

Import libraries

```
[1]: import numpy as np # library to handle data in a vectorized manner

import pandas as pd # library for data analysis
pd.set_option('display.max_columns', None)
pd.set_option('display.max_rows', None)

import json # library to handle JSON files

#!conda install -c conda-forge geopy --yes # uncomment this line if you haven't completed the Foursquare API Lab
#from geopy.geocoders import Nominatim # convert an address into latitude and longitude values

import requests # library to handle requests
from pandas.io.json import json_normalize # tranform JSON file into a pandas dataframe

# Matplotlib and associated plotting modules
%matplotlib inline

import matplotlib as mpl
import matplotlib.pyplot as plt
import matplotlib.cm as cm
import matplotlib.colors as colors

# seaborn
#!conda install -c anaconda seaborn --yes
import seaborn as sns

# import k-means from clustering stage
from sklearn.cluster import KMeans

#!conda install -c conda-forge folium=0.5.0 --yes # uncomment this line if you haven't completed the Foursquare API Lab
import folium # map rendering library

print('Libraries imported.')
```

Libraries imported.

1. Prepare Data

1.1 Obtain Toronto FSA data

1.1a List of Toronto FSA codes

Data source: https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M

```
[ ]: # Only run for first time.
# Extract FSA information from wiki page, and save to csv file.

#!pip install beautifulsoup4
from bs4 import BeautifulSoup
import urllib.request, urllib.parse, urllib.error
import ssl

ctx = ssl.create_default_context()
ctx.check_hostname = False
ctx.verify_mode = ssl.CERT_NONE

url = 'https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M'
html = urllib.request.urlopen(url, context=ctx).read()
soup = BeautifulSoup(html, 'html.parser')

table = soup.find_all('table')[0] # Grab the first table

df = pd.DataFrame(columns=range(0,3))

row_marker = 0
for row in table.find_all('tr'):
    column_marker = 0
    columns = row.find_all('td')
    for column in columns:
        df.loc[row_marker,column_marker] = column.get_text()
        column_marker += 1
    row_marker+=1

df.columns = ['FSA', 'Borough', 'Nb'] # Rename column head
df.replace(to_replace='\n', value="", regex=True, inplace=True) # Replace \n columns

df=df[df['Borough']!="Not assigned"].dropna() # Filter out Borough = "Not assigned"

fsa_df = df.groupby(['FSA', 'Borough']).count()
fsa_df=fsa_df.drop('Nb', axis=1).reset_index()
fsa_df.to_csv(r'toronto_fsa.csv',index=False)
```

```
[2]: fsa_df = pd.read_csv('toronto_fsa.csv')
print('dataframe: fsa_df, shape:', fsa_df.shape)
fsa_df.head(3)
```

dataframe: fsa_df, shape: (103, 2)

```
[2]:
```

	FSA	Borough
0	M1B	Scarborough
1	M1C	Scarborough
2	M1E	Scarborough

1.1b Toronto FSA geolocations

Data source: http://cocl.us/Geospatial_data

```
[3]: geo_df = pd.read_csv('Geospatial_Coordinates.csv')
geo_df.rename(columns={"Postal Code": "FSA"}, inplace = True)
print('dataframe: geo_df, shape:', geo_df.shape)
geo_df.head(3)
```

dataframe: geo_df, shape: (103, 3)

```
[3]:
```

	FSA	Latitude	Longitude
0	M1B	43.806686	-79.194353
1	M1C	43.784535	-79.160497
2	M1E	43.763573	-79.188711

1.1c Toronto FSA populations

Data source: <https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/hltfst/pd-pl/Table.cfm?Lang=Eng&T=1201&S=22&O=A>

```
[4]: pop_df = pd.read_csv('population.csv')
print('dataframe: pop_df, shape:', pop_df.shape)
pop_df.head(3)
```

dataframe: pop_df, shape: (523, 3)

```
[4]:
```

	FSA	Province	Population
0	K0A	Ontario	103474
1	K0B	Ontario	20945
2	K0C	Ontario	52154

1.1 Result: Combine dataframe

```
[5]: df = pd.merge(fsa_df, pop_df[['FSA','Population']], on='FSA')
df = pd.merge(df, geo_df, on='FSA')
print('dataframe: df, shape:', df.shape)
df.head(3)
```

dataframe: df, shape: (102, 5)

```
[5]:
```

	FSA	Borough	Population	Latitude	Longitude
0	M1B	Scarborough	66108	43.806686	-79.194353
1	M1C	Scarborough	35626	43.784535	-79.160497
2	M1E	Scarborough	46943	43.763573	-79.188711

1.2 Explore Restaurants in Toronto

```
[ ]: # Only run for first time
# Foursquare credentials

CLIENT_ID = '' # your Foursquare ID
CLIENT_SECRET = '' # your Foursquare Secret
VERSION = '20180605' # Foursquare API version

print('Your credentials:')
print('CLIENT_ID: ' + CLIENT_ID)
print('CLIENT_SECRET: ' + CLIENT_SECRET)
```

1.2a Obtain list of venues from Foursquare

```
[ ]: # Only run for first time
# To obtain the list of venues directly from foursquare and save to venues.csv

# function for loop through FSA to get nearby venues
def getNearbyVenues(names, latitudes, longitudes, radius=500, LIMIT=100):

    venues_list=[]
    for name, lat, lng in zip(names, latitudes, longitudes):

        # create the API request URL
        url = 'https://api.foursquare.com/v2/venues/explore?&client_id={}&client_secret={}&v={}&ll={},{}&radius={}&limit={}'.format(
            CLIENT_ID,
            CLIENT_SECRET,
            VERSION,
            lat,
            lng,
            radius,
            LIMIT)

        # make the GET request
        results = requests.get(url).json()["response"]["groups"][0]["items"]

        # return only relevant information for each nearby venue
        venues_list.append([(
            name,
            lat,
            lng,
            v['venue']['name'],
            v['venue']['location']['lat'],
            v['venue']['location']['lng'],
            v['venue']['categories'][0]['name']) for v in results])

    nearby_venues = pd.DataFrame([item for venue_list in venues_list for item in venue_list])
    nearby_venues.columns = ['FSA',
                            'Latitude',
                            'Longitude',
                            'Venue',
                            'Venue Latitude',
                            'Venue Longitude',
                            'Venue Category']

    return(nearby_venues)

venues = getNearbyVenues(names=df['FSA'], latitudes=df['Latitude'], longitudes=df['Longitude'])
venues.to_csv(r'venues.csv',index=False)
```

```
[6]: venues = pd.read_csv('venues.csv')
print('dataframe: venues, shape:', venues.shape)
venues.head(3)
```

dataframe: venues, shape: (2205, 7)

[6]:		FSA	Latitude	Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
	0	M3A	43.753259	-79.329656	Brookbanks Park	43.751976	-79.332140	Park
	1	M3A	43.753259	-79.329656	Careful & Reliable Painting	43.752622	-79.331957	Construction & Landscaping
	2	M3A	43.753259	-79.329656	Variety Store	43.751974	-79.333114	Food & Drink Shop

