

IBM Data Science Capstone Project

Opening a restaurant in The Bronx NY

BENMOUSSA Zakaria

20 August 2021

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Introduction

Background

The Bronx is a borough of New York City, coextensive with Bronx County, in the U.S. state of New York. It has a land area of 42 square miles (109 km²).

The Bronx's population is continuing to grow each year. As a borough it's the 4th largest in New York city with 1 472 654 residents, a 6.3% growth compared to the previous study in 2010 according to the 2020 Census.¹

Other factors that favor the Bronx, is the diverse residents and relatively affordable property compared to other boroughs like Manhattan or Brooklyn.

Problem

A couple of investors, with successful restaurants in both Queens and Brooklyn, have noticed the Bronx's continuous growth and aim to open a restaurant in this borough to establish themselves in that area of New York City and solidify their position in the food's industry.

This project looks to explore the Bronx's neighborhoods and determine which are best for a restaurant.

Interest

This project is for the investors who are looking for opening a business in the Bronx area, more specifically a restaurant. The project brings to the table a quantitative perspective to support the decision making.

Data

Data description

The data we will need for this study:

- List of boroughs and neighborhoods in New York City;
- Geo-coordinates of the Bronx;
- List of venues.

¹

<https://mtgis-portal.geo.census.gov/arcgis/apps/MapSeries/index.html?appid=2566121a73de463995ed2b2fd7ff6eb7>

Data sources

The list of boroughs and neighborhoods in New York City is provided by the json file from The New York notebook².

Geo-coordinates of the Bronx are provided by the Geocoder tool.

List of venues is provided by the Foursquare API.

Methodology

Analysis

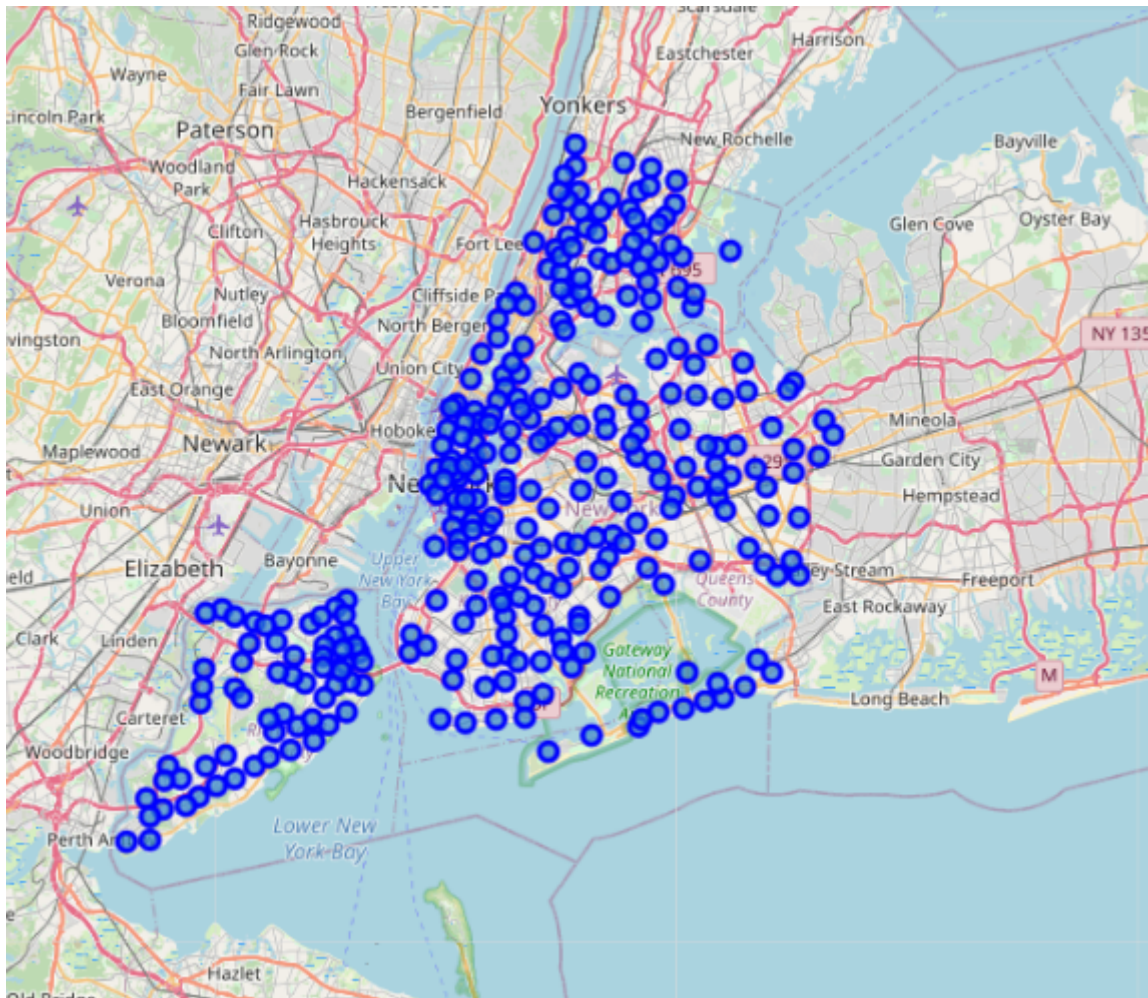
Firstly, we start by downloading the data set and loading it into a dataframe. We get this first table with New York's boroughs, neighborhoods and the latitude and longitude values for each neighborhood.

