Central business district comparison between Frankfurt and London

The Battle of Neighborhoods - Capstone Project - IBM Data Science - coursera

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1. Introduction

1.1. Background

Well known UK stopped being a member of the European Union (EU) at 23:00 GMT on 31 January 2020. It's called also **Brexit** - British exit - refers to the UK leaving the EU. The UK will leave the single market and customs union at the end of the transition. The capital city London, which is today one of the main financial centres of the United Kingdom and even the EU, contains many of corporations and agencies, which are also their european headquarter. Due to Brexit maybe they want to relocate to EU and transfer some staffs and departments for the business within EU.

Definition: a central business district designates an area in the city centre where many banks, insurance companies, and other financial institutions are located.

1.2. Problem

In London, **City of London** (a city and local government district) and **Canary Wharf** are the primary and secondary CBD. In Frankfurt is the **Bankenviertel** (meaning: banking quarter)

My purpose is to make a quantitative analysis about consumption habits between different CBDs. The opportunity is with venues which scattered in CBD area.

An obvious problem is, nether we could describe strict borders of a CBD nor give an official coordinate. For example Bankenviertel (Figure 1.) is commonly defined as the western part of the Innenstadt, the southern part of the Westend and the eastern part of the Bahnhofsviertel.

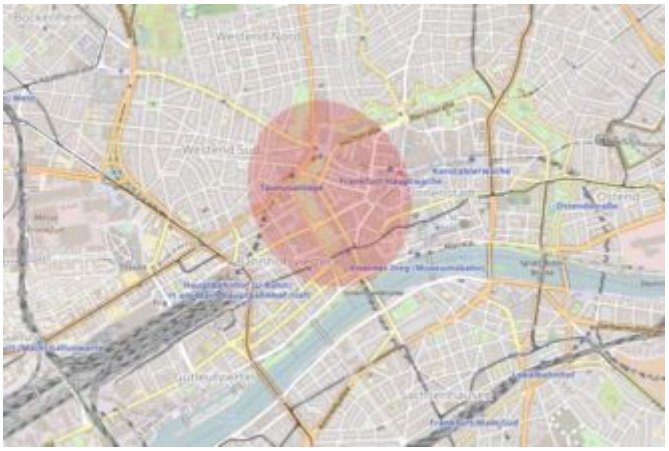


Figure 1. Bankenviertel, Frankfurt am Main
Red area is the commonly defined Bankenviertel

Fortunately we find out, that skyscraper is a significant label of CBD. We can search the tallest buildings' list in the two cities. With address we calculate the coordinates. after that with the coordinates we can get the venues around them in a planed radius. So the analysis is appear to realize.

Figure 2. Panorama view of Bankenviertel from the southeast, Frankfurt am Main

The aim of this report is to study and analyze neighborhoods of London and Frankfurt. The analysis will discover the daily consumption habits of businessman in Frankfurt and London.

2. Data Preparation

2.1. Data acquisition

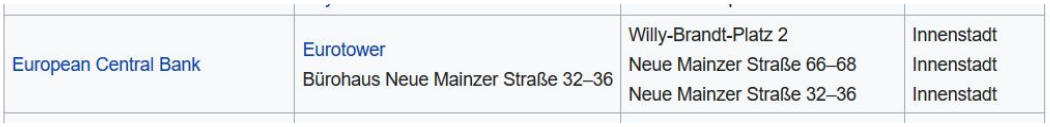
To consider the objective stated above, we need the following data sources used for the analysis. Skyscrapers and tall buildings in central business district in City of

London and Canary Wharf. Financial institutions in central business district in Bankenviertel Frankfurt am Main.

We will calculate coordinate according to every building address from above. And those coordinates will be used in next step crawl venue informations. Using Foursquare we will get all the venues in each neighborhood nearby a skyscrapers. We will regroup these venues later for further analysis.

2.2. Data governance

The crawled dataset from website is sometimes irregular. For example (Figure 3.) there are break lines in a cell. It means that we consider only one row data but actually many rows.



European Central Bank	Eurotower Bürohaus Neue Mainzer Straße 32–36	Willy-Brandt-Platz 2 Neue Mainzer Straße 66–68 Neue Mainzer Straße 32–36	Innenstadt Innenstadt Innenstadt

Figure 3. Break lines in a cell, Wikipedia Website

The Use of tallest buildings is other point that we need to pay attention. It can be office, residential or cathedral. Obviously tall building for office is the target.

