IBM_DS_Capstone_WK5_Final

December 30, 2018

1 IBM Data Science Specialztion Capstone by Coursera

1.0.1 Week 5 Project Final

```
In [1]: #Import necessary packacges & libraries
        !conda install -c conda-forge beautifulsoup4 --yes

        !conda install -c conda-forge geopy --yes

        !conda install -c conda-forge folium=0.5.0 --yes

        print('Libraries installed!')
```

```
Solving environment: done

# All requested packages already installed.

Solving environment: done

# All requested packages already installed.

Solving environment: done

# All requested packages already installed.

Libraries installed!
```

```
In [2]: import numpy as np #library for computations and array manipulations
        import pandas as pd #library for tables
        pd.set_option('display.max_columns', None)
        pd.set_option('display.max_rows', None)

        import requests
        import json

        from bs4 import BeautifulSoup
```

```
from geopy.geocoders import Nominatim

import folium
%matplotlib inline
import matplotlib.pyplot as plt
import matplotlib.cm as cm
import matplotlib.colors as colors

from sklearn.preprocessing import StandardScaler, normalize, scale
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.decomposition import PCA
from sklearn.metrics import mean_squared_error, r2_score

print('Libraries imported!')
```

```
Libraries imported!
```

1.1 I. Prepare the data:

1.1.1 1. Scrap CityRealty website for neighborhoods average prices:

URL: https://www.cityrealty.com/nyc/market-insight/features/get-to-know/map-average-nyc-rent-prices-december-2018/26722

```
In [8]: # Using Beautiful Soup to parse the website's html
        data = requests.get('https://www.cityrealty.com/nyc/market-insight/features/get-to-know/
        soup = BeautifulSoup(data, 'html.parser')
```

```
In [9]: # Scrap the website tables for average prices
        areaList = []
        neighborhoodList = []

        for area in soup.find_all("div", class_="tile _quote _n1 _last"):
            areaText = area.find("a").text
            areaList.append(areaText)

        for index, table in enumerate(soup.find_all("table", class_="table table-bordered table-
            for row in table.find_all("tr"):
                cells = row.find_all("td")
                if len(cells) > 0:
                    neighborhoodName = cells[0].find("a").text.strip()
                    avgPrice = cells[3].text.lstrip("$").strip()
                    if "K" in avgPrice:
                        avgPrice = float(avgPrice.rstrip("K")) * 1000
                    else:
                        if "M" in avgPrice:
```

```
                    avgPrice = float(avgPrice.rstrip("M")) * 1000000

            neighborhoodList.append((
                areaList[index],
                neighborhoodName,
                avgPrice
            ))
```

In [10]:
```
# Put the scrapped data into a dataframe
nyc_neighborhoods_df = pd.DataFrame(neighborhoodList)
nyc_neighborhoods_df.columns = ['Area', 'Neighborhood', 'AvgPrice']
```

In [11]:
```
print(nyc_neighborhoods_df.shape)
nyc_neighborhoods_df.head()
```

```
(54, 3)
```

Out[11]:

	Area	Neighborhood	AvgPrice
0	Brooklyn	Bedford-Stuyvesant	750000
1	Brooklyn	Boerum Hill	1.69e+06
2	Brooklyn	Brooklyn Heights	2.15e+06
3	Brooklyn	Bushwick	967000
4	Brooklyn	Carroll Gardens	1.51e+06

1.1.2 2. Get the neighborhoods coordinate:

Free geodata is available free at: https://geo.nyu.edu/catalog/nyu_2451_34572
A copy has been downloaded and stored in IBM cloud

In [12]:
```
# Download the geodata
!wget -q -O 'nyc_geo.json' https://ibm.box.com/shared/static/fbpwbovar7lf8p5sgddm06cgip
print('Data downloaded!')
```

```
Data downloaded!
```

In [13]:
```
# Load the json file
with open('nyc_geo.json') as nyc_geo_json:
    nyc_geo_data = json.load(nyc_geo_json)
```

In [14]:
```
# Get the neighborhoods list
nyc_geo_list = nyc_geo_data['features']

# Sample neighborhood node
nyc_geo_list[0]
```

Out[14]:
```
{'type': 'Feature',
 'id': 'nyu_2451_34572.1',
```

```
 'geometry': {'type': 'Point',
  'coordinates': [-73.84720052054902, 40.89470517661]},
 'geometry_name': 'geom',
 'properties': {'name': 'Wakefield',
  'stacked': 1,
  'annoline1': 'Wakefield',
  'annoline2': None,
  'annoline3': None,
  'annoangle': 0.0,
  'borough': 'Bronx',
  'bbox': [-73.84720052054902,
   40.89470517661,
   -73.84720052054902,
   40.89470517661]}}
```


