

Lisbon: a new plan of a city for the people

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February, 2021

1 The problem

As many capital cities throughout Europe, Lisbon has greatly changed her profile during the last decades. Throughout the twentieth century, Lisbon was marked by a strong migration movement from the inner Portuguese country to the capital, as people from the countryside were looking for better economical conditions and life opportunities. Not only migrants, but immigrants as well have come to Lisbon, mostly from the Portuguese former colonies: Brazil, Angola, Mozambique, Guinea-Bissau, Cape Verde, Saint Tome and Principe, Goa in India, Macao in China, and Timor in Oceania. This whole composition, together with the already established inhabitants of the city, has created a unique environment of cultural interchangeability, that has been further enhanced by a continuous influx of other foreign people, from Europe and from all over the world, that has marked Lisbon as a city, a port and a metropolis, ever since its foundation.

During the last three decades of the twentieth century, there was a significant enlargement of the urban area within Lisbon Municipality, throughout the peripheral regions of the city, that culminated with the whole rehabilitation of the former eastern port area, where the world exposition *Expo '98* took place. Meanwhile, the historical center, comprising the neighborhoods surrounding the middle age Cathedral and the Castle, was suffering from having many old buildings, that urgently needed to be reconstructed and repaired. By the end of the 90's, a plan was therefore carried out by the local government, for the material rehabilitation of this sector. However, this came at a huge cost: all the inhabitants of the old city were forced to leave their neighborhood and to move either to the outskirts of the city (a few people) or to other residential towns nearby, but outside Lisbon (most people). The newly reconstructed buildings were set to extremely high prices, that their former residents could not afford to buy or rent, and so the whole historical center was mostly occupied by exquisite people who could afford the property, by tourists, as many of the buildings were turned into hotels and other type of accommodation houses, and also by new immigrant communities, specially coming from Asian countries. In this fashion, the traditional local life was set to destruction and even the

commercial establishments, that could temporarily survive by the effort of old residents, that would come and go every day from afar, are now almost completely disappeared. The new face of the old city became therefore one of tourism and exploitation, deprived of inner life. A place without souls that would bind to it by being born and raised there. An extended museum.

Whilst the historical center of Lisbon was turning up into a large museum, the central area of the city developed into a working place, with increasingly less residential buildings, and the same trends were noticed, as those that happened in the historical center, when older buildings were reconstructed and again set to extremely high prices, that local people could not afford. The local stores could however better resist, due to the permanent influx of people everyday coming to and fro from outside towns to work, but the reality of central Lisbon became one of life during the day, and emptiness during the night. Only the peripheral newer areas of Lisbon Municipality remained occupied by local inhabitants, yet fading from two major problems: in some neighborhoods the population became fairly aged, and in other neighborhoods the population became segregated into communities of economically richer people. In the same way as those former residents of the historical center, and the city center as well, that were dominantly middle class to poor people, the immigrant communities mostly had to move out as well, to towns outside of the city.

Aware of this situation, the local government of Lisbon Municipality has initiated a plan for the restoration of Lisbon in different stages, aimed to reshape the city into a new metropolis, able to accommodate her local residents in a lively, balanced, and sustainable way, warm welcome other national people, as well as foreigners that wish to come for a positive contribution, and to develop a plan for the integration of minority groups who remain socially segregated. In order to accomplish this highly demanding and complex task, one of the government requests is a study of the local life in each of the parishes in Lisbon, that can report on the actual living conditions and habits of its inhabitants, so that political measures can be defined, that will prioritize the benefit of the resident population over the benefit of the working external population and tourism population.

A first study approach for this problem, that intends to be exploratory and not comprehensive, is to collect data on the existence and number of Collectivities per parish. Collectivities are associations that have traditionally been extremely relevant for the recreational, cultural, and sportive development of the resident population of Lisbon. Very often, such centers were created by migrant populations from the inner country, that would in this way preserve the local culture of their regions, making Lisbon into a multicultural center of the whole country. For instance, traditional dances and traditional music have been preserved and developed in this centers. On its turn, with the purpose of studying the current life of the city in general, participated by all people who visit it, including external workers and tourists, one can collect data on the current Venues

within each parish. An attempt can then be made to study whether there is a correlation between the local life, using Collectivities as indicators, and external life, using Venues in general as indicators. A cluster algorithm can also be applied to study the city life by venues. With basis on what can be learned from these data, we hope to be able to provide the local government with indicators for further action, if not for concrete measures that can be implemented for restoring Lisbon in terms of resident population, at least with indicators for further studies.

2 Data Collection

We collect data on Collectivities, Parishes, and on Venues in Lisbon Municipality:

- Collectivities

For simplicity, we restrict our dataset to the Collectivities registered in ACCL (*Associação de Colectividades do Concelho de Lisboa* - Association of Colectivities of the Lisbon Council) [www.accl.com.pt], which sum up to close to 300. From this association website we collect a list containing the name of the registered collectivity and its foundation date. We add to this dataset a new column with the name of the parish where the collectivity is located.

