

London boroughs
Capstone Project - The Battle of Neighborhoods
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1. Introduction

1.1 Background

As known, London is considered one of the most important, expensive, and visited cities around the globe. It has diverse cultures with various races and demographics. In short, London is a mix of everything, and uncountable pages can be written to describe its culture, its history, and its economic impacts. Thus, this paper will address the issue of moving to the city of London as an expatriate or as an international student and will consider some criteria in listing the best boroughs to live or to work or to study based on safety measures, average rental rates. Besides, the paper will highlight the population rate of each borough for further measurement and analysis. Once again, the concentration will be upon safety measures and rental rates only.

1.2 Business Problem:

The problem is to precisely find the best place that matches the two criteria in terms of 1) safety and 2) cost. However, the selected data represents the last two years and did not address in depth the kind of crimes or the type of accommodation.

1.3 Targeted Audience:

For those who want to move and live in a megacity with safety surroundings, and for tourists with limited budgets. Moreover, it is for those who are looking for a big picture without so many details.

2. The used Data:

2.1 Data sources:

The used data for this case is as the following:

- List of Boroughs and neighborhoods of the city of London with their geodata (latitude and longitude) and their population from a Wikipedia page.
- List of Boroughs with recoded crime incidents and rental costs from the London datastore website.

2.2 Data cleaning:

First, the data will be derived from its source and decoded for further analysis. The first imported table was empty of nan values but, was full of unnecessary marks that must be removed. For example, I must separate the coordinates column into latitude and longitude columns and clean some unnecessary words in the borough name column to get the table as below:(Table 1)

Table1. First five boroughs in London with their population and address based on alphabet order

	BoroughName	Population	Latitude	Longitude
0	Barking and Dagenham	194352	51.5607	0.1557
1	Barnet	369088	51.6252	-0.1517
2	Bexley	236687	51.4549	0.1505
3	Brent	317264	51.5588	-0.2817
4	Bromley	317899	51.4039	0.0198

Then, with the use of Foursquare API, I managed to get the most common venues in each borough. Second, I have started to clean the two imported datasets from the London Datastore website which are the recorded crime incidents and the rental costs. The same process of cleaning from dropping unneeded columns and nan values to summing up the figures every month to ease the analysis process. (Table 2)

Table 2. Two lists of boroughs in London with their crime and rental rates

```
#List of crimes in each boroughs for on monthly basis
crime.head(5)
```

	BoroughName	MonthlyAverage
0	Barking and Dagenham	1616.083333
1	Barnet	2494.875000
2	Bexley	1412.791667
3	Brent	2524.333333
4	Bromley	2009.791667

```
#List of borough based on avg rent for all categories of accomodation
Borough_rent.head(10)
```

	Area	Average
0	Barking and Dagenham	3569
1	Barnet	4591
2	Bexley	3154
3	Brent	4731
4	Bromley	2704

3. Methodology

3.1 Exploratory Data Analysis:

In this section, after cleaning the data I have started to visualize the data using bar charts for both crime incidents and rental costs. (figure 1, 3).

First, the bar chart below shows the crime incidents regardless of their type per 1000 resident. So, I have divided the number of recorded crimes to the population number to get the ratio of crimes to population. Then, with the help of folium techniques, I have got the coordinates of London which will make it easy to make further visualization. Thus, I have used the choropleth map technique to classify the borough based on the number of crimes as indicated below. (Figure 1&2)

