

IBM Data Science Professional Certificate

Capstone Project

## EXPERIENTIAL ADOPTION

*Increasing Animal Adoption thru Pet Cafes*

*In Northern Germany*

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## **1. Introduction**

Animal Cafés, also known as Pet Cafés have been very popular since it was first established in Taiwan in 1998 was primarily for people who wanted to spend time with animals and at the same time enjoy some drinks and food[1]. Although more of these Cafés were built worldwide, they are still more popular in Asia. In recent years, a number of these cafes have started partnering up with local shelters to help rescued pets to be adopted. In the Philippines, a Non-government organization called PAWS partnered up with one of the biggest mall chains and opened up a cafe in an attempt to raise awareness on animal welfare<sup>[2]</sup>.

Shelters and rescuers are always looking for new ways for homeless pets to interact with potential adoptive families. They have worked to create open and inviting areas where people can have one-on-one time with pets before deciding to adopt, working to change the stereotypes about shelter pets. Getting consumers involved, particularly with social causes, can be challenging, prompting organizations to turn to experiential marketing tactics.

Experiential marketing is a marketing technique that creates experiences between brands and consumers. Experiential campaigns use an activation (e.g., product sampling, immersive experiences, stunts, events, etc.) to bring brands to life and interact directly with the target audience. One such campaign is called experiential adoption<sup>[3]</sup>, whereby people can experience interacting with pets without actual ownership. In this process, potential adoptive persons have a chance to decide thoroughly which pet they would adopt or if they or their family is ready to have a pet at home

In Germany, a country with some of the most progressive animal welfare laws and attitudes, there are private animal shelters called “Tierheim”, which take care of homeless animals. Tierheim literally means animal (*‘tier’*) house (*‘house’*). The shelter takes in a wide variety of animals, including exotic ones. Approximately 15000 animals are taken in annually, 40% of which are stray. The criteria for adoption are strict, for example; they don’t allow adoption where the house is empty for more than 8 hours/day<sup>[4]</sup>.

Germany itself only has a few Pet Cafe's but it's because most restaurants, hotels and public transport are pet-friendly. However, these establishments, though pet-friendly, does not necessarily advertise the importance of pet adoption.

1. Animal Café ([https://en.wikipedia.org/wiki/Animal\\_cafe](https://en.wikipedia.org/wiki/Animal_cafe))
2. Pet Café for a cause (<https://news.abs-cbn.com/life/08/17/19/get-up-close-and-personal-with-shelter-animals-at-this-pet-caf-for-a-cause>)
3. Experiential Adoption(<https://www.trendhunter.com/protrends/experiential-adoption>)
4. Adoption rate at German Shelters(<https://worldanimalrescuefund.org/2017/03/90-adoption-rate-at-german-animal-shelters/#:~:text=Though%20Tierheim%20shelter%20over%2010%2C000,rate%20goes%20far%20beyond%2090%25.>)

## 1.1 Business Problem

This project will aim to find an optimal location to establish Pet Cafes in **North Germany**. This report targets entrepreneurs or NGO's interested in opening a business with a social cause, specifically in Animal welfare.

Since Germany, in general, has an ever-increasing number of pet-friendly restaurants and establishments, we will try to find locations that are nearby Animal Shelters hence making it possible for shelters to showcase their animals in the Cafes. The main goal is to help Animal Shelters in promoting animal adoption and fostering. We will particularly target shelters in districts where there is a bigger population and with a better accessibility in terms of public transport.

A ranking of optimal venues will be done which will give us a better suggestion where to establish Cafes.

## 1.2 Introduction to North Germany

North Germany <sup>[1]</sup> is the region in the northern part of Germany, whose exact area is not precisely or consistently defined. It varies depending on whether one has a linguistic, geographic, socio-cultural or historic standpoint. The following five coastal states are regularly referred to as Northern Germany

- Schleswig-Holstein,
- Mecklenburg-Vorpommern,
- Lower Saxony (Niedersachsen)
- city-states Hamburg and Bremen

Though geographically in the northern half of Germany, North Rhine-Westphalia, Brandenburg, and the northern parts of Saxony-Anhalt are rarely referred to as Northern Germany and instead are almost always associated with Western Germany and the historical East Germany respectively. During the second half of the 20th century, a cultural division of northern Germany into an Eastern and a Western part has become more pronounced due to the 1949–1990 division of all of Germany into West Germany and East Germany, where identities based upon the former Iron Curtain and mutual prejudices regarding what once was the other side may persist today.

1. Northern Germany ([https://en.wikipedia.org/wiki/Northern\\_Germany](https://en.wikipedia.org/wiki/Northern_Germany))

## 2. DATA

### 2.1 Data Source

A list of postal regions and codes can be found in *suche-postleitzahl.org*. The list in *suche-postleitzahl* gives a more detailed list of all the neighborhoods and their corresponding postal codes and population. The data can be downloaded as jpeg, csv, or excel hence this site came in very handy.

suche-postleitzahl.org/niedersachsen.74-expand

ua... List of common Spa... English to French, It... German verb 'müss... JOBBÖRSE - JOBBÖ... Lernbörse Lebenslauf für Bew... The Python Tutorial...

Strasse, Ort oder PLZ suchen

Orte A-Z PLZ-Gebiete Bundesländer

Postleitzahlen Niedersachsen

Ergebnis filtern... 20 12 -

+ PLZ Print Export

PLZ	Name	Einwohner	Fläche (Km²)	Landkreis
19273	Amt Neuhaus	4.965	237,96	Lüneburg
19273-21354	Bleckede	9.471	140,65	Lüneburg
21217-21220	Seevetal	41.591	105,33	Harburg
21224	Rosengarten (Landkreis Harburg)	13.672	63,79	Harburg
21227	Bendestorf	2.354	3,87	Harburg
21228	Harmstorf	821	5,99	Harburg
21244	Buchholz in der Nordheide	39.729	74,76	Harburg
21255	Dohren (Nordheide)	1.253	12,20	Harburg
21255	Kakenstorf	1.450	12,69	Harburg
21255	Königsmoor	622	10,01	Harburg
21255	Tostedt	13.818	48,45	Harburg
21255	Wistedt	1.764	18,61	Harburg
21255-21279	Drestedt	786	5,73	Harburg
21256	Handeloh	2.539	27,00	Harburg
21258	Heidenau (Nordheide)	2.243	38,90	Harburg
21259	Otter	1.721	34,24	Harburg

Table 1: Raw data from *suche-postleitzahl*

For the data frame, I used data from 'suche postleitzahl' website and dropped the Land Area ("Fläche"), and unnamed columns, leaving only the columns for "Landkreis", Population("Einwohner"), States, and Postal Code(PLZ). *Landkreis* is the same as a District. I merged all the data from all the 3 focus

states into one data-frame. I did not include name of neighborhoods as the Landkreis is more accurate for location.

The geospatial coordinates were gathered thru OpenDataSoft(ODS)[4] website. ODS listed coordinates together with the postal codes for better accuracy.

Deutschland Länder

Information

Table

Map

Analyze

Export

API

1

Geo Point

2

Geo Shape

3

Id 0

4

ISO

5

Name 0

6

Id 1

7

Name 1

8

Varname 1

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4

DEU

5

Germany

6

755

7

Berlin

8

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Bavaria

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Germany

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Nordrhein-Westfalen

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North Rhine-Westphalia

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Germany

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Bremen

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Germany

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Brandenburg

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Germany

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Sachsen-Anhalt

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Saxony-Anhalt

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Germany

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Germany

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Baden-Württemberg

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Germany

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763

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Rheinland-Pfalz

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Rhineland-Palatinate

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Niedersachsen

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Hamburg

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Saxony

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60

4

DEU

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Germany

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760

7

Mecklenburg-Vorpommern

8

Mecklenburg-West Pomerania

Table 2: Raw data from ODS website

[3]:

	PostalCode	City	Population	District	Region	Latitude	Longitude
1	21039	Börnsen	4764	Herzogtum Lauenburg	Schleswig-Holstein	53.4306	10.2678
2	21039	Escheburg	3421	Herzogtum Lauenburg	Schleswig-Holstein	53.4667	10.3167
3	21039	Kröppelshagen-Fahrendorf	1287	Herzogtum Lauenburg	Schleswig-Holstein	53.4762	10.2816
4	21465	Wentorf bei Hamburg	13349	Herzogtum Lauenburg	Schleswig-Holstein	53.4858	10.2267
5	21465	Reinbek	27649	Stormarn	Schleswig-Holstein	53.4456	10.2211
...	...	...	...	...	...	...	...
2762	5744	Hamburg-Altona	253735	Hamburg	Hamburg	53.5521	10.0004
2763	5745	Hamburg-Bergedorf	121541	Hamburg	Hamburg	53.5564	10.0144
2764	5746	Hamburg-Harburg	153196	Hamburg	Hamburg	53.5439	10.0133
2765	5747	Hamburg-Wandsbek	416369	Hamburg	Hamburg	53.5467	10.0314
2766	5748	Hamburg-Mitte	282781	Hamburg	Hamburg	53.5564	10.0144

2766 rows × 7 columns

Table 3: Merged data from both datasets

The data described above will be used to find the animal shelters located in each neighborhood from the targeted states and assess their accessibility. Foursquare API and Folium map is used for visualization.