	Name	Location	Latitude	Longitude
0	Leadenhall Building	122 Leadenhall Street	51.513535	-0.082284
1	Heron Tower	110 Bishopsgate	51.516410	-0.081331
2	Tower 42	25 Old Broad Street	51.515348	-0.084350
3	30 St Mary Axe	30 St Mary Axe	51.514550	-0.080880
4	Broadgate Tower	201 Bishopsgate	51.520435	-0.078947
5	20 Fenchurch Street	20 Fenchurch Street	51.511602	-0.083463
6	CityPoint	1 Ropemaker Street	51.519528	-0.088202
7	Willis Building	51 Lime Street	51.512661	-0.082116
8	St. Helen's	1 Undershaft	51.514492	-0.081621
9	99 Bishopsgate	99 Bishopsgate	51.515776	-0.082091
10	Stock Exchange Tower	125 Old Broad Street	51.514537	-0.085931

Figure 4. Tall buildings' address and coordinates, Canary Wharf

So in the end of data governance process, we got the step results - all tallest building in the CBD with latitude and longitude (Figure 4). It is saved in a csv file, because it takes too much time to calculate coordinates meanlessly.

3. Data Analysis

3.1. Relationship of tallest buildings

Normally we could crawl neighborhoods' information for each building in the overview (Figure 5, Figure 9 and Figure 13). Then we become many duplicated informations. We waste time both in crawling and data cleaning.

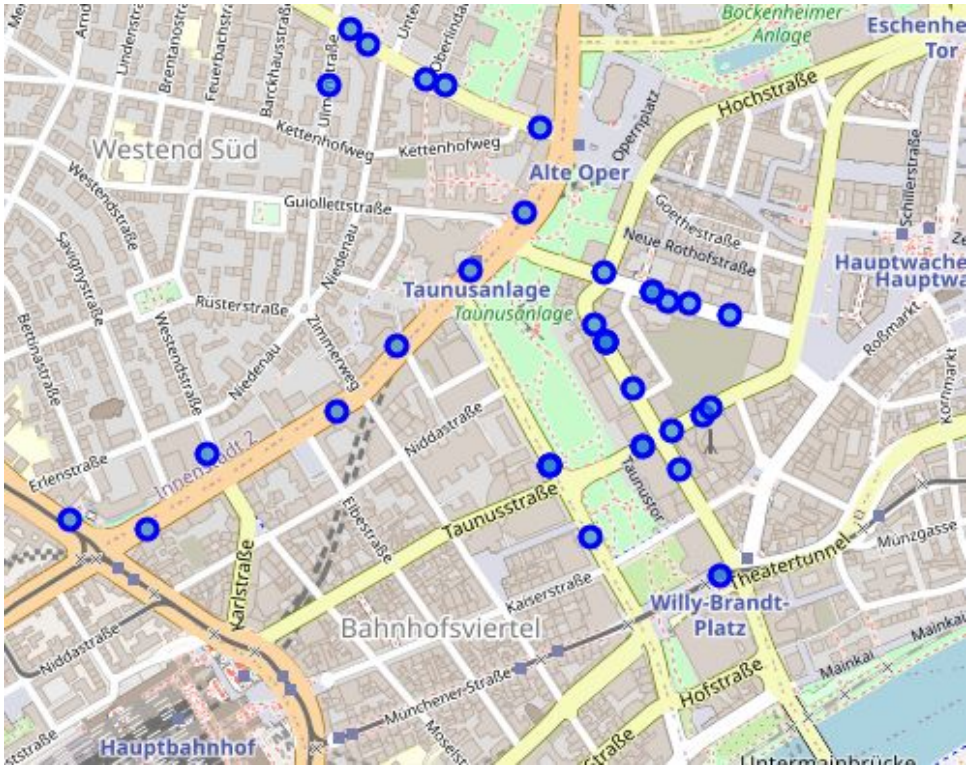


Figure 5. Tall buildings in CBD, Frankfurt am Main

Instead of this we apply a cluster analysis. K-means clustering is a better method for small dataset and robust (trust me, I've tried also Gaussian Mixture Models, the result is so weird). The cluster number was established after sequential iterations(Figure 6).