1.2b Retrieve Categories in Foursquare

Data source: <https://developer.foursquare.com/docs/api/venues/categories>
Web format (for view): <https://developer.foursquare.com/docs/resources/categories>

```
[ ]: # Only run for first time
# To get the categories list from foursquare and save as foursq_cat.csv

# create URL and obtain the json
url = 'https://api.foursquare.com/v2/venues/categories?client_id={}&client_secret={}&v={}&m=foursquare'.format(
    CLIENT_ID,
    CLIENT_SECRET,
    VERSION)
foursq_cat_json = requests.get(url).json()

# instantiate the dataframe with defined columns
column_names = ['id', 'cat_name', 'cat1', 'cat2']
foursq_cat_df = pd.DataFrame(columns=column_names)
foursq_cat_df

# get data from foursq_cat_json
for data1 in foursq_cat_json['response']['categories']:
    id = data1['id']
    cat1 = data1['name']
    foursq_cat_df = foursq_cat_df.append({'id': id, 'cat_name': cat1, 'cat1': cat1, 'cat2': cat1}, ignore_index=True)
    for data2 in data1['categories']:
        if (data2):
            id = data2['id']
            cat2 = data2['name']
            foursq_cat_df = foursq_cat_df.append({'id': id, 'cat_name': cat2, 'cat1': cat1, 'cat2': cat2}, ignore_index=True)
        for data3 in data2['categories']:
            if (data3):
                id = data3['id']
                cat_name = data3['name']
                foursq_cat_df = foursq_cat_df.append({'id': id, 'cat_name': cat_name, 'cat1': cat1, 'cat2': cat2}, ignore_index=True)

foursq_cat_df.rename(columns={"cat_name": "Venue Category"}, inplace = True)
foursq_cat_df.to_csv(r'foursq_cat.csv',index=False)
```

```
[7]: foursq_cat_df = pd.read_csv('foursq_cat.csv')
print('dataframe: foursq_cat_df, shape:', foursq_cat_df.shape)
foursq_cat_df.head(3)
```

dataframe: foursq_cat_df, shape: (833, 4)

[7]:		id	Venue Category	cat1	cat2
	0	4d4b7104d754a06370d81259	Arts & Entertainment	Arts & Entertainment	Arts & Entertainment
	1	56aa371be4b08b9a8d5734db	Amphitheater	Arts & Entertainment	Amphitheater
	2	4fceeaa171983d5d06c3e9823	Aquarium	Arts & Entertainment	Aquarium

1.2 Result: Dataframe on venue of restaurants only

```
[8]: foods = pd.merge(venues, foursq_cat_df[['cat1', 'Venue Category']], on='Venue Category')
foods = foods[foods['cat1']=='Food']
print('dataframe: foods, shape:', foods.shape)
foods.head(3)
```

dataframe: foods, shape: (1203, 8)

[8]:		FSA	Latitude	Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category	cat1
	62	M4A	43.725882	-79.315572	Tim Hortons	43.725517	-79.313103	Coffee Shop	Food
	63	M5A	43.654260	-79.360636	Tandem Coffee	43.653559	-79.361809	Coffee Shop	Food
	64	M5A	43.654260	-79.360636	Arvo	43.649963	-79.361442	Coffee Shop	Food

1.3 Top 10 food venues by FSA

```
[9]: # one hot encoding
onehot = pd.get_dummies(foods[['Venue Category']], prefix="", prefix_sep="")

# add FSA column back to dataframe
onehot['FSA'] = foods['FSA']

# move FSA column to the first column
fixed_columns = [onehot.columns[-1]] + list(onehot.columns[:-1])
onehot = onehot[fixed_columns]

# group
food_grouped = onehot.groupby('FSA').mean().reset_index()

print('dataframe: food_grouped,  shape:', food_grouped.shape)
food_grouped.head(3)
```

dataframe: food_grouped, shape: (79, 82)

[9]:

	FSA	Afghan Restaurant	American Restaurant	Asian Restaurant	BBQ Joint	Bagel Shop	Bakery	Belgian Restaurant	Bistro	Breakfast Spot	Bubble Tea Shop	Burger Joint	Burrito Place	Cafeteria	Café	Re
0	M1B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0	0.0	0.0	0.0	
1	M1E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.333333	0.0	0.0	0.0	0.0	0.0	
2	M1G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0	0.0	0.0	0.0	

```
[10]: def return_most_common_venues(row, num_top_venues):
    row_categories = row.iloc[1:]
    row_categories_sorted = row_categories.sort_values(ascending=False)

    return row_categories_sorted.index.values[0:num_top_venues]

num_top_venues = 10

# create columns according to number of top venues
columns = ['FSA']
for ind in np.arange(num_top_venues):
    columns.append('Top {} Food Venue'.format(ind+1))

# create a new dataframe
FSA_top_venue = pd.DataFrame(columns=columns)
FSA_top_venue['FSA'] = food_grouped['FSA']

for ind in np.arange(food_grouped.shape[0]):
    FSA_top_venue.iloc[ind, 1:] = return_most_common_venues(food_grouped.iloc[ind, :], num_top_venues)

print('dataframe: FSA_top_venue,  shape:', FSA_top_venue.shape)
FSA_top_venue.head(3)
```

dataframe: FSA_top_venue, shape: (79, 11)

[10]:

	FSA	Top 1 Food Venue	Top 2 Food Venue	Top 3 Food Venue	Top 4 Food Venue	Top 5 Food Venue	Top 6 Food Venue	Top 7 Food Venue	Top 8 Food Venue	Top 9 Food Venue	Top 10 Food Venue
0	M1B	Fast Food Restaurant	Wings Joint	Eastern European Restaurant	Cupcake Shop	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant
1	M1E	Mexican Restaurant	Pizza Place	Breakfast Spot	Eastern European Restaurant	Cupcake Shop	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop
2	M1G	Coffee Shop	Korean Restaurant	Wings Joint	Eastern European Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant

1.4 Venue Cat Count by FSA on top 10 venues

```
[11]: Top_foods = foods[['Venue Category', 'cat1']].groupby('Venue Category').count().reset_index().rename(columns={"cat1": "Count"}).sort_
columns = ['FSA']
for i in Top_foods:
    columns.append(i)
columns
```

```
[11]: ['FSA',
'Coffee Shop',
'Café',
'Restaurant',
'Pizza Place',
'Italian Restaurant',
'Bakery',
'Sandwich Place',
'Japanese Restaurant',
'Fast Food Restaurant',
'Burger Joint']
```

```
[12]: # one hot encoding
onehot = pd.get_dummies(foods[['Venue Category']], prefix="", prefix_sep="")

# add FSA column back to dataframe
onehot['FSA'] = foods['FSA']

# move FSA column to the first column
fixed_columns = [onehot.columns[-1]] + list(onehot.columns[:-1])
onehot = onehot[fixed_columns]

# group
food_cat = onehot.groupby('FSA').sum().reset_index()
food_cat = food_cat[columns]
food_cat.set_index('FSA', inplace = True)

print('dataframe: food_cat,  shape:', food_cat.shape)
food_cat.head(3)
```

dataframe: food_cat, shape: (79, 10)

[12]:

	Coffee Shop	Café	Restaurant	Pizza Place	Italian Restaurant	Bakery	Sandwich Place	Japanese Restaurant	Fast Food Restaurant	Burger Joint
FSA										
M1B	0	0	0	0	0	0	0	0	1	0
M1E	0	0	0	1	0	0	0	0	0	0
M1G	2	0	0	0	0	0	0	0	0	0

