CAPSTONE PROJECT – THE BATTLE OF LISBON NEIGHBORHOODS

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1 INTRODUCTION

1.1 Background

Lisbon is Portugal's amazing capital and one of Europe's most charismatic and vibrant cities. It is a city that mixes traditional heritage effortlessly with striking modernism and progressive thinking. Lisbon offers a rich and varied history as a holiday destination, a buzzing nightlife and a glorious year-round climate. This guide will provide an introduction to Lisbon by answering some of the common vacation questions and providing links to more detailed information. The post-crisis evolution of Lisbon and the corresponding tourism boom demonstrate the dramatic impact of overtourism and its lasting ramifications. Discover Lisbon's culture and history as you retrace the famous journey to India by Vasco de Gama. Take a trip to Belem where you'll be able to witness the historic monuments of the city that mark the Portuguese people's fascinating accomplishments, like Mosteiro Dos Jeronimos. Visit Alfama (the oldest district in Lisbon) and try one of the many local craft shops. Take a break to go shopping for souvenirs and taste some genuine Portuguese wine. Admire the scenic river of Lisbon by coach as you pass through the historic and architectural treasures of the city. Before being taken back to your starting point, enjoy live commentary and soak up the famous sights of the city.

1.2 Business Problem description

Legislation encouraging foreign investment, the sharing economy, and a strong start-up scene combined with the city being a comparatively cheap destination has resulted in tons of travelers heading to Lisbon. It is also relevant that Portugal also has lovely, tiled buildings, beautiful beaches, and a vibrant food scene.

Taking this into account is undoubtedly an asset to invest in Portugal, and especially in Lisbon. In this case, implementing machine learning technology is necessary to help entrepreneurs make wise and successful decisions in Lisbon. As a result, the market issue that we are currently facing is:

- What type of business would be most beneficial in being invested in Lisbon?
- What is the best neighborhood in Lisbon to open this business?
- What does tourist hope to find in Lisbon?
- What is most attractive in the city?

One of the strengths of Portuguese culture is the wonderful cuisine. Having this, an idea that could be implemented in Lisbon would be the case of a entrepreneur that desires to be opening a new restaurant/bar. To solve this business problem, it is firstly needed to have a good database of both Lisbon boroughs /neighborhoods as well as the already established restaurants/bars or any food/drink places. This process will be described in the next section.

2 DATA SECTION

2.1 Data of Current Situation

Churches, cathedrals, and a magnificent castle are just a few of the sightseeing splendors of the city center to tick off. There are also world-class museums such as the impressive Museu Calouste Gulbenkian and Museu Nacional de Arte Antiga where can be seen artistic drawings and historical relics. In Sintra, where royal palaces sit in royal splendor surrounded by lush, ancient woodland, more architectural wonders are unveiled. To be able to visit them all as tourist attractions, a city of Lisbon offers an easy and organized uma rede of public transport. According to many tourism guides Lisbon is known mainly for five unique features and characteristics:

- Fado
- Neighbourhood
- Viewpoints
- Festivals
- Food

To tourists dining in Lisbon, one of the big surprises is how cheap the food is. The prato do dia dish is one of Europe's cheapest options! Fresh fish and seafood choices are popular in many restaurants as it is suitable for a seafaring nation: bacalhau (cod) is a delicious staple. The traditional tasks tucked away in the backstreets of the city are looking for hearty provincial fare. The gourmet hotspots of Lisbon deliver a truly international flavor for more sophisticated palates, with Mediterranean gastronomy especially well represented. Exotic Brazilian, Mozambique and other ex-colonies cuisine add spice to an ethnic menu that is already vibrant. There are plenty of Indian restaurants, and some of the sushi bars in the city have gained celebrity status.

2.2 Data Required to resolve the problem

Since gastronomy is a considerable point between Lisbon and Portugal, data collection for analysis should be carefully and organized. In order to make the analysis with the best possible results, we started by creating a dataframe with the boroughs of Lisbon as well as their geographical data and the number of population in each. To accomplish this first task it was used the data from a Wikipedia table [1] where all the data was reorganized so that there was no redundancy. Having this it was used Microsoft Excel in order to create a *CSV* containing the Latitude and Longitude of each Lisbon borough, necessary to make the dataframe complete as it is shown in fig.5.

	Borough	Population	Area(km^2)	Latitude	Longitude
0	Ajuda	15 617	288	38.707500	-9.198333
1	Alcântara	13 943	5,07	38.706389	-9.174167
2	Alvalade	31 813	534	38.746944	-9.136111
3	Areeiro	20 131	174	38.740278	-9.128056
4	Arroios	31 653	213	38.728889	-9.138889
5	Avenidas Novas	21 625	299	38.738889	-9.145833
6	Beato	12 737	2,46	38.734722	-9.105833
7	Belém	16 528	10,43	38.700000	-9.200000
8	Benfica	36 985	803	38.751111	-9.202222
9	Campo de Ourique	22 120	165	38.715278	-9.166944
10	Campolide	15 460	277	38.726389	-9.163333
11	Carnide	19 218	369	38.760833	-9.183611
12	Estrela	20 128	4,60	38.713333	-9.160000
13	Lumiar	45 605	657	38.765278	-9.158611
14	Marvila	37 793	7,12	38.745278	-9.104167
15	Misericórdia	13 044	2,19	38.711389	-9.148056
16	Olivais	33 788	809	38.773611	-9.117500
17	Parque das Nações	21 025	544	38.768056	-9.093889
18	Penha de França	27 967	2,71	38.730000	-9.131667
19	Santa Clara	22 480	336	38.785278	-9.145000
20	Santa Maria Maior	12 822	3,01	38.712778	-9.135556
21	Santo António	11 836	149	38.724167	-9.145000
22	São Domingos de Benfica	33 043	429	38.743611	-9.170000
23	São Vicente	15 339	1,99	38.719444	-9.126389