- Parishes

We furthermore gather a second dataset with information about all the Parishes (in portuguese *Freguesias*) in Lisbon, namely the number of its inhabitants, area, and geographic coordinates of the respective Parish Council (*Junta de Freguesia*). This information can be found in [pt.wikipedia.org/wiki/Lista_de_freguesias_de_lisboa] and in [www.lisboa.pt/municipio/freguesias#c7461].

- Venues

In order to find the Venues within each parish of Lisbon, we collect data from Foursquare [<https://foursquare.com/>], which is a technology company that provides accurate location data. In order to access Foursquare database, one needs to create an account and then make API (Application Programming Interface) calls, using the credentials. In our case, we make search calls on the venues nearby specific locations that we define as the geographical coordinates of each parish council.

3 Methodology

The information contained in our datasets is very rich and lots of interesting data can be extracted from them. Here, we focus on features than can serve our main goal in this study, which is to gain insight on the actual city life with focus of its permanent residents, but also on external workers and tourists. The datasets have been worked out in two different Jupyter Notebooks, that can be found in [Notebook 1](#) and [Notebook 2](#) on GitHub. The detailed steps of our analysis can be followed there. Here, we summarize the general procedure. In *Lisbon Rebuilt: Notebook 1*, parts *A*, *B*, and *D* are treated, and in *Lisbon Rebuilt: Notebook 2*, part *C* may be found. Not all the results are shown in the present report, but they can be consulted in the corresponding Notebooks.

- *A. First dataset: Collectivities.* We import the dataset on Collectivities, as described in the previous section. From here we draw two plots: 1 - the number of Collectivities per Parish and 2 - the number of Collectivities per Foundation Date.

- *B. Second Dataset: Parishes.* We import the dataset on Parishes, as described in the previous section. Here, we prepare a dataset to be used in a different notebook for the Venues, and we draw two plots: 3 - Population per Parish and 4 - a correlation plot between the number of Collectivities and Population in each Parish.

- *C.1 Lisbon Venues with Foursquare.* We extract a list of Venues in Lisbon Municipality, using the Foursquare API. As our aim is to study the Venues per Parish, we use as location the coordinates of the Parish Council for each parish, from which we define a radius. This is however an approximation in two ways: on the one hand, the Parish Council is not always at the geographical center of the Parish and on the other hand, parishes vary in shape, i.e., their areas are not circular. Since we dispose of information on the area of each parish, contained in the Parishes dataset, we will be using a variable radius, that is computed from it. Three dataframes are generated in this subsection and a map: a dataframe containing categorized venues of one choosen parish; a dataframe containing categorized venues of all parishes of Lisbon; a dataframe containing the number of venues per parish, from which we create a new dataset to be used in part *D*; 5 - an interactive map of Lisbon signaling the position of each parish council, using Folium.

- *C.2 Clustering Lisbon by Venues.* We cluster the parishes in Lisbon Municipality according to their venues. The used machine learning algorithm is k-Means. This task is accomplished through the following: preparation of the dataframe for clustering, which will be a normalized dataframe, containing the venues in each parish weighted by category; building of a dataframe containing information on the most frequent venues in each

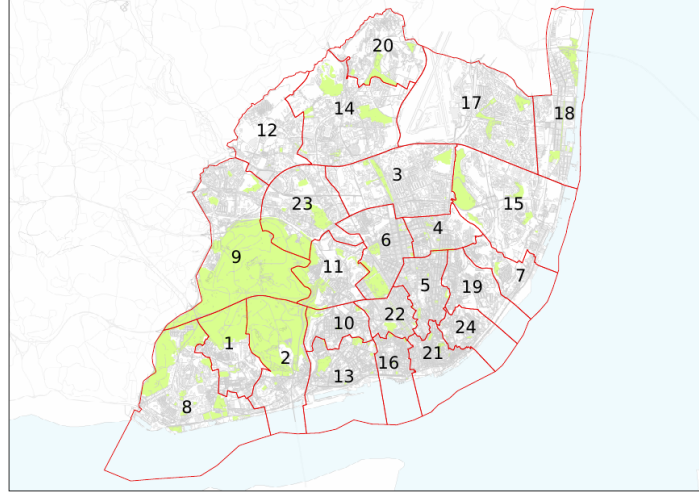
parish, and the assigned cluster label; 6 - drawing of a Folium map of Lisbon containing the clustering results. Many of the venues found with Foursquare are restaurants and coffee shops. However, within the context of our study, we could assume that eating places are not a distinguishing feature for differentiating between residents, tourists, and external workers. Therefore we repeat the clustering procedure, but this time excluding most venues that are restaurants or coffee shops. From here we prepare: 7 - a Folium map of Lisbon with clustering excluding restaurants and coffee shops.

- *D. Venues, Collectivities, and Correlations.* In this section, we study dataframes containing information on Venues per Parish, in Lisbon Municipality, built in part *C*. We import two dataframes: 1) Venues within a variable radius which is the radius of each parish as if its area was circular and the parish council was at its center; 2) Venues within a radius of 500 m from the corresponding parish council. The motivation for this second step has to do with the fact that Foursquare API only allows for the extraction of 100 venues within a defined radius. As this value is saturated for many parishes in 1), we do not have an absolute counting of the number of venues in each parish. By defining a smaller radius, and assuming that parish councils are located at the center of life of the corresponding parish, the resulting number of venues may be regarded as a density. In this part we draw the following plots: 8 - Venues per Parish; 9 - a correlation plot between the Venues and Collectivities in each parish; 10 - Venues vs Population. The Pearson correlations are also computed.

