# Peer-graded Assignment

## IBM Data Science - Capstone Project

(note that this project has been produced to demonstrate the authors Data Science skill set incorporating Web-Scraping, Foursquare API and Folium Maps)

DECEMBER 28 2019

# Introduction

The Objective: Create as you want a problematic idea to solve following the principles used by a data scientist using the principles to leverage relevant Foursquare location data to explore and compare neighbourhoods to solve a problem.

Goals: Investigate and identify a primary location to open a healthy meat-free fast food restaurant using data sources pulled from the web and using methods such as data wrangling, filtering, segmenting, clustering cities suburbs, using visualization tools.

This lab report has sourced information and data, to solve a fictional problem, following the process that a data scientist would usually follow when trying to solve such a problem.

## Problem Description

*There is a need to find a prime location to open a meat free fast food family, healthy eating takeaway/restaurant in a city within Europe. The chosen city needs to be powered by 100% renewable energy. Before we investigate and identify a primary location to open a healthy family fast food restaurant we will elaborate on the actual problem, the history as to why this problem has come about, and how this project will help contribute to solving the problem.*

## Background

Over the last 10 years a large family fast food restaurant chain/franchise has recognised a slow decline in its number of customers. Worryingly in the last four years the waning of its customer traffic has increased, it is true that the fast food restaurant category is experiencing a decline in its customer base. But this world-renowned franchise is declining at a faster rate. There are great concerns with in senior management that increased sales on an ever-shrinking customer base and is now on a certain path to brand disaster.

- In 2013 the new CEO at the time was quoted as saying its goal was “To be a modern and progressive burger company.”
- An international news agency obtained an internal email in October 2016 which summarized a September meeting with executives and franchisees. It read, "Growing customer counts is our main challenge.”

These are two bold statements that did not deliver, as much as the company has focused on:

- Providing great tasting food
- Innovation
- Service Speed
- Focus on franchisee profitable revenue growth
- Building on customer loyalty

The financial health of the franchisee is brand-business imperative and is facing a bleak future.

There is a requirement from senior management to re-engineer the brand or invent a silent sister brand, if it is to have a chance of survival. Without franchisees upholding the brand, shareholders will wind up with nothing to hold.

## Description of the problem

It was suggested by the board to outsource this problem to several customer focused trouble-shooters to investigate and propose a solution that will re-engage the brand with its former customer and entice new customers. The feedback from one trouble-shooter has highlighted that the voice of the customer needs to be heard, highlighting extreme changes to former customer's needs, and this is something that the current brand is unable to offer, unless there is radical change. But radical change will deter the current customer base. They suggest creating a new sister brand which focuses on the needs of today's society and concerns.

The customers they are losing tend to be more healthy eating conscious and ultra-concerned by the impact eating meat products has on the climate. Fact 1 in 10 people on the planet are now vegetarian, a statistic that climbing.

The mass production of meat is the single biggest cause of land clearing around the world, if not directly for the animals themselves then indirectly for the monocultures such as corn or soy that feed them.


Environmental degradation also goes together with the global pandemic of chronic diseases including obesity, diabetes, cancer and heart disease.

Having listened to the VOC (voice of the customer) it has become apparent that many of its custom base have aged, and with age comes life experience, education and health concerns. Many now have had family's and will want to pass on everything that they have learned and experienced on to their children. This does not bode well for its future generation customer. The challenge is to create a different opening for those customers that are falling by the wayside.

It has been proposed to consider creating a new brand for a new era, a non-meat family fast food sustainable restaurant brand, with the core ethos on the environment.

What do we mean by sustainable restaurant? using local produce, using reusable packaging, converting waste in to renewable energy, powering the restaurant using renewable energy. This link will help you understand what it means to be a sustainable restaurant: [https://m.theworlds50best.com/sustainable-restaurant-award.html](https://m.theworlds50best.com/sustainable-restaurant-award.html)

They conclude that the current brand has not been progressive enough and that is understandable due to its DNA with its history of meat-based products and are convinced that if this new branded were marketed correctly it will be a huge success. They also highlight how important it is to emphasise and market this brand as environmentally caring and suggest keeping the new brand apart from the old brand as much as possible (from a promoting aspect).

The boards response having reflected on the suggestions by the trouble-shooter have made it very clear that they would like their flagship restaurant to be based in a city sourced by renewable energy, focusing on customers that enjoy fast food but do not eat meat, hence there is the need to identify European countries with a high percentage of vegetarians and vegans. The target audience will be primarily be focused towards families, though also appealing to shoppers, commuters and tourists depending on the choice of city.

## Sourced Data

### Table 1 - Cities Using Renewable Sources (City-wide electricity Mix)

Cities are increasingly reporting that they are powered by renewable electricity. CDP holds information from over 570 of the world's cities and over 100 cities are now getting at least 70% of their electricity from renewable sources such as hydro, geothermal, solar and wind. This dataset has been compiled of data reported by cities in 2015, 2016 and 2017 in response to our annual questionnaire: https://data.cdp.net/api/views/ycef-psus/rows.csv?accessType=DOWNLOAD

Table Preview

View Data | Create Visualization

| City ↑ | City s... | Coun... | Region | Popu... | Popu... | Access | CDP r... | Biom... | Coal ... | Gas (... | Geot... | Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Abasan Al... | Abasan Al... | State of P... | South an... | 2015 | 30,000 | Public | 2017 | 5 | 17 | 18 | 0 | 0 |
| Abington ... | Abington | USA | North Am... | 2010 | 55,310 | Public | 2017 | 0 | 36.6 | 23 | 0 | 1 |
| Addis Ab... | Addis Ab... | Ethiopia | Africa | 2008 | 3,384,569 | Public | 2017 | 0 | 0 | 0 | 0 | 100 |
| Ajuntame... | Barcelona | Spain | Europe | 2015 | 1,604,555 | Public | 2017 | 0 | 0 | 8.3 | 0 | 5.8 |
| Alcaldía d... | Alcaldía d... | Venezuela | Latin Am... | 2011 | 35,374 | Public | 2017 | 0 | 0 | 0 | 0 | 100 |
| Alcaldía d... | Ibagué | Colombia | Latin Am... | 2017 | 564,077 | Public | 2017 | 0 | 0 | 0 | 0 | 100 |
| Alcaldía d... | Alcaldía d... | Panama | Latin Am... | 2014 | 1,427,862 | Public | 2017 | 0 | 0 | 0 | 0 | 60 |
| Alcaldía d... | Riohacha | Colombia | Latin Am... | 2017 | 277,868 | Public | 2017 | 0 | 99.9 | 0 | 0 | 0 |
| Alcaldiad... | Alcaldiad... | Colombia | Latin Am... | 2015 | 275,207 | Public | 2017 | 0 | 85 | 15 | 0 | 0 |
| Alcaldía ... | Alcaldía ... | Venezuela | Latin Am... | 2015 | 3,518,590 | Public | 2017 | 0 | 0 | 0 | 0 | 0 |
| Amiens M... | Amiens M... | France | Europe | 2014 | 175,000 | Public | 2016 | 2 | 0 | 20 | 3 | 5 |
| Arusha Ci... | Arusha | United Re... | Africa | 2012 | 416,442 | Public | 2017 | 0 | 0 | 10 | 0 | 60 |
| Auckland ... | Auckland | New Zeal... | South Asi... | 2015 | 1,569,900 | Public | 2017 | 1.4 | 4.3 | 15.7 | 16.2 | 57.1 |
| Ayuntami... | Chihuahua | Mexico | Latin Am... | 2015 | 841,490 | Public | 2017 | 0 | 0 | 100 | 0 | 0 |

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We will begin by transforming the data into a panda's data frame, this will allow us to clean and then wrangle and filter the data following the specified criteria highlighted in the recommended requirements. The goal is to create a data frame consisting of seven columns: Continent, Country, City, Population, Renewable Percentage, Longitude, Latitude. We will then filter the data where by the continent is equal to Europe. We will then sort in order Renewable Percentage (high to low), and then by population (high to low). We will then focus on the top five cities with the highest populations and make comparison with the statistics we have on those countries that have the most vegetarians. We will then hope to find at least one country from our statistics in of countries with the most vegetarians in on our list of top five cities/country and then conclude which city to focus our attention on. We will then use visual tools and Foursquare to investigate, analyse, produces results and formulate our final conclusions.