Figure 1: Touristic places of interest in Lisbon using Foursquare API

All the code necessary for obtaining the first dataframe can be found in the file *1_Lisbon_Bourough.ipynb*, this file and every file mencioned in this report can be found in the GitHub repository [2]. Having all data from the 24 Lisbon boroughs ready, we started by creating a dataframe dedicated to the restaurant data. The code regarding the dataframe arrangement of restaurants can be seen in the file *2_Lisboa_Restaurant*. Firstly it was needed to have access to the *CSV* file containing the Lisbon borough data.

Using the date of the boroughs of Lisbon, namely the latitude and longitude variables, a for loop was created to access the Foursquare API and save the data for all the boroughs with places of tourist interest, including hotels, bars, restaurants, historic centers, among others.

	name	id	categories	lat	lng
0	Palácio Nacional da Ajuda	4b0588a3f964a5207bd122e3	Historic Site	38.707653	-9.197758
1	Restaurante Andorinhas	4d9885d59079b1f7a0182d0a	Restaurant	38.704911	-9.199349
2	Páteo Alfacinha	4c532ced72cf0f47267c71d2	Restaurant	38.706537	-9.194202
3	Jardim Botânico da Ajuda	4c8b582be51e6dcb8e7671de	Botanical Garden	38.706430	-9.201222
4	Churrasqueira do Marquês	4c48033e76d72d7fa2043f4d	BBQ Joint	38.703996	-9.199402
...	...	...	...	...	...
1001	Mercado de Santa Clara	4e886bc5be7b88449a912b01	Event Space	38.715564	-9.125582
1002	Jardim Botto Machado	4c962b6e82b56dcbd0f9deaa	Garden	38.715877	-9.123740
1003	Feira da Ladra	4b0588a8f964a520cfd222e3	Flea Market	38.715368	-9.125244
1004	Cafe De Calcada	54d74df1498ec1066a06efaf	Bistro	38.718287	-9.131190
1005	Pastelaria Náná	50952535e4b024b7d7b7e600	Portuguese Restaurant	38.718530	-9.121602

Figure 2: Restaunts dataframe

After Having the dataframe with all touristic places, it was needed to filter only the restaurants/bars or any kind of food/drink places. This was a needed step because the focus of this project investment was to open a new restaurant/bar in Lisbon. According to this objective there was no need to analyze the historic places/hotels and other places that do not represent a treat to the opening of the restaurant.

	Places	ID	Categories	Latitude	Longitude
0	Restaurante Andorinhas	4d9885d59079b1f7a0182d0a	Restaurant	38.704911	-9.199349
1	Páteo Alfacinha	4c532ced72cf0f47267c71d2	Restaurant	38.706537	-9.194202
2	Estufa Real	4b0588a4f964a520ced122e3	Restaurant	38.706840	-9.201975
3	Alcântara 50	50899fb2e4b0167a9c2eddf4	Portuguese Restaurant	38.705462	-9.173533
4	O Palácio	4c5c82867735c9b6507f8c72	Seafood Restaurant	38.706357	-9.173442
...	...	...	...	...	...
433	Penalva da Graça	4f89e174e4b00a6262549ad1	Seafood Restaurant	38.720722	-9.130070
434	Taproom Oitava Colina	5b4928789f8a9f002c28cc08	Beer Bar	38.718390	-9.131880
435	O Cardoso do Estrela de Ouro	4c892b94a0ffb60c7f4228c5	Portuguese Restaurant	38.720650	-9.130091
436	Tazza In Giro	5a09ef5d2619ee11bd25fffc	Vegetarian / Vegan Restaurant	38.715800	-9.125121
437	Pastelaria Náná	50952535e4b024b7d7b7e600	Portuguese Restaurant	38.718530	-9.121602

Figure 3: Final dataframe regarding the places of interest in Lisbon.

The thought process behind this is that likes are a proxy for quality. The more likes there are, the better the restaurant is. This might be incorrect but API call issues (how many I can use for free) holds me back from getting price / rating data. I will then bin this data into a quality categorical variables so we can cluster appropriately. Having this into account to accomplish this project, this solutions seemed the most logical for having a comparative method.

