COURSERA CAPSTONE PROJECT – IBM DATA SCIENCE PROFESSIONAL CERT.

Title: City Insights – Los Angeles and Greater London

Author: Mr. Amit K. Jadhav (BE Computer Engineering, PGDM Operations)

1. Introduction:

Have your ever travelled to any place for a few days and wondered where you want to visit in these few days to make the most of your time there? Or to put it in perspective, have you ever spent hours on finalising the itinerary of your stay at a particular destination on your tour? This is one problem faced by most tourists / travellers when they attempt to travel the places they know little about!

Data Science, like any other branch of science, gives you immense power to bring forth insights and details which would normally be undiscovered given the limited prowess of traditional analytical approaches using varied statistical tools and similar techniques. With this empowerment, I have tried to analyse the neighbourhoods of two very popular and famous cities of Los Angeles, California, US and Greater London, England, UK.

Due to the geographical and cultural vastness of both these cities, it is evident more often than not that people who visit these cities are unclear of the places they would want to visit in the limited time of their stay. Likewise, the people looking to relocate / migrate to these cities are often needing to put in hours of searches and enquiries with various city guides and such websites and social forums to get a hang of which part of the city would be most suited to their current lifestyle. I have taken this problem into consideration and have made a sincere attempt to answer these limitations with the learnings I've received in the IBM Data Science Specialization hosted on Coursera.

The City of Los Angeles reached a historic milestone in 2018, welcoming 50 million visitors annually for the first time ever and accomplishing the destination's ambitious tourism goal.[1] The new record is 1.5 million visitors higher than 2017's total – a 3.1 percent increase – marking the eighth-consecutive year of tourism growth for Los Angeles.[1] As per a report published in 2018, London attracts around 30 million visitors from around the world every year. The number of tourists visiting London has increased from 11 million in 2002 to more than 19 million in 2016.[2]

Both these cities are one of the top few when it comes to international visitors. The stakeholders of this study would be all individuals interested and affected by the added information of the similarities and distinctive features of numerous neighbourhoods in these cities.

1.1. Data:

The data was collected for following aspects of this project:

- List of postal codes for Cities of Los Angeles from [1] and Greater London from [2].
- Respective geographical coordinates in respect of the Latitudes and Longitudes for each of the postal codes in the above list. Los Angeles geo coordinates were extracted from the Geocoder library whereas Latitudes and Longitudes for Greater London were taken from a file downloaded from [2] itself.
- The nearby venues data was fetched from https://developer.foursquare.com using its API.

2. Methodology:

Initially, I considered various cities as candidates to uncover the similarities of their neighbourhoods. Various cities initially considered were:

- Munich and Berlin from Germany
- Manchester and Greater London from the United Kingdom
- Mumbai and Delhi from India
- Chicago and Los Angeles from the United States

- Vienna from Austria

These cities were randomly selected based on my interest in their respective cultures. These cities were further subjected to the following exclusion criteria:

- Cities with geographical area below 1000 sq. Kms were excluded as cities above this area threshold were preferred for analysis. Munich, Berlin, Manchester and Vienna were excluded basis this criterion.
- As Foursquare is the primary software used for Location exploration data of the neighbourhoods of the cities, cities with insufficient foursquare data were excluded. Mumbai and Delhi were excluded basis this condition.
- Chicago was excluded as there were multiple data science projects done using foursquare location data for this city.
- This left us with Greater London and Los Angeles whose geographical areas are around 1500 sq. Kms. and 1200 sq. Kms. respectively.

The postal code system about these two cities was studied and finally the [3] and [4] were decided as the sources of the list of neighbourhoods for these cities.

2.1. Neighbourhoods, Latitude and Longitude Data Extraction:
- The neighbourhood names for Los Angeles were extracted by web scrapping the [3] URL and using beautiful soup package available in python for this purpose. A total of 200 Neighbourhoods were obtained.
- The Latitude and Longitude values were plotted for the Neighbourhood names obtained from above data using the geopy.geocoders package. For a total of 36 neighbourhoods, the latitude and longitude data were either absent or obtained for some undesired location out of the locus of the city. These 36 were excluded from the list. This left us with 164 neighbourhoods of Los Angeles. These were then plotted on the map to observe the geographical distribution using Folium Package.
- The data of Neighbourhoods for Greater London was taken by means of an Exhaustive data sheet downloaded from [2]. Inactive neighbourhoods in the list available at [4] were excluded. For the remaining data with 558 distinct combinations of Postal Code and District, an average was taken for all latitude and longitude values in each combination so as to find a geographical mid-point of each of the 558 'Postal Code – District' combinations. Basis this total of 558 Neighbourhoods were obtained for Greater London. These were plotted on a map of Greater London using Folium Package.
- In those areas of the city where the neighbourhoods were cluttered, the map was later de-cluttered for both Los Angeles and Greater London basis the below mentioned rationale.
- A few neighbourhoods were removed in such a way that a minimum distance of 1/50 of the distance covered by a degree of Latitude (or a degree of Longitude at the equator) i.e. 2.22 km is maintained between any two consecutive neighbourhoods' latitude and longitude values of the centre point. A total of 89 neighbourhoods for Los Angeles and 204 neighbourhoods for Greater London were finalised after the de-cluttering exercise.

2.2. Foursquare API Querying for Location / Nearby Venues data:
- The foursquare API was used to query the nearby venues for each of these neighbourhoods. The nearby venues were selected such that a maximum of 50 venues are observed within a distance of 1 km from the centre of the neighbourhood.[5]
- For 1 neighbourhood each in Los Angeles and Greater London there were no nearby venues returned by Foursquare API. These neighbourhoods were excluded leaving 88 neighbourhoods in Los Angeles and 203 in Greater London for further exploration.
- Followed by this, each venue category in each neighbourhood was assigned a 1 or 0 using one hot encoding technique (1 if venue category is present, 0 if absent). The venues categories were extracted for each venue and frequency of occurrence of each venue category was plotted in descending order of frequency. Top 10 occurring venues for each neighbourhood in both the cities were respectively saved in a Pandas Data frame.

2.3. Clustering similar neighbourhoods using K-Means:
- The optimum number of clusters for each City were calculated using a combination of Elbow method and Silhouette score. The Elbow method detects a presence of an elbow i.e. a sudden fall in the rate of decrease

of squared intra-cluster distance for a given cluster size, whereas, the silhouette score gives a goodness of fit score on a scale of zero to one.

- Based on the scores, 4 number of clusters were finalised for Los Angeles and 7 for Greater London. The k-means algorithm was seeded with "k-means++" initiation method to start with optimum location for the initial cluster centres.
- Upon finishing clustering for both the cities, following was the number of neighbourhoods obtained for each cluster are as listed in figure x.x