	Borough	Neighborhood	Latitude	Longitude
0	Bronx	Wakefield	40.894705	-73.847201
1	Bronx	Co-op City	40.874294	-73.829939
2	Bronx	Eastchester	40.887556	-73.827806
3	Bronx	Fieldston	40.895437	-73.905643
4	Bronx	Riverdale	40.890834	-73.912585

Then, using the Folium library, we visualize the neighborhoods of New York City.

²

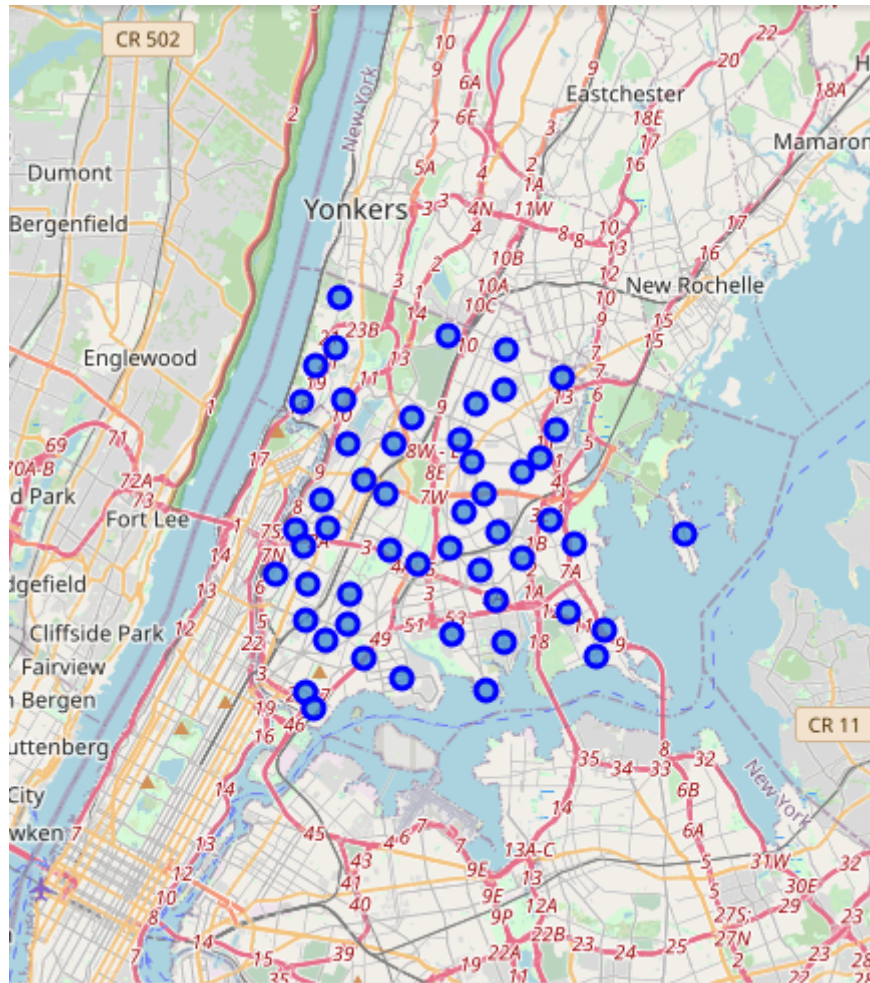
https://cf-courses-data.s3.us.cloud-object-storage.appdomain.cloud/IBMDeveloperSkillsNetwork-DS0701EN-SkillsNetwork/labs/newyork_data.json



