February 13, 2021

Battle of the Neighbourhoods.

Johannesburg, South Africa

VS

London, United Kingdom

Is London the most ideal city to immigrate to?

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Introduction.

We mostly believe, at one time or another, that ‘the grass is always greener on the other side’ and this is probably true for most people wanting to move outside of their home country with the belief that they would be improving their living conditions. Due to globalization and increased connectivity because of technology advancements, people have become increasingly more interested in pursuing opportunities outside of their birth countries. This is particularly true for South Africans. Approximately 4.3 million South Africans have left their homes during the 20th and 21st century. The main reasons for South Africans looking for greener pastures is because of poor economic conditions, concerns about safety due to the high crime rate and better job opportunities abroad.

As per an article written by FinGloabl:

> *"As it turns out, psychology is very much at play when moving to a new country. Psychology tells us that as humans, we have an inbuilt need to belong. It’s not enough for us just to belong to this huge clan of “humans”, we actually want to have individualized belonging, which means we want to identify with specific groups of people in a population of humans. This comes into play quite evidently with emigration."*

We can , thus, assume that many South Africans, when deciding where to immigrate, would chose a location that would feel familiar. Given this, the analysis will focus on where South Africans most commonly live outside of South Africa and how similar this location is to their city in order to decide whether or not they would feel a sense of belonging and how much of a change they would have to adapt to.

Business Problem.

The aim of our analysis is to help those South Africans that are looking to leave the country, in order to improve their living conditions, make a decision about which city would be best suited for them. The purpose and goal would be to uncover neighbourhoods in a given city that are most similar to the South African way of life. The findings from the analysis will help stakeholders make an informed decision based on their own preferences according to what the city has to offer, which includes, but is not limited to, entertainment, in door and outdoor activities, different cuisines and stores.

Data Description.

To answer or enitial research question, we need to gather geographical data in terms of longitude and latitude coordinates for areas in major cities in both the UK and South Africa. The pupose for these coordinates is to allow us to gather venue information for suburbs/towns/neighbourhoods from the Foursquare API, thus allowing us to perform a cluster analysis to determine two things:

1. What are the popular venues/activities/food outlets in a given city in South Africa.
    - This will give us an inclination as to what South Africans enjoy doing or what they may be accustomed to doing.
2. What are the popular venues/activities/food outlets in a given city in London.
    - This will allow us to make a statistical comparison, though our analysis methods, between South African interests and the interests of the British.

The outcome of the analysis will tell us two things, these are:

1. There is a large enough presence of activities/venues/cuisines that align with South African preferences that will allow South African to adapt quicker to this massive change and, thereby, feel comfortable to live there, or
2. There aren't many venues that accomodate South African tastes and, therefore,

a) South Africans may not adapt well by chosing this destination to move to.

b) There may be a market for South African venues and, therefore, an opportunity for South Africans wanting to immigrate to open up a business that will cater to South African tastes.

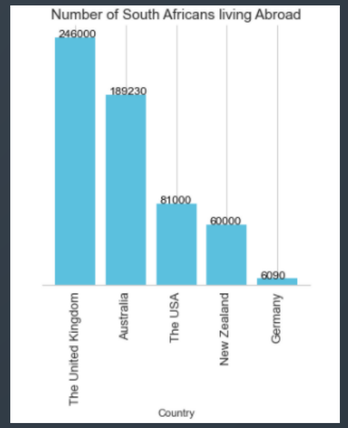
Gathering the Data:

We first need to determine which countries are the most common for South Africans to move to.

According to an article written by BUSINESSTECH the most common destinations for South African to move to are:

- New Zealand
- The United Kingdom
- Australie
- The USA
- Germany.

As per the graph below, we can see the number of South Africans in each of these countries:



We had determined that the UK has the most South African immigrants, moreover, according to [BBC UK](http://news.bbc.co.uk/2/shared/spl/hi/uk/05/born_abroad/countries/html/south_africa.stm), the most popular areas in the UK for South Africans to reside are Wimbledon N, Putney E, Putney W, Golders Green, Wimbledon S, Richmond N, Highgate, Acton, Fulham, and Kensington. Therefore, we will collect and use data for London for our analysis. Additionally, because we are making a comparison of two locations, we will collect data for a South African city too. Moreover, to aid our analysis we will need geographical location data, that is, the longitude and latitude of each area in the city. The postal codes for each location will help us get started in this regard.

London Data Collection

The best possible source to gather London location data is from https://en.wikipedia.org/wiki/List_of_areas_of_London as this page has geolocation data about all neighbourhoods in London that includes:

- Location(area)
- London Borough
- Post town
- Postcode district

We will gather this data by scraping this wikipedia page with the use of the Python library Pandas.

Unfortunately, the wikipedia page does not include information about the geographical locations we need for London. In order to solve this, we will use the pgeocode library to pull the necessary information from the web using each locations postal code.

Pgeocode:

pgeocode is a Python library for high performance off-line querying of GPS coordinates, region name and municipality name from postal codes. Distances between postal codes as well as general distance queries are also supported. The used GeoNames database includes postal codes for 83 countries.

We have used this library to obtain latitude and longitude coordinates based on each locations postal code. The resulting pandas dataset includes the coordinates for each neighbourhood(borough) in London.

Data Collection of A South African City:

According to Stats SA(, the province of Gauteng has the largest population, with approximately 15,5 million people living here. We will, therefore, gather data for Johannesburg, which is the capital city of Gauteng.

This city data will be obtained from www.blaauwberg.net where there is a publicly available database containing South African Postcodes.

This website includes postal information for the cities that is spread across a total of 26 pages. Each page will be scraped to obtain the data needed. After scraping we will have a data frame consisting of the following variables:

- Place Name(neighbourhood)
- Street Code(Post Code)
- PO Box Code
- City
- Province

Unfortunately, the pgeocode library did not work well to obtain the geolocation data for the areas in Johannesburg. Due to this not working in our favour, we will use the arcGIS API instead.

ArcGIS API:

ArcGIS API for Python is a Python library for working with maps and geospatial data, powered by web GIS.

We will specifically use arcGIS API location functionality to retrieve the longitude and latitude coordinates based on each locations postal code. The resulting pandas dataset includes the coordinates for each neighbourhood in Johannesburg.

Foursquare API Data Collection:

The Fourquare ApI provides location based data for a specific are of interest. Bt querying this API we can obtain information on an areas food outlets, malls, parks, stadiums or any venue of interest that is location specific.

Retrieving this data based on areas in London and Johannesburg is essential in order to answer our initial research questions, and will, also, allow stakeholders to make informed decisions based on venues in each location.

Once we have retrieved postal and geospacial data on areas in both Johannesburg and London, we will connect to the Foursquare API with the use of each initial dataset and the location data therein in order to gather the venue data we require for our final analysis. For both Johannesburg and London, we will request the API to retrieve information on all venues within a 500 meter radius of the longitude and latitude coordinates of each area.

Once the venue data for each city has been retrieved from the API call, the resulting data obtained will be as follows:

-

Neighbourhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Bexley, Greenwich	51.4869	0.1075	Co-op Food	51.487650	0.113490	Grocery Store
Bexley, Greenwich	51.4869	0.1075	Bostal Gardens	51.486670	0.110462	Playground
Bexley, Greenwich	51.4869	0.1075	Meghna Tandoori	51.485709	0.101681	Indian Restaurant
City	51.5085	-0.1257	National Gallery	51.508876	-0.128478	Art Museum
City	51.5085	-0.1257	Gordon's Wine Bar	51.507911	-0.123293	Wine Bar

Methodology.

Before gathering our data we import the necessary libraries to perform our gathering, cleaning, visualizing and testing, these are:

```
import pandas as pd
import numpy as np
import json
from geopy.geocoders import Nominatim
import requests
import matplotlib.cm as cm
import matplotlib.colors as colors
from sklearn.cluster import KMeans
import folium
import pgeocode
from arcgis.geocoding import geocode
from arcgis.gis import GIS
from sklearn.cluster import KMeans
from yellowbrick.cluster import KElbowVisualizer
```

Our approach here is to explore each city individually, identify issues that may hinder our analysis, clean these identified issues, visualize areas being considered for each city on a geo map, and, finally, cluster areas for each city, and then build our cluster model, plot clusters again on geomap for each city and examine clusters to make a conclusion.