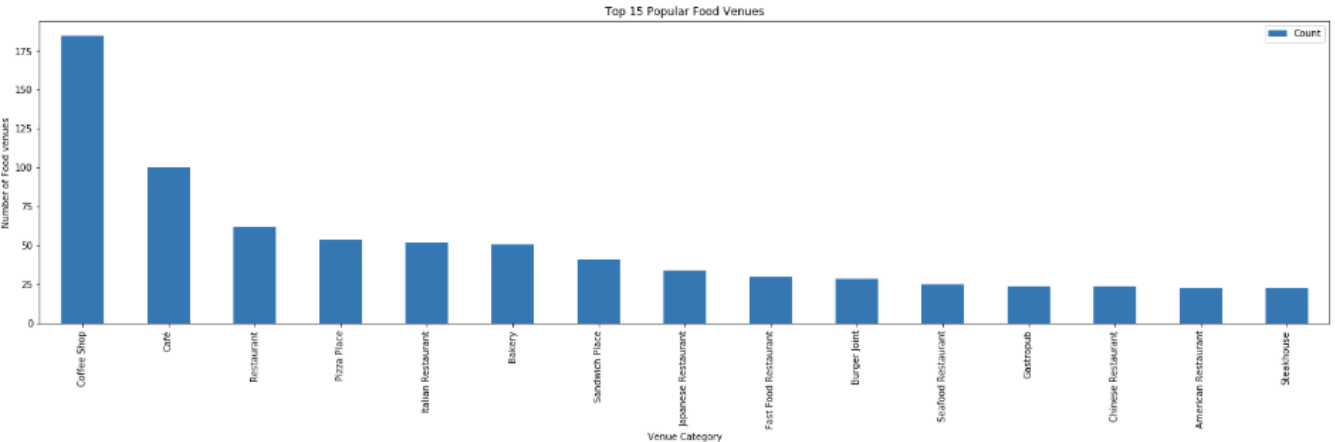
2. Visualization

2.1 Food Venues in Toronto

```
[13]: venue_count = foods[['FSA', 'Venue Category']].groupby('Venue Category').count().rename(columns={"FSA": "Count"})
venue_count.sort_values(by='Count', ascending=False, inplace=True)
venue_count.head(15).plot(kind='bar', figsize=(25, 6))

plt.xlabel('Venue Category') # add to x-Label to the plot
plt.ylabel('Number of Food venues') # add y-label to the plot
plt.title('Top 15 Popular Food Venues') # add title to the plot

plt.show()
```



2.2 Food Venues by FSAs

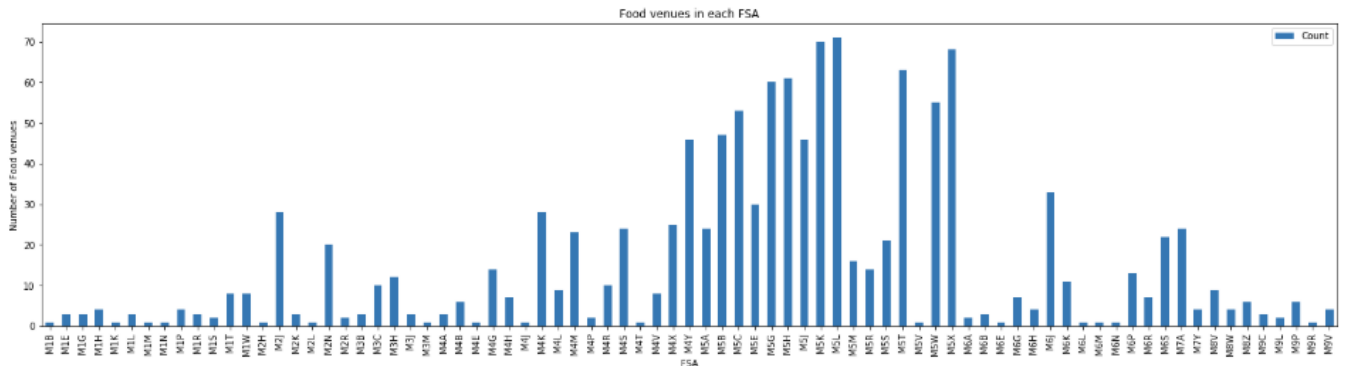
Bar chart

```
14]: food_count = foods[['FSA', 'Venue Category']].groupby('FSA').count().rename(columns={"Venue Category": "Count"})

food_count.plot(kind='bar', figsize=(25, 6))

plt.xlabel('FSA') # add to x-label to the plot
plt.ylabel('Number of Food venues') # add y-label to the plot
plt.title('Food venues in each FSA') # add title to the plot

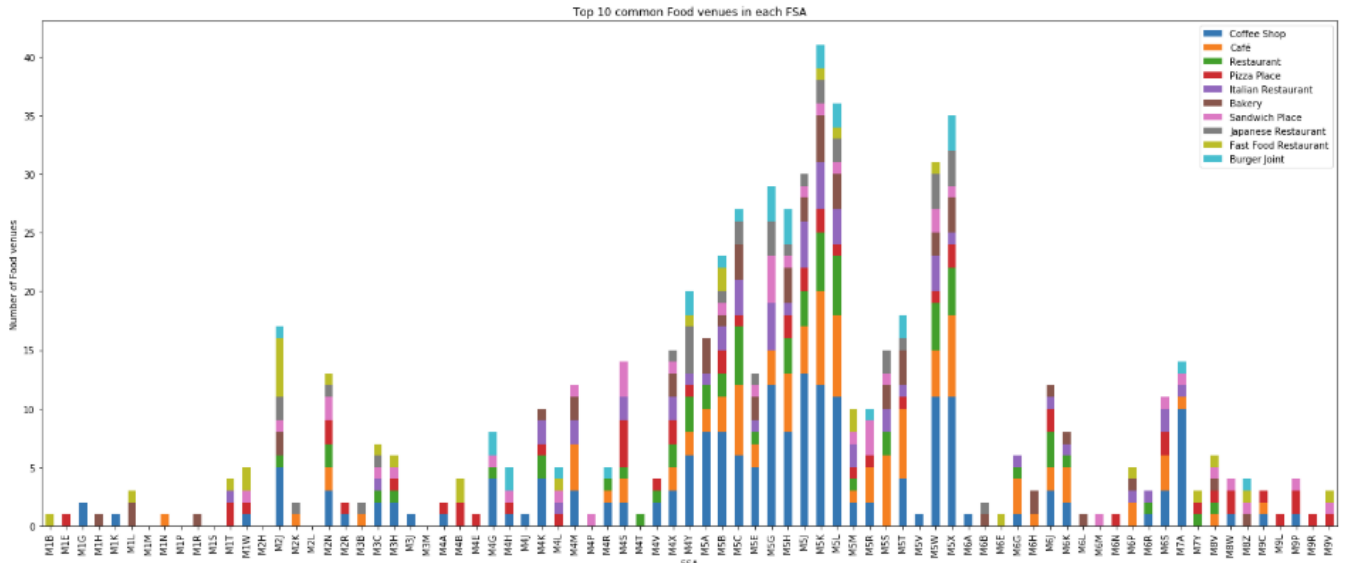
plt.show()
```



```
15]: food_cat.plot(kind='bar', stacked = True, figsize=(25, 10))

plt.xlabel('FSA') # add to x-label to the plot
plt.ylabel('Number of Food venues') # add y-label to the plot
plt.title('Top 10 common Food venues in each FSA') # add title to the plot

plt.show()
```



