Department Store in London

Coursera Capstone Project

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Department Store in London

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1. **Introduction**
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Introduction
Department Store in London

- A Dutch Dutch Department Store would like to open a shop in London
- Characteristics of the Department Store:
  - Quality
  - Low Prices
  - Affordable
  - Accessible
  - Typical Dutch
- Products:
  - Food
  - Clothing
  - Household Appliances

Introduction

Department Store in London

- The Dutch Department is looking for the Best Location for opening one store in a Neighbourhood in London

- Target Group: Decision Makers from the Dutch Department Store

- They would like to have an Analysis of the Neighborhoods in London
  - Exploration of surrounding Venues
  - Demographics and Characteristics

- They are looking for area's with high population numbers, but not in area's with a lot of restaurants

Introduction

Department Store in London

- The Business Problem is defined as follows:

For serving the right people on the right location: What is the most appropriate Neighborhood for the Dutch Department Store in London?

Data Description

Department Store in London

- Wikipedia provides a 'List of London Boroughs'. These are the local authority districts within Greater London, including 32 London boroughs and the City of London.

- The City of London is the 33rd principal division of Greater London but it is officially not a London borough.

- Source: https://en.wikipedia.org/wiki/List_of_London_boroughs#List_of_boroughs_and_local_authorities

Data Description
Department Store in London

- On Wikipedia, the following information is provided. Per Borough in London:
  - Geospatial Coordinates
  - Population
  - Area (in Square Mile)
  - Inner / Outer London
  - Status (City / Royal / None)
  - Political Control (Conservative / Labour / Liberal Democrat / None)
- The total Dataframe has 33 Boroughs. The data of the 32 London Boroughs is merged with the data of City of London.

Data Description

Department Store in London

- **Foursquare API** is used to get the most common venue categories in each Neighborhood

- Visualization Library *Folium* is used for creating maps

- The Data Set has 33 Rows (Boroughs) and 12 Columns (Features)

	Borough	Inner	Status	Local authority	Political control	Headquarters	Area (sq mi)	Population (2013 est)[1]	Co-ordinates	Nr. in map
0	Barking and Dagenham [note 1]	NaN	NaN	Barking and Dagenham London Borough Council	Labour	Town Hall, 1 Town Square	13.93	194352	51°33'39"N 0°09'21"E / 51.5607°N 0.1557°E	25
1	Barnet	NaN	NaN	Barnet London Borough Council	Conservative	Barnet House, 2 Bristol Avenue, Colindale	33.49	369088	51°37'31"N 0°09'06"W / 51.6252°N 0.1517°W	31
2	Bexley	NaN	NaN	Bexley London Borough Council	Conservative	Civic Offices, 2 Watling Street	23.38	236687	51°27'18"N 0°09'02"E / 51.4549°N 0.1505°E	23
3	Brent	NaN	NaN	Brent London Borough Council	Labour	Brent Civic Centre, Engineers Way	16.70	317264	51°33'32"N 0°16'54"W / 51.5588°N 0.2817°W	12
4	Bromley	NaN	NaN	Bromley London Borough Council	Conservative	Civic Centre, Stockwell Close	57.97	317899	51°24'14"N 0°01'11"E / 51.4039°N 0.0198°E	20