Now we create a dataframe containing the data of the neighborhoods of the Bronx borough.

	Borough	Neighborhood	Latitude	Longitude
0	Bronx	Wakefield	40.894705	-73.847201
1	Bronx	Co-op City	40.874294	-73.829939
2	Bronx	Eastchester	40.887556	-73.827806
3	Bronx	Fieldston	40.895437	-73.905643
4	Bronx	Riverdale	40.890834	-73.912585

And then we visualize the neighborhoods.



Now that we have explored the neighborhoods in the Bronx, we'll be using the Foursquare API to get information about the venues.

The following table shows some of the venues.

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Wakefield	40.894705	-73.847201	Lollipops Gelato	40.894123	-73.845892	Dessert Shop
1	Wakefield	40.894705	-73.847201	Rite Aid	40.896649	-73.844846	Pharmacy
2	Wakefield	40.894705	-73.847201	Walgreens	40.896528	-73.844700	Pharmacy
3	Wakefield	40.894705	-73.847201	Carvel Ice Cream	40.890487	-73.848568	Ice Cream Shop
4	Wakefield	40.894705	-73.847201	Dunkin'	40.890459	-73.849089	Donut Shop

After grouping rows by neighborhood and taking the mean of the frequency of occurrence of each category, we get the table for the top ten most common values.

	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	Allerton	Chinese Restaurant	Pizza Place	Supermarket	Pharmacy	Deli / Bodega	Discount Store	Cosmetics Shop	Playground	Check Cashing Service	Dessert Shop
1	Baychester	Bank	Donut Shop	Fast Food Restaurant	Sandwich Place	Convenience Store	Electronics Store	Mattress Store	Burger Joint	Men's Store	Bus Station
2	Bedford Park	Deli / Bodega	Diner	Pizza Place	Chinese Restaurant	Pharmacy	Mexican Restaurant	Sandwich Place	Spanish Restaurant	Supermarket	Food Truck
3	Belmont	Italian Restaurant	Pizza Place	Deli / Bodega	Bakery	Grocery Store	Bank	Dessert Shop	Sandwich Place	Coffee Shop	Mexican Restaurant
4	Bronxdale	Chinese Restaurant	Pizza Place	Italian Restaurant	Mexican Restaurant	Spanish Restaurant	Eastern European Restaurant	Bank	Paper / Office Supplies Store	Breakfast Spot	Gym

