# Coursera Capstone

# IBM Applied Data Science Capstone

# "Opening a vegan restaurant in Munich, Germany"

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# 1   Introduction

## 1.1   Business Problem

Munich is the capital and most populous city of Bavaria and the second most populous German state. There are thousands of bars and restaurants within city limits and the environment is highly competitive. The majority of places offer German, Italian and Asian cuisine. As vegan and vegetarian lifestyles have been increasing in popularity over the past years, opening a vegetarian restaurant is a plausible business idea. Munich is divided into 25 districts, and the purpose of this capstone project is to find the best location for a vegan restaurant.

## 1.2   Target audience

This project will help potential investors who are looking for a suitable location for opening a vegan restaurant in Munich.

# 2   Data

Following data will be needed for the project:

- The list of Munich districts
- Latitude and longitude coordinates of the districts
- Venue data, particularly data on restaurants in Munich and their location

# 3   Sources of data

- The list of Munich districts including their postal codes was downloaded from the website https://www.muenchen.de/int/en/living/postal-codes.html and converted into a Microsoft Excel spreadsheet.
- Latitude and longitude coordinates of the districts based on their  postal codes were downloaded from the website https://public.opendatasoft.com/explore/dataset/postleitzahlen-deutschland/table/ as a Microsoft Excel spreadsheet.
- Venue data were obtained through Foursquare API.

# 4  Methodology

## 4.1  Data

First, the Microsoft Excel Spreadsheet containing the list of Munich districts and their postal codes in Munich and corresponding districts was converted into a dataframe.

| | PostalCode | District |
|---|---|---|
| 0 | 80997 | Allach-Untermenzing |
| 1 | 80999 | Allach-Untermenzing |
| 2 | 81247 | Allach-Untermenzing |
| 3 | 80331 | Altstadt-Lehel |
| 4 | 80333 | Altstadt-Lehel |

The second Microsoft Excel Spreadsheet was converted into a dataframe containing a list of all postal codes in Munich and their coordinates.
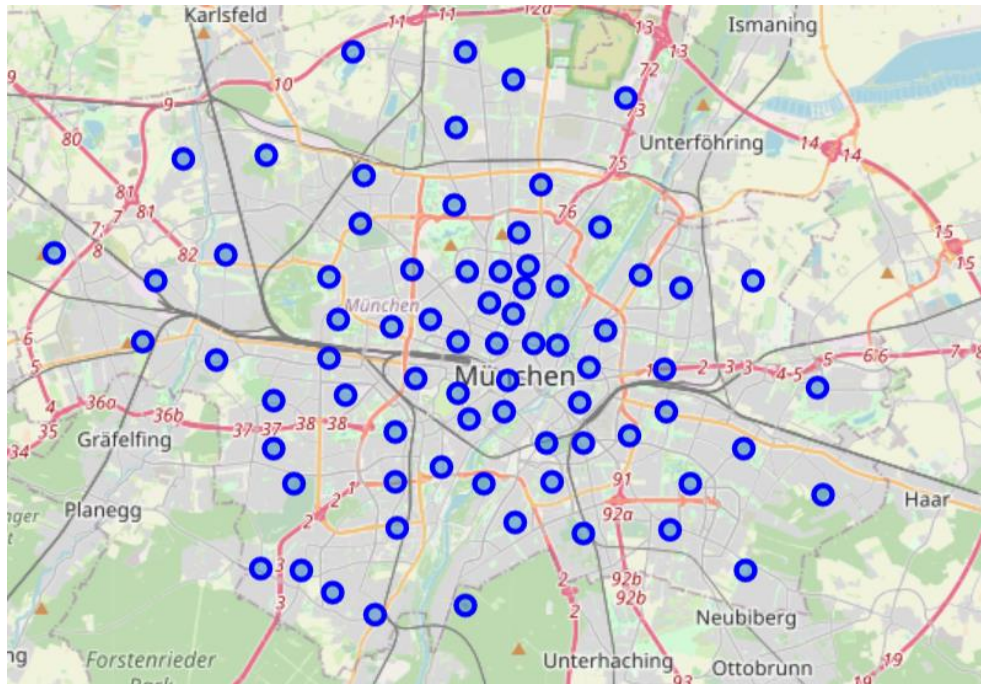
| | PostalCode | Latitude | Longitude |
|---|---|---|---|
| 0 | 80331 | 48.135964 | 11.572905 |
| 1 | 80333 | 48.145190 | 11.568744 |
| 2 | 80335 | 48.145558 | 11.553952 |
| 3 | 80336 | 48.132633 | 11.554171 |
| 4 | 80337 | 48.126389 | 11.558385 |