Methodology
Department Store in London

- Explore Data Set

- Explore Neighborhoods in London

- Analyze Each Neighborhood

- Cluster Neighborhood

- Examine Clusters
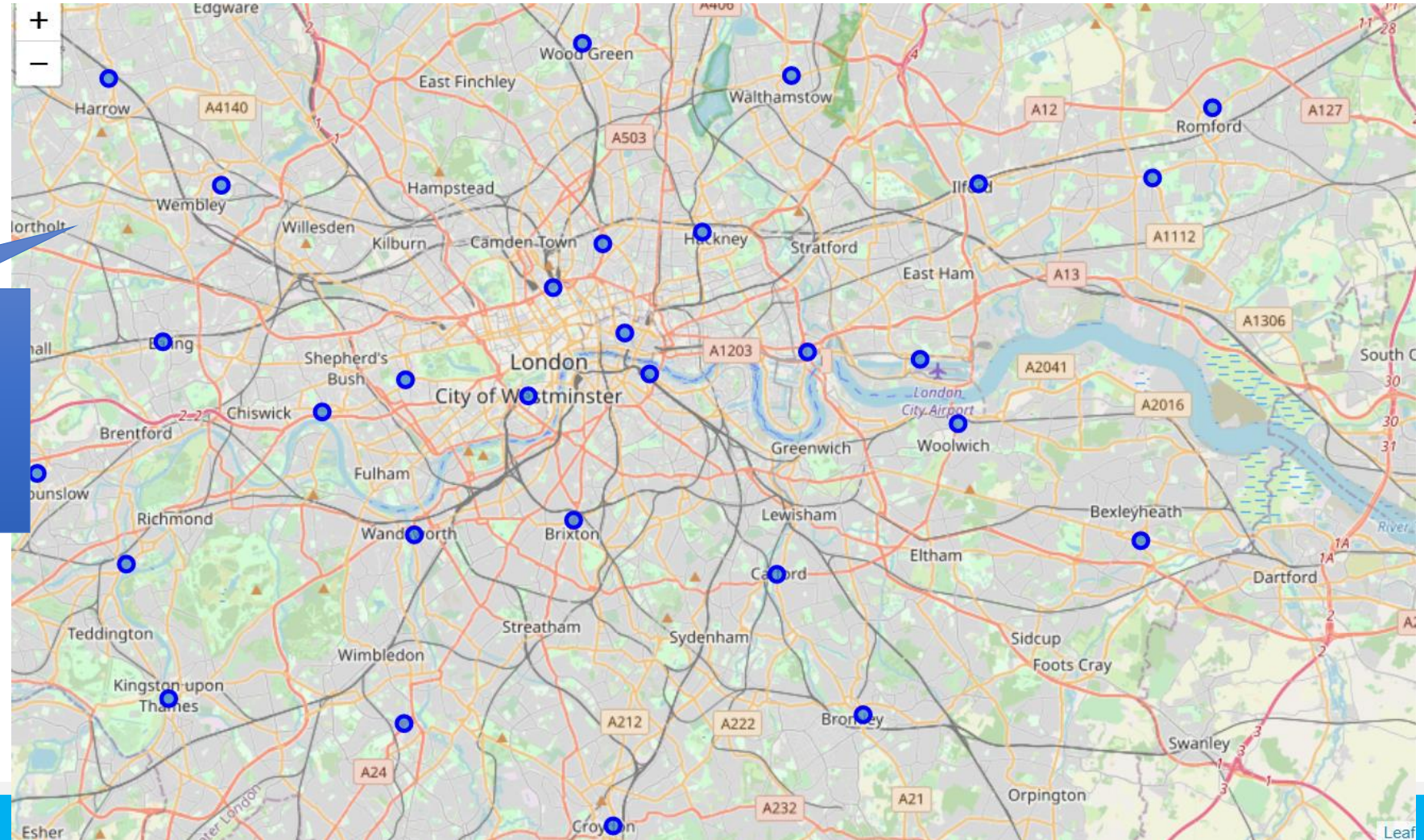
Methodology

Explore Data Set

- There are 33 Boroughs in London
- Each Borough have Geospatial Co-ordinates for latitude and longitude
- Other relevant features are included as well:

	Borough	Inner	Status	Local authority	Political control	Headquarters	Area (sq mi)	Population (2013 est)[1]	Co-ordinates	Nr. in map
0	Barking and Dagenham [note 1]	NaN	NaN	Barking and Dagenham London Borough Council	Labour	Town Hall, 1 Town Square	13.93	194352	51°33'39"N 0°09'21"E / 51.5607°N 0.1557°E	25
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Methodology

Explore Neighborhoods in London

- Creation of Map of London
- Boroughs superimposed on Top with Visualization Library *Folium*
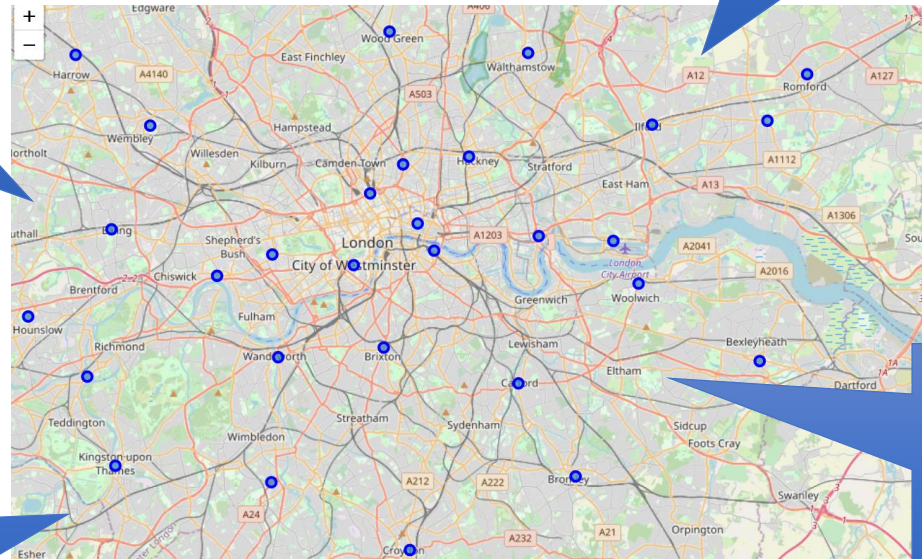
Methodology

Explore 33 Boroughs in London

Political Control:
- Labour: 21
- Conservative: 8
- Liberal Democrats: 3
- Unknown: 1

Inner / Outer London:
- Inner: 13
- Outer: 20

Status:
- Royal: 3
- City: 2
- Nothing: 28

East / West of Greenwich Meridian:
- East: 7
- West: 26

Methodology
Explore Neighborhoods in London

- *Islington* has relative the most habitants per Square Mile

- Most habitants (in absolute numbers) live in *Croydon*

- Greatest area in Square Miles is *Bromley*

Borough	pop_sq_mi	Area_sq_mi	Population
Islington	37572.648084	5.74	215667.0
Tower Hamlets	35765.399738	7.63	272890.0
Hackney	34969.972826	7.36	257379.0
Kensington and Chelsea	33246.581197	4.68	155594.0
Lambeth	30332.239382	10.36	314242.0
Hammersmith and Fulham	28228.278041	6.33	178685.0
Westminster	27363.208685	8.29	226841.0
Camden	27347.500000	8.40	229719.0
Southwark	26792.100539	11.14	298464.0
Wandsworth	23470.597128	13.23	310516.0

Borough	Population
Croydon	372752.0
Barnet	369088.0
Ealing	342494.0
Enfield	320524.0
Newham	318227.0
Bromley	317899.0
Brent	317264.0
Lambeth	314242.0
Wandsworth	310516.0
Southwark	298464.0

Borough	Area_sq_mi
Bromley	57.97
Hillingdon	44.67
Havering	43.35
Barnet	33.49
Croydon	33.41
Enfield	31.74
Bexley	23.38
Richmond upon Thames	22.17
Redbridge	21.78
Hounslow	21.61

