Business Opportunities of Opening a New Restaurant in Cologne

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1. Introduction/Business Understanding

Cologne is a city near which the author lives nearby, and it is well-known for its cathedral, trade fairs and conferences, shopping boulevard, and lively party scene. Since it draws a massive amount of visitors, there is a large business potential for restaurants because there is never a lack of people from all over Europe and the world visiting the beautiful region. So ther is wide variety of cousines and restaurants one can chose to start their business venture into. Thus, the goal I want to reach with this exercise is to give a simple recommendation to businesses and stakeholders who are looking to open a new restaurant in Cologne and solve issues like in which district of the city will you find a large number or even concentration of which types of restaurants? Where to open a Mediterranean food, German food, or where to get fast food and the list of competitors in that area. The target audience is Food Entrepreneurs and Business owners.

2. Analytic Approach

First, we analyzed the data using exploratory data analysis to uncover the hidden patterns in data and to provide useful insights to the stakeholders. And secondly we will use prescriptive analysis to help decide a location to construct new shopping mall using K-means clustering.

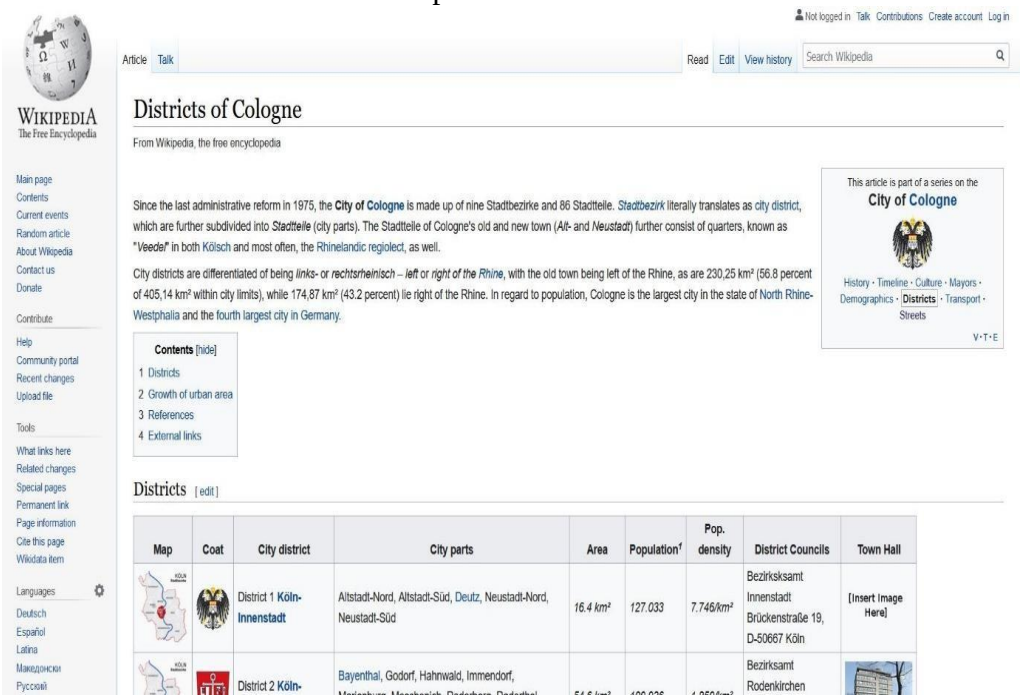
3. Data Requirements

As mentioned in the project requirements, I will use foursquare data about restaurants in Cologne. Foursquare is a US tech company from New York focusing on location data. Their technology and data powers apps such as Apple's Maps, Uber, Twitter and many other household names. Here is an example of a restaurants in Cologne on foursquare: https://de.foursquare.com/v/sattgr%C3%BCn/5c33306cc824ae002c2b414c. I will use foursquare data such as the restaurant name, ID, location and category of food (vegetarian, Italian etc.).