Figure 1. Crime to Population Ratio of the city London

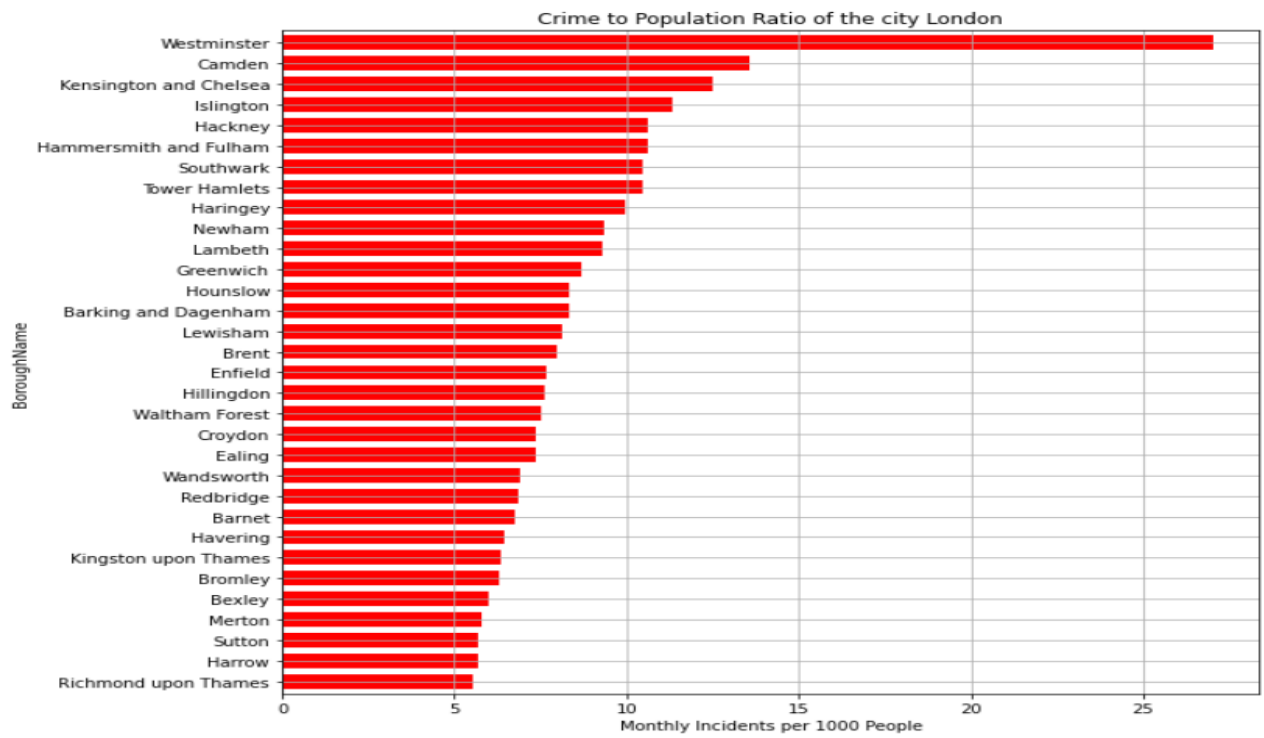
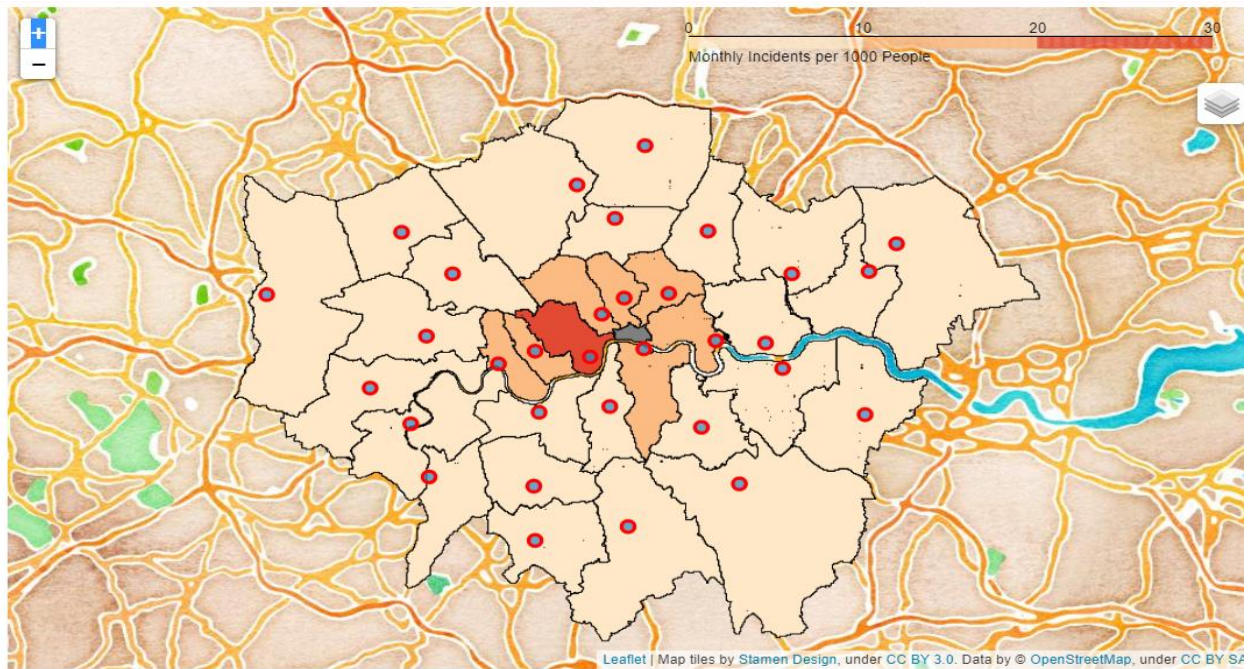