Data Processing For Johannesburg Data:

After the postal data for areas in Johannesburg was gathered we had a total of 16687 rows and 5 columns. This data was assessed programmatically and the following data issues were identified and cleaned:

1. The gathered data included postal information on all cities in South Africa and we only want the postal codes that belong to Joburg, the records that do not represent Joburg areas will be dropped from the dataframe.
2. There are some suburb names that have been used for "City" instead of Johannesburg. This will have to be fixed. The steps taken to fix this issue are as follows:
   - Make a copy of city column, and rename this new column 'suburb' because we need the suburbs to eventually gather our venue data from Foursquare.
   - Rreplace all incorrect records that are in the city column with Johannesburg.
3. There are missing values in the 'Street Code' column, these will be dropped because we need a full dataset with street codes(postal codes to gather our location data(langitude and longitude).
4. Our dataset is too big at 3837 rows, it was found when gathering venue data from foursquare that it does not respond well to large datasets, therefore, we grab a random sample of the data at a threshold of 387 rows(to match the final df for the London data)

Our final dataset for Johannesbur is 600 rows and 5 columns.

After our initial dataset is cleaned, we use the arcGIS API to gather our geolocation data for the areas in Johannesburg.

We query the API to retrieve location data based on the postal codes of areas in Johannesburg. Here is an example of our final dataset with latitude and longitude coordinates:

Place Name	Street Code	PO Box Code	suburb	City	Province	Latitude	Longitude
BEDFORDVIEW EXT 3	2007	NaN	BEDFORDVIEW	JOHANNESBURG	Gauteng	-26.203403	27.912240
GERMISTON UIT 10	1401	NaN	GERMISTON	JOHANNESBURG	Gauteng	-26.459906	27.762565
TERENURE	1619	NaN	KEMPTON PARK	JOHANNESBURG	Gauteng	-26.045319	28.160992
FLORIDA UIT 9	1709	NaN	FLORIDA	JOHANNESBURG	Gauteng	-26.163893	27.920800
VAN RIEBEECKPARK EXT 10	1619	NaN	KEMPTON PARK	JOHANNESBURG	Gauteng	-26.045319	28.160992
BRYANSTON-WES	2191	2060	BRYANSTON	JOHANNESBURG	Gauteng	-26.041410	28.017490
STAFFORD	2197	NaN	JOHANNESBURG	JOHANNESBURG	Gauteng	-26.246600	28.092102
ELANDSHAVEN EXT 3	1429	NaN	ELANDSFONTEIN	JOHANNESBURG	Gauteng	-26.242249	28.124268
WELTEVREDENPARK EXT 45	1709	NaN	FLORIDA	JOHANNESBURG	Gauteng	-26.163893	27.920800
MIDWAY	1818	1816	TSHIAWELO	JOHANNESBURG	Gauteng	-26.278064	27.836890

Data Processing for London Data:

The London data was a little easier to gather and process.

After the postal data for areas in London was gathered we had a total of 531 rows and 6 columns. This data was assessed programmatically and the following data issues were identified and cleaned:

1. Column names where verbose and were renamed for simplicity.
2. Unnecessary columns were identified and dropped.
3. There were erroneous numerical characters after some borough names, these characters are removed from values.
4. There were other cities in the df, in addition to London, these were removed from the dataset because we are only concerned with London data for our analysis.

Our final dataset for London is 308 rows and 4 columns.

Once our data is cleaned, we use pgeocode to gather our geolocation data for the areas in London. pgeocode was used to gather location data for London. as previously stated, this is a Python library for high performance off-line querying of GPS coordinates from postal codes. This library was specifically used because it is one that is most familiar.

On the next slide is an example of our final dataset after obtaining the coordinates:

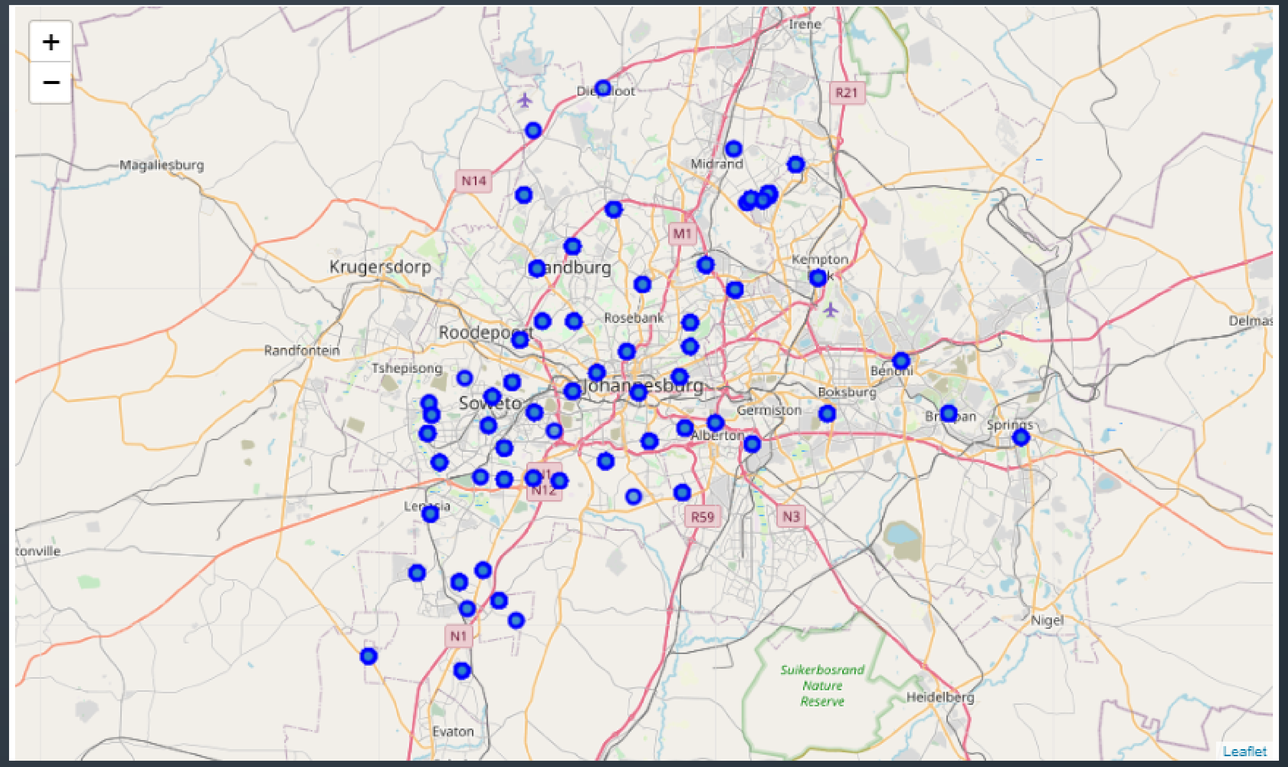
location	borough	town	district	Latitude	Longitude
Abbey Wood	Bexley, Greenwich	LONDON	SE2	51.4869	0.107500
Acton	Ealing, Hammersmith and Fulham	LONDON	W3, W4	NaN	NaN
Aldgate	City	LONDON	EC3	51.5085	-0.125700
Aldwych	Westminster	LONDON	WC2	51.5142	-0.123382
Anerley	Bromley	LONDON	SE20	51.4065	-0.056950
Angel	Islington	LONDON	EC1, N1	NaN	NaN
Archway	Islington	LONDON	N19	51.5649	-0.135100
Arkley	Barnet	BARNET, LONDON	EN5, NW7	NaN	NaN
Arnos Grove	Enfield	LONDON	N11, N14	NaN	NaN
Balham	Wandsworth	LONDON	SW12	51.4469	-0.138400

Mapping London and Johannesburg:

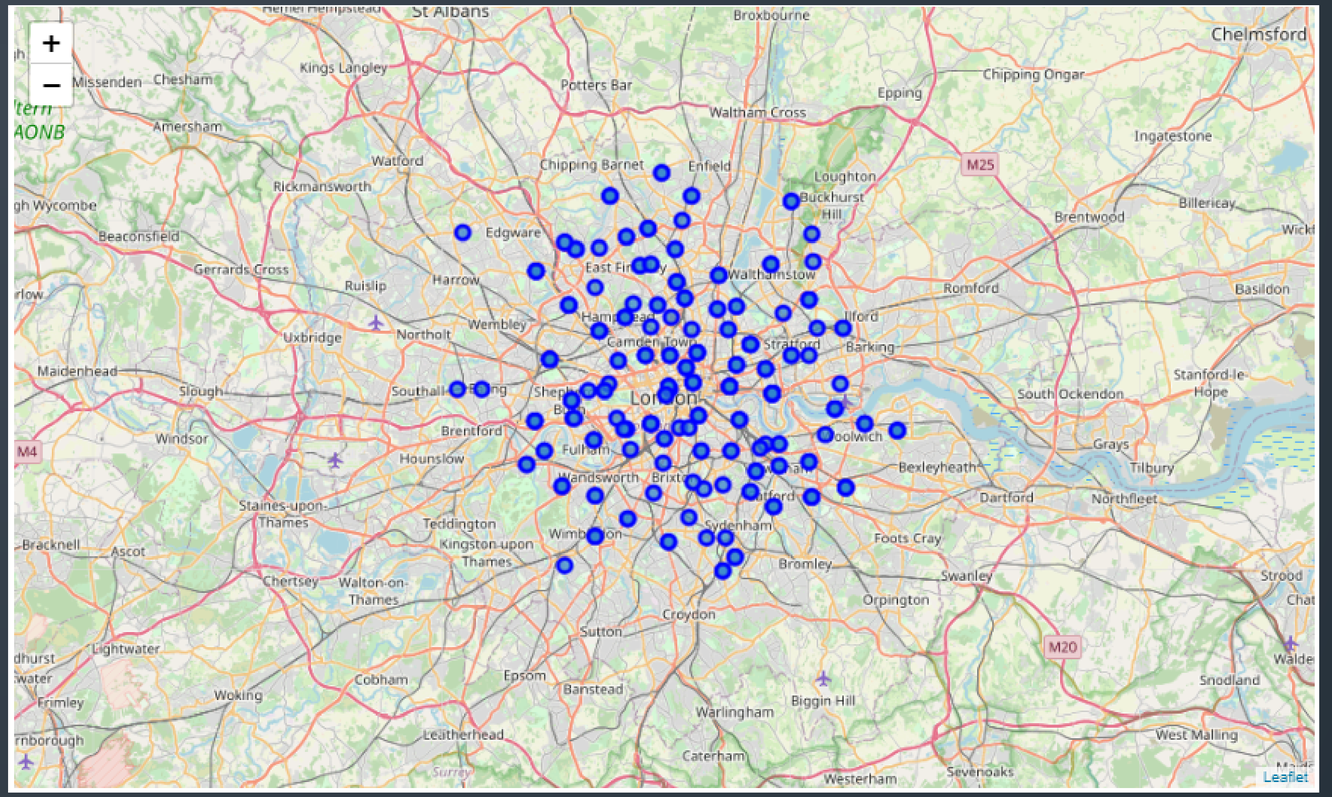
The folium library was used to graphically visualize the areas of Johannesburg and London. The folium library was the choice here because folium makes it easy to visualize data that's been manipulated in Python on an interactive leaflet map. It enables both the binding of data to a map for choropleth visualizations as well as passing rich vector/raster/HTML visualizations as markers on the map.

We have visualized each locations data on a map, whereby each locations longitude and latititude was used as a baseline for the map and then markers are used to identify areas in each city.

Map Of Johannesburg and suburbs superimposed ontop:



Map Of London and boroughs superimposed ontop:



The retrieval of data with Foursquare:

At this stage, we utilize the Foursquare API to specifically retrieve venue information for each area in London and Johannesburg and the locations of these venues.

- The retrieval of said data and the API was designed to gather and store the most common venues within a 500 mile radius of each area queried.

This step is essential for our prepping step of the data for our final analysis.

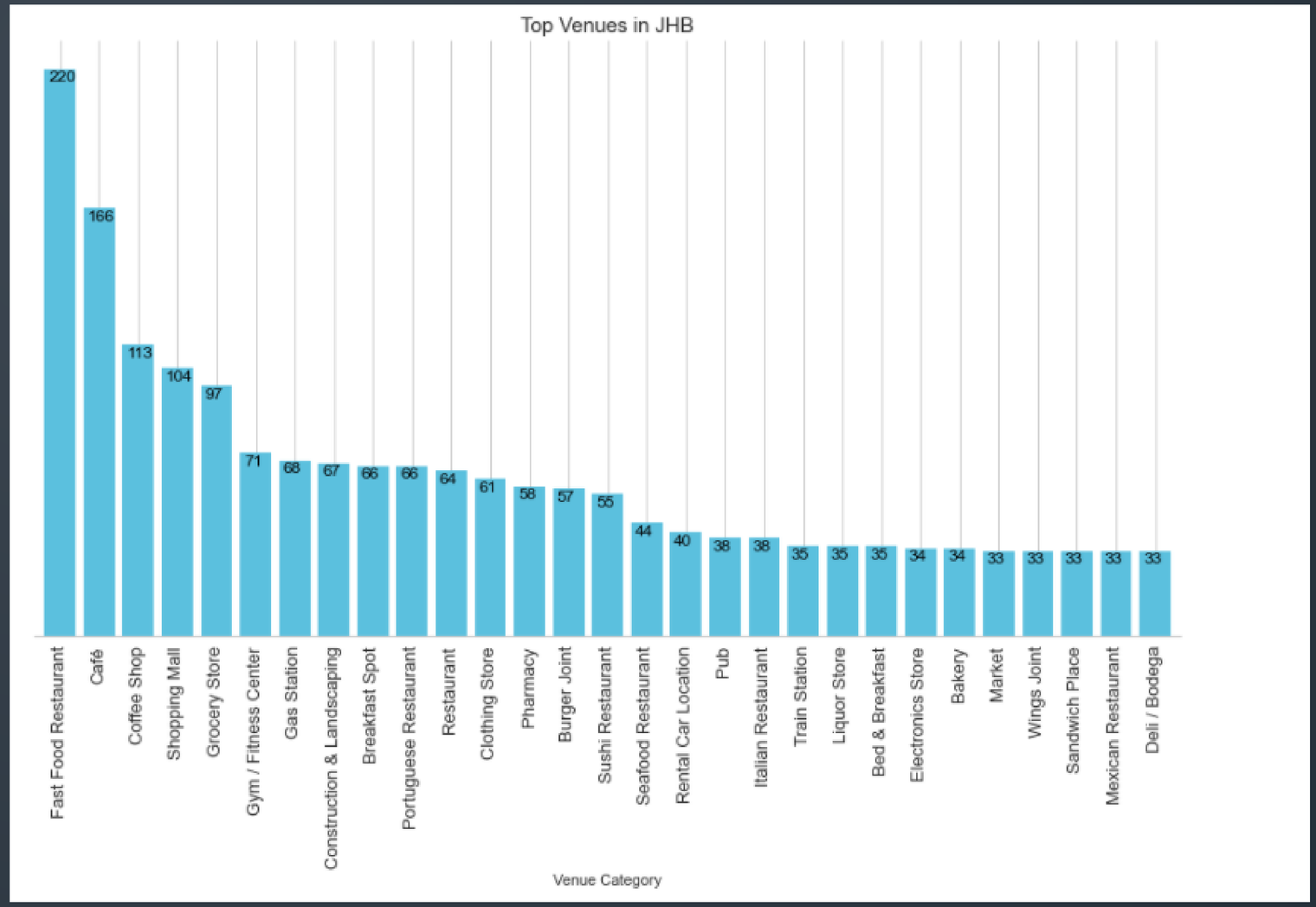
Johannesburg Venue Retrieval:

We retrieved this venue data for all areas in Johannesburg based on the longitude and latitude of each suburb.

Here is an example of the resulting data gathered from the API:

Neighbourhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
JOHANNESBURG	-26.041410	28.017490	Dong Sheng Sushi Bar	-26.043715	28.015403	Sushi Restaurant
JOHANNESBURG	-26.097485	27.938177	Pick n Pay	-26.101022	27.940586	Grocery Store
KEMPTON PARK	-26.106558	28.230853	The Coffee Bean, Arwyp	-26.106579	28.233706	Coffee Shop
ALBERTON	-26.307447	28.089000	Jackson Dam, Alberton	-26.308573	28.091438	Park
JOHANNESBURG	-26.198395	28.086503	Kensington Bowling Club	-26.197044	28.086734	Bar
JOHANNESBURG	-26.041410	28.017490	The Campus Par 3 Classic Golf	-26.040816	28.020950	Golf Course
BENONI	-26.183333	28.316667	Tiger Wheel and Tyre	-26.186702	28.314643	Automotive Shop
JOHANNESBURG	-26.097485	27.938177	Lone Wolf Spur	-26.093348	27.937811	Breakfast Spot
JOHANNESBURG	-26.028779	27.924082	Pick n Pay Family Cosmo City	-26.031014	27.925282	Clothing Store
JOHANNESBURG	-26.041410	28.017490	The Campus Par 3 Classic Golf	-26.040816	28.020950	Golf Course
EDENVALE	-26.117800	28.144581	KFC	-26.120700	28.144000	Fast Food Restaurant
JOHANNESBURG	-26.258625	28.054473	Southern Suburbs Squash Club	-26.260815	28.058353	Athletics & Sports
JOHANNESBURG	-26.041410	28.017490	Woolworths	-26.042498	28.014678	Grocery Store
BENONI	-26.183333	28.316667	LegalWise Benoni	-26.184319	28.316480	Lawyer
EDENVALE	-26.117800	28.144581	Virgin Active	-26.116231	28.145470	Gym
EDENVALE	-26.117800	28.144581	Pick 'n Pay Hypermarket	-26.118292	28.141259	Supermarket
BENONI	-26.183333	28.316667	Woolworths	-26.185365	28.317432	Grocery Store
JOHANNESBURG	-26.076490	27.975095	N1 / Malibongwe Dr	-26.072261	27.973745	Road
BENONI	-26.183333	28.316667	Wimpy	-26.184646	28.315929	Burger Joint
JOHANNESBURG	-26.097485	27.938177	Simply Asia	-26.093407	27.940096	Asian Restaurant

