



# IBM-Coursera

## Applied Data Science Assignment

### The Battle of Neighborhoods

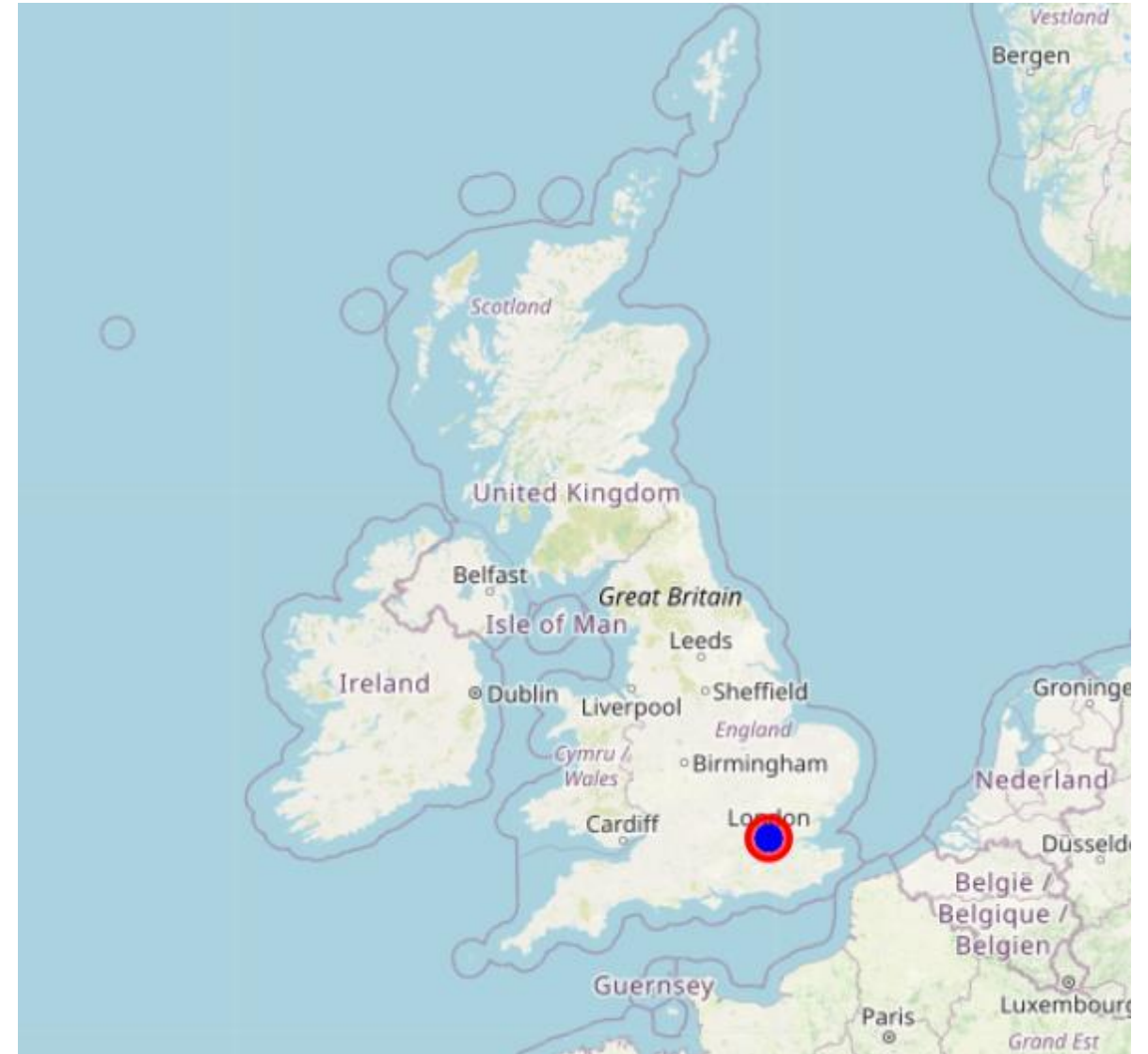
June, 2020



# Introduction

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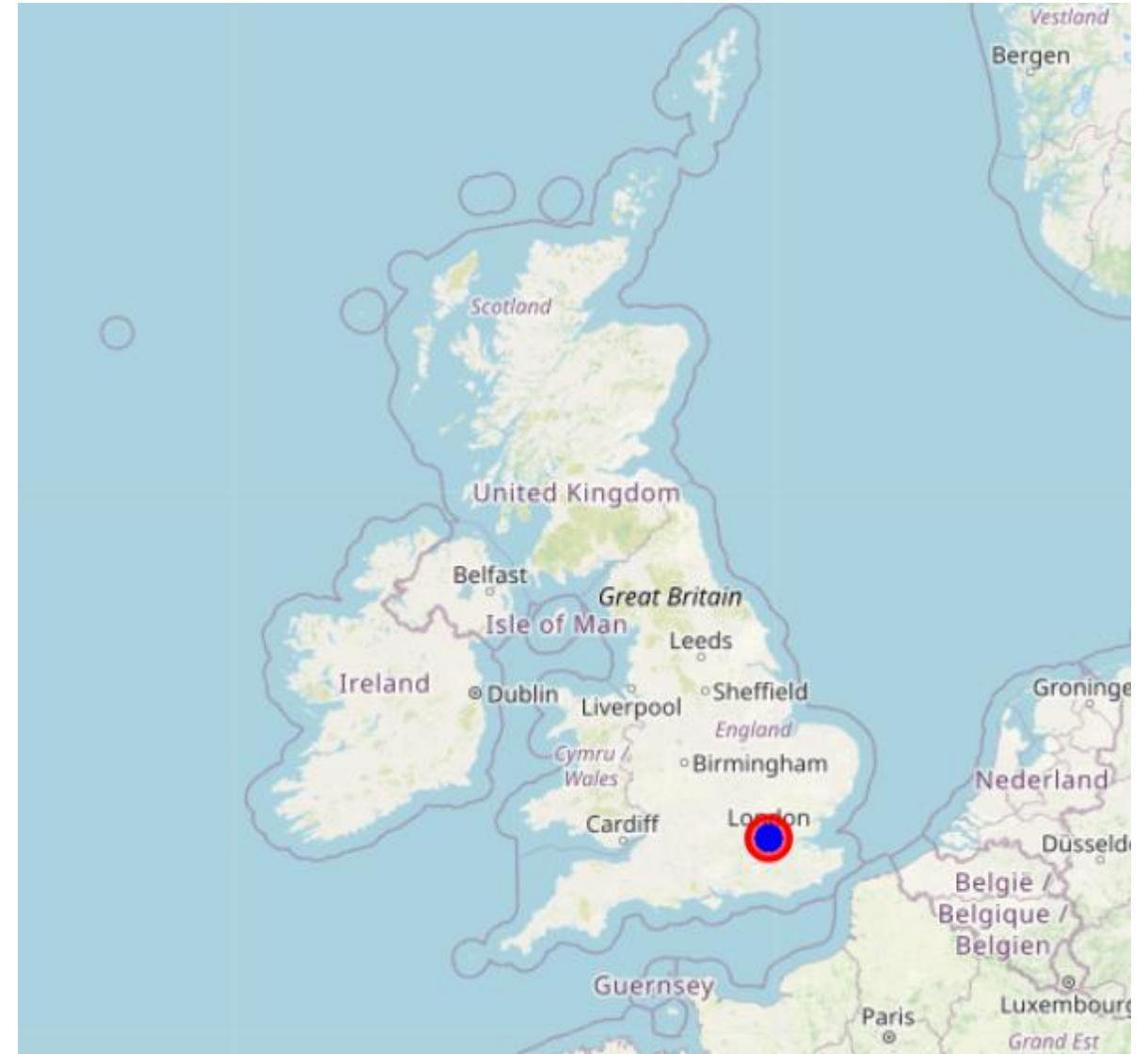
- ❑ London is the **capital** and **largest city** of **England** and the **United Kingdom**. London has been a major settlement for two millennia.
- ❑ London is considered to be one of the world's most important **global** cities and has been called the world's most powerful, most desirable, most influential, most visited, most expensive, sustainable, most investment-friendly, and most-popular-for-work city.
- ❑ London also has largest **financial** institutions and is also home to **top-ranked** universities in the world. ([Wiki](#))