Both dataframes have been merged, resulting in a dataframe "munich_df" containing coordinates of every district in Munich.

| | PostalCode | Latitude | Longitude | District | Neighborhood |
|---|---|---|---|---|---|
| 0 | 80331 | 48.135964 | 11.572905 | Altstadt-Lehel | Altstadt-Lehel |
| 1 | 80333 | 48.145190 | 11.568744 | Altstadt-Lehel | Altstadt-Lehel |
| 2 | 80335 | 48.145558 | 11.553952 | Schwanthalerhöhe | Schwanthalerhöhe |
| 3 | 80336 | 48.132633 | 11.554171 | Ludwigsvorstadt-Isarvorstadt | Ludwigsvorstadt-Isarvorstadt |
| 4 | 80337 | 48.126389 | 11.558385 | Ludwigsvorstadt-Isarvorstadt | Ludwigsvorstadt-Isarvorstadt |

## 4.2  Visualisation of districts

The latitude and longitude values of Munich were obtained using a geopy library. Then a map of Munich was created using folium.  All 25 districts listed in the dataframe "munich_df" are visualised in the map.

## 4.3   Obtaining data on venues in Munich

The next step was to obtain data on all Munich venues using Foursquare API. API calls containing coordinates of districts were made to Foursqare. Foursquare returned venue data in a json format. Using a python loop, data on venue name, category and its coordinates were extracted and converted into a pandas dataframe.

| | District | District Latitude | District Longitude | Venue | Venue Latitude | Venue Longitude | Venue Category |
|---|---|---|---|---|---|---|---|
| 0 | Altstadt-Lehel | 48.135964 | 11.572905 | Marienplatz | 48.137125 | 11.575483 | Plaza |
| 1 | Altstadt-Lehel | 48.135964 | 11.572905 | Asamkirche (St. Johann Nepomuk) | 48.135053 | 11.569746 | Church |
| 2 | Altstadt-Lehel | 48.135964 | 11.572905 | Galeria Gourmet | 48.137432 | 11.573217 | Gourmet Shop |
| 3 | Altstadt-Lehel | 48.135964 | 11.572905 | Viktualienmarkt | 48.135296 | 11.576368 | Farmers Market |
| 4 | Altstadt-Lehel | 48.135964 | 11.572905 | Kustermann | 48.136242 | 11.574897 | Department Store |

Next, the number of venues in every district was listed:

```
District
Allach-Untermenzing            28
Altstadt-Lehel                120
Au-Haidhausen                 104
Aubing-Lochhausen-Langwied     25
Berg am Laim                   63
Bogenhausen                    81
Feldmoching-Hasenbergl         17
Hadern                         35
Laim                           40
Ludwigsvorstadt-Isarvorstadt   60
Maxvorstadt                   120
Milbertshofen-Am Hart          34
Moosach                        63
Neuhausen-Nymphenburg          78
Obergiesing                    53
Pasing-Obermenzing             20
Ramersdorf-Perlach             32
Schwabing-Freimann             95
Schwabing-West                120
Schwanthalerhöhe               60
Sendling                      100
Thalkirchen                    66
Trudering-Riem                 34
Untergiesing-Harlaching        17
```