A total of 2489 venues were returned by Foursquare. Of these 2489 venues, 139 venues are unique and a total of 74 individual venue categories were retrieved. Here is a graphical representation of the top venues overall:



Venue data was retrieved for a total of 22 suburbs in Johannesburg, of these 22, we have broken down the total number of venues per suburb and the results are as follows:

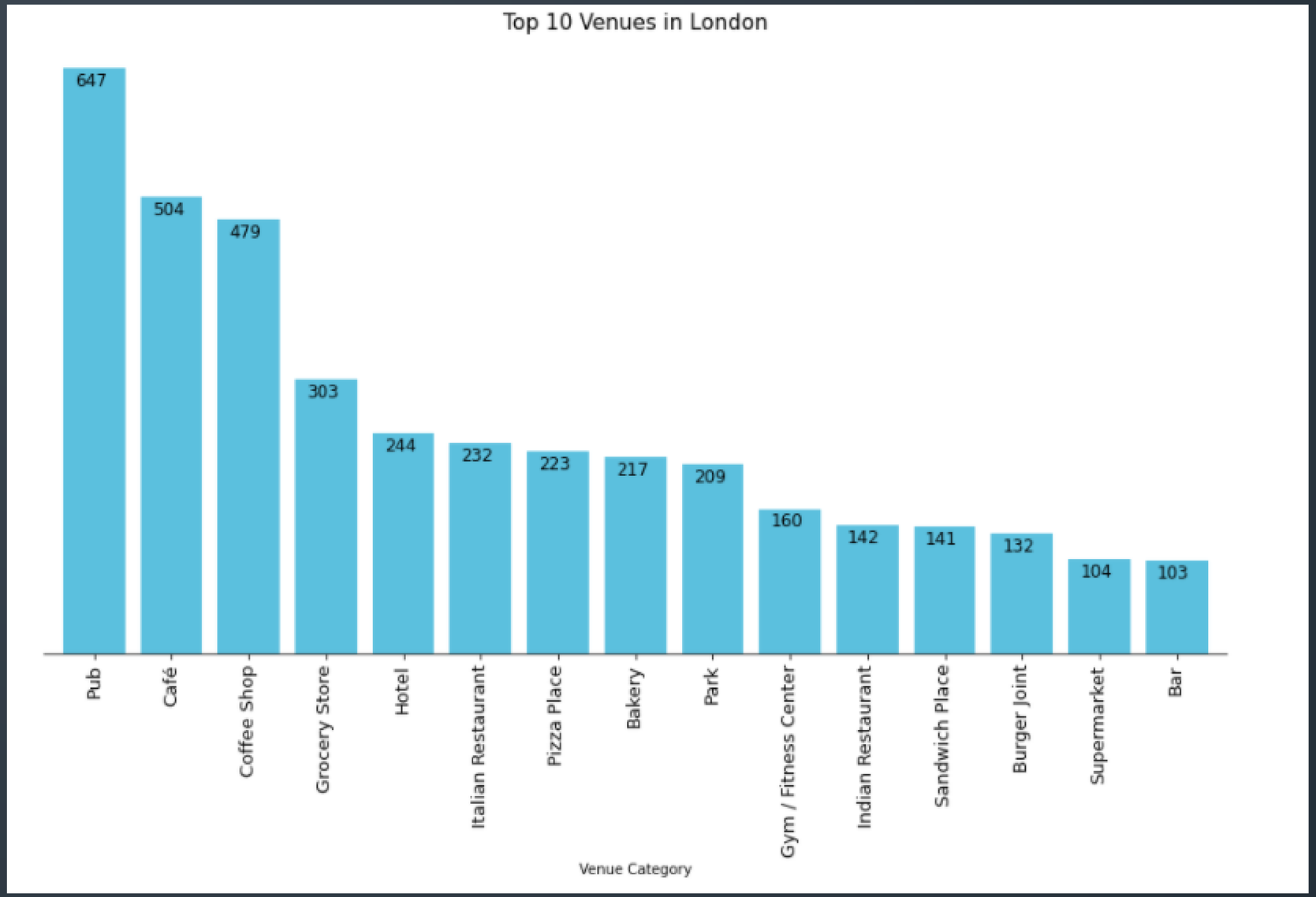
Suburb	Number of Venues
JOHANNESBURG	1221
EDENVALE	390
KEMPTON PARK	280
BENONI	155
BRYANSTON	134
SPRINGS	56
PIMVILLE	40
FLORIDA	40
TSAKANE	32
ALBERTON	27
GERMISTON	26
ELDORADOPARK	24
LENASIA	13
DALPARK	12
TEMBISA	11
MEADOWLANDS	10
DUBE	5
ORLANDO	4
JEPPESTOWN	4
MIDRAND	2
BROMHOF	2
ELANDSFONTEIN	1

London Venue Retrieval:

We retrieved this venue data for all areas in London based on the longitude and latitude of each borough.
Here is an example of the resulting data gathered from the API:

Neighbourhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Kensington and Chelsea	51.4876	-0.169400	Proud Chelsea	51.487905	-0.167680	Art Gallery
Tower Hamlets	51.5085	-0.125700	Dishoom	51.512383	-0.126949	Indian Restaurant
Westminster	51.5156	-0.184580	Park Grand Paddington Court London	51.513552	-0.179752	Hotel
Wandsworth	51.4307	-0.164700	Boom Bap Burgers	51.428994	-0.165840	Burger Joint
Southwark	51.4935	-0.052800	Card Factory	51.495277	-0.046437	Gift Shop
Tower Hamlets	51.5272	-0.055525	La Forchetta	51.527176	-0.057829	Pizza Place
Greenwich	51.4506	0.054280	KFC	51.450549	0.055248	Fast Food Restaurant
Islington	51.5354	-0.094400	The Life Centre Islington	51.538056	-0.099171	Yoga Studio
Haringey, Islington	51.5693	-0.106900	La Porchetta	51.569903	-0.113530	Pizza Place
Tower Hamlets	51.5138	-0.061773	Ibis Budget Hotel	51.517655	-0.064794	Hotel
Brent	51.5490	-0.193189	West End Green	51.552081	-0.192486	Park
Ealing	51.5122	-0.311625	Pasta Remoli	51.513472	-0.306686	Italian Restaurant
Camden	51.5166	-0.098643	Christ Church Greyfriars Garden	51.515670	-0.098760	Garden
Westminster	51.4911	-0.141792	Premier Inn London Victoria	51.493023	-0.142959	Hotel
Lewisham, Bromley	51.4193	-0.066500	Brown & Green	51.418218	-0.072803	Coffee Shop
Islington	51.5262	-0.105518	Old Ivy House	51.525834	-0.099797	Pub
Westminster	51.4911	-0.141792	Al Hayat	51.487837	-0.140363	Grocery Store
Lambeth	51.4812	-0.127600	Bar Estrela	51.479284	-0.123585	Portuguese Restaurant
Bromley	51.4065	-0.056950	Birkbeck London Tramlink Stop	51.403222	-0.056305	Tram Station
Hounslow	51.4927	-0.258000	JOE & THE JUICE	51.492823	-0.255286	Juice Bar

A total of 8411 venues were returned by Foursquare. Of these 8411 venues, 2614 venues are unique and a total of 281 individual venue categories were retrieved. Here is a graphical representation of the top 10 venues overall:



Venue data was retrieved for a total of 44 Boroughs in London, of these 44, we have broken down the total number of venues per borough and the results are as follows:

Borough	Number of Venues
Westminster	1490
Tower Hamlets	739
Islington	670
Camden	627
Hammersmith and Fulham	551
Hackney	447
Lewisham	331
Southwark	315
Greenwich	276
Haringey	267
Kensington and Chelsea	264
Barnet	218
Wandsworth	195
Hounslow	192
City	170
Ealing	161
Merton	152
Brent	145
Lambeth	122
Waltham Forest	109
Islington, City	100
Hounslow, Ealing, Hammersmith and Fulham	96
Croydon	84
Richmond upon Thames	82
Enfield	64
Newham	57
Camden, Islington	56
Redbridge	50
Haringey, Barnet	50
Brent, Camden	47
nsington and Chelsea, Hammersmith and Fulham	47
Haringey, Islington	46
Bromley	42
Lambeth, Southwark	39
Redbridge, Waltham Forest	31
Lambeth, Wandsworth	25
Lewisham, Bromley	17
Barnet, Brent, Camden	9
Brent, Ealing	7
Bexley	6
Brent, Harrow	4
Greenwich, Lewisham	4
Kingston upon Thames	4
Bexley, Greenwich	3

Cluster Analysis:

A cluster analysis, also known as clustering, is the method of grouping a set of objects in a way that objects in the same group(cluster) are most similar to each other than to those objects in other groups.