# Problem Description

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- ❑ London has always been a **dream** city for me personally to move and live there.
- ❑ To move to such a vibrant city, one of the main concerns is to find good **affordable** accommodation in a **safe** neighborhood.
- ❑ Therefore in this project, I intend to explore London neighborhoods and find the best the neighborhood to move in.
- ❑ Through this project, I would like to get to know the safest borough (less crime rate as one of main factor) and its neighborhoods venues.
- ❑ This project could potentially help other people who have similar interests to move to London and live there.

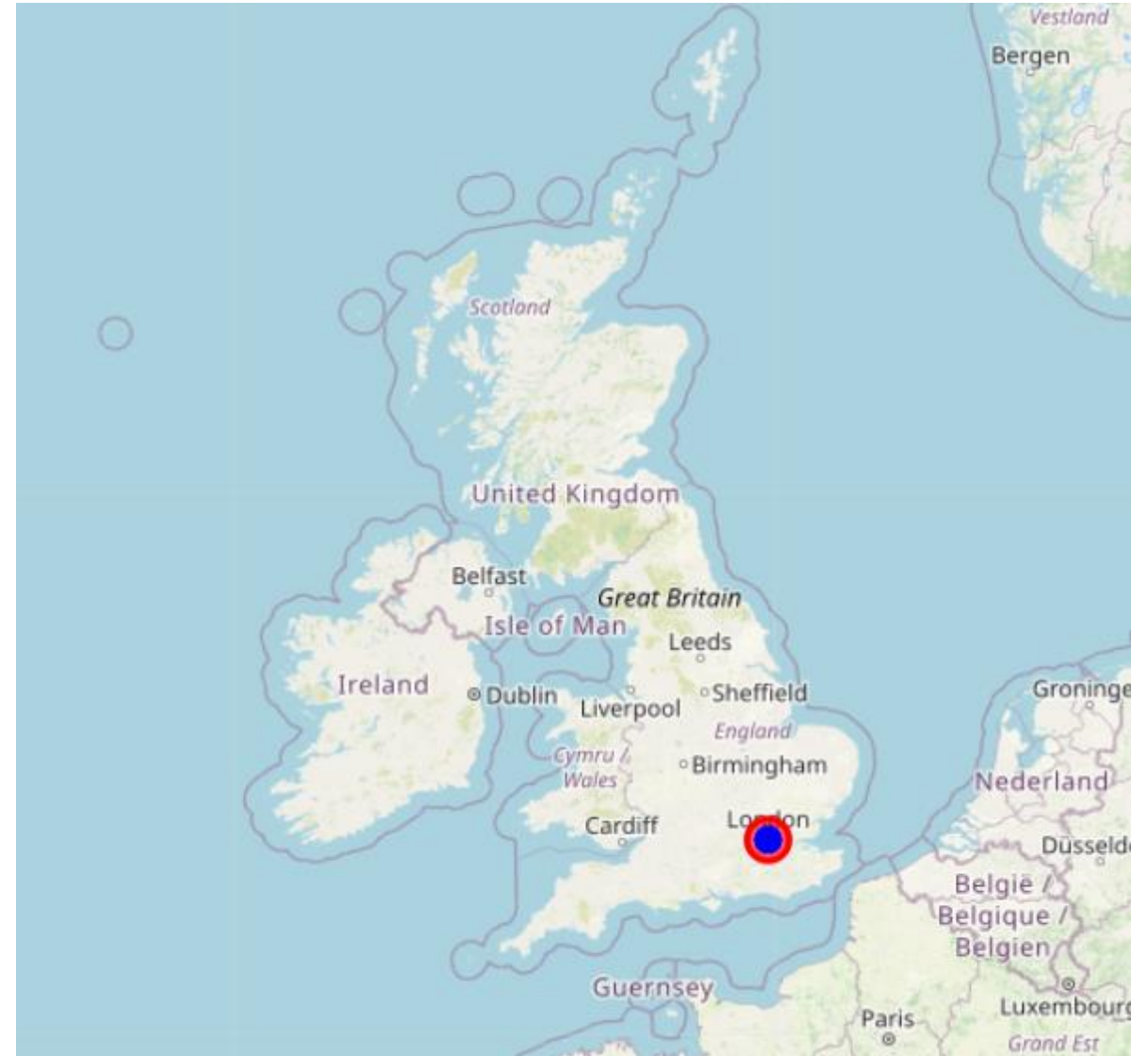


# Data Description

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To get the desired results, following data sources will be used.

- London Recorded Crime ([Crime Data](#))(Last 24 months data is considered for evaluation)
- List of London Boroughs ([List](#))
- Foursquare APIs are used too explore neighborhoods and target different venues according to the presence of needed facilities.
- The data is stored in the data frame and used for visualization.