### Table 2 - Demographics of Vegetarians and Vegan by Country

All percentages in the following table are raw estimates taken from Wikipedia https://en.wikipedia.org/wiki/Vegetarianism_by_country. The data will be used to help identify which countries have the higher rates of non-meat eaters. This information will be used to help to conclude which city/s we should consider exploring as opportunities to open the new family targeted restaurant.

### Table 3 - City Postcodes

In order to use Foursquare, we will need to get the latitude and the longitude coordinates of each suburb of the city as we conclude which are appropriate options to open the first restaurant. Please note that the details of this source will be referenced in section 5.2 of this project, having not yet identified the city we will target to open the new branded restaurant.

## Method & Data Analysis: Part 1, Cities Using Renewable Sources

1. Analyze Data to Find European City Suitable to Open Restaurant

    1.1. *Download the dataset and transformed into a panda's data frame allowing us to wrangle the data, to conform to the requirements set.*

    1.2. Get basic information about your data frame (we can do this by using the info () method)

    1.3. Data Wrangling - Evaluating & Clean Data (make some modifications to the original dataset to make it easier to create our future visualizations).

        *1.3.1. Count missing values in each column* (find code on GitHub)

        *1.3.2. Create Field with Total Percentage Power Created Using Renewable Energies* (find code on GitHub)

        *1.3.3. Drop Non-Required Columns* (find code on GitHub)

    1.4. Focus on Criteria Request and Filter Out Non-Required Data

        *1.4.1. Filter so that only the European cities appear* (find code on GitHub)

        *1.4.2. Show only data records where the renewables are greater than or to 75%* (find code on GitHub)

        *1.4.3. Rename some of the columns so that they make sense* (find code on GitHub)

    1.5. Order Data

        *1.5.1. By 'Population' and 'Renewables'*

```
[52]: df_europe_75_Renewables_Population = df_europe_75.sort_values(by=['Renewables', 'Population'], ascending=False)
```

```
[53]: df_europe_75_Renewables_Population
```

[53]:

| | City | Country | Continent | Population | Renewables | Latitude | Longitude |
|---|---|---|---|---|---|---|---|
| 95 | Basel | Switzerland | Europe | 197005 | 100.0 | 47.5619 | 7.5928 |
| 59 | Reykjavík | Iceland | Europe | 122460 | 100.0 | 64.12652 | -21.81744 |
| 230 | Bolzano | Italy | Europe | 106397 | 100.0 | 46.499681 | 11.356576 |
| 60 | Fafe | Portugal | Europe | 50845 | 100.0 | 41.4508217 | -8.1728619 |
| 82 | Akureyri | Iceland | Europe | 18300 | 100.0 | 65.688492 | -18.126169 |
| 308 | Ærøskøbing | Denmark | Europe | 6200 | 100.0 | 54.891456 | 10.404684 |
| 190 | Alba-Iulia | Romania | Europe | 63536 | 99.0 | 46.082337 | 23.569027 |
| 101 | Arendal | Norway | Europe | 44574 | 99.0 | 58.461757 | 8.77245 |
| 216 | Oslo | Norway | Europe | 658390 | 98.0 | 59.9138688 | 10.7522454 |
| 125 | Oristano | Italy | Europe | 31630 | 93.0 | 39.720664 | 8.898007 |
| 223 | Lausanne | Switzerland | Europe | 140000 | 90.8 | 46.5198 | 6.6335 |
| 337 | Nyon | Switzerland | Europe | 20444 | 90.8 | 46.383268 | 6.234785 |
| 249 | Bærum Kommune | Norway | Europe | 122660 | 89.0 | 59.920545 | 10.593765 |
| 297 | Braga | Portugal | Europe | 182000 | 79.0 | 41.533751 | -8.438218 |
| 219 | Porto | Portugal | Europe | 238954 | 75.3 | 41.1579438 | -8.6291053 |

We now have a data frame consisting of the rows representing cities within Europe that are powered by 75% or more renewable energy and 7 columns headers: City, Country, Continent, Population, Renewables, Latitude and Longitude.

1.6. **Cities within Europe that are powered by 75% or more renewable energy** (created using Folium)

Fig1.