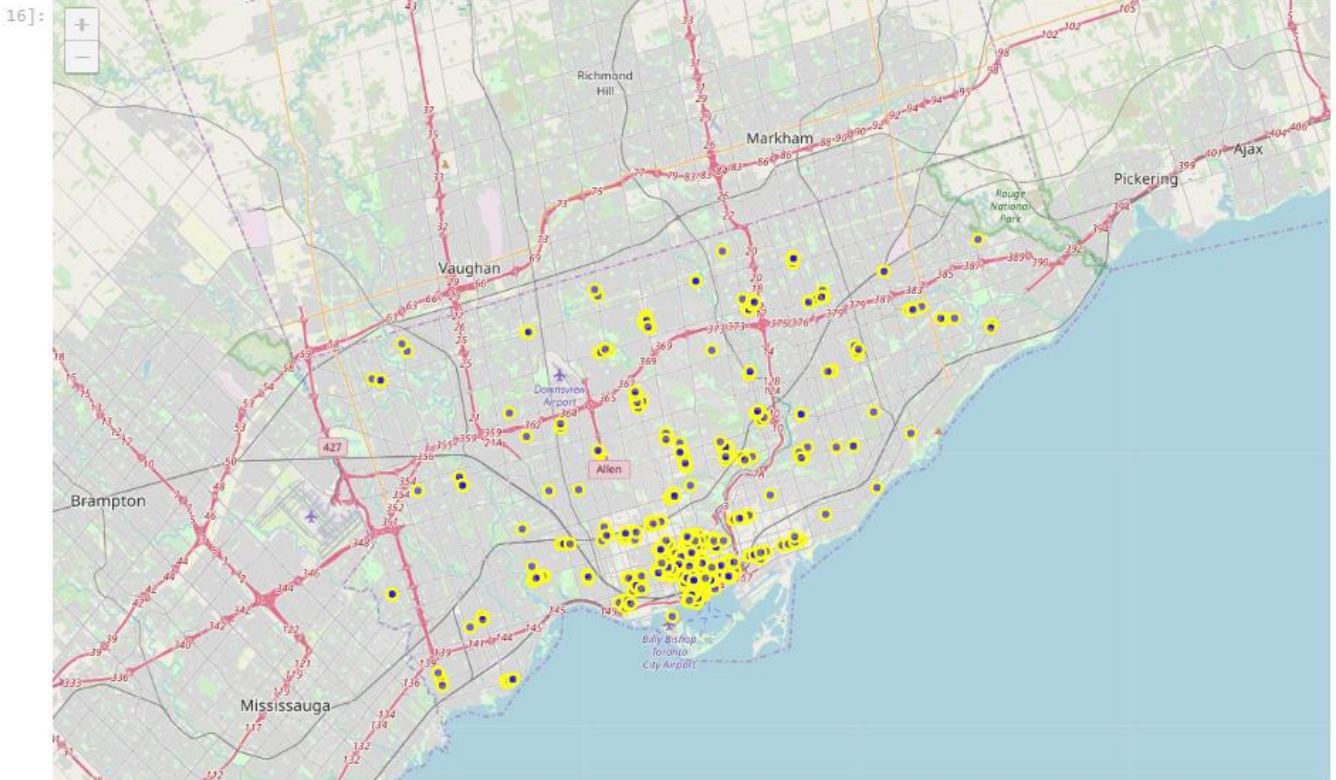
Geographical location of food venues on map

```
16]: map = folium.Map(location=[43.722622, -79.383561], zoom_start=11, min_zoom = 11, max_zoom = 11, width = 1200, height = 800)

# instantiate a feature group for the food venue in the dataframe
foodvenue = folium.map.FeatureGroup()

# Loop through the 100 crimes and add each to the incidents feature group
for lat, lng, in zip(foods['Venue Latitude'], foods['Venue Longitude']):
    foodvenue.add_child(
        folium.features.CircleMarker(
            [lat, lng],
            radius=5, # define how big you want the circle markers to be
            color='yellow',
            fill=True,
            fill_color='blue',
            fill_opacity=0.6
        )
    )

# add incidents to map
map.add_child(foodvenue)
```



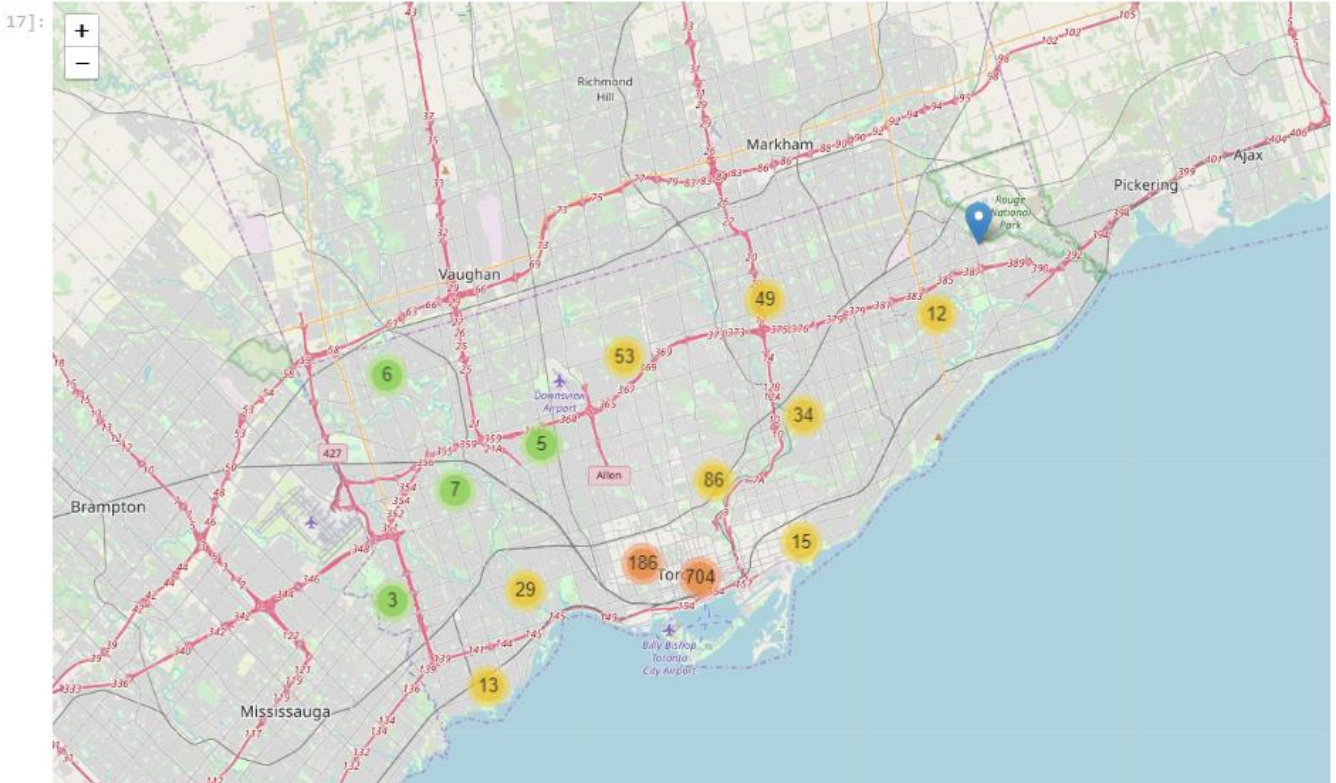
```
17]: map = folium.Map(location=[43.722622, -79.383561], zoom_start=11, width = 1200, height = 800)

from folium import plugins

# instantiate a mark cluster object for the food venue in the dataframe
foodvenue = plugins.MarkerCluster().add_to(map)

# Loop through the dataframe and add each data point to the mark cluster
for lat, lng, label, in zip(foods['Venue Latitude'], foods['Venue Longitude'], foods['Venue Category']):
    folium.Marker(
        location=[lat, lng],
        icon=None,
        popup=label,
    ).add_to(foodvenue)

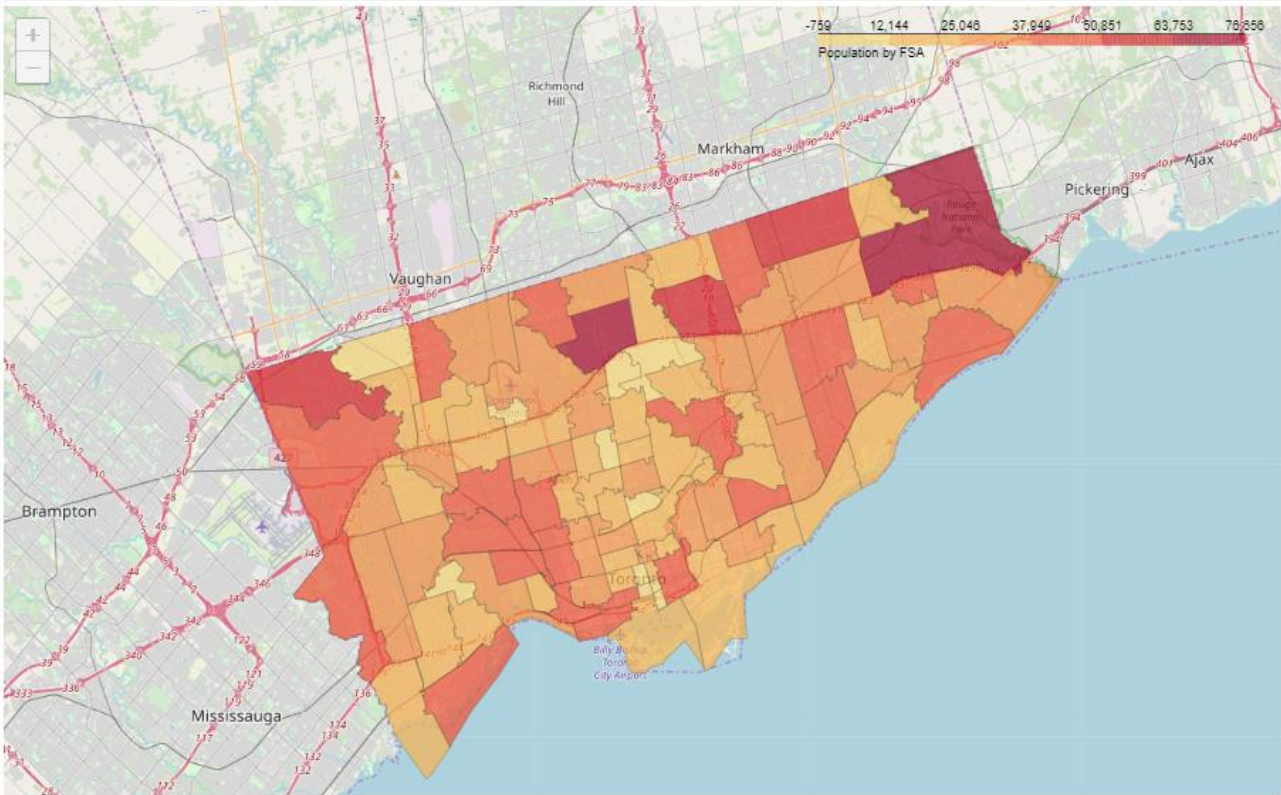
# display map
map
```