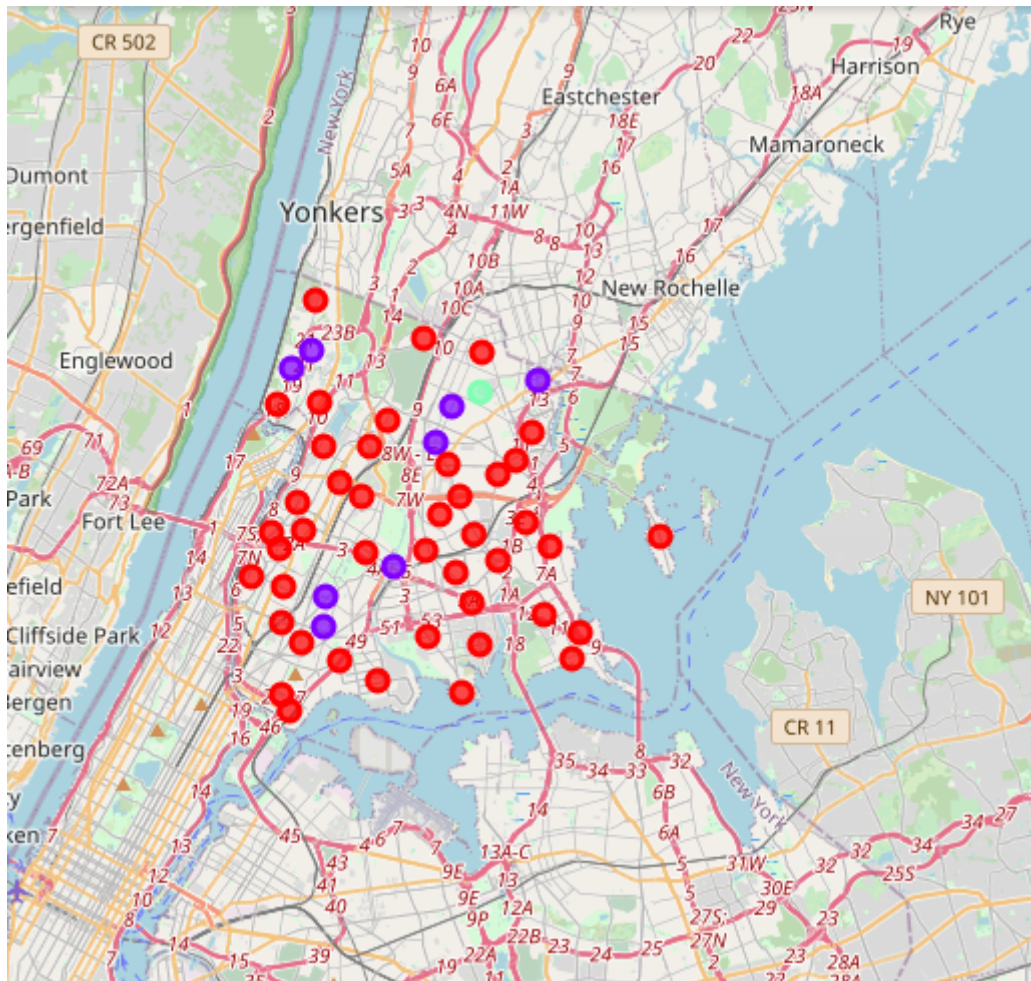
Clustering

With the dataset ready we can now use the K-means clustering method. Determining the number of clusters can be complicated. After a number of iterations, we have settled on three ($K = 3$), as it seems the most suitable for our case.

We get the following table of the clusters, neighborhoods, coordinates and top ten venues for each neighborhood.

	Borough	Neighborhood	Latitude	Longitude	Cluster Labels	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	Bronx	Wakefield	40.894705	-73.847201	0	Pharmacy	Sandwich Place	Ice Cream Shop	Deli / Bodega	Donut Shop	Caribbean Restaurant	Dessert Shop	Laundromat	Women's Store	Farmers Market
1	Bronx	Co-op City	40.874294	-73.829939	0	Accessories Store	Baseball Field	Grocery Store	Market	Fast Food Restaurant	Donut Shop	Discount Store	Park	Pharmacy	Post Office
2	Bronx	Eastchester	40.887556	-73.827806	1	Caribbean Restaurant	Bus Station	Deli / Bodega	Diner	Pizza Place	Food & Drink Shop	Platform	Chinese Restaurant	Bus Stop	Seafood Restaurant
3	Bronx	Fieldston	40.895437	-73.905643	1	River	Plaza	Music Venue	Bus Station	Discount Store	Electronics Store	Eastern European Restaurant	Donut Shop	Doctor's Office	Dive Bar
4	Bronx	Riverdale	40.890834	-73.912585	1	Bus Station	Park	Playground	Plaza	Gym	Food Truck	Baseball Field	Bank	Women's Store	Distillery

Then we visualize the clusters on a map using Folium.



Cluster 1 is in red, Cluster 2 is purple and Cluster 3 is blue.

