

Capstone Project :

The battle of Neighborhoods

Munich

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June 2021

Introduction

Munich is a beautiful town in Bavaria, Southern Germany. There are many restaurants of all kind for ca 1.5 Mio inhabitants plus many tourists. I like to compare the 25 different boroughs in Size, Number of restaurants, Number of hotels, ...



The heart of Munich is the MARIENPLATZ, which is the center and starting point of all streets in Bavaria. Despite the fact, that Munich is famous for breweries, beer festival and beer gardens, sometimes it is called northeast city of ITALY.

The interested audience might be an investor, landlord or Italian chef, who is looking for the best environment for success

Questions:

- Is the number of restaurants decreasing in the suburbs ?
- Where is a good place to open a new Italian Restaurant ?
- What is the ratio Restaurants/Inhabitants ?

Data Section

1. First I get 25 Munich boroughs from a opengov page (www.opengov-muenchen.de).
2. I created a list of Neighborhoods (bezirksteile.xls).
3. Let's add the size, the geospatial coordinates from GeoCoder, ...
4. Now we calculate the distance from center using the haversine algorithm
5. In a second step the list of venues is retrieved from **Foursquare**
6. Now count the number of Hotels, Italian and other Restaurants
7. The venues have to be assigned to the neighborhoods
8. In a next step I will cluster Italian vs Other Restaurants

The **Italian Restaurants** cover the venue categories Pizzeria, Osteria, Trattoria, ...
All other restaurants are aggregated.

1. Munich Boroughs

On the OpenGov page a CSV is available with the size (sqm), the number of inhabitants, the density is available.

Out[6]:

	Boroughs	population	size	density	latitude	longitude	distance_to_center
0	Altstadt-Lehel	20422	314.57	65.0	48.137828	11.574582	0.084877
1	Ludwigsvorstadt-Isarvorstadt	50620	440.14	115.0	48.131771	11.555809	1.565809
2	Maxvorstadt	51642	429.79	120.0	48.151092	11.562418	1.812394
3	Schwabing-West	65892	436.30	151.0	48.168271	11.569873	3.473506
4	Au-Haidhausen	59752	421.96	142.0	48.130274	11.598334	1.876146
5	Sendling	39953	393.87	101.0	48.118012	11.539083	3.429908
6	Sendling-Westpark	55405	781.45	71.0	48.118031	11.519333	4.665564
7	Schwanthalerhöhe	29663	207.02	143.0	48.133782	11.541057	2.566542
8	Neuhausen-Nymphenburg	95906	1291.45	74.0	48.154222	11.531517	3.754590
9	München-Moosach	51537	1109.36	46.0	48.180166	11.506122	7.003790
10	Milbertshofen-Am Hart	73617	1341.64	55.0	48.182385	11.575043	5.018751
11	Schwabing-Freimann	69676	2567.22	27.0	48.189278	11.608583	6.289478
12	Bogenhausen	82138	2370.97	35.0	48.154782	11.633484	4.736422
13	Berg am Laim	43068	631.46	68.0	48.123483	11.633451	4.576795
14	Trudering-Riem	67009	2245.05	30.0	48.123175	11.664078	6.768709
15	Ramersdorf-Perlach	108244	1989.50	54.0	48.100894	11.633371	5.905068
16	Obergiesing	51499	572.04	90.0	48.087547	11.607184	6.006372
17	Untergiesing-Harlaching	51937	805.67	64.0	48.114963	11.570189	2.502145
18	Thalkirchen-Obersendling-Forstenried-Fürstenri...	90790	1776.31	51.0	48.084213	11.508051	7.718810
19	Hadern	48945	922.37	53.0	48.118064	11.481842	7.250074
20	Pasing-Obermenzing	70783	1649.78	43.0	48.152363	11.468434	8.098986
21	Aubing-Lochhausen-Langwied	42305	3406.02	12.0	48.165059	11.400221	13.342083
22	Allach-Untermenzing	30737	1545.17	20.0	48.195157	11.462973	10.522982
23	Feldmoching-Hasenberg	59391	2893.78	21.0	48.218462	11.520409	9.901101
24	Laim	54030	528.59	102.0	48.139551	11.502166	5.427992

Figure 1 List of Boroughs

2. Munich Neihborhoods

Based on some government website, I created a list in Excel of all neighborhoods (Bezirksteile.xls), which is a local substructure of the boroughs.

```
neighborhoods.sort_values('distance_to_center').tail()
```

[11]:

	Borough	Neighbourhood	latitude	longitude	distance_to_center
104	Feldmoching - Hasenberg	Ludwigsfeld	48.211638	11.489946	10.410234
97	Aubing - Lochhausen - Langwied	Aubing-Süd	48.155600	11.414201	12.116562
99	Aubing - Lochhausen - Langwied	Freiham	48.140008	11.410070	12.255281
98	Aubing - Lochhausen - Langwied	Lochhausen	48.176021	11.408845	13.069573
96	Aubing - Lochhausen - Langwied	Altaubing	48.165736	11.401493	13.268056

Figure 2 The 5 outermost neighbourhoods from center

3. GeoCoder

To find the correct longitude and latitude of all boroughs/neighborhoods in my home town, it is necessary to add “, **München**” to the address search in geopy. As an example the neighborhood “St.Ulrich” is not unique and the first result was far outside Munich.

4. Foursquare API

The API can be used with EXPLORE or with a specific SEARCH. The structure of the json response contains a lot of data, which needs to be reduced, structured.

5. Aggregation

I enhanced the data frame with 4 columns, counting the aggregate result from Foursquare.

```
neighborhoods2['Total_venues'] =
munich_neighborhood_venues.groupby(['Neighborhood']).count()

neighborhoods2['Italian'] =
munich_neighborhood_venues2[(munich_neighborhood_venues2['Venue
Category'].isin(Italian1))].groupby(['Neighborhood']).count()

neighborhoods2['Hotel'] =
munich_neighborhood_venues2[(munich_neighborhood_venues2['Venue
Category']=='Hotel')].groupby(['Neighborhood']).count()

neighborhoods2['Other'] =
munich_neighborhood_venues2[(munich_neighborhood_venues2['Venue
Category'].isin(Restaurants2))].groupby(['Neighborhood']).count()
```

¹ 'Italian Restaurant', 'Pizzeria', 'Pizza Place', 'Trattoria/Osteria'

² 'German Restaurant', 'Indian Restaurant', 'Afghan Restaurant', 'Cafe', 'Asian Restaurant', 'Sushi Restaurant', 'Spanish Restaurant', 'Chinese Restaurant', 'Doner Restaurant', 'Vietnamese Restaurant', 'Greek Restaurant', 'Turkish Restaurant', 'Bavarian Restaurant', 'Thai Restaurant', 'Japanese Restaurant', 'Steakhouse'

```
neighborhoods2.sort_values('Italian', ascending=False).head()
```

[41]:

	Borough	latitude	longitude	distance_to_center	Total_venues	Hotel	Italian	Other
Neighbourhood								
Lehel	Altstadt - Lehel	48.139656	11.587921	0.975821	84.0	2.0	11.0	14.0
Deutsches Museum	Ludwigsvorstadt - Isarvorstadt	48.130041	11.582909	0.978316	53.0	1.0	7.0	7.0
Glockenbach	Ludwigsvorstadt - Isarvorstadt	48.130817	11.567400	0.920825	46.0	2.0	5.0	12.0
Kreuzviertel	Altstadt - Lehel	48.139698	11.573209	0.315073	31.0	0.0	4.0	4.0
Angerviertel	Altstadt - Lehel	48.133670	11.571569	0.481096	58.0	9.0	4.0	8.0


```
neighborhoods2.sort_values('Italian', ascending=False).tail()
```

[42]:

	Borough	latitude	longitude	distance_to_center	Total_venues	Hotel	Italian	Other
Neighbourhood								
Alte Kaserne	Neuhausen - Nymphenburg	48.156058	11.548703	2.874666	0.0	0.0	0.0	0.0
St. Vinzenz	Neuhausen - Nymphenburg	48.147099	11.540946	2.772327	0.0	0.0	0.0	0.0
Oberwiesenfeld	Neuhausen - Nymphenburg	48.185998	11.547622	5.794918	0.0	0.0	0.0	0.0
Nymphenburg	Neuhausen - Nymphenburg	48.145917	11.539117	2.850184	0.0	0.0	0.0	0.0
St. Ulrich, Laim	Laim	48.140154	11.499468	5.631281	0.0	0.0	0.0	0.0

Figure 3 Base table enhanced with results from Foursquare

Methodology

I applied mainly some standards top 5 analysis

Matplot for visualisation of relations

Clustering with kMeans

Results

Visualisation

Venues found per Boroughs (1095, 7)
Venues found per Neighbourhood (717, 7)

[16]:

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Graggenau	48.137828	11.574582	Marienplatz	48.137132	11.575992	Plaza
1	Graggenau	48.137828	11.574582	Elly Seidl	48.139410	11.575512	Candy Store
2	Graggenau	48.137828	11.574582	Fischbrunnen	48.137211	11.576047	Fountain
3	Graggenau	48.137828	11.574582	Alois Dallmayr	48.138469	11.577372	Gourmet Shop
4	Graggenau	48.137828	11.574582	Kustermann	48.136242	11.574897	Department Store

Figure 4 First 5 Venue List per neighbourhood



Figure 5 Munich map with Boroughs and Neighbourhoods

The size of the blue circles reflects the density, i.e. inhabitants per squaremeter. The MARIENPLATZ is marked with a yellow circle. The red dots are the neighborhoods.

```
neighborhoods2.sort_values('Italian', ascending=False).head()
```

[28]:

	Borough	latitude	longitude	distance_to_center	Total_venues	Hotel	Italian	Other
Neighbourhood								
Lehel	Altstadt - Lehel	48.139656	11.587921	0.975821	87.0	2.0	11.0	13.0
Deutsches Museum	Ludwigsvorstadt - Isarvorstadt	48.130041	11.582909	0.978316	51.0	1.0	6.0	7.0
Glockenbach	Ludwigsvorstadt - Isarvorstadt	48.130817	11.567400	0.920825	46.0	2.0	5.0	12.0
Kreuzviertel	Altstadt - Lehel	48.139698	11.573209	0.315073	31.0	0.0	4.0	3.0
Angerviertel	Altstadt - Lehel	48.133670	11.571569	0.481096	57.0	8.0	4.0	8.0

Figure 6 Top 5 Neighbourhoods with most Italian Restaurants

```
neighborhoods2.sort_values('Italian', ascending=False).tail()
```

[29]:

	Borough	latitude	longitude	distance_to_center	Total_venues	Hotel	Italian	Other
Neighbourhood								
Alte Kaserne	Neuhausen - Nymphenburg	48.156058	11.548703	2.874666	0.0	0.0	0.0	0.0
St. Vinzenz	Neuhausen - Nymphenburg	48.147099	11.540946	2.772327	0.0	0.0	0.0	0.0
Oberwiesenfeld	Neuhausen - Nymphenburg	48.185998	11.547622	5.794918	0.0	0.0	0.0	0.0
Nymphenburg	Neuhausen - Nymphenburg	48.145917	11.539117	2.850184	0.0	0.0	0.0	0.0
St. Ulrich, Laim	Laim	48.140154	11.499468	5.631281	0.0	0.0	0.0	0.0

Figure 7 Last 5 Neighbourhoods with zero Italian Restaurants

Most Italian Restaurants can be found in the borough LEHEL. There are many neighborhoods in Nymphenburg³ without Italian Restaurants.

³ Strange, data quality (?)