	Places	ID	Categories	Latitude	Longitude	Likes
0	Restaurante Andorinhas	4d9885d59079b1f7a0182d0a	Restaurant	38.704911	-9.199349	23
1	Páteo Alfacinha	4c532ced72cf0f47267c71d2	Restaurant	38.706537	-9.194202	44
2	Estufa Real	4b0588a4f964a520ced122e3	Restaurant	38.706840	-9.201975	25
3	Alcântara 50	50899fb2e4b0167a9c2eddf4	Portuguese Restaurant	38.705462	-9.173533	27
4	O Palácio	4c5c82867735c9b6507f8c72	Seafood Restaurant	38.706357	-9.173442	86
...	...	...	...	...	...	...
433	Penalva da Graça	4f89e174e4b00a6262549ad1	Seafood Restaurant	38.720722	-9.130070	12
434	Taproom Oitava Colina	5b4928789f8a9f002c28cc08	Beer Bar	38.718390	-9.131880	12
435	O Cardoso do Estrela de Ouro	4c892b94a0ffb60c7f4228c5	Portuguese Restaurant	38.720650	-9.130091	9
436	Tazza In Giro	5a09ef5d2619ee11bd25fffc	Vegetarian / Vegan Restaurant	38.715800	-9.125121	6
437	Pastelaria Náná	50952535e4b024b7d7b7e600	Portuguese Restaurant	38.718530	-9.121602	3

438 rows × 6 columns

Figure 4: Borough Table

2.3 Mapping of Data

The data will be used as follows: Use Foursquare and geopy data to map the 24 boroughs for all Lisbon and use foursquare and geopy data to map the location of restaurants and places of interest for the business. After this cluster all data in a map in order to be able to identify the neighbourhoods each location separately. This will allow to have a simplified version of all the data. Addresses from restaurant locations will be converted to geodata (lat, long) and will be used in the *folium.Map* in order to the examination and analysis easier.

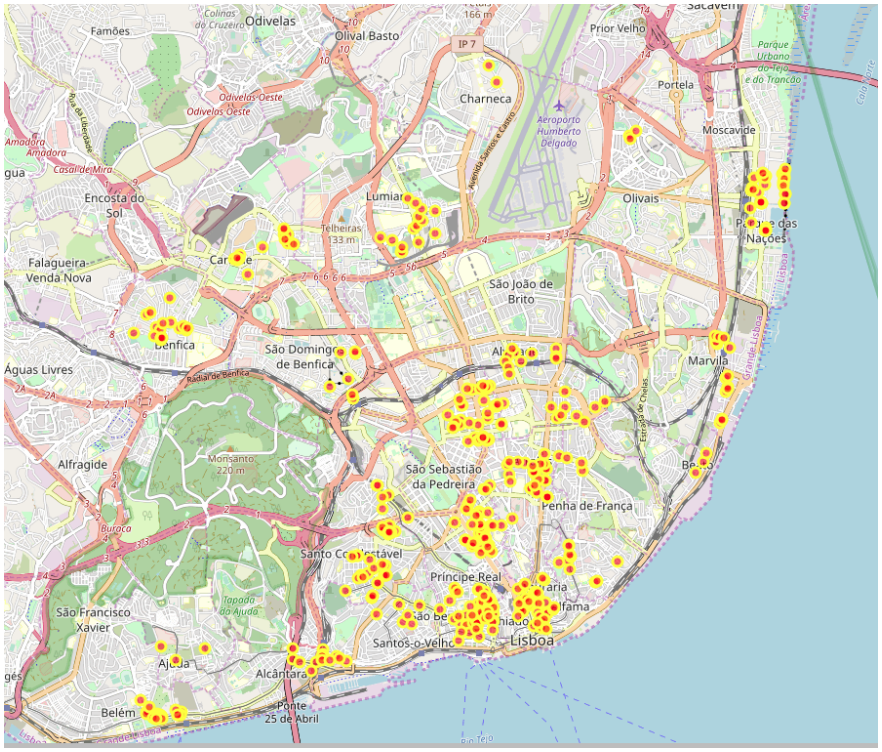

Figure 5: Lisbon Map with places of interest

3 METHODOLOGY SECTION

3.1 Stragegy and Exploratory analysis

After getting the data sets "clean", it was created some data visualizations in order to better interpret and study the results. Initially it was analysed the number of citizens per borough was carried out in order to be aware of the influence that this factor may have on local trade. The graph bar in fig.6 shows the population for each of the boroughs in the dataframe.