Also, I will use the overview of districts/city parts of Cologne from Wikipedia: https://en.wikipedia.org/wiki/Districts_of_Cologne

Based on this criterion, we will use Data science Python libraries to create a few promising neighborhoods. The benefits of each region can then be specifically articulated so that

stakeholders will choose the best possible final location.



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Districts of Cologne

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This article is part of a series on the
City of Cologne

History · Timeline · Culture · Mayors · Demographics · Districts · Transport · Streets

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Since the last administrative reform in 1975, the **City of Cologne** is made up of nine Stadtbezirke and 86 Stadtteile. *Stadtbezirk* literally translates as city district, which are further subdivided into *Stadtteile* (city parts). The Stadtteile of Cologne's old and new town (*Alt-* and *Neustadt*) further consist of quarters, known as "*Veedel*" in both Kölsch and most often, the Rhinelandic regiolect, as well.

City districts are differentiated of being *links-* or *rechtsrheinisch* – *left* or *right of the Rhine*, with the old town being left of the Rhine, as are 230,25 km² (56.8 percent of 405,14 km² within city limits), while 174,87 km² (43.2 percent) lie right of the Rhine. In regard to population, Cologne is the largest city in the state of North Rhine-Westphalia and the fourth largest city in Germany.

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Districts [edit]

Map	Coat	City district	City parts	Area	Population[1]	Pop. density	District Councils	Town Hall
		District 1 **Köln-Innenstadt**	Altstadt-Nord, Altstadt-Süd, Deutz, Neustadt-Nord, Neustadt-Süd	*16.4 km²*	*127.033*	*7.746/km²*	Bezirksamt Innenstadt Brückenstraße 19, D-50667 Köln	[Insert Image Here]
		District 2 **Köln-**	Bayenthal, Godorf, Hahnwald, Immendorf,				Bezirksamt Rodenkirchen	

4. Data Preparation and Pre-Processing

This section we will do data preparation and collection starting with scraping of the Wikipedia page districts of Cologne: https://en.wikipedia.org/wiki/Districts_of_Cologne. To create a pandas dataframe and then perform data cleaning task to make the results look presentable and drop and remove inconsistencies in the dataframe