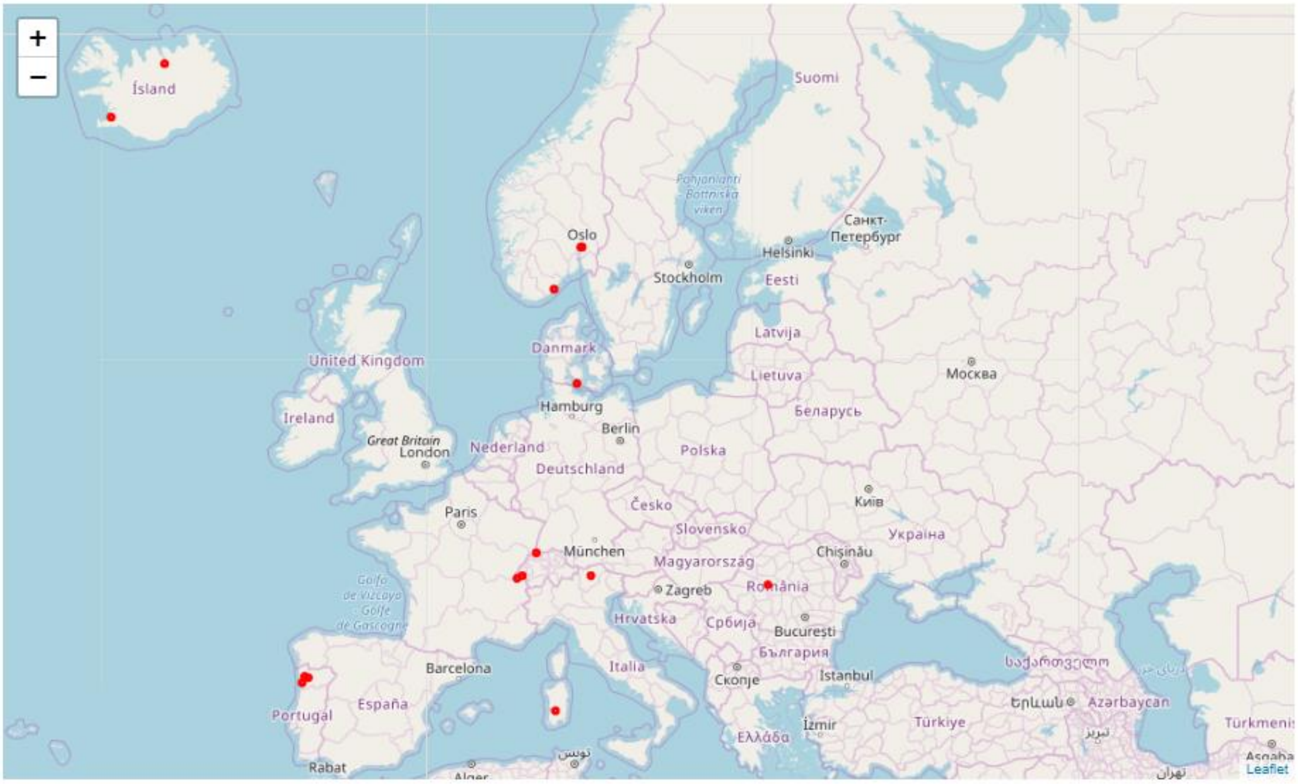



Fig.2

| | City | Country | Continent | Population | Renewables (%) | Biomass (%) | Coal (%) | Gas (%) | Geothermal (%) | Hydro (%) | Nuclear (%) | Oil (%) | Solar (%) | Wind (%) | Unknown sources (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | Basel | Switzerland | Europe | 197005 | 100.0 | 0.8 | 0.0 | 0.00 | 0.0 | 88.9 | 0.0 | 0.00 | 0.50 | 9.80 | 0.0 |
| **1** | Reykjavík | Iceland | Europe | 122460 | 100.0 | 0.0 | 0.0 | 0.00 | 30.0 | 70.0 | 0.0 | 0.00 | 0.00 | 0.00 | 0.0 |
| **2** | Bolzano | Italy | Europe | 106397 | 100.0 | 0.0 | 0.0 | 0.00 | 0.0 | 100.0 | 0.0 | 0.00 | 0.00 | 0.00 | 0.0 |
| **3** | Fafe | Portugal | Europe | 50845 | 100.0 | 0.0 | 0.0 | 0.00 | 0.0 | 97.0 | 0.0 | 0.00 | 3.00 | 0.00 | 0.0 |
| **4** | Akureyri | Iceland | Europe | 18300 | 100.0 | 0.0 | 0.0 | 0.00 | 30.0 | 70.0 | 0.0 | 0.00 | 0.00 | 0.00 | 0.0 |
| **5** | Ærøskøbing | Denmark | Europe | 6200 | 100.0 | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.00 | 10.00 | 90.00 | 0.0 |
| **6** | Alba-Iulia | Romania | Europe | 63536 | 99.0 | 0.0 | 0.0 | 1.00 | 0.0 | 96.0 | 0.0 | 0.00 | 2.00 | 1.00 | 0.0 |
| **7** | Arendal | Norway | Europe | 44574 | 99.0 | 0.0 | 0.0 | 0.00 | 0.0 | 99.0 | 0.0 | 0.00 | 0.00 | 0.00 | 1.0 |
| **8** | Oslo | Norway | Europe | 658390 | 98.0 | 0.0 | 0.0 | 0.00 | 0.0 | 98.0 | 0.0 | 0.00 | 0.00 | 0.00 | 2.0 |
| **9** | Oristano | Italy | Europe | 31630 | 93.0 | 0.0 | 0.0 | 1.00 | 0.0 | 90.0 | 0.0 | 6.00 | 3.00 | 0.00 | 0.0 |
| **10** | Lausanne | Switzerland | Europe | 140000 | 90.8 | 6.3 | 0.0 | 0.52 | 0.0 | 83.7 | 7.4 | 1.28 | 0.42 | 0.38 | 0.0 |
| **11** | Nyon | Switzerland | Europe | 20444 | 90.8 | 0.0 | 0.0 | 2.50 | 0.0 | 86.0 | 0.0 | 0.00 | 4.80 | 0.00 | 6.7 |
| **12** | Bærum Kommune | Norway | Europe | 122660 | 89.0 | 0.0 | 0.0 | 0.00 | 0.0 | 89.0 | 0.0 | 3.00 | 0.00 | 0.00 | 8.0 |
| **13** | Braga | Portugal | Europe | 182000 | 79.0 | 2.0 | 7.0 | 1.00 | 4.0 | 14.0 | 2.0 | 11.00 | 7.00 | 52.00 | 0.0 |
| **14** | Porto | Portugal | Europe | 238954 | 75.3 | 11.8 | 8.2 | 0.00 | 0.0 | 13.9 | 0.0 | 0.00 | 0.00 | 49.60 | 16.5 |

The statistics in fig 2 show:

- six cities in Europe who energy power sources are 100% sustainable by means of renewable energy
- one city whose population clearly stands from the rest (Oslo, population of 658,390)
- two cities fall into the top three in regards to the highest percentage of renewable energy used to power the city and having one of the larger populations

In **Method & Data Analysis: Part 2** we will investigate which countries in Europe have the highest number of non-meat eaters.

## Method & Data Analysis: Part 2, Demographics of Vegetarians and Vegan by Country

2. Analyze Data to Find European City's Where A High Percentage of The Population Are Vegetarians or Vegans
   2.1. Download the dataset *(scrape data from Wikipedia)* and transformed into a panda's data frame allowing us to wrangle the data and following the requirements set.
   2.2. Get basic information about your data frame (we can do this by using the info () method)
   2.3. Data Wrangling - Evaluating & Clean Data (make some modifications to the original dataset to make it easier to create our future visualizations).
      2.3.1. Clean Country Data Field, rouge 1st character (find code on GitHub)
      2.3.2. Clean Vegetarian Diet Data, rouge characters (find code on GitHub)
      2.3.3. Clean Vegan Diet Data, rouge characters (find code on GitHub)
      2.3.4. Convert Vegetarian Diet Data to Int, (find code on GitHub)
      2.3.5. Convert Vegan Diet Data to Int, (find code on GitHub)
      2.3.6. Create Field with Total Percentage of Non-Meat Eaters

```
[127]: df_veg_stats["No Meat Diet"] = df_veg_stats["Vegetarian diet (%)"] + df_veg_stats["Vegan diet (%)"]
```

```
[130]: df_veg_stats.head(10)
```

[130]:

| | Country | Vegetarian diet (%) | Vegan diet (%) | No Meat Diet |
|---|---|---|---|---|
| 0 | Argentina | 5.0 | 0.0 | 5.0 |
| 1 | Australia | 12.0 | 2.0 | 14.0 |
| 2 | Austria | 9.0 | 0.0 | 9.0 |
| 3 | Belgium | 7.0 | 0.0 | 7.0 |
| 4 | Brazil | 14.0 | 3.0 | 17.0 |
| 5 | Canada | 9.4 | 2.3 | 11.7 |
| 6 | Chile | 6.0 | 0.0 | 6.0 |
| 7 | China | 4.0 | 0.0 | 4.0 |
| 8 | Czech Republic | 2.0 | 0.0 | 2.0 |
| 9 | Denmark | 5.0 | 0.0 | 5.0 |

We now have a clean table of non-meat diet stats by country ready to merge with our table of European cities that use 75% or more renewable energy. In Method & Data Analysis: Part 3 we merge the data tables created in Method & Data Analysis: Part 1 and Part2.

## Method & Data Analysis: Part 3, Merge Tables Part 1 & Part 2 By Continent “Europe”

**3.** Compare European countries with cities powered by renewable energy w**ith the statistics of countries with the higher number of No Meat eaters**

### 3.1. Merge the Tables Created in Part 1 and Part 2 By Country

[107]:
```
df_merge_eur = pd.merge(df_europe_75_Renewables_Population, df_veg_stats, on=['Country','Country'])
df_merge_eur
```

[107]:

| | City | Country | Continent | Population | Renewables | Latitude | Longitude | Vegetarian diet (%) | Vegan diet (%) | No Meat Diet |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Basel | Switzerland | Europe | 197005 | 100.0 | 47.561900 | 7.592800 | 14.0 | 3.0 | 17.0 |
| 1 | Lausanne | Switzerland | Europe | 140000 | 90.8 | 46.519800 | 6.633500 | 14.0 | 3.0 | 17.0 |
| 2 | Nyon | Switzerland | Europe | 20444 | 90.8 | 46.383268 | 6.234785 | 14.0 | 3.0 | 17.0 |
| 3 | Bolzano | Italy | Europe | 106397 | 100.0 | 46.499681 | 11.356576 | 7.1 | 0.6 | 7.7 |
| 4 | Oristano | Italy | Europe | 31630 | 93.0 | 39.720664 | 8.898007 | 7.1 | 0.6 | 7.7 |
| 5 | Fafe | Portugal | Europe | 50845 | 100.0 | 41.450822 | -8.172862 | 1.2 | 0.6 | 1.8 |
| 6 | Braga | Portugal | Europe | 182000 | 79.0 | 41.533751 | -8.438218 | 1.2 | 0.6 | 1.8 |
| 7 | Porto | Portugal | Europe | 238954 | 75.3 | 41.157944 | -8.629105 | 1.2 | 0.6 | 1.8 |
| 8 | Ærøskøbing | Denmark | Europe | 6200 | 100.0 | 54.891456 | 10.404684 | 5.0 | 0.0 | 5.0 |
| 9 | Arendal | Norway | Europe | 44574 | 99.0 | 58.461757 | 8.772450 | 2.0 | 0.2 | 2.2 |
| 10 | Oslo | Norway | Europe | 658390 | 98.0 | 59.913869 | 10.752245 | 2.0 | 0.2 | 2.2 |
| 11 | Bærum Kommune | Norway | Europe | 122660 | 89.0 | 59.920545 | 10.593765 | 2.0 | 0.2 | 2.2 |

### 3.2. Calculate the Estimated Number of Non-Meat Eaters

The calculated estimate number of People in each city that have a meat free diet is derived by using the same percentage of the non-meat eaters in the country the city is located in.