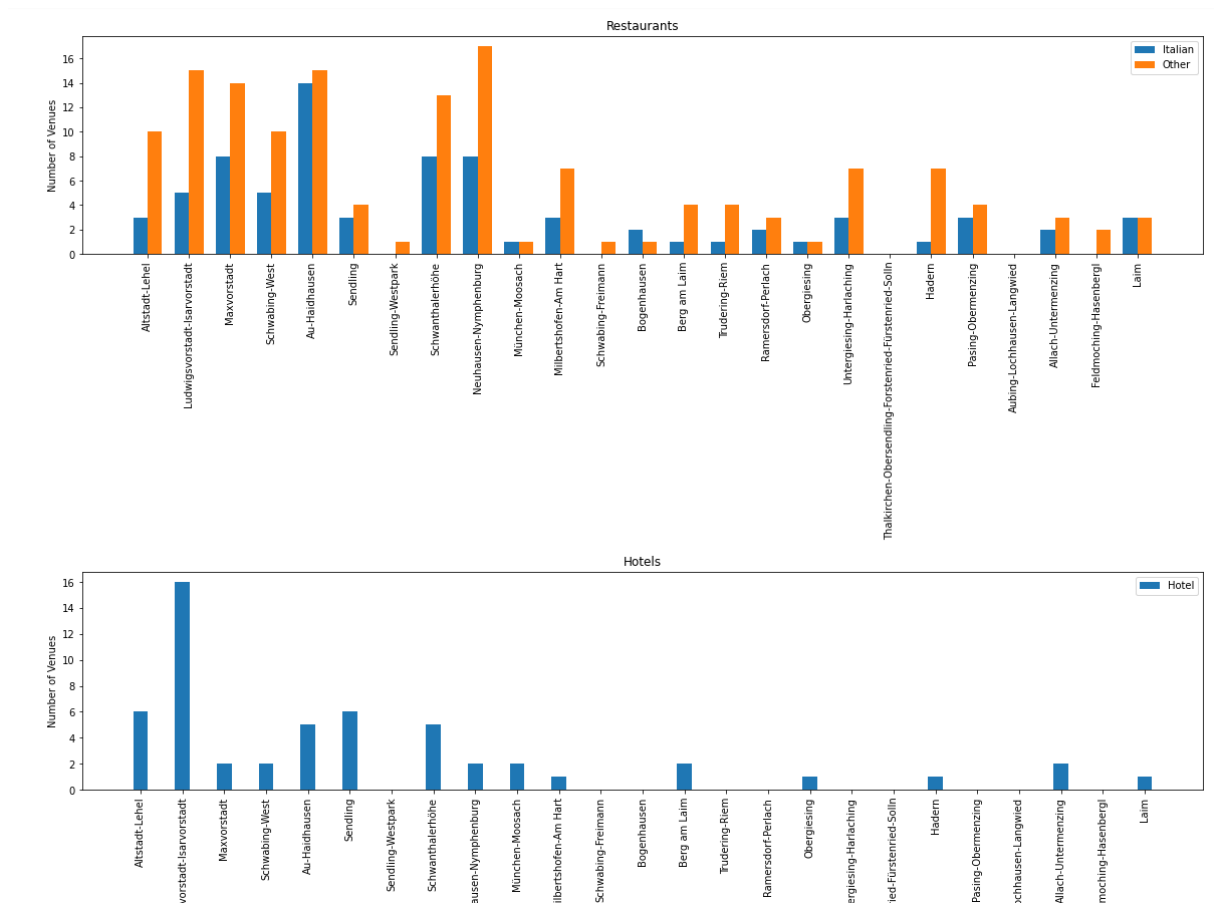


Figure 8 Boroughs with Italian Restaurants compared to number of Hotels

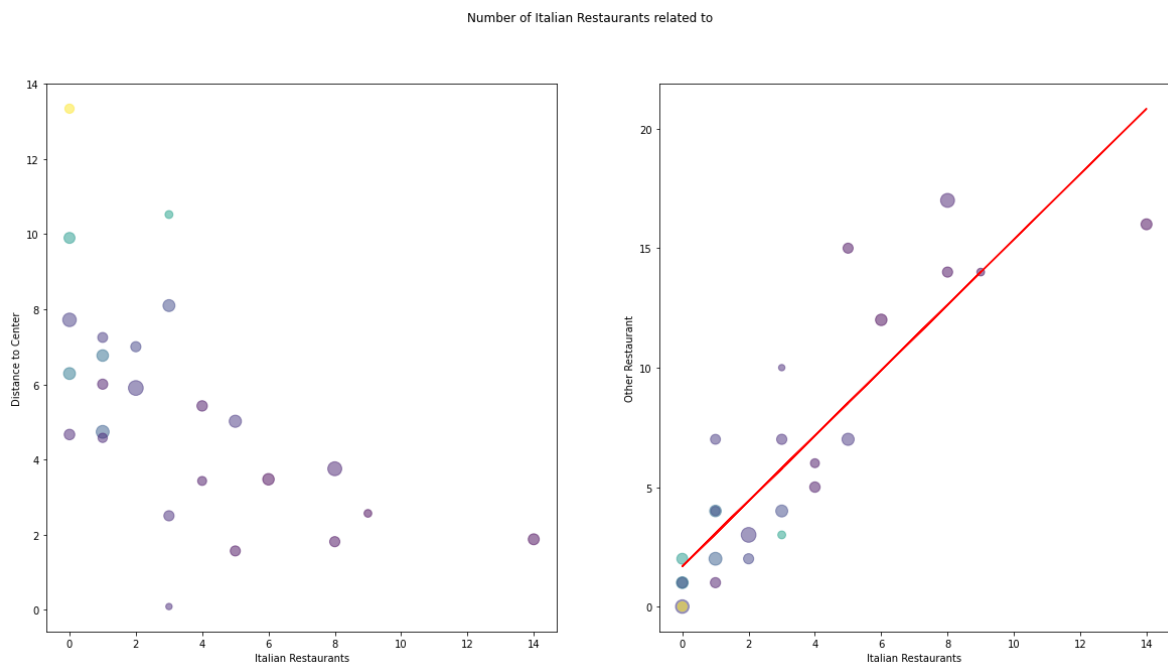