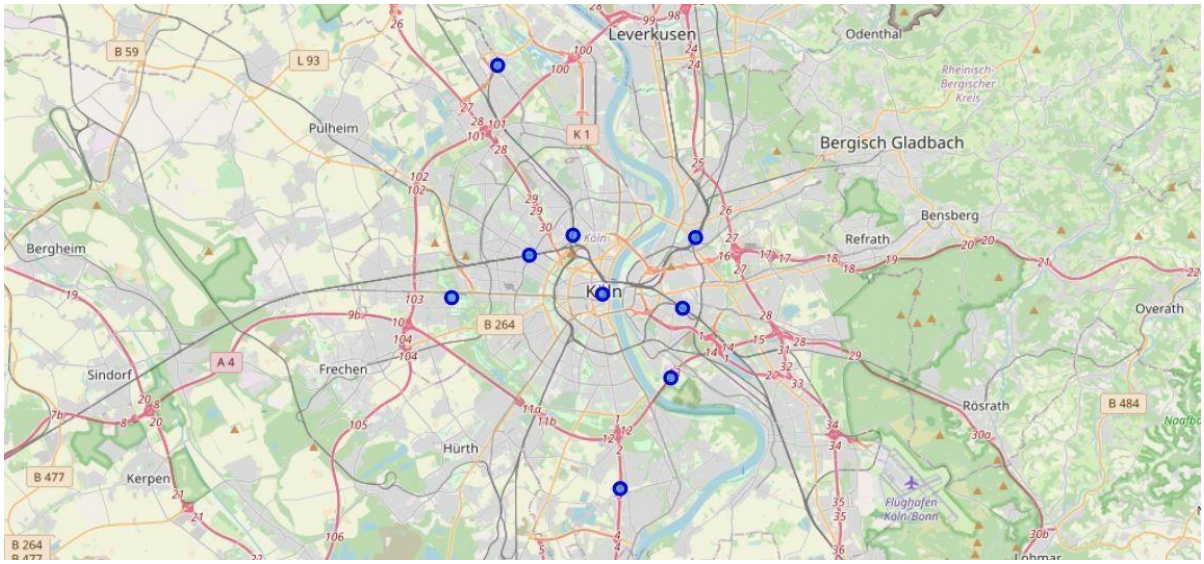
	City district	City parts	Area	Population1	Pop. density	District Councils
0	Köln-Innenstadt	Altstadt-Nord, Altstadt-Süd, Deutz, Neustadt-N...	16.4 km²	127.033	7.746/km²	Bezirksksamt Innenstadt Brückenstraße 19, D-50...
1	Köln-Rodenkirchen	Bayenthal, Godorf, Hahnwald, Immendorf, Marien...	54.6 km²	100.936	1.850/km²	Bezirksamt Rodenkirchen Hauptstraße 85, D-5099...
2	Köln-Lindenthal	Braunsfeld, Junkersdorf, Klettenberg, Lindenth...	41.6 km²	137.552	3.308/km²	Bezirksamt Lindenthal Aachener Straße 220, 509...
3	Köln-Ehrenfeld	Bickendorf, Bocklemünd/Mengenich, Ehrenfeld, N...	23.8 km²	103.621	4.348/km²	Bezirksamt Ehrenfeld Venloer Straße 419 – 421,...
4	Köln-Nippes	Bilderstöckchen, Longerich, Mauenheim, Niehl, ...	31.8 km²	110.092	3.462/km²	Bezirksamt NippesNeusser Straße 450,D-50733 Köln
5	Köln-Chorweiler	Blumenberg, Chorweiler, Esch/Auweiler, Fühling...	67.2 km²	80.870	1.204/km²	Bezirksamt Chorweiler Pariser Platz 1, D-50765...
6	Köln-Porz	Eil, Elsdorf, Ensen, Finkenberg, Gremberghoven...	78.8 km²	106.520	1.352/km²	Bezirksamt PorzFriedrich-Ebert-Ufer 64–70, D-5...
7	Köln-Kalk	Brück, Höhenberg, Humboldt/Gremberg, Kalk, Mer...	38.2 km²	108.330	2.841/km²	Bezirksamt KalkKalker Hauptstraße 247–273,D-51...
8	Köln-Mülheim	Buchforst, Buchheim, Dellbrück, Dünnwald, Flit...	52.2 km²	144.374	2.764/km²	Bezirksamt Mülheim Wiener Platz 2a,D-51065 Köln

5. Data Analysis

First we utilized Geospatial data from Foursquare then used geopy functions to extract necessary Geospatial Data from Foursquare API where I used the nominatim function to add geospatial data to the data frame, The lat and long is on the right side of the following table.

