common. All three types of crime are most common Brooklyn.

Table 2 to 6 show the 5 most common type of crimes in each borough.

	Borough	FELONY	MISDEMEANOR	VIOLATION	sum	Sum
4	STATEN ISLAND	926	2370	799	4095	1176.7
3	QUEENS	6196	8943	2301	17440	5576.9
0	BRONX	5826	10879	2562	19267	5857.4
2	MANHATTAN	7140	11223	2392	20755	6532.2
1	BROOKLYN	9041	13439	3669	26149	8309.0

Table 1:Total Crime and Weighted Total Crime
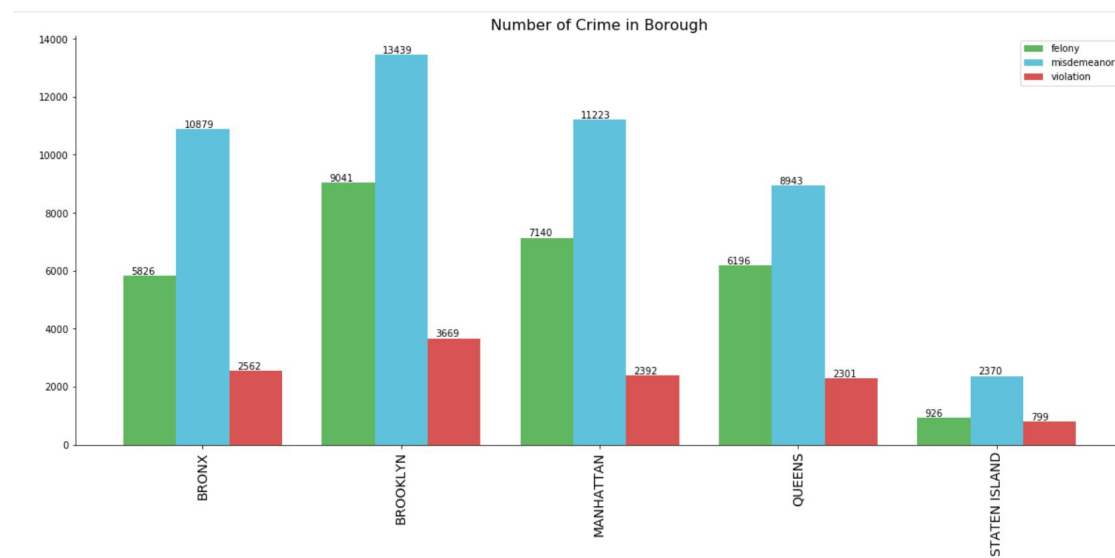
Graph1: Graph of Felony crime, Misdemeanor crime and Violation crime in 5 different borough

	Type	Borough	Counts
14	HARRASSMENT 2	STATEN ISLAND	797
25	PETIT LARCENY	STATEN ISLAND	676
5	CRIMINAL MISCHIEF & RELATED OF	STATEN ISLAND	523
3	ASSAULT 3 & RELATED OFFENSES	STATEN ISLAND	419
19	OFF. AGNST PUB ORD SENSBLTY &	STATEN ISLAND	289

Table2: 5 most common crime in Staten Island

	Type	Borough	Counts
36	PETIT LARCENY	MANHATTAN	4472
19	GRAND LARCENY	MANHATTAN	3333
21	HARRASSMENT 2	MANHATTAN	2345
4	ASSAULT 3 & RELATED OFFENSES	MANHATTAN	1843
7	CRIMINAL MISCHIEF & RELATED OF	MANHATTAN	1336

Table3: 5 most common crime in Manhattan

	Type	Borough	Counts
38	PETIT LARCENY	BROOKLYN	4271
22	HARRASSMENT 2	BROOKLYN	3605
5	ASSAULT 3 & RELATED OFFENSES	BROOKLYN	2905
9	CRIMINAL MISCHIEF & RELATED OF	BROOKLYN	2704
20	GRAND LARCENY	BROOKLYN	2288