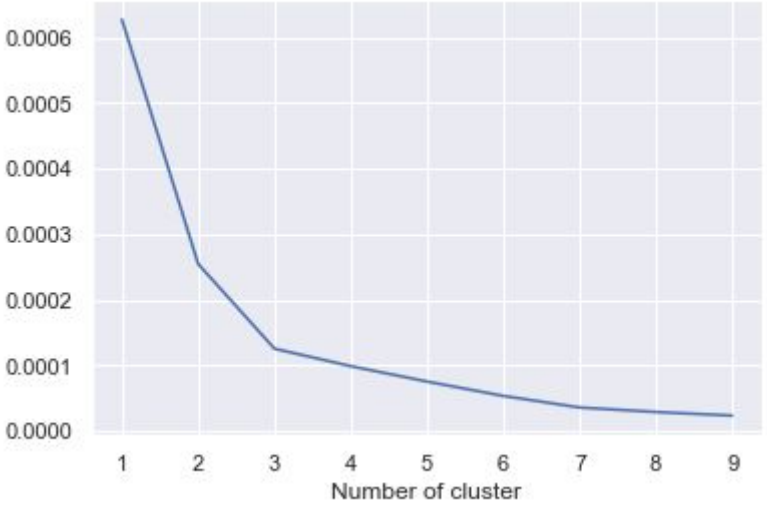


Figure 6. Cluster analysis of tall buildings, Frankfurt am Main

We separate buildings into three partitions (Figure 7). Now we calculate the central coordinate for each cluster. (Figure 8)

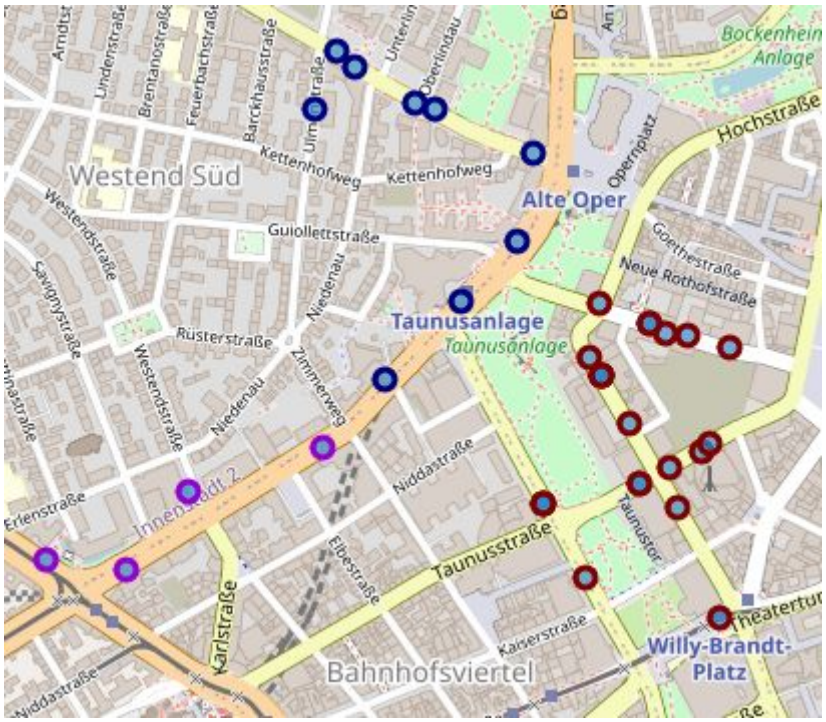


Figure 7. According to 3 clusters, tall buildings in CBD, Frankfurt/M

	Color	Latitude	Longitude
0	darkviolet	50.110535	8.662603
1	maroon	50.111793	8.672510
2	navy	50.115334	8.667863

Figure 8. Central coordinate according to 3 clusters, Frankfurt am Main

We do the same process for Canary Wharf and City of London. namely Figure 9 to Figure