3. Results:

The logical soundness of this study can only be demonstrated by showing the actual outcomes of various steps listed in the above methodology. This demonstration is attempted using screenshots of the Jupyter notebook as well as webpages used for the data collection.
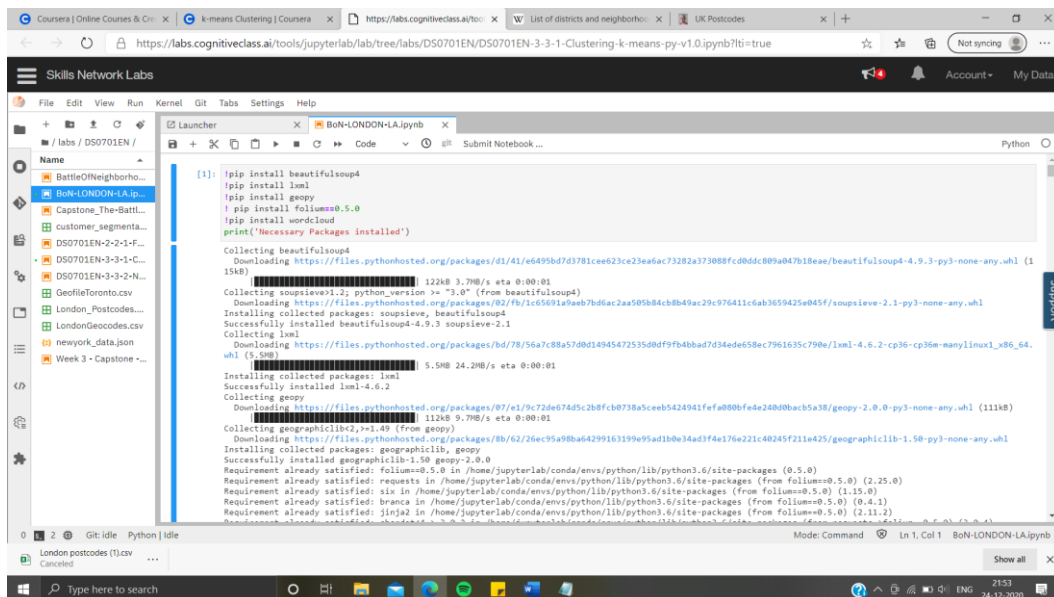
Figure 1 Snapshot of installed packages
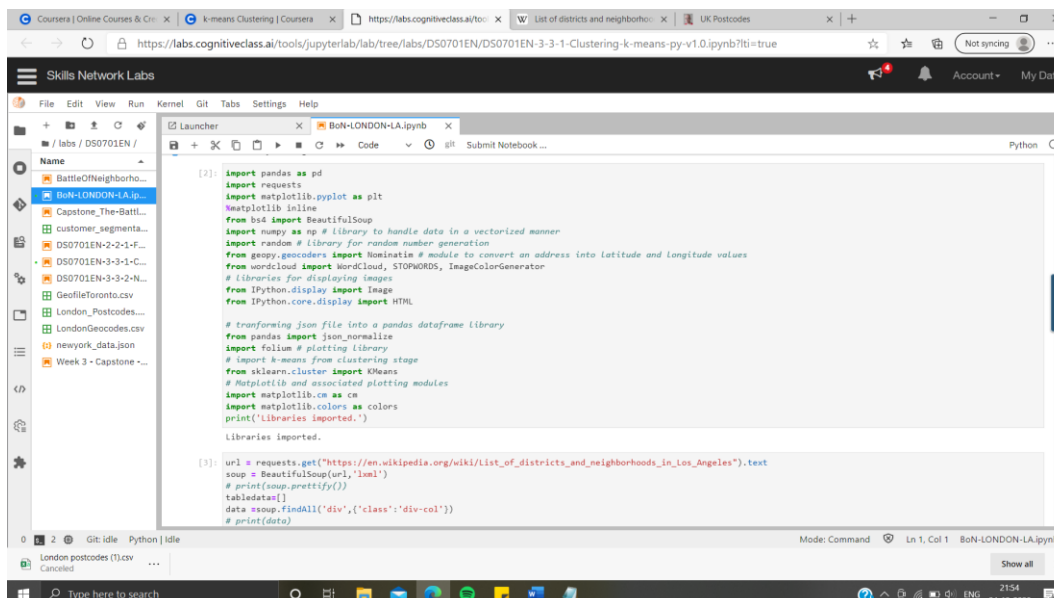
Figure 2 Snapshot of imported libraries
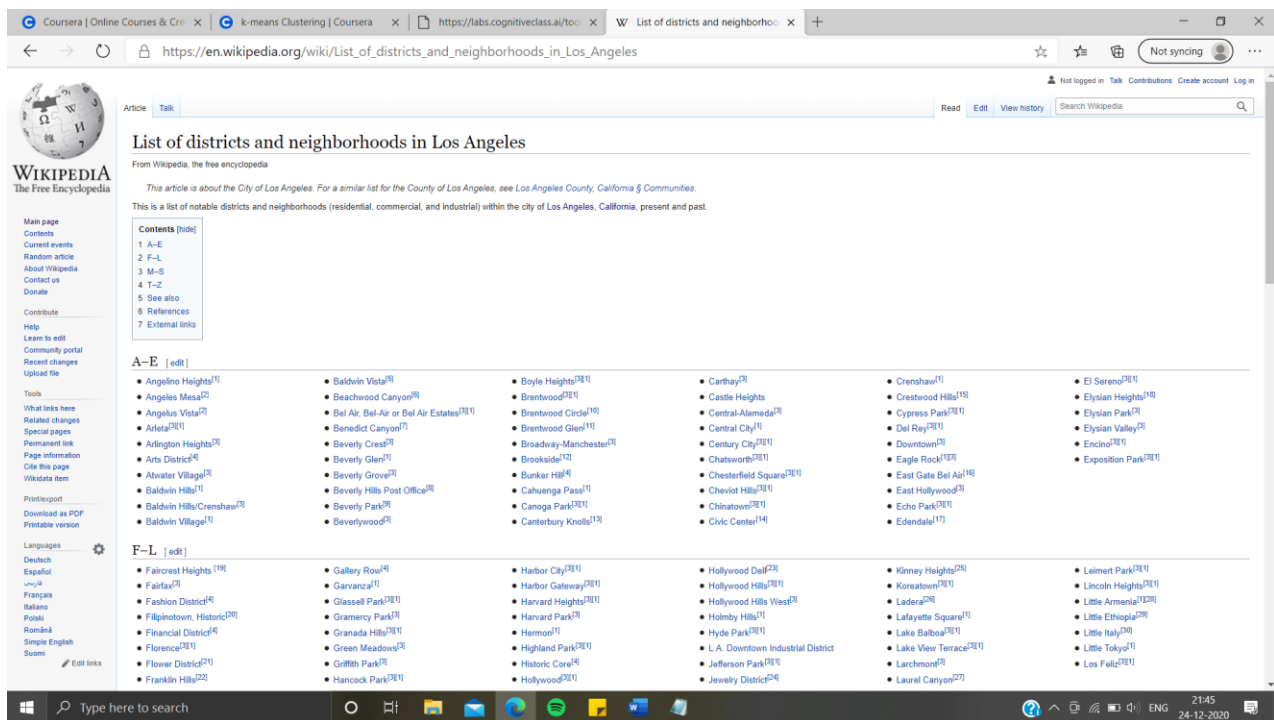
Figure 3 Source: List of neighbourhoods in Los Angeles
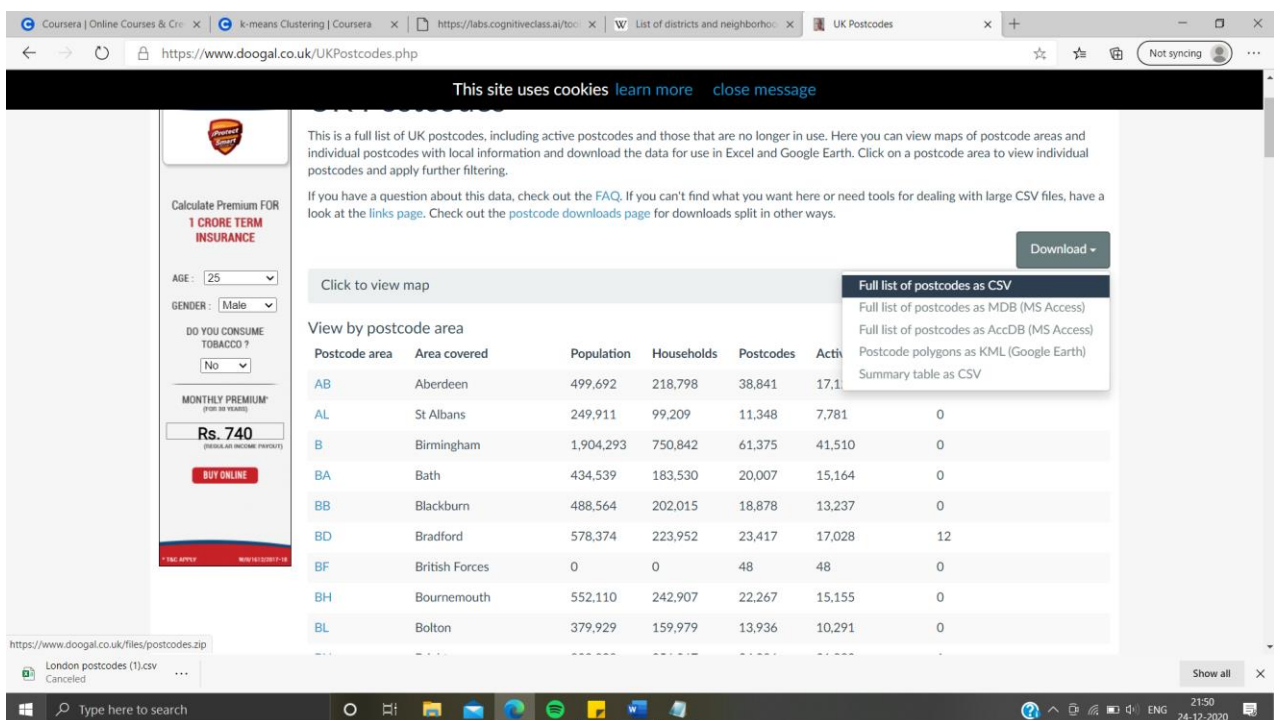
Figure 4 Source: List and geographical coordinates of neighbourhoods in Greater London
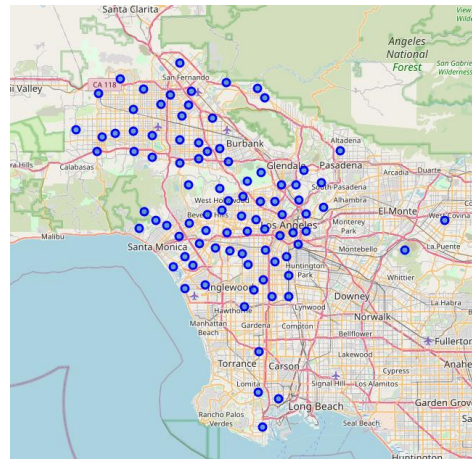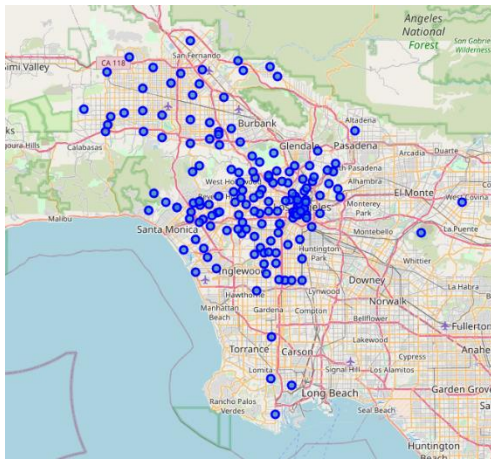
Figure 5 Map of Los Angeles – a. Initial 164 Cluttered Neighbourhoods and b. Final 89 De-cluttered Neighbourhoods
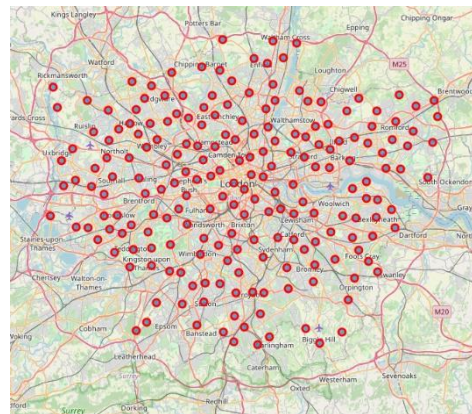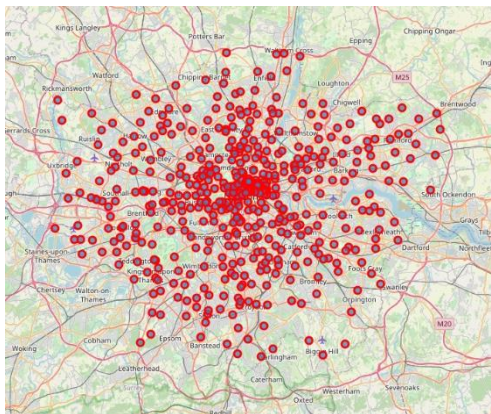
Figure 6 Map of Greater London – a. Initial 558 Cluttered Neighbourhoods and b. Final 204 De-cluttered Neighbourhoods

Figure 7 Sample Venues near first neighbourhoods of Los Angeles and Greater London – Fetched by Foursquare API

```
[27]:  #Storing the nearby venues obtained using a call to the above function in to a new data frame

       dfLAVenues = getNearbyVenues(names=dfLA['Neighborhood'],
                                    latitudes=dfLA['Latitude'],
                                    longitudes=dfLA['Longitude']
                                    )
       dfLAVenues.shape

[27]:  (3135, 7)

[28]:  #Checking the count of venues returned for each neighborhood
       dfLAVenues.groupby('Neighborhood').count()
       # dfLAVenues.shape
```

[28]:

| Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Angeles Mesa, Los Angeles	34	34	34	34	34	34
Angelino Heights, Los Angeles	50	50	50	50	50	50
Arleta, Los Angeles	12	12	12	12	12	12
Arlington Heights, Los Angeles	40	40	40	40	40	40
Arts District, Los Angeles	50	50	50	50	50	50
...	...	...	...	...	...	...
Westchester, Los Angeles	50	50	50	50	50	50
Westwood, Los Angeles	50	50	50	50	50	50
Wilmington, Los Angeles	26	26	26	26	26	26

Figure 8 Foursquare API – All Venues – Los Angeles – Maximum 50 Venues for each neighbourhoods and Maximum Radius of 1000 meters from the centre of the corresponding neighbourhood

```
[55]:  #Storing the nearby venues obtained using a call to the above function in to a new data frame

       dfLondonVenues = getNearbyVenues(names=dfLondon['Neighborhood'],
                                        latitudes=dfLondon['Latitude'],
                                        longitudes=dfLondon['Longitude']
                                        )
       dfLondonVenues.shape

[55]:  (5793, 7)

[56]:  #Checking the count of venues returned for each neighborhood
       dfLondonVenues.groupby('Neighborhood').count()
       # dfLondonVenues.shape
```

[56]:

Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
BR1, Bromley	49	49	49	49	49	49
BR1, Lewisham	13	13	13	13	13	13
BR2, Bromley	7	7	7	7	7	7
BR3, Bromley	50	50	50	50	50	50
BR3, Croydon	20	20	20	20	20	20

Figure 9 Foursquare API – All Venues – Greater London – Maximum 50 Venues for each neighbourhoods and Maximum Radius of 1000 meters from the centre of the corresponding neighbourhood

[91]:

	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	BR1, Bromley	Clothing Store	Coffee Shop	Pub	Bar	Café	Burger Joint	Pizza Place	Gym / Fitness Center	Indian Restaurant	Bookstore
1	BR1, Lewisham	Grocery Store	Park	Gym / Fitness Center	Fried Chicken Joint	Fish & Chips Shop	Clothing Store	Café	Yoga Studio	Flea Market	Financial or Legal Service
2	BR2, Bromley	Soccer Stadium	Gym / Fitness Center	Fruit & Vegetable Store	Park	English Restaurant	Gym	Pub	Forest	Fish Market	Fried Chicken Joint
3	BR3, Bromley	Italian Restaurant	Coffee Shop	Pub	Park	Supermarket	Grocery Store	Café	Fish & Chips Shop	Pizza Place	Indian Restaurant
4	BR3, Croydon	Grocery Store	Fast Food Restaurant	Pub	Supermarket	Pizza Place	Café	Train Station	Pet Store	Coffee Shop	Pharmacy

Figure 10 LA – Most frequent venues – Neighbourhood wise

[32]:

	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	Angeles Mesa, Los Angeles	Playground	Fried Chicken Joint	Chinese Restaurant	Mobile Phone Shop	Pharmacy	Burger Joint	Liquor Store	Restaurant	Hardware Store	Marijuana Dispensary
1	Angelino Heights, Los Angeles	Coffee Shop	Bar	Japanese Restaurant	Mexican Restaurant	Breakfast Spot	Taco Place	American Restaurant	Park	Art Gallery	Pizza Place
2	Arleta, Los Angeles	Taco Place	Home Service	Historic Site	Ice Cream Shop	Video Store	Liquor Store	Convenience Store	Mexican Restaurant	Fast Food Restaurant	Asian Restaurant
3	Arlington Heights, Los Angeles	Korean Restaurant	Mexican Restaurant	Rental Car Location	Italian Restaurant	Latin American Restaurant	Coffee Shop	Nightclub	Food	Donut Shop	Bakery
4	Arts District, Los Angeles	Cocktail Bar	Coffee Shop	Ice Cream Shop	Italian Restaurant	Art Gallery	Bookstore	Brewery	Grocery Store	Vegetarian / Vegan Restaurant	German Restaurant

Figure 11 Greater London – Most frequent venues – Neighbourhood wise

	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	Angelino Heights, Los Angeles	34.070289	-118.254796	1	Coffee Shop	Bar	Japanese Restaurant	Mexican Restaurant	Breakfast Spot	Taco Place	American Restaurant	Park	Art Gallery	Pizza Place
1	Angeles Mesa, Los Angeles	33.991402	-118.319520	0	Playground	Fried Chicken Joint	Chinese Restaurant	Mobile Phone Shop	Pharmacy	Burger Joint	Liquor Store	Restaurant	Hardware Store	Marijuana Dispensary
2	Arleta, Los Angeles	34.241327	-118.432205	0	Taco Place	Home Service	Historic Site	Ice Cream Shop	Video Store	Liquor Store	Convenience Store	Mexican Restaurant	Fast Food Restaurant	Asian Restaurant
3	Arlington Heights, Los Angeles	34.043494	-118.321374	1	Korean Restaurant	Mexican Restaurant	Rental Car Location	Italian Restaurant	Latin American Restaurant	Coffee Shop	Nightclub	Food	Donut Shop	Bakery
4	Arts District, Los Angeles	34.041239	-118.234450	1	Cocktail Bar	Coffee Shop	Ice Cream Shop	Italian Restaurant	Art Gallery	Bookstore	Brewery	Grocery Store	Vegetarian / Vegan Restaurant	German Restaurant
5	Atwater Village, Los Angeles	34.116398	-118.256464	1	Coffee Shop	Pizza Place	Vietnamese Restaurant	Gym	Mediterranean Restaurant	Gym / Fitness Center	Liquor Store	Indie Theater	Gaming Cafe	New American Restaurant
6	Baldwin Hills, Los Angeles	34.017616	-118.381694	1	New American Restaurant	Park	Food Truck	Dog Run	Comedy Club	Big Box Store	Chinese Restaurant	Furniture / Home Store	Scenic Lookout	Garden
7	Baldwin Hills/Crenshaw, Los Angeles	34.012748	-118.354724	0	Clothing Store	Chinese Restaurant	Park	Athletics & Sports	Mobile Phone Shop	Pizza Place	Fast Food Restaurant	Fried Chicken Joint	Supermarket	Sandwich Place
9	Beachwood Canyon, Los Angeles	34.122292	-118.321384	3	Trail	Gym / Fitness Center	Scenic Lookout	Photography Studio	Speakeasy	Cave	Sculpture Garden	Café	Grocery Store	Entertainment Service

Figure 12 Los Angeles – Neighbourhoods with Cluster Labels Assigned

	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	BR1, Bromley	51.408148	0.025313	3	Clothing Store	Coffee Shop	Pub	Bar	Café	Burger Joint	Pizza Place	Gym / Fitness Center	Indian Restaurant	Bookstore
1	BR1, Lewisham	51.426757	0.003879	1	Grocery Store	Park	Gym / Fitness Center	Fried Chicken Joint	Fish & Chips Shop	Clothing Store	Café	Yoga Studio	Flea Market	Financial or Legal Service
2	BR2, Bromley	51.387282	0.022406	1	Soccer Stadium	Gym / Fitness Center	Fruit & Vegetable Store	Park	English Restaurant	Gym	Pub	Forest	Fish Market	Fried Chicken Joint
3	BR3, Bromley	51.404544	-0.030594	3	Italian Restaurant	Coffee Shop	Pub	Park	Supermarket	Grocery Store	Café	Fish & Chips Shop	Pizza Place	Indian Restaurant
4	BR3, Croydon	51.378711	-0.027304	4	Grocery Store	Fast Food Restaurant	Pub	Supermarket	Pizza Place	Café	Train Station	Pet Store	Coffee Shop	Pharmacy
7	BR5, Bromley	51.391709	0.103367	3	Portuguese Restaurant	Train Station	Business Service	Stationery Store	Shopping Plaza	Bookstore	Miscellaneous Shop	Outdoor Supply Store	Gift Shop	Martial Arts School
8	BR6, Bromley	51.365328	0.090194	5	Platform	Pub	Bar	Coffee Shop	Grocery Store	Health & Beauty Service	Train Station	Bakery	Field	Film Studio

Figure 13 Los Angeles – Neighbourhoods with Cluster Labels Assigned
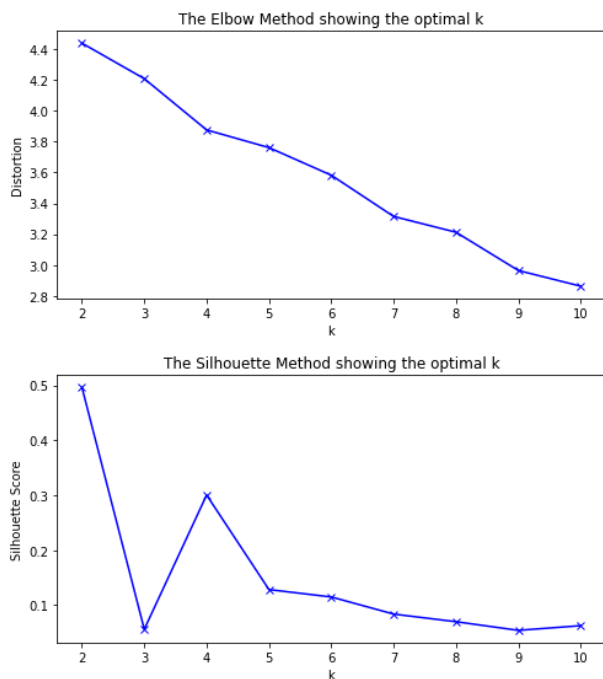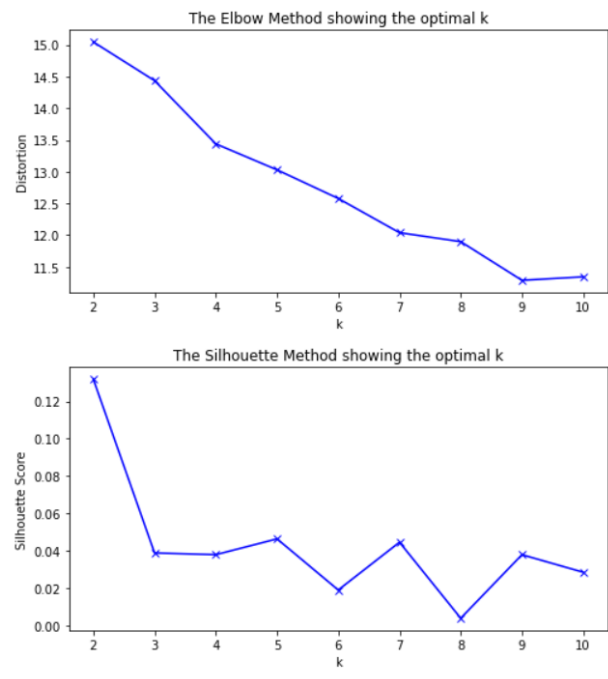