[43]:
```
df_merge_eur['No Meat Population'] = (df_merge_eur['Population'] * df_merge_eur['No Meat Diet'])/100
```

[44]:
```
df_merge_eur = df_merge_eur.sort_values(by=['No Meat Population', 'Renewables'], ascending=False)
df_merge_eur
```

[44]:

| | City | Country | Continent | Population | Renewables | Latitude | Longitude | Vegetarian diet (%) | Vegan diet (%) | No Meat Diet | No Meat Population |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Basel | Switzerland | Europe | 197005 | 100.0 | 47.561900 | 7.592800 | 14.0 | 3.0 | 17.0 | 33490.850 |
| 1 | Lausanne | Switzerland | Europe | 140000 | 90.8 | 46.519800 | 6.633500 | 14.0 | 3.0 | 17.0 | 23800.000 |
| 10 | Oslo | Norway | Europe | 658390 | 98.0 | 59.913869 | 10.752245 | 2.0 | 0.2 | 2.2 | 14484.580 |
| 3 | Bolzano | Italy | Europe | 106397 | 100.0 | 46.499681 | 11.356576 | 7.1 | 0.6 | 7.7 | 8192.569 |
| 7 | Porto | Portugal | Europe | 238954 | 75.3 | 41.157944 | -8.629105 | 1.2 | 0.6 | 1.8 | 4301.172 |
| 2 | Nyon | Switzerland | Europe | 20444 | 90.8 | 46.383268 | 6.234785 | 14.0 | 3.0 | 17.0 | 3475.480 |
| 6 | Braga | Portugal | Europe | 182000 | 79.0 | 41.533751 | -8.438218 | 1.2 | 0.6 | 1.8 | 3276.000 |
| 11 | Bærum Kommune | Norway | Europe | 122660 | 89.0 | 59.920545 | 10.593765 | 2.0 | 0.2 | 2.2 | 2698.520 |
| 4 | Oristano | Italy | Europe | 31630 | 93.0 | 39.720664 | 8.898007 | 7.1 | 0.6 | 7.7 | 2435.510 |
| 9 | Arendal | Norway | Europe | 44574 | 99.0 | 58.461757 | 8.772450 | 2.0 | 0.2 | 2.2 | 980.628 |
| 5 | Fafe | Portugal | Europe | 50845 | 100.0 | 41.450822 | -8.172862 | 1.2 | 0.6 | 1.8 | 915.210 |
| 8 | Ærøskøbing | Denmark | Europe | 6200 | 100.0 | 54.891456 | 10.404684 | 5.0 | 0.0 | 5.0 | 310.000 |

### 3.3. Normalize the Data

By normalizing the data, we can compare statistical values measured on different scales to a notionally common scale.

```
[45]: features_to_normalize = ['No Meat Population', 'Renewables','No Meat Diet']
      # could be ['A','B']

      df_merge_eur[features_to_normalize] = df_merge_eur[features_to_normalize].apply(lambda x:(x-x.min()) / (x.max()-x.min()))
```

```
[46]: df_merge_eur
```

[46]:

| | City | Country | Continent | Population | Renewables | Latitude | Longitude | Vegetarian diet (%) | Vegan diet (%) | No Meat Diet | No Meat Population |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | Basel | Switzerland | Europe | 197005 | 1.000000 | 47.561900 | 7.592800 | 14.0 | 3.0 | 1.000000 | 1.000000 |
| **1** | Lausanne | Switzerland | Europe | 140000 | 0.627530 | 46.519800 | 6.633500 | 14.0 | 3.0 | 1.000000 | 0.707938 |
| **10** | Oslo | Norway | Europe | 658390 | 0.919028 | 59.913869 | 10.752245 | 2.0 | 0.2 | 0.026316 | 0.427192 |
| **3** | Bolzano | Italy | Europe | 106397 | 1.000000 | 46.499681 | 11.356576 | 7.1 | 0.6 | 0.388158 | 0.237564 |
| **7** | Porto | Portugal | Europe | 238954 | 0.000000 | 41.157944 | -8.629105 | 1.2 | 0.6 | 0.000000 | 0.120285 |
| **2** | Nyon | Switzerland | Europe | 20444 | 0.627530 | 46.383268 | 6.234785 | 14.0 | 3.0 | 1.000000 | 0.095401 |
| **6** | Braga | Portugal | Europe | 182000 | 0.149798 | 41.533751 | -8.438218 | 1.2 | 0.6 | 0.000000 | 0.089389 |
| **11** | Bærum Kommune | Norway | Europe | 122660 | 0.554656 | 59.920545 | 10.593765 | 2.0 | 0.2 | 0.026316 | 0.071985 |
| **4** | Oristano | Italy | Europe | 31630 | 0.716599 | 39.720664 | 8.898007 | 7.1 | 0.6 | 0.388158 | 0.064058 |
| **9** | Arendal | Norway | Europe | 44574 | 0.959514 | 58.461757 | 8.772450 | 2.0 | 0.2 | 0.026316 | 0.020211 |
| **5** | Fafe | Portugal | Europe | 50845 | 1.000000 | 41.450822 | -8.172862 | 1.2 | 0.6 | 0.000000 | 0.018240 |
| **8** | Ærøskøbing | Denmark | Europe | 6200 | 1.000000 | 54.891456 | 10.404684 | 5.0 | 0.0 | 0.210526 | 0.000000 |

In the next part of this report **Method & Data Analysis: Results** we will discuss the results and conclude which city we will choose as to explore using Foursquare, investigating an appropriate location to open the meat free restaurant.