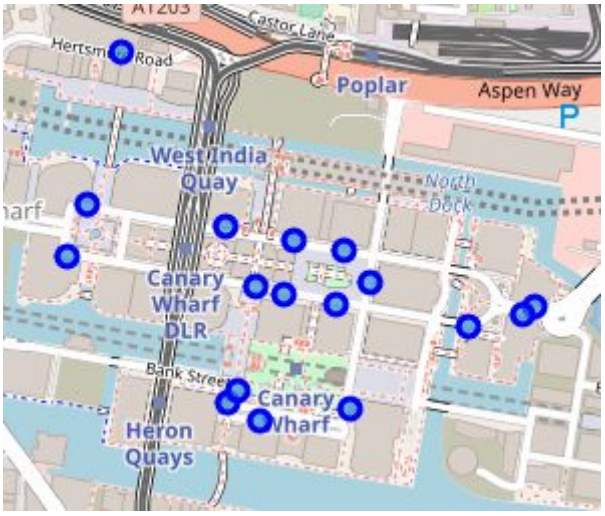


Figure 9. Tall buildings in CBD, Canary Wharf

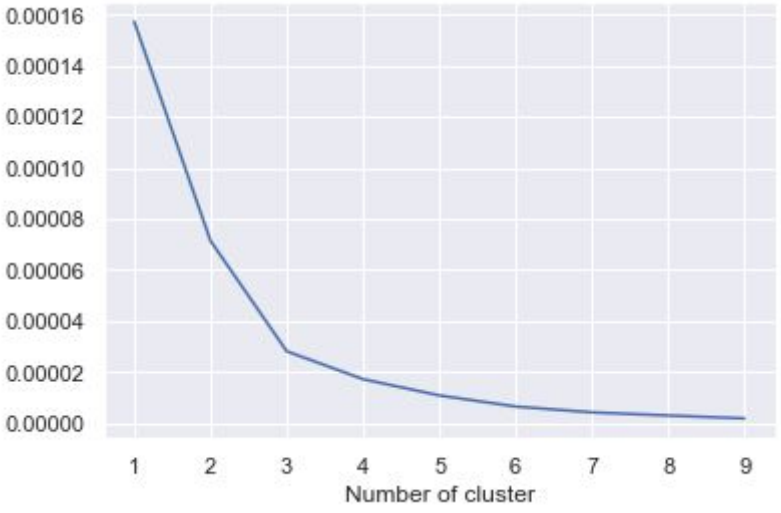


Figure 10. Cluster analysis of tall buildings, Canary Wharf

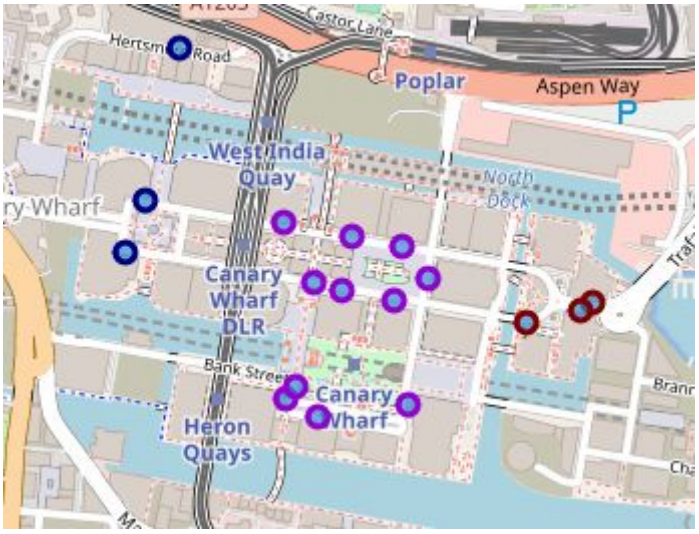


Figure 11. According to 3 clusters, tall buildings in CBD, Canary Wharf

	Color	Latitude	Longitude
0	darkviolet	51.504166	-0.018769
1	maroon	51.504216	-0.014073
2	navy	51.506145	-0.022987

