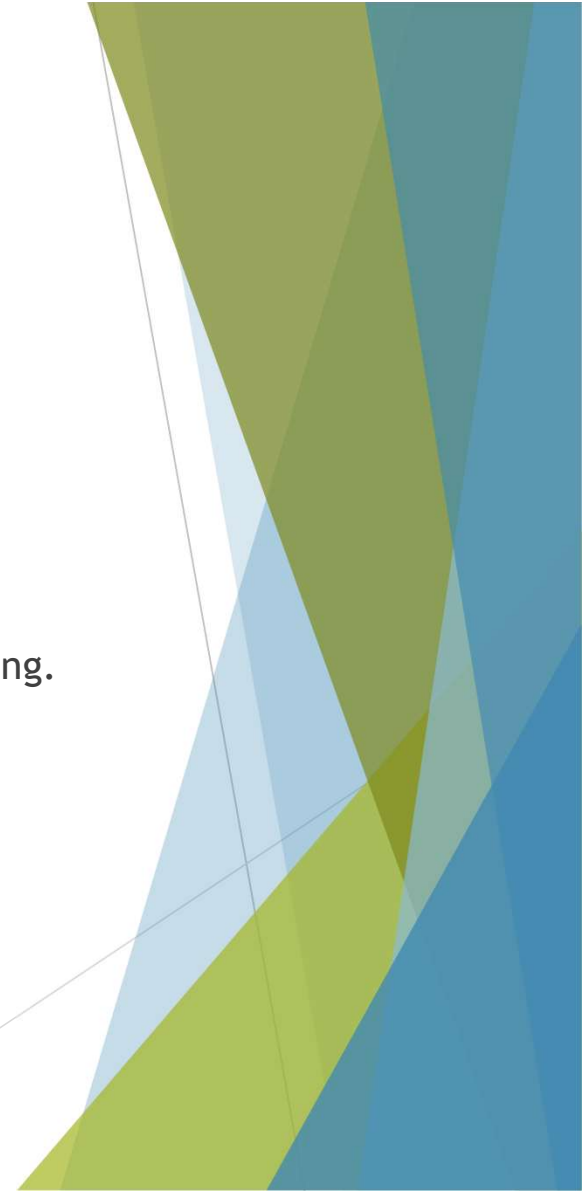




SHORTLISTING OPTIMUM LOCATIONS FOR AN ITALIAN RESTAURANT IN HAMBURG

Background/Business Problem

- ▶ Hamburg is one the biggest cities in Germany with a large number of restaurants.
- ▶ A person want to open an Italian restaurant in Hamburg
- ▶ Restaurant is targeted at the mid to upper segment of the market.
- ▶ Best neighborhoods to be shortlisted using data science and machine learning.



Data sources

- ▶ Data on neighborhoods taken from Wikipedia page:
https://de.wikipedia.org/wiki/Liste_der_Bezirke_und_Stadtteile_Hamburgs
- ▶ Data on average income taken from the report: https://www.statistik-nord.de/fileadmin/Dokumente/Statistik_informiert_SPEZIAL/SI_SPEZIAL_VIII_2017.pdf
- ▶ Data on food venues taken from Foursquare places API.
- ▶ Population density, average income, number and type of food venues used for analysis.