In [15]:

```python
# Parse the json data into neighborhoods list
neighborhood_geo_list = []
for data in nyc_geo_list:
    borough = neighborhood_name = data['properties']['borough']
    neighborhood_name = data['properties']['name']

    neighborhood_latlon = data['geometry']['coordinates']
    neighborhood_lat = neighborhood_latlon[1]
    neighborhood_lon = neighborhood_latlon[0]

    neighborhood_geo_list.append((
        borough, neighborhood_name, neighborhood_lat, neighborhood_lon
    ))
```

In [16]:

```python
# Put into a dataframe
neighborhood_geo_df = pd.DataFrame(neighborhood_geo_list)
neighborhood_geo_df.columns = ['Borough', 'Neighborhood', 'Latitude', 'Longitude']

# Avg price data is only available for Manhattan and Brooklyn
neighborhood_geo_df = neighborhood_geo_df[(neighborhood_geo_df['Borough'] == 'Manhattan

neighborhood_geo_df.reset_index(drop=True, inplace=True)
```

In [17]:

```python
print(neighborhood_geo_df.shape)
neighborhood_geo_df.head()
```

```
(110, 4)
```

Out[17]:

	Borough	Neighborhood	Latitude	Longitude
0	Manhattan	Marble Hill	40.876551	-73.910660
1	Brooklyn	Bay Ridge	40.625801	-74.030621
2	Brooklyn	Bensonhurst	40.611009	-73.995180
3	Brooklyn	Sunset Park	40.645103	-74.010316
4	Brooklyn	Greenpoint	40.730201	-73.954241

1.1.3 3. Combine the two dataframes:

There are three problems here causing the number of neighborhoods doesn't match:
- First, avg price data isn't available to all neighborhoods. - Second, some neighborhoods name scrapped from the website is not same as their corresponding ones in the geo dataset. - Third, real estate market names some neighborhoods differently, or make up of new names. All for the purpose of sale.

Each line of price data will be considered, and suitable action will be performed: - If the names is different, decide which one to use after searching on the internet. - If the neighborhood is missing from the geo datafram, add it's coordinate. - If the neighborhoods is makeup, combine them into the larger neighborhood which exist in the geo dataframe.