We will use a cluster analysis because our goal here is to group the data by neighborhood and venue category to determine the most common venues in areas in Johannesburg and London. Essentially, we want to retrieve a collection of data objects(venue types, e.g, bar, parks, restaurants) that are similar to each other and group them into different clusters based on similarity.

Becaue our aim is to divide our venue data into groups based on similarity, we will use K-Mean clustering algorithm.

K-Means Cluster Algorithm

K-mean is one of the most commonly used methods in clustering. K-Means can be defined as:

> *"K-means clustering is a simple unsupervised learning algorithm that is used to solve clustering problems. It follows a simple procedure of classifying a given data set into a number of clusters, defined by the letter "k," which is fixed beforehand."*

*The K-M*ean algorithm will allow us to analyze the different clusters produced by our model and determine which venues are most common in London and Johannesburg.

Before our analysis, we progrommatically prep our data and create two new dataframes from the existing ones.

These new dataframes contain the top 10 most common venues by area in our cities of interest. On the next slide are examples of what our new datasets look like:

Johannesburg Common Venues:

town	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
ALBERTON	Park	BBQ Joint	Lake	Arcade	Wings Joint	Department Store	Dog Run	Electronics Store	Farmers Market	Fried Chicken Joint
BENONI	BBQ Joint	Wings Joint	Concert Hall	Golf Course	Gas Station	Furniture / Home Store	Fruit & Vegetable Store	Frozen Yogurt Shop	Fried Chicken Joint	Fast Food Restaurant
BOKSBURG	BBQ Joint	Wings Joint	Concert Hall	Golf Course	Gas Station	Furniture / Home Store	Fruit & Vegetable Store	Frozen Yogurt Shop	Fried Chicken Joint	Fast Food Restaurant
BRAKPAN	Construction & Landscaping	Grocery Store	Fried Chicken Joint	Concert Hall	Golf Course	Gas Station	Furniture / Home Store	Fruit & Vegetable Store	Frozen Yogurt Shop	Fast Food Restaurant
BROMHOF	Clothing Store	Wings Joint	Concert Hall	Golf Course	Gas Station	Furniture / Home Store	Fruit & Vegetable Store	Frozen Yogurt Shop	Fried Chicken Joint	Fast Food Restaurant

London Common Venues:

Neighbourhood	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
Barnet	Café	Grocery Store	Park	Pub	Indian Restaurant	Bakery	Golf Course	Italian Restaurant	Coffee Shop	Clothing Store
Barnet, Brent, Camden	Chinese Restaurant	Grocery Store	Sporting Goods Shop	Warehouse Store	Supermarket	Arts & Crafts Store	Clothing Store	Hardware Store	Farm	Ethiopian Restaurant
Bexley	Grocery Store	Indian Restaurant	Playground	Fast Food Restaurant	Ethiopian Restaurant	Event Space	Exhibit	Falafel Restaurant	Farm	Farmers Market
Bexley, Greenwich	Grocery Store	Indian Restaurant	Playground	Fast Food Restaurant	Ethiopian Restaurant	Event Space	Exhibit	Falafel Restaurant	Farm	Farmers Market
Brent	Café	Coffee Shop	Pub	Platform	Lighting Store	Spanish Restaurant	Fast Food Restaurant	Brazilian Restaurant	Gastropub	Vietnamese Restaurant

Before building our model, we need to choose the number of clusters we want. We do this with the **elbow method.**

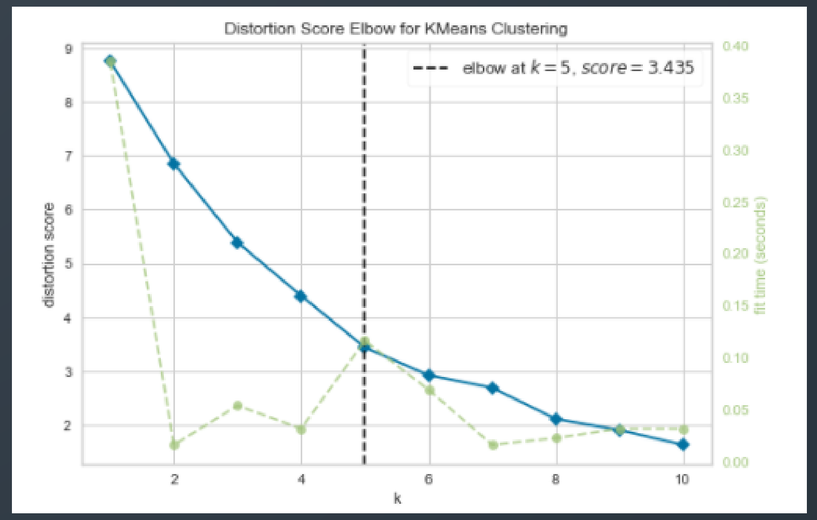
- This is done in order to determine the best k(number of clusters) into which the data may be clustered for our models.

The elbow method:

The elbow method is used as it's one of the most common analytical approaches to test k means models.

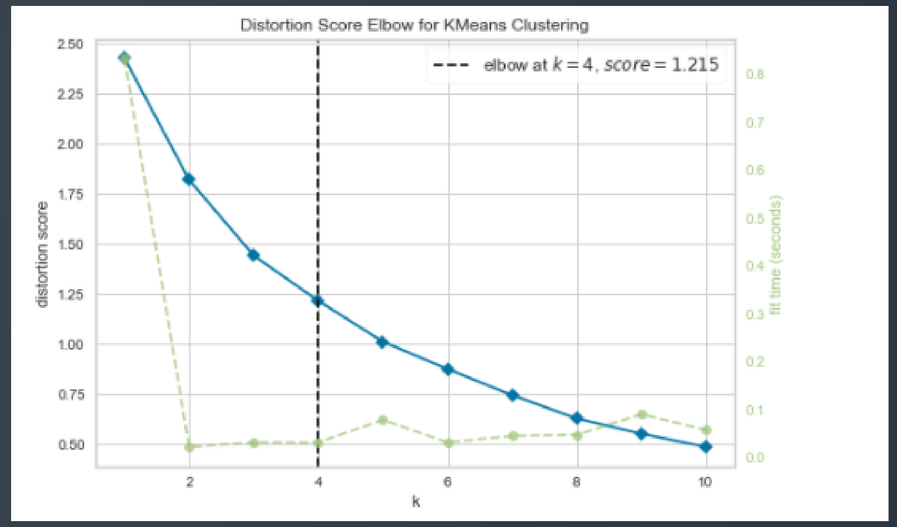
By applying the albow method for our Johannesburg data, we found that using k=5(5 clusters) would be the optimal number for our model.

- Here we can see the optimal k for our Johannesburg data with the following graph:



By applying the albow method for our London data, we found that using k=4(4 clusters) would be the optimal number for our model.

- Here we can see the optimal k for our London data with the following graph:



We now build our model s with the optimal number of clusters for each dataset. We add cluster labels that determine which cluster(k, 1-n) our data wil be grouped into.

On the following two slides, you will see an example of the new datsaets with the resulting cluster labels.