The external libraries that have been used for the analysis are: pandas, datetime, matplotlib.pyplot, seaborn, stats from scipy, pandas, math, folium, Nominatim from geopy.geocoders, json, requests, json_normalize from pandas, KMeans from sklearn.cluster, matplotlib.cm, matplotlib.colors, and numpy. The clustering algorithm k-Means is an unsupervised machine learning algorithm that produces non-overlapping clusters, which are found through the determination of the similarity or dissimilarity between elements, that is measured by the computation of the distance between attributes. The algorithm works through the minimization of intra-cluster distances and maximization of inter-cluster distances. The number of clusters k has to be chosen. In this study, we choose $k = 7$, although the analysis has been done for other values of k . In principle, one can calculate a metric of accuracy for the k value, that would return the best value for k . However, for simplicity, and also because we consider it to be an unjustifiable detail, for the general purpose of our study, we do not go through that step. Finally, when using Foursquare, we only make regular calls with search for venues. The returning results come in a JSON file with the attributes for each venue: unique ID, name, location, and category. Other calls could be made with requests on tips or on users, but that would be beyond our aim.

4 Results

Before presenting the results of this study, in Fig. 1 we briefly analyze a map of Lisbon delimiting the current parishes of the city, as established in the year 2019. Lisbon has grown in an onion-like structure, meaning that the old city is located nearby the Tagus river, with parish 21 - *Santa Maria Maior*, being the one that includes both the Cathedral and the Castle. Parishes tend to be smaller in the historical center than in peripheral areas, which is related to the historical development of the city.



1 Ajuda	9 Benfica	17 Olivais
2 Alcântara	10 Campo de Ourique	18 Parque das Nações
3 Alvalade	11 Campolide	19 Penha de França
4 Areeiro	12 Carnide	20 Santa Clara
5 Arroios	13 Estrela	21 Santa Maria Maior
6 Avenidas Novas	14 Lumiar	22 Santo António
7 Beato	15 Marvila	23 São Domingos de Benfica
8 Belém	16 Misericórdia	24 São Vicente

Figure 1: Current parishes of Lisbon Municipality.

4.1 Collectivities and Parishes

In Fig. 2 we plot the number of collectivities per parish, in a total of 265 collectivities. We can straightly verify that *Santa Maria Maior* is the parish with more registered collectivities, although, as we can see in Fig. 3, it is one of the least populated parishes of the city. On its turn, the most peripheral parishes seem to be the ones with the least number of registered collectivities, although they are the most populated ones. In order to clearly verify this tendency, we draw a correlation plot between the number of collectivities and the population in each parish, which can be found in Fig. 4. We compute the Pearson correlation coefficient ρ and the p -value between collectivities and population, obtaining

the values $\rho = -0.16$ and $p = 0.45$, meaning that the negative correlation is negligible, but without certainty, i.e., that there is a tendency for the least populated parishes to have registered a greater number of collectivities. In Fig. 5, we can examine how many collectivities have been founded per decade, from the end of nineteenth century up to now. It is clear that the foundation of new collectivities has been quite active throughout the decades, which only proves their importance for the life of the inhabitants of Lisbon. It is possible that the observed variations in the number of foundations per decade are connected to political events, however that is out of the scope of this study.

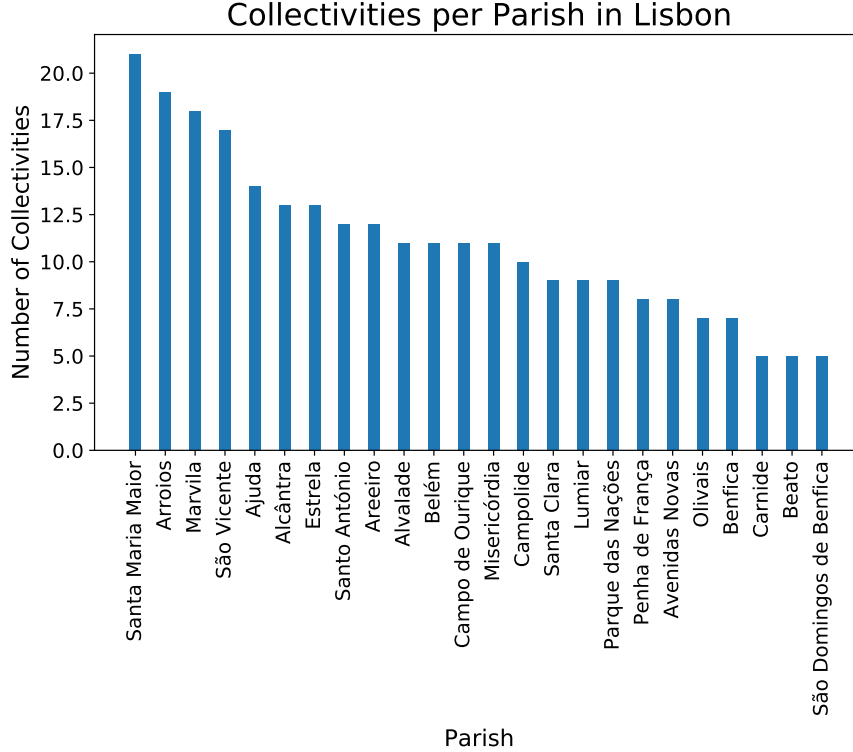


Figure 2: Number of collectivities per parish in Lisbon Municipality.