Table4: 5 most common crime in Brooklyn

	Type	Borough	Counts
39	PETIT LARCENY	BRONX	2846
23	HARRASSMENT 2	BRONX	2540
5	ASSAULT 3 & RELATED OFFENSES	BRONX	2370
9	CRIMINAL MISCHIEF & RELATED OF	BRONX	1923
11	DANGEROUS DRUGS	BRONX	1404

Table5: 5 most common crime in Bronx

	Type	Borough	Counts
35	PETIT LARCENY	QUEENS	2973
20	HARRASSMENT 2	QUEENS	2276
4	ASSAULT 3 & RELATED OFFENSES	QUEENS	1886
8	CRIMINAL MISCHIEF & RELATED OF	QUEENS	1824
18	GRAND LARCENY	QUEENS	1735

Table6: 5 most common crime in Queens

3.1.2 Neighborhood Map
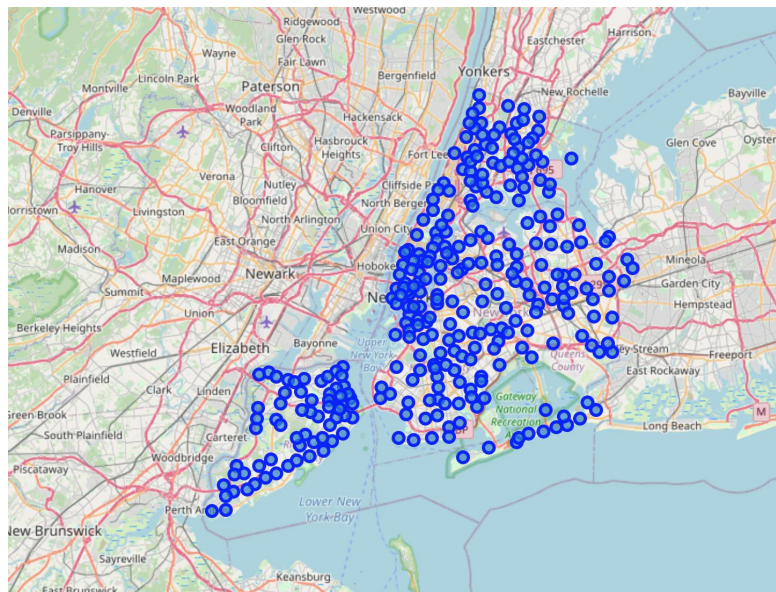
Graph2: map of New York City with Neighborhoods superimposed on top.
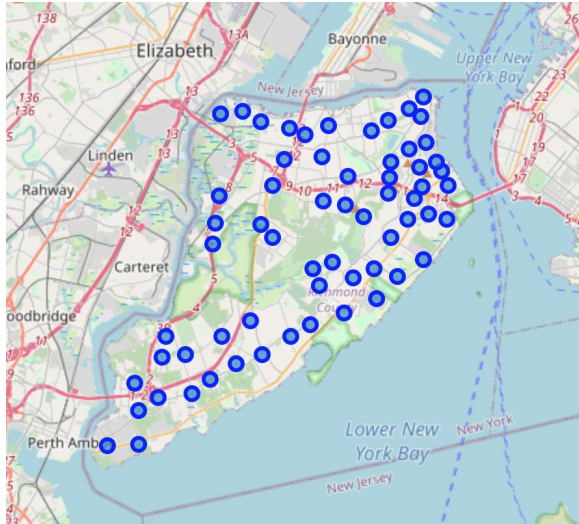
Graph2: map of Staten Island with Neighborhoods superimposed on top.

3.2 Inferential Statistical Testing and Machine Learning

No inferential statistical testing is used in this project. Machine learning is applied. Data visualization is used to produce histogram graph(Graph1) and heat map(Graph2). In addition, machine learning such as k cluster is used to find the most common restaurants in each neighborhood.