Johannesburg data with cnew "Cluster Labels":

town	Cluster Labels	1st Most Common Venue	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
SBURG	0	Café	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center
MISTON	1	Construction & Landscaping	Construction & Landscaping	Wings Joint	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fast Food Restaurant	Fish Market
EMBISA	2	Clothing Store	Clothing Store	Wings Joint	Fast Food Restaurant	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fish Market
SBURG	0	Café	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center
SBURG	0	Café	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center
LORIDA	4	Rental Car Location	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
SBURG	0	Café	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center
SBURG	0	Café	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center
SAKANE	1	Construction & Landscaping	Construction & Landscaping	Grocery Store	Fried Chicken Joint	Wings Joint	Farmers Market	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store
ENVALE	0	Fast Food Restaurant	Fast Food Restaurant	Café	Coffee Shop	Supermarket	Clothing Store	Shopping Mall	Burger Joint	Convenience Store	Mediterranean Restaurant	Multiplex

London data with new "Cluster Labels":

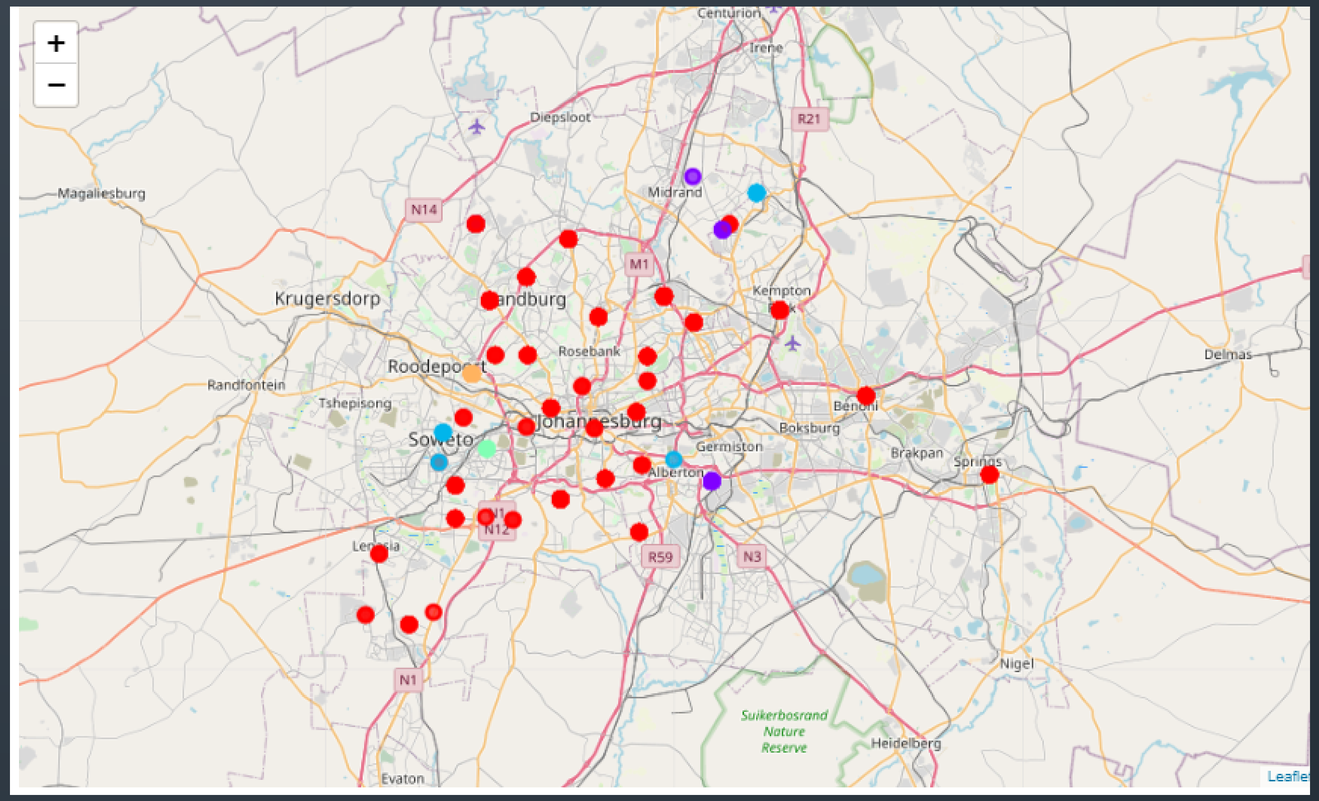
borough	Cluster Labels	1st Most Common Venue	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
Tower Hamlets	0	Pub	Pub	Hotel	Coffee Shop	Indian Restaurant	Pizza Place	Grocery Store	Burger Joint	Park	Sandwich Place	Steakhouse
Merton	0	Café	Café	Clothing Store	Burger Joint	Italian Restaurant	Gym	Restaurant	Sushi Restaurant	Bar	Thai Restaurant	Theater
Croydon	0	Platform	Platform	Coffee Shop	Café	Pub	Italian Restaurant	Pizza Place	Gastropub	Sports Bar	Gym / Fitness Center	Supermarket
Kensington and Chelsea	0	Bakery	Bakery	Italian Restaurant	Hotel	Café	Pub	Ice Cream Shop	Exhibit	Coffee Shop	Burger Joint	English Restaurant
Tower Hamlets	0	Pub	Pub	Hotel	Coffee Shop	Indian Restaurant	Pizza Place	Grocery Store	Burger Joint	Park	Sandwich Place	Steakhouse
Lewisham	0	Grocery Store	Grocery Store	Café	Coffee Shop	Pub	Convenience Store	Clothing Store	Bus Stop	Fish & Chips Shop	Gastropub	Supermarket
Barnet	0	Café	Café	Grocery Store	Park	Pub	Indian Restaurant	Bakery	Golf Course	Italian Restaurant	Coffee Shop	Clothing Store
Hammersmith and Fulham	0	Coffee Shop	Coffee Shop	Pub	Grocery Store	Clothing Store	Hotel	Café	Gym / Fitness Center	Bakery	Burger Joint	Chinese Restaurant
Lewisham	0	Grocery Store	Grocery Store	Café	Coffee Shop	Pub	Convenience Store	Clothing Store	Bus Stop	Fish & Chips Shop	Gastropub	Supermarket
Lewisham	0	Grocery Store	Grocery Store	Café	Coffee Shop	Pub	Convenience Store	Clothing Store	Bus Stop	Fish & Chips Shop	Gastropub	Supermarket

Visualizing Clusters:

Before we examine our clusters, we can visually see where clusters fall on the maps of Johannesburg and London.

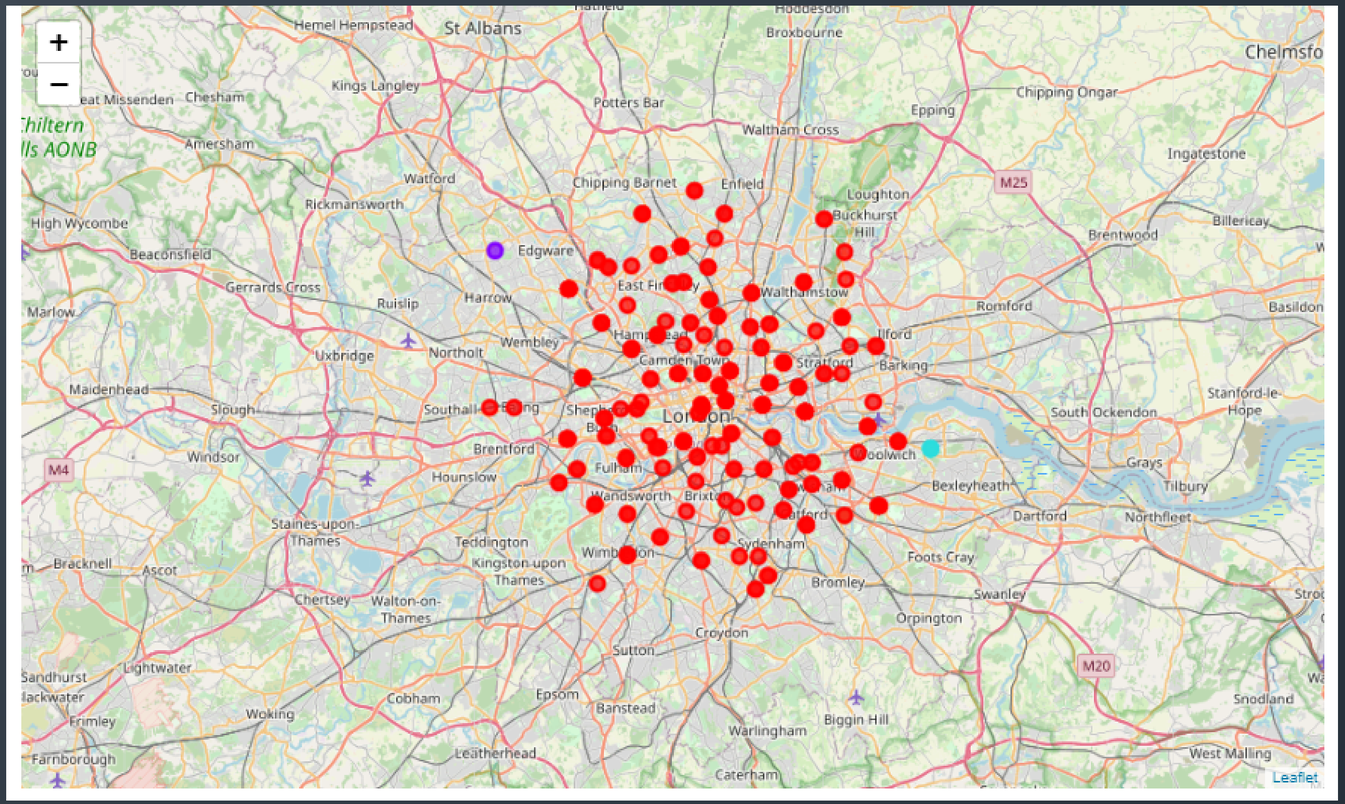
Johannesburg venue cluster:

- Red(cluster 1)
- Purple(cluster 2)
- Blue(cluster 3)
- Cyan(cluster 4)
- Orange(cluster 5)



London venue cluster:

- Red(cluster 1)
- Purple(cluster 2)
- Cyan(cluster 3)



Examining Clusters:

On the next few slides we will see how Johannesburg venue data has been grouped into clusters 1 to 5.

- Cluster 1:

town	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
JEPPESTOWN	0	Bar	Scenic Lookout	Home Service	Hotel	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market
ELDORADOPARK	0	Portuguese Restaurant	Shopping Mall	Concert Hall	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store
LENASIA	0	Indian Restaurant	Pharmacy	Fast Food Restaurant	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market
JOHANNESBURG	0	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center
SPRINGS	0	Shopping Mall	Auto Dealership	Wings Joint	Fast Food Restaurant	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market
JOHANNESBURG	0	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center
JOHANNESBURG	0	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center
JOHANNESBURG	0	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center
JOHANNESBURG	0	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center
PIMVILLE	0	Fast Food Restaurant	Bar	Café	Shopping Mall	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market
JOHANNESBURG	0	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center
BRYANSTON	0	Café	Fast Food Restaurant	Wings Joint	Sandwich Place	Deli / Bodega	Gas Station	Golf Course	Grocery Store	Market	Mexican Restaurant
KEMPTON PARK	0	Fast Food Restaurant	Gym / Fitness Center	Bed & Breakfast	Gas Station	Pub	Coffee Shop	Train Station	Auto Workshop	Cupcake Shop	Grocery Store
JOHANNESBURG	0	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center
JOHANNESBURG	0	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center
BENONI	0	Portuguese Restaurant	Seafood Restaurant	Burger Joint	Breakfast Spot	Grocery Store	Athletics & Sports	Convenience Store	Golf Course	Gas Station	Fruit & Vegetable Store
JOHANNESBURG	0	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center
SPRINGS	0	Shopping Mall	Auto Dealership	Wings Joint	Fast Food Restaurant	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market
EDENVALE	0	Fast Food Restaurant	Café	Coffee Shop	Supermarket	Clothing Store	Shopping Mall	Burger Joint	Convenience Store	Mediterranean Restaurant	Multiplex
JOHANNESBURG	0	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center
JOHANNESBURG	0	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center
JOHANNESBURG	0	Café	Fast Food Restaurant	Grocery Store	Sushi Restaurant	Coffee Shop	Restaurant	Pharmacy	Italian Restaurant	Liquor Store	Gym / Fitness Center

- Cluster 2:

town	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
DALPARK	1	Construction & Landscaping	Grocery Store	Fried Chicken Joint	Wings Joint	Farmers Market	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store
TSAKANE	1	Construction & Landscaping	Grocery Store	Fried Chicken Joint	Wings Joint	Farmers Market	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store
GERMISTON	1	Construction & Landscaping	Wings Joint	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fast Food Restaurant	Fish Market
GERMISTON	1	Construction & Landscaping	Wings Joint	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fast Food Restaurant	Fish Market
GERMISTON	1	Construction & Landscaping	Wings Joint	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fast Food Restaurant	Fish Market
GERMISTON	1	Construction & Landscaping	Wings Joint	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fast Food Restaurant	Fish Market
GERMISTON	1	Construction & Landscaping	Wings Joint	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fast Food Restaurant	Fish Market
TSAKANE	1	Construction & Landscaping	Grocery Store	Fried Chicken Joint	Wings Joint	Farmers Market	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store
GERMISTON	1	Construction & Landscaping	Wings Joint	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fast Food Restaurant	Fish Market
MIDRAND	1	Heliport	Construction & Landscaping	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fast Food Restaurant	Fish Market
GERMISTON	1	Construction & Landscaping	Wings Joint	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fast Food Restaurant	Fish Market
GERMISTON	1	Construction & Landscaping	Wings Joint	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fast Food Restaurant	Fish Market
GERMISTON	1	Construction & Landscaping	Wings Joint	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fast Food Restaurant	Fish Market
GERMISTON	1	Construction & Landscaping	Wings Joint	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fast Food Restaurant	Fish Market
TSAKANE	1	Construction & Landscaping	Grocery Store	Fried Chicken Joint	Wings Joint	Farmers Market	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store
GERMISTON	1	Construction & Landscaping	Wings Joint	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fast Food Restaurant	Fish Market
GERMISTON	1	Construction & Landscaping	Wings Joint	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fast Food Restaurant	Fish Market
TSAKANE	1	Construction & Landscaping	Grocery Store	Fried Chicken Joint	Wings Joint	Farmers Market	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store
GERMISTON	1	Construction & Landscaping	Wings Joint	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fast Food Restaurant	Fish Market
TSAKANE	1	Construction & Landscaping	Grocery Store	Fried Chicken Joint	Wings Joint	Farmers Market	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store

- Cluster 3:

town	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
MEADOWLANDS	2	Clothing Store	Concert Hall	Bar	Music Venue	Home Service	Stadium	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store
MEADOWLANDS	2	Clothing Store	Concert Hall	Bar	Music Venue	Home Service	Stadium	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store
MEADOWLANDS	2	Clothing Store	Concert Hall	Bar	Music Venue	Home Service	Stadium	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store
TEMBISA	2	Clothing Store	Wings Joint	Fast Food Restaurant	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fish Market
TEMBISA	2	Clothing Store	Wings Joint	Fast Food Restaurant	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fish Market
TEMBISA	2	Clothing Store	Wings Joint	Fast Food Restaurant	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fish Market
MEADOWLANDS	2	Clothing Store	Concert Hall	Bar	Music Venue	Home Service	Stadium	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store
TEMBISA	2	Clothing Store	Wings Joint	Fast Food Restaurant	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fish Market
TEMBISA	2	Clothing Store	Wings Joint	Fast Food Restaurant	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fish Market
TEMBISA	2	Clothing Store	Wings Joint	Fast Food Restaurant	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fish Market
MEADOWLANDS	2	Clothing Store	Concert Hall	Bar	Music Venue	Home Service	Stadium	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store
TEMBISA	2	Clothing Store	Wings Joint	Fast Food Restaurant	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fish Market
MEADOWLANDS	2	Clothing Store	Concert Hall	Bar	Music Venue	Home Service	Stadium	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store
TEMBISA	2	Clothing Store	Wings Joint	Fast Food Restaurant	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fish Market
ELANDSFONTEIN	2	Clothing Store	Wings Joint	Fast Food Restaurant	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fish Market
TEMBISA	2	Clothing Store	Wings Joint	Fast Food Restaurant	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fish Market
TEMBISA	2	Clothing Store	Wings Joint	Fast Food Restaurant	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fish Market
TEMBISA	2	Clothing Store	Wings Joint	Fast Food Restaurant	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market	Fish Market

- Cluster 4:

town	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
ORLANDO	3	Soccer Field	Wings Joint	Fast Food Restaurant	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market
ORLANDO	3	Soccer Field	Wings Joint	Fast Food Restaurant	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market
ORLANDO	3	Soccer Field	Wings Joint	Fast Food Restaurant	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market
ORLANDO	3	Soccer Field	Wings Joint	Fast Food Restaurant	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Farmers Market

- Cluster 5:

town	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
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant
FLORIDA	4	Rental Car Location	Wings Joint	Farmers Market	Convenience Store	Cosmetics Shop	Cupcake Shop	Deli / Bodega	Department Store	Electronics Store	Fast Food Restaurant

Over the next few slides we will see how London venue data has been grouped into clusters 1 to 4.