### 3. Methodology

#### 3.1 Data Analysis

Based on the data we have, we can already infer which districts we can focus on evidenced by its population. The top 10 Districts with a big population density are as follows:

- Hamburg
- Hannover (Niedersachsen)
- Bremen
- Osnabrück (Niedersachsen)
- Göttingen (Niedersachsen)
- Emsland (Niedersachsen)
- Oldenburg (Niedersachsen)
- Pinneberg (Schleswig-Holstein)
- Rendsburg-Eckernförde (Schleswig-Holstein)
- Hildesheim (Niedersachsen)

[21]:

	District	Population
0	Hamburg	1779308
1	Region Hannover	1157624
2	Bremen	546634
3	Osnabrück	522091
4	Göttingen	328074
...	...	...
64	Delmenhorst	77607
65	Wilhelmshaven	76278
66	Holzminden	70975
67	Wittmund	56882
68	Emden	50195

69 rows × 2 columns

As you can notice, most of the populated District are in Lower Saxony (Niedersachsen) and the top 10 areas does not equally represent the 5 states that we selected. However, we can take 3 Districts from each state with a good population distribution (excluding Hamburg and Bremen as they are a state by themselves) to represent all the states to have a candidate location for each state. With this consideration in mind, the new list will be as follows:

- Hamburg
- Bremen
- Hannover (Niedersachsen)
- Osnabrück (Niedersachsen)
- Göttingen (Niedersachsen)
- Mecklenburgische Seenplatte (Mecklenburg-Vorpommern)
- Vorpommern-Greifswald (Mecklenburg-Vorpommern)
- Landkreis Rostock (Mecklenburg-Vorpommern)
- Pinneberg (Schleswig-Holstein)
- Rendsburg-Eckernförde (Schleswig-Holstein)
- Kiel (Schleswig-Holstein)

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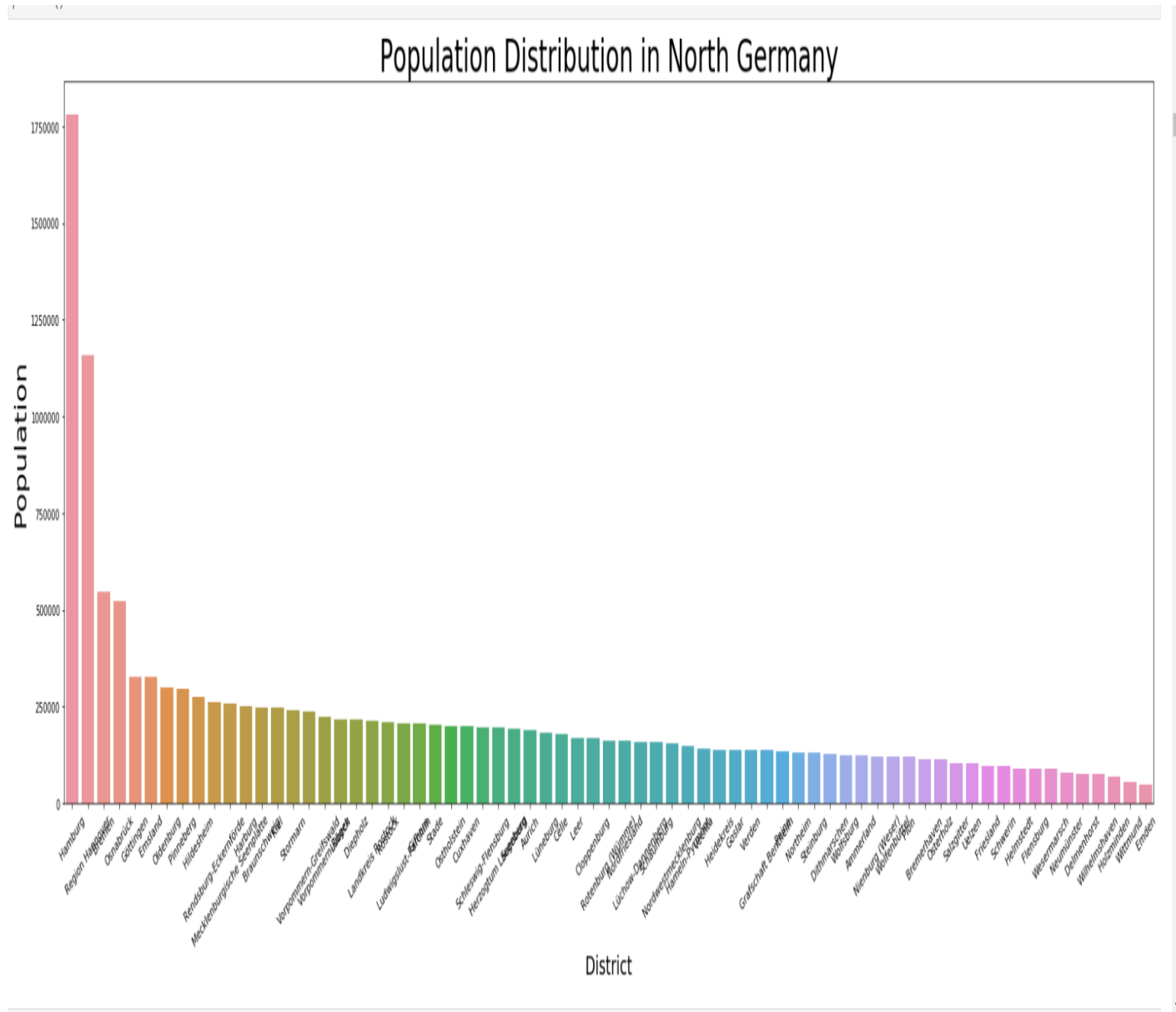


Figure 1: Distribution of Population for each district in North Germany

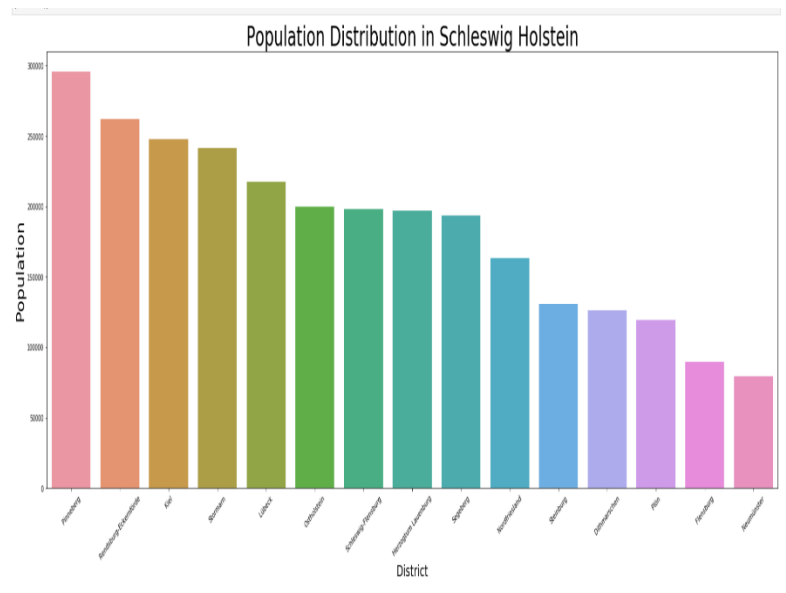
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A comparison of the population distribution for each State is made in order for us to get the top candidate locations for our selection.

**Fig.3&4: Data for Schleswig-Holstein**

	District	Region	Population
0	Pinneberg	Schleswig-Holstein	295323
1	Rendsburg-Eckernförde	Schleswig-Holstein	262175
2	Kiel	Schleswig-Holstein	247548
3	Stormarn	Schleswig-Holstein	241463
4	Lübeck	Schleswig-Holstein	217198
5	Ostholstein	Schleswig-Holstein	199928
6	Schleswig-Flensburg	Schleswig-Holstein	197834
7	Herzogtum Lauenburg	Schleswig-Holstein	196931
8	Segeberg	Schleswig-Holstein	193389
9	Nordfriesland	Schleswig-Holstein	163282
10	Steinburg	Schleswig-Holstein	130824
11	Dithmarschen	Schleswig-Holstein	126413
12	Plön	Schleswig-Holstein	119460
13	Flensburg	Schleswig-Holstein	89504
14	Neumünster	Schleswig-Holstein	79487