The most popular places in every districts were listed using a newly defined python function:

| | District | 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 |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Allach-Untermenzing | Hotel | Bakery | Park | German Restaurant | Bus Stop | Supermarket | Tennis Court | Indian Restaurant |
| 1 | Altstadt-Lehel | Café | Italian Restaurant | Plaza | Art Museum | German Restaurant | Ice Cream Shop | Pizza Place | History Museum |
| 2 | Au-Haidhausen | German Restaurant | Italian Restaurant | Greek Restaurant | Supermarket | Restaurant | Café | Plaza | Bar |
| 3 | Aubing-Lochhausen-Langwied | Bus Stop | Supermarket | Bakery | Asian Restaurant | Automotive Shop | Park | Bowling Alley | Light Rail Station |
| 4 | Berg am Laim | Supermarket | Drugstore | Bakery | Italian Restaurant | Bus Stop | Asian Restaurant | Metro Station | Bavarian Restaurant |
| 5 | Bogenhausen | Italian Restaurant | Park | Bakery | Drugstore | Bus Stop | Restaurant | Plaza | Supermarket |
| 6 | Feldmoching-Hasenbergl | Supermarket | Plaza | Bus Stop | Greek Restaurant | Café | Lake | Bakery | Beer Garden |
| 7 | Hadern | Bus Stop | Supermarket | Plaza | Trattoria/Osteria | German Restaurant | Greek Restaurant | Italian Restaurant | Bakery |
| 8 | Laim | Supermarket | Bakery | Tram Station | Greek Restaurant | Restaurant | Drugstore | Doner Restaurant | Bank |

## 4.4   Clustering of districts

The next step was to build clusters of similar districts, based on most popular venues in the districts. This is important as it helps determine busy areas with many restaurants, where opening a new place would be risky.

Cluster 0: Residential area:

| | District | 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 Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|
| 24 | Schwabing-Freimann | 0 | Supermarket | Hotel | Bus Stop | Italian Restaurant | Bakery | Plaza | Café | Gastropub |
| 42 | Sendling | 0 | Supermarket | Italian Restaurant | Hotel | Bakery | Drugstore | Bus Stop | German Restaurant | Gastropub |
| 61 | Berg am Laim | 0 | Supermarket | Drugstore | Bakery | Italian Restaurant | Bus Stop | Asian Restaurant | Metro Station | Bavarian Restaurant |
| 62 | Bogenhausen | 0 | Italian Restaurant | Park | Bakery | Drugstore | Bus Stop | Restaurant | Plaza | Supermarket |

## Cluster 1: Residential / lively area

| | District | 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 Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | Ludwigsvorstadt-Isarvorstadt | 1 | Café | Italian Restaurant | German Restaurant | Restaurant | Hotel | Jazz Club | Bavarian Restaurant | Falafel Restaurant |
| 11 | Moosach | 1 | Café | Supermarket | Greek Restaurant | Bakery | Bus Stop | Trattoria/Osteria | Tram Station | Light Rail Station |
| 14 | Laim | 1 | Supermarket | Bakery | Tram Station | Greek Restaurant | Restaurant | Drugstore | Doner Restaurant | Bank |
| 16 | Hadern | 1 | Bus Stop | Supermarket | Plaza | Trattoria/Osteria | German Restaurant | Greek Restaurant | Italian Restaurant | Bakery |
| 27 | Milbertshofen-Am Hart | 1 | Museum | Gift Shop | Bus Stop | Pizza Place | Concert Hall | Soccer Field | Shipping Store | Scenic Lookout |
| 28 | Feldmoching-Hasenbergl | 1 | Supermarket | Plaza | Bus Stop | Greek Restaurant | Café | Lake | Bakery | Beer Garden |
| 35 | Allach-Untermenzing | 1 | Hotel | Bakery | Park | German Restaurant | Bus Stop | Supermarket | Tennis Court | Indian Restaurant |
| 37 | Pasing-Obermenzing | 1 | German Restaurant | Hotel | Automotive Shop | Organic Grocery | Pool | Drugstore | Bus Stop | Supermarket |
| 38 | Aubing-Lochhausen-Langwied | 1 | Bus Stop | Supermarket | Bakery | Asian Restaurant | Automotive Shop | Park | Bowling Alley | Light Rail Station |
| 48 | Thalkirchen | 1 | Bus Stop | Bakery | Drugstore | Fast Food Restaurant | Bank | Supermarket | German Restaurant | BBQ Joint |
| 52 | Obergiesing | 1 | Supermarket | Café | Soccer Field | German Restaurant | Tram Station | Plaza | Italian Restaurant | Hotel |
| 54 | Untergiesing-Harlaching | 1 | Tram Station | Soccer Field | Athletics & Sports | Bus Stop | Beer Garden | Gastropub | Bakery | Lake |
| 60 | Ramersdorf-Perlach | 1 | Bus Stop | German Restaurant | Supermarket | Bakery | Hotel | Italian Restaurant | Shipping Store | Soccer Field |
| 69 | Trudering-Riem | 1 | Hotel | Clothing Store | Electronics Store | Bus Stop | Italian Restaurant | Coffee Shop | Pizza Place | Plaza |