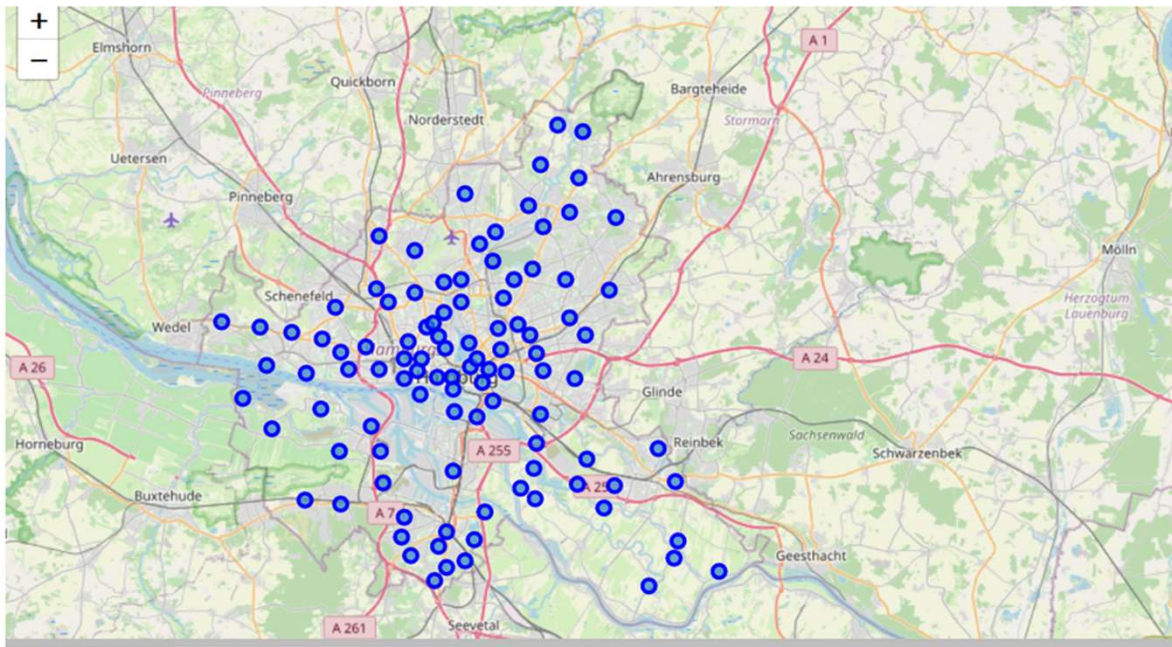
Data collection

- Dataframe showing data on neighborhoods and there location

| | Neighborhood | Borough | Population | Population_per_km2 | latitude | longitude |
|---|------------------|---------------|------------|--------------------|-----------|-----------|
| 0 | Hamburg-Altstadt | Hamburg-Mitte | 2350 | 979 | 53.550468 | 9.994640 |
| 1 | HafenCity | Hamburg-Mitte | 4925 | 2239 | 53.542913 | 9.995835 |
| 2 | Neustadt | Hamburg-Mitte | 12762 | 5549 | 53.549881 | 9.979048 |
| 3 | St. Pauli | Hamburg-Mitte | 22097 | 8839 | 53.553935 | 9.959432 |
| 4 | St. Georg | Hamburg-Mitte | 11358 | 4733 | 53.556993 | 10.014162 |

Data collection

- Map of Hamburg with neighborhoods marked



Data collection

- Slice of dataframe showing income data added to neighborhoods dataframe.

| | Neighborhood | Borough | Population | Population_per_km2 | latitude | longitude | Average income |
|---|------------------|---------------|------------|--------------------|-----------|-----------|----------------|
| 0 | Hamburg-Altstadt | Hamburg-Mitte | 2350 | 979 | 53.550468 | 9.994640 | 31336.0 |
| 1 | HafenCity | Hamburg-Mitte | 4925 | 2239 | 53.542913 | 9.995835 | 93206.0 |
| 2 | Neustadt | Hamburg-Mitte | 12762 | 5549 | 53.549881 | 9.979048 | 34521.0 |
| 3 | St. Pauli | Hamburg-Mitte | 22097 | 8839 | 53.553935 | 9.959432 | 27977.0 |
| 4 | St. Georg | Hamburg-Mitte | 11358 | 4733 | 53.556993 | 10.014162 | 44121.0 |

Data collection

- Data on venues obtained from Foursquare API

| | Neighborhood | Neighborhood Latitude | Neighborhood Longitude | Venue | Venue Latitude | Venue Longitude | Venue Category |
|---|------------------|-----------------------|------------------------|--------------------|----------------|-----------------|----------------------|
| 0 | Hamburg-Altstadt | 53.550468 | 9.99464 | Café Paris | 53.550106 | 9.994227 | Café |
| 1 | Hamburg-Altstadt | 53.550468 | 9.99464 | frittenwerk | 53.551136 | 9.994500 | Fast Food Restaurant |
| 2 | Hamburg-Altstadt | 53.550468 | 9.99464 | Pastaria Da Franco | 53.551148 | 9.994428 | Italian Restaurant |
| 3 | Hamburg-Altstadt | 53.550468 | 9.99464 | Salam-City | 53.549939 | 9.995543 | Falafel Restaurant |
| 4 | Hamburg-Altstadt | 53.550468 | 9.99464 | Picasso | 53.549934 | 9.995627 | Spanish Restaurant |