**Fig.5: Data for Lower Saxony**

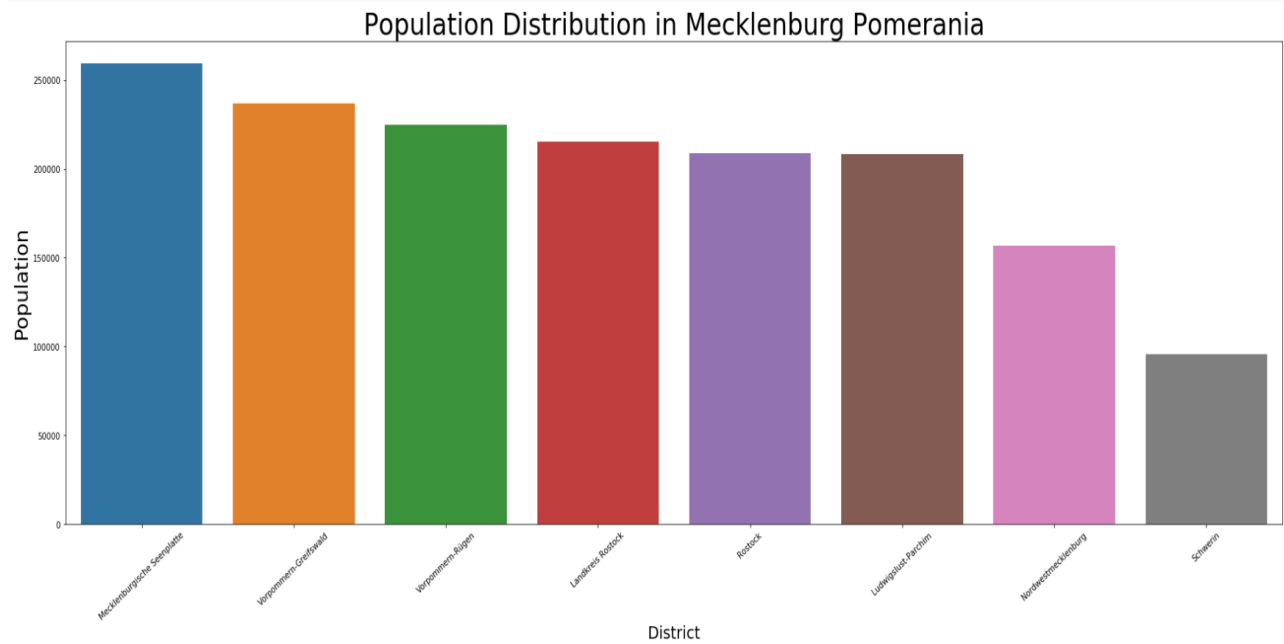
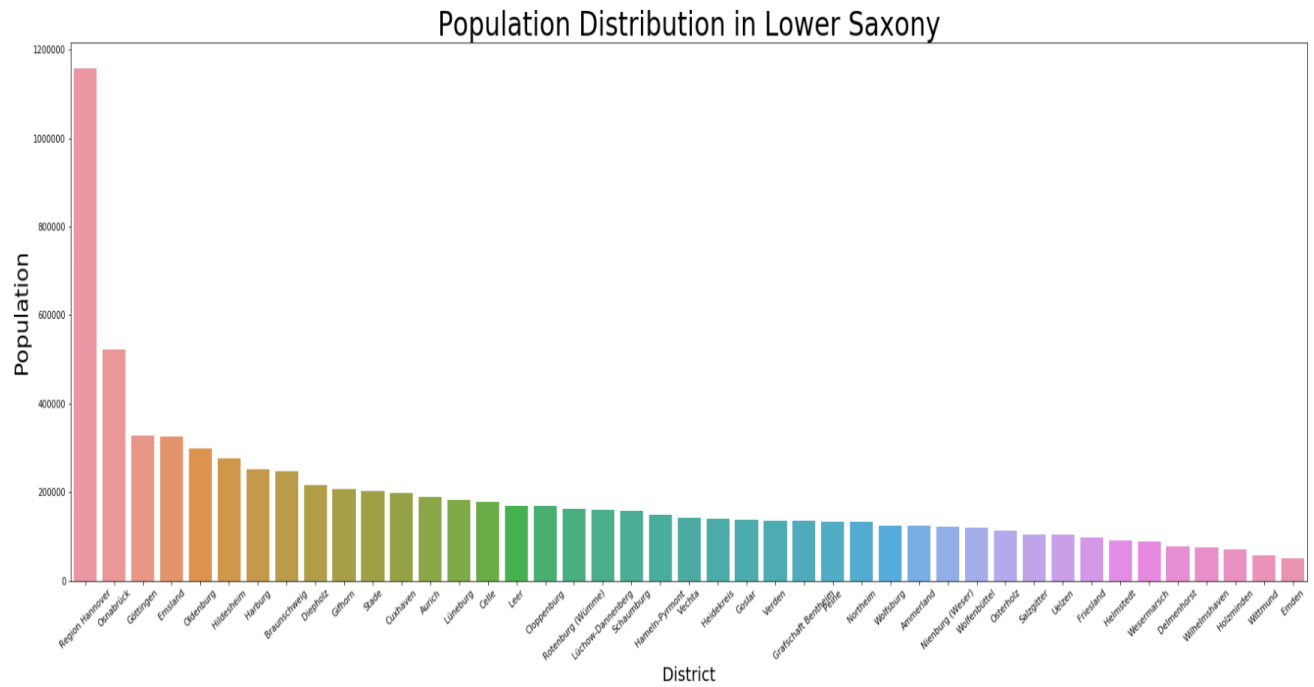
	District	Region	Population
0	Region Hannover	Niedersachsen	1157624
1	Osnabrück	Niedersachsen	522091
2	Göttingen	Niedersachsen	328074
3	Emsland	Niedersachsen	325657
4	Oldenburg	Niedersachsen	298354
5	Hildesheim	Niedersachsen	276594
6	Harburg	Niedersachsen	252776
7	Braunschweig	Niedersachsen	248292

	District	Region	Population
0	Mecklenburgische Seenplatte	Mecklenburg-Vorpommern	259130
1	Vorpommern-Greifswald	Mecklenburg-Vorpommern	236697
2	Vorpommern-Rügen	Mecklenburg-Vorpommern	224684
3	Landkreis Rostock	Mecklenburg-Vorpommern	215113
4	Rostock	Mecklenburg-Vorpommern	208886
5	Ludwigslust-Parchim	Mecklenburg-Vorpommern	208085
6	Nordwestmecklenburg	Mecklenburg-Vorpommern	156729
7	Schwerin	Mecklenburg-Vorpommern	95818

**Fig.6 Data for Mecklenburg-Pomerania**

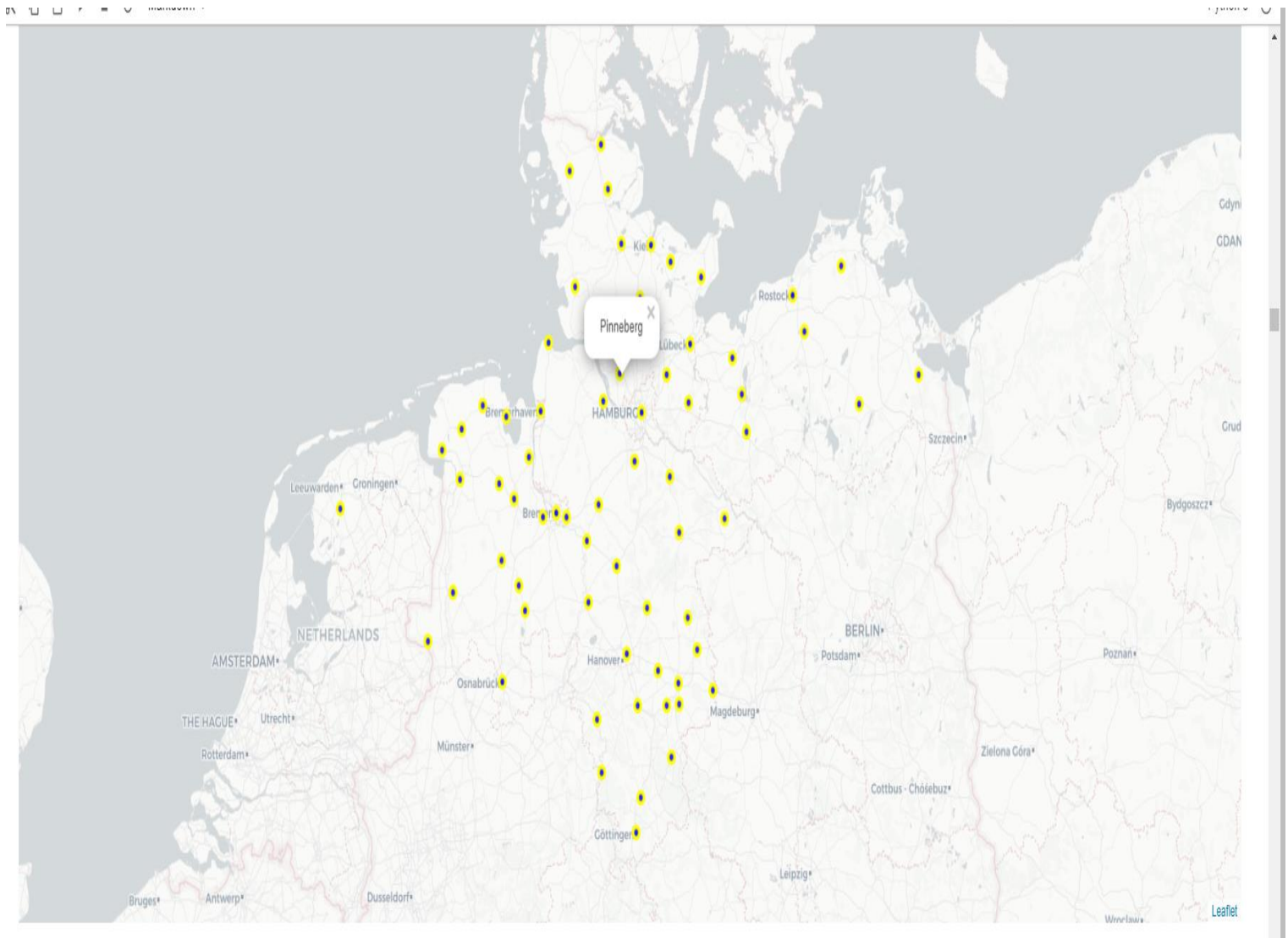


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### 3.2 Map Visualization

Folium makes it easy to visualize data that's been manipulated in Python on an interactive leaflet map. It enables both the binding of data to a map for [choropleth](#) visualizations as well as passing rich vector/raster/HTML visualizations as markers on the map. In this project, folium map is used to visualize the Districts of North Germany. The feature for a pop-up is also added so that when we hover and click on the label, the name of the District is displayed.

