Where should I go? Finding the optimal neighbourhood in Bonn to move to from Munich

IBM Applied Data Science Capstone Project

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1 Introduction

1.1 Background

Bonn and Munich are two German cities, that on the first glance are quite dissimilar. Munich is a big metropolis with $1\,485\,671$ inhabitants[1](1), while Bonn has only $329\,673$ [2] (2). Due to the different population numbers, it is only expected, that different kinds of restaurants, stores, and leisure amenities exist in those two cities. For example, based on the number of inhabitants we would expect the smaller town of Bonn to have less variety in international cuisine.

However, this is not necessarily the case for all of Bonn. Bonn is divided into 51 different neighbourhoods, whose structure and population varies. For example, the area near the Rhine contains international embassies and offices of the United Nations. Therefore, these areas to be more international and have more amenities than the 'average' neighbourhood in Bonn.

For a person moving to Bonn, this variety between the neighbourhoods poses a problem: Which neighbourhood should they choose, so that the restaurants, stores and other venues near them fulfill their expectations? This is exactly the problem we are studying in this report.

1.2 Problem

We are investigating the following problem. A person, currently living in the *Kaulbachstraße* next to the main building of Munich University is planning a move from their current home to Bonn. They enjoy the amenities and variety of venues in their current neighbourhood and therefore want to move to a neighbourhood with a similar structure. Our goal is to recommend the neighbourhoods best suited to this person.

1.3 Proposed methodology

To solve the problem, we study the venues in each of Bonns neighbourhood and compare them to venues near the current home in Munich. We find the most common categories of venues per neighbourhood and use them to define the similarity between each of Bonn's neighbourhoods and Munich. Based on this similarity, we recommend which neighbourhood the person from Munich should move to, and which they should avoid.

Our analysis consists of three parts. In the first part we qualitatively explore the data, by finding the most common venue categories per neighbourhood. In the second part we quantify the similarity of each neighbourhood with the Munich area and find the single most similar neighbourhood. In the third part we group alike neighbourhoods into clusters and find the cluster of neighbourhoods most similar to Munich.

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[1] as of 30th September 2020
[2] as of 30th September 2019

2 Data

2.1 Used Datasets and -sources

In this analysis, we require data on the positions of Bonn's neighbourhoods, as well as on the location and category of amenities, restaurants, stores, and other facilities in Bonn and near the current home in Munich. We describe our two data sets in the following.

2.1.1 Location and centre of Bonn's neighbourhoods

We use the location and borders of Bonn's neighbourhoods provided by the city administration on their open data platform [1](3). This data is available as a GeoJSON file and contains the name, ID and polygon shape of each of the 51 neighbourhoods (in German: 'Stadtteile'), as well as their respective city district and district ID. The data was first published on 11th February 2015 and is updated daily. It is available publicly under a Creative Commons CC Zero License, meaning that it is in the Public Domain and can be freely used and shared for any purpose.

We access the data with the python package `geopandas`[2] and read it into a data frame. We also visualize the location of Bonn's neighbourhoods, using the `folium` package [3]. The resulting map is shown in Fig. 2.1.

To simplify our analysis, we drop the columns describing the neighbourhood ID, the district name, and the district ID from this data frame, as these are not related to our analysis. We also find the centre of each neighbourhood using the `centroid` method of `geopandas` data frames and add the longitude and latitude of the centres to the data frame as new columns. Table 2.1 shows the first five rows of the dataframe of Bonn's neighbourhoods used in the following analysis.

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[1] https://opendata.bonn.de/dataset/fl%C3%A4chen-der-ortsteile

[2] https://geopandas.org/

[3] https://python-visualization.github.io/folium/

Table 2.1: First five rows of `neighborhoods` data frame, containing the name, shape, and center coordinates of Bonn's neighbourhoods. Data from (3)