Exploring data

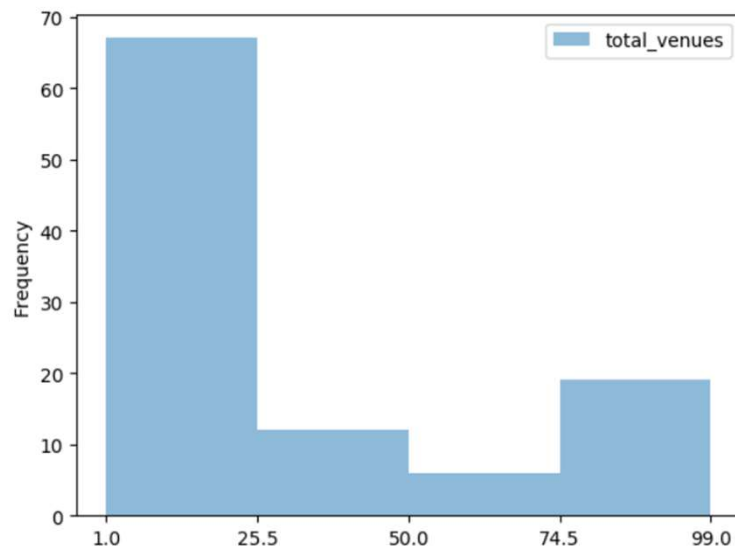
- ▶ Top five categories of food venues obtained from Foursquare API

| Venue Category | |
|--------------------|-----|
| Bakery | 402 |
| Café | 399 |
| Italian Restaurant | 242 |
| German Restaurant | 226 |
| Restaurant | 186 |

- ▶ Italian restaurants can be seen to be very common in Hamburg

Exploring data

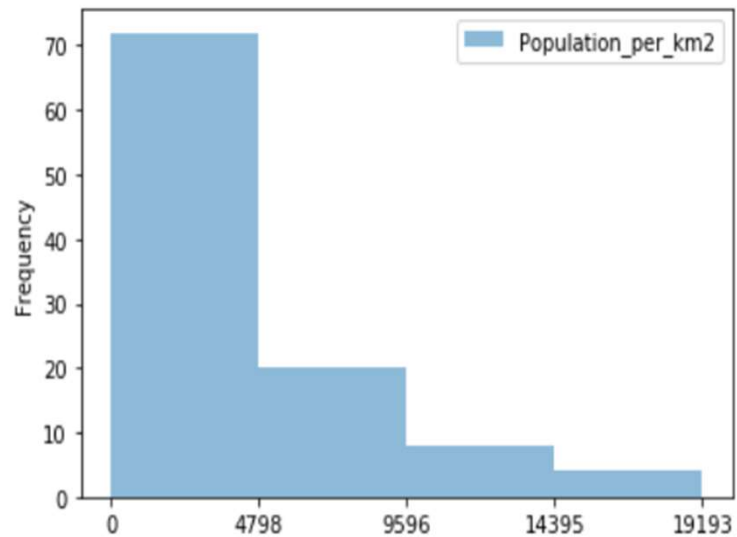
- ▶ Histogram showing total venues and their frequency e.g. first bar shows 67 Neighborhoods have less then 25 venues.