## Formulate Results and Conclusions: Part 1 Select City

**4.** Make observations and discuss results.

**Having normalized and merged the data tables we have been able to produce the following graph:**

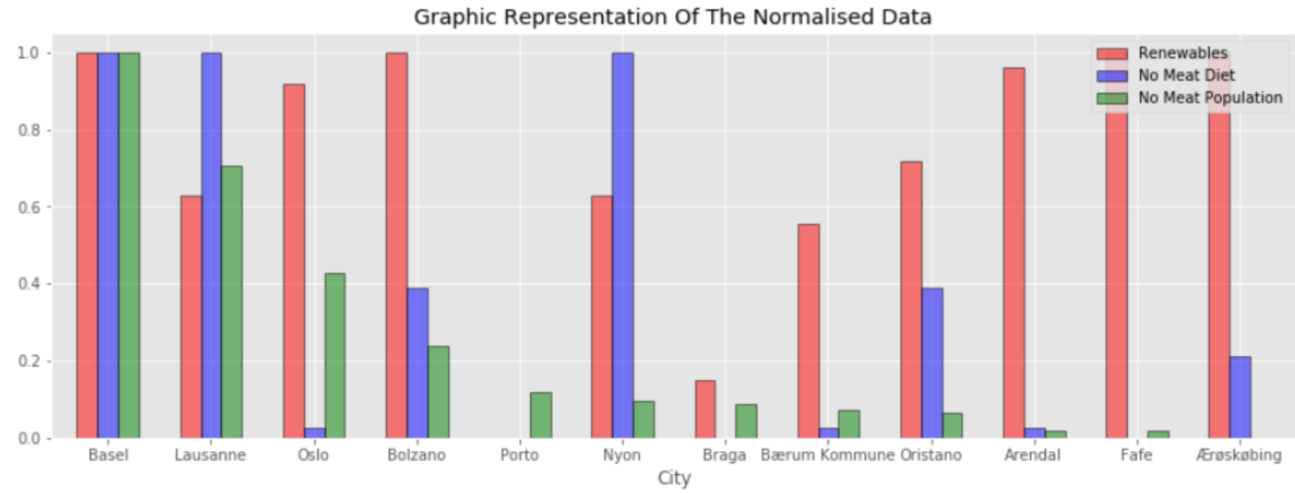
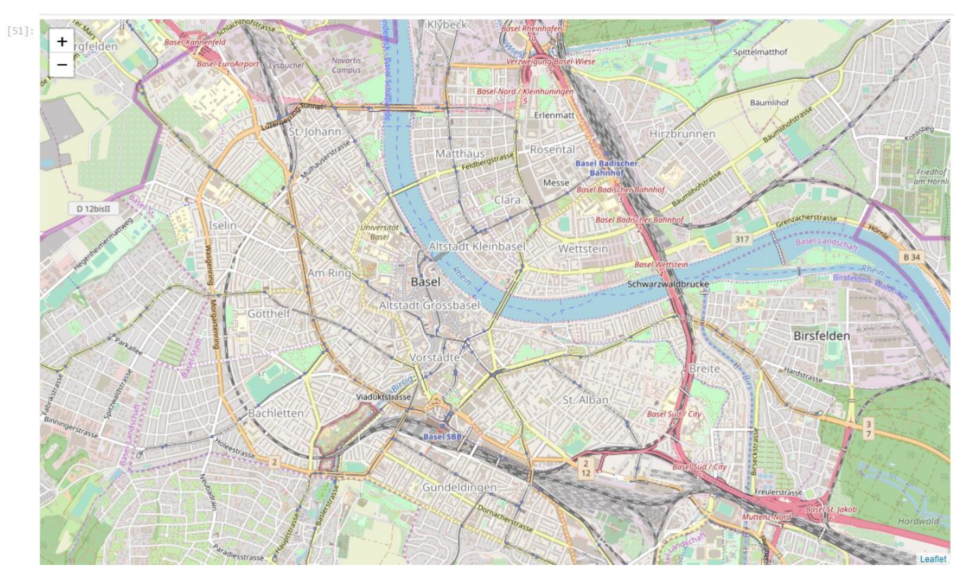



Fig 1. A graphical representation of results based on the specification requirements:

- highest percentage of renewable energy used to power the city of choice (red)
- highest percentage of a countries population that are on a meat free diet (blue
- highest estimated meat free diet population (green)

Oslo would be an interesting city to track for the future having by far the largest population, knowing that trends across Europe that meat free diets are becoming more popular. The graphical statistics show us that with a very small percentage of the country's population (2.2%) following a non-meat diet, it can challenge for a top three place in our charts. When comparing this to the percentage of Swiss on a meat free diet (17%). Additionally, from a marketing perspective, sourced by 100% renewable energy is more appealing for to the customer.

Basel is the city of choice, it meets the marketing requirements "a city powered 100% by renewable energy". It is in a country where 17% of the population are on a meat free diet, for which we have estimated (calculated) to have the highest number of non-meat eaters (33490 people). **It has been concluded through this investigation that the most appropriate location to start this new restaurant is in Basel.**




**In the next part of this report we will look at exploring the city of Basel, using the Four-Square tools.**

## **Method & Data Analysis:** Exploring the Neighborhoods of Basel

5. *Explore and cluster the neighborhoods in European City of Choice Where Existing Restaurants Exist (*Which neighborhood is suitable for starting a restaurant business?)

To begin the quest to find explore and cluster the neighborhoods in Basel we need to get the coordinates of the postcodes in Basel and the geocodes.

5.1. *In order to use Four Square, we will need to get the latitude and the longitude coordinates of each neighborhood.*
5.2. Build a data frame of the postal code for each street along with the suburb name this dataset is about postal codes in Basel.

The data set includes details of all the postcodes in Basel. It includes following fields:

| Field | Description |
|---|---|
| Postcode | A series digits, included in a postal address for the purpose of sorting mail. |
| Suburb | An administrative subdivision of a major city |
| Street | A street name within a town or city. |
| lat | Lattitude |
| lon | Longtitude |

**The Postal data has been scraped from the following site:**
**https://addresses.lorenz.lu/oad_dach/cityDetail/-1683619**

**Sample data:**

[59]:

| | Housenumber | Street | Postcode | City | Suburb | Country | Housename | Place | Hamlet | lat | lon |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 15 | Andreasplatz | 4001.0 | Basel | Altstadt Grossbasel | CH | NaN | NaN | NaN | 47.558273 | 7.586400 |
| **1** | 14 | BarfÃ¼sserplatz | 4001.0 | Basel | Altstadt Grossbasel | CH | NaN | NaN | NaN | 47.554394 | 7.589294 |
| **2** | 24 | BarfÃ¼sserplatz | 4001.0 | Basel | Altstadt Grossbasel | CH | NaN | NaN | NaN | 47.554813 | 7.589135 |
| **3** | 3 | FahnengÃ¤sslein | 4001.0 | Basel | Altstadt Grossbasel | CH | NaN | NaN | NaN | 47.556560 | 7.590167 |
| **4** | 1 | Falknerstrasse | 4001.0 | Basel | Altstadt Grossbasel | CH | NaN | NaN | NaN | 47.556656 | 7.588933 |
| **5** | 11 | Falknerstrasse | 4001.0 | Basel | Altstadt Grossbasel | CH | NaN | NaN | NaN | 47.556213 | 7.589081 |
| **6** | 12 | Falknerstrasse | 4001.0 | Basel | Altstadt Grossbasel | CH | NaN | NaN | NaN | 47.556164 | 7.588882 |
| **7** | 13 | Falknerstrasse | 4001.0 | Basel | Altstadt Grossbasel | CH | NaN | NaN | NaN | 47.556076 | 7.589103 |
| **8** | 16 | Falknerstrasse | 4001.0 | Basel | Altstadt Grossbasel | CH | NaN | NaN | NaN | 47.556107 | 7.588874 |
| **9** | 17 | Falknerstrasse | 4001.0 | Basel | Altstadt Grossbasel | CH | NaN | NaN | NaN | 47.555870 | 7.589167 |

### 5.3. Wrangle Data

**5.3.1. Drop columns from suburbs** (find code on GitHub)
**5.3.2. Count Missing Values** (see code on GitHub)
**5.3.3. Replace Empty Cells With np.nan** (see code on GitHub)
**5.3.4. Group Data by Suburb** (see code on GitHub)

[93]:

| | PostalCode | Suburb | Street |
|---|---|---|---|
| **0** | 402 | St. Alban | Gellertstrasse |
| **1** | 4001 | Altstadt Grossbasel | Andreasplatz,BarfÃ¼sserplatz,FahnengÃ¤sslein,F... |
| **2** | 4002 | Gundeldingen | Gartenstrasse |
| **3** | 4002 | St. Alban | Centralbahnplatz,Centralbahnstrasse,Peter Meri... |
| **4** | 4003 | Am Ring | Missionsstrasse |
| **5** | 4005 | Altstadt Kleinbasel | Greifengasse |
| **6** | 4012 | St. Johann | Wilhelm Klein-Strasse |
| **7** | 4019 | Kleinhüningen | Grenzstrasse |
| **8** | 4031 | Am Ring | Mittlere Strasse |
| **9** | 4051 | Altstadt Grossbasel | Andreasplatz,Augustinergasse,BarfÃ¼ssergasse,B... |