4.2 Venues and Clustering

In this section, we show the results returned by Foursquare concerning the venues in Lisbon Municipality. A total of 1984 venues were returned, grouped in 216 categories. We applied a k-Means cluster algorithm for the two cases discussed in Sec. 3, i.e., including restaurants and coffee shops, and excluding those. The clustering results may be seen in Fig. 6. It is interesting to notice that the clustering structure is actually very similar in both cases, which is an indicator that restaurants are evenly distributed throughout the city, and that they are not a distinctive mark among the clusters. It is also interesting to verify that the resulting clusters have followed the onion-like structure that characterizes Lisbon city. In Table 1, we may find the parishes in each cluster for the case without

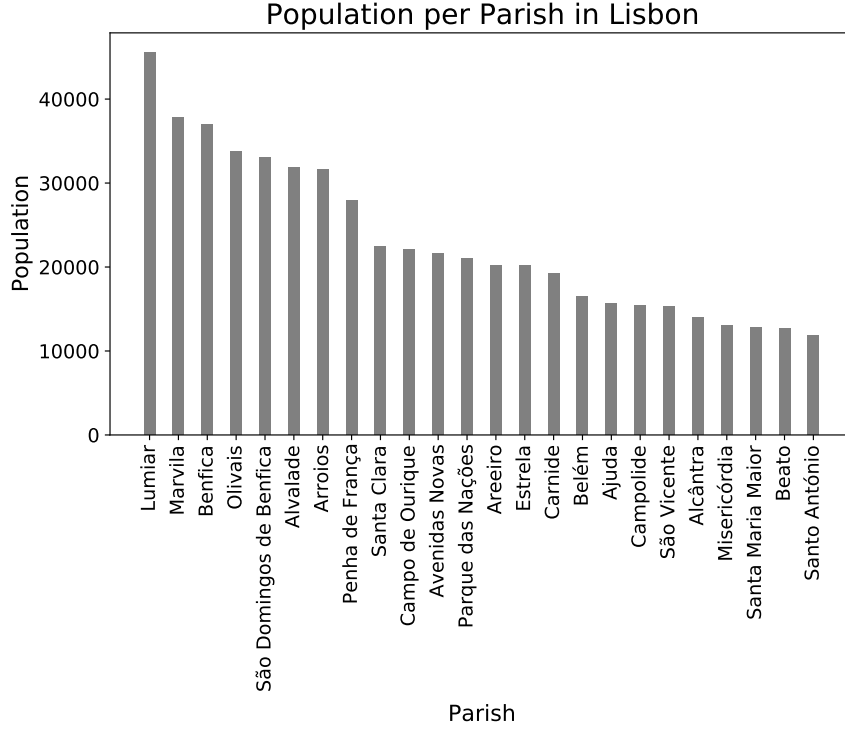


Figure 3: Population per parish in Lisbon Municipality, in the year 2013.

restaurants and coffee shops. In both cases, with and without eating places, we find two outlier parishes, viz. *Beato* and *Santo António*. The existence of these outliers is the reason why we have chosen a value of $k = 7$ clusters, which might have seemed too high. We verified that a smaller k value always distinguishes these outliers from the rest of the city, leaving only up to 4 clusters to differentiate the rest of the city, which is not much.

Cluster	Parishes
1	Arroios, Penha de França, Santa Maria Maior, São Vicente
2	Benfica, Carnide, Parque das Nações, São Domingos de Benfica
3	Beato
4	Santo António
5	Alcântara, Alvalade, Areeiro, Avenidas Novas, Belém, Campo de Ourique, Campolide, Marvila, Olivais
6	Lumiar, Santa Clara
7	Ajuda, Estrela, Misericórdia

Table 1: Parishes sorted by cluster, as shown in Fig. 6, on the right.

It is also interesting to examine the type of venues that can be found within each cluster. This results can be consulted in greater detail in the corresponding Jupyter Notebook, however here we only mention a few of them. When including eating places, most venues fall within restaurant and coffee shop categories, so that a quick look on the most common venues does not clarify entirely on the distinguishable features among the clusters. One can however verify that *Beato* differentiates by having *Museum* and

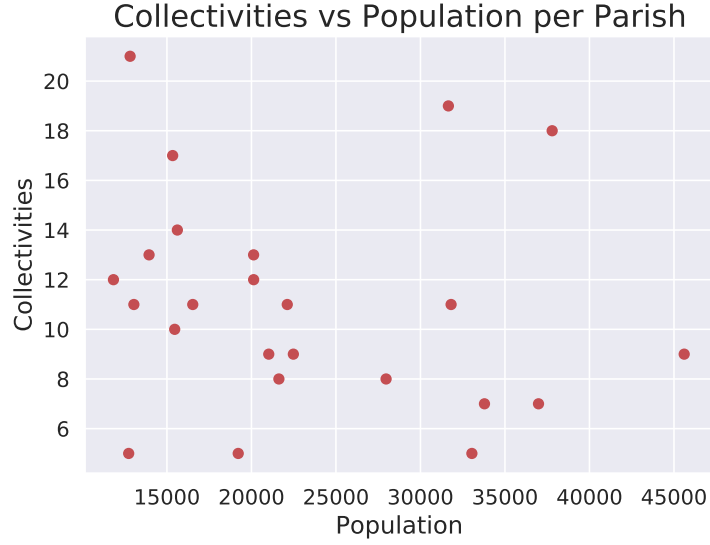


Figure 4: Correlation between collectivities and population in Lisbon Municipality.