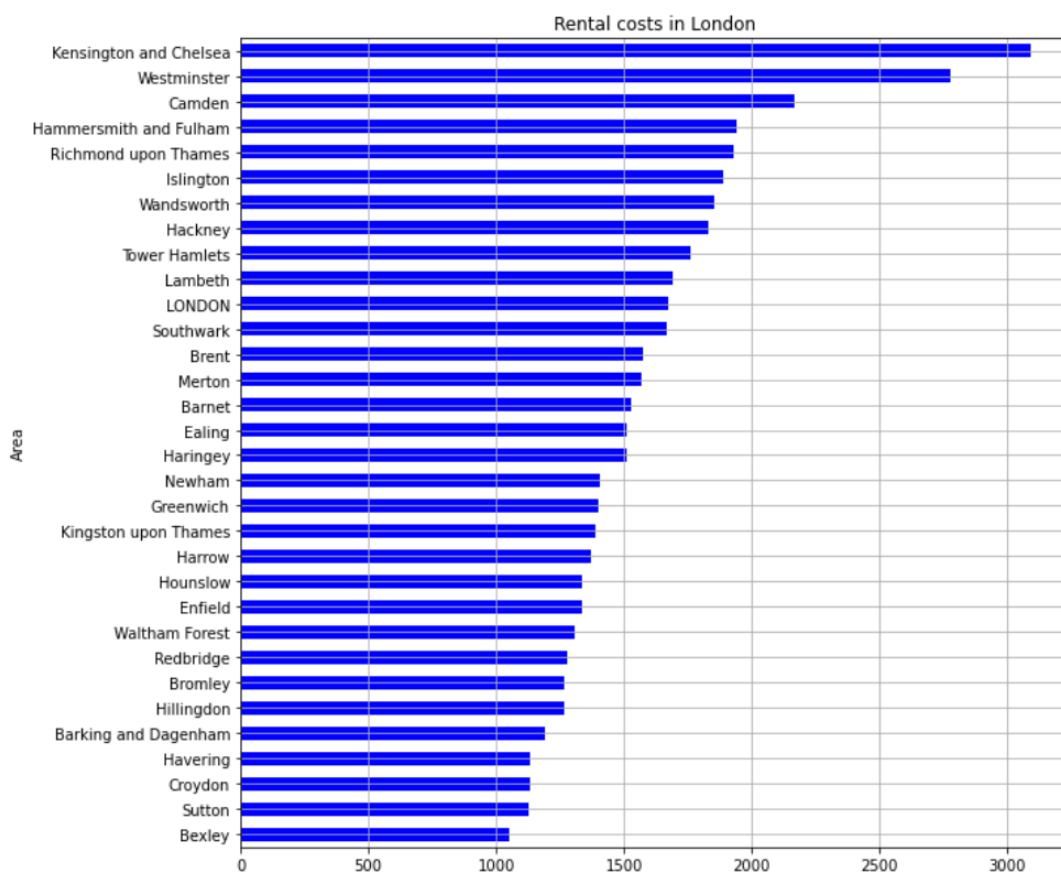
Figure 2. Choropleth map of recorded crimes



As shown above, the added marker in the choropleth map is for the purpose to label the boroughs. To illustrate more, the idea behind this type of map is to classify places based on figures. In which the higher values get the darker color and the lower figures get a brighter color. However, some Nan values or data have been missing and were colored with grey color. The finding indicates that suburbs have less recorded crime incidents than the areas near the city center.