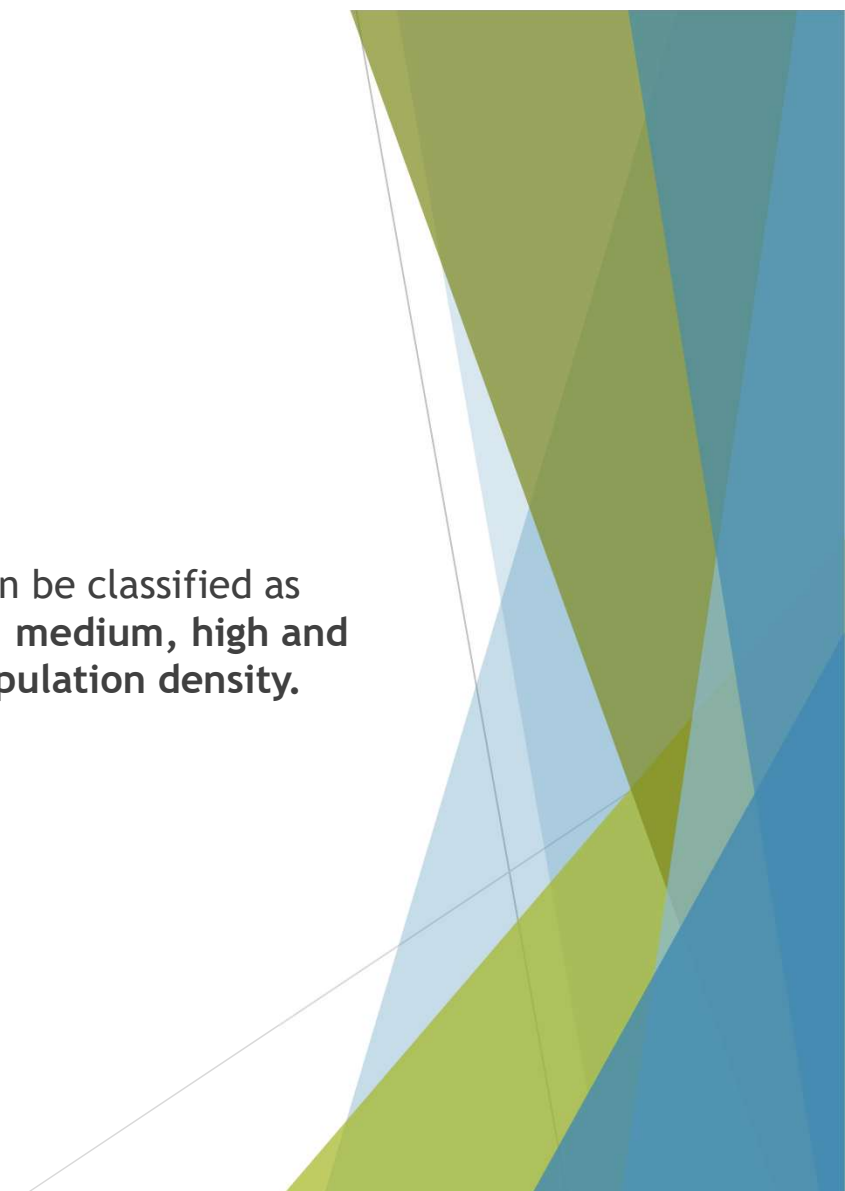
- ▶ The 4 bins can be classified as **low, medium, high and very high competition.**

Exploring data

- Histogram showing the population density and its frequency

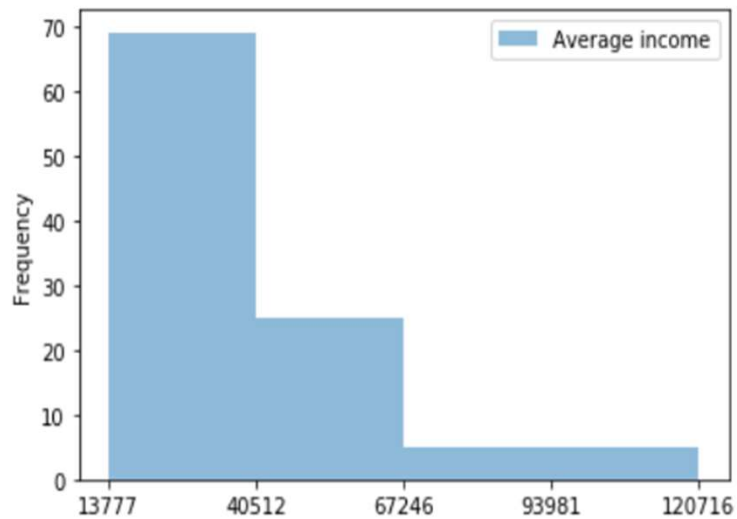


- The 4 bins can be classified as **low/average, medium, high and very high** population density.