|	name	geometry	longitude	latitude
0	Auerberg	POLYGON ((7.06486 50.75323, 7.06502 50.75339, ...	7.070968	50.755913
1	Bonn-Castell	POLYGON ((7.09779 50.75559, 7.09781 50.75560, ...	7.097325	50.747996
2	Bonn-Zentrum	POLYGON ((7.10191 50.73247, 7.10163 50.73225, ...	7.101694	50.736540
3	Buschdorf	POLYGON ((7.06502 50.75339, 7.06486 50.75323, ...	7.053905	50.757436
4	Dottendorf	POLYGON ((7.10961 50.70893, 7.10961 50.70890, ...	7.115320	50.703584
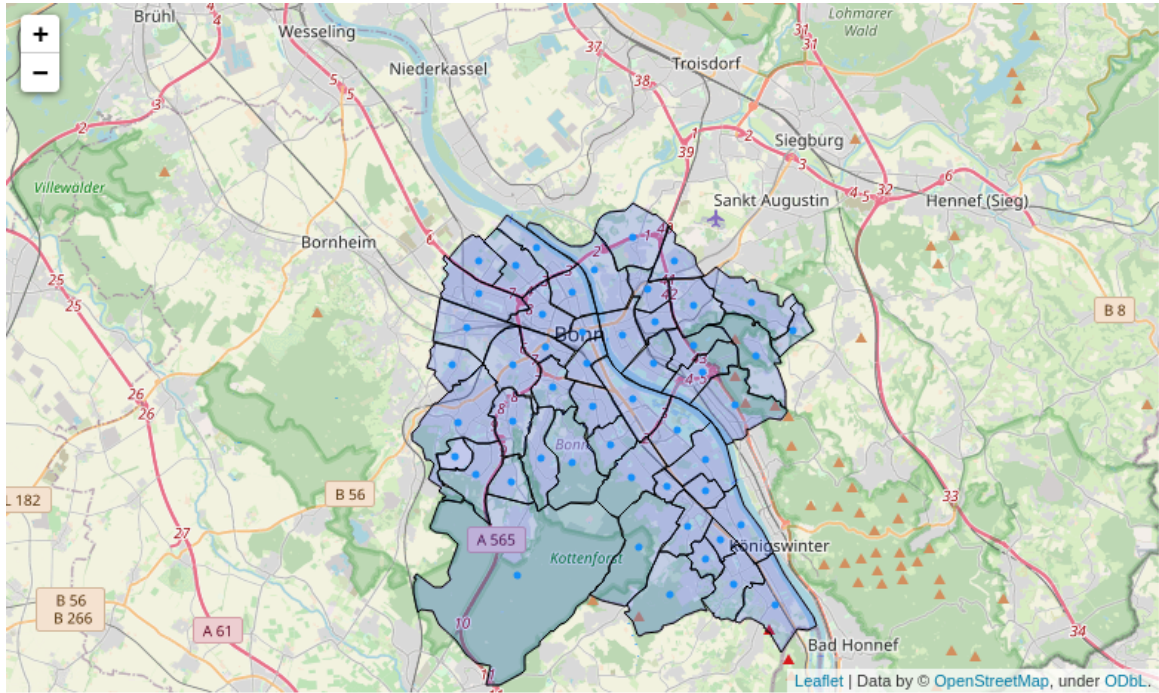
Figure 2.1: Map of Bonn with neighborhoods overlayed in blue and centres of neighbourhoods marked by blue circles. Location and shape of neighbourhoods is from (3), the map of Bonn was created with `folium`.

2.1.2 Location and categories of venues

To obtain the location and categories close to the Munich address and in each neighbourhood in Bonn, we use Foursquare. Foursquare is a search and discovery mobile app that provides users with the opportunity to find new venues close to them, recommend and review visited venues and 'check-in' at their favourite places. Due to the app's popularity, Foursquare has obtained a large dataset of the location, category and rating of venues like restaurants, stores, and leisure amenities all over the world. This dataset is accessible via an Application Programm Interface (API), which we are using for our analysis. Using the Foursquare API and data commercially requires a paid subscription. However, here we are only considering personal use, which is free.

We use the API to obtain the name, location and category of each venue listed on Foursquare within 500 m of the centre of each of Bonn's neighbourhoods and the Kaulbachstraße in Munich. From the API we obtain 433 venues in Bonn, most of which are supermarkets, and 38 in Munich, most of which are cafés. The first five rows of the data frame containing the venues in Bonn are shown in Table 2.2, while the first five rows of the data frame containing the venues in Munich are shown in Table 2.3.

To visually inspect the data, we display the venues along with the neighbourhood centres in Bonn in Fig 2.2. This inspection reveils that there are four neighbourhoods, which do not have any listed venues (Röttgen, Schweinheim, Heiderhof, and Hardthöhe). Our analysis, therefore, cannot apply to these neighbourhoods and we drop their corresponding rows.

Table 2.2: First five rows of `venues_Bonn` data frame, containing the neighbourhood, neighbourhood centre coordinates, venue name, venue coordinates and venue category of venues in Bonn.

	Neighbour-hood	Neighbourhood Latitude	Neighbourhood Longitude	Venue	Venue Latitude	Venue Longi-tude	Venue Category
0	Auerberg	50.755913	7.070968	H Kopen-hagener Strasse	50.757418	7.071644	Tram Sta-tion
1	Auerberg	50.755913	7.070968	REWE	50.755647	7.076839	Supermarket
2	Auerberg	50.755913	7.070968	H Auer-berger Mitte	50.755102	7.076088	Tram Sta-tion
3	Auerberg	50.755913	7.070968	PENNY	50.756300	7.076302	Supermarket
4	Auerberg	50.755913	7.070968	Packstation 116	50.752412	7.073921	Shipping Store

Table 2.3: First five rows of `venues_Munich` data frame, containing the neighbourhood, neighbourhood centre coordinates, venue name, venue coordinates and venue category of venues in Bonn.