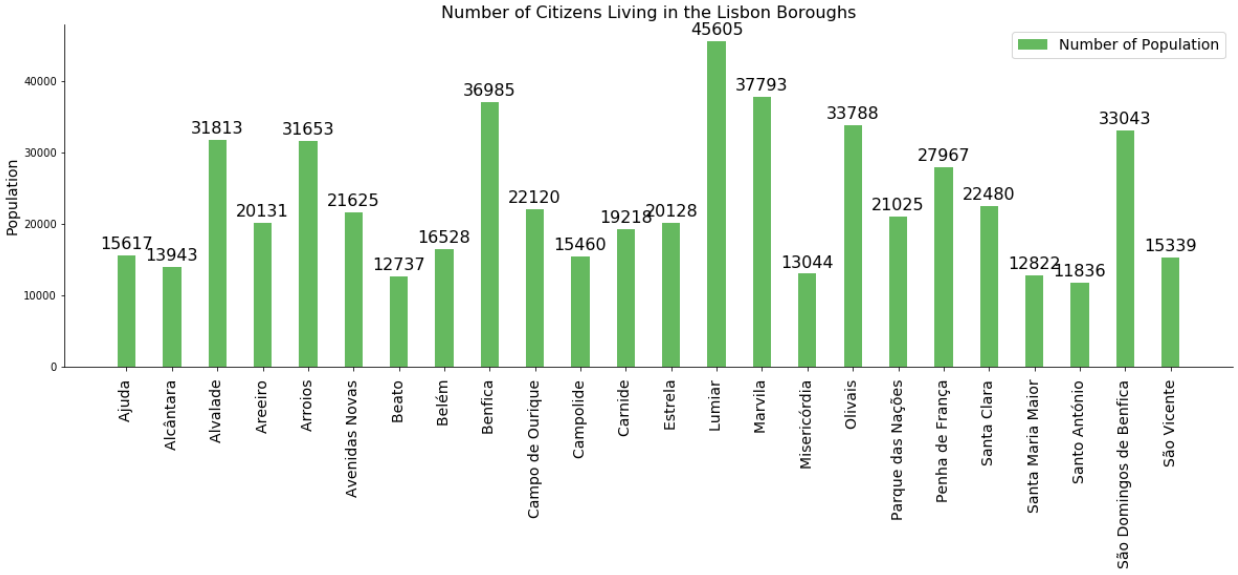

Figure 6: Number of Citizens Living in each Lisbon borough

After knowing the population of each borough, it is important to relate this number to the number of restaurants and bars in each borough. For this purpose, the bar graph shown in figure 7 was created. It is possible to verify that there is no reliable relationship between the number of inhabitants and the number of restaurants. At most the correlation that can be made is that the areas with the largest housing tend to have a number of medium / low restaurants.

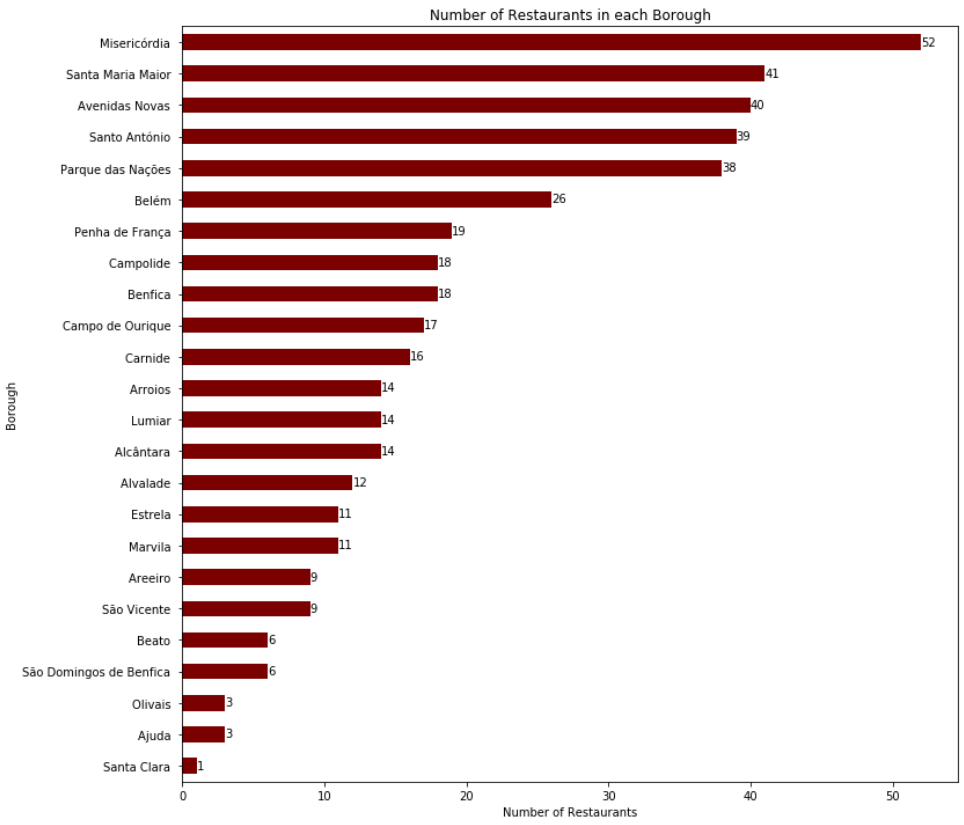

Figure 7: Number of Restaurants/Bars in each Lisbon borough

Taking into account an overview of all of Lisbon, the 15 categories with the most established restaurants were filtered. Through figure 8 it can be seen that clearly stand out the "Restaurants" which are mainly those traditional restaurants with a high variety, and in the first place the Restaurants specialized in Portuguese food.