Exploring data

- Histogram showing average income and its frequency



- The 4 bins can be classified as **low, medium, high and very high income.**



Preprocessing data for analysis

- Standardizing features to be used K-Means clustering by removing the mean and scaling to unit variance

| | Neighborhood | Population_per_km2 | Average income | total_venues |
|---|------------------|--------------------|----------------|--------------|
| 0 | Hamburg-Altstadt | 979 | 31336.0 | 97 |
| 1 | HafenCity | 2239 | 93206.0 | 93 |
| 2 | Neustadt | 5549 | 34521.0 | 99 |
| 3 | St. Pauli | 8839 | 27977.0 | 98 |
| 4 | St. Georg | 4733 | 44121.0 | 94 |



Standardizing

| | Neighborhood | Population_per_km2 | Average income | total_venues |
|---|------------------|--------------------|----------------|--------------|
| 0 | Hamburg-Altstadt | -0.726399 | -0.480244 | 2.042690 |
| 1 | HafenCity | -0.434408 | 2.418739 | 1.922328 |
| 2 | Neustadt | 0.332648 | -0.331008 | 2.102871 |
| 3 | St. Pauli | 1.095069 | -0.637634 | 2.072781 |
| 4 | St. Georg | 0.143549 | 0.118810 | 1.952418 |

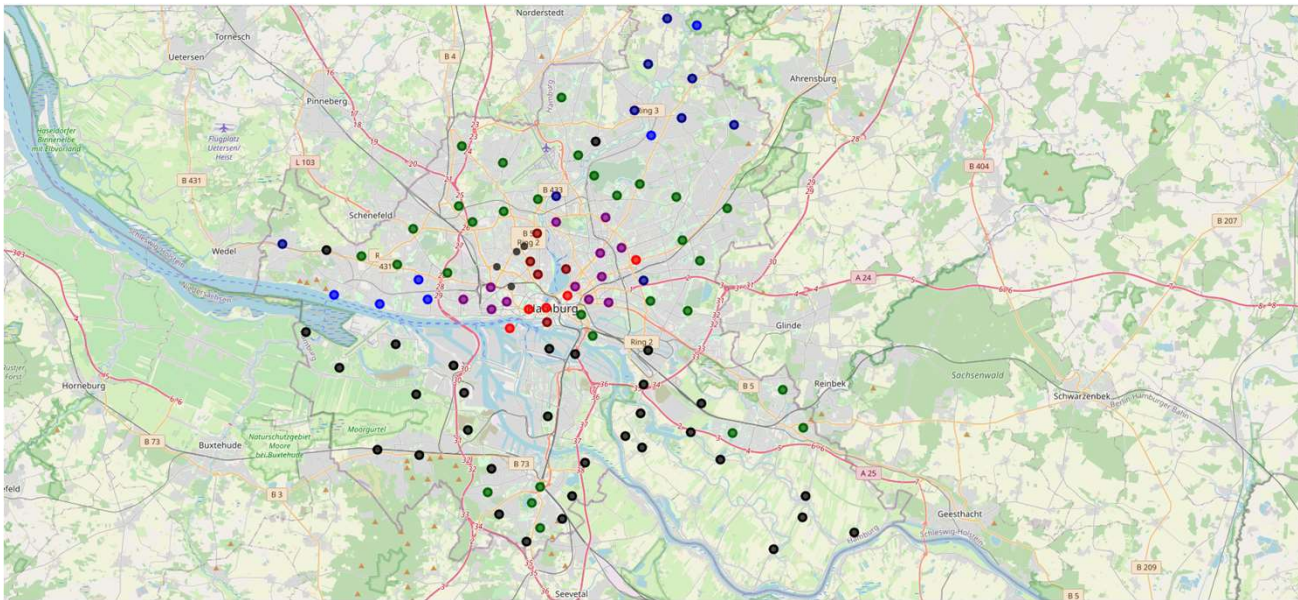
Preprocessing data for analysis

- Data on venues is processed to give the ten most common venues for each neighborhood