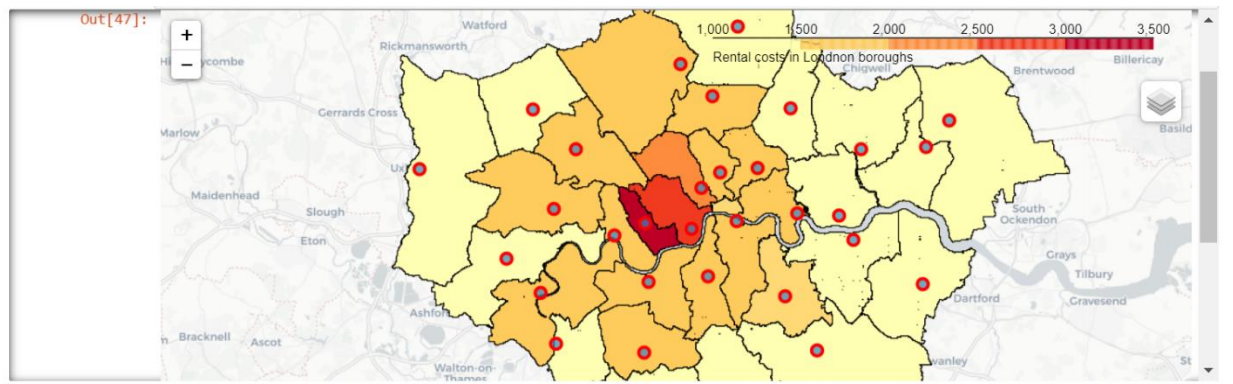
Second, the rental cost data has shown nearly the same trend which is logically true. Since a city like London considered one of the most expensive cities in the world. The bar chart below indicates the average cost of all kinds of accommodation monthly. (Figure3)

Figure3. The rental cost in London



In addition to the bar chart, visualizing the figures on a map would be more appropriate to have a good vision of the distribution of different levels of costs in London. So, I have implemented the choropleth technique for this purpose. (figure 4)

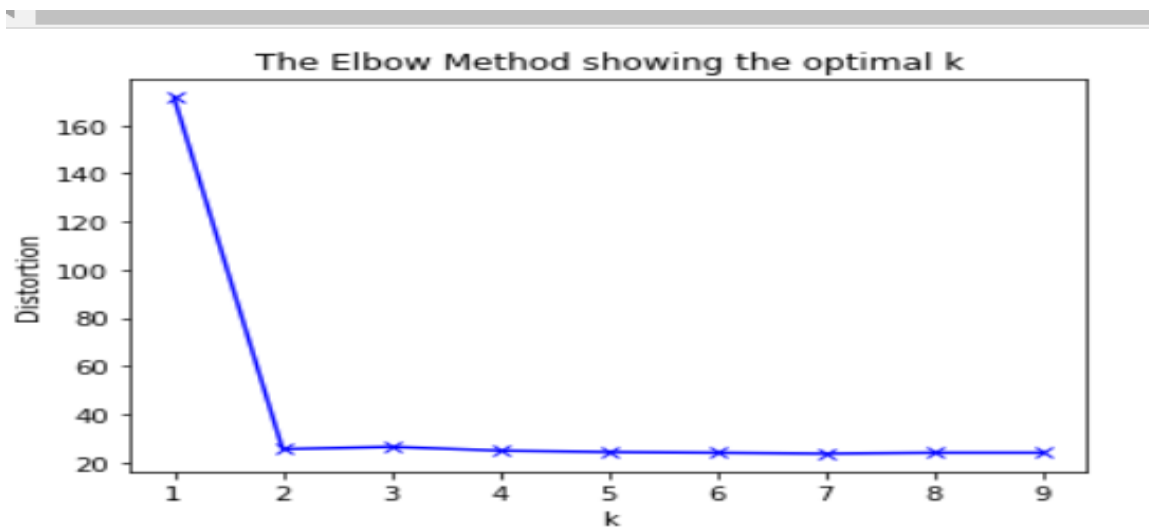
Figure 4. Choropleth map of the rental cost