Figure 14.1 LOS ANGELES Figure 14.2 **GREATER LONDON**

Figure 14 K – Means Optimisation for Los Angeles (fig 14.1) and Greater London (fig 14.2) using Elbow method and Silhouette score – 4 and 7 Clusters finalized for Los Angeles and Greater London respectively
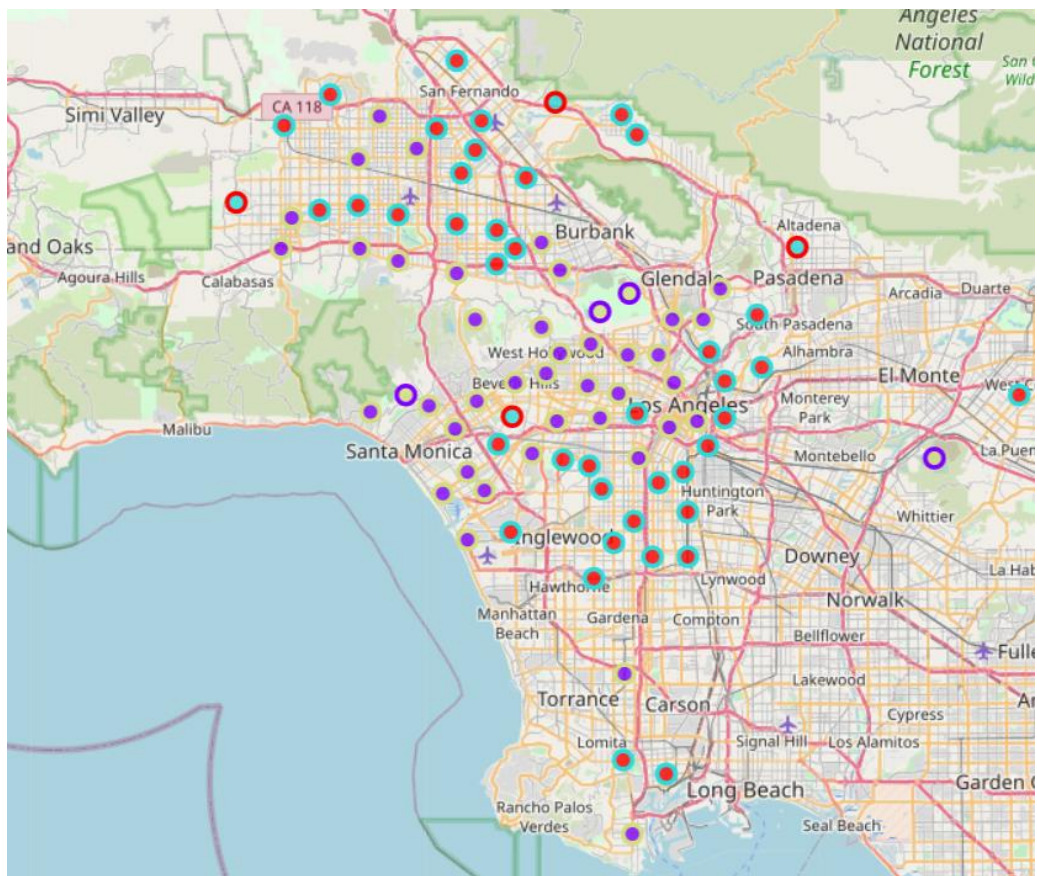
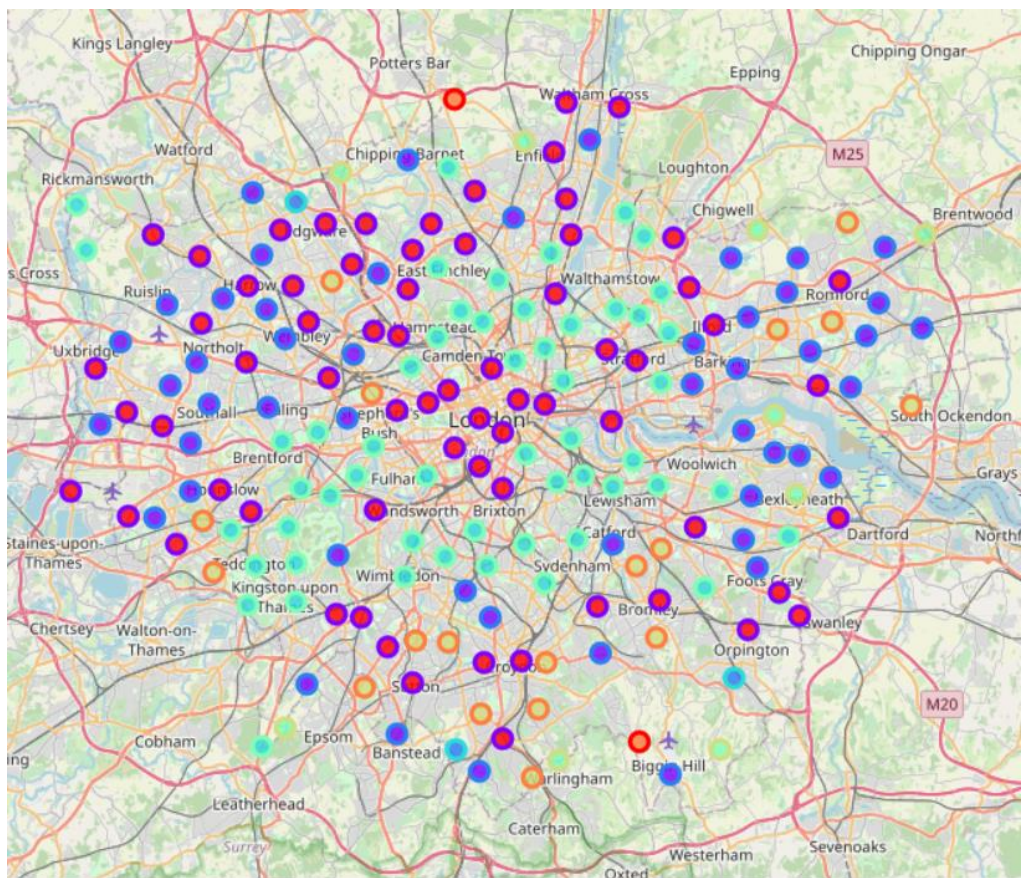*Figure 15 Los Angeles - Clustered Neighbourhood Map*

Figure 16 Greater London – Clustered Neighbourhood Map

Los Angeles – 4 Clusters – Snapshot of actual venue categories

Cluster 1 has 40 neighborhoods. Most occuring 10 types of venues in each of these neighborhoods are listed below.

	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	Angeles Mesa, Los Angeles	Playground	Fried Chicken Joint	Chinese Restaurant	Mobile Phone Shop	Pharmacy	Burger Joint	Liquor Store	Restaurant	Hardware Store	Marijuana Dispensary
1	Arleta, Los Angeles	Taco Place	Home Service	Historic Site	Ice Cream Shop	Video Store	Liquor Store	Convenience Store	Mexican Restaurant	Fast Food Restaurant	Asian Restaurant
2	Baldwin Hills/Crenshaw, Los Angeles	Clothing Store	Chinese Restaurant	Park	Athletics & Sports	Mobile Phone Shop	Pizza Place	Fast Food Restaurant	Fried Chicken Joint	Supermarket	Sandwich Shop
3	Boyle Heights, Los Angeles	Mexican Restaurant	Grocery Store	Fast Food Restaurant	Seafood Restaurant	Bar	Bookstore	Burger Joint	Taco Place	Sandwich Place	Pizza Place
4	Broadway-Manchester, Los Angeles	Fast Food Restaurant	Hotel	Sandwich Place	Gas Station	Donut Shop	Clothing Store	Jewelry Store	Park	Burger Joint	Pizza Place
5	Central-Alameda, Los Angeles	Mexican Restaurant	Fast Food Restaurant	Taco Place	Food	Discount Store	Mobile Phone Shop	Fried Chicken Joint	Seafood Restaurant	Light Rail Station	Kitchen Supply Store
6	Chatsworth, Los Angeles	Mexican Restaurant	Hotel	Gym / Fitness Center	Fast Food Restaurant	Park	Flower Shop	BBQ Joint	Building	Medical Center	Cajun / Creole Restaurant
7	Crenshaw, Los Angeles	Fast Food Restaurant	Coffee Shop	Cosmetics Shop	Pharmacy	Mexican Restaurant	Sandwich Place	Clothing Store	Discount Store	Department Store	Pet Store
8	Cypress Park, Los Angeles	Mexican Restaurant	Coffee Shop	Film Studio	Bakery	Garden	Latin American Restaurant	Lawyer	Liquor Store	Breakfast Spot	Burger Joint
9	El Sereno, Los Angeles	Mexican Restaurant	Fast Food Restaurant	Coffee Shop	Brazilian Restaurant	Restaurant	Bank	Bakery	Liquor Store	Asian Restaurant	Thrift / Vintage Store
10	Elysian Heights, Los Angeles	Fast Food Restaurant	Food Truck	Coffee Shop	Mexican Restaurant	Art Gallery	Gas Station	Restaurant	Sandwich Place	Bank	Nightclub
11	Florence, Los Angeles	Mexican Restaurant	Pharmacy	Pizza Place	Burger Joint	Ice Cream Shop	Grocery Store	Bakery	Juice Bar	Fast Food Restaurant	Shoe Store
12	Garvanza, Los Angeles	Trail	Pizza Place	Burger Joint	Grocery Store	Park	History Museum	Stables	Donut Shop	Taco Place	Bakery
13	Gramercy Park, Los Angeles	Pizza Place	Intersection	Southern / Soul Food Restaurant	Shoe Store	Seafood Restaurant	Fried Chicken Joint	Supermarket	Coffee Shop	Discount Store	Rental Car Location
14	Harbor City, Los Angeles	Fast Food Restaurant	Mexican Restaurant	Pizza Place	Coffee Shop	Convenience Store	Food	Sushi Restaurant	Korean Restaurant	Lake	Food Court
15	Lake Balboa, Los Angeles	Pizza Place	Fast Food Restaurant	Convenience Store	Donut Shop	Mexican Restaurant	Sandwich Place	Tea Room	Spa	Thai Restaurant	Automotive Shop
16	Laurel Canyon, Los Angeles	Pizza Place	Mexican Restaurant	Convenience Store	Fast Food Restaurant	Coffee Shop	Video Store	Grocery Store	Cosmetics Shop	Women's Store	Liquor Store
17	Leimert Park, Los Angeles	Southern / Soul Food Restaurant	Fried Chicken Joint	Cosmetics Shop	Mobile Phone Shop	Sandwich Place	Pizza Place	Grocery Store	Lingerie Store	Convenience Store	Supplement Shop
18	Lincoln Heights, Los Angeles	Mexican Restaurant	Fast Food Restaurant	Convenience Store	Pharmacy	Music Venue	Pizza Place	Restaurant	Park	Video Store	Sandwich Place
19	Mission Hills, Los Angeles	Sandwich Place	Pharmacy	Coffee Shop	Burger Joint	Fast Food Restaurant	Rental Car Location	Italian Restaurant	Frozen Yogurt Shop	Pizza Place	Steakhouse
20	Mount Olympus, Los Angeles	Pharmacy	Cosmetics Shop	Convenience Store	Noodle House	Skating Rink	Japanese Restaurant	Pizza Place	Department Store	Cajun / Creole Restaurant	Seafood Restaurant
21	Pacoima, Los Angeles	Mexican Restaurant	Fast Food Restaurant	Grocery Store	Home Service	Breakfast Spot	Middle Eastern Restaurant	Business Service	Fried Chicken Joint	Fruit & Vegetable Store	Taco Place
22	Palms, Los Angeles	Pizza Place	Mexican Restaurant	Taco Place	Indonesian Restaurant	Burger Joint	Italian Restaurant	Café	Coffee Shop	Convenience Store	Cuban Restaurant
23	Panorama City, Los Angeles	Mexican Restaurant	Fast Food Restaurant	Shoe Store	Mobile Phone Shop	Grocery Store	Pharmacy	Clothing Store	Filipino Restaurant	Video Game Store	Pizza Place
24	Pico-Union, Los Angeles	Korean Restaurant	Mexican Restaurant	Grocery Store	Diner	Food Truck	Coffee Shop	School	Sandwich Place	Spa	South American Restaurant
25	Porter Ranch, Los Angeles	Fast Food Restaurant	Bank	Grocery Store	Golf Course	Coffee Shop	Chinese Restaurant	Big Box Store	Optical Shop	Supermarket	Clothing Store
26	Reseda, Los Angeles	Convenience Store	Mexican Restaurant	Vietnamese Restaurant	Gym	Pharmacy	Fast Food Restaurant	Grocery Store	Fried Chicken Joint	Rental Car Location	Coffee Shop
27	Sherman Village, Los Angeles	Pizza Place	Mexican Restaurant	Garden	Pharmacy	Bar	Ice Cream Shop	Park	Supermarket	Board Shop	Chinese Restaurant
28	South Park, Los Angeles	Park	Fried Chicken Joint	Home Service	Grocery Store	Shopping Mall	Flower Shop	Mexican Restaurant	Pizza Place	Fast Food Restaurant	Café
29	Sunland, Los Angeles	Grocery Store	Fast Food Restaurant	Liquor Store	Pizza Place	Business Service	Café	Chinese Restaurant	Basketball Stadium	Bar	Coffee Shop
30	Sun Valley, Los Angeles	Fast Food Restaurant	Convenience Store	Pizza Place	Grocery Store	Restaurant	Women's Store	Breakfast Spot	Shipping Store	Sandwich Place	Chinese Restaurant
31	Sylmar, Los Angeles	Pizza Place	Home Service	Doctor's Office	Liquor Store	Business Service	Tree	Park	Food Truck	Seafood Restaurant	Skate Park
32	Tujunga, Los Angeles	Gym	Mexican Restaurant	Restaurant	Burger Joint	Sports Bar	Sushi Restaurant	Thai Restaurant	Pizza Place	Hardware Store	Donut Shop
33	Valley Glen, Los Angeles	Pizza Place	Mexican Restaurant	Cosmetics Shop	Pharmacy	Convenience Store	Smoke Shop	Park	Shipping Store	Cajun / Creole Restaurant	Café
34	Van Nuys, Los Angeles	Mexican Restaurant	Convenience Store	Rental Car Location	Fast Food Restaurant	Pizza Place	Burger Joint	Hot Dog Joint	Sandwich Place	Bank	Grocery Store