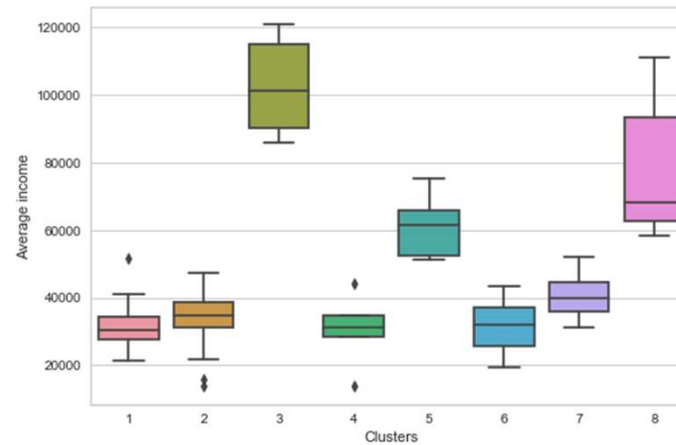
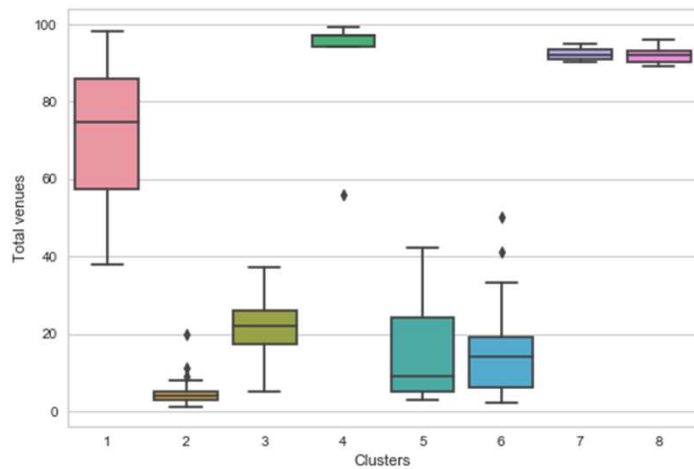
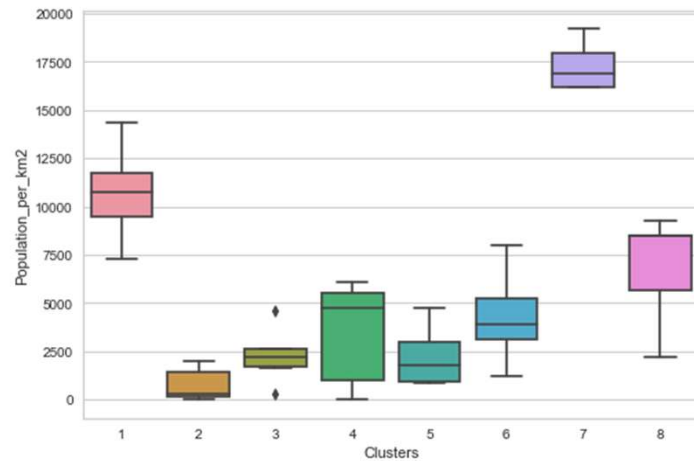
| | Neighborhood | 1st Most Common Venue | 2nd Most Common Venue | 3rd Most Common Venue | 4th Most Common Venue | 5th Most Common Venue | 6th Most Common Venue | 7th Most Common Venue | 8th Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|-----------------|-----------------------|-----------------------|-----------------------|-----------------------------|-----------------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|
| 0 | Allermöhe | German Restaurant | Wings Joint | Food Truck | Dumpling Restaurant | Eastern European Restaurant | English Restaurant | Ethiopian Restaurant | Falafel Restaurant | Fast Food Restaurant | Fish & Chips Shop |
| 1 | Alsterdorf | Restaurant | Café | Vietnamese Restaurant | Asian Restaurant | Greek Restaurant | Doner Restaurant | Burger Joint | German Restaurant | Lebanese Restaurant | Fast Food Restaurant |
| 2 | Altengamme | Diner | Café | Food Truck | Eastern European Restaurant | English Restaurant | Ethiopian Restaurant | Falafel Restaurant | Fast Food Restaurant | Fish & Chips Shop | Food |
| 3 | Altenwerder | Diner | Gastropub | Food Truck | Dumpling Restaurant | Eastern European Restaurant | English Restaurant | Ethiopian Restaurant | Falafel Restaurant | Fast Food Restaurant | Fish & Chips Shop |
| 4 | Altona-Altstadt | Café | Seafood Restaurant | Italian Restaurant | Restaurant | Pizza Place | German Restaurant | Burger Joint | French Restaurant | Asian Restaurant | Thai Restaurant |
| 5 | Altona-Nord | Café | Pizza Place | Burger Joint | German Restaurant | Asian Restaurant | Indian Restaurant | Vietnamese Restaurant | Restaurant | Italian Restaurant | French Restaurant |
| 6 | Bahrenfeld | Restaurant | Italian Restaurant | German Restaurant | Café | Snack Place | Indian Restaurant | BBQ Joint | Asian Restaurant | Diner | Fast Food Restaurant |
| 7 | Barmbek-Nord | Café | Italian Restaurant | Taverna | German Restaurant | Fast Food Restaurant | Falafel Restaurant | Greek Restaurant | Asian Restaurant | Thai Restaurant | Indian Restaurant |
| 8 | Barmbek-Süd | Café | German Restaurant | Doner Restaurant | Italian Restaurant | Indian Restaurant | Fast Food Restaurant | Pizza Place | Greek Restaurant | Taverna | Vietnamese Restaurant |
| 9 | Bergedorf | Restaurant | German Restaurant | Falafel Restaurant | Fast Food Restaurant | Café | Burger Joint | Asian Restaurant | Trattoria/Osteria | Sushi Restaurant | Steakhouse |