- New Feature
- Number of habitants per Square Mile
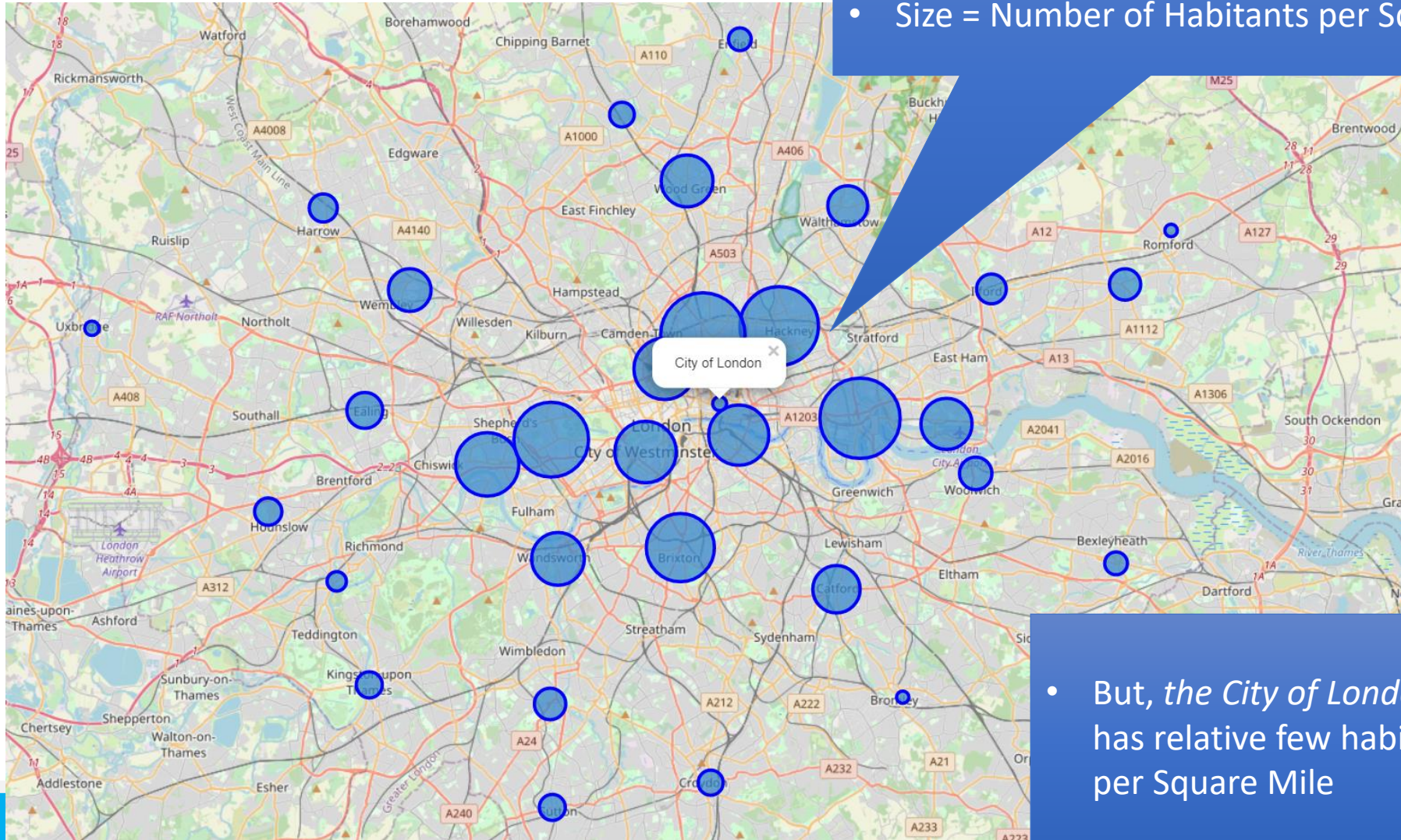- (= Population / Area)

Methodology

Histogram of Population per Square Mile

Histogram of Population Density for the 33 Boroughs of London
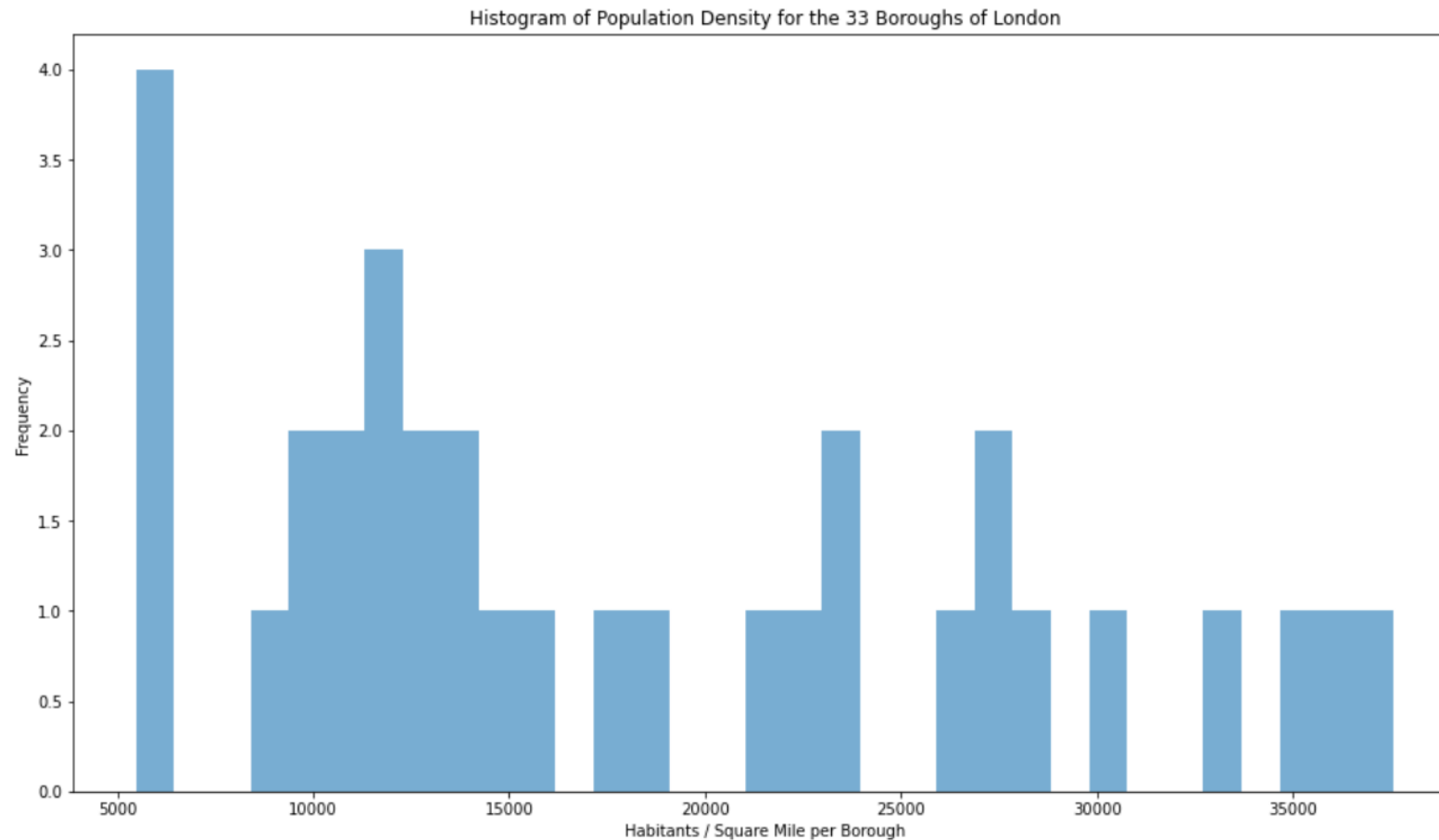
Methodology
Population Density