3.2 Cluster Analysis:

In this section, I have conducted K-Means clustering to group the boroughs according to what convenience facilities they have using Foursquare data. With the help of foursquare facilities, I managed to get the common venues for each borough. Also, the elbow method, help us to get the optimal value of k-Means which was 2 values as shown below. (figure 5)

Figure 5. The elbow method with optimal K method



Since the K-Means clustered Boroughs into two clusters, and to find a name to each cluster. I grouped the venues based on the number of the cluster and the first common venues. As a result, the graph below shows how the labeling of clusters could be. (figure 6). Also, I have labeled the two clusters into relaxing boroughs and busy boroughs based on the number of common venues in each area. The graph shows the crowded cluster which is cluster 0 and uncrowded cluster which is cluster 1.

Figure 6. Number of Venues in each cluster

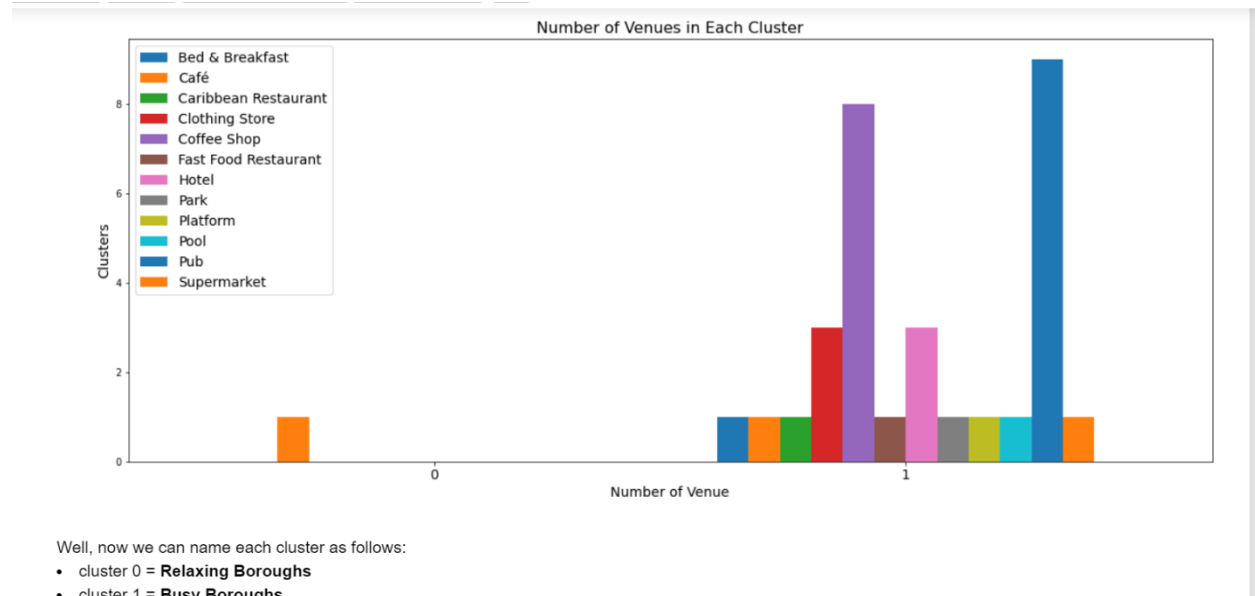
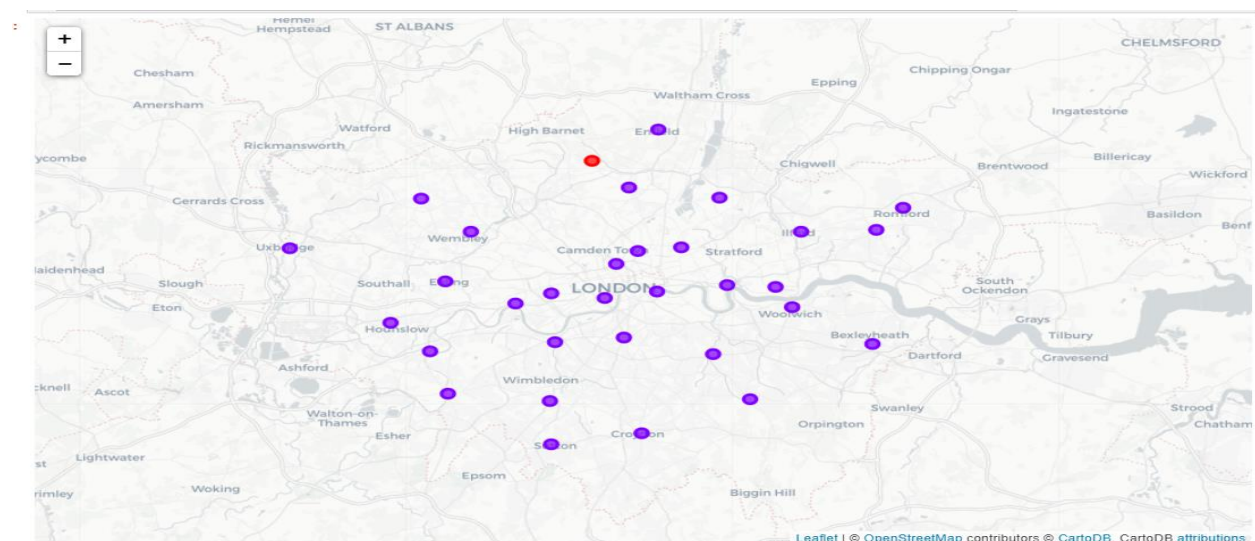