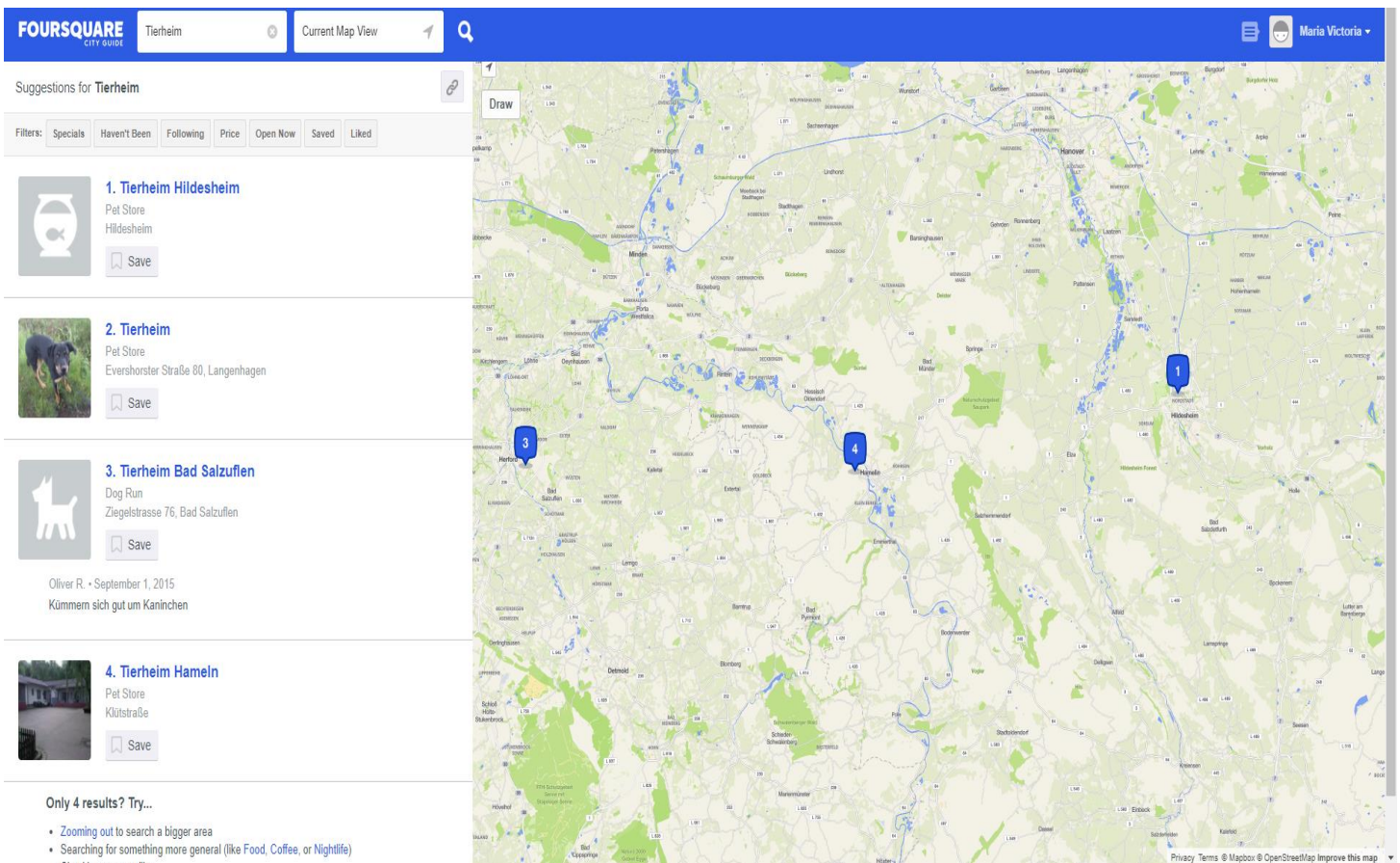


**Figure 9: Map showing districts in North Germany**

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### 3.3 Foursquare

**Foursquare City Guide**, commonly known as **Foursquare**, is a local search-and-discovery mobile app developed by Foursquare Labs Inc. The app provides personalized recommendations of places to go near a user's current location based on users' previous browsing history and check-in history.



As we are interested in specific type of venue such as Animal Shelter and Transportation services, we will have to use an API which can provide us with the data of the venues of interest in North Germany. Different types of calls can be made on Foursquare but as the numbers of calls per day are limited, I've set the 'Limit' to 100. There is another variable which is very important to raise a call with Foursquare, to get proper data: Radius. It decides the range in which the API will search for the Venues of interest and will provide the venues within that range. In this instance, after being able to acquire the list of Animal Shelters available in Foursquare, we would then extract an additional call to determine the transportation services nearby. We will not do this for all Animal Shelters but only for those that belong to the candidate districts.

## Experiential Adoption: Increasing Animal Adoption thru Pet Cafes in Northern Germany

### 3.4 Analysis of Foursquare Data

The Foursquare Places API provides location-based experiences with diverse information about venues, users, photos, and check-ins. The API supports real time access to places, Snap-to-Place that assigns users to specific locations, and Geo-tag. Additionally, Foursquare allows developers to build audience segments for analysis and measurement. JSON is the preferred response format.

Fig.11&12: Raw data from Foursquare API

```
[48]: LIMIT = 100 # limit of number of venues returned by Foursquare API (Maximum 50 responses)
search_query = 'Tierheim', 'Tierschutz'
radius = 5000000000 # define radius
category = '4e52d2d203646f7c19daa8ae' # Animal Shelter

# create URL
url = 'https://api.foursquare.com/v2/venues/search?client_id={}&client_secret={}&v={}&query={}&categoryId={}&ll={}&radius={}&limit={}'.format(
    CLIENT_ID,
    CLIENT_SECRET,
    VERSION,
    search_query,
    category,
    latitude_SH,
    longitude_SH,
    radius,
    LIMIT)

url # display URL

[48]: "https://api.foursquare.com/v2/venues/search?client_id=DWHF5RIKVN23G81PQ1L0U20K1CYPQ53HBPV3EZGDQC4DGDY&client_secret=5Q0uX5GE03D0CY4G5HAXRAJED5IST2PB0LGZMDFYQYP0BBR&v=20200820&query=('Tierheim', 'Tierschutz')&categoryId=4e52d2d203646f7c19daa8ae&ll=54.1853998,9.8220089&radius=5000000000&limit=100"

[49]: # get request for results
results = requests.get(url).json()
results # display results

[49]: {'meta': {'code': 200, 'requestId': '5f61d122ade1e67e9a76dac0'},
      'response': {'venues': [{'id': '592fe0f80a464d423f164f31',
                              'name': 'Tierheim Wasbek',
                              'location': {'address': 'Krusenhofer Weg 111',
                                           'lat': 54.08494,
                                           'lng': 9.933420000000007,
                                           'labeledLatLngs': [{'label': 'display',
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                                                                'lng': 9.933420000000007}],
                                           'distance': 13336,
                                           'postalCode': '24647',
                                           'cc': 'DE',
                                           'city': 'Wasbek',
                                           'state': 'Schleswig-Holstein',
                                           'country': 'Deutschland',
                                           'formattedAddress': ['Krusenhofer Weg 111',
                                                                '24647 Wasbek']}]}]}
```

The response format yielded is JSON, hence the data might not make sense if you try to decipher it without cleaning the data and importing it as a data frame. Once the data is cleaned, we get a better picture of the details included in the search

[50]:	id	name	categories	referralld	hasPerk	location.address	location.lat	location.lng	location.labeledLatLngs	location.distance	location.postalCode	location.cc	location.city	location.state	location.country
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3	4fa3b008e4b09d4d443c0664	Tierheim Lübeck	['id': '4e52d2d203646f7c19daa8ae', 'name': 'A...']	1600246051	v-	False	Resebiergweg 20	53.923382	10.833955	72272	23569	DE	Lübeck	Schleswig-Holstein	Deutschland
4	4cb197bbeb65b1f7bee275cd	Franziskus-Tierheim	['id': '4e52d2d203646f7c19daa8ae', 'name': 'A...']	1600246051	v-	False	Lokstedter Grenzstr. 7	53.597206	9.942069	65948	22527	DE	Hamburg	Hamburg	Deutschland
5	4c6d4390e13db60c682fd8b1	Hamburger Tierschutzverein von 1841	['id': '4e52d2d203646f7c19daa8ae', 'name': 'A...']	1600246051	v-	False	Süderstraße 399	53.546099	10.066138	72948	20537	DE	Hamburg	Hamburg	Deutschland
6	5e4564468f54b100882002d4	Tierschutzverein Hundeliebe WauWau	['id': '4e52d2d203646f7c19daa8ae', 'name': 'A...']	1600246051	v-	False	Im Schätzendorfer 37	53.212324	10.030094	109186	21272	DE	Egestorf	Niedersachsen	Deutschland

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We now managed to obtain a list of Animal Shelters in North Germany. In this data, the address, as well as the latitude and longitude were included. But this are not the only details that you can obtain thru Foursquare. There are other functions such as getting tips, rating and photos for selected venues.