	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	Annadale	Pizza Place	American Restaurant	Sports Bar	Dance Studio	Cosmetics Shop	Restaurant	Pharmacy	Food	Diner	Train Station
1	Arden Heights	Deli / Bodega	Pizza Place	Coffee Shop	Pharmacy	Yoga Studio	Fast Food Restaurant	French Restaurant	Food Truck	Food & Drink Shop	Food
2	Arlington	Bus Stop	American Restaurant	Boat or Ferry	Furniture / Home Store	Deli / Bodega	Intersection	Asian Restaurant	Fish & Chips Shop	Gastropub	Gas Station
3	Arrochar	Italian Restaurant	Deli / Bodega	Bus Stop	Pharmacy	Polish Restaurant	Supermarket	Middle Eastern Restaurant	Outdoors & Recreation	Mediterranean Restaurant	Sandwich Place
4	Bay Terrace	Italian Restaurant	Supermarket	Home Service	Playground	Salon / Barbershop	Donut Shop	Sushi Restaurant	Shipping Store	Farmers Market	Food & Drink Shop
5	Bloomfield	Recreation Center	Bus Stop	Burger Joint	Theme Park	Dog Run	Donut Shop	French Restaurant	Diner	Food Truck	Discount Store
6	Bulls Head	Bus Stop	Pizza Place	Sandwich Place	Pharmacy	Chinese Restaurant	Deli / Bodega	Ice Cream Shop	Italian Restaurant	Gym / Fitness Center	Mattress Store
7	Butler Manor	Baseball Field	Pool	Convenience Store	Yoga Studio	Furniture / Home Store	French Restaurant	Food Truck	Food & Drink Shop	Food	Flower Shop
8	Castleton Corners	Pizza Place	Indian Restaurant	Bank	Grocery Store	Tattoo Parlor	Sandwich Place	Mini Golf	Bar	Bagel Shop	Go Kart Track
9	Charleston	Big Box Store	Cosmetics Shop	Coffee Shop	Burger Joint	Supplement Shop	Gift Shop	Pizza Place	Sporting Goods Shop	Furniture / Home Store	American Restaurant
10	Chelsea	Steakhouse	Park	Spanish Restaurant	Sandwich Place	French Restaurant	Food Truck	Food & Drink Shop	Food	Flower Shop	Fish & Chips Shop

Table4: top 10 most common venue in each neighborhood in Staten Island(head 10)