Figure 7. Mapping boroughs based on clustering with K-Means



Note: The time I was doing the report the mapping was slightly different with two boroughs under the red color

4. Results

Then, after doing the clustering, I have started to conduct the weighted score to calculate the score for each borough based on the criteria in this study. The selected criteria that I have chosen earlier are safety score, rental cost score and cluster analysis which is named the surrounding score. The table below shows the result of the scores in ascending order. (Table 8)

Table 8. List of boroughs based on scores

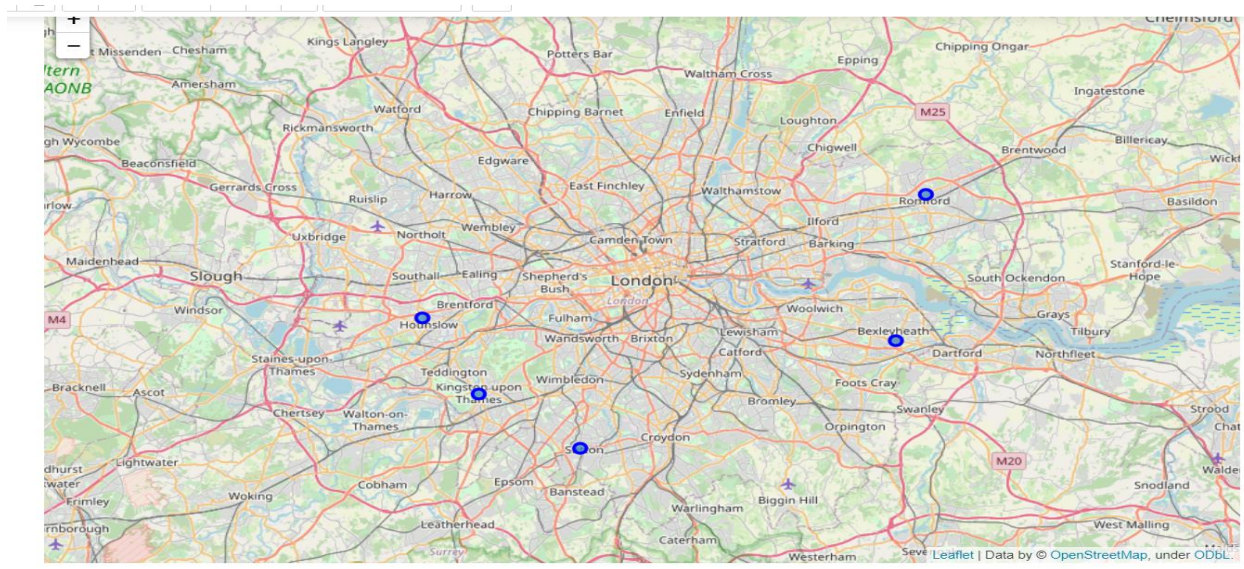
ut [75] :