[68]:

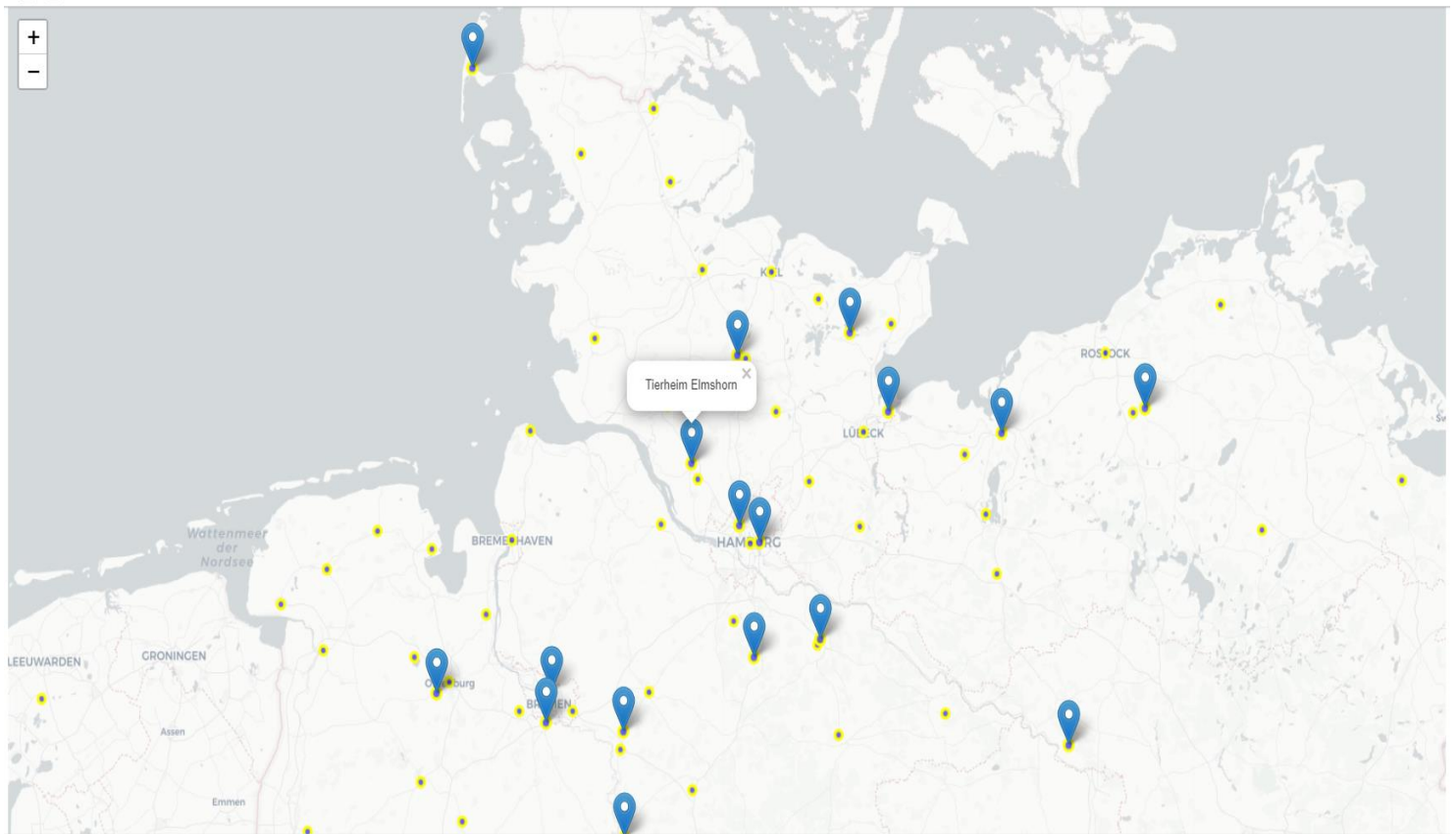
	AnimalShelter	State	Address	X	Y
0	Tierheim Wasbek	Schleswig-Holstein	[Krusenhofer Weg 111, 24647 Wasbek, Deutschland]	54.084940	9.933420
1	Tierheim Elmshorn	Schleswig-Holstein	[Deutschland]	53.775885	9.655183
2	Tierheim Eutin	Schleswig-Holstein	[Diekstauen 5, Deutschland]	54.148230	10.599702
3	Tierheim Lübeck	Schleswig-Holstein	[Resebergweg 20, 23569 Lübeck, Deutschland]	53.923382	10.833955
4	Franziskus-Tierheim	Hamburg	[Lokstedter Grenzstr. 7, 22527 Hamburg, Deutsc...	53.597206	9.942069
5	Hamburger Tierschutzverein von 1841	Hamburg	[Süderstraße 399, 20537 Hamburg, Deutschland]	53.546099	10.066138
6	Tierschutzverein Hundeliebe WauWau	Niedersachsen	[Im Schätzendorfe 37, 21272 Egestorf, Deutschl...	53.212324	10.030094
7	Tierheim Tierschutz Nienburg „Drakenburger Hei...	Niedersachsen	[Auf der Heide 1 (Schipse), 31582 Nienburg - O...	52.683813	9.253760
8	Tierheim Arche-Noah	Niedersachsen	[Rodendamm 10, 28816 Stuhr, Deutschland]	53.020377	8.788493
9	Bremer Tierschutzverein e.V.	Bremen	[Hemmstr. 491, 28357 Bremen, Deutschland]	53.113618	8.819876
10	Tierheim Verden	Niedersachsen	[Waller Heerstraße 11, 27283 Verden-Aller, Deu...	52.994733	9.247881
11	Tierheim Oldenburg	Niedersachsen	[Nordmoslesfehrer Str. 412, 26131, Deutschland]	53.108350	8.135376
12	Tierschutzverein Minden	Schleswig-Holstein	[Deutschland]	52.313978	8.981522
13	Tierschutzhof Krevinghausen	Schleswig-Holstein	[Deutschland]	52.296705	8.271451
14	Tierheim Lüneburg	Niedersachsen	[Bockelmannstr. 3, 21337 Lüneburg, Deutschland]	53.265288	10.425434
15	Tierschutz Osnabrück und Umgebung e.V.	Niedersachsen	[Zum Flugplatz 3, Osnabrück, Deutschland]	52.269915	7.981966
16	Tierheim Lingen	Niedersachsen	[Husarenstraße, Lingen, Deutschland]	52.540625	7.340824
17	Tierheim Rostock Laage	Mecklenburg-Vorpommern	[Pinnow Chaussee 3, 18299 Laage, Deutschland]	53.934620	12.364206
18	Tierheim Dorf Mecklenburg	Mecklenburg-Vorpommern	[Dorf Mecklenburg, Deutschland]	53.862221	11.510797
19	Tierheim SOS Hundehilfe Prignitz e.V.	Brandenburg	[Abbau Lanken 13, 19336 Bad Wilsnack, Deutschl...	52.955494	11.906967
20	Tierheim Gell...	Schleswig-Holstein	[Deutschland]	53.923382	10.833955

Fig.13 List of Animal Shelters in North Germany

Experiential Adoption:

*Increasing Animal Adoption thru Pet Cafes in Northern Germany*

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Using folium, we can visualize where the Animal shelters are situated. We can infer that despite the number of states and districts we considered, there are only a few animal shelters established in each state, hence the importance of selecting representative locations in order for us to establish Cafes equally in the targeted States.



## Experiential Adoption:

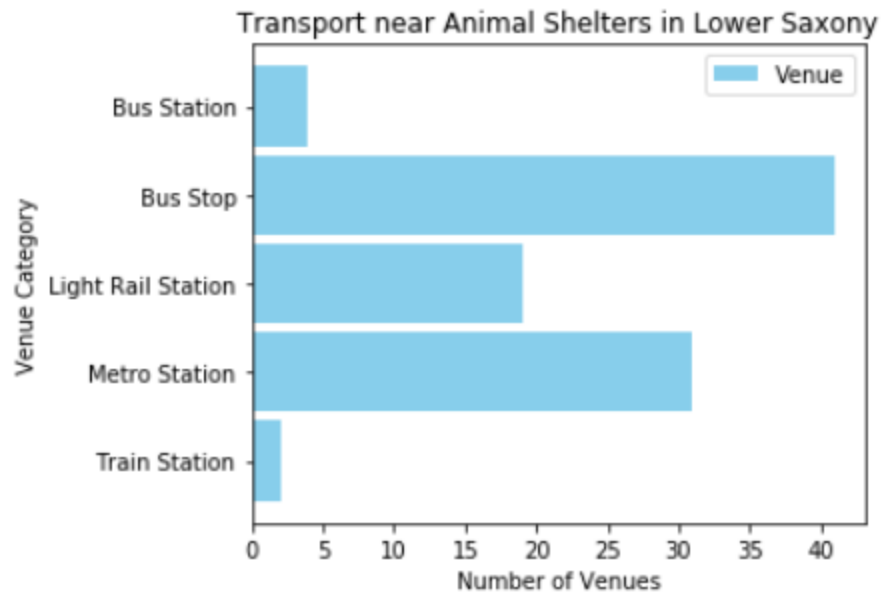
### Increasing Animal Adoption thru Pet Cafes in Northern Germany

By further using Foursquare, we also managed to extract the location and number of transportations that are available within the range of the Animal Shelters.