- Not surprisingly, the Boroughs with the highest *"Population Density"* can be found in the "Inner London" Neighborhoods
- Size = Number of Habitants per Square Mile

- But, *the City of London* has relative few habitants per Square Mile

Methodology
Distribution Population Density

Distribution Population Density for the 33 Boroughs of Inner / Outer London
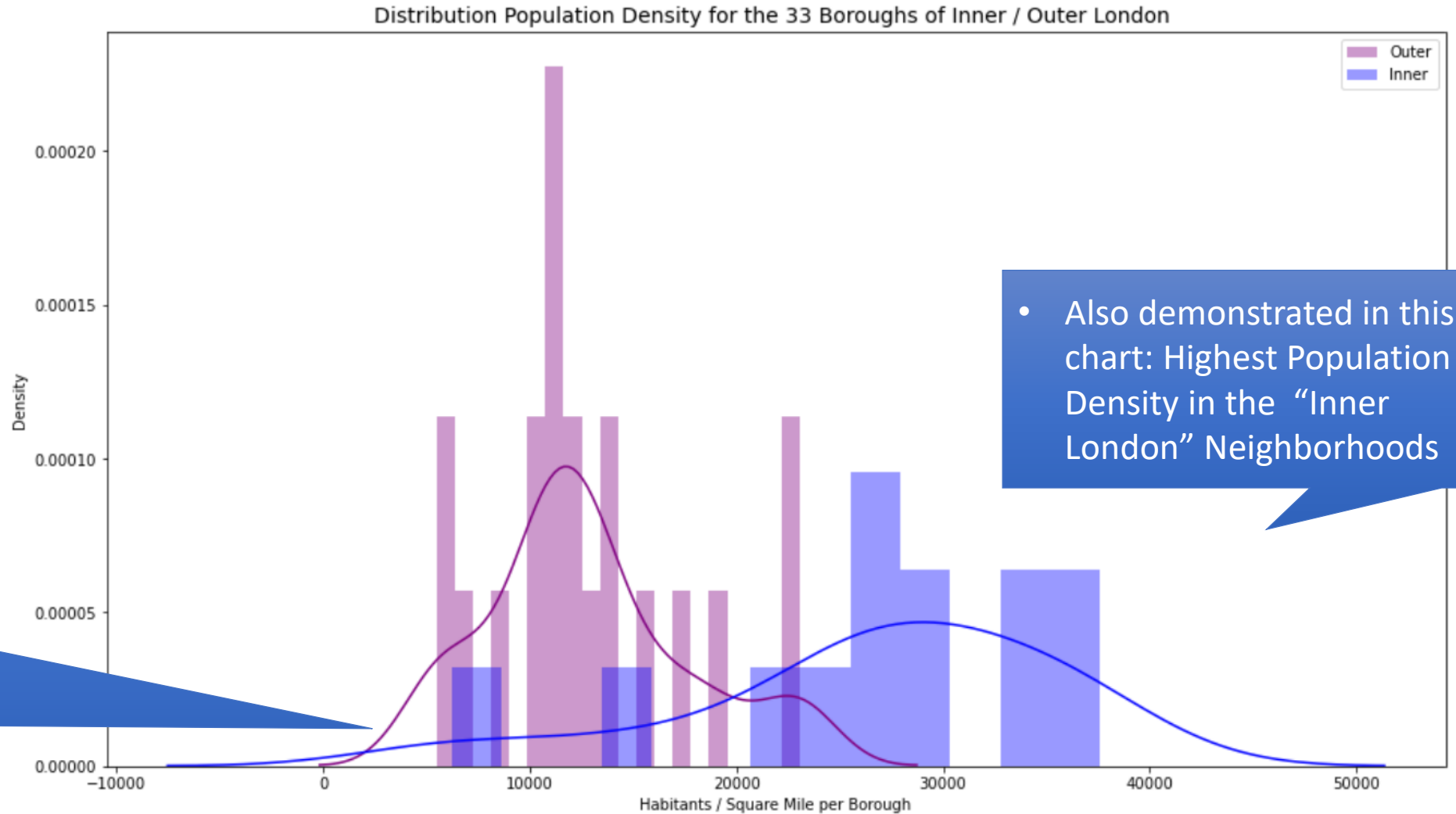
- *The City of London* (Borough of *Inner London*) with relative few habitants per square mile

- Also demonstrated in this chart: Highest Population Density in the "Inner London" Neighborhoods

Methodology

Analyzing the Neighborhoods

- Investigating the Top Venues per Neigborhood

- Foursquare API:
  - Radius: 500
  - Limit: 100 venues
  - Name, Categories, Latitude and Longitude from Foursquare