Results

Examining the clusters

Cluster 1

	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	Wakefield	Pharmacy	Sandwich Place	Ice Cream Shop	Deli / Bodega	Donut Shop	Caribbean Restaurant	Dessert Shop	Laundromat	Women's Store	Farmers Market
1	Co-op City	Accessories Store	Baseball Field	Grocery Store	Market	Fast Food Restaurant	Donut Shop	Discount Store	Park	Pharmacy	Post Office
5	Kingsbridge	Pizza Place	Sandwich Place	Bakery	Deli / Bodega	Latin American Restaurant	Bar	Mexican Restaurant	Pharmacy	Donut Shop	Fried Chicken Joint
6	Woodlawn	Deli / Bodega	Pub	Pizza Place	Park	Bus Station	Rental Car Location	Food Truck	Bar	Playground	Italian Restaurant
7	Norwood	Pizza Place	Park	Pharmacy	Bank	Bus Station	Food Truck	Coffee Shop	Mexican Restaurant	Liquor Store	Sandwich Place
9	Baychester	Bank	Donut Shop	Fast Food Restaurant	Sandwich Place	Convenience Store	Electronics Store	Mattress Store	Burger Joint	Men's Store	Bus Station
10	Pelham Parkway	Pizza Place	Italian Restaurant	Frozen Yogurt Shop	Chinese Restaurant	Bank	Coffee Shop	Deli / Bodega	Plaza	Café	Bus Station
11	City Island	Thrift / Vintage Store	Deli / Bodega	Grocery Store	Seafood Restaurant	Harbor / Marina	Spanish Restaurant	Boat or Ferry	French Restaurant	Smoke Shop	Café
12	Bedford Park	Deli / Bodega	Diner	Pizza Place	Chinese Restaurant	Pharmacy	Mexican Restaurant	Sandwich Place	Spanish Restaurant	Supermarket	Food Truck
13	University Heights	Fast Food Restaurant	Pizza Place	Burrito Place	Convenience Store	Latin American Restaurant	Restaurant	Supermarket	Fried Chicken Joint	Sandwich Place	Bank
14	Morris Heights	Grocery Store	Pizza Place	Bank	Pharmacy	Spanish Restaurant	Deli / Bodega	Bus Station	Farmers Market	Electronics Store	Eastern European Restaurant
15	Fordham	Mobile Phone Shop	Spanish Restaurant	Donut Shop	Bank	Gym / Fitness Center	Shoe Store	Fast Food Restaurant	Supplement Shop	Pharmacy	Clothing Store
16	East Tremont	Pizza Place	Bank	Cosmetics Shop	Discount Store	Puerto Rican Restaurant	Café	Restaurant	Mobile Phone Shop	Donut Shop	Shoe Store
18	High Bridge	Chinese Restaurant	Pizza Place	Pharmacy	Latin American Restaurant	Deli / Bodega	Health & Beauty Service	Bus Station	Market	Food	Spanish Restaurant
19	Meirose	Pizza Place	Pharmacy	Sandwich Place	Grocery Store	Department Store	Mexican Restaurant	Marital Arts School	Bus Station	Bus Stop	Discount Store
20	Mott Haven	Grocery Store	Pizza Place	Spanish Restaurant	Gym	Fried Chicken Joint	Latin American Restaurant	Fish & Chips Shop	Donut Shop	Storage Facility	Discount Store
21	Port Morris	Latin American Restaurant	Photography Studio	Furniture / Home Store	Metro Station	Donut Shop	Spanish Restaurant	Storage Facility	Baseball Field	Distillery	Brewery
22	Longwood	Pizza Place	Grocery Store	Fast Food Restaurant	Donut Shop	Latin American Restaurant	Sandwich Place	Diner	Mexican Restaurant	Department Store	Dessert Shop
23	Hunts Point	Pizza Place	Gourmet Shop	Café	Seafood Restaurant	Farmers Market	Spanish Restaurant	Bank	BBQ Joint	Juice Bar	Food
25	Soundview	Chinese Restaurant	Video Store	Liquor Store	Pizza Place	Latin American Restaurant	Discount Store	Bus Stop	Bus Station	Burger Joint	Basketball Court
26	Clason Point	Park	Convenience Store	Business Service	South American Restaurant	Playground	Pool	Grocery Store	Boat or Ferry	Bus Stop	Electronics Store
27	Throgs Neck	Coffee Shop	Pizza Place	American Restaurant	Deli / Bodega	Italian Restaurant	Asian Restaurant	Liquor Store	Juice Bar	Sports Bar	Bar