### 5.3.5. Merge Post Codes to Formulate Coordinates of Suburbs by Post Code

[120]:

| | PostalCode | Suburb | Street | Latitude | Longitude |
|---|---|---|---|---|---|
| 0 | 4001 | Altstadt Grossbasel | Andreasplatz,BarfÃ¼sserplatz,FahnengÃ¤sslein,F... | 47.5564 | 7.5889 |
| 1 | 4002 | Gundeldingen | Gartenstrasse | 47.5488 | 7.5904 |
| 2 | 4002 | St. Alban | Centralbahnplatz,Centralbahnstrasse,Peter Meri... | 47.5488 | 7.5904 |
| 3 | 4003 | Am Ring | Missionsstrasse | 47.5592 | 7.5788 |
| 4 | 4005 | Altstadt Kleinbasel | Greifengasse | 47.5623 | 7.5946 |
| 5 | 4012 | St. Johann | Wilhelm Klein-Strasse | 47.5667 | 7.6000 |
| 6 | 4019 | Kleinhüningen | Grenzstrasse | 47.5667 | 7.6000 |
| 7 | 4051 | Altstadt Grossbasel | Andreasplatz,Augustinergasse,BarfÃ¼ssergasse,B... | 47.5542 | 7.5867 |
| 8 | 4051 | Am Ring | Auberg,Austrasse,Binningerstrasse,Burgunderstr... | 47.5542 | 7.5867 |
| 9 | 4051 | Bachletten | Arnold Böcklin-Strasse,Bundesstrasse,Paulusgas... | 47.5542 | 7.5867 |

## 5.4. Cluster the neighborhoods in Basel By Suburb - Cluster analysis or clustering is the task of grouping a set of objects in such a way that objects in the same group (called a cluster) are more similar (in some sense) to each other than to those in other groups (clusters)

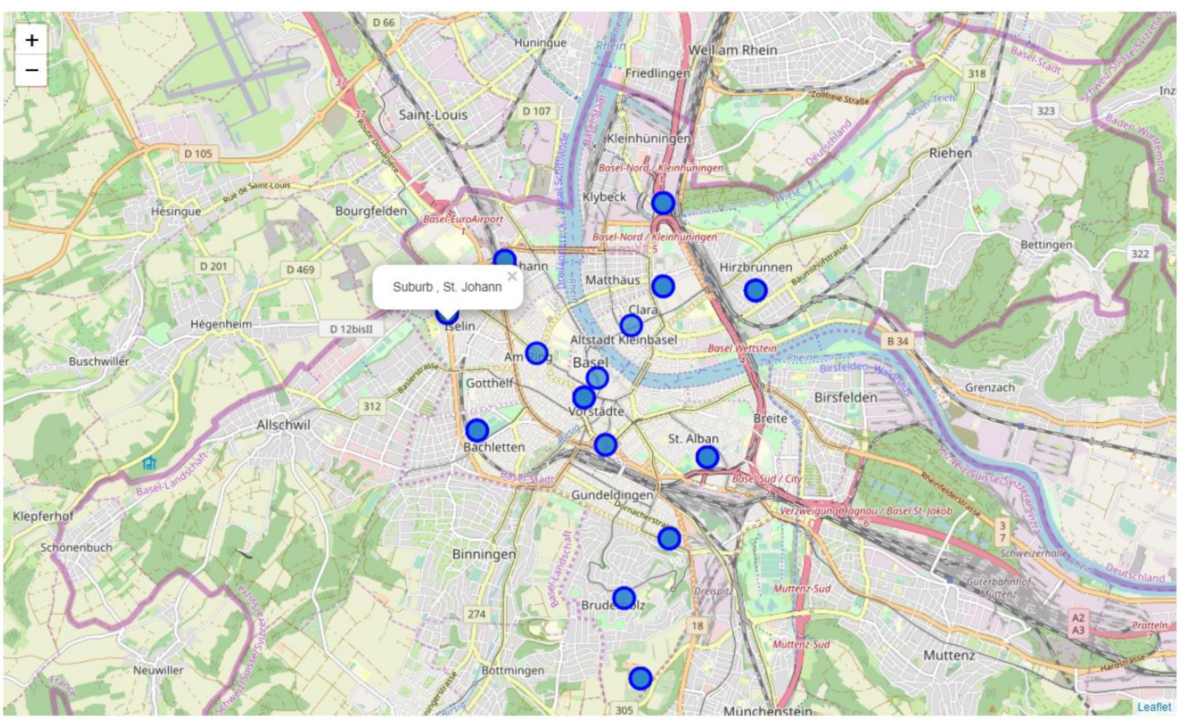
[100]:

```
# create map of Basel using latitude and longitude values
map_basel = folium.Map(location=[latitude, longitude], zoom_start=12)

# add markers to map
for lat, lng, suburb, street, in zip(basel_post ['Latitude'], basel_post ['Longitude'], basel_post ['Suburb'], basel_post ['Street']):
    label = '{}, {}'.format("Suburb " ,suburb)
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=10,
        popup=label,
        color='blue',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=0.7,
        parse_html=False).add_to(map_basel)

map_basel
```

[100]:



### 5.5. Using Foursquare developer Explore surrounding areas of the neighborhoods in Basel

*(Foursquare – Used by the world's top companies and more than 150,000 registered developers rely of Foursquare to power geo-tagging, venue search and more in their apps)*

#### 5.5.1. In order to use Foursquare, we require login credentials

#### 5.5.2. Using Foursquare we will begin to explore the surrounding areas of Basel

[455]:

| | Street | Accessories Store | American Restaurant | Art Museum | Asian Restaurant | Athletics & Sports | Bakery | Bar | Beer Garden | Beer Store | Botanical Garden | Brewery | Bus Station | Bus Stop | Café | Chinese Restaurant | Chocolate Shop | Cocktail Bar | Coffee Shop |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Achilles Bischoff-Strasse,Arlesheimerstrasse,B... | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.071429 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.142857 | 0.000000 | 0.000000 | 0.071429 | 0.000000 |
| 1 | Aeneas Silvius-Strasse,Airolostrasse,Albert Sc... | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 2 | Aeschengraben,Centralbahnplatz,Centralbahnstra... | 0.000000 | 0.000000 | 0.033333 | 0.000000 | 0.000000 | 0.000000 | 0.133333 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.033333 | 0.033333 | 0.033333 |
| 3 | Aescherstrasse,Bachlettenstrasse,Bättwilerstra... | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.166667 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.166667 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 4 | Ahornstrasse,Allschwilerplatz,Allschwilerstras... | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.090909 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.090909 | 0.181818 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.090909 |
| 5 | Ahornstrasse,Allschwilerplatz,Allschwilerstras... | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.090909 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.090909 | 0.181818 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.090909 |
| 6 | Akazienweg,Freiburgerstrasse | 0.142857 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 7 | Alemannengasse,Bannwartweg,Bergalingerstrasse,... | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 8 | Allmendstrasse,Am Bahndamm,An der hohlen Gasse... | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 9 | Allschwilerstrasse,Altkircherstrasse,Belchenst... | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.166667 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.166667 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 10 | Am Bachgraben,Am Krayenrain,Beckenstrasse,Damm... | 0.000000 | 0.066667 | 0.000000 | 0.000000 | 0.000000 | 0.066667 | 0.066667 | 0.000000 | 0.000000 | 0.000000 | 0.066667 | 0.000000 | 0.000000 | 0.133333 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 11 | Am Umschlagbahnhof,Badenstrasse,Bonergasse,Dor... | 0.142857 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 12 | Amerbachstrasse,Andlauerstrasse,Bärenfelserstr... | 0.142857 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 13 | Andreasplatz,Augustinergasse,BarfÃ¼ssergasse,B... | 0.000000 | 0.000000 | 0.033333 | 0.000000 | 0.000000 | 0.000000 | 0.133333 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.033333 | 0.033333 | 0.033333 |
| 14 | Andreasplatz,BarfÃ¼sserplatz,FahnengÃ¤sslein,F... | 0.000000 | 0.000000 | 0.033333 | 0.000000 | 0.000000 | 0.000000 | 0.033333 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.100000 | 0.000000 | 0.066667 | 0.000000 | 0.033333 |
| 15 | Arnold Böcklin-Strasse,Bundesstrasse,Paulusgas... | 0.000000 | 0.000000 | 0.033333 | 0.000000 | 0.000000 | 0.000000 | 0.133333 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.033333 | 0.033333 | 0.033333 |