Figure 12. Central coordinate according to 3 clusters, Canary Wharf

Figure 13. Tall buildings in CBD, City of London

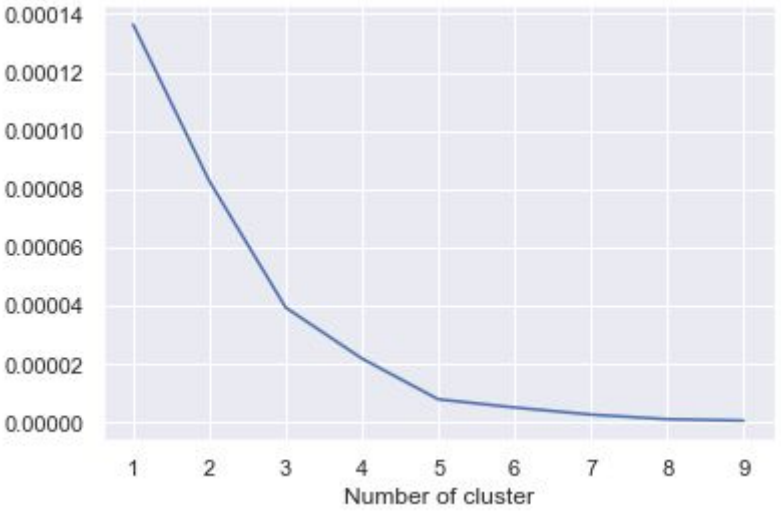


Figure 14. Cluster analysis of tall buildings, City of London

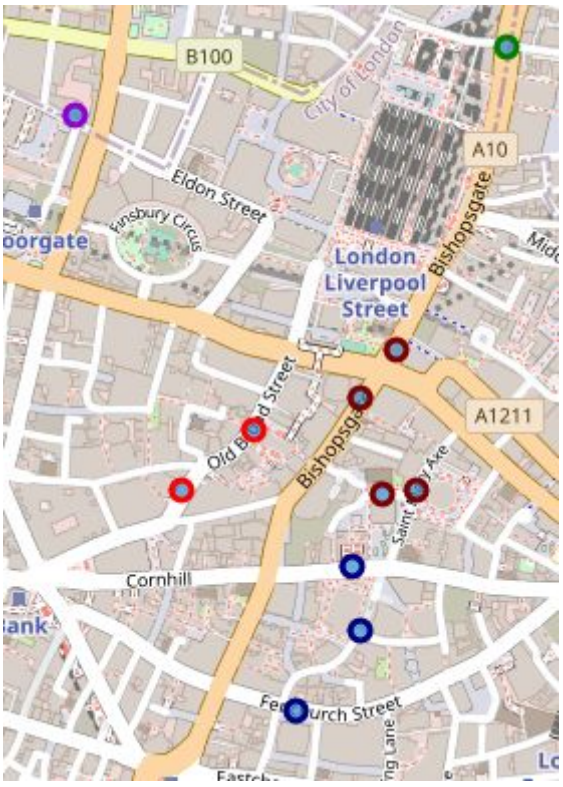


Figure 15. According to 5 clusters, tall buildings in CBD, City of London

	Color	Latitude	Longitude
0	darkviolet	51.519528	-0.088202
1	green	51.520435	-0.078947
2	maroon	51.515307	-0.081481
3	navy	51.512599	-0.082621
4	red	51.514942	-0.085140

Figure 16. Central coordinate according to 5 clusters, City of London

3.2. Classification of venues

I would like mention two Foursquare parameters. Version is 20200131 date of Brexit, radius is 500, comfortable walking distance.

The venue category of Foursquare is professional in diversification. but for a quantitative analysis it means fragmentation. Let's see this example: (Figure 17 and 18).

Venue Category	Venue Group	Count
Italian Restaurant	Catering Services	16
Hotel	Lodging	12
Coffee Shop	Catering Services	8
Café	Catering Services	7
German Restaurant	Catering Services	6
Steakhouse	Catering Services	6
Indian Restaurant	Catering Services	5
Bakery	Catering Services	5
Restaurant	Catering Services	5
Asian Restaurant	Catering Services	5

Figure 17. Top 10 Venue Categories in CBD, Frankfurt am Main

If we use the Foursquare's original category, the analysis will become a "Michelin guide". Even with Foursquare's category we could determine the top ten consumption habits in Frankfurt is very like London. This is a bad guide.

Venue Category	Venue Group	Count
Coffee Shop	Catering Services	28
Hotel	Lodging	24
Gym / Fitness Center	Sport	19
Italian Restaurant	Catering Services	16
Sandwich Place	Catering Services	15
Café	Catering Services	11
Restaurant	Catering Services	10
Steakhouse	Catering Services	9
Cocktail Bar	Catering Services	9
French Restaurant	Catering Services	8

Figure 18. Top 10 Venue Categories in CBD, London

(* London includes City of London and Canary Wharf)

So a over group is required. We reference some experimence from Google Maps. The over group include six parts: Catering Services, Free time, Sport, Medical care, Lodging and Public Service.

- Catering Service: Food court, Restuarant, Backery, Bar, Pub, Bistro, Lounge, Cafe.
- Free time: Art gallery, Shop, Store, Museum, Theater, Opera house, Music venue, Nightclub, Club, Park.
- Sport: Aquarium, Stadium, Arena, Gym, Fitness studio.
- Medical care: Hospital, Pharmacy, Drugstore, Medical center.
- Lodging: Hostel, Hotel, Motel.
- Public Service: Court, Post office, Train station, Metro station, Bus.

We try a semi automatic process to group venue category.

1. Export all anti-duplicate venue categories in bankenviertel Frankfurt into a csv file.
2. In the column Venue Group tape above defined Group name and save to a csv file.
3. Read above csv file into a Dataframe. Apply mapped venue categories map in Canary Wharf and City of London. Do step 1 and 2 for all not mapped venue categories.

Summary there are 180 venues and 77 categories nearby Bankenviertel in Frankfurt, 150 venues and 81 categories nearby Canary Wharf, then 262 venues and 101 categories in City of London.

4. Result and Discussion

Now under the over group we can find clearly the Similarities and differences between Frankfurt and London. The determination shows us in four directions. In the total venue amount, the amount of nearby venues in London (Canary Wharf and City of London together) is fast double than in Frankfurt (Figure 19). The naive amount comparison show only small shortage in Frankfurt. If we perform in the unique venue (here “unique” means the venue category exist only in Frankfurt or London) (Figure 20).

