Where to live in Stuttgart?

Introduction

Stuttgart is the capital and largest city of the German state of Baden-Württemberg. Its urban area has a population of 634,830, making it the sixth largest city in Germany. 2.8 million people live in the city's administrative region and 5.3 million people in its metropolitan area, making it the fourth largest metropolitan area in Germany [1]. People used to live happy in this city, as depicted by the Figure 1.

Figure 1. People happy in Stuttgart

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the virus strain that causes coronavirus disease 2019 (COVID-19), a respiratory illness. It is colloquially known as the coronavirus. It is contagious in humans, and the World Health Organization (WHO) has designated the ongoing pandemic of COVID-19 a Public Health Emergency of International Concern [1].

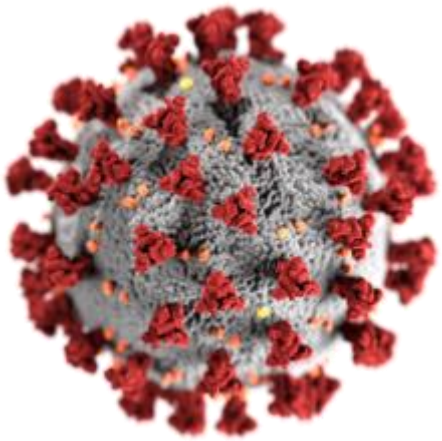

Figure 2. Photo of a SARS-CoV-2 virion (not at scale)

Now because of the virus, the restaurants or other recreation places are closed; the workplaces are empty because people are doing home office. In the end, nowadays, it is best to live in a place that offers gardens/parks as well as abundant medical centers rather than jobs and activities. This report will answer the question where it is the best place to live in Stuttgart. The methodology can be applied to other cities of your choice.

The Data

Data are mainly coming from two sources.

1. The first data are locations. Stuttgart is partitioned into neighborhoods. These data are freely available on the Internet [2], in csv form for example.

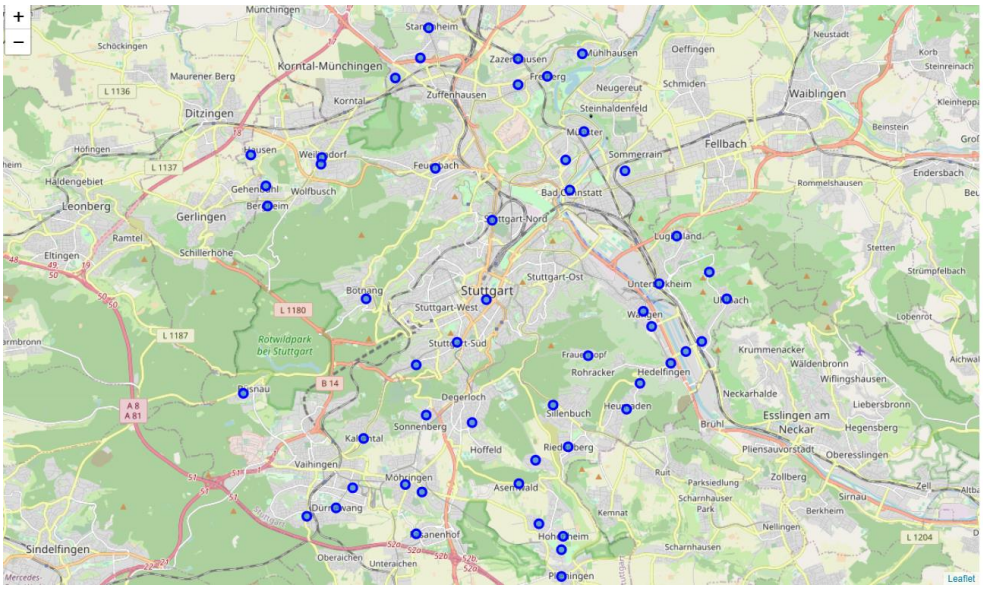

Figure 3. Neighborhoods in Stuttgart

2. Most of the data will be acquired with the FourSquare API [1]. At each location previously defined, we will gather many data. For example, we can found all food places in each neighborhood:

Table 1. Food places in Stuttgart

	Neighborhood	Afghan Restaurant	African Restaurant	American Restaurant	Asian Restaurant	BBQ Joint	Bakery	Bar	Beer Garden	Bistro	...
0	Asemwald	0	0	0	0	0	0	0	0	0	...
1	Bad Cannstatt	0	0	0	0	0	2	0	0	0	...
2	Bergheim	0	0	0	0	1	1	0	0	0	...
3	Birkach	0	0	0	0	0	0	0	0	0	...
4	Botnang	0	0	0	1	0	1	0	0	0	...