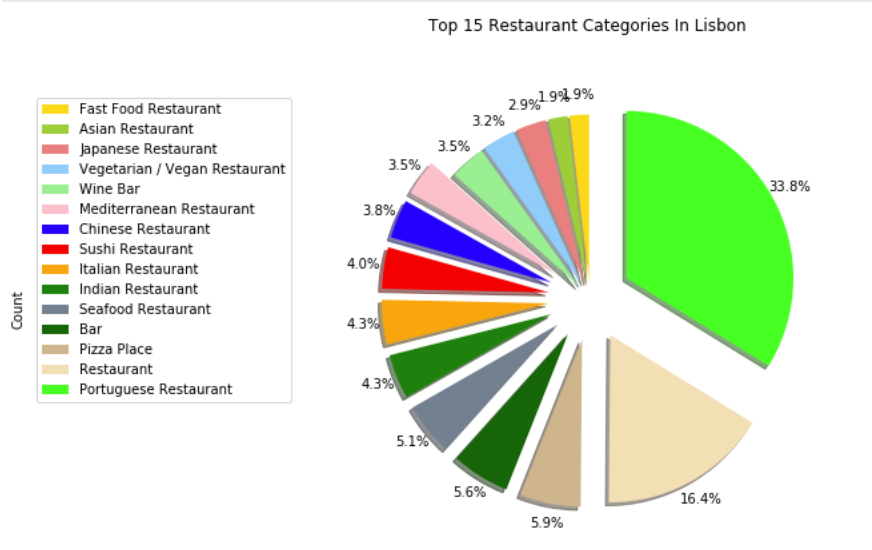

Figure 8: Lisbon Map with places of interest

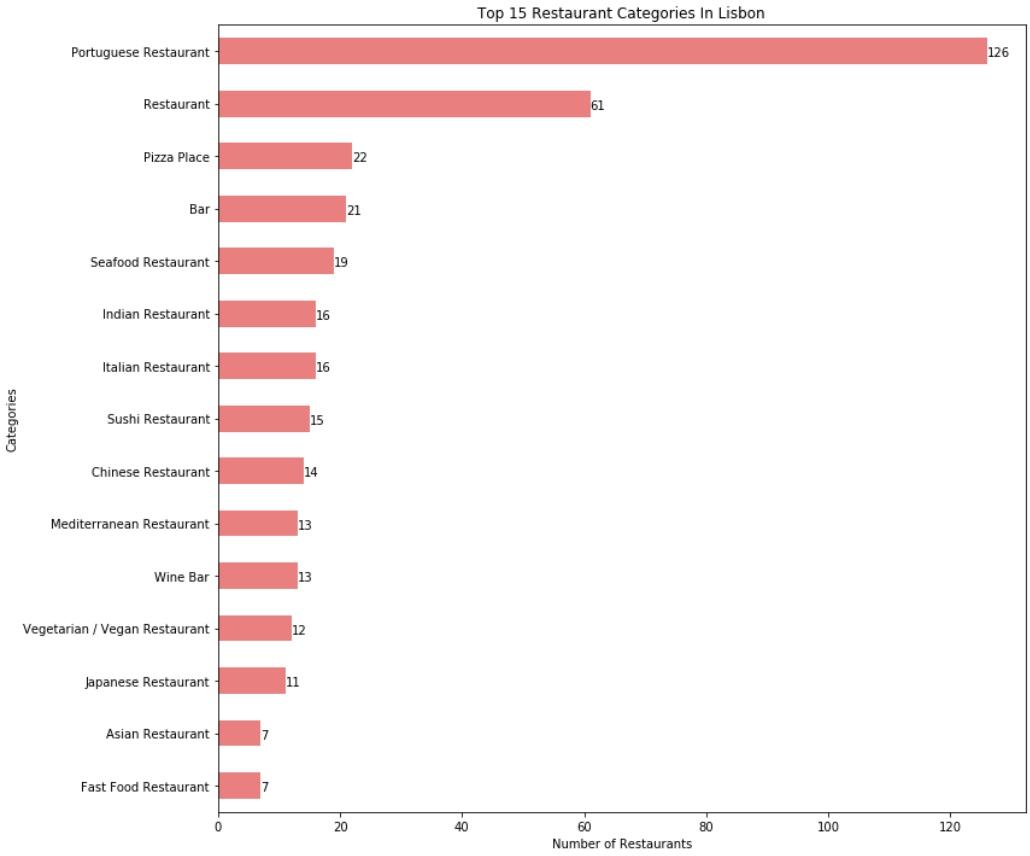

Figure 9: Lisbon Map with places of interest

One of the important factors in opening a new restaurant is to see what are the trends of tourists passing through Lisbon. As such, figures 8 and 9 clearly demonstrate what preferences visitors have had when choosing restaurants in Lisbon.

Another very important factor is to see the competition of each borough of Lisbon. This requires checking how many restaurants and what types each location has. As such, a map was created with clusters relating to restaurants in Lisbon areas, so that it is possible to have a visual perception of the current situation of the city where each data point mark a cluster.

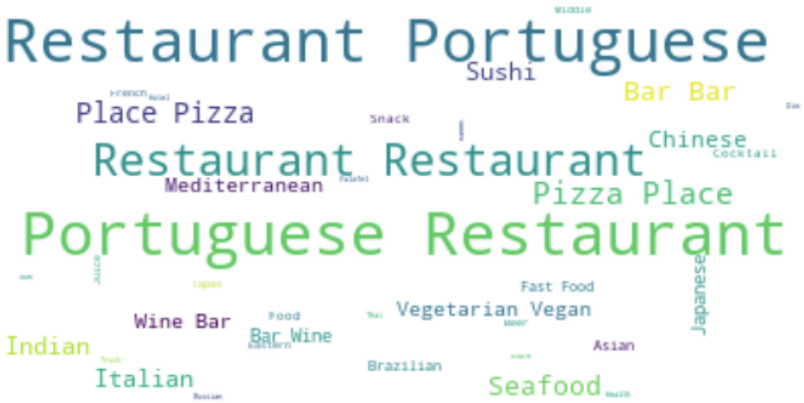

Figure 10: Cluster Map of restaurants.