71]:

	Tierheim	Latitude	Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category	State	Address	District	haversine_dist
0	Tierheim Wasbek	54.084940	9.933420	Bahnhof Neumünster Stadtwald	54.083361	9.962025	Train Station	Schleswig-Holstein	(111, Krusenhofer Weg, Wasbek, Rendsburg-Ecker...	Rendsburg-Eckernförde	3.183395
1	Tierheim Wasbek	54.084940	9.933420	Bahnhof Wasbek	54.075595	9.898081	Train Station	Schleswig-Holstein	(111, Krusenhofer Weg, Wasbek, Rendsburg-Ecker...	Rendsburg-Eckernförde	4.058135
2	Tierheim Wasbek	54.084940	9.933420	ZOB Neumünster	54.075989	9.980879	Bus Station	Schleswig-Holstein	(111, Krusenhofer Weg, Wasbek, Rendsburg-Ecker...	Rendsburg-Eckernförde	5.364117
3	Tierheim Wasbek	54.084940	9.933420	Deutsche Bahn Werk Neumünster	54.082166	9.983988	Train Station	Schleswig-Holstein	(111, Krusenhofer Weg, Wasbek, Rendsburg-Ecker...	Rendsburg-Eckernförde	5.627548
4	Tierheim Wasbek	54.084940	9.933420	H Ringstraße	54.070315	9.997279	Bus Stop	Schleswig-Holstein	(111, Krusenhofer Weg, Wasbek, Rendsburg-Ecker...	Rendsburg-Eckernförde	7.274637
5	Tierheim Wasbek	54.084940	9.933420	Bahnhof Neumünster Süd	54.060242	9.996826	Train Station	Schleswig-Holstein	(111, Krusenhofer Weg, Wasbek, Rendsburg-Ecker...	Rendsburg-Eckernförde	7.546796
6	Tierheim Wasbek	54.084940	9.933420	Bahnhof Neumünster	54.075660	9.979940	Train Station	Schleswig-Holstein	(111, Krusenhofer Weg, Wasbek, Rendsburg-Ecker...	Rendsburg-Eckernförde	5.268354
7	Tierheim Elmshorn	53.775885	9.655183	Bahnhof Horst (Holst)	53.806550	9.641703	Train Station	Schleswig-Holstein	(Bohn Segel, 6, Justus-von-Liebig-Straße, Indu...	Pinneberg	3.678257
8	Tierheim Elmshorn	53.775885	9.655183	Bahnhof Elmshorn	53.754433	9.659380	Train Station	Schleswig-Holstein	(Bohn Segel, 6, Justus-von-Liebig-Straße, Indu...	Pinneberg	2.395921
9	Tierheim Eutin	54.148230	10.599702	Bahnhof Bad Malente-Gremsmühlen	54.167155	10.551146	Train Station	Schleswig-Holstein	(Tierschutz Eutin und Umgebung e.V., 5, Diekst...	Ostholstein	5.778264
10	Tierheim Eutin	54.148230	10.599702	Bahnhof Eutin	54.135400	10.610038	Train Station	Schleswig-Holstein	(Tierschutz Eutin und Umgebung e.V., 5, Diekst...	Ostholstein	1.811996
11	Franziskus-Tierheim	53.597206	9.942069	H Hagenbeck	53.593635	9.943966	Bus Stop	Hamburg	(Franziskustierheim, 7, Lokstedter Grenzstraße...	Lübeck	0.444125
12	Franziskus-Tierheim	53.597206	9.942069	U Hagenbecks Tierpark	53.592912	9.944086	Metro Station	Hamburg	(Franziskustierheim, 7, Lokstedter Grenzstraße...	Lübeck	0.520743
13	Franziskus-Tierheim	53.597206	9.942069	U Hagendeel	53.603457	9.945201	Metro Station	Hamburg	(Franziskustierheim, 7, Lokstedter Grenzstraße...	Lübeck	0.767646
14	Franziskus-Tierheim	53.597206	9.942069	H Nedderfeld	53.603970	9.962550	Bus Stop	Hamburg	(Franziskustierheim, 7, Lokstedter Grenzstraße...	Lübeck	2.393350

Above we see a list of the transportation venues that were gathered thru Foursquare. The Venues are categorized as per what mode of transportation it is and the Address of each venue.



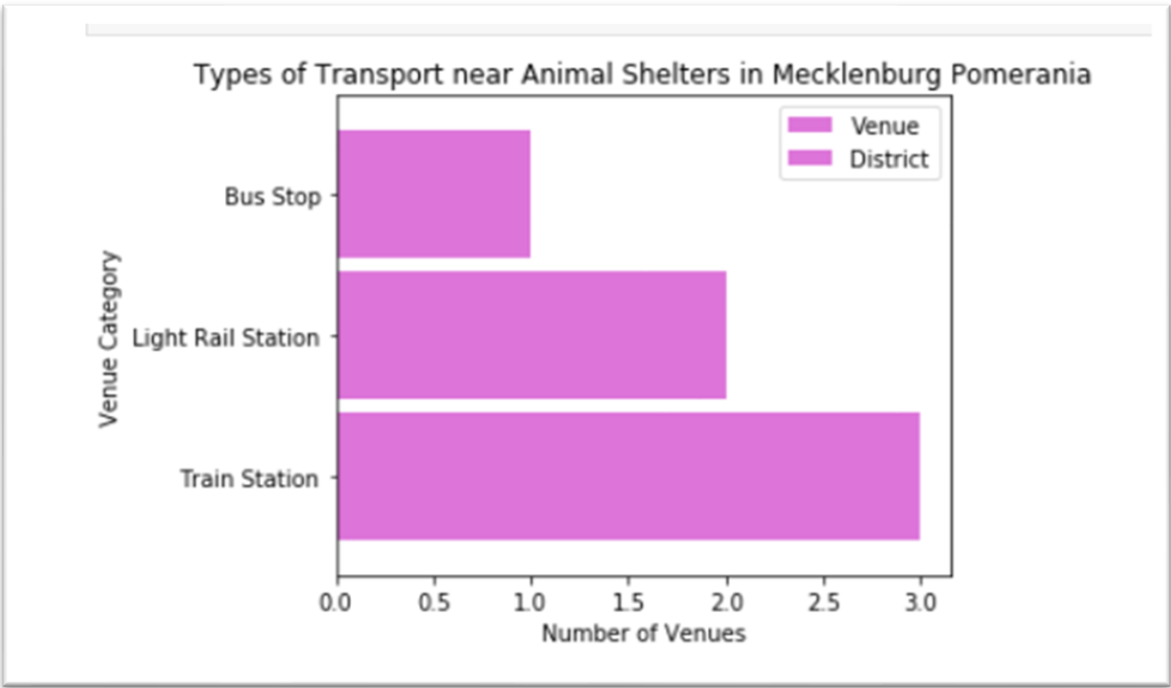
Here we see the number of transportation facilities available nearby the animal shelters in Lower Saxony (Niedersachsen).

| :

				Venue Category
Tierheim		State	District	
Tierheim Arche-Noah		Niedersachsen	Diepholz	19
Tierheim Lingen		Niedersachsen	Emsland	1
Tierheim Lüneburg		Niedersachsen	Osnabrück	7
Tierheim Tierschutz Nienburg „Drakenburger Heide“ e.V.		Niedersachsen	Nienburg	1
Tierheim Verden		Niedersachsen	Verden	1

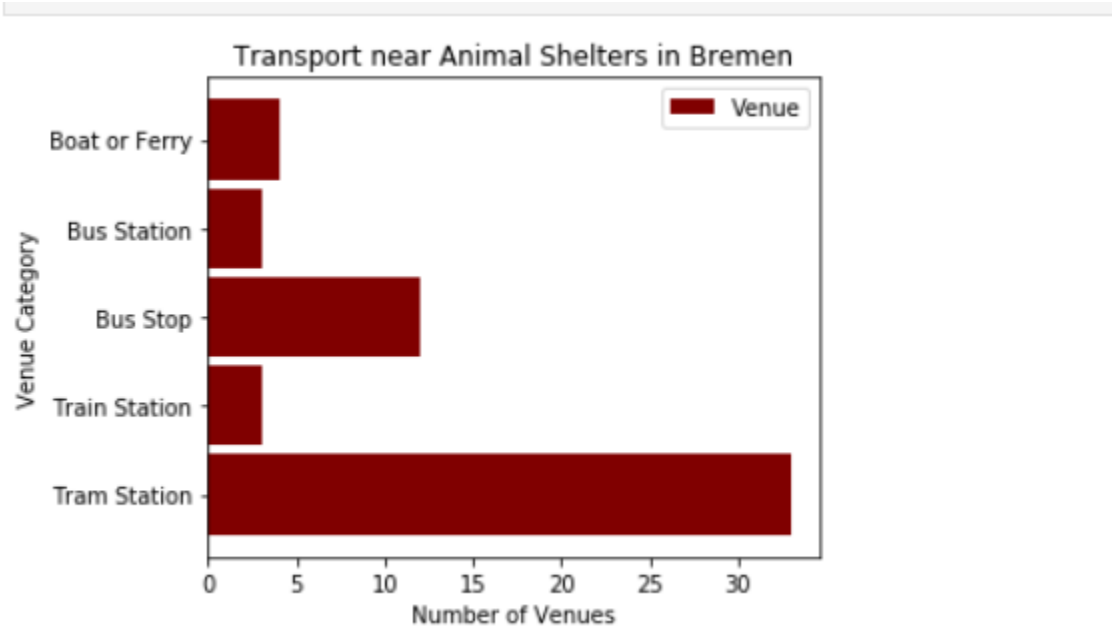


Transportation nearby Animal shelters in Mecklenburg-Vorpommern



	Venue	District
Venue Category		
Bus Stop	1	1
Light Rail Station	2	2
Train Station	3	3