- 7 venues from first Borough: *Barking and Dagenham*

	name	categories	lat	lng
0	Central Park	Park	51.559560	0.161981
1	Crowlands Heath Golf Course	Golf Course	51.562457	0.155818
2	Robert Clack Leisure Centre	Martial Arts School	51.560808	0.152704
3	Morrisons	Supermarket	51.559774	0.148752
4	Beacontree Heath Leisure Centre	Gym / Fitness Center	51.560997	0.148932
5	Becontree Heath Bus Station	Bus Station	51.561065	0.150998
6	Dagenham Swimming Pool	Pool	51.560946	0.150054

Methodology

Analyzing the Neighborhoods

- Creation of new DataFrame: *London_venues*

- 1578 Venues were found by **Foursquare**

- These are the last 10 rows:

|	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
1568	City of London	51.5155	-0.0922	Golden Gallery	51.513756	-0.098287	Scenic Lookout
1569	City of London	51.5155	-0.0922	Coco di Mama	51.514903	-0.098512	Italian Restaurant
1570	City of London	51.5155	-0.0922	Paternoster Square	51.514572	-0.099226	Plaza
1571	City of London	51.5155	-0.0922	Digme Fitness	51.518244	-0.090744	Cycle Studio
1572	City of London	51.5155	-0.0922	The Ivy Asia	51.513588	-0.096036	Asian Restaurant
1573	City of London	51.5155	-0.0922	The Nickel Bar	51.513613	-0.090161	Hotel Bar
1574	City of London	51.5155	-0.0922	Notes Coffee & Wine	51.519202	-0.089496	Coffee Shop
1575	City of London	51.5155	-0.0922	The Refinery Citypoint	51.519491	-0.089993	Building
1576	City of London	51.5155	-0.0922	Stone Gallery	51.513793	-0.098323	Scenic Lookout
1577	City of London	51.5155	-0.0922	The Arbitrager	51.514904	-0.086117	Pub

Methodology

Analyzing the Neighborhoods

- Neighbourhoods are grouped and the mean frequency of occurence of category are calculated

- There are 230 unique categories

- A new Dataframe is created with the Top 10 Venues for each Neighborhood. These are the first 10 Rows:

	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	Barking and Dagenham	Pub	Gym / Fitness Center	Pool	Golf Course	Park	Bus Station	Supermarket	Martial Arts School	English Restaurant	Escape Room
1	Barnet	Café	Home Service	Bus Stop	Salon / Barbershop	Yoga Studio	Electronics Store	Flea Market	Fish Market	Fish & Chips Shop	Film Studio
2	Bexley	Clothing Store	Pub	Coffee Shop	Furniture / Home Store	Fast Food Restaurant	Pharmacy	Supermarket	Portuguese Restaurant	Bakery	Italian Restaurant
3	Brent	Coffee Shop	Hotel	Bar	Sporting Goods Shop	Clothing Store	Grocery Store	Sandwich Place	Italian Restaurant	Restaurant	Indian Restaurant
4	Bromley	Coffee Shop	Clothing Store	Bar	Pizza Place	Burger Joint	Gym / Fitness Center	Bookstore	Gelato Shop	Chocolate Shop	Sushi Restaurant
5	Camden	Coffee Shop	Hotel	Café	Pub	Burger Joint	Italian Restaurant	Modern European Restaurant	Deli / Bodega	Sandwich Place	Restaurant
6	City of London	Coffee Shop	Gym / Fitness Center	Italian Restaurant	French Restaurant	Scenic Lookout	Restaurant	Hotel	Steakhouse	Seafood Restaurant	Clothing Store
7	Croydon	Pub	Coffee Shop	Portuguese Restaurant	Italian Restaurant	Asian Restaurant	Breakfast Spot	Spanish Restaurant	Burger Joint	Burrito Place	Café
8	Ealing	Coffee Shop	Clothing Store	Park	Pub	Italian Restaurant	Bakery	Burger Joint	Bus Stop	Café	Bar
9	Enfield	Clothing Store	Coffee Shop	Café	Pub	Supermarket	Department Store	Pharmacy	Shopping Mall	Gift Shop	Optical Shop

Methodology

Clustering the Neighborhoods

- Neighbourhoods are clustered with **k-Means** cluster ("Unsupervised Learning").

- Input for Clustering: Top 10 Venues per Borough, Status Borough, Political Control

- 5 Clusters found with "Elbow Method"