Figure 17 CLUSTER 1 – LOS ANGELES – TRUNCATED SNAPSHOT – 40 NEIGHBOURHOODS

Cluster 2 has 40 neighborhoods. Most occuring 10 types of venues in each of these neighborhoods are listed below.

	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	Angelino Heights, Los Angeles	Coffee Shop	Bar	Japanese Restaurant	Mexican Restaurant	Breakfast Spot	Taco Place	American Restaurant	Park	Art Gallery	Pizza Place
1	Arlington Heights, Los Angeles	Korean Restaurant	Mexican Restaurant	Rental Car Location	Italian Restaurant	Latin American Restaurant	Coffee Shop	Nightclub	Food	Donut Shop	Bakery
2	Arts District, Los Angeles	Cocktail Bar	Coffee Shop	Ice Cream Shop	Italian Restaurant	Art Gallery	Bookstore	Brewery	Grocery Store	Vegetarian / Vegan Restaurant	German Restaurant
3	Atwater Village, Los Angeles	Coffee Shop	Pizza Place	Vietnamese Restaurant	Gym	Mediterranean Restaurant	Gym / Fitness Center	Liquor Store	Indie Theater	Gaming Cafe	New American Restaurant
4	Baldwin Hills, Los Angeles	New American Restaurant	Park	Food Truck	Dog Run	Comedy Club	Big Box Store	Chinese Restaurant	Furniture / Home Store	Scenic Lookout	Garden
5	Beverly Crest, Los Angeles	Playground	Accessories Store	Food Truck	Arts & Entertainment	Gym / Fitness Center	Women's Store	Farm	Entertainment Service	Ethiopian Restaurant	Event Space
6	Beverly Grove, Los Angeles	Juice Bar	Sushi Restaurant	Café	Mexican Restaurant	Vegetarian / Vegan Restaurant	French Restaurant	Coffee Shop	Poke Place	Hotel	Gym / Fitness Center
7	Beverly Hills Post Office, Los Angeles	Boutique	Hotel	American Restaurant	Italian Restaurant	Dessert Shop	Wine Bar	New American Restaurant	Bar	Sushi Restaurant	Coffee Shop
8	Brentwood, Los Angeles	Italian Restaurant	Coffee Shop	Juice Bar	Salad Place	Sushi Restaurant	Pizza Place	Gym / Fitness Center	Grocery Store	Salon / Barbershop	Burger Joint
9	Canoga Park, Los Angeles	Furniture / Home Store	American Restaurant	Food Court	Pet Store	Toy / Game Store	Cosmetics Shop	Lingerie Store	Hot Dog Joint	Japanese Restaurant	Jewelry Store
10	Del Rey, Los Angeles	Mexican Restaurant	Café	Bakery	Food Truck	American Restaurant	Vegetarian / Vegan Restaurant	Sandwich Place	Yoga Studio	Farmers Market	Sushi Restaurant
11	Eagle Rock, Los Angeles	Mexican Restaurant	American Restaurant	Chinese Restaurant	Burger Joint	Coffee Shop	Thai Restaurant	Bakery	Wine Shop	Ramen Restaurant	Pharmacy
12	East Hollywood, Los Angeles	Pizza Place	Middle Eastern Restaurant	Thai Restaurant	Mexican Restaurant	Taco Place	Asian Restaurant	Coffee Shop	Bakery	Café	Convenience Store
13	Encino, Los Angeles	Yoga Studio	Sushi Restaurant	Coffee Shop	Japanese Restaurant	Grocery Store	American Restaurant	Chinese Restaurant	Frozen Yogurt Shop	Sandwich Place	Cuban Restaurant
14	Exposition Park, Los Angeles	Science Museum	Museum	Sandwich Place	Food Court	History Museum	Coffee Shop	Pizza Place	Mexican Restaurant	Restaurant	Sports Bar
15	Fashion District, Los Angeles	Coffee Shop	Hotel	Bar	Café	Italian Restaurant	Mediterranean Restaurant	American Restaurant	Theater	Movie Theater	Middle Eastern Restaurant
16	Glassell Park, Los Angeles	Café	Food Truck	Bakery	Other Great Outdoors	Pharmacy	Shipping Store	Massage Studio	Big Box Store	Sandwich Place	Taco Place
17	Granada Hills, Los Angeles	Pizza Place	Pharmacy	Middle Eastern Restaurant	Café	Fast Food Restaurant	Chinese Restaurant	Coffee Shop	Bank	Discount Store	Sandwich Place
18	Hancock Park, Los Angeles	Burger Joint	Spa	Supplement Shop	Sake Bar	Financial or Legal Service	Korean Restaurant	Coffee Shop	Martial Arts School	Italian Restaurant	Food Truck
19	Harbor Gateway, Los Angeles	Hotel	Sushi Restaurant	Paper / Office Supplies Store	Intersection	Gym	Pharmacy	Fast Food Restaurant	Café	Sandwich Place	Shoe Store
20	Hollywood, Los Angeles	Lounge	Pizza Place	Nightclub	Coffee Shop	Asian Restaurant	Gym	Salon / Barbershop	Speakeasy	Bar	Hotel
21	Hollywood Hills West, Los Angeles	Home Service	Hotel	Gym / Fitness Center	Other Great Outdoors	Scenic Lookout	Night Market	Grocery Store	Italian Restaurant	Music Venue	Café
22	Koreatown, Los Angeles	Korean Restaurant	Café	Ice Cream Shop	Coffee Shop	Japanese Restaurant	Brazilian Restaurant	Burger Joint	Beer Bar	Speakeasy	South American Restaurant
23	Mar Vista, Los Angeles	Coffee Shop	Mexican Restaurant	Japanese Restaurant	Thai Restaurant	Pizza Place	Grocery Store	Bakery	Café	Pet Store	Fast Food Restaurant
24	Mid-City, Los Angeles	Bakery	Café	Coffee Shop	American Restaurant	Taco Place	Restaurant	Print Shop	New American Restaurant	Furniture / Home Store	Food Truck
25	North Hills, Los Angeles	Golf Course	Coffee Shop	Tree	Bar	Bakery	Grocery Store	Asian Restaurant	Donut Shop	Arts & Crafts Store	Fast Food Restaurant
26	North Hollywood, Los Angeles	Mexican Restaurant	Pizza Place	Gym / Fitness Center	Coffee Shop	Theater	Dance Studio	Yoga Studio	North Indian Restaurant	Dive Bar	Diner
27	Northridge, Los Angeles	Chinese Restaurant	Burger Joint	Coffee Shop	Hot Dog Joint	Sandwich Place	Japanese Restaurant	Thai Restaurant	Mexican Restaurant	Asian Restaurant	Middle Eastern Restaurant
28	Pacific Palisades, Los Angeles	Ice Cream Shop	Italian Restaurant	Sushi Restaurant	Café	Supermarket	American Restaurant	Pharmacy	Bank	Coffee Shop	Gas Station
29	Playa del Rey, Los Angeles	Gym / Fitness Center	Beach	Scenic Lookout	Pizza Place	Park	Speakeasy	Gym	Laundromat	Liquor Store	Massage Studio
30	San Pedro, Los Angeles	Pizza Place	Italian Restaurant	Sandwich Place	Coffee Shop	Bar	Sushi Restaurant	Mexican Restaurant	Burger Joint	Thai Restaurant	Café
31	Sawtelle, Los Angeles	Japanese Restaurant	Sushi Restaurant	Noodle House	Coffee Shop	Ice Cream Shop	Gym / Fitness Center	Supermarket	Grocery Store	Ramen Restaurant	Yoga Studio

Figure 18 CLUSTER 2 – LOS ANGELES – TRUNCATED SNAPSHOT – 40 NEIGHBOURHOOD

Cluster 3 has 4 neighborhoods. Most occuring 10 types of venues in each of these neighborhoods are listed below.

	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	Benedict Canyon, Los Angeles	Lawyer	Park	Playground	Field	Baseball Field	Golf Course	Gym Pool	Tennis Court	Boutique	Fast Food Restaurant
1	Castle Heights, Los Angeles	Playground	Wings Joint	Chinese Restaurant	Park	Recreation Center	Falafel Restaurant	English Restaurant	Entertainment Service	Ethiopian Restaurant	Event Space
2	Lake View Terrace, Los Angeles	Stables	Park	Garden	Food & Drink Shop	Nightlife Spot	Record Shop	Farm	Recreation Center	Women's Store	English Restaurant
3	West Hills, Los Angeles	Park	Home Service	Locksmith	Gym / Fitness Center	Women's Store	Fabric Shop	English Restaurant	Entertainment Service	Ethiopian Restaurant	Event Space

Figure 19 CLUSTER 3 – LOS ANGELES – 4 NEIGHBOURHOODS

Cluster 4 has 4 neighborhoods. Most occuring 10 types of venues in each of these neighborhoods are listed below.