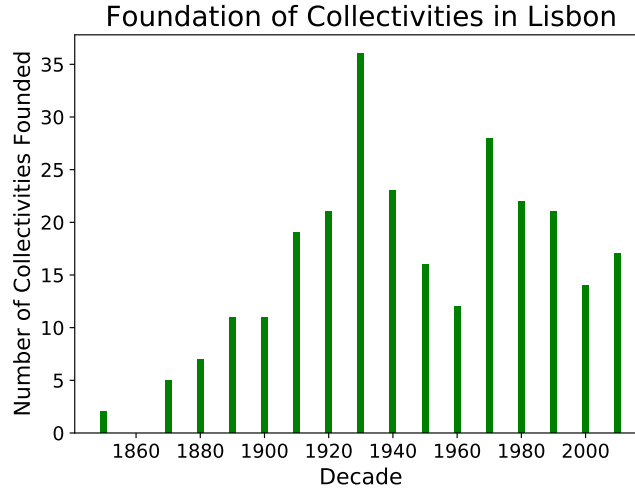


Figure 5: Number of collectivities founded per decade in Lisbon Municipality.

Theater in the most common venues, whereas other clusters exclude these from the seventh most common venues, and *Santo António* differentiates by having *Hotel* in the first most common venue category, even upfront restaurants. When examining the most common venues, excluding eating places, we can see that cluster 1 in Table 1, including *Santa Maria Maior* parish, in the old city, is dominated by hotels and accommodation places; cluster 5, the second onion-layer, corresponding to the city center, including *Avenidas Novas*, is rich in hotels, monuments, bookstores, historical sites and daily-life shops, thus oriented to cultural activities; cluster 2, the outer onion-layer, including *Benfica*, is characterized by daily-life shops, thus indicating a focus on the resident population; cluster 6, including *Santa Clara*, is characterized by *park* and *gym* venues, and other venues oriented to daily-life. Finally, cluster 7, close to the river, including *Estrela*, exhibits the categories *lounge*, *garden*, and *scenic places*, as the most common venues.

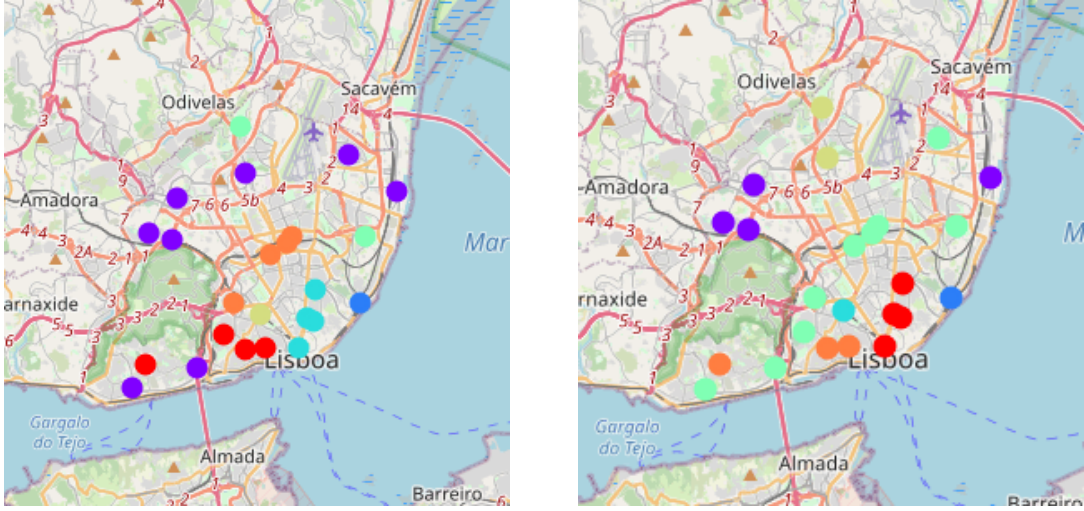


Figure 6: Lisbon in clusters by venues. Left: all type of venues included. Right: all type of venues excluding restaurants and coffee shops.

4.3 Venues and Collectivities

Finally, in order to better understand the venues and their relationship to the local life, we show in Fig. 7 a plot with the number of venues per parish. Unfortunately, as we were limited to the extraction of 100 venues within each radius, many parishes are ‘saturated’ in the number of venues, and so what we observe is not an absolute counting. We notice, however, that some parishes are rather poor in the number of venues. In particular, our detected outlier *Beato* includes 8 venues only. Hence, if our previous clustering results could have suggested *Beato* as an cultural area rich in museums and theaters, now we can see that its differentiating feature is rather that the parish is poor in venues. In contrast, *Santo António* seems to be a true outlier, in what concerns venues.