	BoroughName	Safety	renting	surrounding	Score
28	Sutton	0.989340	0.962842	0.8	2.752181
2	Bexley	0.930625	1.000000	0.8	2.730625
14	Havering	0.901392	0.959568	0.8	2.660960
19	Kingston upon Thames	1.000000	0.835816	0.8	2.635816
0	Barking and Dagenham	0.890493	0.932067	0.8	2.622560
13	Harrow	0.937017	0.842527	0.8	2.579544
23	Merton	0.976648	0.746603	0.8	2.523251
4	Bromley	0.812769	0.895237	0.8	2.508006
25	Redbridge	0.819300	0.887707	0.8	2.507007
30	Waltham Forest	0.813839	0.875102	0.8	2.488941
1	Barnet	0.717007	0.764773	1.0	2.481780
15	Hillingdon	0.778395	0.895237	0.8	2.473631
16	Hounslow	0.778625	0.859060	0.8	2.437685
6	Croydon	0.666881	0.961532	0.8	2.428413
8	Enfield	0.725076	0.860534	0.8	2.385610
9	Greenwich	0.756712	0.827795	0.8	2.384507
26	Richmond upon Thames	0.999482	0.568997	0.8	2.368478
7	Ealing	0.711044	0.774759	0.8	2.285802
12	Haringey	0.691697	0.774922	0.8	2.266619

The table above shows the score for each borough based on their safety, cost and surrounding. To explain more, boroughs with high recorded crimes and rental costs scored lower. While, boroughs with low recorded crimes and rental cost, got high scores.

For the surrounding column, I have given the name of busy boroughs to boroughs under cluster 1, and the other cluster was named relaxing boroughs. Also, I have listed the best five boroughs with the highest score and map them as shown in the following figure. (figure 9)

Figure 9. Mapping the best boroughs



5. Discussion

As discussed earlier, the best boroughs to live are Sutton, Bexley, Havering, Hounslow and Kingston upon Thames with lower rental costs and lower recorded crime incidents. However, it seems to be that, all the selected five boroughs are outer boroughs near to the suburbs more than to the city center. This is logically true if we take into consideration that London is one of the most expensive places to rent an apartment. Also, the recorded crimes represent the big population density that London has with around 9 million inhabitants according to the office for National Statistics (2018). The rent prices and crime rate figures are only limited to a certain time. Thus, larger data are needed for more accuracy of the figures. Also, the crime types were not considered in the study to ease the analysis. Moreover, the targeted accommodations were not considered as well. Since, the paper focuses on the overall safety and cost in each borough in London. Furthermore, it is for an overall vision that could be the introduction and the key for further research.

6. Conclusions

To conclude, this paper has pointed out the best places to settle in London based on some criteria that are limited to a certain period and it is guided for those who intend to move soon. Besides, it seems that the best boroughs based on the explained criteria are near the suburbs of the city of London and somehow far from the city center. It brings backs the dilemma of living at the heart

of the center of mega-cities for those with a limited budget and those who seek more safe surroundings. However, considering the well-designed transportation services in a city like London, and the way that the Metropolitan Police and local authorities deal with crimes, living in suburban areas with many safe surroundings and low rental costs does not seem to be a problem.

This paper is established to get a big vision on the boroughs in London and does not take the criteria in detail.

7. Reference

- 1). (2018). List of London boroughs. Retrieved from https://en.wikipedia.org/wiki/List_of_London_boroughs
- 2) London Datastore. (2019). Recorded crime rates. Retrieved from https://data.london.gov.uk/dataset/recorded_crime_rates
- 3) London Datastore. (2019). Average private rents borough, Retrieved from <https://data.london.gov.uk/dataset/average-private-rents-borough>
- 4) Estimates of the population for the UK, England and Wales, Scotland and Northern Ireland". ONS. 28 September 2018. Retrieved 15 August 2019.