**In the next part of this report we will look at the final conclusions**

## Formulate Results and Conclusions: Part 3, Cluster Neighborhoods and Conclude

**6.** Run *k* to cluster groups, to start the investigation k=5 cluster groups, we then incremented to eventually k=9 to differentiate further differences between neighborhoods

### 6.1. Set Number of Cluster

```
[640]: # set number of clusters
kclusters = 9
basel_grouped_clustering = basel_grouped.drop('Street', 1)

# run k-means clustering
kmeans = KMeans(n_clusters=kclusters, random_state=0).fit(basel_grouped_clustering)

# check cluster labels generated for each row in the dataframe
kmeans.labels_[0:10]
```

```
[640]: array([2, 8, 6, 3, 7, 7, 1, 4, 4, 3], dtype=int32)
```

```
[641]: suburbs_basel = suburbs_basel.rename(columns={'Street':'Street'}, inplace=False)
```

```
[642]: # add clustering labels

street_venues_sorted.insert(0, 'Cluster Labels', kmeans.labels_)
basel_merged = basel_post

# merge basel_grouped with basel_data to add latitude/longitude for each neighborhood
basel_merged = basel_merged.join(street_venues_sorted.set_index('Street'), on='Street')

basel_merged.head(20) # check the last columns!
```

[642]:

| | PostalCode | Suburb | Street | 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 Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 4001 | Altstadt Grossbasel | Andreasplatz,BarfÃ¼sserplatz,FahnengÃ¤sslein,F... | 47.5564 | 7.5889 | 6 | Swiss Restaurant | Café | Plaza | Hotel | Chocolate Shop | French Restaurant | Fountain | Museum | Pedestrian Plaza | Creperie |
| **1** | 4002 | Gundeldingen | Gartenstrasse | 47.5488 | 7.5904 | 6 | Italian Restaurant | Hotel | Bakery | Bar | Pizza Place | Chocolate Shop | Pub | Café | Gym | Food Court |
| **2** | 4002 | St. Alban | Centralbahnplatz,Centralbahnstrasse,Peter Meri... | 47.5488 | 7.5904 | 6 | Italian Restaurant | Hotel | Bakery | Bar | Pizza Place | Chocolate Shop | Pub | Café | Gym | Food Court |
| **3** | 4003 | Am Ring | Missionsstrasse | 47.5592 | 7.5788 | 0 | Hotel | Middle Eastern Restaurant | Indian Restaurant | Supermarket | Café | Ice Cream Shop | Botanical Garden | Gastropub | Historic Site | Vietnamese Restaurant |
| **4** | 4005 | Altstadt Kleinbasel | Greifengasse | 47.5623 | 7.5946 | 0 | Restaurant | Bar | Bakery | Hotel | Wine Bar | French Restaurant | Performing Arts Venue | Modern European Restaurant | Italian Restaurant | Gourmet Shop |
| **5** | 4012 | St. Johann | Wilhelm Klein-Strasse | 47.5667 | 7.6000 | 0 | Hotel | Thai Restaurant | Supermarket | Steakhouse | Bar | Restaurant | Sandwich Place | Lounge | Plaza | Cocktail Bar |

### 6.2. Using Folium Library, we can create a representation of the clusters (color coded);

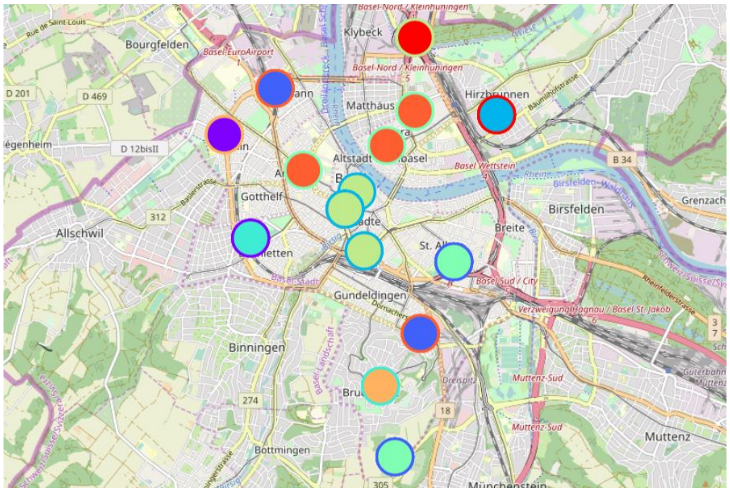
```
[643]: # create map
map_clusters = folium.Map(location=[latitude, longitude], zoom_start=13)

# set color scheme for the clusters
x = np.arange(kclusters)
ys = [i + x + (i*x)**2 for i in range(kclusters)]
colors_array = cm.rainbow(np.linspace(0, 1, len(ys)))
rainbow = [colors.rgb2hex(i) for i in colors_array]

# add markers to the map
markers_colors = []
for lat, lon, poi, cluster in zip(basel_merged['Latitude'], basel_merged['Longitude'], basel_merged['PostalCode'], basel_merged['Cluster Labels']):
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
    folium.CircleMarker(
        [lat, lon],
        radius=20,
        popup=label,
        color=rainbow[cluster-5],
        fill=True,
        fill_color=rainbow[cluster-2],
        fill_opacity=1).add_to(map_clusters)

map_clusters
```

## Cluster Map of Frequented Venues in Basel (Dec 2019)




| Cluster | Venues/freq | Cluster Observations |
|---|---|---|

**Cluster 0**

Hotel 1/ 0.17
Middle Eastern Rest/ 0.10
Indian Restaurant/ 0.07
Café 0.07
Hotel 2/ 0.20
Thai Restaurant/ 0.10
Supermarket/0.07
Bar 1/ 0.07
Steakhouse/0.07
Restaurant/0.17
Bar 2/ 0.10
Bakery/0.07
Hotel/0.07
Wine Bar/0.03

| PostalCode | Street | 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 Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4003 | Missionsstrasse | 47.5592 | 7.5788 | 0 | Hotel | Middle Eastern Restaurant | Indian Restaurant | Supermarket | Café | Ice Cream Shop | Botanical Garden | Gastropub | Historic Site | Vietnamese Restaurant |
| 4005 | Greifengasse | 47.5623 | 7.5946 | 0 | Restaurant | Bar | Bakery | Hotel | Wine Bar | French Restaurant | Performing Arts Venue | Modern European Restaurant | Italian Restaurant | Gourmet Shop |
| 4012 | Wilhelm Klein-Strasse | 47.5667 | 7.6000 | 0 | Hotel | Thai Restaurant | Supermarket | Steakhouse | Bar | Restaurant | Sandwich Place | Lounge | Plaza | Cocktail Bar |
| 4019 | Grenzstrasse | 47.5667 | 7.6000 | 0 | Hotel | Thai Restaurant | Supermarket | Steakhouse | Bar | Restaurant | Sandwich Place | Lounge | Plaza | Cocktail Bar |
| 4070 | Grenzacherstrasse | 47.5667 | 7.6000 | 0 | Hotel | Thai Restaurant | Supermarket | Steakhouse | Bar | Restaurant | Sandwich Place | Lounge | Plaza | Cocktail Bar |