# Analyzing Data – Crime Data

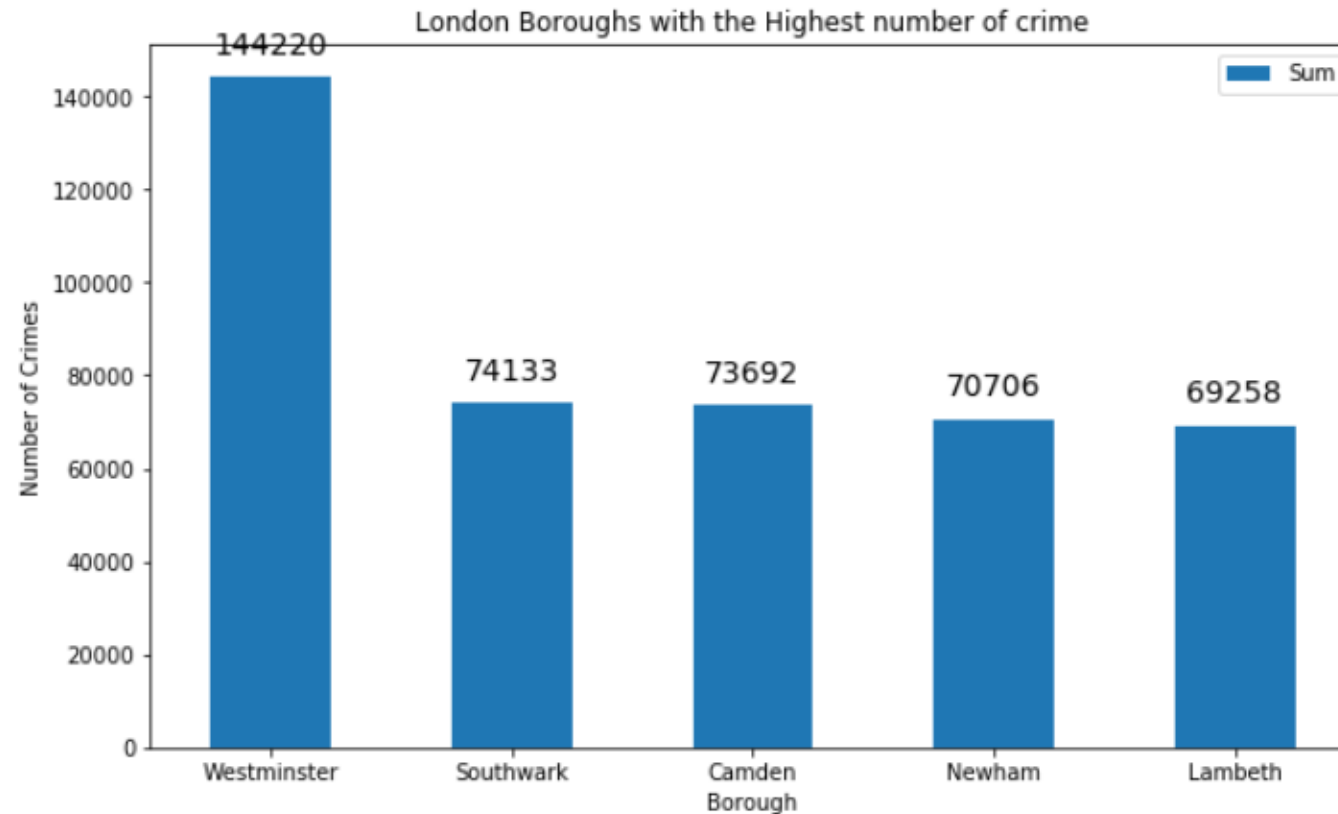
# London Crime Data

- Data from last 24 months
- Data Size: (1566, 27)

	MajorText	MinorText	LookUp_BoroughName	201806	201807	201808	201809	201810	201811	201812	201901	201902	201903	201904	201905	201906	201907	201908
0	Arson and Criminal Damage	Arson	Barking and Dagenham	12	6	5	3	8	5	1	5	2	5	5	11	3	5	3
1	Arson and Criminal Damage	Criminal Damage	Barking and Dagenham	123	127	101	107	132	105	88	97	127	138	130	140	113	134	118
2	Burglary	Burglary - Business and Community	Barking and Dagenham	33	30	18	33	32	39	33	45	24	29	27	21	27	31	35
3	Burglary	Burglary - Residential	Barking and Dagenham	77	94	84	99	94	106	164	114	107	99	96	114	96	71	67
4	Drug Offences	Drug Trafficking	Barking and Dagenham	6	8	7	10	7	7	4	5	2	6	5	9	6	11	7
5	Drug Offences	Possession of Drugs	Barking and Dagenham	69	77	70	72	64	75	69	79	74	117	104	86	100	92	74
6	Miscellaneous Crimes Against Society	Bail Offences	Barking and Dagenham	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Miscellaneous Crimes Against Society	Bigamy	Barking and Dagenham	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

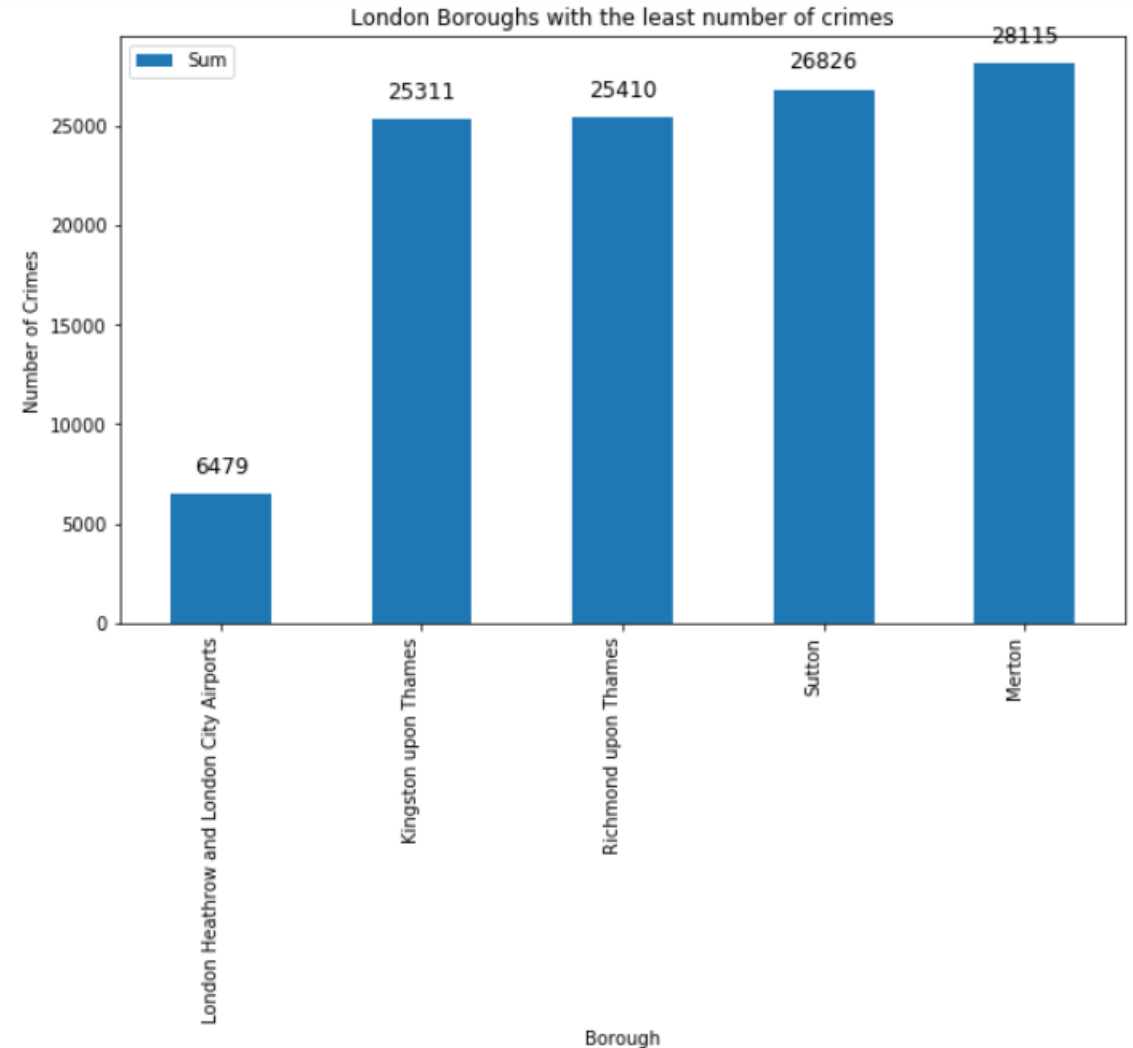
# Top 5 Boroughs with highest crime incidents

- Graph shows top 5 boroughs with crime rate
- **Westminster** has **highest** crime rate (*probably due to more touristic attractions in the Borough*) followed by Southwark , Camden, Newham and Lambeth.