	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	Beachwood Canyon, Los Angeles	Trail	Gym / Fitness Center	Scenic Lookout	Photography Studio	Speakeasy	Cave	Sculpture Garden	Café	Grocery Store	Entertainment Service
1	Griffith Park, Los Angeles	Trail	Scenic Lookout	Park	Historic Site	Playground	Fast Food Restaurant	Mountain	Garden	Theme Park	Tea Room
2	Mandeville Canyon, Los Angeles	Trail	Boutique	Women's Store	Farmers Market	Entertainment Service	Ethiopian Restaurant	Event Space	Eye Doctor	Fabric Shop	Falafel Restaurant
3	Rose Hills, Los Angeles	Pizza Place	Trail	Performing Arts Venue	Women's Store	Falafel Restaurant	English Restaurant	Entertainment Service	Ethiopian Restaurant	Event Space	Eye Doctor

Figure 20 CLUSTER 4 – LOS ANGELES – 4 NEIGHBOURHODOS

Greater London – 7 Clusters – Snapshot of actual venue categories

Cluster 1 has 9 neighborhoods. Most occuring 10 types of venues in each of these neighborhoods are listed below.

	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	CM14, Havering	Noodle House	Hardware Store	Pub	Convenience Store	Hotel	Yoga Studio	Food	Film Studio	Financial or Legal Service	Fish & Chips Shop
1	CR6, Croydon	Gym	Pub	Grocery Store	Construction & Landscaping	Fast Food Restaurant	Rugby Pitch	Yoga Studio	Flower Shop	Film Studio	Financial or Legal Service
2	DA7, Bexley	Pub	Convenience Store	Café	Grocery Store	Pizza Place	Supermarket	Bus Station	Fish & Chips Shop	Train Station	Kebab Restaurant
3	EN2, Enfield	Pub	Grocery Store	Coffee Shop	Pizza Place	Stationery Store	Tennis Court	Auto Workshop	Train Station	Indian Restaurant	Bar
4	IG7, Redbridge	Bakery	Pub	Gym	BBQ Joint	Track	Grocery Store	Auto Garage	Convenience Store	Pharmacy	Skate Park
5	KT18, Kingston upon Thames	Pub	Grocery Store	Lake	Electronics Store	Yoga Studio	Food	Financial or Legal Service	Fish & Chips Shop	Fish Market	Fishing Store
6	SE28, Bexley	Soccer Field	Grocery Store	Pub	Convenience Store	Construction & Landscaping	History Museum	Yoga Studio	Film Studio	Financial or Legal Service	Fish & Chips Shop
7	TN14, Bromley	Performing Arts Venue	Pub	Construction & Landscaping	Campground	Food	Film Studio	Financial or Legal Service	Fish & Chips Shop	Fish Market	Fishing Store
8	WD6, Barnet	Pub	Steakhouse	Supermarket	Campground	Yoga Studio	Food	Film Studio	Financial or Legal Service	Fish & Chips Shop	Fish Market

Figure 21 CLUSTER 1 – GREATER LONDON – 9 NEIGHBOURHOODS

Cluster 2 has 18 neighborhoods. Most occuring 10 types of venues in each of these neighborhoods are listed below.

	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	BR1, Lewisham	Grocery Store	Park	Gym / Fitness Center	Fried Chicken Joint	Fish & Chips Shop	Clothing Store	Café	Yoga Studio	Flea Market	Financial or Legal Service
1	BR2, Bromley	Soccer Stadium	Gym / Fitness Center	Fruit & Vegetable Store	Park	English Restaurant	Gym	Pub	Forest	Fish Market	Fried Chicken Joint
2	CR0, Croydon	Park	Fast Food Restaurant	Grocery Store	Café	Chinese Restaurant	Tram Station	Golf Course	Bakery	Diner	Pub
3	CR2, Croydon	Fish & Chips Shop	Train Station	Park	Yoga Studio	Fast Food Restaurant	Film Studio	Financial or Legal Service	Fish Market	Fishing Store	Flea Market
4	CR3, Croydon	Pub	Park	Train Station	Platform	Soccer Stadium	Massage Studio	Pet Service	Grocery Store	Food & Drink Shop	Financial or Legal Service
5	CR4, Sutton	Park	Train Station	Breakfast Spot	Food Truck	Tram Station	River	Supermarket	Rugby Pitch	Yoga Studio	Fishing Store
6	CR8, Sutton	Gym	Grocery Store	Construction & Landscaping	Park	Yoga Studio	Flower Shop	Financial or Legal Service	Fish & Chips Shop	Fish Market	Fishing Store
7	KT17, Sutton	Grocery Store	Café	Gym / Fitness Center	Indian Restaurant	Train Station	Convenience Store	Park	Flea Market	Film Studio	Financial or Legal Service
8	NW9, Brent	Park	Playground	Indian Restaurant	Fruit & Vegetable Store	Dessert Shop	Greek Restaurant	Bus Stop	Sandwich Place	Café	Hookah Bar
9	RM15, Havering	Clothing Store	Restaurant	Park	Video Store	Yoga Studio	Flower Shop	Field	Film Studio	Financial or Legal Service	Fish & Chips Shop
10	RM4, Havering	Scenic Lookout	Pub	Park	Electronics Store	Tourist Information Center	Yoga Studio	Flea Market	Field	Film Studio	Financial or Legal Service
11	RM7, Barking and Dagenham	Park	Bar	Gas Station	Bus Station	Grocery Store	Farm	Convenience Store	Coffee Shop	Pizza Place	Flower Shop
12	RM8, Barking and Dagenham	Chinese Restaurant	Plaza	Clothing Store	Park	History Museum	Gym / Fitness Center	Forest	Food Truck	Field	Film Studio
13	SE12, Bromley	Park	Platform	Grocery Store	Gym / Fitness Center	Indian Restaurant	Veterinarian	Other Repair Shop	Fish & Chips Shop	Gym	Fried Chicken Joint
14	SM4, Sutton	Park	Fast Food Restaurant	Café	Tennis Court	Train Station	Athletics & Sports	Supermarket	Tour Provider	Indoor Play Area	Food Truck
15	TW12, Richmond upon Thames	Grocery Store	Park	Convenience Store	Train Station	Pizza Place	Seafood Restaurant	Café	Supermarket	Pool	Garden
16	TW4, Richmond upon Thames	Park	Convenience Store	Café	Soccer Field	Yoga Studio	Food	Financial or Legal Service	Fish & Chips Shop	Fish Market	Fishing Store
17	W10, Hammersmith and Fulham	Park	Gym / Fitness Center	Pub	Bakery	Coffee Shop	Furniture / Home Store	Greek Restaurant	Harbor / Marina	Grocery Store	Thai Restaurant

Figure 22 CLUSTER 2 – GREATER LONDON – 18 NEIGHBOURHOODS

Cluster 3 has 2 neighborhoods. Most occuring 10 types of venues in each of these neighborhoods are listed below.

	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	CR6, Bromley	Farm	Construction & Landscaping	Massage Studio	Yoga Studio	Food	Film Studio	Financial or Legal Service	Fish & Chips Shop	Fish Market	Fishing Store
1	EN6, Enfield	Farm	Yoga Studio	Fast Food Restaurant	Film Studio	Financial or Legal Service	Fish & Chips Shop	Fish Market	Fishing Store	Flea Market	Flower Shop

Figure 23 CLUSTER 3 – GREATER LONDON – 2 NEIGHBOURHOODS

Cluster 4 has 67 neighborhoods. Most occuring 10 types of venues in each of these neighborhoods are listed below.

	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	BR1, Bromley	Clothing Store	Coffee Shop	Pub	Bar	Café	Burger Joint	Pizza Place	Gym / Fitness Center	Indian Restaurant	Bookstore
1	BR3, Bromley	Italian Restaurant	Coffee Shop	Pub	Park	Supermarket	Grocery Store	Café	Fish & Chips Shop	Pizza Place	Indian Restaurant
2	BR5, Bromley	Portuguese Restaurant	Train Station	Business Service	Stationery Store	Shopping Plaza	Bookstore	Miscellaneous Shop	Outdoor Supply Store	Gift Shop	Martial Arts School
3	BR8, Bromley	Diner	Fast Food Restaurant	Yoga Studio	Food & Drink Shop	Film Studio	Financial or Legal Service	Fish & Chips Shop	Fish Market	Fishing Store	Flea Market
4	CR0, Sutton	Furniture / Home Store	Clothing Store	Sporting Goods Shop	Supermarket	Hardware Store	Shopping Plaza	Electronics Store	Sandwich Place	Fast Food Restaurant	Bistro
...	...	...	...	...	...	...	...	...	...	...	...
62	UB11, Hillingdon	Sandwich Place	Coffee Shop	Bakery	Airport Terminal	Stadium	Health & Beauty Service	Auto Garage	Soccer Field	Bookstore	Gym / Fitness Center
63	UB6, Ealing	Clothing Store	Sporting Goods Shop	Sandwich Place	Golf Course	Supermarket	Bookstore	Motorcycle Shop	Café	Shopping Plaza	Fast Food Restaurant
64	UB8, Hillingdon	Pub	Bus Stop	Coffee Shop	Gym	History Museum	Golf Course	Sandwich Place	Fish & Chips Shop	Supermarket	Gastropub
65	W11, Kensington and Chelsea	Italian Restaurant	Pub	Bookstore	Bakery	Clothing Store	Cocktail Bar	Breakfast Spot	Bar	Restaurant	Chocolate Shop
66	W2, Westminster	Café	Hotel	Coffee Shop	Garden	Pub	Greek Restaurant	Souvenir Shop	Beer Bar	Malay Restaurant	Gourmet Shop

67 rows × 11 columns

Figure 24 CLUSTER 4 – GREATER LONDON – TRUNCATED SNAPSHOT – 67 NEIGHBOURHOODS

Cluster 5 has 50 neighborhoods. Most occuring 10 types of venues in each of these neighborhoods are listed below.