But we received some interesting results in other hand. If we adjust the direction to percentage. the scores are all same either Frankfurt and London or Bankenviertel, Canary Wharf and City of London. It indicate, there are same consumption habits under our defined six groups in CBDs Frankfurt and London. (Figure 21 and 22)

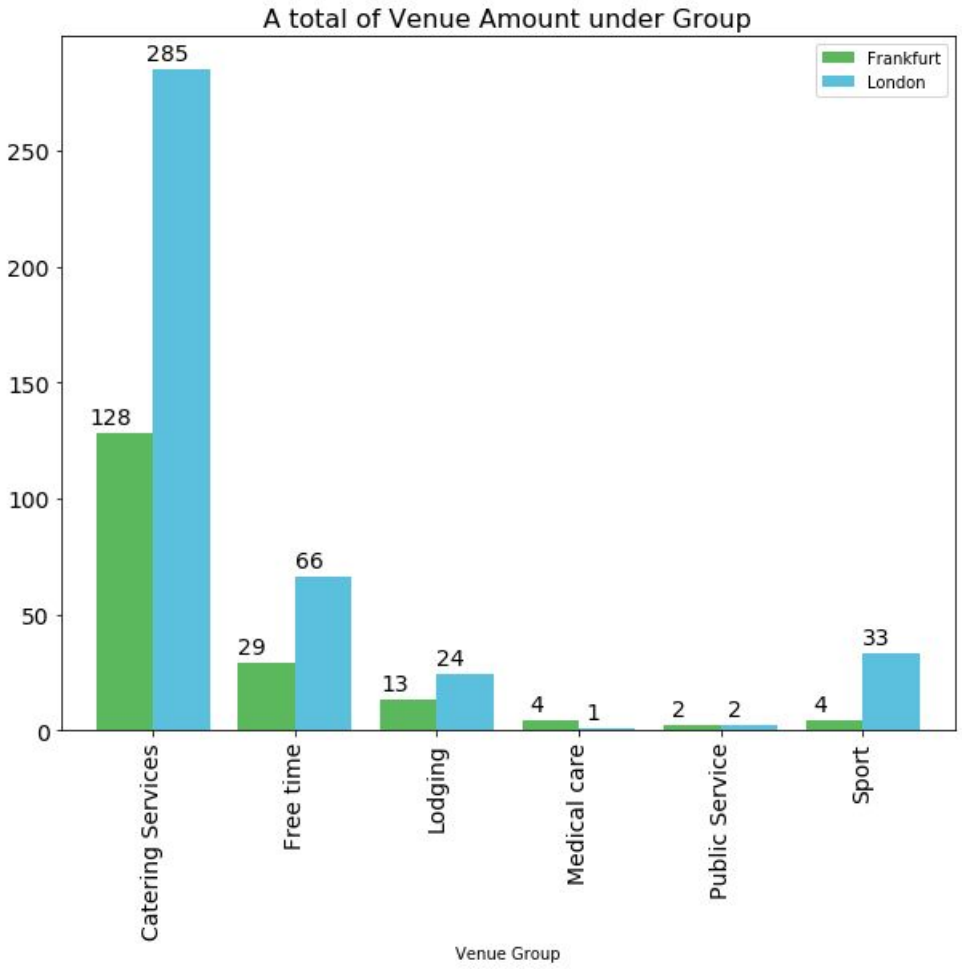


Figure 19. Comparison of Total Venue Amount
* London includes City of London and Canary Wharf