Successive API calls will allows us to gather much information about each neighborhood concerning the work places, the transportation system, the food places, the outdoor possibilities and the medical system.

Methodology

Successive pre-processing steps are performed

- Data will be collected, cleaned and processed into a dataframe
- Location are visually observed at this point
- FourSquare calls for each neighborhood the work places, the transportation system, the food places, the outdoor possibilities and the medical system
- These data are cleaned and processed and standardized.

Then, the k-means clustering model is applied:

- k-means clustering is a method of vector quantization that aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean (cluster centers or cluster centroid), serving as a prototype of the cluster.
- Our objective is obviously to solve $\arg\min_{\mathbf{S}} \sum_{i=1}^{k} \sum_{\mathbf{x} \in S_i} \|\mathbf{x} - \boldsymbol{\mu}_i\|^2 = \arg\min_{\mathbf{S}} \sum_{i=1}^{k} |S_i| \operatorname{Var} S_i$
- Once done we should obtained a neighborhood classification without a priori assumptions.

The last step is visualization and result evaluation.

Results

We obtain 4 clusters as shown in Figure 4. We display the first three neighborhoods of each cluster

Table 2. Cluster 1

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
2	Bergheim	TotalOutdoor	TotalWork	TotalFood	TotalTransport	TotalMedic
4	Botnang	TotalWork	TotalFood	TotalOutdoor	TotalTransport	TotalMedic
6	Büsnau	TotalOutdoor	TotalFood	TotalTransport	TotalWork	TotalMedic

Table 3. Cluster 2

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
1	Bad Cannstatt	TotalFood	TotalWork	TotalOutdoor	TotalTransport	TotalMedic
3	Birkach	TotalTransport	TotalFood	TotalWork	TotalOutdoor	TotalMedic
5	Burgholzhof	TotalFood	TotalWork	TotalOutdoor	TotalTransport	TotalMedic

Table 4. Cluster 3

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
17	Heumaden	TotalMedic	TotalWork	TotalOutdoor	TotalFood	TotalTransport
33	Rotenberg	TotalMedic	TotalOutdoor	TotalWork	TotalFood	TotalTransport
34	Schönberg	TotalMedic	TotalOutdoor	TotalWork	TotalFood	TotalTransport

Table 5. Cluster 4

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	Asemwald	TotalFood	TotalWork	TotalOutdoor	TotalTransport	TotalMedic
9	Fasanenhof	TotalFood	TotalWork	TotalOutdoor	TotalTransport	TotalMedic
11	Flughafen	TotalFood	TotalWork	TotalMedic	TotalTransport	TotalOutdoor