Figure 9 Number of Italian Restaurants vs different dimensions

Clustering

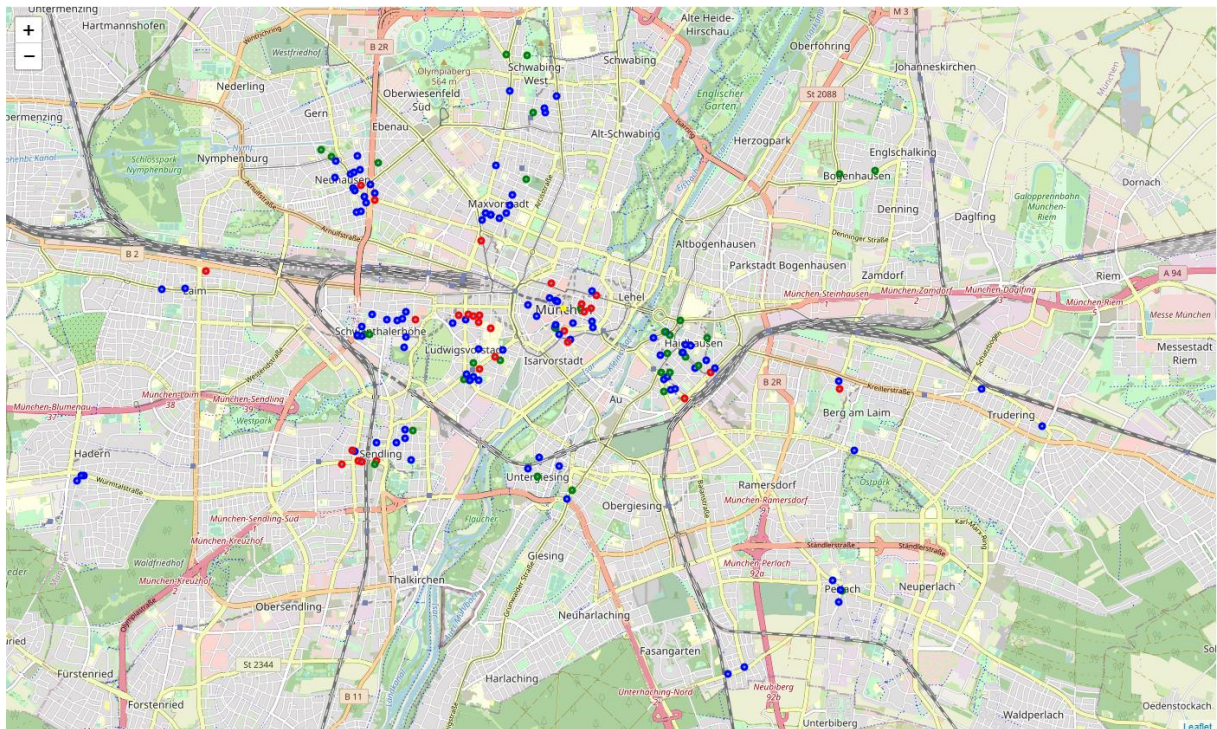
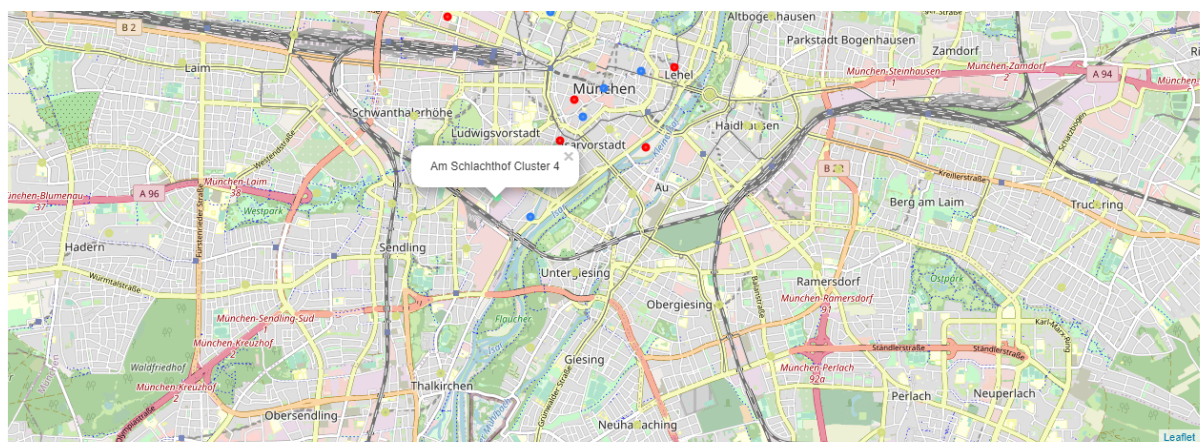