# Bottom 5 Boroughs with highest crime incidents

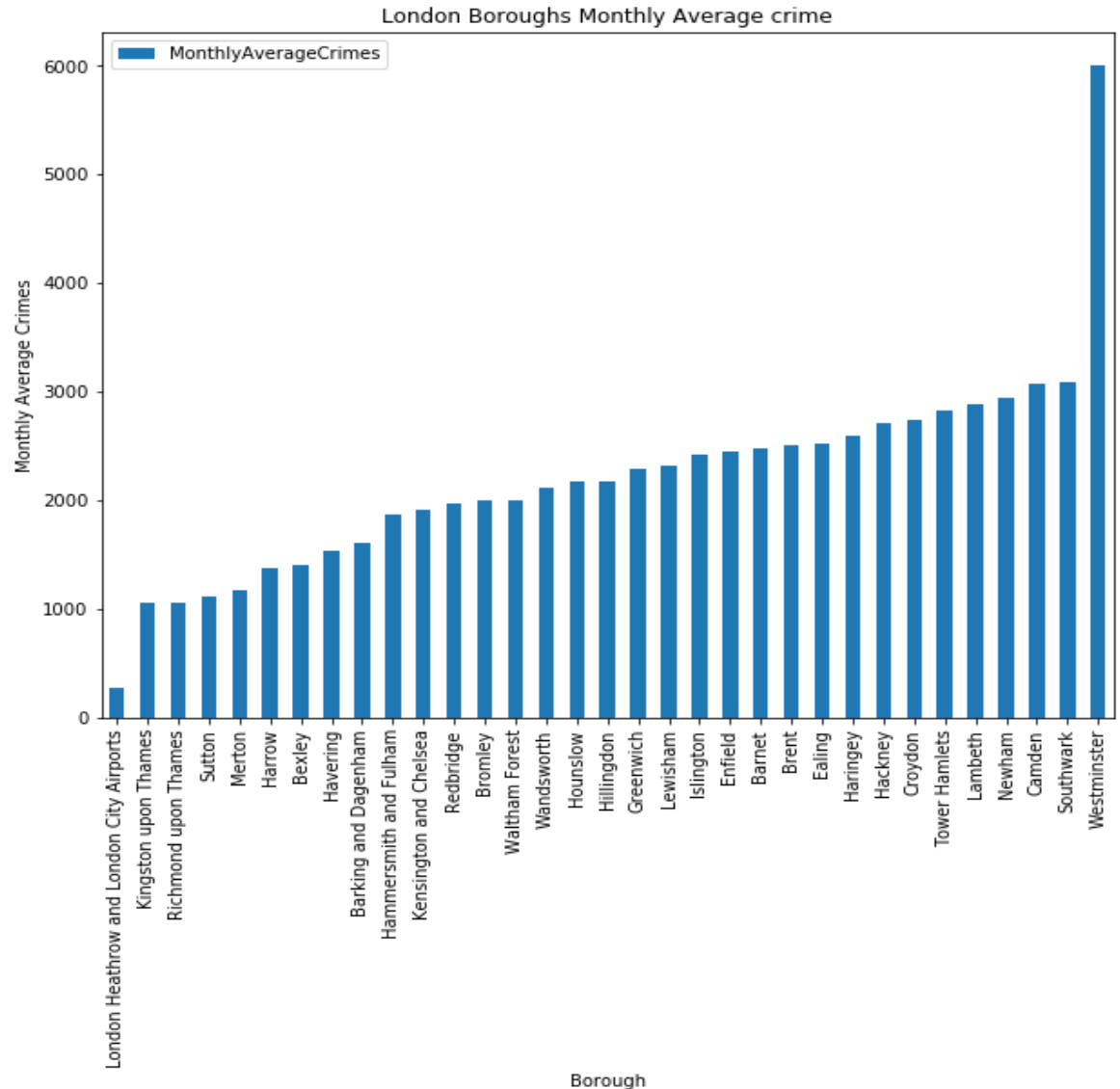
- Graph shows bottom 5 boroughs with crime rate
- **Airport areas** has **lowest** crime rate (*probably due to more security and also not a residential areas*)
- Airport areas are ignored in the scope of this project based on the assumption that there are no residential area in vicinity of Airport.
- Kingston upon Thames is the Borough with **lowest** crime incident





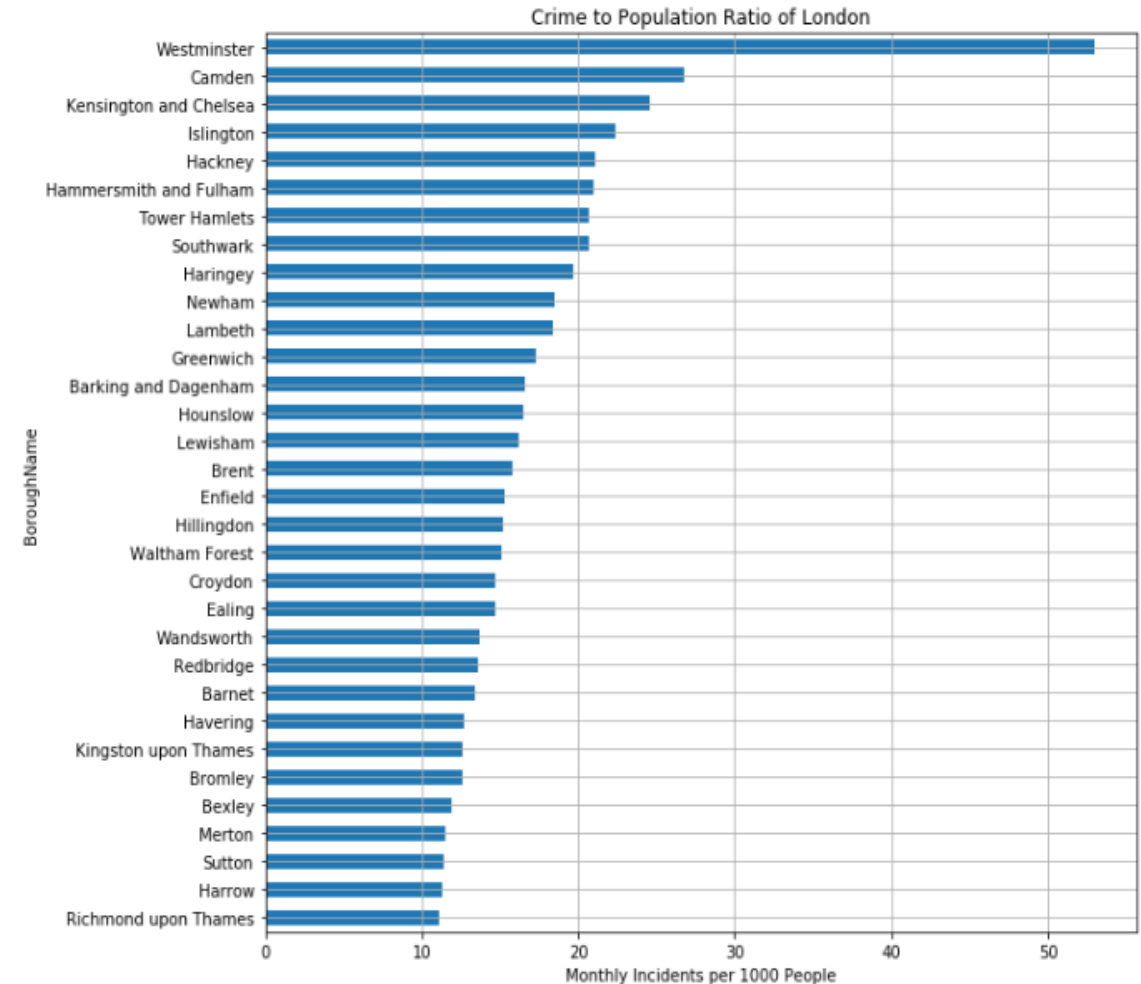
# Monthly Average Crime Rates in London

- Plot shows monthly average Crime rates in London
- Westminster has highest and Kingston upon Thames has lowest monthly average crime rate
- Airport areas are ignored in the scope of this project based on the assumption that there are no residential area in vicinity of Airport.