**Cluster 1**

Accessories Store/0.17
River/ 0.17
Fast Food Restaurant/ 0.17
Steakhouse/ 0.17
Swiss Restaurant/ 0.17

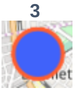
| PostalCode | Street | Latitude | Longitude | Cluster Labels | 1st Most Common Venue | 2nd Most Common Venue | 3rd Most Common Venue | 4th Most Common Venue | 5th Most Common Venue | 6th Most Common Venue | 7th Most Common Venue | 8th Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4057 | Claragraben,Klingentalgraben,Klingentalstrasse... | 47.5761 | 7.5999 | 1 | Accessories Store | Swiss Restaurant | Fast Food Restaurant | Steakhouse | River | Hotel | Department Store | Donut Shop | Electronics Store | Falafel Restaurant |

**Cluster 2**

Tram Station/0.2
Bus Stop /0.2
Bus Station/0.1
German Restaurant/ 0.1
Mexican Restaurant/ 0.1

| PostalCode | Street | 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 Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4055 | Birmannsgasse,Hegenheimerstrasse,Heinrichsgass... | 47.5637 | 7.564 | 2 | Tram Station | Bus Stop | Bus Station | Coffee Shop | German Restaurant | Park | Mexican Restaurant | Supermarket | Wine Bar | Electronics Store |

**Cluster 3**



Supermarket/0.19
Café/0.12
Italian Restaurant/0.06
Brewery/0.06
Plaza/0.06

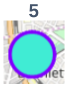
| PostalCode | Street | Latitude | Longitude | Cluster Labels | 1st Most Common Venue | 2nd Most Common Venue | 3rd Most Common Venue | 4th Most Common Venue | 5th Most Common Venue | 6th Most Common Venue | 7th Most Common Venue | 8th Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4053 | Dorenbachviadukt | 47.5383 | 7.6010 | 3 | Supermarket | Café | Restaurant | Hardware Store | Nightclub | Cocktail Bar | Sandwich Place | Shopping Mall | Sporting Goods Shop | Gym / Fitness Center |
| 4056 | Luzernerring | 47.5696 | 7.5735 | 3 | Supermarket | Café | Restaurant | Bakery | Plaza | Brewery | Gastropub | Bar | Italian Restaurant | Thai Restaurant |

**Cluster 4**

Supermarket/0.25
Tram Station/0.25
Skating Rink/0.25
Grocery Store/0.25

| PostalCode | Street | 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 Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4058 | Claragraben,Claraplatz,Dolderweg,Greifengasse,... | 47.5662 | 7.6154 | 4 | Tram Station | Grocery Store | Skating Rink | Supermarket | Wine Bar | Food & Drink Shop | Diner | Donut Shop | Electronics Store | Falafel Restaurant |

**Cluster 5**



Grocery Store/0.33
Athletics & Sports/0.17
Bakery/0.17
Hotel/0.17
Bus Stop/0.17

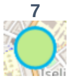
| PostalCode | Street | Latitude | Longitude | Cluster Labels | 1st Most Common Venue | 2nd Most Common Venue | 3rd Most Common Venue | 4th Most Common Venue | 5th Most Common Venue | 6th Most Common Venue | 7th Most Common Venue | 8th Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4054 | Auberg,Birsigstrasse,Hasenberg,Lohweg,Rümelinb... | 47.5505 | 7.5689 | 5 | Grocery Store | Bus Stop | Hotel | Athletics & Sports | Bakery | Wine Bar | Electronics Store | Falafel Restaurant | Farm | Fast Food Restaurant |

**Cluster 6**

Supermarket/0.17
Farm/0.17
Hotel/0.17
Bakery/0.17
Shopping Mall/0.17

| PostalCode | Street | 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 Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4052 | Baldeggerstrasse,Bechburgerstrasse,Beim Letzit... | 47.5225 | 7.5962 | 6 | Hotel | Bakery | Shopping Mall | Farm | Supermarket | Plaza | Gourmet Shop | German Restaurant | Gastropub | French Restaurant |

**Cluster 7**



Swiss Restaurant/0.13
Plaza/0.10
Café/0.10
French Restaurant/0.07
Chocolate Shop/0.07
Bar/0.13
Hotel/0.10
Swiss Restaurant/0.07
Pizza Place/0.07
Italian Restaurant/0.07

| PostalCode | Street | 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 Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4001 | Andreasplatz,BarfÃ¼sserplatz,FahnengÃ¤sslein,F... | 47.5564 | 7.5889 | 7 | Swiss Restaurant | Plaza | Café | French Restaurant | Hotel | Chocolate Shop | Coffee Shop | Shopping Mall | Pedestrian Plaza | Creperie |
| 4002 | Gartenstrasse | 47.5488 | 7.5904 | 7 | Italian Restaurant | Hotel | Bakery | Bar | Pizza Place | Chocolate Shop | Pub | Café | Gym / Fitness Center | Food Court |
| 4002 | Centralbahnplatz,Centralbahnstrasse,Peter Meri... | 47.5488 | 7.5904 | 7 | Italian Restaurant | Hotel | Bakery | Bar | Pizza Place | Chocolate Shop | Pub | Café | Gym / Fitness Center | Food Court |
| 4051 | Andreasplatz,Augustinergasse,BarfÃ¼ssergasse,B... | 47.5542 | 7.5867 | 7 | Bar | Hotel | Pizza Place | Italian Restaurant | Swiss Restaurant | French Restaurant | Fountain | Cocktail Bar | Chocolate Shop | Plaza |
| 4051 | Auberg,Austrasse,Binningerstrasse,Burgunderstr... | 47.5542 | 7.5867 | 7 | Bar | Hotel | Pizza Place | Italian Restaurant | Swiss Restaurant | French Restaurant | Fountain | Cocktail Bar | Chocolate Shop | Plaza |

**Cluster 8**

Supermarket/0.2
Italian Restaurant/0.2
Scenic Lookout/0.2
Tram Station/0.2
Swiss Restaurant/0.2

| PostalCode | Street | 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 Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4059 | Aeneas Silvius-Strasse,Airolostrasse,Albert Sc... | 47.5316 | 7.5934 | 8 | Tram Station | Scenic Lookout | Italian Restaurant | Swiss Restaurant | Supermarket | Wine Bar | Food & Drink Shop | Diner | Donut Shop | Electronics Store |

## 6.3 Explore Cluster Labels (0-8)

### Conclusion

**Certain restaurants succeed simply because their locations are so accessible, like restaurants landmarks,** the most famous landmarks of Basel are mostly found in cluster 0.

**There is plenty of foot traffic in urbanized areas, and restaurants only need to attract customers from the street into their business.**
The urbanized areas of Basel have been incorporated in our analysis, clusters 0 to 8 as we move close to the city center the pedestrian areas become denser with foot traffic.

**Most successful restaurants—other than the truly elite—are easy to find, and you will find them in city centers or unique locations throughout the world.** The city center of Basel can be found situated in clusters labelled 0 and 7.

To conclude I would recommend opening a fast food meat free restaurant in the surroundings of Clusters 0 or 7. The streets that stretch across these clusters are populated with well-established cafes/bars and restaurants, which the city dwellers and workers will be familiar with. The location is a central point of the shops and is equally distance for those living in the surrounding suburbs. I would suggested try and finding a location close to one of Basel's known landmarks to catch the passing tourist trade and near one of the tram stations, this should prove to help guarantee customers and enhance the success of the restaurant.

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This report has been written to demonstrate the tools, theories and skills learnt whilst completing modules 1-8 in this IBM Data Science Specialization, helping one to understand the ideas and principles and how apply and analyze more real-life challenges ahead using data-science.