It is possible to verify through figure 10 that the red data point has the largest cluster of restaurants, with 133 elements. As such, it has been analyzed in greater detail in Figure 18 that there is enormous competition especially in Campo Pequeno, Arroios and the Marquês de Pombal areas.

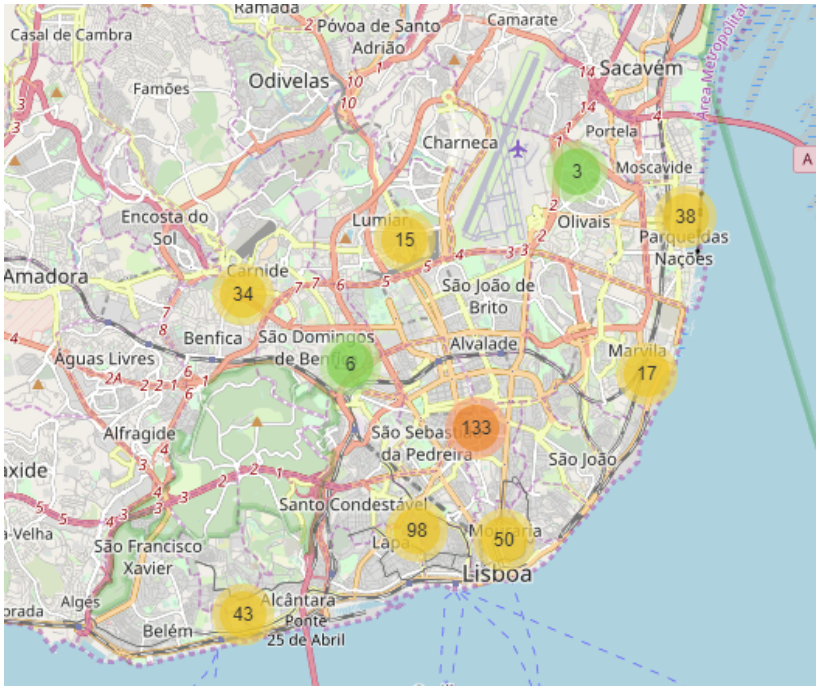

Figure 11: General Cluster Map of Lisbon Restaurants

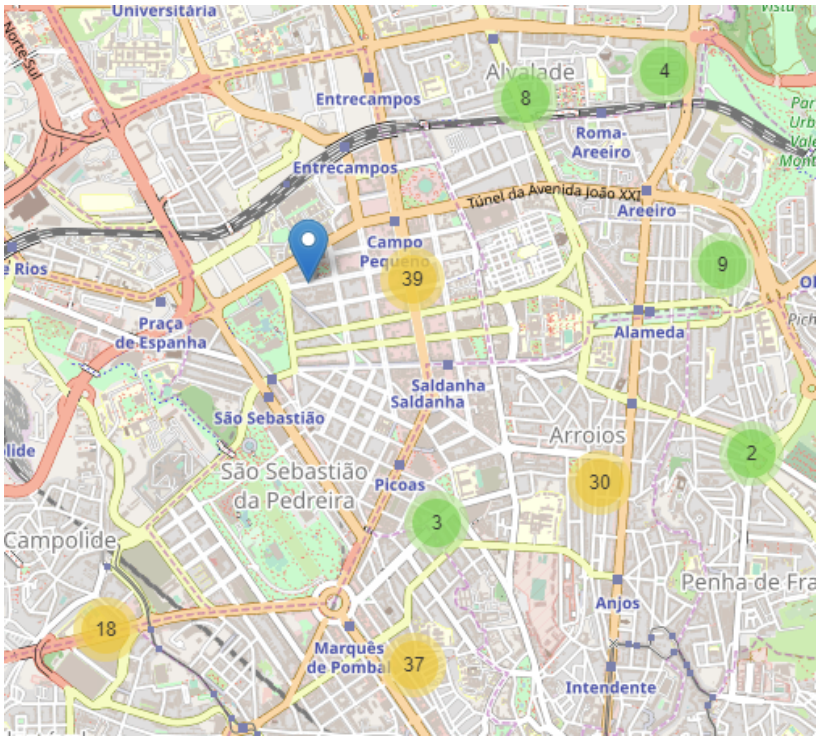

Figure 12: Cluster Map of restaurants red zone.

3.2 K-Cluster analysis

Subsequently, K-Means Clustering was performed the Lisbon boroughs according to which restaurant category used from Foursquere information to experience each borough's opportunity. A hot encoding was performed as the first step of cluster analysis to give binary values to each restaurant category. After that, borough names clustered the data to find out how many category of each class occur within each of the boroughs. We could obtain a list of the most common venue categories n each borough based on the frequency as follows.