28	Country Club	Sandwich Place	Comic Shop	Playground	Moving Target	Athletics & Sports	Distillery	Farmers Market	Electronics Store	Eastern European Restaurant	Donut Shop
29	Parkchester	Supermarket	Pizza Place	Kids Store	Women's Store	Fried Chicken Joint	Shipping Store	Sandwich Place	Mexican Restaurant	Restaurant	Mobile Phone Shop
29	Parkchester	Supermarket	Pizza Place	Kids Store	Women's Store	Fried Chicken Joint	Shipping Store	Sandwich Place	Mexican Restaurant	Restaurant	Mobile Phone Shop
30	Westchester Square	Fast Food Restaurant	Sandwich Place	Mexican Restaurant	Pizza Place	Indie Theater	Pharmacy	Donut Shop	Latin American Restaurant	Pub	Supermarket
31	Van Nest	Pizza Place	Deli / Bodega	Supermarket	Grocery Store	Donut Shop	Diner	College Gym	Coffee Shop	Chinese Restaurant	Bus Stop
32	Morris Park	Pizza Place	Bakery	Deli / Bodega	Burger Joint	Pharmacy	Coffee Shop	Donut Shop	Restaurant	Sandwich Place	Buffet
33	Belmont	Italian Restaurant	Pizza Place	Deli / Bodega	Bakery	Grocery Store	Bank	Dessert Shop	Sandwich Place	Coffee Shop	Mexican Restaurant
34	Spytten Duvvyl	Park	Pharmacy	Grocery Store	Scenic Lookout	Bus Line	Bank	Tennis Stadium	Thai Restaurant	Tennis Court	American Restaurant
35	North Riverdale	Pizza Place	Chinese Restaurant	Bank	Coffee Shop	Italian Restaurant	Sandwich Place	Bus Station	Donut Shop	Social Club	Mexican Restaurant
36	Pelham Bay	Fast Food Restaurant	Bank	Gym / Fitness Center	Chinese Restaurant	Italian Restaurant	Metro Station	Donut Shop	Convenience Store	Doctor's Office	Mexican Restaurant
37	Schuylerville	Pizza Place	Mexican Restaurant	Pharmacy	Diner	Fast Food Restaurant	Hookah Bar	American Restaurant	Convenience Store	Bar	Bank
38	Edgewater Park	Italian Restaurant	Deli / Bodega	Ice Cream Shop	Pizza Place	Coffee Shop	Pub	Bookstore	Bar	Donut Shop	Liquor Store
39	Castle Hill	Pizza Place	Pharmacy	Market	Diner	Bank	Dive Bar	Fast Food Restaurant	Farmers Market	Electronics Store	Eastern European Restaurant
41	Pelham Gardens	Pharmacy	Bus Station	Bank	Italian Restaurant	Spanish Restaurant	Boat or Ferry	Liquor Store	Chinese Restaurant	Playground	Grocery Store
42	Concourse	Grocery Store	Fried Chicken Joint	Chinese Restaurant	Pizza Place	Bakery	Dance Studio	Deli / Bodega	Metro Station	Spanish Restaurant	Caribbean Restaurant
43	Unionport	Latin American Restaurant	Ice Cream Shop	Donut Shop	Comfort Food Restaurant	Pizza Place	Cosmetics Shop	Cuban Restaurant	Dance Studio	Deli / Bodega	Caribbean Restaurant
46	Concourse Village	Sandwich Place	Mexican Restaurant	Pharmacy	Fast Food Restaurant	Hotel	Cosmetics Shop	Post Office	Pizza Place	Pet Store	Coffee Shop
47	Mount Eden	Pharmacy	Deli / Bodega	Fast Food Restaurant	Food Truck	Bar	Fried Chicken Joint	Supermarket	Pizza Place	Café	Mobile Phone Shop
48	Mount Hope	Deli / Bodega	Grocery Store	Pharmacy	Donut Shop	Mobile Phone Shop	Sandwich Place	Spanish Restaurant	Supermarket	Metro Station	Video Game Store
49	Bronxdale	Chinese Restaurant	Pizza Place	Italian Restaurant	Mexican Restaurant	Spanish Restaurant	Eastern European Restaurant	Bank	Paper / Office Supplies Store	Breakfast Spot	Gym
50	Allerton	Chinese Restaurant	Pizza Place	Supermarket	Pharmacy	Deli / Bodega	Discount Store	Cosmetics Shop	Playground	Check Cashing Service	Dessert Shop
51	Kingsbridge Heights	Pizza Place	Bus Station	Chinese Restaurant	Grocery Store	Coffee Shop	Check Cashing Service	Korean Restaurant	Shipping Store	Shoe Store	Mexican Restaurant