Number of k for k-Means Cluster

- Optimum k for k-Means Cluster
- $k = 5$
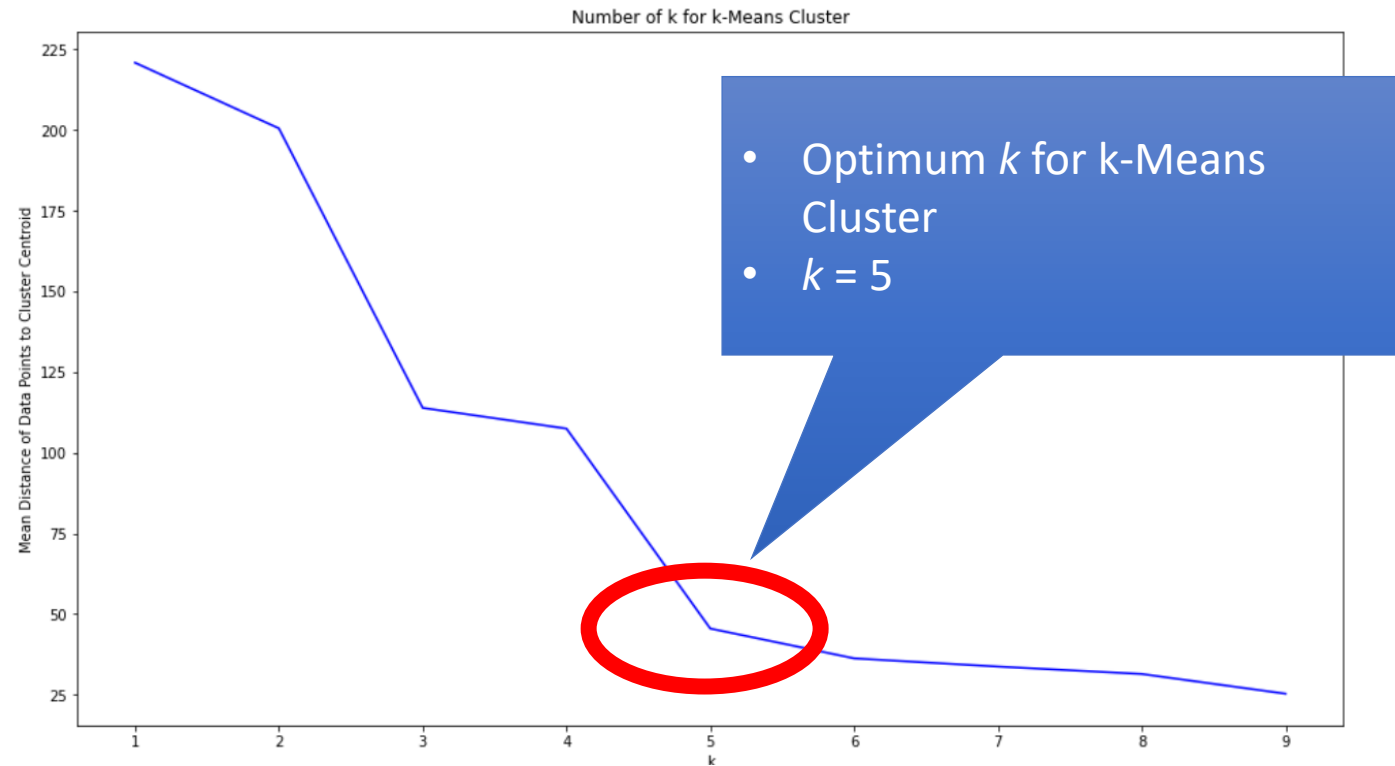
Methodology

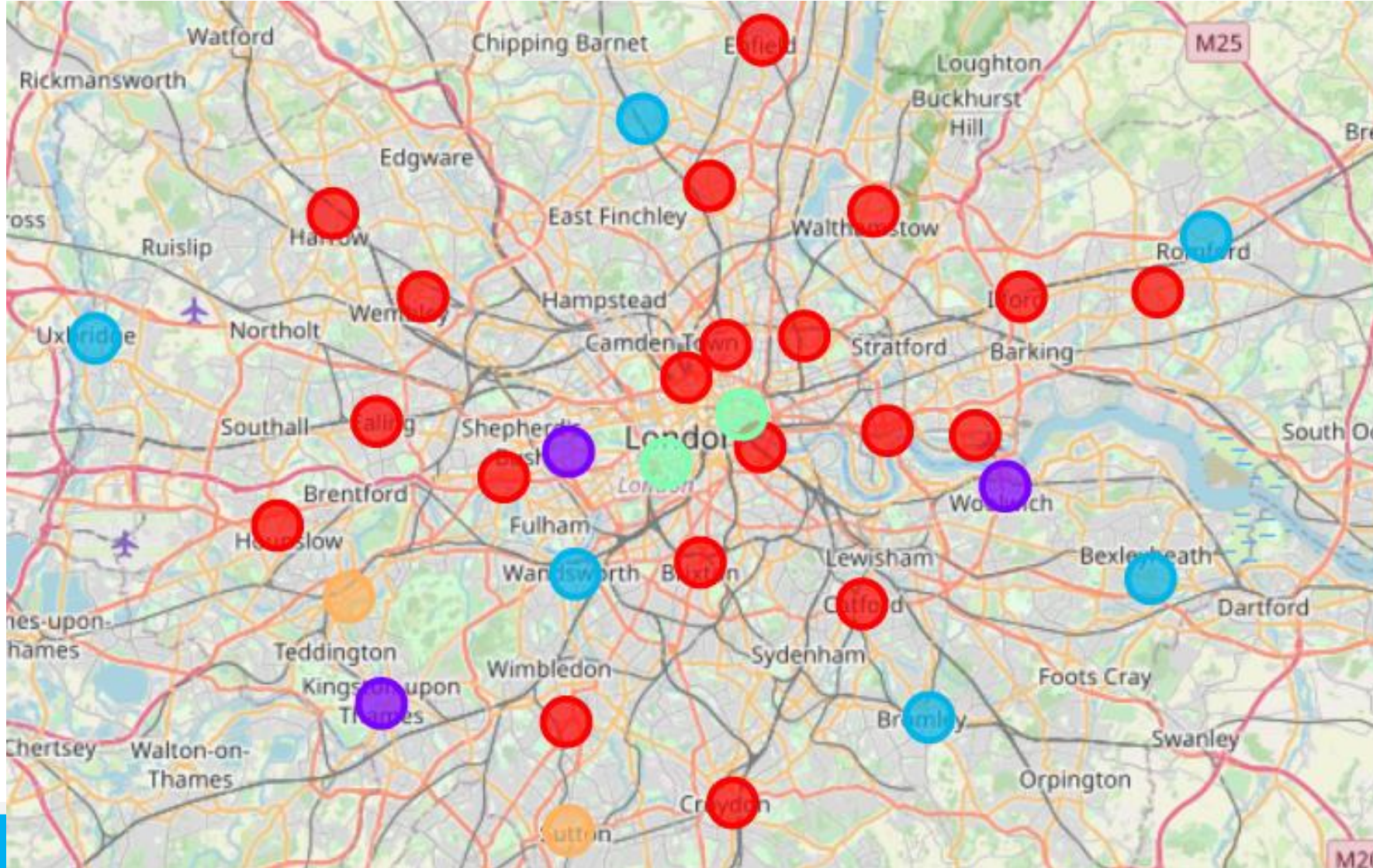Examine Clusters

- Interpretation:
  - Cluster 1 (20 Boroughs – Label 0):   Labour, No Status
  - Cluster 2 (3 Boroughs – Label 1):   Royal Status, No Political Color
  - Cluster 3 (6 Boroughs – Label 2):   Conservative, No Status
  - Cluster 4 (2 Boroughs – Label 3):   Inner, City Status
  - Cluster 5 (2 Boroughs – Label 4):   Liberal Democrats, No Status

```
Cluster Labels
0    20
1     3
2     6
3     2
4     2
Name: Borough, dtype: int64
```