	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	BR3, Croydon	Grocery Store	Fast Food Restaurant	Pub	Supermarket	Pizza Place	Café	Train Station	Pet Store	Coffee Shop	Pharmacy
1	CR4, Croydon	Fast Food Restaurant	Supermarket	Grocery Store	Bus Stop	Park	Convenience Store	Food	Financial or Legal Service	Fish & Chips Shop	Fish Market
2	CR4, Lambeth	Grocery Store	Supermarket	Breakfast Spot	Fish & Chips Shop	Train Station	Go Kart Track	Pizza Place	Platform	Cosmetics Shop	Bus Stop
3	CR5, Croydon	Supermarket	Platform	Hotel	Grocery Store	Pharmacy	Train Station	Coffee Shop	Martial Arts School	Pub	Food Court
4	DA14, Bexley	Coffee Shop	Grocery Store	Fast Food Restaurant	Pharmacy	Gym / Fitness Center	Pizza Place	Café	Supermarket	Bakery	Burger Joint
5	DA15, Bexley	Grocery Store	Dessert Shop	Pizza Place	Bakery	Beer Bar	Italian Restaurant	Fish & Chips Shop	Hotel	Coffee Shop	Train Station
6	DA16, Bexley	Supermarket	Grocery Store	Pub	Coffee Shop	Fast Food Restaurant	Italian Restaurant	Train Station	Pharmacy	Soccer Stadium	Pizza Place
7	DA17, Bexley	Grocery Store	Eastern European Restaurant	Supermarket	Hardware Store	Trail	Park	Fast Food Restaurant	Food Truck	Food Court	Film Studio
8	DA8, Bexley	Grocery Store	Furniture / Home Store	Café	Chinese Restaurant	Hardware Store	Clothing Store	Train Station	Athletics & Sports	Pizza Place	Supermarket
9	E12, Newham	Indian Restaurant	Grocery Store	Restaurant	Gas Station	Hotel	Train Station	Park	Yoga Studio	Fishing Store	Field
10	E6, Newham	Pub	Fast Food Restaurant	Park	Coffee Shop	Grocery Store	Optical Shop	Soccer Field	Clothing Store	Supermarket	Sandwich Place
11	EN3, Enfield	Grocery Store	Breakfast Spot	Park	Turkish Restaurant	Pub	Kebab Restaurant	Gym / Fitness Center	Clothing Store	Train Station	Pharmacy
12	EN5, Barnet	Coffee Shop	Grocery Store	Pub	Restaurant	Bookstore	Park	Movie Theater	Convenience Store	Pharmacy	Bus Stop
13	HA0, Brent	Indian Restaurant	Grocery Store	Fast Food Restaurant	Pizza Place	Pharmacy	Bakery	Hotel	Clothing Store	Park	Furniture / Home Store
14	HA1, Brent	Indian Restaurant	Golf Course	Gastropub	Bookstore	Athletics & Sports	Coffee Shop	Yoga Studio	Fish & Chips Shop	Fish Market
15	HA2, Harrow	Grocery Store	Indian Restaurant	Coffee Shop	Fast Food Restaurant	Pizza Place	Furniture / Home Store	Pub	Bus Stop	Café	Supermarket
16	HA3, Harrow	Indian Restaurant	Coffee Shop	Pub	Grocery Store	Asian Restaurant	Pharmacy	Chinese Restaurant	Sandwich Place	Park	Fish & Chips Shop
17	HA4, Hillingdon	Grocery Store	Indian Restaurant	Coffee Shop	Fish & Chips Shop	Fast Food Restaurant	Pharmacy	Park	Sandwich Place	Liquor Store	Pizza Place
18	IG11, Barking and Dagenham	Grocery Store	Pub	Fish & Chips Shop	Auto Garage	Coffee Shop	Supermarket	Pharmacy	Pharmacy	Metro Station	Sandwich Place	Pizza Place
19	IG3, Redbridge	Supermarket	Train Station	Fast Food Restaurant	Convenience Store	Coffee Shop	Café	Asian Restaurant	Pub	Irish Pub	Indian Restaurant
20	IG6, Redbridge	Indian Restaurant	Grocery Store	Café	Supermarket	Metro Station	Pub	Golf Course	Pizza Place	Miscellaneous Shop	Farmers Market
21	KT19, Kingston upon Thames	Convenience Store	Breakfast Spot	Grocery Store	Train Station	Platform	Fast Food Restaurant	French Restaurant	Flea Market	Film Studio	Financial or Legal Service
22	N13, Enfield	Grocery Store	Greek Restaurant	Pub	Park	Platform	Supermarket	Thrift / Vintage Store	Bus Stop	Pub	Bar
23	NW10, Brent	Grocery Store	Pub	Convenience Store	Sandwich Place	Fast Food Restaurant	Bakery	Coffee Shop	Pharmacy	Romanian Restaurant	Pizza Place
24	NW4, Barnet	Grocery Store	Coffee Shop	Park	Gym / Fitness Center	Hotel	Pizza Place	Turkish Restaurant	Café	Gastropub	Middle Eastern Restaurant
25	RM10, Barking and Dagenham	Grocery Store	Pub	Metro Station	Platform	Gas Station	Café	Supermarket	Gym	Coffee Shop	Restaurant
26	RM11, Havering	Supermarket	Café	Grocery Store	Coffee Shop	Park	Theater	Fast Food Restaurant	Train Station	Pharmacy	Turkish Restaurant
27	RM12, Havering	Grocery Store	Gym / Fitness Center	Café	Metro Station	Park	Coffee Shop	Pizza Place	Home Service	English Restaurant	Bakery
28	RM13, Havering	Grocery Store	Kebab Restaurant	Chinese Restaurant	Fish & Chips Shop	Pharmacy	Hill	Pizza Place	Historic Site	Fast Food Restaurant	Supermarket
29	RM14, Havering	Coffee Shop	Park	Grocery Store	Platform	Pub	Café	Greek Restaurant	Burger Joint	Supermarket	Fast Food Restaurant
30	RM3, Havering	Fast Food Restaurant	Grocery Store	Supermarket	Pool	Hardware Store	Park	Bakery	Burger Joint	Food Truck	Pharmacy
31	RM5, Barking and Dagenham	Chinese Restaurant	Bowling Alley	Gym	Event Space	Fast Food Restaurant	Indian Restaurant	Flea Market	Film Studio	Financial or Legal Service	Fruit & Vegetable Store
32	RM6, Barking and Dagenham	Grocery Store	Indian Restaurant	Pub	Golf Course	Hotel	Park	Restaurant	Mini Golf	Pharmacy	Supermarket
33	SE2, Bexley	Supermarket	Platform	Campground	Grocery Store	Train Station	Convenience Store	Coffee Shop	Historic Site	Film Studio	Financial or Legal Service
34	SE28, Greenwich	Grocery Store	Supermarket	Fast Food Restaurant	Park	Pet Store	Clothing Store	Pharmacy	Miscellaneous Shop	Pizza Place	Furniture / Home Store

Figure 25 CLUSTER 5 – GREATER LONDON – TRUNCATED SNAPSHOT – 50 NEIGHBOURHOODS

Cluster 6 has 3 neighborhoods. Most occuring 10 types of venues in each of these neighborhoods are listed below.

	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	BR6, Bromley	Platform	Pub	Bar	Coffee Shop	Grocery Store	Health & Beauty Service	Train Station	Bakery	Field	Film Studio
1	CR5, Sutton	Home Service	Construction & Landscaping	Platform	Train Station	Gym / Fitness Center	Fountain	Fried Chicken Joint	Field	Film Studio	Financial or Legal Service
2	HA7, Barnet	Platform	Fast Food Restaurant	Fish & Chips Shop	Grocery Store	Metro Station	Park	Mini Golf	Golf Course	Yoga Studio	Film Studio

Figure 26 CLUSTER 6 – GREATER LONDON – 3 NEIGHBOURHOODS

Cluster 7 has 54 neighborhoods. Most occuring 10 types of venues in each of these neighborhoods are listed below.

	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	BR7, Bromley	Pub	Italian Restaurant	Coffee Shop	Indian Restaurant	Wine Shop	Bar	French Restaurant	Café	Cricket Ground	Cave
1	DA16, Greenwich	English Restaurant	Park	Farm	Pub	Garden Center	Forest	Train Station	Café	Golf Course	Platform
2	DA5, Bexley	Pub	Fast Food Restaurant	Chinese Restaurant	Indian Restaurant	Breakfast Spot	Italian Restaurant	Greek Restaurant	Tennis Court	Train Station	Flea Market
3	E10, Waltham Forest	Café	Grocery Store	Park	Pub	Hotel	Supermarket	Coffee Shop	Fish & Chips Shop	Restaurant	Farm
4	E11, Redbridge	Pub	Grocery Store	Park	Restaurant	English Restaurant	Café	Coffee Shop	Gym / Fitness Center	Bakery	Sushi Restaurant
5	E11, Waltham Forest	Pub	Café	Grocery Store	Gym	Park	Coffee Shop	Thai Restaurant	Fast Food Restaurant	Chinese Restaurant	Restaurant
6	E13, Newham	Pub	Gym / Fitness Center	Convenience Store	Café	Grocery Store	Bus Stop	Bookstore	Rugby Pitch	Hostel	Vietnamese Restaurant
7	E2, Tower Hamlets	Coffee Shop	Pub	Yoga Studio	Park	Bakery	Market	Italian Restaurant	Restaurant	Hotel	Wine Bar
8	E4, Waltham Forest	Pub	Grocery Store	Café	Gym	Gym / Fitness Center	Park	Sandwich Place	Coffee Shop	Pizza Place	English Restaurant
9	E5, Hackney	Pub	Park	Grocery Store	Café	Coffee Shop	Turkish Restaurant	Pizza Place	Vegetarian / Vegan Restaurant	Nature Preserve	Burger Joint
10	E7, Redbridge	Pub	Grocery Store	Market	Bakery	Park	Train Station	Lake	Fast Food Restaurant	Flower Shop
11	E8, Islington	Pub	Café	Restaurant	Coffee Shop	Plaza	Pizza Place	Dumpling Restaurant	Burger Joint	Beer Bar	Market
12	EN4, Barnet	Pub	Train Station	Fried Chicken Joint	Café	Grocery Store	Park	Coffee Shop	Modern European Restaurant	Supermarket	Gym / Fitness Center
13	IG8, Waltham Forest	Pub	Turkish Restaurant	Italian Restaurant	Indian Restaurant	Mediterranean Restaurant	Park	Steakhouse	Cantonese Restaurant	Outdoor Sculpture	Coffee Shop
14	KT1, Kingston upon Thames	Pub	Café	Coffee Shop	Burger Joint	Japanese Restaurant	Sushi Restaurant	Italian Restaurant	Gym / Fitness Center	Supermarket	Rock Club
15	KT2, Richmond upon Thames	Pub	Bakery	Indian Restaurant	Café	Harbor / Marina	Park	Athletics & Sports	Supermarket	Field	Gym / Fitness Center
16	KT22, Kingston upon Thames	Golf Course	Auto Garage	Pub	Athletics & Sports	Food	Film Studio	Financial or Legal Service	Fish & Chips Shop	Fish Market	Fishing Store
17	KT8, Richmond upon Thames	Café	Garden	Pub	Park	Hotel	Fountain	Italian Restaurant	Historic Site	Chinese Restaurant	Tea Room
18	N1, Islington	Pub	Cocktail Bar	Boutique	Mediterranean Restaurant	Burger Joint	Bakery	Theater	Ice Cream Shop	Spanish Restaurant	Park
19	N15, Islington	Pub	Café	Coffee Shop	Italian Restaurant	Pizza Place	Bar	Gastropub	Indian Restaurant	Park	Bakery
20	N17, Haringey	Pub	Supermarket	Café	Grocery Store	Bar	Pizza Place	Gym / Fitness Center	Train Station	Soccer Stadium	Park
21	N2, Barnet	Pub	Grocery Store	Café	Park	Bakery	Coffee Shop	Bus Stop	Platform	Italian Restaurant	Breakfast Spot
22	N4, Hackney	Café	Pub	Pizza Place	Gym / Fitness Center	Turkish Restaurant	Italian Restaurant	Park	Reservoir	Organic Grocery	Sporting Goods Shop
23	N6, Camden	Pub	Café	Coffee Shop	Gastropub	Mediterranean Restaurant	Italian Restaurant	Bakery	Pizza Place	Lake	Food
24	N8, Brent	Pub	Bakery	Thai Restaurant	Middle Eastern Restaurant	Bar	Brazilian Restaurant	Indian Restaurant	Pizza Place	Coffee Shop	Italian Restaurant
25	N8, Haringey	Pub	Café	Coffee Shop	Gym / Fitness Center	Grocery Store	Park	Thai Restaurant	Pizza Place	French Restaurant	Bakery
26	NW3, Camden	Café	Bakery	Pub	Bookstore	Ice Cream Shop	Thai Restaurant	Gastropub	Museum	Movie Theater	Pizza Place
27	SE10, Greenwich	Pub	Park	Garden	History Museum	Historic Site	Trail	Brewery	Turkish Restaurant	Market	French Restaurant
28	SE13, Greenwich	Pub	Café	Hotel	Gym / Fitness Center	Food Truck	Gym	Gastropub	Library	Grocery Store	Coffee Shop
29	SE14, Lewisham	Café	Pub	Coffee Shop	Park	Chinese Restaurant	Convenience Store	Grocery Store	Supermarket	Gastropub	Bus Stop
30	SE15, Southwark	Pub	Italian Restaurant	Art Gallery	Bar	Cocktail Bar	Grocery Store	Indie Movie Theater	Brewery	Community Center	Restaurant
31	SE16, Southwark	Pub	Café	Brewery	Coffee Shop	Breakfast Spot	Vietnamese Restaurant	Park	Gym / Fitness Center	Bar	Pizza Place
32	SE17, Southwark	Pub	Café	Coffee Shop	Sandwich Place	Gym	Park	Italian Restaurant	Food & Drink Shop	Supermarket	Middle Eastern Restaurant
33	SE19, Bromley	Italian Restaurant	Pub	Coffee Shop	Café	Gastropub	Park	RV Park	Thai Restaurant	Latin American Restaurant	Bike Shop
34	SE21, Lambeth	Coffee Shop	Pub	Bakery	Grocery Store	Gift Shop	Gym / Fitness Center	Performing Arts Venue	Thai Restaurant	Park	Supermarket
35	SE23, Lewisham	Pub	Coffee Shop	Café	Grocery Store	Bus Stop	Gym / Fitness Center	Pizza Place	Sandwich Place	Park	Farmers Market