	City district	City parts	Area	Population1	Pop. density	District Councils	Latitude	Longitude
0	Köln-Innenstadt	Altstadt-Nord, Altstadt-Süd, Deutz, Neustadt-N...	16.4 km²	127.033	7.746/km²	Bezirksksamt Innenstadt Brückenstraße 19, D-50...	50.937328	6.959234
1	Köln-Rodenkirchen	Bayenthal, Godorf, Hahnwald, Immendorf, Marien...	54.6 km²	100.936	1.850/km²	Bezirksamt Rodenkirchen Hauptstraße 85, D-5099...	50.865622	6.969718
2	Köln-Lindenthal	Braunsfeld, Junkersdorf, Klettenberg, Lindenth...	41.6 km²	137.552	3.308/km²	Bezirksamt Lindenthal Aachener Straße 220, 509...	50.935935	6.871246
3	Köln-Ehrenfeld	Bickendorf, Bocklemünd/Mengenich, Ehrenfeld, N...	23.8 km²	103.621	4.348/km²	Bezirksamt Ehrenfeld Venloer Straße 419 – 421,...	50.951502	6.916529
4	Köln-Nippes	Bilderstöckchen, Longerich, Mauenheim, Niehl, ...	31.8 km²	110.092	3.462/km²	Bezirksamt NippesNeusser Straße 450,D-50733 Köln	50.958994	6.941777
5	Köln-Chorweiler	Blumenberg, Chorweiler, Esch/Auweiler, Fühling...	67.2 km²	80.870	1.204/km²	Bezirksamt Chorweiler Pariser Platz 1, D-50765...	51.021167	6.898034
6	Köln-Porz	Eil, Elsdorf, Ensen, Finkenberg, Gremberghoven...	78.8 km²	106.520	1.352/km²	Bezirksamt PorzFriedrich-Ebert-Ufer 64–70, D-5...	50.906705	6.999129
7	Köln-Kalk	Brück, Höhenberg, Humboldt/Gremberg, Kalk, Mer...	38.2 km²	108.330	2.841/km²	Bezirksamt KalkKalker Hauptstraße 247–273,D-51...	50.931923	7.005806
8	Köln-Mülheim	Buchforst, Buchheim, Dellbrück, Dünnwald, Flit...	52.2 km²	144.374	2.764/km²	Bezirksamt Mülheim Wiener Platz 2a,D-51065 Köln	50.958147	7.013526

Next we worked on Generating a map of City of Cologne, where we utilised folium package and data frame, finally created a map with the nine city districts on it.



Next on this we made use of Foursquare API to explore the neighbourhoods and grabbed all Nearby venues of the locality.

	City district	City district Latitude	City district Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Köln-Innenstadt	50.937328	6.959234	Craftbeer Corner	50.937222	6.958928	Beer Bar
1	Köln-Innenstadt	50.937328	6.959234	LEGO Store	50.937091	6.956605	Toy / Game Store
2	Köln-Innenstadt	50.937328	6.959234	Papa Joe's Jazzlokal	50.937882	6.962241	Jazz Club
3	Köln-Innenstadt	50.937328	6.959234	Alter Markt	50.938623	6.960070	Plaza
4	Köln-Innenstadt	50.937328	6.959234	Heumarkt	50.936161	6.960461	Plaza

To find clusters of restaurant types in the different city districts, first we had to transform the dataframe with the restaurant venues, associated to city districts, by one-hot encoding (0/1), as seen in the picture below.

	City district	Bavarian Restaurant	Chinese Restaurant	Doner Restaurant	Ethiopian Restaurant	Falafel Restaurant	Fast Food Restaurant	Greek Restaurant	Italian Restaurant	Kebab Restaurant	Lebanese Restaurant	Restaurant
0	Köln-Chorweiler	0.00	0.0	0.0	0.00	0.00	0.083333	0.00	0.000000	0.00	0.00	0.0
1	Köln-Ehrenfeld	0.00	0.0	0.0	0.05	0.05	0.000000	0.00	0.050000	0.05	0.00	0.1
2	Köln-Innenstadt	0.05	0.0	0.0	0.00	0.00	0.050000	0.00	0.000000	0.00	0.05	0.0
3	Köln-Kalk	0.00	0.0	0.0	0.00	0.00	0.000000	0.25	0.000000	0.00	0.00	0.0
4	Köln-Lindenthal	0.00	0.0	0.0	0.00	0.00	0.000000	0.00	0.111111	0.00	0.00	0.0

This shows used grouped data an to show the frequency of each category of restaurants in each city district.

By using this information to create a data frame in which you can see the most common restaurant venue types for each city district.