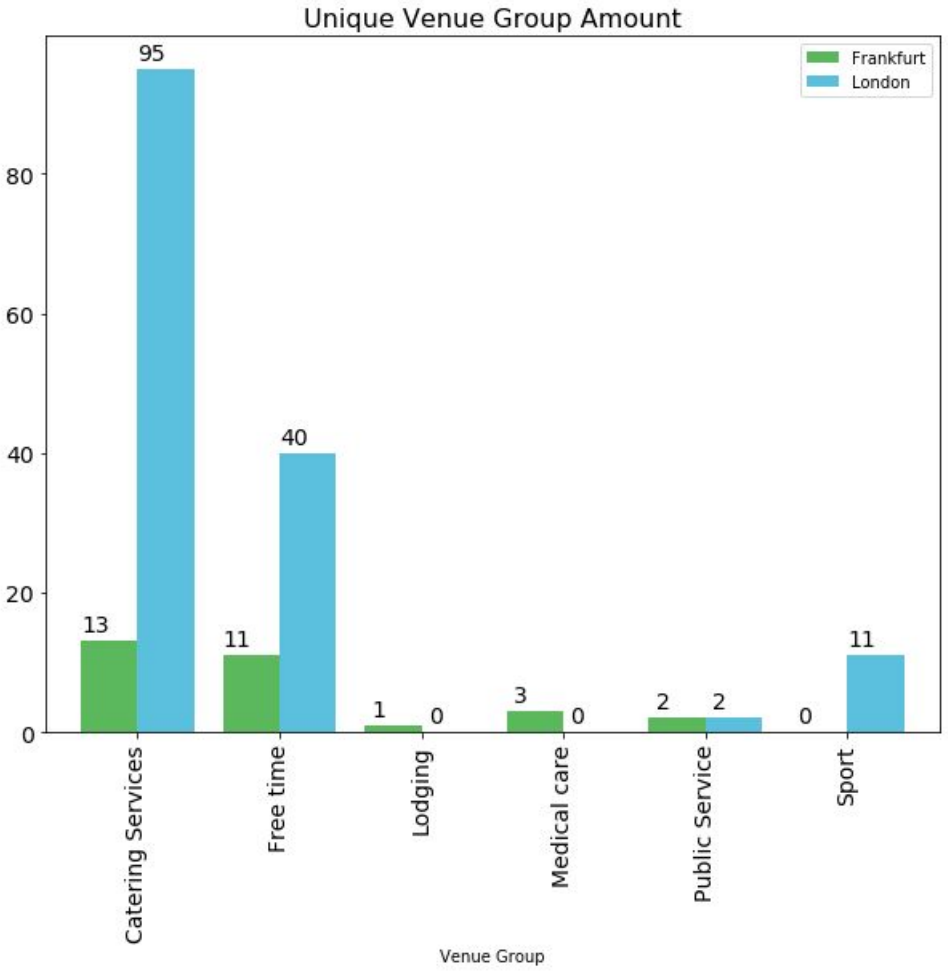


Figure 20. Comparison of Unique Venue Amount
* London includes City of London and Canary Wharf