# Crime to Population Ratio Incidents in London

- Graph shows the crime rate for every 1000 people in London Boroughs
- **Westminster** has **highest** crime rate for every 1000 people (*probably due to more touristic attractions in the Borough*)
- **Richmond upon Thames** has **lowest** crime rate Ratio



# Analyzing Data – Borough Data

# List of Boroughs in London

- Data table from Wiki for list of borough in London
- Size: (32,10)

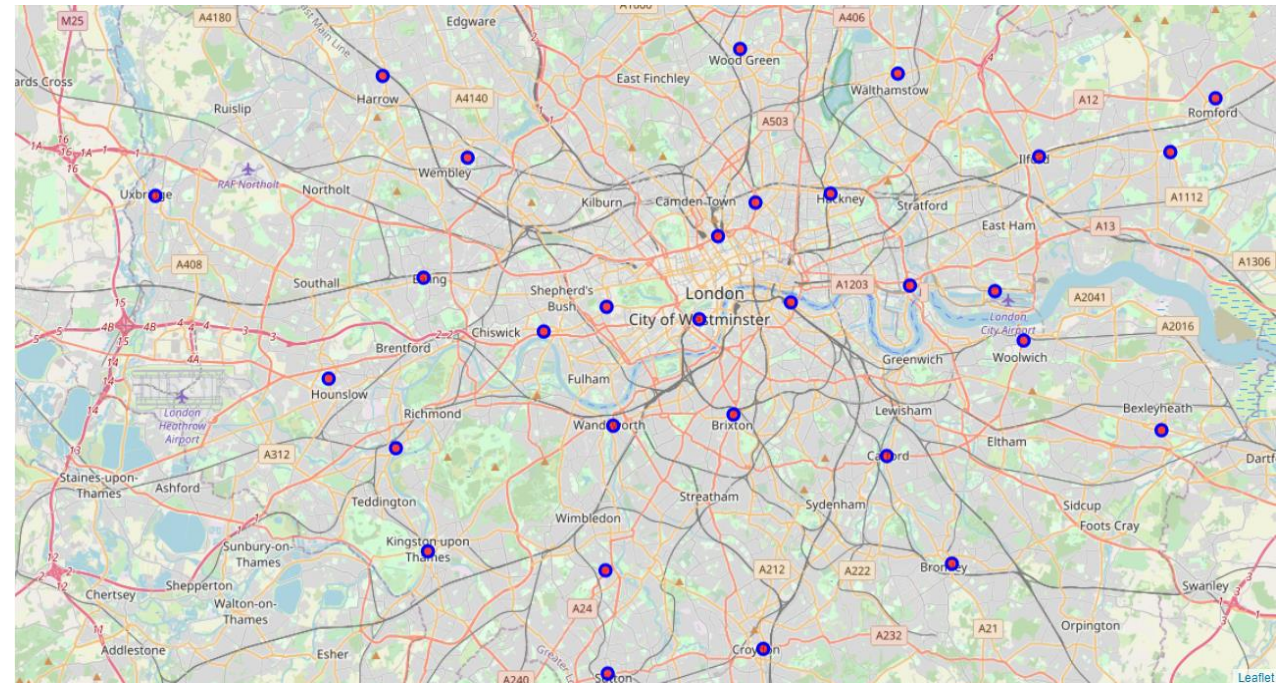
	Borough	Inner	Status	Local authority	Political control	Headquarters	Area (sq mi)	Population	Co-ordinates	Nr. in map
0	Barking and Dagenham [note 1]			Barking and Dagenham London Borough Council	Labour	Town Hall, 1 Town Square	13.93	194,352	51°33′39″N 0°09′21″E / 51.5607°N 0.1557°E / ...	25
1	Barnet			Barnet London Borough Council	Conservative	Barnet House, 2 Bristol Avenue, Colindale	33.49	369,088	51°37′31″N 0°09′06″W / 51.6252°N 0.1517°W / ...	31
2	Bexley			Bexley London Borough Council	Conservative	Civic Offices, 2 Watling Street	23.38	236,687	51°27′18″N 0°09′02″E / 51.4549°N 0.1505°E / ...	23
3	Brent			Brent London Borough Council	Labour	Brent Civic Centre, Engineers Way	16.70	317,264	51°33′32″N 0°16′54″W / 51.5588°N 0.2817°W / ...	12
4	Bromley			Bromley London Borough Council	Conservative	Civic Centre, Stockwell Close	57.97	317,899	51°24′14″N 0°01′11″E / 51.4039°N 0.0198°E / ...	20
5	Camden	Y		Camden London Borough Council	Labour	Camden Town Hall, Judd Street	8.40	229,719	51°31′44″N 0°07′32″W / 51.5290°N 0.1255°W / ...	11
6	Croydon			Croydon London Borough Council	Labour	Bernard Weatherill House, Mint Walk	33.41	372,752	51°22′17″N 0°05′52″W / 51.3714°N 0.0977°W / ...	19
7	Ealing			Ealing London Borough Council	Labour	Perceval House, 14-16 Uxbridge Road	21.44	342,494	51°30′47″N 0°18′32″W / 51.5130°N 0.3089°W / ...	13
8	Enfield			Enfield London Borough Council	Labour	Civic Centre, Silver Street	31.74	320,524	51°39′14″N 0°04′48″W / 51.6538°N 0.0799°W / ...	30
9	Greenwich [note 2]	Y [note 3]	Royal	Greenwich London Borough Council	Labour	Woolwich Town Hall, Wellington Street	18.28	264,008	51°29′21″N 0°03′53″E / 51.4892°N 0.0648°E / ...	22



# Boroughs in London



Map of City of London



Boroughs in London

# Modeling

# Popular Venues in each Borough

- Using Foursquare APIs get top 50 venues and with one hot encoding method, find most popular venues in each Borough
- There are total 179 unique venues in London

----Barking and Dagenham----

	venue	freq
0	Pool	0.14
1	Martial Arts Dojo	0.14
2	Supermarket	0.14
3	Golf Course	0.14
4	Gym / Fitness Center	0.14

----Barnet----

	venue	freq
0	Café	0.67
1	Bus Stop	0.33
2	African Restaurant	0.00
3	Park	0.00
4	Optical Shop	0.00

----Bexley----

	venue	freq
0	Pub	0.10
1	Coffee Shop	0.10
2	Clothing Store	0.10
3	Fast Food Restaurant	0.07
4	Pharmacy	0.07

----Brent----

	venue	freq
0	Coffee Shop	0.12
1	Hotel	0.10
2	Clothing Store	0.08
3	Grocery Store	0.06
4	Sporting Goods Shop	0.04