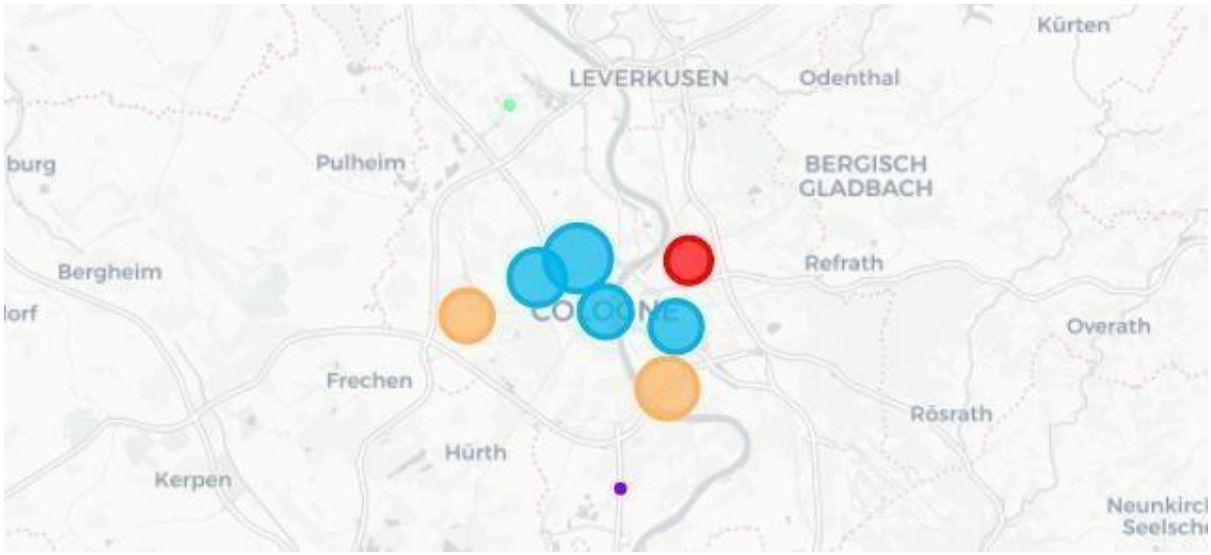
	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	Köln-Chorweiler	Fast Food Restaurant	Italian Restaurant	Sushi Restaurant	Vietnamese Restaurant	Japanese Restaurant	Indian Restaurant	Greek Restaurant	German Restaurant	French Restaurant	Falafel Restaurant
1	Köln-Ehrenfeld	Tapas Restaurant	Italian Restaurant	Restaurant	German Restaurant	Sushi Restaurant	Vietnamese Restaurant	Modern European Restaurant	Chinese Restaurant	French Restaurant	Greek Restaurant
2	Köln-Innenstadt	Italian Restaurant	Sushi Restaurant	Vietnamese Restaurant	German Restaurant	French Restaurant	Middle Eastern Restaurant	Modern European Restaurant	Restaurant	Schnitzel Restaurant	Falafel Restaurant
3	Köln-Kalk	Greek Restaurant	Turkish Restaurant	Italian Restaurant	Middle Eastern Restaurant	Restaurant	German Restaurant	Indian Restaurant	Kurdish Restaurant	Vegetarian / Vegan Restaurant	Mediterranean Restaurant
4	Köln-Lindenthal	German Restaurant	Sushi Restaurant	Italian Restaurant	Greek Restaurant	American Restaurant	Indian Restaurant	French Restaurant	Mexican Restaurant	Modern European Restaurant	Restaurant
5	Köln-Mülheim	Turkish Restaurant	Italian Restaurant	Asian Restaurant	Mediterranean Restaurant	German Restaurant	Vegetarian / Vegan Restaurant	Greek Restaurant	Middle Eastern Restaurant	Vietnamese Restaurant	Seafood Restaurant
6	Köln-Nippes	Italian Restaurant	French Restaurant	Vietnamese Restaurant	Austrian Restaurant	Modern European Restaurant	Greek Restaurant	Restaurant	Sushi Restaurant	German Restaurant	Spanish Restaurant
7	Köln-Porz	German Restaurant	Italian Restaurant	Restaurant	Greek Restaurant	Thai Restaurant	Seafood Restaurant	French Restaurant	Fast Food Restaurant	Turkish Restaurant	Kurdish Restaurant
8	Köln-Rodenkirchen	German Restaurant	Restaurant	Scandinavian Restaurant	Vietnamese Restaurant	Kebab Restaurant	Italian Restaurant	Indian Restaurant	Greek Restaurant	French Restaurant	Fast Food Restaurant