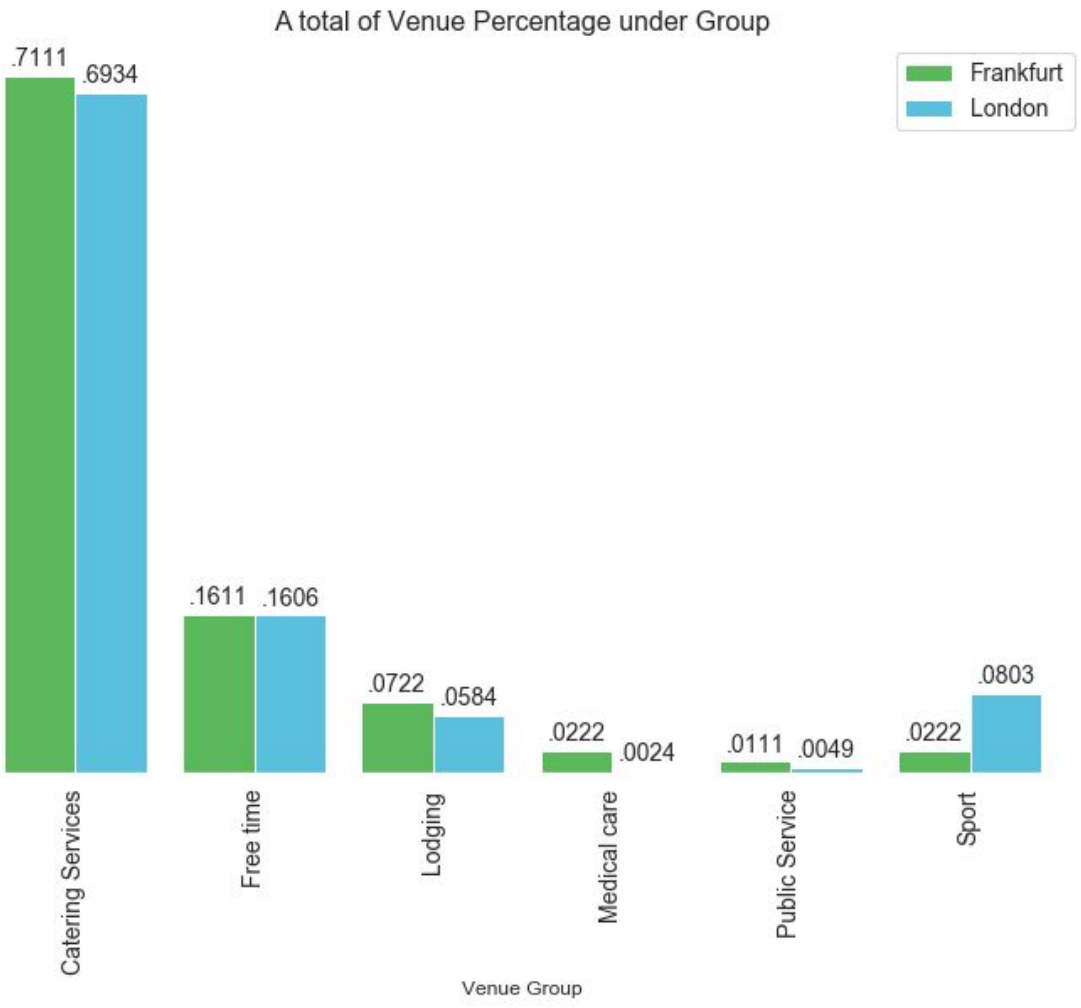


Figure 21. Comparison of Total Venue Percentage
* London includes City of London and Canary Wharf

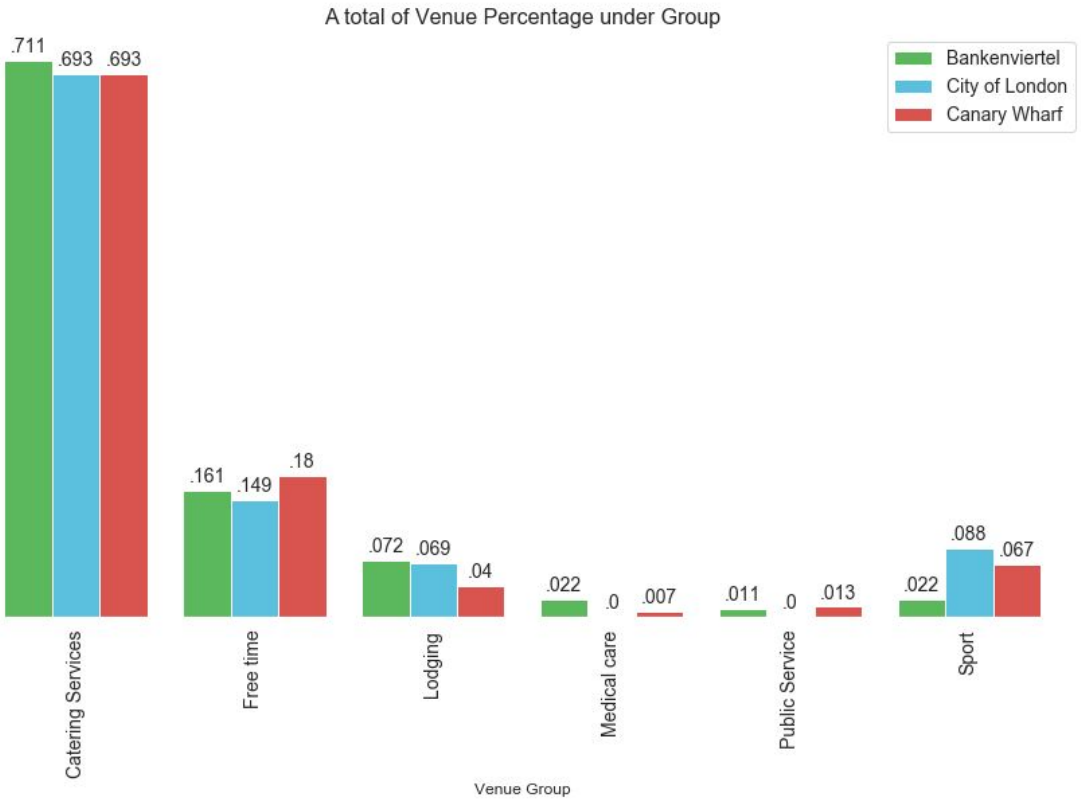


Figure 22. Comparison of Total Venue Percentage

5. Conclusion

In conclusion, the scope of this analysis is somewhat limited. From comparison, there are some big difference in Central Business District between Frankfurt and London. People in London have more opportunities for Catering Services, Free time, Lodging and Sport.

Overall, although Frankfurt hat enough tallest buildings and fast same "landscape", but it is not more charming than London. They need to do something more in order to improve soft skills.

6. Reference

6.1. Wikipedia content

- https://en.wikipedia.org/wiki/City_of_London
- https://en.wikipedia.org/wiki/Canary_Wharf
- https://en.wikipedia.org/wiki/Bankenviertel

6.2. API

- geopy
- FOURSQUARE
- folium
- scikit-learn