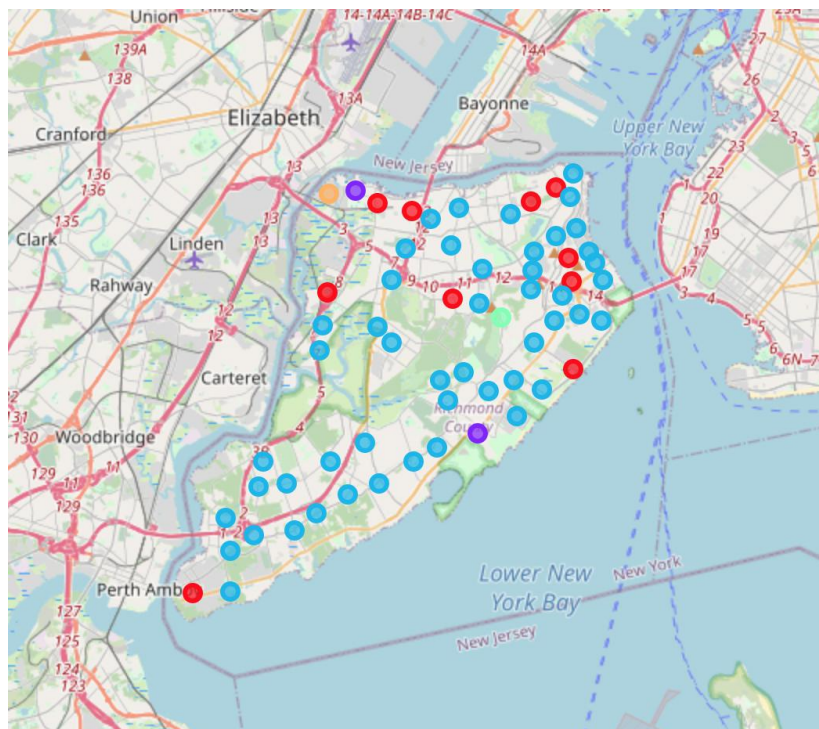|	Neighborhood	1st least Common Venue	2nd least Common Venue	3rd least Common Venue	4th least Common Venue	5th least Common Venue	6th least Common Venue	7th least Common Venue	8th least Common Venue	9th least Common Venue	10th least Common Venue
0	Annadale	Italian Restaurant	Music Venue	Nail Salon	New American Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Music Store
1	Arden Heights	American Restaurant	New American Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Park	Peruvian Restaurant	Nail Salon
2	Arlington	Italian Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Park	Peruvian Restaurant	Pet Store	Pharmacy
3	Arrochar	American Restaurant	Music Venue	Nail Salon	New American Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outlet Mall	Park	Music Store
4	Bay Terrace	American Restaurant	Music Venue	Nail Salon	New American Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Music Store
5	Bloomfield	American Restaurant	New American Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Park	Peruvian Restaurant	Nail Salon
6	Bulls Head	Yoga Studio	Martial Arts Dojo	Massage Studio	Supplement Shop	Mediterranean Restaurant	Mexican Restaurant	Middle Eastern Restaurant	Mini Golf	Miscellaneous Shop	Mobile Phone Shop
7	Butler Manor	American Restaurant	New American Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Park	Peruvian Restaurant	Pet Store
8	Castleton Corners	American Restaurant	New American Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Park	Peruvian Restaurant	Nail Salon
9	Charleston	Italian Restaurant	Music Store	Nail Salon	New American Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Museum
10	Chelsea	American Restaurant	Nail Salon	New American Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Peruvian Restaurant	Music Venue

Table5: Top 10 least common venue in each neighborhood in Staten Island(head 10)

	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	St. George	Clothing Store	Italian Restaurant	Sporting Goods Shop	Bar	Baseball Stadium	Outlet Mall	Snack Place	Scenic Lookout	Plaza	Pizza Place
2	Stapleton	Cosmetics Shop	Bank	Sandwich Place	Restaurant	Discount Store	Mexican Restaurant	New American Restaurant	Fast Food Restaurant	Park	Donut Shop
3	Rosebank	Pizza Place	Italian Restaurant	Pharmacy	Grocery Store	Beach	Eastern European Restaurant	Cosmetics Shop	Restaurant	Sandwich Place	Filipino Restaurant
4	West Brighton	Bank	Coffee Shop	Italian Restaurant	Pizza Place	Bar	Pharmacy	Breakfast Spot	Music Store	Sandwich Place	Food & Drink Shop
5	Grymes Hill	Video Store	Dog Run	Yoga Studio	Fast Food Restaurant	Furniture / Home Store	French Restaurant	Food Truck	Food & Drink Shop	Food	Flower Shop
8	Port Richmond	Pizza Place	Rental Car Location	Bus Station	Bus Stop	Food Truck	Martial Arts Dojo	Bar	Donut Shop	Deli / Bodega	Eastern European Restaurant
11	Castleton Corners	Pizza Place	Indian Restaurant	Bank	Grocery Store	Tattoo Parlor	Sandwich Place	Mini Golf	Bar	Bagel Shop	Go Kart Track
12	New Springville	Pizza Place	Deli / Bodega	Coffee Shop	Chinese Restaurant	Bagel Shop	Martial Arts Dojo	Donut Shop	Pharmacy	Restaurant	Sandwich Place
13	Travis	Hotel	Bowling Alley	Deli / Bodega	Comedy Club	Spanish Restaurant	Food	Park	Gym	Gym / Fitness Center	Baseball Field
14	New Dorp	Italian Restaurant	Deli / Bodega	Pizza Place	Taco Place	Mexican Restaurant	Salon / Barbershop	Martial Arts Dojo	Sushi Restaurant	Sandwich Place	Chinese Restaurant
16	Great Kills	Italian Restaurant	Pizza Place	Bar	Spanish Restaurant	Japanese Restaurant	Liquor Store	Grocery Store	Food & Drink Shop	Falafel Restaurant	Pharmacy
17	Eltingville	Sushi Restaurant	Pizza Place	Italian Restaurant	Fast Food Restaurant	Sandwich Place	Bank	Pharmacy	Gastropub	Gourmet Shop	Optical Shop
18	Annadale	Pizza Place	American Restaurant	Sports Bar	Dance Studio	Cosmetics Shop	Restaurant	Pharmacy	Food	Diner	Train Station
19	Woodrow	Pharmacy	Italian Restaurant	Miscellaneous Shop	Grocery Store	Sushi Restaurant	Mexican Restaurant	Donut Shop	Chinese Restaurant	Martial Arts Dojo	Cosmetics Shop