Now, with all this data, we ran finally run k-means clustering algorithm from the scikit-learn package. One could use the ellbow method to systematically define the k value, but I simply chose k to be 5. And the table and output below shows that

	City district	City parts	Area	Population1	Pop. density	District Councils	Latitude	Longitude	Cluster Labels	Common Venue	Common Venue	Co
0	Köln-Innenstadt	Altstadt-Nord, Altstadt-Süd, Deutz, Neustadt-N...	16.4 km²	127.033	7.746/km²	Bezirksksamt Innenstadt Brückenstraße 19, D-50...	50.937328	6.959234	1.0	Vegetarian / Vegan Restaurant	Lebanese Restaurant	Fast Fo Restau
2	Köln-Lindenthal	Braunsfeld, Junkersdorf, Klettenberg, Lindenth...	41.6 km²	137.552	3.308/km²	Bezirksamt Lindenthal Aachener Straße 220, 509...	50.935935	6.871246	0.0	Italian Restaurant	Vegetarian / Vegan Restaurant	Scandi Restau
3	Köln-Ehrenfeld	Bickendorf, Bocklemünd/Mengenich, Ehrenfeld, N...	23.8 km²	103.621	4.348/km²	Bezirksamt Ehrenfeld Venloer Straße 419 – 421,...	50.951502	6.916529	3.0	Restaurant	Kebab Restaurant	Italian Restau
5	Köln-Chorweiler	Blumenberg, Chorweiler, Esch/Auweiler, Fühling...	67.2 km²	80.870	1.204/km²	Bezirksamt Chorweiler Pariser Platz 1, D-50765...	51.021167	6.898034	4.0	Fast Food Restaurant	Vegetarian / Vegan Restaurant	Scandi Restau
7	Köln-Kalk	Brück, Höhenberg, Humboldt/Gremberg, Kalk, Mer...	38.2 km²	108.330	2.841/km²	Bezirksamt KalkKalker Hauptstraße 247–273 D-	50.931923	7.005806	2.0	Greek Restaurant	Vegetarian / Vegan Restaurant	Scandi Restau

The table includes the city districts and their most popular venues, which have now been allocated one of five distinct cluster labels ranging from 0 to 4.

Next, We use the cluster labels to show the city districts marked with a cluster-specific color on a map using the library folium:



What you see above is the nine bubbles for the nine city districts, with five different colors for the five different clusters.

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6. Examination Of The Clusters and Result

Cluster 1 - First cluster result shows Italian Cuisine Cluster in Lindenthal

	City parts	District Councils	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Com V
2	Braunsfeld, Junkersdorf, Klettenberg, Lindenth...	Bezirksamt Lindenthal Aachener Straße 220, 509...	50.935935	6.871246	0.0	Italian Restaurant	Vegetarian / Vegan Restaurant	Scandinavian Restaurant	Restaurant	Lebanese Restaurant	Kebab Restaurant	Greek Restaurant	Fast F Restau

Cluster 2 - Second cluster result shows Vegan Cuisine Cluster in InnenStadt

	City parts	District Councils	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Con V
0	Altstadt-Nord, Altstadt-Süd, Deutz, Neustadt-N...	Bezirksksamt Innenstadt Brückenstraße 19, D-50...	50.937328	6.959234	1.0	Vegetarian / Vegan Restaurant	Lebanese Restaurant	Fast Food Restaurant	Bavarian Restaurant	Scandinavian Restaurant	Restaurant	Kebab Restaurant	Italian Resta