Cluster Labels	Inner	status_City	status_Nothing	status_Royal	pc_Conservative	pc_Labour	pc_Liberal_Democrat	pc_Unknown	pop_sq_mi	Area_sq_mi	Population
0	0.400000	0.0	1.0	0.0	0.000000	1.000000	0.000000	0.0	21384.841942	15.277000	272264.8
1	0.666667	0.0	0.0	1.0	0.333333	0.333333	0.333333	0.0	19762.662949	12.446667	195465.0
2	0.166667	0.0	1.0	0.0	1.000000	0.000000	0.000000	0.0	10350.606488	36.015000	293846.0
3	1.000000	1.0	0.0	0.0	0.500000	0.000000	0.000000	0.5	16806.604343	4.705000	116920.5
4	0.000000	0.0	1.0	0.0	0.000000	0.000000	1.000000	0.0	10101.855940	19.550000	193639.5

Methodology
Examine Clusters

1. Labour, No Status
2. Royal Status, No Political Color
3. Conservative, No Status
4. Inner, City Status,
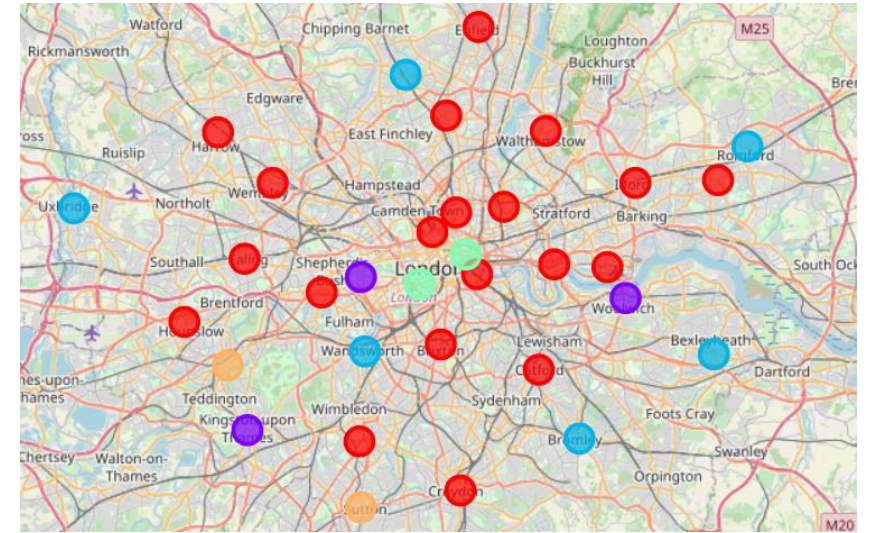5. Liberal Democrats, No Status

Methodology

Examine Clusters

	Cluster Labels	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
0	0	Barking and Dagenham	Pub	Gym / Fitness Center	Pool	Golf Course	Park	Bus Station	Supermarket	Martial Arts School	English Restaurant
3	0	Brent	Coffee Shop	Hotel	Bar	Sporting Goods Shop	Clothing Store	Grocery Store	Sandwich Place	Italian Restaurant	Restaurant
5	0	Camden	Coffee Shop	Hotel	Café	Pub	Burger Joint	Italian Restaurant	Modern European Restaurant	Deli / Bodega	Sandwich Place
6	0	Croydon	Pub	Coffee Shop	Portuguese Restaurant	Italian Restaurant	Asian Restaurant	Breakfast Spot	Spanish Restaurant	Burger Joint	Burrito Place
7	0	Ealing	Coffee Shop	Clothing Store	Park	Pub	Italian Restaurant	Bakery	Burger Joint	Bus Stop	Café
8	0	Enfield	Clothing Store	Coffee Shop	Café	Pub	Supermarket	Department Store	Pharmacy	Shopping Mall	Gift Shop
10	0	Hackney	Pub	Coffee Shop	Bakery	Café	Cocktail Bar	Organic Grocery	Brewery	Clothing Store	Park
11	0	Hammersmith and Fulham	Pub	Café	Indian Restaurant	Coffee Shop	Italian Restaurant	Grocery Store	Hotel	Gastropub	Clothing Store
12	0	Haringey	Park	Café	Bar	Indian Restaurant	Bakery	Hotel Bar	Italian Restaurant	Gym / Fitness Center	Grocery Store
13	0	Harrow	Indian Restaurant	Coffee Shop	Grocery Store	Supermarket	Platform	Thai Restaurant	Indie Movie Theater	Fish & Chips Shop	Fish Market
16	0	Hounslow	Pizza Place	Café	Park	Bed & Breakfast	Yoga Studio	English Restaurant	Food Court	Flea Market	Fish Market
17	0	Islington	Pub	Mediterranean Restaurant	Cocktail Bar	Café	Ice Cream Shop	Park	Theater	Burger Joint	Boutique
20	0	Lambeth	Caribbean Restaurant	Cocktail Bar	Pub	Market	Coffee Shop	Pizza Place	Beer Bar	Gym / Fitness Center	Fried Chicken Joint
21	0	Lewisham	Supermarket	Grocery Store	Italian Restaurant	Platform	Coffee Shop	Train Station	Furniture / Home Store	Pharmacy	Fast Food Restaurant
22	0	Merton	Café	Supermarket	Italian Restaurant	Indian Restaurant	Park	Fast Food Restaurant	Garden Center	Sandwich Place	Bakery
23	0	Newham	Hotel	Chinese Restaurant	Rafting	Light Rail Station	Sandwich Place	Duty-free Shop	Pharmacy	Airport Service	Airport Lounge
24	0	Redbridge	Supermarket	Fast Food Restaurant	Clothing Store	Grocery Store	Bakery	Sandwich Place	Coffee Shop	Department Store	Turkish Restaurant
26	0	Southwark	Coffee Shop	Pub	Bar	Restaurant	French Restaurant	Scenic Lookout	Cocktail Bar	Indian Restaurant	Italian Restaurant
28	0	Tower Hamlets	Coffee Shop	Italian Restaurant	Sandwich Place	Hotel	Bus Station	Asian Restaurant	Chinese Restaurant	Outdoor Sculpture	Gym / Fitness Center
29	0	Waltham Forest	Pub	Vegetarian / Vegan Restaurant	Tea Room	Bar	Trail	Gym / Fitness Center	Art Gallery	Beer Store	Coffee Shop