## Cluster 2: Lively area

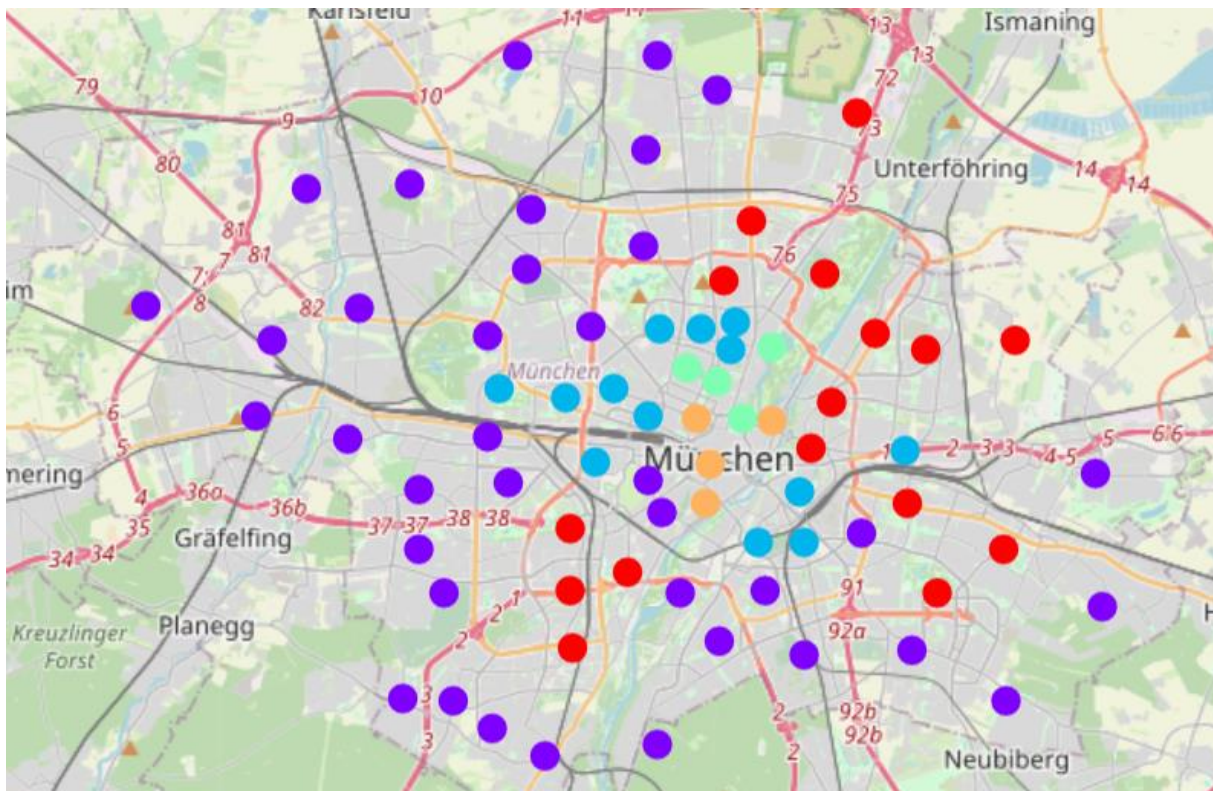| | District | Cluster Labels | 1st Most Common Venue | 2nd Most Common Venue | 3rd Most Common Venue | 4th Most Common Venue | 5th Most Common Venue | 6th Most Common Venue | 7th Most Common Venue | 8th Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | Schwanthalerhöhe | 2 | Café | Hotel | Ice Cream Shop | Italian Restaurant | Middle Eastern Restaurant | Sushi Restaurant | Burger Joint | Vietnamese Restaurant |
| 9 | Neuhausen-Nymphenburg | 2 | Café | German Restaurant | Italian Restaurant | Plaza | Bakery | Vietnamese Restaurant | Pizza Place | Greek Restaurant |
| 17 | Schwabing-West | 2 | Italian Restaurant | Café | Vietnamese Restaurant | Thai Restaurant | German Restaurant | Coffee Shop | Supermarket | Ice Cream Shop |
| 53 | Au-Haidhausen | 2 | German Restaurant | Italian Restaurant | Greek Restaurant | Supermarket | Restaurant | Café | Plaza | Bar |