In order to circumvent the problem of the saturation of venues observed in Fig. 7, we restricted the radius of extraction to 500 m, as discussed in Sec. 3. The number of venues can then be regarded as a ‘density’, i.e., the number of venues within an area of $\pi \times 500^2$ surrounding the parish council. We attempt to extrapolate this ‘density’ to the whole parish area, but the observed results (cf. Notebook 1) are in strong disagreement with Fig. 7, because indeed, venues are not evenly distributed throughout the parishes. It would be good to get a more accurate number of venues per parish, which could be done, for instance, by subdividing the parishes in smaller areas when extracting the venues with Foursquare. In any case, we expect that *all* parishes have larger numbers of venues than those shown in Fig. 8, and not only the larger ones, apart for those parishes that have not saturated the number of venues in Fig. 7. This ‘density’ of venues per parish is plotted in Fig. 8. We can see that our ‘density’ of venues within a radius of 500 m from the parish council is higher in the old city and progressively diminishes throughout the city center to the most peripheral areas of Lisbon.

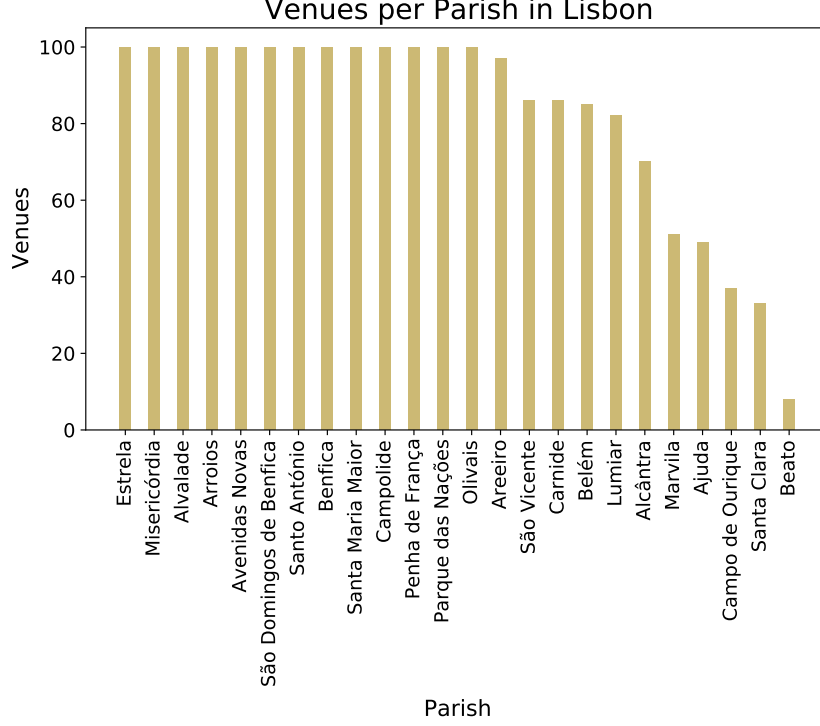


Figure 7: Number of venues per parish, within an area proportional to the parish size.

We find it worthy attempting to find a correlation between the number of venues within the radius 500 m and the number of inhabitants per parish, a result we show in Fig. 9. The Pearson correlation between venues and population gives $\rho \simeq -0.43$ and $p \simeq 0.04$, meaning that there is a weak negative correlation between the two variables, with moderate certainty, i.e., the number of venues is higher in less populated parishes.

Finally, in Fig. 10 we show a correlation plot between the number of venues within the radius 500 m and the number of registered collectivities per parish. The Pearson parameters give $\rho \simeq 0.51$ and $p \simeq 0.01$, indicating a moderate positive correlation between the two variables, with moderate certainty, i.e., the number of venues tends to accompany the number of collectivities. Parishes *Marvila* and *Ajuda*, with a relatively high number of collectivities, show up as clear exceptions for this tendency, with a poor number of venues, even considering an extended radius, as seen in Fig. 7.

5 Discussion

The study of collectivities is very interesting on itself, as a reflection of the active life of Lisbon residents. In a more complete study, one would need to take into account some of their important characteristics that have been neglected here, e.g. the number of *collectors*, i.e. associate individuals or members, registered in each collectivity. Indeed, some of the collectivities listed in our dataset extend their importance to the city level