Transportation Services near Animal Shelters in Bremen

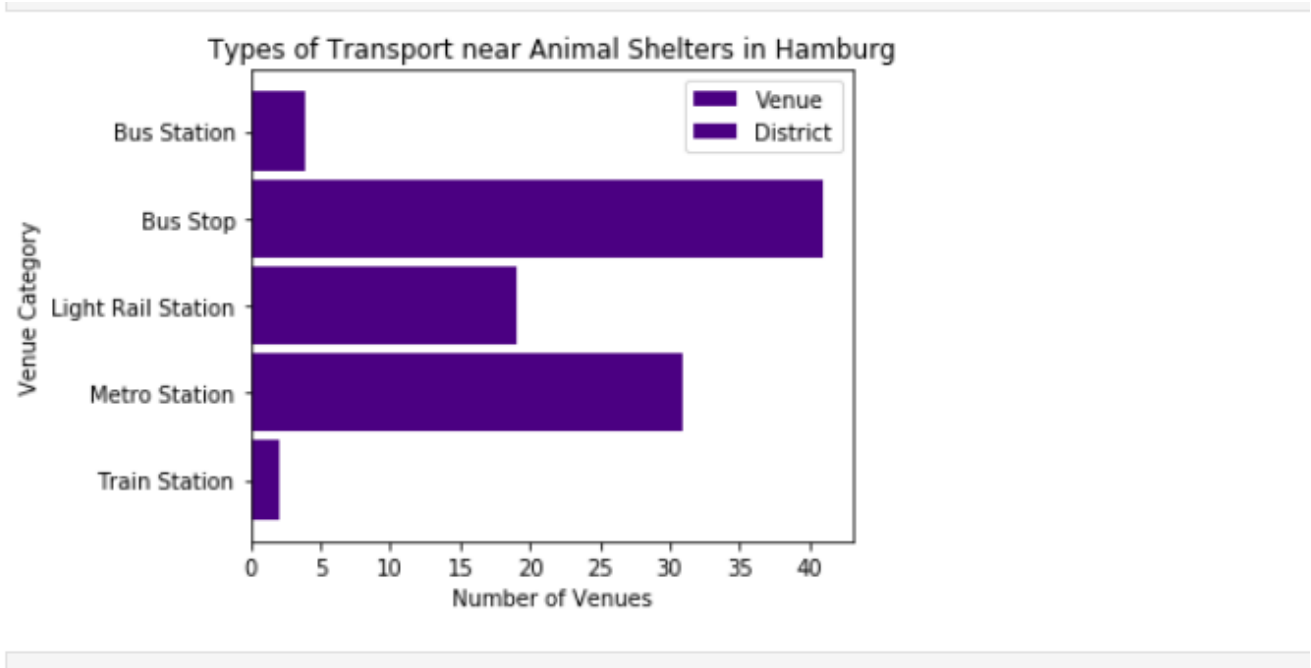


3]:

	Venue	District
--	-------	----------

Venue Category		
Boat or Ferry	4	4
Bus Station	3	3
Bus Stop	12	12
Train Station	3	3
Tram Station	33	33

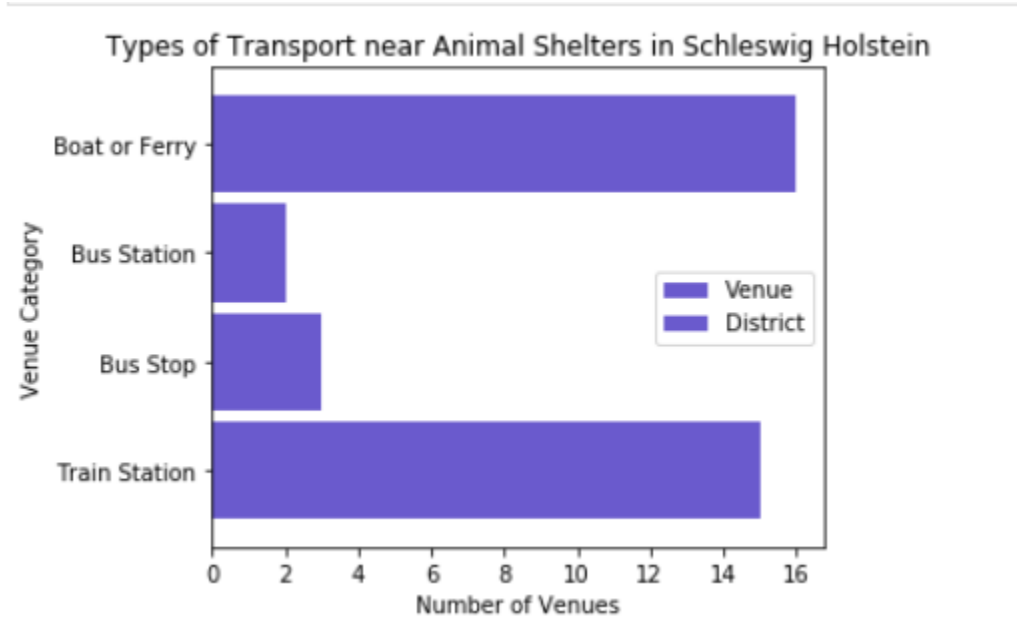
Transportation Services near Animal Shelters in Hamburg



[ 57 ] :

	Venue	District
Venue Category		
Bus Station	4	4
Bus Stop	41	41
Light Rail Station	19	19
Metro Station	31	31
Train Station	2	2

Transportation Services near Animal Shelters in Schleswig Holstein



2]:

			Venue Category
Tierheim	State	District	
Tierheim Elmshorn	Schleswig-Holstein	Pinneberg	2
Tierheim Eutin	Schleswig-Holstein	Ostholstein	2
Tierheim Lübeck	Schleswig-Holstein	Hamburg	20
Tierheim Sylt	Schleswig-Holstein	Nordfriesland	3
Tierheim Wasbek	Schleswig-Holstein	Rendsburg-Eckernförde	7

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## 4. Analysis

### *Using Haversine Formula to calculate distance*

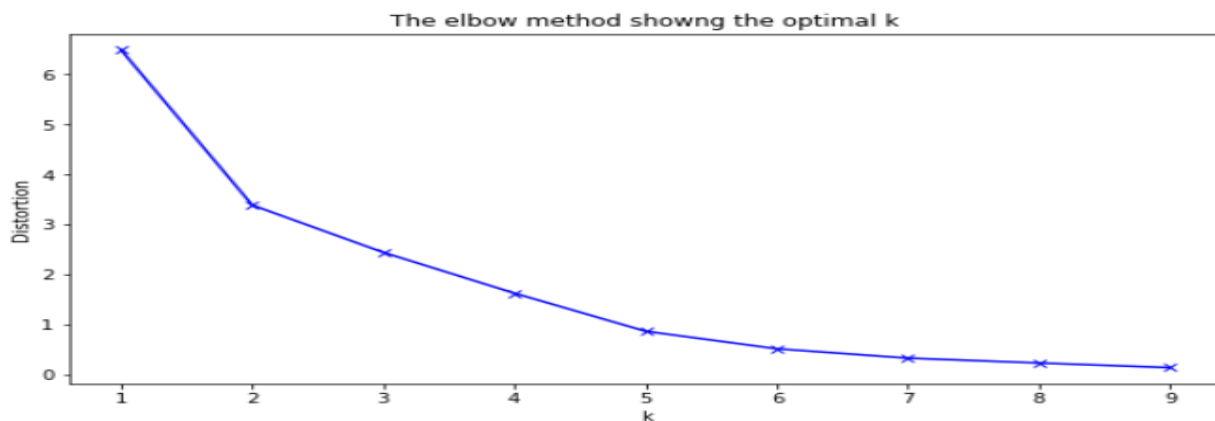
This uses the '**haversine**' formula to calculate the great-circle distance between two points – that is, the shortest distance over the earth's surface – giving an 'as-the-crow-flies' distance between the points.

The haversine formula<sup>1</sup> 'remains particularly well-conditioned for numerical computation even at small distances' – unlike calculations based on the *spherical law of cosines*. The '(re)versed sine' is  $1 - \cos\theta$ , and the 'half-versed-sine' is  $(1 - \cos\theta)/2$  or  $\sin^2(\theta/2)$  as used above. Once widely used by navigators, it was described by Roger Sinnott in *Sky & Telescope* magazine in 1984 ("Virtues of the Haversine"): Sinnott explained that the angular separation between Mizar and Alcor in Ursa Major –  $0^{\circ}11'49.69''$  – could be accurately calculated on a TRS-80 using the haversine.

```
def haversine_vectorize(lon1, lat1, lon2, lat2):  
  
    lon1, lat1, lon2, lat2 = map(np.radians, [lon1, lat1, lon2, lat2])  
  
    newlon = lon2 - lon1  
    newlat = lat2 - lat1  
  
    haver_formula = np.sin(newlat/2.0)**2 + np.cos(lat1) * np.cos(lat2) * np.sin(newlon/2.0)**2  
  
    dist = 2 * np.arcsin(np.sqrt(haver_formula ))  
    km = 6367 * dist #6367 for distance in KM for miles use 3958  
    return km
```

## K-means clustering

In cluster analysis, the '*elbow method*' is a heuristic used in determining the number of clusters in a data set. The method consists of plotting the explained variation as a function of the number of clusters and picking the elbow of the curve as the number of clusters to use. The same method can be used to choose the number of parameters in other data-driven models, such as the number of principal components to describe a data set.