- *Per Cluster the Top 10 of most Common Venues per Borough is calculated.*
- *This is the Top 10 for each of the 20 Boroughs of Cluster 1*

Methodology

Examine Top 3 Venues per Cluster

- Cluster 1 – Labour: 🔴
  Pubs / Coffeeshops / Restaurants / Clothing Stores / Supermarkets / Hotel / Gym

- Cluster 2 – Royal: 🟣
  Pub / Café / Coffeeshops / Restaurants

- Cluster 3 – Conservative: 🔵
  Café / Coffeeshops / Clothing Stores / Pharmacy / Shopping Mall

- Cluster 4 – City: 🟢
  Hotel / Coffeeshop / Restaurant / Sandwich Place

- Cluster 5 – Liberal Democrats: 🟠
  Coffeeshop / Café / Pub / Restaurant

Results

Best Location for Decision Makers Dutch Department Store

- **Cluster 3** – Conservative is the Cluster with a very low percentage for Restaurants. There are no restaurants in the Top 3 of Venues.

- Within Cluster 3, the Neighborhood *Wandsworth* has relative the highest population density (habitants per square meter).

- So given the criteria of the Dutch Department Store (No restaurants, High Density), *Wandsworth* is the best option for location for opening
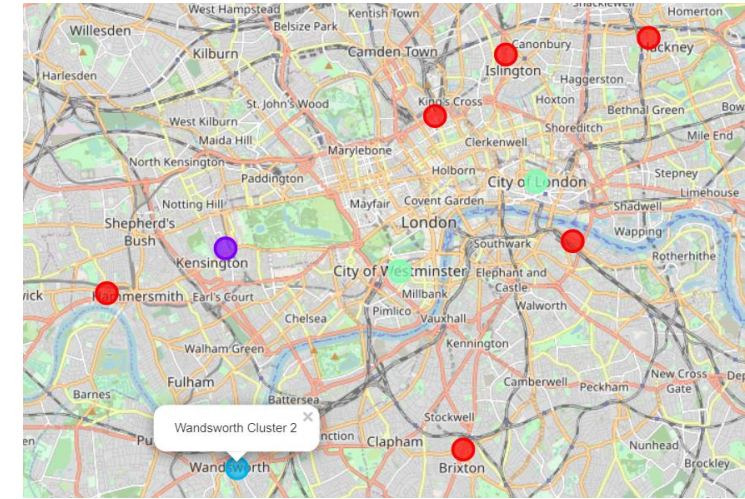
Cluster Labels	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	pop_sq_mi
2	Wandsworth	Pub	Coffee Shop	Clothing Store	23470.597128
2	Barnet	Café	Home Service	Bus Stop	11020.842042
2	Bexley	Clothing Store	Pub	Coffee Shop	10123.481608
2	Hillingdon	Coffee Shop	Clothing Store	Pharmacy	6420.550705
2	Havering	Coffee Shop	Clothing Store	Shopping Mall	5584.313725
2	Bromley	Coffee Shop	Clothing Store	Bar	5483.853717

Discussion
Best Location for Decision Makers Dutch Department Store

- London is a very big city with more than 9 Million People. So the data and clustering can be extended and be more detailed with available data (see Conclusion and Future Directions)

- Other clustering techniques can be considered as well for determining the right amount of clusters (for example *Hierarchical Clustering*).

- The Clustering is also done with only the Top 10 Venues per Neigborhood (without other Features). But this provided an unpractical division of clusters. Therefore, the features *Political Control* and *Status* are also included in the Clustering.

Discussion

Best Location for Decision Makers Dutch Department Store

- Although there are 33 Boroughs, these Districts are very big on itself. So, for the Foursquare API, the values of the parameters can be increased in the Future. These are the current parameters:
  - Radius = 500
  - Limit = 100
- For example, for the *City of London* or *Lambeth*, it reached the Max of 100 venues. But for example for *Islington* (54) or *Kensington and Chelsea* (58), the number of venues can be extended by enlarging the Foursquare parameters.

Discussion

Best Location for Decision Makers Dutch Department Store

- For more Detail and Nuance, each Borough can be splitted into 'Wards'. In total, there are more than 600 'Wards' in London (https://data.london.gov.uk/dataset/ward-profiles-and-atlas).

- So the Foursquare API can be used to get the Top Venues on 'Ward'-level. This provides a bigger data set of course, but provides more detail. Instead of Clustering the Boroughs, a Clustering of Wards is an option for analysing appropriate locations.

Conclusions and Future Directions

Best Location for Decision Makers Dutch Department Store

- The current Clustering provides a first glimpse of the Neighborhoods of Greater London. The Foursquare API provides the top Venues per Borough.

- A discussed earlier, the data set can easily be extended. This provides more detail in the analyses. For example the data can be enriched per Neigborhood with the following variables (if available):
  - *Income*
  - *Employment Rate*
  - *Houseprices*
  - *Well-Being scores*
  - *Safety scores*