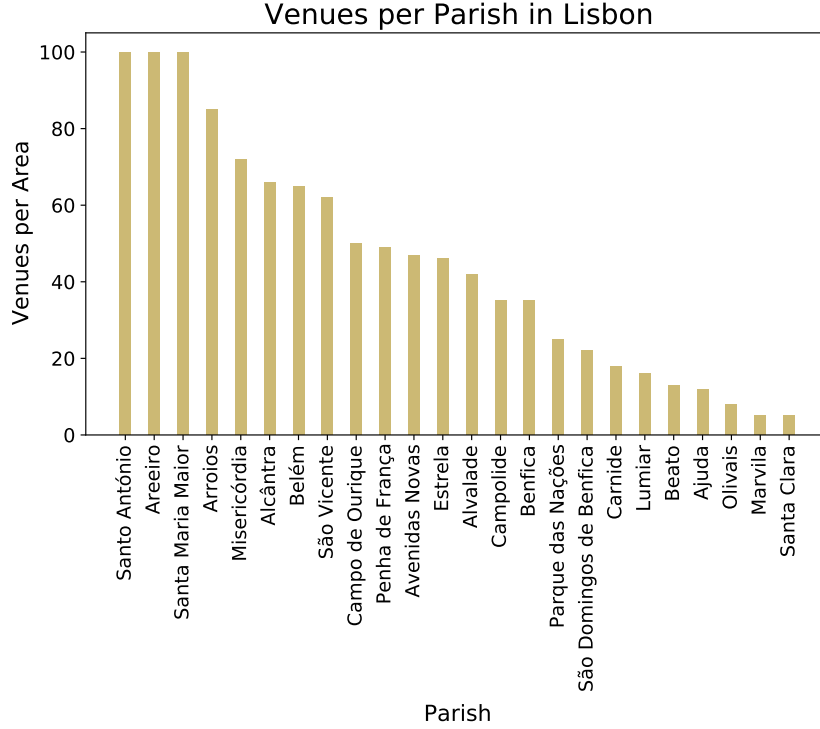


Figure 8: Number of venues per parish, within a fixed circular area with radius 500 m.

or even to the national level, and have thousands of members. For instance, three of the most important Soccer Clubs in Portugal, viz. SLB - *Sport Lisboa e Benfica*, SCP - *Sporting Clube de Portugal*, and CFB - *Clube de Futebol os Belenenses* are part of our dataset. Furthermore, important Gyms, such as *Lisboa Ginásio Clube* or *Ginásio Clube Português* extend their relevance beyond their parishes, the same for the jazz music school *Hot Clube de Portugal*. In the context of our study, however, one can argue that since those clubs have members all over Lisbon city, they contribute to the life of every parish in the city, so on the local level they may still count as only one, because even the most important clubs promote local activities specially directed to the resident population. Notwithstanding the number of members of a certain collectivity, one can still regard the number of different collectivities as a sign of cultural diversity and activity within a parish. Perhaps, more relevant for our study, would be to know whether all of the registered collectivities are still active, or if they are struggling to survive, considering that many of them have been founded decades ago. When observing the results obtained in Sec. 4.1, one could be surprised to verify this tendency towards a negative correlation between the number of collectivities and the number of local residents, as it would be natural to expect that in most populated areas the activity should be higher, both in number of collectivities and in number of members. The fact that we do *not* observe a positive correlation between the number of collectivities and the number of residents, it is already a sign that something is unbalanced in the heart of Lisbon. The high number

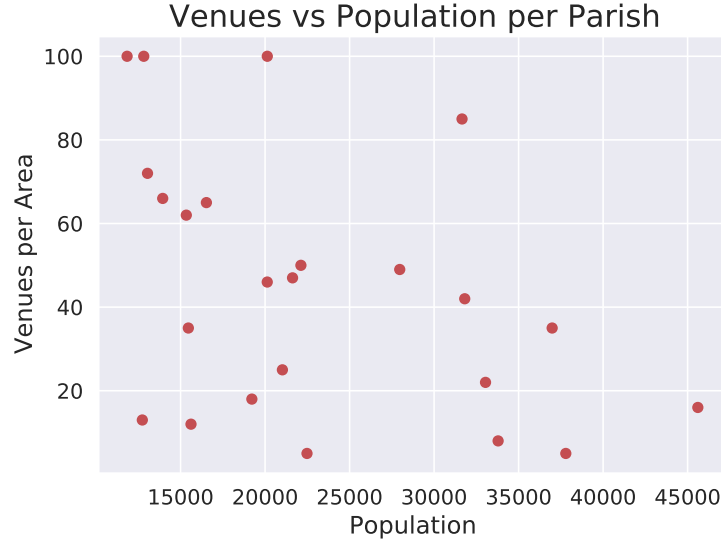


Figure 9: Correlation between venues per area and population per parish.

of collectivities in the older parishes is definitely a sign of life, past or present, in these areas. Yet one would expect that, given the comparatively low numbers of residential population in the historical center, many of those collectivities are probably struggling to survive these days, what would be a pity.

The analysis of the venues returned by Foursquare are equally interesting within the aim of this study. Indeed, many venues were returned, and actualized. More difficult is to distinguish which of the returned venues could classify as indicators of touristic activity, resident population activity, or external workers activity. It would be interesting, in a further study, to apply a machine learning classification algorithm to group the results in much fewer categories than the returned 216. Nonetheless, the general features of each cluster can already provide us some indication of the dominant life trait of the parishes. For instance, *Santa Maria Maior* is dominated by accommodation places, that clearly point out a touristic orientation. On its turn, the dominance of hotels, and not merely any type of accommodation places, in *Santo António*, may indicate an area that has specifically been designed for a higher level type of accommodation within the city. The outer clusters 2 and 6 (see Table 1 and Fig. 6) could be seen as areas dominated by resident population, cluster 5 as a type of center for cultural activity, with some traits of resident population, and cluster 7 as a sort of scenic area, yet not necessarily oriented for tourists exclusively, thus is that sense, more balanced. Finally, we notice that the parish *Santa Clara*, in cluster 6, has been grouped together with *Beato* when restaurants and coffee shops were included (see Fig. 6 on the left), meaning that, considering what has been discussed in Sec.4.3, those are probably the poorest parishes of Lisbon city.