2.3 Population and number of food venues

Population in each FSA

```
18]: map = folium.Map(location=[43.722622, -79.383561], zoom_start=11, min_zoom = 11, max_zoom = 11, width = 1200, height = 800)
geo = "toronto.geojson"
map.choropleth(
    geo_data = geo,
    data = df,
    columns=['FSA','Population'],
    key_on='feature.properties.CFSAUID',
    fill_color='YlOrRd',
    fill_opacity=0.7,
    line_opacity=0.2,
    legend_name='Population by FSA')
map
```



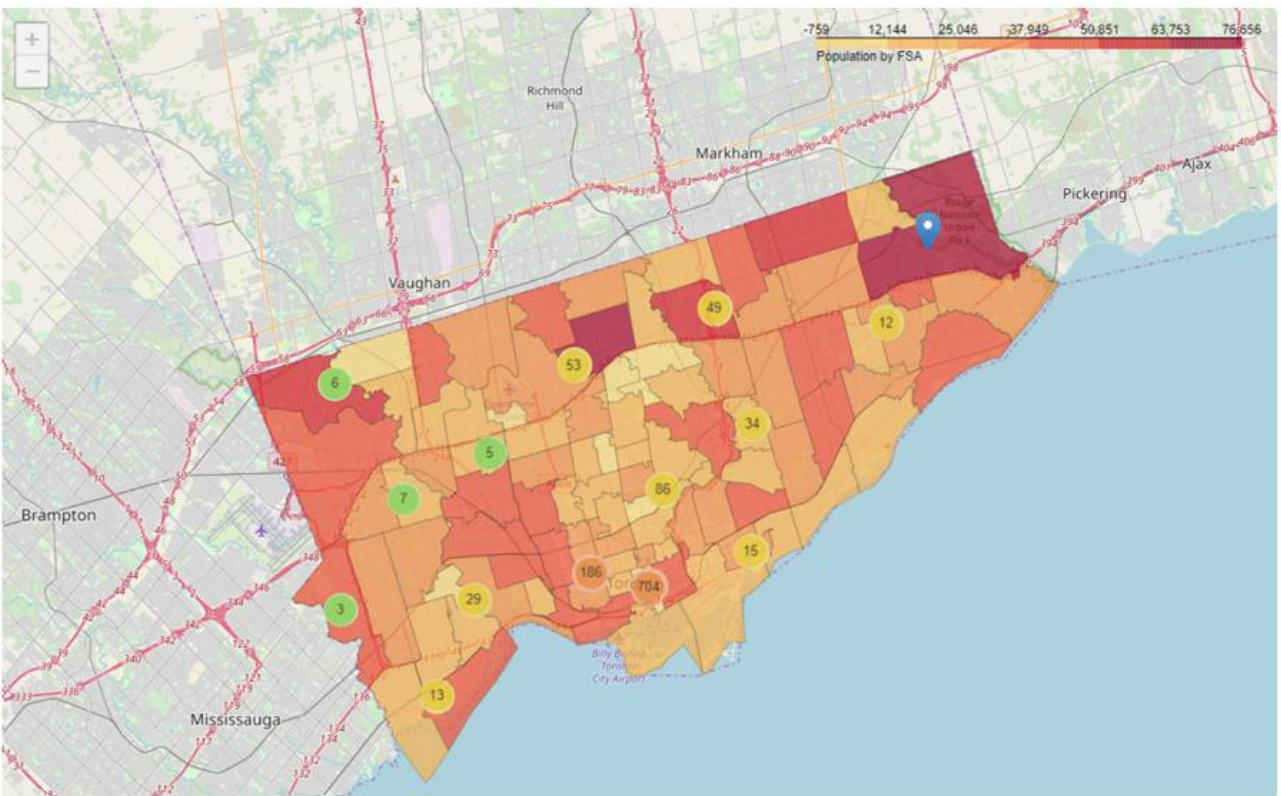
Population and food venues in each FSA

```
19]: map = folium.Map(location=[43.722622, -79.383561], zoom_start=11, min_zoom = 11, max_zoom = 11, width = 1200, height = 800)
geo = "toronto.geojson"
map.choropleth(
    geo_data = geo,
    data = df,
    columns=['FSA','Population'],
    key_on='feature.properties.CFSAUID',
    fill_color='YlOrRd',
    fill_opacity=0.7,
    line_opacity=0.2,
    legend_name='Population by FSA')

# instantiate a mark cluster object for the food venue in the dataframe
foodvenue = plugins.MarkerCluster().add_to(map)

# Loop through the dataframe and add each data point to the mark cluster
for lat, lng, label, in zip(foods['Venue Latitude'], foods['Venue Longitude'], foods['Venue Category']):
    folium.Marker(
        location=[lat, lng],
        icon=None,
        popup=label,
    ).add_to(foodvenue)

map
```