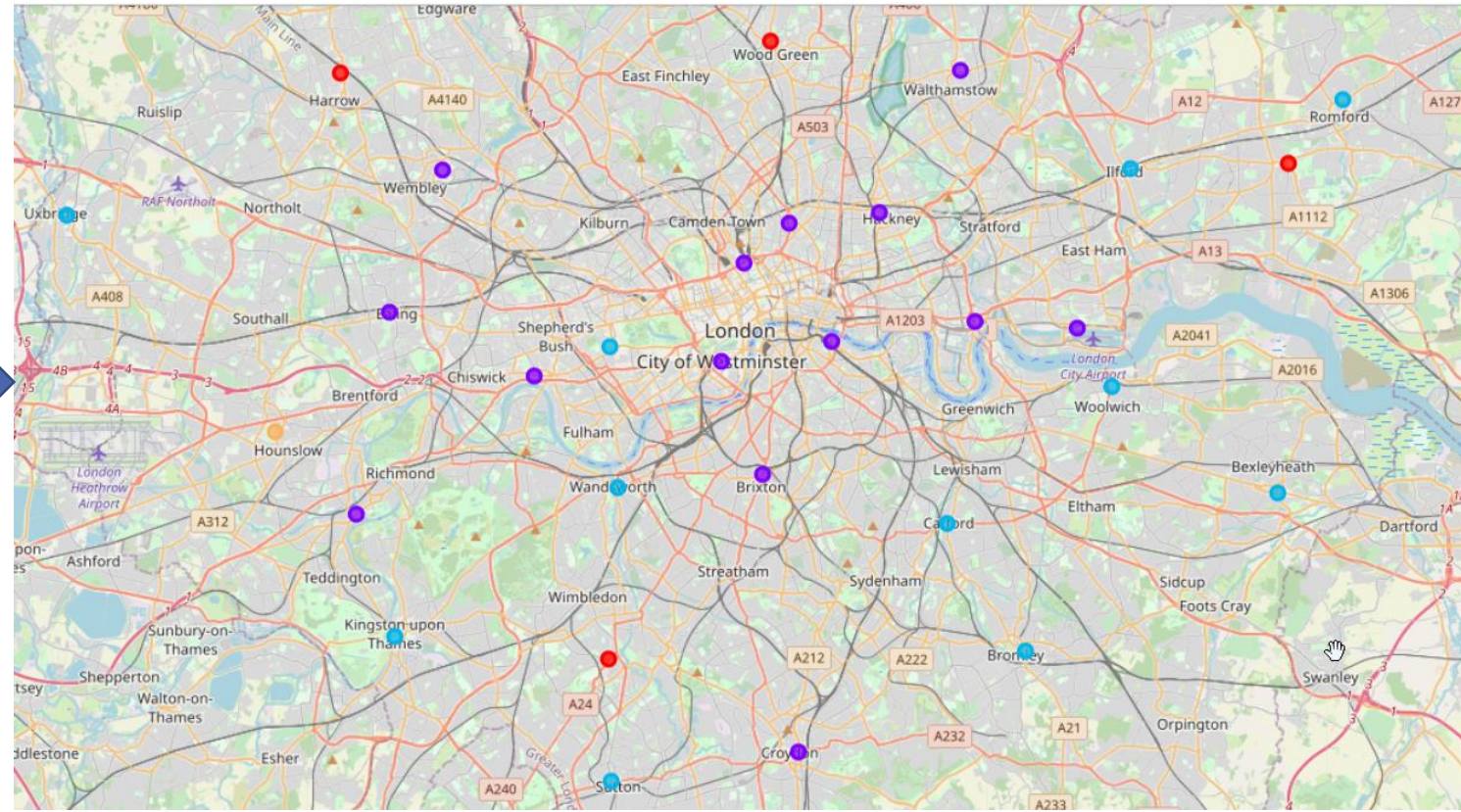
	BoroughName	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	Barking and Dagenham	Pool	Bus Station	Supermarket	Park	Golf Course	Gym / Fitness Center	Martial Arts Dojo	Electronics Store	Fish Market	Film Studio
1	Barnet	Café	Bus Stop	Yoga Studio	Gaming Cafe	French Restaurant	Food Court	Flea Market	Fish Market	Film Studio	Fast Food Restaurant
2	Bexley	Coffee Shop	Clothing Store	Pub	Fast Food Restaurant	Italian Restaurant	Supermarket	Pharmacy	Bakery	Sandwich Place	Furniture / Home Store
3	Brent	Coffee Shop	Hotel	Clothing Store	Grocery Store	American Restaurant	Sandwich Place	Sporting Goods Shop	Bar	Hotel Bar	Bubble Tea Shop
4	Bromley	Clothing Store	Coffee Shop	Gym / Fitness Center	Bar	Burger Joint	Pizza Place	Electronics Store	Cosmetics Shop	Portuguese Restaurant	Pub
5	Camden	Hotel	Coffee Shop	Café	Burger Joint	Train Station	Pizza Place	Garden	Breakfast Spot	Deli / Bodega	Used Bookstore
6	Croydon	Pub	Coffee Shop	Portuguese Restaurant	Hotel Bar	Sandwich Place	Malay Restaurant	Gaming Cafe	Burger Joint	Burrito Place	Mediterranean Restaurant
7	Ealing	Coffee Shop	Italian Restaurant	Pizza Place	Hotel	Burger Joint	Vietnamese Restaurant	Park	Pub	Polish Restaurant	Sandwich Place
8	Enfield	Coffee Shop	Clothing Store	Optical Shop	Pub	Pharmacy	Sandwich Place	Shopping Mall	Bookstore	Supermarket	Café
9	Greenwich	Pub	Coffee Shop	Fast Food Restaurant	Clothing Store	Sandwich Place	Hotel	Grocery Store	Pharmacy	Supermarket	Platform



# K means-clustering

- Based on common Top 5 venues category, each borough are grouped into different(5) cluster as shown by different markers in Map

BoroughName	MonthlyAverageCrimes	Population	Latitude	Longitude	CrimeToPopulation	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
0 Kingston upon Thames	1054.625000	166793	51.4085	-0.3064	6.322957	2	Cafe	Coffee Shop	Italian Restaurant	Pub	Burger Joint	Department Store	Restau
1 Richmond upon Thames	1058.750000	191365	51.4479	-0.3280	5.532621	1	Pub	Coffee Shop	Italian Restaurant	Indian Restaurant	Grocery Store	Steakhouse	Pharm
2 Sutton	1117.750000	195914	51.3618	-0.1945	5.705309	2	Clothing Store	Pub	Coffee Shop	Department Store	Bar	Italian Restaurant	Pizza F
3 Merton	1171.450333	203223	51.4014	-0.1958	5.764398	0	Italian Restaurant	Cafe	Supermarket	Bus Stop	Park	Garden Center	Gro S
4 Harrow	1375.666667	243372	51.5898	-0.3346	5.652526	0	Indian Restaurant	Coffee Shop	Supermarket	Fast Food Restaurant	Grocery Store	Yoga St	
5 Bexley	1409.666667	236687	51.4549	0.1505	5.955826	2	Coffee Shop	Clothing Store	Pub	Fast Food Restaurant	Italian Restaurant	Supermarket	Pharm
6 Havering	1537.791667	242080	51.5812	0.1837	6.352411	2	Coffee Shop	Shopping Mall	Clothing Store	Bakery	Fast Food Restaurant	Bookstore	Supers
7 Barking and Dagenham	1613.041667	194352	51.5607	0.1557	8.295989	0	Pool	Bus Station	Supermarket	Park	Golf Course	Gym / Fitness Center	Marial
8 Hammersmith and Fulham	1872.166667	178685	51.4927	-0.2339	10.477470	1	Pub	Indian Restaurant	Italian Restaurant	Cafe	Clothing Store	Japanese Restaurant	Vietnam Restau
9 Kensington and Chelsea	1913.375000	155594	51.5020	-0.1947	12.297229	2	Juice Bar	Cafe	Clothing Store	Bakery	Restaurant	Burger Joint	Break