	Places	Borough	Likes	Latitude	Longitude	Cluster Labels	1st Most Common Category	2nd Most Common Category	3rd Most Common Category	4th Most Common Category	5th Most Common Category	6th Most Common Category	7th Most Common Category	8th Most Common Category	9th Most Common Category	10th Most Common Category
0	Restaurante Andorinhas	Ajuda	23	38.704911	-9.199349	1	Restaurant	Wine Bar	Eastern European Restaurant	Health Food Store	Gay Bar	French Restaurant	Food Truck	Food Service	Food	Fast Food Restaurant
1	Páteo Alfacinha	Ajuda	44	38.706537	-9.194202	1	Restaurant	Wine Bar	Eastern European Restaurant	Health Food Store	Gay Bar	French Restaurant	Food Truck	Food Service	Food	Fast Food Restaurant
2	Estufa Real	Ajuda	25	38.706840	-9.201975	1	Restaurant	Wine Bar	Eastern European Restaurant	Health Food Store	Gay Bar	French Restaurant	Food Truck	Food Service	Food	Fast Food Restaurant
3	Alcântara 50	Alcântara	27	38.705462	-9.173533	2	Portuguese Restaurant	Mediterranean Restaurant	Seafood Restaurant	Eastern European Restaurant	Pizza Place	Restaurant	Indian Restaurant	Beer Bar	Sushi Restaurant	Beer Garden
4	O Palácio	Alcântara	86	38.706357	-9.173442	2	Portuguese Restaurant	Mediterranean Restaurant	Seafood Restaurant	Eastern European Restaurant	Pizza Place	Restaurant	Indian Restaurant	Beer Bar	Sushi Restaurant	Beer Garden

Figure 13: Cluster initial dataframe.

4 RESULTS SECTION

Regarding the K-Means clustering methodology used the results can be seen below:

	Borough	Cluster Labels	1st Most Common Category	2nd Most Common Category	3rd Most Common Category	4th Most Common Category	5th Most Common Category	6th Most Common Category	7th Most Common Category	8th Most Common Category	9th Most Common Category	10th Most Common Category
52	Avenidas Novas	0	Portuguese Restaurant	Restaurant	Italian Restaurant	Vegetarian / Vegan Restaurant	Pizza Place	Asian Restaurant	Fast Food Restaurant	Sushi Restaurant	Brazilian Restaurant	Japanese Restaurant
124	Benfica	0	Portuguese Restaurant	Seafood Restaurant	Restaurant	Asian Restaurant	Sushi Restaurant	Food	Chinese Restaurant	Pizza Place	Dim Sum Restaurant	French Restaurant
142	Campo de Ourique	0	Portuguese Restaurant	Bar	Restaurant	Seafood Restaurant	Italian Restaurant	Japanese Restaurant	Pizza Place	Indian Restaurant	Cantonese Restaurant	Brazilian Restaurant
159	Campolide	0	Restaurant	Portuguese Restaurant	Seafood Restaurant	French Restaurant	Japanese Restaurant	Fast Food Restaurant	Falafel Restaurant	Dim Sum Restaurant	Pizza Place	Health Food Store
177	Carnide	0	Portuguese Restaurant	Sushi Restaurant	Restaurant	Dim Sum Restaurant	Tapas Restaurant	Asian Restaurant	Food	Mediterranean Restaurant	Pizza Place	Food Truck
204	Lumiar	0	Pizza Place	Japanese Restaurant	Fast Food Restaurant	Chinese Restaurant	Restaurant	Vegetarian / Vegan Restaurant	Italian Restaurant	Sushi Restaurant	Wine Bar	Eastern European Restaurant
218	Marvila	0	Restaurant	Portuguese Restaurant	Pizza Place	Argentinian Restaurant	Mediterranean Restaurant	Wine Bar	French Restaurant	Food Truck	Food Service	Food
284	Parque das Nações	0	Portuguese Restaurant	Restaurant	Sushi Restaurant	Chinese Restaurant	Seafood Restaurant	Bar	Hotel Bar	Italian Restaurant	Pizza Place	Falafel Restaurant
422	São Domingos de Benfica	0	Bar	Japanese Restaurant	Food Truck	Seafood Restaurant	Fast Food Restaurant	Portuguese Restaurant	Wine Bar	Eastern European Restaurant	Gay Bar	French Restaurant

Figure 14: Cluster 1.

	Borough	Cluster Labels	1st Most Common Category	2nd Most Common Category	3rd Most Common Category	4th Most Common Category	5th Most Common Category	6th Most Common Category	7th Most Common Category	8th Most Common Category	9th Most Common Category	10th Most Common Category
0	Ajuda	1	Restaurant	Wine Bar	Eastern European Restaurant	Health Food Store	Gay Bar	French Restaurant	Food Truck	Food Service	Food	Fast Food Restaurant
92	Beato	1	Restaurant	Tapas Restaurant	Cantonese Restaurant	Wine Bar	Eastern European Restaurant	Gay Bar	French Restaurant	Food Truck	Food Service	Food
281	Olivais	1	Restaurant	Chinese Restaurant	Wine Bar	Eastern European Restaurant	Health Food Store	Gay Bar	French Restaurant	Food Truck	Food Service	Food

Figure 15: Cluster 2.