3. Regression Analysis

Analysing relationship between population and number of restaurant

```
20]: regression_df = pd.merge(df[['FSA','Population']], food_count.reset_index(), on='FSA').rename(columns={"Count":"Venue_no"})

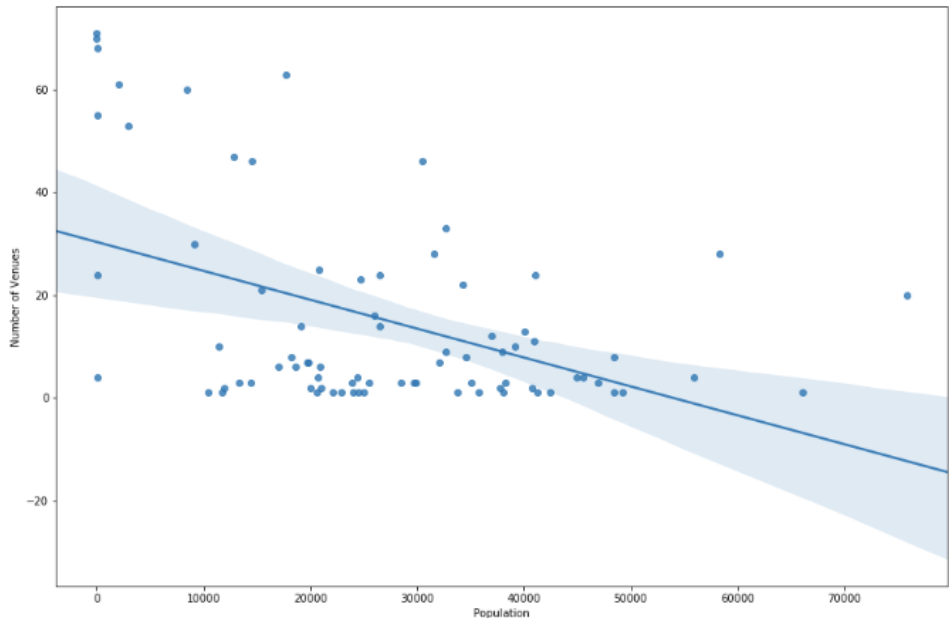
print('dataframe: regression_df,  shape:', regression_df.shape)
regression_df.head(3)
```

dataframe: regression_df, shape: (79, 3)

	FSA	Population	Venue_no
0	M1B	66108	1
1	M1E	46943	3
2	M1G	29690	3

```
21]: plt.figure(figsize=(15, 10))
ax = sns.regplot(x='Population', y='Venue_no', data=regression_df)
ax.set(xlabel='Population', ylabel='Number of Venues')
```

```
21]: [Text(0, 0.5, 'Number of Venues'), Text(0.5, 0, 'Population')]
```



4. Clustering with k-means

Prepare Clusters

```
22]: # set number of clusters
kclusters = 4

food_cluster = food_grouped.drop('FSA', 1)

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

# add clustering Labels
FSA_top_venue.insert(0, 'Cluster Labels', kmeans.labels_)

df_cluster = df

# merge toronto_grouped with toronto_data to add Latitude/Longitude for each neighborhood
df_cluster = df_cluster.join(FSA_top_venue.set_index('FSA'), on='FSA')
df_cluster.dropna(inplace = True)
df_cluster['Cluster Labels'] = pd.to_numeric(df_cluster['Cluster Labels'], downcast='integer')

print('dataframe: df_cluster,  shape:', df_cluster.shape)
df_cluster.head(3)
```

dataframe: df_cluster, shape: (79, 16)

	FSA	Borough	Population	Latitude	Longitude	Cluster Labels	Top 1 Food Venue	Top 2 Food Venue	Top 3 Food Venue	Top 4 Food Venue	Top 5 Food Venue	Top 6 Food Venue	Top 7 Food Venue	Top 8 Food Venue
0	M1B	Scarborough	66108	43.806686	-79.194353	0	Fast Food Restaurant	Wings Joint	Eastern European Restaurant	Cupcake Shop	Deli / Bodega	Dessert Shop	Diner	Donut Shop
2	M1E	Scarborough	46943	43.763573	-79.188711	3	Mexican Restaurant	Pizza Place	Breakfast Spot	Eastern European Restaurant	Cupcake Shop	Deli / Bodega	Dessert Shop	Donut Shop
3	M1G	Scarborough	29690	43.770992	-79.216917	2	Coffee Shop	Korean Restaurant	Wings Joint	Eastern European Restaurant	Deli / Bodega	Dessert Shop	Diner	Donut Shop

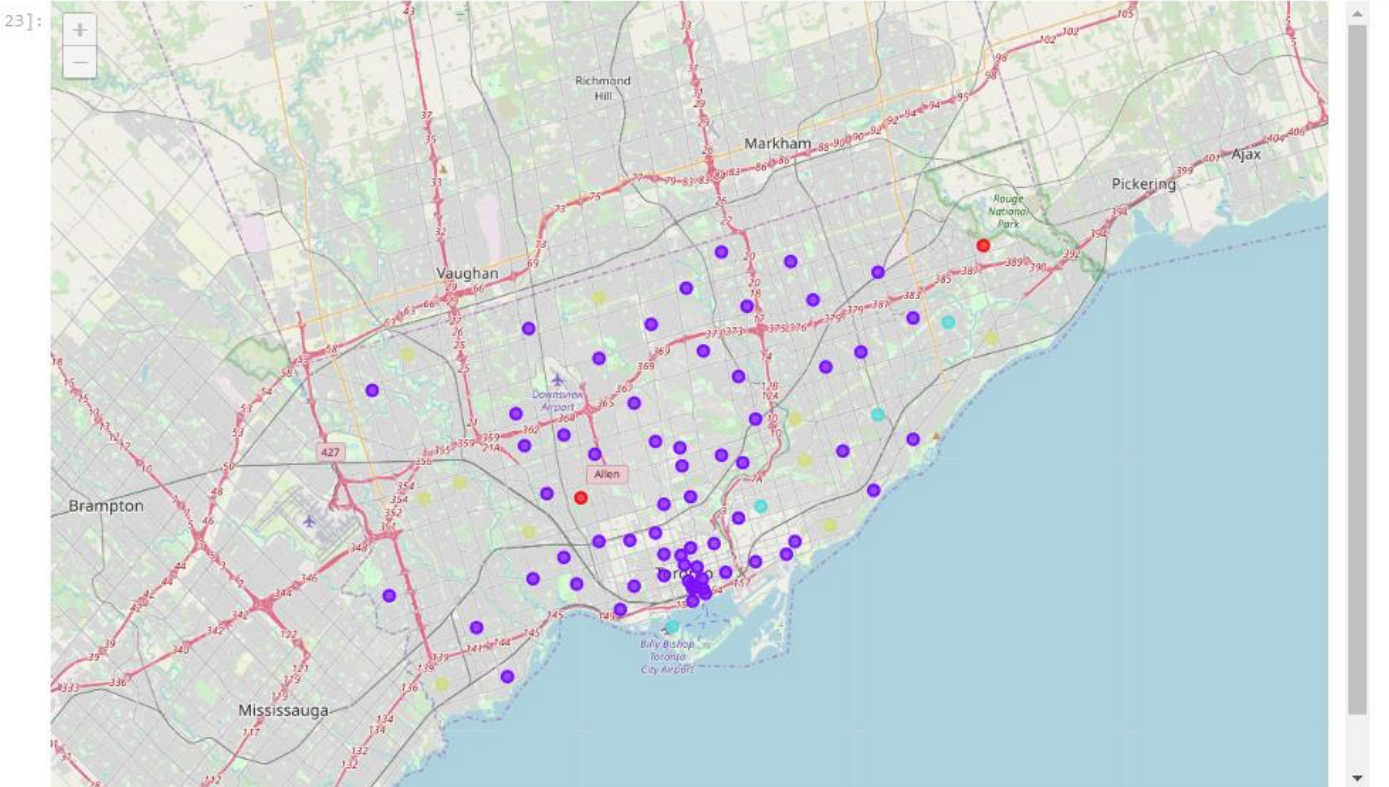
Visualization of clusters on map

```
23]: # create map
map_clusters = folium.Map(location=[43.722622, -79.383561], zoom_start=11, min_zoom = 11, max_zoom = 11, width = 1200, height = 800)

# 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(df_cluster['Latitude'], df_cluster['Longitude'], df_cluster['FSA'], df_cluster['Cluster Labels']):
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
    folium.CircleMarker(
        [lat, lon],
        radius=5,
        popup=label,
        color=rainbow[cluster-1],
        fill=True,
        fill_color=rainbow[cluster-1],
        fill_opacity=0.7).add_to(map_clusters)

map_clusters
```