# K means-clustering - Groups

- Based on common Top 5 venues category, each borough are grouped into different(5) cluster as shown by different markers in Map

BoroughName	CrimeToPopulation	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	
3	Merton	5.764398	0	Italian Restaurant	Café	Supermarket	Bus Stop	Park	Garden Center	Grocery Store	Bar	Bakery	Coffee Shop
4	Harrow	5.652526	0	Indie Movie Theater	Indian Restaurant	Coffee Shop	Supermarket	Fast Food Restaurant	Grocery Store	Yoga Studio	English Restaurant	Food Court	Flea Market
7	Barking and Dagenham	8.299589	0	Pool	Bus Station	Supermarket	Park	Golf Course	Gym / Fitness Center	Martial Arts Dojo	Electronics Store	Fish Market	Film Studio
23	Haringey	9.860528	0	Park	Café	Fast Food Restaurant	Grocery Store	Mediterranean Restaurant	Movie Theater	Bar	Bakery	Gym / Fitness Center	Turkish Restaurant

Cluster 1: Pools, Gyms, Cafes, Restaurants, Parks and Super Markets → Fitness Area

	BoroughName	CrimeToPopulation	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
1	Richmond upon Thames	5.532621	1	Pub	Coffee Shop	Italian Restaurant	Indian Restaurant	Grocery Store	Steakhouse	Pharmacy	Mediterranean Restaurant	Gastropub	Portuguese Restaurant
8	Hammersmith and Fulham	10.477470	1	Pub	Indian Restaurant	Italian Restaurant	Café	Clothing Store	Japanese Restaurant	Vietnamese Restaurant	Gastropub	Jazz Club	Pharmacy
12	Waltham Forest	7.535042	1	Pub	Pool	Vegetarian / Vegan Restaurant	Pizza Place	Tea Room	Beer Store	Coffee Shop	Gym / Fitness Center	Art Gallery	Deli / Bodega
18	Islington	11.201876	1	Pub	Bakery	Mediterranean Restaurant	Boutique	Theater	Burger Joint	Music Venue	Ice Cream Shop	Liquor Store	Gift Shop
21	Brent	7.905220	1	Coffee Shop	Hotel	Clothing Store	Grocery Store	American Restaurant	Sandwich Place	Sporting Goods Shop	Bar	Hotel Bar	Bubble Tea Shop
				Coffee	Italian			Vietnamese				Polish	Sandwich

Cluster 2: Cafes, Pubs, Restaurants, Hotels → Lively Area

	BoroughName	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	Kingston upon Thames	-0.3064	2	Café	Coffee Shop	Italian Restaurant	Pub	Burger Joint	Department Store	Thai Restaurant	Sushi Restaurant	Clothing Store	Portuguese Restaurant
2	Sutton	-0.1945	2	Clothing Store	Pub	Coffee Shop	Department Store	Bar	Italian Restaurant	Pizza Place	Sandwich Place	Café	Fast Food Restaurant
5	Bexley	0.1505	2	Coffee Shop	Clothing Store	Pub	Fast Food Restaurant	Italian Restaurant	Supermarket	Pharmacy	Bakery	Sandwich Place	Furniture / Home Store
6	Havering	0.1837	2	Coffee Shop	Shopping Mall	Clothing Store	Bakery	Fast Food Restaurant	Bookstore	Supermarket	Pub	Café	Department Store
9	Kensington and Chelsea	-0.1947	2	Juice Bar	Café	Clothing Store	Bakery	Restaurant	Burger Joint	Breakfast Spot	Gym / Fitness Center	Pub	Modern European Restaurant

Cluster 3: Cafes, Stores, Shopping malls, fast foods → Busy Area

# K means-clustering - Groups

- Based on common Top 5 venues category, each borough are grouped into different(5) cluster as shown by different markers in Map

	BoroughName	CrimeToPopulation	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
20	Barnet	26.416013	3	Café	Bus Stop	Yoga Studio	Gaming Cafe	French Restaurant	Food Court	Flea Market	Fish Market	Film Studio	Fast Food Restaurant

Cluster 4: Cafe, Bus stop, Yoga studio, Gaming Cafe → Quite Area

	BoroughName	CrimeToPopulation	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
14	Hounslow	32.46293	4	Pizza Place	Café	Park	Metro Station	Yoga Studio	Event Space	Food Court	Flea Market	Fish Market	Film Studio

Cluster 5: Pizza Place, Cafe, parks, Metro Station → Noisy Area

# Results

# Safety Score

- For safety, normalizing the Crime to Population values → borough with score of 1 are safe places or less crime ration for 1000 people

	BoroughName	CrimeToPopulation	Cluster Labels	Safety
0	Kingston upon Thames	24.885637	2	0.961917
1	Richmond upon Thames	21.708515	1	1.000000
2	Sutton	22.391628	2	0.991812
3	Merton	22.656966	0	0.988631
4	Harrow	22.205376	0	0.994044
5	Bexley	23.397638	2	0.979753
6	Havering	25.013081	2	0.960390
7	Barking and Dagenham	32.583920	0	0.869642
8	Hammersmith and Fulham	41.270952	1	0.765515
9	Kensington and Chelsea	48.614771	2	0.677488



# Best Amenities

- For best facilities, score based on personal preference are provided in the data.
  - Highest score for Cluster 2 and lowest for Cluster 5