- Cluster 1:

location	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
Aldgate	0	Theater	Hotel	Burger Joint	Plaza	Cocktail Bar	Bakery	Steakhouse	Ice Cream Shop	Coffee Shop	Café
Aldwych	0	Hotel	Coffee Shop	Pub	Italian Restaurant	Café	Sandwich Place	Bakery	Gym / Fitness Center	Theater	Pizza Place
Anerley	0	Fast Food Restaurant	Supermarket	Grocery Store	Pub	Train Station	Tram Station	Gastropub	Convenience Store	Mediterranean Restaurant	Pharmacy
Archway	0	Pub	Café	Coffee Shop	Park	Grocery Store	Italian Restaurant	Cocktail Bar	Pizza Place	Gym / Fitness Center	Bar
Balham	0	Pub	Indian Restaurant	Bar	Supermarket	Portuguese Restaurant	Burger Joint	Grocery Store	Park	Fish & Chips Shop	Coffee Shop
Bankside	0	Pub	Bus Stop	Park	Café	Grocery Store	Coffee Shop	Pizza Place	Pharmacy	Gym / Fitness Center	Beer Bar
Barnes	0	Pub	Grocery Store	Coffee Shop	Pizza Place	Farmers Market	Park	Café	Italian Restaurant	Chinese Restaurant	Gastropub
Barnsbury	0	Pub	Café	Coffee Shop	Park	Grocery Store	Italian Restaurant	Cocktail Bar	Pizza Place	Gym / Fitness Center	Bar
Battersea	0	Pub	Indian Restaurant	Bar	Supermarket	Portuguese Restaurant	Burger Joint	Grocery Store	Park	Fish & Chips Shop	Coffee Shop
Bayswater	0	Hotel	Coffee Shop	Pub	Italian Restaurant	Café	Sandwich Place	Bakery	Gym / Fitness Center	Theater	Pizza Place
Bedford Park	0	Coffee Shop	Café	Pub	Pizza Place	Bakery	Grocery Store	Italian Restaurant	Ice Cream Shop	Burger Joint	Park
Belgravia	0	Hotel	Coffee Shop	Pub	Italian Restaurant	Café	Sandwich Place	Bakery	Gym / Fitness Center	Theater	Pizza Place
Bellingham	0	Grocery Store	Café	Coffee Shop	Pub	Convenience Store	Clothing Store	Bus Stop	Fish & Chips Shop	Gastropub	Supermarket
Belsize Park	0	Café	Coffee Shop	Pub	Zoo Exhibit	Bakery	Italian Restaurant	Pizza Place	Grocery Store	Gym / Fitness Center	Museum
Bermondsey	0	Pub	Bus Stop	Park	Café	Grocery Store	Coffee Shop	Pizza Place	Pharmacy	Gym / Fitness Center	Beer Bar
Bethnal Green	0	Pub	Hotel	Coffee Shop	Indian Restaurant	Pizza Place	Grocery Store	Burger Joint	Park	Sandwich Place	Steakhouse
Blackfriars	0	Theater	Hotel	Burger Joint	Plaza	Cocktail Bar	Bakery	Steakhouse	Ice Cream Shop	Coffee Shop	Café
Blackheath	0	Grocery Store	Café	Coffee Shop	Pub	Convenience Store	Clothing Store	Bus Stop	Fish & Chips Shop	Gastropub	Supermarket
Blackwall	0	Pub	Hotel	Coffee Shop	Indian Restaurant	Pizza Place	Grocery Store	Burger Joint	Park	Sandwich Place	Steakhouse
Bloomsbury	0	Café	Coffee Shop	Pub	Zoo Exhibit	Bakery	Italian Restaurant	Pizza Place	Grocery Store	Gym / Fitness Center	Museum
Bow	0	Pub	Hotel	Coffee Shop	Indian Restaurant	Pizza Place	Grocery Store	Burger Joint	Park	Sandwich Place	Steakhouse
Bowes Park	0	Café	Coffee Shop	Pub	Park	Pizza Place	Grocery Store	Bus Stop	Italian Restaurant	Tapas Restaurant	French Restaurant
Brent Park	0	Café	Coffee Shop	Pub	Platform	Lighting Store	Spanish Restaurant	Fast Food Restaurant	Brazilian Restaurant	Gastropub	Vietnamese Restaurant

- Cluster 2:

location	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
Kenton	1	Steakhouse	Fish & Chips Shop	Pharmacy	Film Studio	Event Space	Exhibit	Falafel Restaurant	Farm	Farmers Market	Fast Food Restaurant

- Cluster 3:

Neighbourhood	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
Bexley, Greenwich	0.1075	2	Grocery Store	Indian Restaurant	Playground	Fast Food Restaurant	Ethiopian Restaurant	Event Space	Exhibit	Falafel Restaurant	Farm	Farmers Market
Bexley	0.1075	2	Grocery Store	Indian Restaurant	Playground	Fast Food Restaurant	Ethiopian Restaurant	Event Space	Exhibit	Falafel Restaurant	Farm	Farmers Market
Bexley	0.1075	2	Grocery Store	Indian Restaurant	Playground	Fast Food Restaurant	Ethiopian Restaurant	Event Space	Exhibit	Falafel Restaurant	Farm	Farmers Market

- Cluster 4:

Neighbourhood	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
Greenwich, Lewisham	0.0209	3	Fast Food Restaurant	Pub	Park	Bus Stop	Zoo Exhibit	Event Space	Exhibit	Falafel Restaurant	Farm	Farmers Market

Results and Discussion.

The results from our K-Means model for Johannesburg venues tells us that the most common venues throughout Johannesburg are eateries, cafes, bars and pubs, liquor stores, coffee shops, grocery stores/convenience stores/department stores, malls, gym and fitness centers, markets such as farmers markets and fish markets, stadiums, concert and music venues, sports fields, and, oddly, a cupcake store.

Through our cluster analysis, we can assume that South Africans like to eat and shop, have a fondness for caffeine, are conscious about fitness and health and enjoy leisure activities such as going to stadiums, sporting events, music events, and enjoy drinking and partying. In terms of restaurants, South Africans seem to prefer specific cuisines such as seafood, sushi, Portuguese, Italian, Indian, and fast food.

The most common venues throughout London are eateries, bars and pubs, coffee shops, grocery stores, parks, bakeries, gym and fitness centers, cafes, farmers market, fish markets, clothing stores and event space. In terms of restaurants, we found the most common to be Italian, fast food, Indian, fish and chips, Asian, steakhouse, Gastropub, burger joint, sandwich place and pizza place.

Moreover, it appears that the most common forms of public transportation are buses, trains and trams.

Conclusion.

If South Africans chose to leave their birth country for a chance at a better life and if they consider the UK to be one of their destinations of choice, they may have comfort knowing that they can eat at restaurants that have similar cuisines in London that are common in Johannesburg such as Indian restaurants, Italian restaurants and fast food restaurants. However, seafood restaurants don't seem to be too popular in London, but, fish markets and fish and chips shops do appear to be quite common. South Africans can also still enjoy going to bar and pubs as pubs are one of the most common venues in London. concerts and music venues appear to be popular among South Africans, however, the only popular venue that may align with these preferences is an event space. It is not clear what these events may be, thus, there is not enough data to make an assumption on whether or not South Africans can enjoy music and concert events if they immigrate to London. Furthermore, coffee shops are popular in both London and Johannesburg and South Africans can still get their caffeine fix. Bakeries also appear to be quite common in London, therefore, South Africans who enjoy cupcakes on the regular will be happy to know that these will be available.

It was noted that South Africans enjoy shopping and it was found that clothing stores, grocery stores and supermarkets are common in London and they can shop for all their needs. Also, since South Africans care about their fitness, gyms and fitness centers appear to be common in London too.

Moreover, It's common for South Africans to rely on public transportation, and London has common modes of transportation such as buses, trains and trams.

Conclusion Cont.

Given our results, can we say that South Africans would feel comfortable making this change and perhaps adapt quicker in this new environment?

We can, cautiously, say maybe as the results from our analysis tells us that there is a big presence of activities/venues/cuisines that align with South African preferences. In London, South Africans can still eat the cuisines they prefer, can drink and party in pubs and bars, can hang out at cafes and coffee shops, and still stay health conscious with gyms and fitness centers around London.

It should be noted that the data we obtained for Johannesburg is a small sample and does not represent the whole population. Also, we are not sure how accurate the venue data is as Foursquare is not that popular in South Africa as opposed to London. Therefore, our results are solely based on assumption given the data and model we built based on retrieved data. These results are not based on facts and may not be 100% accurate. More research will be needed to be done and more data obtained to better fit our data to an analysis model to determine the accuracy of our conclusion.