## Cluster 3: Lively area

| | District | 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 Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | Maxvorstadt | 3 | Café | Bar | Italian Restaurant | Plaza | Vietnamese Restaurant | German Restaurant | Bakery | Trattoria/Osteria |

Cluster 4: Lively area

| | District | 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 Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Altstadt-Lehel | 4 | Café | Italian Restaurant | Plaza | Art Museum | German Restaurant | Ice Cream Shop | Pizza Place | History Museum |

## 4.5   Visualisation of clusters



Cluster 0 (residential area): red

Cluster 1 (residential / lively area): purple

Cluster 2 (lively area): blue

Cluster 3 (lively area): light green

Cluster 4 (lively area): orange

## 4.6 Listing of vegetarian and vegan restaurants

| | District | Vegetarian / Vegan Restaurant |
|---|---|---|
| 0 | Allach-Untermenzing | 0 |
| 1 | Altstadt-Lehel | 1 |
| 2 | Au-Haidhausen | 1 |
| 3 | Aubing-Lochhausen-Langwied | 0 |
| 4 | Berg am Laim | 0 |
| 5 | Bogenhausen | 0 |
| 6 | Feldmoching-Hasenbergl | 0 |
| 7 | Hadern | 0 |
| 8 | Laim | 0 |
| 9 | Ludwigsvorstadt-Isarvorstadt | 0 |
| 10 | Maxvorstadt | 1 |
| 11 | Milbertshofen-Am Hart | 0 |
| 12 | Moosach | 0 |
| 13 | Neuhausen-Nymphenburg | 0 |
| 14 | Obergiesing | 0 |
| 15 | Pasing-Obermenzing | 0 |
| 16 | Ramersdorf-Perlach | 0 |
| 17 | Schwabing-Freimann | 0 |
| 18 | Schwabing-West | 0 |
| 19 | Schwanthalerhöhe | 1 |
| 20 | Sendling | 0 |
| 21 | Thalkirchen | 0 |
| 22 | Trudering-Riem | 0 |
| 23 | Untergiesing-Harlaching | 0 |

# 5 Results

According to the cluster analysis and data on Munich venues, the best location to open a vegetarian / vegan restaurant would be cluster 2,3 or 4. Even though there are a lot of restaurants in this area, there are only four restaurants in Munich offering vegetarian or vegan food, so the market is actually not too competitive.