When observing Figs. 8 and 9 we notice the same correlation trait that has been seen when studying the collectivities, i.e., the correlation between the number of venues per

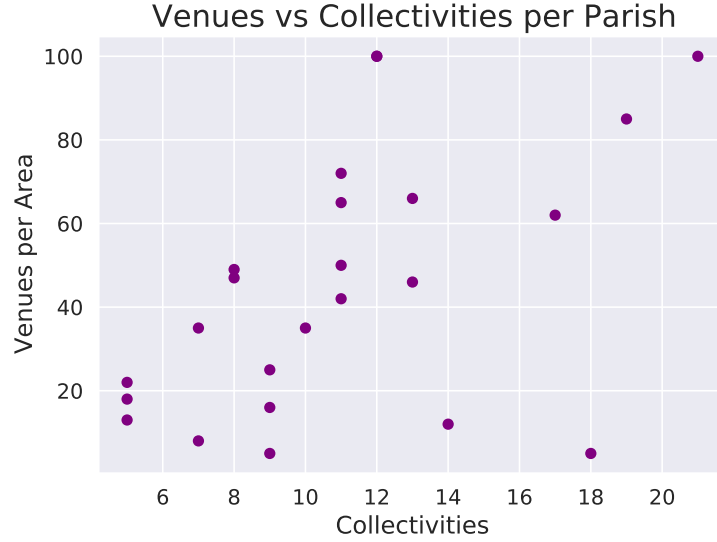


Figure 10: Correlation between venues per area and collectivities, in Lisbon Municipality.

area, defined by a radius of 500 m from the parish council, and the population within a parish is weakly negative with moderate certainty. One could argue that the population density varies among parish, however we verified that there is no obvious relationship between population density and parish location (cf. Notebook 1), whereas as we can see in Fig. 8, *there is* a clear relationship between venue ‘density’ and parish location, i.e., venue ‘density’ diminishes from the historical center to the outer layers of the city, indicating a higher activity in terms of venues from the innermost layers to the outermost layers of the city. Our final result, shown in Fig. 10, is the correlation we aimed for in the beginning of our study. Indeed, the number of venues is positively correlated with the number of collectivities, with moderate strength and moderate certainty, apart from the ‘outliers’ *Marvila* and *Ajuda*, with proportionally more collectivities than venues, and perhaps *Santo António* with proportionally more venues than collectivities. Such result would show a healthy development of the city, *if*, furthermore, the correlation between venues and collectivities *and* the population was also clearly positive, but it is not. This means that most of the current activity in Lisbon Municipality is happening exactly where the number of residents is the smallest. This further indicates that most of the activity in Lisbon is *not* held by or for the resident population, but rather by or for external workers and tourists. We regard this as an unsustainable and therefore unhealthy trait.

In face of our results in general, other more comprehensive studies would be encouraged for examining the reality of each parish in Lisbon. Beyond the directions pointed out throughout the present discussion, one could further examine the actual local life of each parish, for instance throughout the social activities that are usually promoted by the parish councils, and also by the existence of municipal libraries, pools, and parks within each parish. Particular attention should furthermore be paid to those seemingly poorer

parishes such as *Beato* and *Santa Clara*, as the possibility that they might enclose social segregation should not be discarded.

6 Conclusion

In conclusion, we have found that both the correlation between collectivities and population, as a life indicator of the resident population, and the correlation between venues and population, as an indicator of Lisbon life in general, is *not* positive, and even shows a tendency to be negative. Furthermore, the most populated parishes in Lisbon lie on the peripheral layers of the city, whereas the innermost layers, corresponding to the historical center, are the least populated neighborhoods. This results could mean that the much fewer people in the historical center and in the city center are much more active than the bulk of the population in the peripheral areas, but it is more likely that the current life that is being held in the innermost layers of the city is rather tourism oriented or external worker oriented, and not residents oriented. It is furthermore likely that the higher number of registered collectivities in the historical center is actually an indicator of past local life in this area, rather than of present life, a supposition that could be confirmed by data on the current activity of those same collectivities. Exceptions of our overall analysis are parishes *Beato* and *Santo António*, the former probably for being poorer, and the latter probably for being richer.

In face of this results, a sign of an unsustainable development has been detected, as an empty hole appears to be developing throughout the innermost layers of Lisbon, where the number of residents appears to be too small in comparison to the amount of activity detected in the same areas. If we assume that a parish cannot survive in the long run without permanent residents, this indicates the need for intervention from the local government of Lisbon Municipality, with a plan for repopulating the historical center and the city center with Portuguese people, possibly at the expense of diminishing the amount of accommodation houses in the same region. A new plan for a sustainable and healthy development of the city does not mean coming back to any old model, but rather to search for a new model that takes into account the local people. More comprehensive studies of the kind we present here, using data, can bring significant insights on this quest.