Cluster 1 is the biggest one, it covers most of the Bronx and has the most restaurants.

Cluster 2

	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
2	Eastchester	Caribbean Restaurant	Bus Station	Deli / Bodega	Diner	Pizza Place	Food & Drink Shop	Platform	Chinese Restaurant	Bus Stop	Seafood Restaurant
3	Fieldston	River	Plaza	Music Venue	Bus Station	Discount Store	Electronics Store	Eastern European Restaurant	Donut Shop	Doctor's Office	Dive Bar
4	Riverdale	Bus Station	Park	Playground	Plaza	Gym	Food Truck	Baseball Field	Bank	Women's Store	Distillery
8	Williamsbridge	Metro Station	Nightclub	Fast Food Restaurant	Caribbean Restaurant	Bar	Soup Place	Fish & Chips Shop	Farmers Market	Electronics Store	Eastern European Restaurant
17	West Farms	Bus Station	Park	Bus Stop	Coffee Shop	Bank	Outdoors & Recreation	Chinese Restaurant	Playground	Diner	Donut Shop
24	Morrisania	Bus Station	Pizza Place	Discount Store	Donut Shop	Grocery Store	Fast Food Restaurant	Fried Chicken Joint	Chinese Restaurant	Bus Stop	Sandwich Place
40	Oliverie	Caribbean Restaurant	Supermarket	Metro Station	Food	Deli / Bodega	Liquor Store	Doctor's Office	Fish & Chips Shop	Fast Food Restaurant	Farmers Market
45	Claremont Village	Bus Station	Grocery Store	Bakery	Chinese Restaurant	Liquor Store	Discount Store	Caribbean Restaurant	Gift Shop	Gym	Food

Cluster 2 contains mostly public facilities, the most popular venues there are related to public transportation, parks, playgrounds, banks etc. This cluster wouldn't be suitable for a restaurant.

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
44	Edenwald	Supermarket	Grocery Store	Sandwich Place	Women's Store	Distillery	Fast Food Restaurant	Farmers Market	Electronics Store	Eastern European Restaurant	Donut Shop

The last cluster has one neighborhood, it's located at the north side of the Bronx, the top two venues are a supermarket and a grocery store. Also not a good candidate for opening a restaurant.

Recommendations

From the K-means clustering method we can say that cluster one is the best choice for a restaurant. It is a big cluster and offers a diverse choice of neighborhoods. Some neighborhoods like Bronxdale, Edgewater Park and Westchester Square are an excellent choice, with thriving communities and facilities that bring in big foot traffic like hotels, theatres etc.

Conclusion

This study aimed to determine the best area for opening a restaurant. Starting a business in the food's industry is a risky task. But thanks to data science and the quantitative aspect it brings to the table, such a decision would be more rational and supported with hard evidence.

References

Notebook link:

https://github.com/BenmoussaZakaria/Coursera_Capstone/blob/main/Week%205/Data_science_capstone_project.ipynb

Presentation link:

https://github.com/BenmoussaZakaria/Coursera_Capstone/blob/main/Week%205/data_science_capstone_presentation.pdf