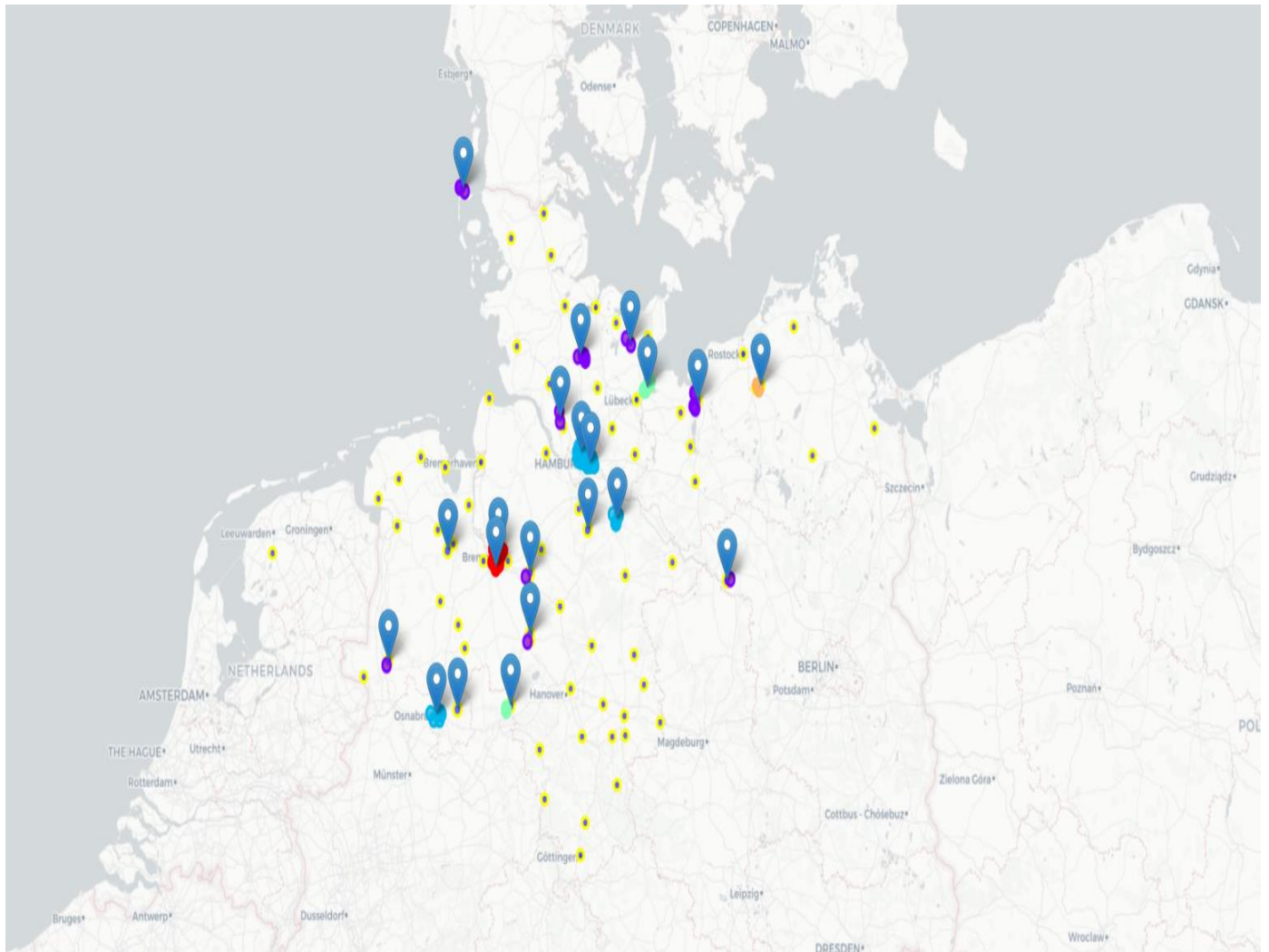
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Using K-means clustering, we get a list of the Most Common Venues for each of District

		Tierheim	1st Most common Venues	2nd Most common Venues	3rd Most common Venues	4th Most Common Venue.	5th Most Common Venue.	6th Most Common Venue.	7th Most Common Venue.
0	Bremer Tierschutzverein e.V.		Tram Station	Bus Stop	Boat or Ferry	Train Station	Bus Station	Metro Station	Light Rail Station
1	Franziskus-Tierheim		Bus Stop	Metro Station	Light Rail Station	Bus Station	Tram Station	Train Station	Boat or Ferry
2	Hamburger Tierschutzverein von 1841		Metro Station	Bus Stop	Light Rail Station	Bus Station	Train Station	Tram Station	Boat or Ferry
3	Tierheim Arche-Noah		Tram Station	Bus Stop	Bus Station	Train Station	Metro Station	Light Rail Station	Boat or Ferry
4	Tierheim Dorf Mecklenburg		Train Station	Bus Stop	Tram Station	Metro Station	Light Rail Station	Bus Station	Boat or Ferry
5	Tierheim Elmshorn		Train Station	Tram Station	Metro Station	Light Rail Station	Bus Stop	Bus Station	Boat or Ferry
6	Tierheim Eutin		Train Station	Tram Station	Metro Station	Light Rail Station	Bus Stop	Bus Station	Boat or Ferry
7	Tierheim Lingen		Train Station	Tram Station	Metro Station	Light Rail Station	Bus Stop	Bus Station	Boat or Ferry
8	Tierheim Lübeck		Boat or Ferry	Train Station	Bus Stop	Tram Station	Metro Station	Light Rail Station	Bus Station
9	Tierheim Lüneburg		Train Station	Bus Stop	Bus Station	Boat or Ferry	Tram Station	Metro Station	Light Rail Station

Having the data above, we can use folium to visualize the distribution of transportation services for each District. The clustering will also enable us to see similarities for each designated cluster.



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## **Exploring the Clusters**

### **Cluster 0**

1. Comprised of 7 Districts, Emsland, Osnabrück, Verden, Bremen, Diepholz, Lüneberg and Nienburg
2. Foursquare returned 4 similar transportation categories for each district namely: Train Station, Bus Stop, Boat or Ferry, and Tram Station.
3. Out of all these categories, the cluster's main similarities is derived from the list of " Most common venues". As you may notice, the districts above have the same top 3 rankings for the "most common venues"

### **Cluster 1**

1. Comprised of 5 Districts: Nordfriesland, Minden-Lübecke, Lübeck, Ostholstein, Pinneberg, and Rendsburg-Eckernförde.
2. Foursquare returned 4 similar transportation categories for each district namely: Train Station, Bus Stop, Boat or Ferry, Bus Station.
3. Out of all these categories, the cluster's main similarities is derived from the list of " Most common venues". As you may notice, the districts above have the same top 3 rankings for the "most common venues"

### **Cluster 2**

1. Comprised of only 1 District: Brandenburg
2. Foursquare Train Station for the unique category for this district

### **Cluster 3**

1. Comprised of only one District: Hamburg.
2. Foursquare returned 5 similar transportation categories for each district namely: Train Station, Bus Stop, Metro Station, Bus Station, Light rail station.
3. Out of all these categories, the cluster's main similarities is derived from the list of " Most common venues". As you may notice, the districts above have the same top 3 rankings for the "most common venues"



#### **Cluster 4**

1. Comprised of only one District: Mecklenburg-Vorpommern.
2. Foursquare returned 3 similar transportation categories for each district namely: Train Station, Bus Stop, Light rail station.
3. Out of all these categories, the cluster's main similarities is derived from the list of " Most common venues". As you may notice, the districts above have the same top 3 rankings for the "most common venues"

### **5. Results and Discussion**

Our analysis shows that although our selected land Area is big, the number of Animal Shelters yielded were only a few. The venues for these shelters are also not close to the city centers, most of them are in remote villages-most likely to be able to accommodate space and not to disturb residential areas. Being in remote areas will also help their animals to be more at rest.

Although there are a lot of transportation facilities available around the Animal Shelters, most of them are situated approximately around 1 km away from the Shelter. At most, one bus stop is ~300 meters from the Animal Shelter in Hamburg. Most of the Shelters are more accessible thru use of private vehicles. Train Stations are even further with approximates ~5km distance from each Shelter.

Interestingly, some Shelters can be accessed by Boat and Ferry. Most of which are located near the coast.

Recommended zones should therefore be considered only as a starting point for more detailed analysis which could eventually result in location which has not only no nearby competition, but also other factors taken into account and all other relevant conditions met.

It is also noteworthy that as compared with Foursquare, Google maps had yielded more results for Animal Shelters using the 'Search Nearby' option. This might be attributed to the fact that Foursquare is not popularly used in Germany.

## 6. Conclusion

The purpose of this project was to identify areas in North Germany with Animal Shelters close to transportation services and with a good population distribution in order to aid stakeholders in narrowing down the search for optimal location for a new Pet Cafe. By acquiring Animal Shelter venues from Foursquare and the Population data from each District, we have identified the top Districts that justify further analysis

We then generated extensive collection of transportation locations which satisfy some basic requirements regarding nearby transportation services. Clustering of those locations was then performed in order to create areas of interest and addresses were created to be used as starting points for final exploration by stakeholders.