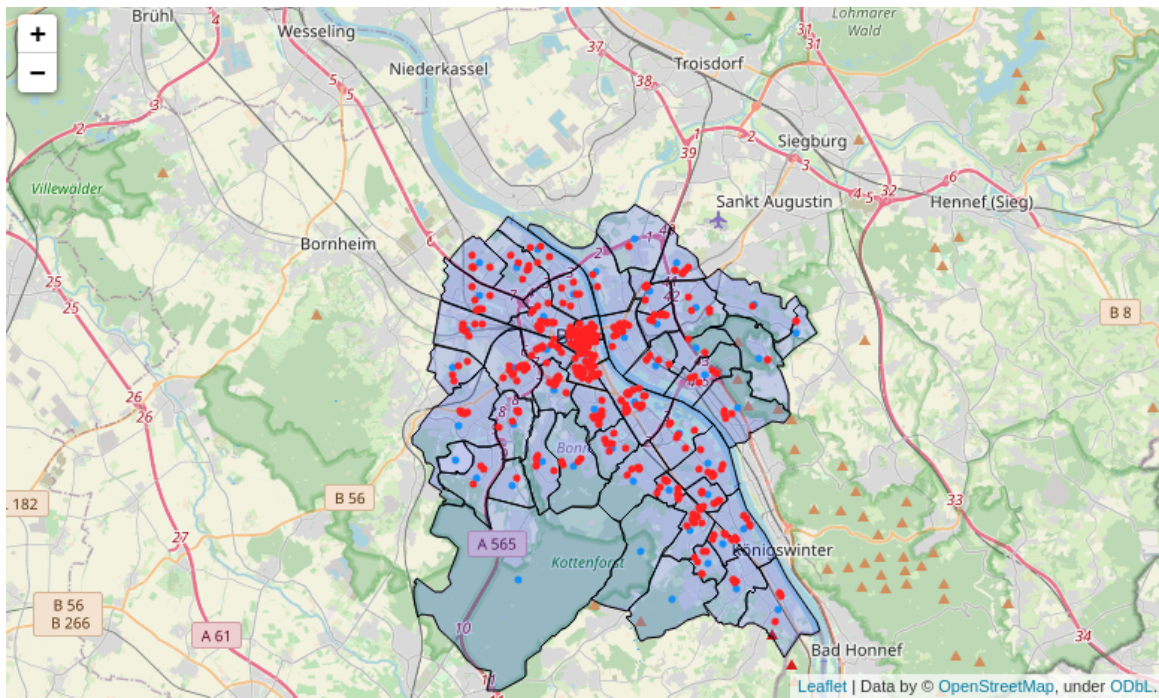|	Neighbour-hood	Neighbourhood Latitude	Neighbourhood Longitude	Venue	Venue Latitude	Venue Longit-ude	Venue Category
0	Munich	48.15113	11.58415	Dinatale	48.150196	11.583001	Café
1	Munich	48.15113	11.58415	Geschwister-Scholl-Platz	48.150850	11.581383	Plaza
2	Munich	48.15113	11.58415	Koenigin 43	48.150173	11.584367	Café
3	Munich	48.15113	11.58415	Milchhaeusl	48.149882	11.585483	Beer Garden
4	Munich	48.15113	11.58415	DELI STAR Bagel & Coffee	48.150024	11.583972	Bagel Shop

Figure 2.2: Map of venues in Bonn (red circles) around neighbourhoods centers (blue circles).

Bibliography

[1] **Bayerisches Landesamt für Statistik**. *Statistische Berichte - Einwohnerzahlen am 30. September 2020*. 09 2020. URL `https://www.statistik.bayern.de/mam/produkte/veroffentlichungen/statistische_berichte/a1200c_202043.pdf`.

[2] **Landesbetrieb Information und Technik Nordrhein-Westfalen**. *Bevölkerung der Gemeinden Nordrhein-Westfalens am 31. Dezember 2019*. 12 2019. URL `https://www.landesdatenbank.nrw.de/ldbnrw/online;jsessionid=FBC481AAC50656B8CA9E933111BC242A.ldb2?sequenz=tabelleErgebnis&selectionname=12411-31iz#abreadcrumb`.

[3] **Stadt Bonn**. *Flächen der Ortsteile*. 03 2020. URL `https://opendata.bonn.de/dataset/fl%C3%A4chen-der-ortsteile`. Accessed on 19.12.2020.