Clustering data using K-Means

- ▶ Data is clustered based on the characteristics **population density, average income, and total number of venues.**
- ▶ Eight clusters are formed
- ▶ The dots on the map denote the neighborhood and the color of the dots the cluster in which they fall



Results and discussion



- ▶ Clusters 1,2,4,6 and 7 have lower income.
- ▶ Cluster 8 has high income
- ▶ Clusters 3 and 5 have good income and low competition

Results and discussion

Cluster 3

| | Neighborhood | Population | Population_per_km2 | Average income | total_venues | 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 | 9th Most Common Venue | 10th Most Common Venue |
|----|-------------------|------------|--------------------|----------------|--------------|----------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------------|-----------------------|-----------------------------|-----------------------|-----------------------|------------------------|
| 24 | Groß Flottbek | 11111 | 4630 | 85952.0 | 37 | 2 | Café | Italian Restaurant | Restaurant | Indian Restaurant | Asian Restaurant | German Restaurant | Sushi Restaurant | Snack Place | Doner Restaurant | Portuguese Restaurant |
| 25 | Othmarschen | 15737 | 2623 | 108258.0 | 18 | 2 | Café | German Restaurant | Restaurant | Burger Joint | Falafel Restaurant | Deli / Bodega | Steakhouse | Sushi Restaurant | Italian Restaurant | Brazilian Restaurant |
| 28 | Nienstedten | 7181 | 1670 | 120716.0 | 17 | 2 | Café | Seafood Restaurant | Snack Place | Restaurant | German Restaurant | French Restaurant | Portuguese Restaurant | Diner | Fried Chicken Joint | Ethiopian Restaurant |
| 29 | Blankenese | 13730 | 1783 | 117139.0 | 26 | 2 | Café | Seafood Restaurant | Restaurant | Snack Place | Italian Restaurant | French Restaurant | Fast Food Restaurant | Steakhouse | Sushi Restaurant | Burger Joint |
| 63 | Wellingsbüttel | 10848 | 2646 | 88606.0 | 26 | 2 | Italian Restaurant | Café | Sushi Restaurant | Trattoria/Osteria | Seafood Restaurant | Pizza Place | Eastern European Restaurant | Restaurant | Sandwich Place | Burger Joint |
| 69 | Wohldorf-Ohlstedt | 4650 | 269 | 94234.0 | 5 | 2 | German Restaurant | Wings Joint | Food Truck | Dumpling Restaurant | Eastern European Restaurant | English Restaurant | Ethiopian Restaurant | Falafel Restaurant | Fast Food Restaurant | Fish & Chips Shop |