Figure 27 CLUSTER 7 – GREATER LONDON – TRUNCATED SNAPSHOT – 54 NEIGHBOURHOODS

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[119]:  #Listing each cluster neighborhoods details side by side for Inspection eith wordclouds.
        print('LA Cluster 1: '+str(LA_merged_cluster1.shape[0])+' neighborhoods.')
        print('LA Cluster 2: '+str(LA_merged_cluster2.shape[0])+' neighborhoods.')
        print('LA Cluster 3: '+str(LA_merged_cluster3.shape[0])+' neighborhoods.')
        print('LA Cluster 4: '+str(LA_merged_cluster4.shape[0])+' neighborhoods.')
        print('London Cluster 1: '+str(London_merged_cluster1.shape[0])+' neighborhoods.')
        print('London Cluster 2: '+str(London_merged_cluster2.shape[0])+' neighborhoods.')
        print('London Cluster 3: '+str(London_merged_cluster3.shape[0])+' neighborhoods.')
        print('London Cluster 4: '+str(London_merged_cluster4.shape[0])+' neighborhoods.')
        print('London Cluster 5: '+str(London_merged_cluster5.shape[0])+' neighborhoods.')
        print('London Cluster 6: '+str(London_merged_cluster6.shape[0])+' neighborhoods.')
        print('London Cluster 7: '+str(London_merged_cluster7.shape[0])+' neighborhoods.')

        LA Cluster 1: 40 neighborhoods.
        LA Cluster 2: 40 neighborhoods.
        LA Cluster 3: 4 neighborhoods.
        LA Cluster 4: 4 neighborhoods.
        London Cluster 1: 9 neighborhoods.
        London Cluster 2: 18 neighborhoods.
        London Cluster 3: 2 neighborhoods.
        London Cluster 4: 67 neighborhoods.
        London Cluster 5: 50 neighborhoods.
        London Cluster 6: 3 neighborhoods.
        London Cluster 7: 54 neighborhoods.
```

Figure 28 Number of Neighbourhoods per Cluster

In the discussion section following the above results, we will cover more insights into each cluster obtained using the K means clustering algorithm.

4. Discussion:

K Means clustering is clearly one of the powerful techniques of unsupervised learning, given that the clusters were effectively plotted with little or no idea about the meaning of the Venue categories. For optimizing the number of Clusters, rather than using either the elbow method or the silhouette score, it was more profound and clear to use both these scoring techniques in conjunction and observe their results together before arriving at the optimal number of clusters.

The results obtained for various clusters based on the similarity of venue categories, also precise, are painfully hard to visualize and draw meaningful conclusions. To address this, word clouds were plotted for the top venue frequencies in each cluster based on the number of times a particular venue category has featured in the top 10 most occurring venue category in a particular neighbourhood. Word cloud is a simple visualization tool, which assigns more weight in terms of font size to the more frequently occurring words in a piece of Text OR a group of words. The higher number of times any given venue category features in the top 10 categories of numerous neighbourhoods in one cluster, the higher space it assumes in the resulting Word Cloud.

Let us now dive into the individual clusters quickly.

Cluster 1 - Los Angeles: Cluster 1 with 40 Neighbourhoods forms one major portion of LA City with majority of top venues revolving around fast food joints, and grocery/ convenience stores. These are most likely residential neighbourhoods where most local population would be coming by for quick bites and routine shopping.

Cluster 1 - Los Angeles - 40 Neighbourhoods

Cluster 2 - Los Angeles - 40 Neighbourhoods

Cluster 2 - Los Angeles: Cluster 2 also with another 40 Neighbourhoods forms the second major portion of LA City with numerous Cafes, and Continental as well as Oriental fine dine restaurants. These are most likely more corporate neighbourhoods where most local and floating population would be coming by for spending time during office hours.

Cluster 3 - Los Angeles: Cluster 3 is a small cluster with 4 Neighbourhoods and it is likely formed with neighbourhoods surrounding the central LA city area. There is clear majority of Parks, Playgrounds, Event spaces and Courts for various outdoor sports, Recreation Centres, Continental Restaurants & Nightlife spots, Drink shops etc. These are probably the outskirts of the city, which is again reconfirmed in the clustered Map of LA.

Cluster 3 - Los ANgeles - 4 Neighbourhoods

Cluster 4 - Los Angeles - 4 Neighbourhoods

Cluster 4 - Los Angeles: Cluster 4 with 4 remaining Neighbourhoods is that part of LA City where most tourists would likely be interested to visit in daytime. This cluster is filled with multiple distinct genres of places to explore in and around LA city. These include Trails, Event Spaces, Scenic Lookouts, one or more Caves, Historic Sites, a Mountain etc. These are the neighbourhoods surrounded by Nature and must be most likely places of high demand for Real Estate. A further detailed study to explore Real Estate data into these neighbourhoods would be slightly an advanced scope.

Cluster 1 - Greater London - 9 Neighbourhoods

Cluster 2 - Greater London - 18 Neighbourhoods

Cluster 1 - Greater London: Cluster 1 has 9 Neighbourhoods all of which are distinctly located in the peripheral districts of Greater London. This cluster has a concentration of a mix of routine shopping and essentials stores, maintenance stores as well as a well complemented display of Night life support depicted by numerous Pubs in the cluster. There are also places of outdoor activities and recreation.

Cluster 2 - Greater London: Cluster 2 with 18 Neighbourhoods is also comprised of Neighbourhoods located in peripheral districts of Greater London. One point of distinction evident at these neighbourhoods from those in cluster 1 is the majority of Parks above all else. Also abundant are the Grocery Stores, Fitness Centres and Gyms, Fish and Chips Shops. Restaurants of Worldwide cuisines and sports spaces are comparatively lower in this cluster. This could possibly be residential zones in Greater London.

Cluster 3 - Greater London: Cluster 3 with only 2 Neighbourhoods is probably the least city like cluster with both these neighbourhoods lying far from both the geographical boundaries and the semantical definition of a City. These 2 neighbourhoods majorly have Agricultural Farms, Film Studios, Yoga Studios, Massage studios and Seafood/Chips shops. One of the two neighbourhoods has an Airport quite nearby - an observation that was worth noting for some frequent visiting travellers.

Cluster 3 - Greater London - 2 Neighbourhoods

Cluster 4 - Greater London - 67 Neighbourhoods

Cluster 4 - Greater London: Cluster 4 with the highest number of 67 Neighbourhoods, is the closest cluster bearing resemblance of a global city, with the neighbourhoods likely in the central parts of various district counties in Greater London. This cluster's neighbourhoods are abundant in Night life with numerous PUBs, Cafes, Hotels, Clothing Stores and other shopping points.

Cluster 5 - Greater London: Cluster 5 with 50 Neighbourhoods most resembles a residential cluster, with highly populated Grocery stores, Super Markets, Other Essentials, Convenience stores, Oriental restaurants etc. Although with a high number of neighbourhoods, this cluster has geographical spread only in the peripheral districts again!

Cluster 5 - Greater London - 50 Neighbourhoods

Cluster 6 - Greater London - 3 Neighbourhoods

Cluster 6 - Greater London: Cluster 6 has 3 Neighbourhoods all located in outskirts of Greater London. Given the abundance of Train stations, Film Studios and construction sites, this is likely a cluster comprising of locations undergoing recent urbanization which could be sparsely populated given the low number of convenience stores and fast foods as well as Fine Dine places here.

Cluster 7 - Greater London - 54 Neighbourhoods

Cluster 7 - Greater London: Cluster 7, our last cluster of this study, has 53 Neighbourhoods. The neighbourhoods are mostly dispersed around the central part of Greater London with a principal spread around east west direction. These neighbourhoods have high abundance of Cafes, PUBs, Parks and Food places of worldwide cuisine making it ideal for city life lovers to get the flavour of Greater London.

5. Conclusion:

It can be distinctively noted that city of LA has a good geographical balance of residential and Corporate neighbourhoods (our clusters 1 and 2), evenly spread in the two different centres forming the heart of the City.

One observation worth jotting down about Greater London is that, unlike Los Angeles, it has an extensive network of Train Stations and Soccer fields which are deep rooted in the entire country's culture if not limited to Greater London itself. For an individual looking to relocate from one of these cities to the other, this study project would serve as a rough time saving guide as to what to expect in various parts of the cities. We can relate Cluster 1 of LA with Cluster 5 of Greater London. Also, some similarity can be seen between cluster 2 of LA and clusters 4 and 7 of Greater London. When it comes to the neighbourhoods on the outskirts of each of these cities, LA is more likely a preferred destination for tourists with historical interests.

It is fascinating how these simple analytical tools of Data Science gave us such profound insights without having visited the actual geographies and with minimal epidemiological / monetary efforts!

– To the bright future of the world of Data Science

6. References:

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