Cluster 3 - Third cluster result shows Greek Cuisine Cluster in KalkKalker

	City parts	District Councils	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Mo Comm Venu
7	Brück, Höhenberg, Humboldt/Gremberg, Kalk, Mer...	Bezirksamt KalkKalker Hauptstraße 247–273,D-51...	50.931923	7.005806	2.0	Greek Restaurant	Vegetarian / Vegan Restaurant	Scandinavian Restaurant	Restaurant	Lebanese Restaurant	Kebab Restaurant	Italian Restaura

Cluster 4 - Fourth cluster result shows Turkish Cuisine Cluster in Ehrenfeld

	City parts	District Councils	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th M Com Ve
3	Bickendorf, Bocklemünd/Mengenich, Ehrenfeld, N...	Bezirksamt Ehrenfeld Venloer Straße 419 – 421,...	50.951502	6.916529	3.0	Restaurant	Kebab Restaurant	Italian Restaurant	Falafel Restaurant	Ethiopian Restaurant	Vegetarian / Vegan Restaurant	Scandina Restaura

Cluster 5 - Fifth cluster result shows Thai Cuisine Cluster in Chorweiler

	City parts	District Councils	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Co
5	Blumenberg, Chorweiler, Esch/Auweiler, Fühling...	Bezirksamt Chorweiler Pariser Platz 1, D-50765...	51.021167	6.898034	4.0	Fast Food Restaurant	Vegetarian / Vegan Restaurant	Scandinavian Restaurant	Restaurant	Lebanese Restaurant	Kebab Restaurant	Italian Restaurant	Gree Res

7. Discussion And Conclusion

The aim of this project was to find Cologne areas near the center with a low number of restaurants in order to assist stakeholders in narrowing their quest for an optimal location for a new restaurant. We defined analysis (köln Innenstadt) and then created an extensive set of locations that satisfy some specific requirements about existing nearby restaurants by measuring restaurant density distribution from Foursquare data. Clustering of those areas was then conducted in order to establish major zones of interest, and addresses for those zone centers were generated to be used as starting points for stakeholders' final discovery.
Answer to Business Question:
Cluster 1 is relects that most preffered place where customers prefer Italian Cuisine but opening an Italian Restaurant In cluster 1 would also lead to sheer level of high competition. Whereas Cluster 2,3 and 5 have less footfall for Italian Cuisine but there is a huge business opportunity for good Italian Cuisine Restaurant.
Cluster 2 reflects that Vegetarian/Vegan Restaurant is most preffered by customers and visitors there and opening Vegan Cuisine restaurant in this cluster would lead to lot of competition but Cluster 4 would be the best place for stakeholders and business owners to open a good Vegan cuisine restaurant.
Cluster 3 reflects that Greek Restaurant is most preffered by customers and visitors there and opening Greek Cuisine restaurant in this cluster would lead to lot of competition but Cluster 2 would be the best place for stakeholders and business owners to open a good Vegan cuisine restaurant and Cluster 1,4 and 5 also looks to be a good place as well.
Cluster 4 reflects that Turkish Restaurant is most preffered by customers and visitors there and opening Turkish Cuisine restaurant in this cluster would lead to lot of competition but Cluster 2 would be the best place for stakeholders and business owners to open a good Turkish cuisine restaurant and Cluster 1, 3 and 5 also looks to be a good place as well.
Cluster 5 reflects that Thai Restaurant is most preffered by customers and visitors there and opening Thai Cuisine restaurant in this cluster would lead to lot of competition but Cluster 4 would be the best place for stakeholders and business owners to open a good Turkish cuisine

restaurant.

Stakeholders will make the final decision on optimal restaurant position based on unique characteristics of communities and areas in each recommended district, taking into account additional factors such as attractiveness of each location, levels of noise / proximity to major connection roads, real estate, costs, social and economic complexities of each neighborhood.

Acknowledgement & sources

The courses of the IBM Data Science Professional Certificate itself and the plethora of hours I spent with them: https://www.coursera.org/professional-certificates/ibm-data-science.