Cluster 5

| | Neighborhood | Population | Population_per_km2 | Average income | total_venues | 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 | 9th Most Common Venue | 10th Most Common Venue |
|----|----------------------|------------|--------------------|----------------|--------------|----------------|-----------------------|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|
| 32 | Rissen | 15886 | 951 | 65855.0 | 3 | 4 | Indian Restaurant | German Restaurant | Café | Wings Joint | Food Court | Eastern European Restaurant | English Restaurant | Ethiopian Restaurant | Falafel Restaurant | Fast Food Restaurant |
| 45 | Alsterdorf | 15204 | 4751 | 52426.0 | 27 | 4 | Restaurant | Café | Vietnamese Restaurant | Asian Restaurant | Greek Restaurant | Doner Restaurant | Burger Joint | German Restaurant | Lebanese Restaurant | Fast Food Restaurant |
| 57 | Marienthal | 13521 | 4225 | 59131.0 | 42 | 4 | Chinese Restaurant | Asian Restaurant | Café | Turkish Restaurant | Italian Restaurant | Doner Restaurant | Burger Joint | Seafood Restaurant | Vietnamese Restaurant | Dumpling Restaurant |
| 64 | Sasel | 23750 | 2827 | 61360.0 | 9 | 4 | Asian Restaurant | Indian Restaurant | Trattoria/Osteria | Taverna | Chinese Restaurant | Gastropub | Sushi Restaurant | Food | Food Court | Eastern European Restaurant |
| 65 | Poppenbüttel | 23901 | 2951 | 52157.0 | 24 | 4 | Italian Restaurant | Restaurant | Fast Food Restaurant | Seafood Restaurant | Café | Sushi Restaurant | Deli / Bodega | Sandwich Place | Middle Eastern Restaurant | Steakhouse |
| 67 | Lemsahl-Mellingstedt | 6852 | 857 | 75191.0 | 5 | 4 | German Restaurant | Restaurant | Pizza Place | Seafood Restaurant | Food | Dumpling Restaurant | Eastern European Restaurant | English Restaurant | Ethiopian Restaurant | Falafel Restaurant |
| 68 | Duvenstedt | 6160 | 906 | 65694.0 | 5 | 4 | Café | Pizza Place | German Restaurant | Modern European Restaurant | Burger Joint | Wings Joint | English Restaurant | Ethiopian Restaurant | Falafel Restaurant | Fast Food Restaurant |
| 70 | Bergstedt | 10736 | 1534 | 51374.0 | 6 | 4 | German Restaurant | Italian Restaurant | Snack Place | Pizza Place | Restaurant | BBQ Joint | Food Truck | Eastern European Restaurant | English Restaurant | Ethiopian Restaurant |
| 71 | Volksdorf | 20978 | 1808 | 63763.0 | 17 | 4 | Café | Greek Restaurant | Italian Restaurant | Tapas Restaurant | Fast Food Restaurant | Seafood Restaurant | Doner Restaurant | Brazilian Restaurant | Steakhouse | German Restaurant |

Results and discussion

- ▶ The optimum locations selected from cluster 3 and cluster 5 are shown below
- ▶ These location have no Italian restaurants in the top 10 venues, competition is low and the income is high.

| | Neighborhood | Population | Population_per_km2 | Average income | total_venues | 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 | 9th Most Common Venue | 10th Most Common Venue |
|----|----------------------|------------|--------------------|----------------|--------------|----------------|-----------------------|-----------------------|-----------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------|-----------------------|------------------------|
| 28 | Nienstedten | 7181 | 1670 | 120716.0 | 17 | 2 | Café | Seafood Restaurant | Snack Place | Restaurant | German Restaurant | French Restaurant | Portuguese Restaurant | Diner | Fried Chicken Joint | Ethiopian Restaurant |
| 69 | Wohldorf-Ohlstedt | 4650 | 269 | 94234.0 | 5 | 2 | German Restaurant | Wings Joint | Food Truck | Dumpling Restaurant | Eastern European Restaurant | English Restaurant | Ethiopian Restaurant | Falafel Restaurant | Fast Food Restaurant | Fish & Chips Shop |
| 32 | Rissen | 15886 | 951 | 65855.0 | 3 | 4 | Indian Restaurant | German Restaurant | Café | Wings Joint | Food Court | Eastern European Restaurant | English Restaurant | Ethiopian Restaurant | Falafel Restaurant | Fast Food Restaurant |
| 67 | Lemsahl-Mellingstedt | 6852 | 857 | 75191.0 | 5 | 4 | German Restaurant | Restaurant | Pizza Place | Seafood Restaurant | Food | Dumpling Restaurant | Eastern European Restaurant | English Restaurant | Ethiopian Restaurant | Falafel Restaurant |
| 68 | Duvenstedt | 6160 | 906 | 65694.0 | 5 | 4 | Café | Pizza Place | German Restaurant | Modern European Restaurant | Burger Joint | Wings Joint | English Restaurant | Ethiopian Restaurant | Falafel Restaurant | Fast Food Restaurant |

Conclusion

- ▶ Data science and machine learning used effectively to make business decision.
- ▶ Five neighborhoods are shortlisted using the data on average income, population density and the number of venues in each neighborhood
- ▶ Even though the competition of Italian restaurants is high it still possible to find suitable location using appropriate data
- ▶ The stakeholder may consider other factors like real estate availability, running cost, availability of workforce etc. before making a final decision