	Borough	Cluster Labels	1st Most Common Category	2nd Most Common Category	3rd Most Common Category	4th Most Common Category	5th Most Common Category	6th Most Common Category	7th Most Common Category	8th Most Common Category	9th Most Common Category	10th Most Common Category
3	Alcântara	2	Portuguese Restaurant	Mediterranean Restaurant	Seafood Restaurant	Eastern European Restaurant	Pizza Place	Restaurant	Indian Restaurant	Beer Bar	Sushi Restaurant	Beer Garden
38	Arroios	2	Portuguese Restaurant	Indian Restaurant	Vegetarian / Vegan Restaurant	Italian Restaurant	Brazilian Restaurant	Chinese Restaurant	Restaurant	Mediterranean Restaurant	Argentinian Restaurant	Falafel Restaurant
229	Misericórdia	2	Portuguese Restaurant	Bar	Wine Bar	Cocktail Bar	Restaurant	Italian Restaurant	Juice Bar	Pizza Place	Brazilian Restaurant	French Restaurant
342	Santa Maria Maior	2	Portuguese Restaurant	Wine Bar	Restaurant	Indian Restaurant	Bar	Mediterranean Restaurant	African Restaurant	Ramen Restaurant	Food Service	Vegetarian / Vegan Restaurant
428	São Vicente	2	Mediterranean Restaurant	Portuguese Restaurant	Indian Restaurant	Vegetarian / Vegan Restaurant	Bar	Beer Bar	Seafood Restaurant	Empanada Restaurant	French Restaurant	Food Truck

Figure 16: Cluster 3.

	Borough	Cluster Labels	1st Most Common Category	2nd Most Common Category	3rd Most Common Category	4th Most Common Category	5th Most Common Category	6th Most Common Category	7th Most Common Category	8th Most Common Category	9th Most Common Category	10th Most Common Category
341	Santa Clara	3	Portuguese Restaurant	Wine Bar	Hotel Bar	Health Food Store	Gay Bar	French Restaurant	Food Truck	Food Service	Food	Fast Food Restaurant

Figure 17: Cluster 4.

	Borough	Cluster Labels	1st Most Common Category	2nd Most Common Category	3rd Most Common Category	4th Most Common Category	5th Most Common Category	6th Most Common Category	7th Most Common Category	8th Most Common Category	9th Most Common Category	10th Most Common Category
17	Alvalade	4	Portuguese Restaurant	Bar	Persian Restaurant	Pizza Place	Snack Place	Indian Restaurant	Thai Restaurant	Beer Bar	Eastern European Restaurant	French Restaurant
29	Areeiro	4	Portuguese Restaurant	Asian Restaurant	Italian Restaurant	Chinese Restaurant	Restaurant	Pizza Place	Wine Bar	Eastern European Restaurant	French Restaurant	Food Truck
98	Belém	4	Portuguese Restaurant	Restaurant	Pizza Place	Chinese Restaurant	Fast Food Restaurant	Italian Restaurant	Japanese Restaurant	Juice Bar	Mediterranean Restaurant	French Restaurant
193	Estrela	4	Portuguese Restaurant	Pizza Place	Vegetarian / Vegan Restaurant	Bar	Japanese Restaurant	Restaurant	French Restaurant	Food Truck	Food Service	Food
322	Penha de França	4	Portuguese Restaurant	Snack Place	Chinese Restaurant	Indian Restaurant	Asian Restaurant	Italian Restaurant	Restaurant	Pizza Place	Middle Eastern Restaurant	Bar
383	Santo António	4	Portuguese Restaurant	Restaurant	Pizza Place	Russian Restaurant	Middle Eastern Restaurant	Italian Restaurant	Japanese Restaurant	Brazilian Restaurant	Himalayan Restaurant	Mediterranean Restaurant

Figure 18: Cluster 5.

Based on our initial parameters, we were able to discover the best neighborhood after various analyzes. Now we're going to review all the analyzes completed in this project before and finally come to the conclusions about starting up a business as an entrepreneur.

5 DISCUSSION SECTION AND CONCLUSIONS

We find from this study that the five boroughs below are the best places to build a student building, based on the borough's opportunity of business. One option would be to open a restaurant dedicated to Portuguese food in the Olivais region of cluster 2, because despite the tourist trend being "Portuguese Restaurant", this borough has no competition at this level which makes it stand out as a Portuguese restaurant. On the other hand, it is an area with a considered population of 33788, which allows it not to depend exclusively on tourists, so this region stands out from the rest of cluster 2. Another opportunity would be to open, for example, a pizzeria in Santa Clara, cluster 4. Because it has no such venture it is one of the most prominent tourist categories. In addition to this I would like to highlight, the reward with the efforts, time and money spent. I believe this course with all the topics covered is well worthy of appreciation. This project showed me a practical application to solve the real situation with the use of Data Science tools that have an impact on personal and financial impact. Folium mapping is a very powerful technique for consolidating information and thoroughly and confidently making the analysis and decision. I'd recommend using it in similar situations.

6 LIMITATIONS AND RECOMMENDATION FOR FUTURE STUDY

We only took into consideration which sort of restaurant categories are common and how many likes that restaurant and category has, among various factors that determine a good borough. A higher number of influencing factors might give a more precise algorithm as well as a more perfectionist analysis. Apart from that, it is also needed to mentioned that all project was done only using the default/free access to Foursquare what might be a limiting factor in terms of data access.

REFERENCES

[1] Lista de freguesias de lisboa. URL https://pt.wikipedia.org/wiki/Lista_de_freguesias_de_Lisboa.

[2] Capstone repository. URL https://github.com/Danielorasleite/Coursera_Capstone.