Table6: Top 10 most common venue in each neighborhood in Staten Island by cluster

	Neighborhood	1st least Common Venue	2nd least Common Venue	3rd least Common Venue	4th least Common Venue	5th least Common Venue	6th least Common Venue	7th least Common Venue	8th least Common Venue	9th least Common Venue	10th least Common Venue
0	St. George	Yoga Studio	Massage Studio	Mattress Store	Mediterranean Restaurant	Mexican Restaurant	Middle Eastern Restaurant	Mini Golf	Miscellaneous Shop	Martial Arts Dojo	Mobile Phone Shop
2	Stapleton	Italian Restaurant	Museum	Music Store	Music Venue	Nail Salon	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall
3	Rosebank	American Restaurant	Music Venue	Nail Salon	New American Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Park
4	West Brighton	Yoga Studio	Market	Martial Arts Dojo	Massage Studio	Mattress Store	Mediterranean Restaurant	Middle Eastern Restaurant	Mini Golf	Miscellaneous Shop	Mobile Phone Shop
5	Grymes Hill	American Restaurant	New American Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Park	Peruvian Restaurant	Pet Store
8	Port Richmond	American Restaurant	New American Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Park	Peruvian Restaurant	Nail Salon
11	Castleton Corners	American Restaurant	New American Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Park	Peruvian Restaurant	Nail Salon
12	New Springville	American Restaurant	Nail Salon	New American Restaurant	Nightlife Spot	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Park	Peruvian Restaurant	Pet Store
13	Travis	American Restaurant	Nail Salon	New American Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Peruvian Restaurant	Music Venue
14	New Dorp	American Restaurant	Music Venue	Nail Salon	New American Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Park
16	Great Kills	American Restaurant	Music Venue	Nail Salon	New American Restaurant	Nightlife Spot	Optical Shop	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Music Store
17	Eltingville	American Restaurant	Music Store	Music Venue	Nail Salon	New American Restaurant	Nightlife Spot	Other Repair Shop	Outdoors & Recreation	Outlet Mall	Park

Table7: Top 10 least common venue in each neighborhood in Staten Island by cluster

Graph3: Cluster Graph

4.Results

According to the New York Crime dataset, the safest borough in New York City is Staten Island. The most and the least common venue varies a lot by neighborhood for example Italian Restaurant is the least common venue in Annadale but the most common in Arrachor. In general,

according to the cluster results, American restaurant is the least common venue restaurant in Staten Island and Italian restaurant is the most common venue restaurant in Staten Island.

5.Discussion

If one would like to open a new restaurant, Staten Island is the most recommended borough. In term of neighborhood it depends on the type of restaurant. For example, if one want to open an American Restaurant, Chelsa or Castlelon are recommended because of the lack of similar restaurant. If an Italian restaurant is interested, Charleston is the best place.

6.Conclusion

I was able to find the "best" neighborhood to open a restaurant based on borough crime rate from 2016-2017, neighborhood existing venue. However, besides those two, there are other factors play major roles such as leasing price, surrounding environment(i.e. places surrounding by companies will attract workers on weekdays results a much higher business profit). Also, the data used is out of date, therefore, the significance may lower than expected.

presentation