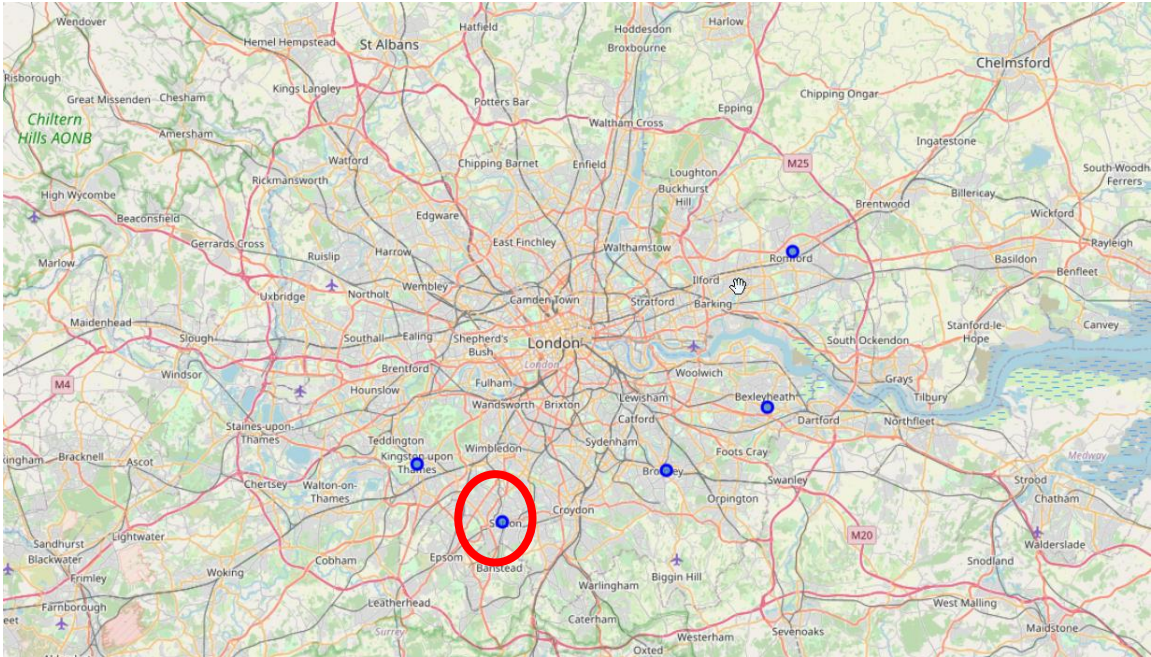
	BoroughName	CrimeToPopulation	Cluster Labels	Safety	Amenities
0	Kingston upon Thames	24.885637	2.0	0.961917	1.0
1	Richmond upon Thames	21.708515	1.0	1.000000	0.9
2	Sutton	22.391628	2.0	0.991812	1.0
3	Merton	22.656966	0.8	0.988631	0.0
4	Harrow	22.205376	0.8	0.994044	0.0
5	Bexley	23.397638	2.0	0.979753	1.0
6	Havering	25.013081	2.0	0.960390	1.0
7	Barking and Dagenham	32.583920	0.8	0.869642	0.0
8	Hammersmith and Fulham	41.270952	1.0	0.765515	0.9
9	Kensington and Chelsea	48.614771	2.0	0.677488	1.0

# Final Score

➤ Adding Safety and Amenities score, we get to choose the best Borough

	BoroughName	Safety	Amenities	Score
2	Sutton	0.991812	1.0	1.991812
5	Bexley	0.979753	1.0	1.979753
11	Bromley	0.964143	1.0	1.964143
0	Kingston upon Thames	0.961917	1.0	1.961917
6	Havering	0.960390	1.0	1.960390
10	Redbridge	0.939072	1.0	1.939072
13	Wandsworth	0.938054	1.0	1.938054
15	Hillingdon	0.902262	1.0	1.902262
19	Enfield	0.901386	1.0	1.901386
1	Richmond upon Thames	1.000000	0.9	1.900000
17	Lewisham	0.878935	1.0	1.878935
16	Greenwich	0.852783	1.0	1.852783
25	Croydon	0.914100	0.9	1.814100
22	Ealing	0.914006	0.9	1.814006
12	Waltham Forest	0.906097	0.9	1.806097
21	Brent	0.888156	0.9	1.788156

Sutton is good borough to move considering the safety and amenities together

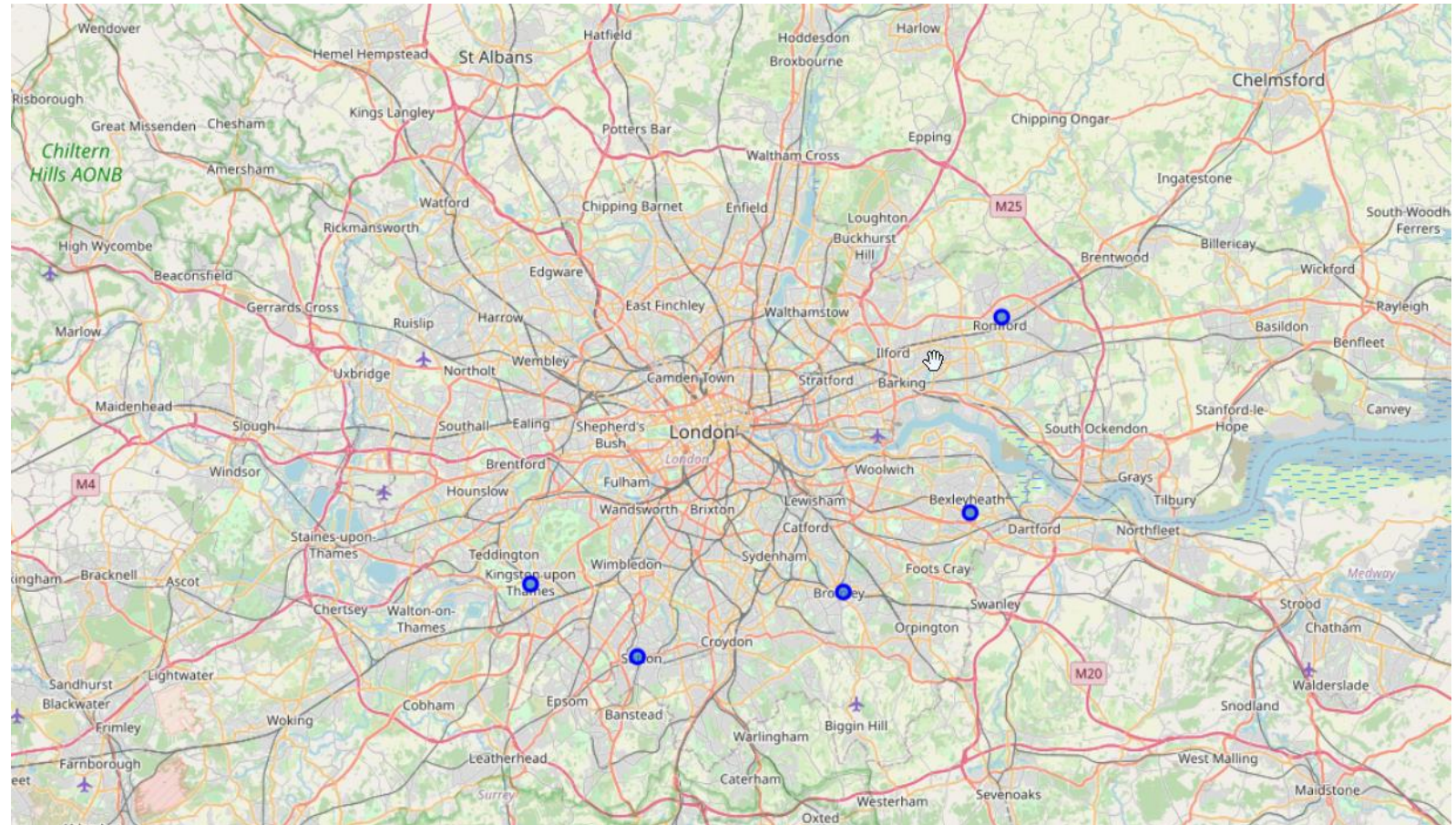




# Boroughs good to move-in

- Based on the data analysis performed, following Boroughs can be good to relocate in London

- ❖ Sutton
- ❖ Bexley
- ❖ Bromley
- ❖ Kingston upon Thames
- ❖ Havering



# Conclusions

- From the analysis done in the course of this project, best five boroughs in London are identified based on the safety and best venues in the neighborhood. These boroughs contain Pubs, Cafes, Restaurants and stores needed for good living and also mixing with local and international people in London.
- As seen in the map, the above boroughs are a bit far from Central London. It would take considerable amount of time to commute towards central London (assuming the work place location).
- Moreover, we only considered venues which are popular and have reviews.
- We could as well consider each borough individually and all the neighborhoods in each of borough to determine good location.





# THANK YOU