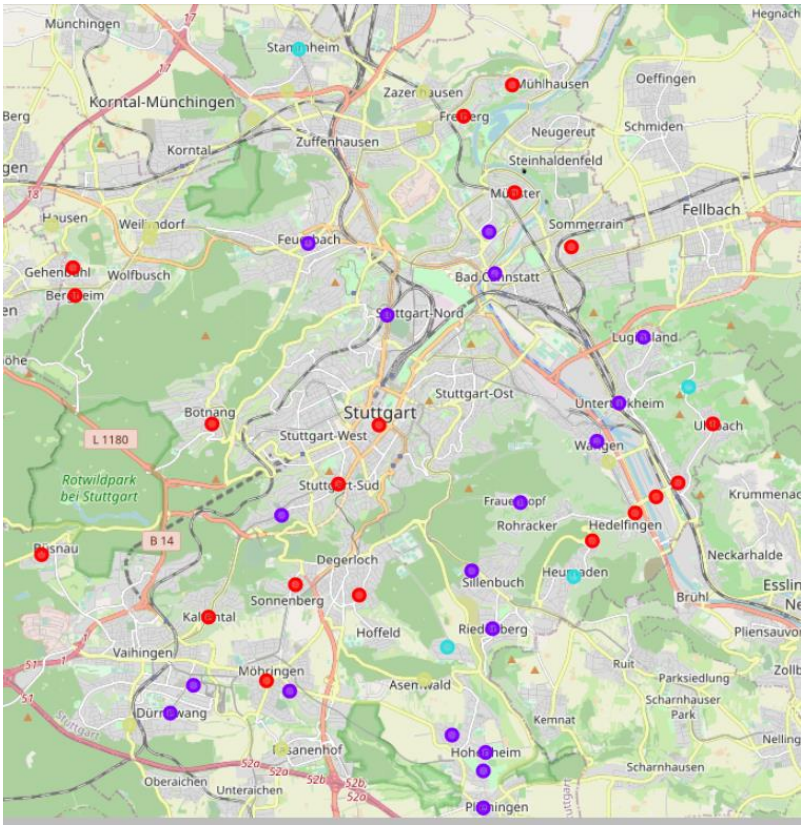

Figure 4. Neighborhoods clusterized (Cluster 1: Red, Cluster 2: Purple, Cluster 3: Cyan, Cluster 4: Green/Yellow)

We can describe these clusters as follows:

Cluster 1 -> Many possibilities of outdoor activities
Cluster 2 -> Food, transport and work
Cluster 3 -> Dominant medical sector, also many gardens. No transport
Cluster 4 -> Food > work > outdoor

We can also display the medical score in a map, as in Figure 5. The bigger the circle, the better is the medical score. We see the big cyan circle that shows the excellent medical coverage of cluster 3. We see that cluster 1 and 4 are very poor in medical centers.

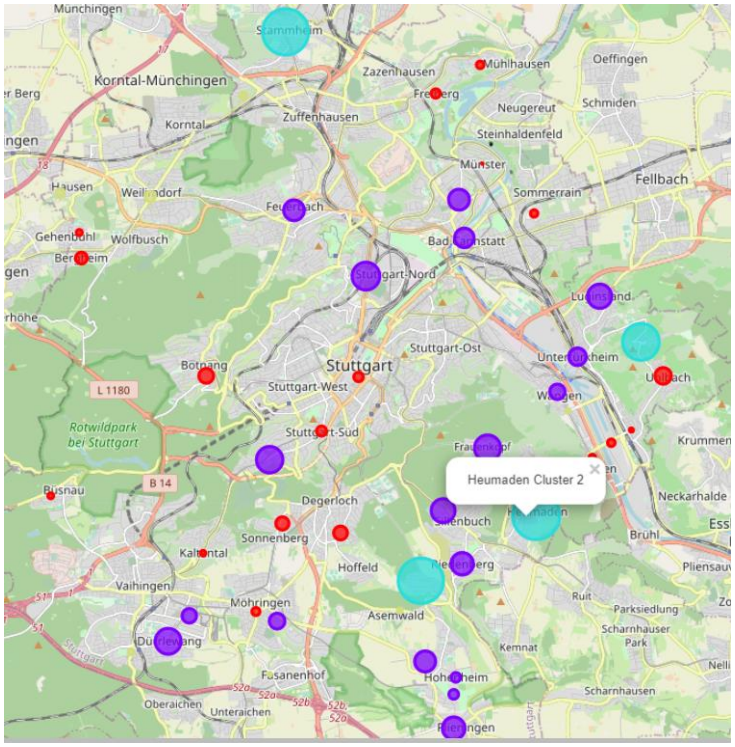

Figure 5. Medical score

Discussion

We can say, based on these results that cluster 3 is the best place to live in. Not only it offers the best medical possibilities, but we can also take some fresh air. Then I would recommend cluster 1, a bit risky (few medical center), but offers parks. Then cluster 2 and 4 are empty places that should be avoided.

Conclusion

We have reviewed the best places to live in Stuttgart in the time of coronavirus. Now, it is time to move out https://www.wg-gesucht.de/.

References

[1] Wikipedia
[2] https://raw.githubusercontent.com/zauberware/postal-codes-json-xml-csv/master/data/DE/zipcodes.de.csv
[3] foursquare.com

Aknowledgment

Wikipedia