Figure 10 Munich Map with Hotels, Italian and Other Restaurants

The green dots are ITALIAN, the red are OTHER restaurants. Blue circles correspond to Hotels. The yellow dot is the MARIENPLATZ.



munich_merged.loc[munich_merged['Cluster_Labels'] == 4, munich_merged.columns[[1] + list(range(5, munich_merged.shape[1]))]]						
Neighbourhood	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
11 Am Schlachthof	4.0	Greek Restaurant	Turkish Restaurant	Trattoria/Osteria	Thai Restaurant	Sushi Restaurant
23 Neuschwabing	4.0	Greek Restaurant	Turkish Restaurant	Trattoria/Osteria	Thai Restaurant	Sushi Restaurant

munich_merged.loc[munich_merged['Cluster_Labels'] == 5, munich_merged.columns[[1] + list(range(5, munich_merged.shape[1]))]]						
Neighbourhood	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
3 Kreuzviertel	5.0	Italian Restaurant	Thai Restaurant	Spanish Restaurant	Pizza Place	Greek Restaurant
6 Gärtnerplatz	5.0	NaN	NaN	NaN	NaN	NaN
10 Am alten südlichen Friedhof	5.0	Italian Restaurant	Greek Restaurant	Turkish Restaurant	Thai Restaurant	German Restaurant

Figure 11 Munich Map with Cluster 4 and Cluster 5

In Cluster 5 – all neighbourhoods with many ITALIAN Restaurants

In Cluster 4 – all neighbourhoods with few ITALIAN Restaurants

Discussion

There are several issues, which could not be finally answered in this report.

- The data quality, the completeness and accuracy of the Foursquare data
It is unclear how many venues are stored in Foursquare database for Europe/Germany.
Probably there are some obsolete venues, probably some venues
I assume that Google maps is more popular and widely used. In consequence the venue owner reaches more audience and care for proper quality.
- The best radius of the neighbourhood search
I assume, that some venues are counted double in overlapping neighbourhoods. So a restaurant on the border line contributes to more places. The assignment of a location to a neighbourhood should be checked with some GeoJson file, some Choropleth map.
- The traffic junction
Some restaurants are very popular due to the fact the public transport (metro, bus, airplane) is crossing and the daily transit traffic is high.
- The social aspects, spending capacity, age was not considered.
Suburbs can be very different:
 - downtown
with many hotels/theatres/sightseeing highlights
 - villa and diplomats quarter
green, expensive
 - airport / exhibitions and fairs / factories
 - suburbs with high-rise apartment complexes

Conclusion

There are many opportunities in Munich for further Italian Restaurants.

The more I investigate the more I came to know the data is not reliable yet. Running out of time, but stay curious !

Contents

Introduction.....	1
Data Section	2
1. Munich Boroughs	2
2. Munich Neighbourhoods.....	2
3. GeoCoder.....	3
4. Foursquare API	3
5. Aggregation	3
Methodology	4
Results	4
Visualisation	4
Clustering.....	7
Discussion	8
Conclusion	8

List of Figures

Figure 1	List of Boroughs	2
Figure 2	The 5 outermost neighbourhoods from center	3
Figure 3	Base table enhanced with results from Foursquare	4
Figure 4	First 5 Venue List per neighbourhood	4
Figure 5	Munich map with Boroughs and Neighbourhoods	5
Figure 6	Top 5 Neighbourhoods with most Italian Restaurants.....	5
Figure 7	Last 5 Neighbourhoods with zero Italian Restaurants	5
Figure 8	Boroughs with Italian Restaurants compared to number of Hotels	6
Figure 9	Number of Italian Restaurants vs different dimensions	6
Figure 10	Munich Map with Hotels, Italian and Other Restaurants	7
Figure 11	<i>Munich Map with Cluster 4 and Cluster 5</i>	<i>7</i>