Cluster 1

```
24]: df_cluster.loc[df_cluster['Cluster Labels'] == 0, df_cluster.columns[[1] + list(range(5, df_cluster.shape[1]))]]
```

	Borough	Cluster Labels	Top 1 Food Venue	Top 2 Food Venue	Top 3 Food Venue	Top 4 Food Venue	Top 5 Food Venue	Top 6 Food Venue	Top 7 Food Venue	Top 8 Food Venue	Top 9 Food Venue	Top 10 Food Venue
0	Scarborough	0	Fast Food Restaurant	Wings Joint	Eastern European Restaurant	Cupcake Shop	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant
74	York	0	Fast Food Restaurant	Wings Joint	Eastern European Restaurant	Cupcake Shop	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant

Cluster 2

```
25]: df_cluster.loc[df_cluster['Cluster Labels'] == 1, df_cluster.columns[[1] + list(range(5, df_cluster.shape[1]))]]
```

	Borough	Cluster Labels	Top 1 Food Venue	Top 2 Food Venue	Top 3 Food Venue	Top 4 Food Venue	Top 5 Food Venue	Top 6 Food Venue	Top 7 Food Venue	Top 8 Food Venue	Top 9 Food Venue	Top 10 Food Venue
4	Scarborough	1	Fried Chicken Joint	Thai Restaurant	Caribbean Restaurant	Bakery	Wings Joint	Empanada Restaurant	Dessert Shop	Diner	Doner Restaurant	Donut Shop
7	Scarborough	1	Bakery	Fast Food Restaurant	Wings Joint	Empanada Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant
8	Scarborough	1	American Restaurant	Wings Joint	Empanada Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant	Donut Shop
9	Scarborough	1	Café	Wings Joint	Cuban Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant	Donut Shop
10	Scarborough	1	Indian Restaurant	Vietnamese Restaurant	Chinese Restaurant	Empanada Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant
11	Scarborough	1	Bakery	Breakfast Spot	Middle Eastern Restaurant	Wings Joint	Empanada Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop
12	Scarborough	1	Latin American Restaurant	Breakfast Spot	Wings Joint	Empanada Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant
13	Scarborough	1	Pizza Place	Fried Chicken Joint	Thai Restaurant	Chinese Restaurant	Fast Food Restaurant	Noodle House	Italian Restaurant	Wings Joint	Donut Shop	Dumpling Restaurant
15	Scarborough	1	Fast Food Restaurant	Chinese Restaurant	Coffee Shop	Pizza Place	Breakfast Spot	Sandwich Place	Filipino Restaurant	Falafel Restaurant	Ethiopian Restaurant	Donut Shop
17	North York	1	Mediterranean Restaurant	Wings Joint	Cuban Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant	Donut Shop
18	North York	1	Coffee Shop	Fast Food Restaurant	Japanese Restaurant	Bakery	Food Court	Restaurant	Greek Restaurant	Juice Bar	Deli / Bodega	Donut Shop
19	North York	1	Chinese Restaurant	Café	Japanese Restaurant	Wings Joint	Eastern European Restaurant	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant
20	North York	1	Cafeteria	Wings Joint	Cuban Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant	Donut Shop
22	North York	1	Coffee Shop	Restaurant	Sandwich Place	Café	Pizza Place	Juice Bar	Japanese Restaurant	Indonesian Restaurant	Ice Cream Shop	Donut Shop

26	North York	1	Caribbean Restaurant	Café	Japanese Restaurant	Wings Joint	Eastern European Restaurant	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Diner
27	North York	1	Asian Restaurant	Coffee Shop	Sandwich Place	Restaurant	Chinese Restaurant	Fast Food Restaurant	Japanese Restaurant	Italian Restaurant	Dessert Shop	
28	North York	1	Coffee Shop	Sandwich Place	Fried Chicken Joint	Fast Food Restaurant	Diner	Deli / Bodega	Middle Eastern Restaurant	Chinese Restaurant	Pizza Place	Restaurant
29	North York	1	Coffee Shop	Caribbean Restaurant	Falafel Restaurant	Wings Joint	Eastern European Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	
32	North York	1	Food Truck	Wings Joint	Eastern European Restaurant	Cupcake Shop	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Diner
38	East York	1	Coffee Shop	Burger Joint	Mexican Restaurant	Fish & Chips Shop	Middle Eastern Restaurant	Bagel Shop	Dessert Shop	Breakfast Spot	Sandwich Place	Restaurant
39	East York	1	Burger Joint	Indian Restaurant	Sandwich Place	Coffee Shop	Pizza Place	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	
41	East Toronto	1	Greek Restaurant	Coffee Shop	Ice Cream Shop	Italian Restaurant	Restaurant	Diner	Pizza Place	American Restaurant	Juice Bar	
42	East Toronto	1	Fish & Chips Shop	Fast Food Restaurant	Steakhouse	Italian Restaurant	Ice Cream Shop	Sandwich Place	Pizza Place	Burger Joint	Burrito Place	
43	East Toronto	1	Café	Coffee Shop	Gastropub	American Restaurant	Italian Restaurant	Bakery	Sandwich Place	Ice Cream Shop	Diner	American Restaurant
45	Central Toronto	1	Sandwich Place	Breakfast Spot	Wings Joint	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant	Eastern Restaurant
46	Central Toronto	1	Coffee Shop	Mexican Restaurant	Restaurant	Dessert Shop	Diner	Bagel Shop	Chinese Restaurant	Café	Burger Joint	
47	Central Toronto	1	Pizza Place	Dessert Shop	Sandwich Place	Coffee Shop	Italian Restaurant	Café	Restaurant	Indian Restaurant	Deli / Bodega	Restaurant
48	Central Toronto	1	Restaurant	Wings Joint	Eastern European Restaurant	Cupcake Shop	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Diner
49	Central Toronto	1	Coffee Shop	Fried Chicken Joint	Restaurant	American Restaurant	Vietnamese Restaurant	Bagel Shop	Pizza Place	Dessert Shop	Diner	Restaurant
51	Downtown Toronto	1	Coffee Shop	Chinese Restaurant	Bakery	Italian Restaurant	Café	Pizza Place	Restaurant	Japanese Restaurant	Indian Restaurant	
52	Downtown Toronto	1	Coffee Shop	Japanese Restaurant	Restaurant	Bubble Tea Shop	Burger Joint	Café	Gastropub	Mediterranean Restaurant	Wings Joint	Eastern Restaurant
53	Downtown Toronto	1	Coffee Shop	Bakery	Mexican Restaurant	Café	Restaurant	French Restaurant	Breakfast Spot	Italian Restaurant	Greek Restaurant	Ice Cream Shop
54	Downtown Toronto	1	Coffee Shop	Middle Eastern Restaurant	Café	Fast Food Restaurant	Pizza Place	Restaurant	Italian Restaurant	Bubble Tea Shop	Tea Room	
55	Downtown Toronto	1	Coffee Shop	Café	Restaurant	Diner	Italian Restaurant	Bakery	Breakfast Spot	Japanese Restaurant	BBQ Joint	Restaurant
56	Downtown Toronto	1	Coffee Shop	Steakhouse	Seafood Restaurant	Café	Bakery	Breakfast Spot	French Restaurant	Italian Restaurant	Japanese Restaurant	
57	Downtown Toronto	1	Coffee Shop	Italian Restaurant	Sandwich Place	Café	Burger Joint	Japanese Restaurant	Ice Cream Shop	Middle Eastern Restaurant	Juice Bar	Salad Bar
58	Downtown Toronto	1	Coffee Shop	Café	Steakhouse	Burger Joint	Salad Place	Thai Restaurant	Asian Restaurant	Restaurant	Bakery	Pizza Place
59	Downtown Toronto	1	Coffee Shop	Café	Italian Restaurant	Restaurant	Fried Chicken Joint	Pizza Place	Bakery	Bubble Tea Shop	Japanese Restaurant	Restaurant
60	Downtown Toronto	1	Coffee Shop	Café	Restaurant	Italian Restaurant	Bakery	Seafood Restaurant	Deli / Bodega	Gastropub	Steakhouse	American Restaurant
61	Downtown Toronto	1	Coffee Shop	Café	Restaurant	Deli / Bodega	American Restaurant	Bakery	Gastropub	Steakhouse	Italian Restaurant	Restaurant
62	North York	1	Coffee Shop	Fast Food Restaurant	Italian Restaurant	American Restaurant	Comfort Food Restaurant	Thai Restaurant	Juice Bar	Greek Restaurant	Sandwich Place	
65	Central Toronto	1	Sandwich Place	Café	Coffee Shop	Vegetarian / Vegan Restaurant	American Restaurant	BBQ Joint	Pizza Place	Burger Joint	Indian Restaurant	Eastern Restaurant
66	Downtown Toronto	1	Café	Restaurant	Japanese Restaurant	Bakery	Italian Restaurant	French Restaurant	Dessert Shop	Comfort Food Restaurant	Chinese Restaurant	
67	Downtown Toronto	1	Café	Chinese Restaurant	Vietnamese Restaurant	Dumpling Restaurant	Vegetarian / Vegan Restaurant	Coffee Shop	Bakery	Mexican Restaurant	Donut Shop	Taco Shop
69	Downtown Toronto	1	Coffee Shop	Café	Restaurant	Seafood Restaurant	Japanese Restaurant	Italian Restaurant	Bakery	Creperie	Sandwich Place	Eastern Restaurant
70	Downtown Toronto	1	Coffee Shop	Café	Restaurant	Steakhouse	Seafood Restaurant	Japanese Restaurant	Bakery	Gastropub	Burger Joint	
71	North York	1	Vietnamese Restaurant	Coffee Shop	Empanada Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant	Eastern Restaurant
72	North York	1	Asian Restaurant	Bakery	Japanese Restaurant	Wings Joint	Empanada Restaurant	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Diner
75	Downtown Toronto	1	Café	Italian Restaurant	Coffee Shop	Diner	Restaurant	Cuban Restaurant	Deli / Bodega	Dessert Shop	Doner Restaurant	
76	West Toronto	1	Bakery	Café	Middle Eastern Restaurant	Wings Joint	Eastern European Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	
77	West Toronto	1	Asian Restaurant	Coffee Shop	Restaurant	Vegetarian / Vegan Restaurant	Vietnamese Restaurant	New American Restaurant	Café	Pizza Place	Mexican Restaurant	Restaurant
78	West Toronto	1	Café	Coffee Shop	Breakfast Spot	Restaurant	Bakery	Italian Restaurant	Burrito Place	Wings Joint	Diner	Restaurant
79	North York	1	Bakery	Wings Joint	Empanada Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant	Eastern Restaurant
80	York	1	Sandwich Place	Wings Joint	Cupcake Shop	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant	Eastern Restaurant
82	West Toronto	1	Mexican Restaurant	Café	Thai Restaurant	Fried Chicken Joint	Gastropub	Bakery	Diner	Fast Food Restaurant	Italian Restaurant	Restaurant
83	West Toronto	1	Eastern European Restaurant	Italian Restaurant	Coffee Shop	Dessert Shop	Breakfast Spot	Restaurant	Cuban Restaurant	Deli / Bodega	Diner	Restaurant
84	West Toronto	1	Coffee Shop	Café	Italian Restaurant	Pizza Place	Burrito Place	French Restaurant	Gastropub	Falafel Restaurant	Diner	
85	Downtown Toronto	1	Coffee Shop	Diner	Burger Joint	Fried Chicken Joint	Italian Restaurant	Creperie	Mexican Restaurant	Chinese Restaurant	Café	Poached Restaurant
86	East Toronto	1	Burrito Place	Pizza Place	Fast Food Restaurant	Restaurant	Wings Joint	Cupcake Shop	Deli / Bodega	Dessert Shop	Diner	Restaurant
87	Etobicoke	1	Fried Chicken Joint	Mexican Restaurant	Fast Food Restaurant	Bakery	Seafood Restaurant	Sandwich Place	Café	Restaurant	Pizza Place	
91	Etobicoke	1	Wings Joint	Bakery	Burrito Place	Burger Joint	Fast Food Restaurant	Sandwich Place	Fish & Chips Shop	Filipino Restaurant	Food	Restaurant
94	Etobicoke	1	Coffee Shop	Pizza Place	Café	Wings Joint	Cuban Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	
100	Etobicoke	1	Fried Chicken Joint	Fast Food Restaurant	Pizza Place	Sandwich Place	Food	Fish & Chips Shop	Cupcake Shop	Deli / Bodega	Dessert Shop	Food

Cluster 3

```
26]: df_cluster.loc[df_cluster['Cluster Labels'] == 2, df_cluster.columns[[1] + list(range(5, df_cluster.shape[1]))]]
```

26]:

	Borough	Cluster Labels	Top 1 Food Venue	Top 2 Food Venue	Top 3 Food Venue	Top 4 Food Venue	Top 5 Food Venue	Top 6 Food Venue	Top 7 Food Venue	Top 8 Food Venue	Top 9 Food Venue	Top 10 Food Venue
3	Scarborough	2	Coffee Shop	Korean Restaurant	Wings Joint	Eastern European Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant
6	Scarborough	2	Coffee Shop	Wings Joint	Cuban Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant	Eastern European Restaurant
40	East York	2	Coffee Shop	Wings Joint	Cuban Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant	Eastern European Restaurant
68	Downtown Toronto	2	Coffee Shop	Wings Joint	Cuban Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant	Eastern European Restaurant

Cluster 4

```
27]: df_cluster.loc[df_cluster['Cluster Labels'] == 3, df_cluster.columns[[1] + list(range(5, df_cluster.shape[1]))]]
```

27]:

	Borough	Cluster Labels	Top 1 Food Venue	Top 2 Food Venue	Top 3 Food Venue	Top 4 Food Venue	Top 5 Food Venue	Top 6 Food Venue	Top 7 Food Venue	Top 8 Food Venue	Top 9 Food Venue	Top 10 Food Venue
2	Scarborough	3	Mexican Restaurant	Pizza Place	Breakfast Spot	Eastern European Restaurant	Cupcake Shop	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop
24	North York	3	Coffee Shop	Pizza Place	Wings Joint	Eastern European Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant
34	North York	3	Coffee Shop	Pizza Place	Portuguese Restaurant	Dumpling Restaurant	Cupcake Shop	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop
35	East York	3	Pizza Place	Fast Food Restaurant	Gastropub	Breakfast Spot	Wings Joint	Eastern European Restaurant	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant
37	East Toronto	3	Pizza Place	Wings Joint	Eastern European Restaurant	Cupcake Shop	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant
81	York	3	Pizza Place	Wings Joint	Eastern European Restaurant	Cupcake Shop	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant
88	Etobicoke	3	Pizza Place	Coffee Shop	Sandwich Place	Cupcake Shop	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant
95	North York	3	Empanada Restaurant	Pizza Place	Eastern European Restaurant	Cupcake Shop	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant
98	Etobicoke	3	Pizza Place	Sandwich Place	Coffee Shop	Chinese Restaurant	Middle Eastern Restaurant	Filipino Restaurant	Fast Food Restaurant	Cupcake Shop	Food Court	Food
99	Etobicoke	3	Pizza Place	Wings Joint	Eastern European Restaurant	Cupcake Shop	Deli / Bodega	Dessert Shop	Diner	Doner Restaurant	Donut Shop	Dumpling Restaurant