In [18]:
```
# Bedford Stuyvesant missing a '-' in the middle
neighborhood_geo_df.at[18, 'Neighborhood'] = 'Bedford-Stuyvesant'

# Downtown is Downtown Brooklyn
neighborhood_geo_df.at[41, 'Neighborhood'] = 'Downtown Brooklyn'

# Dumbo should be DUMBO
neighborhood_geo_df.at[104, 'Neighborhood'] = 'DUMBO'

# Prospect Lefferts Gardens missing a '-' in the middle
nyc_neighborhoods_df.at[15, 'Neighborhood'] = 'Prospect-Lefferts Gardens'
neighborhood_geo_df.at[43, 'Neighborhood'] = 'Prospect-Lefferts Gardens'

# South Slope - Greenwood Heights is just South Slope
nyc_neighborhoods_df.at[17, 'Neighborhood'] = 'South Slope'
# South Slope coordinates is missing
neighborhood_geo_df = neighborhood_geo_df.append({'Borough': 'Brooklyn',
                                                  'Neighborhood': 'South Slope',
                                                  'Latitude': 40.662349,
                                                  'Longitude': -73.990350}, ignore_inde

# Park, Fifth Ave to 79th St is Upper East Side
nyc_neighborhoods_df.at[24, 'Neighborhood'] = 'Upper East Side'

# Flatiron/Union Square is just Flatiron
nyc_neighborhoods_df.at[29, 'Neighborhood'] = 'Flatiron District'
neighborhood_geo_df.at[99, 'Neighborhood'] = 'Flatiron District'

# Gramercy Park is just Gramercy
nyc_neighborhoods_df.at[30, 'Neighborhood'] = 'Gramercy'

# NOHO should be just NoHo
nyc_neighborhoods_df.at[33, 'Neighborhood'] = 'NoHo'
neighborhood_geo_df.at[88, 'Neighborhood'] = 'NoHo'

# NoLiTa/Little Italy is just NoLiTa
```

```
nyc_neighborhoods_df.at[34, 'Neighborhood'] = 'NoLiTa'
neighborhood_geo_df.at[76, 'Neighborhood'] = 'NoLiTa'

# SOHO should be just SoHo
nyc_neighborhoods_df.at[35, 'Neighborhood'] = 'SoHo'
neighborhood_geo_df.at[77, 'Neighborhood'] = 'SoHo'

# Stuyvesant Town / PCV is just Stuyvesant Town
nyc_neighborhoods_df.at[36, 'Neighborhood'] = 'Stuyvesant Town'

# Beekman/Sutton Place is just Sutton Place
nyc_neighborhoods_df.at[39, 'Neighborhood'] = 'Sutton Place'

# Midtown East and Midtown West will be combined into Midtown
nyc_neighborhoods_df.at[40, 'Neighborhood'] = 'Midtown'
midtown_avg = (nyc_neighborhoods_df.at[40, 'AvgPrice'] + nyc_neighborhoods_df.at[41, 'A
nyc_neighborhoods_df.at[40, 'AvgPrice'] = midtown_avg
nyc_neighborhoods_df.at[41, 'AvgPrice'] = '-'

# Turtle Bay/United Nations is just Turtle Bay
nyc_neighborhoods_df.at[43, 'Neighborhood'] = 'Turtle Bay'

# Central Harlem is Harlem
neighborhood_geo_df.at[60, 'Neighborhood'] = 'Harlem'

# Lincoln Center is Lincoln Square
nyc_neighborhoods_df.at[51, 'Neighborhood'] = 'Lincoln Square'

# Broadway Cooridor, Central Park West and Riverside Dr./West End Ave. will be combined
nyc_neighborhoods_df.at[49, 'Neighborhood'] = 'Upper West Side'
midtown_avg = (nyc_neighborhoods_df.at[49, 'AvgPrice'] + nyc_neighborhoods_df.at[50, 'A
nyc_neighborhoods_df.at[49, 'AvgPrice'] = midtown_avg
nyc_neighborhoods_df.at[50, 'AvgPrice'] = '-'
nyc_neighborhoods_df.at[53, 'AvgPrice'] = '-'

# Drop the Red Hook row
nyc_neighborhoods_df.drop([16], inplace=True)
```

```
In [19]: # Inner join the two dataframes by Neighborhoods
nyc_neighborhood_price_df = pd.concat([nyc_neighborhoods_df.set_index('Neighborhood'),
nyc_neighborhood_price_df.drop(columns=['Area', 'Borough'], inplace=True)
nyc_neighborhood_price_df.reset_index(inplace=True)
```

```
In [20]: # The joined dataframe
print(nyc_neighborhood_price_df.shape)
nyc_neighborhood_price_df.head()
```

```
(50, 4)
```

```
Out[20]:          Neighborhood  AvgPrice   Latitude  Longitude
         0  Bedford-Stuyvesant    750000  40.687232 -73.941785
         1         Boerum Hill  1.69e+06  40.685683 -73.983748
         2    Brooklyn Heights  2.15e+06  40.695864 -73.993782
         3            Bushwick    967000  40.698116 -73.925258
         4     Carroll Gardens  1.51e+06  40.680540 -73.994654
```

1.1.4 4. Visualize the data onto a map

```
In [21]: # for choropleth map, we need another geo data which contain the Polygon type Coordinat
         !wget -q -O 'nyc_geo.geojson' http://data.beta.nyc//dataset/0ff93d2d-90ba-457c-9f7e-39e
         print('Data downloaded!')

         nyc_polygon_geo_data = r'nyc_geo.geojson'
         latitude = 40.8021285
         longitude = -73.9777254
```

```
Data downloaded!
```

```
In [22]: # Map without markers

         # create a plain world map
         nyc_map = folium.Map(location=[latitude, longitude], zoom_start=11)

         # generate choropleth map
         nyc_map.choropleth(
             geo_data=nyc_polygon_geo_data,
             data=nyc_neighborhood_price_df,
             columns=['Neighborhood', 'AvgPrice'],
             key_on='feature.properties.neighborhood',
             fill_color='YlOrRd',
             fill_opacity=0.7,
             line_opacity=0.2,
             legend_name='Average 2 bedrooms condo price in New York city'
         )

         # display map
         nyc_map
```

```
Out[22]: <folium.folium.Map at 0x7f64bcd90320>
```

```
In [23]: # Map with markers

         # create a plain world map
         nyc_map = folium.Map(location=[latitude, longitude], zoom_start=11)

         # generate choropleth map
         nyc_map.choropleth(
```

```
        geo_data=nyc_polygon_geo_data,
        data=nyc_neighborhood_price_df,
        columns=['Neighborhood', 'AvgPrice'],
        key_on='feature.properties.neighborhood',
        fill_color='YlOrRd',
        fill_opacity=0.7,
        line_opacity=0.2,
        legend_name='Average 2 bedrooms condo price in New York city'
    )

    # add markers to map
    for lat, lng, neighborhood, price in zip(nyc_neighborhood_price_df['Latitude'], nyc_nei
        label = '{}, ${:3.0f}'.format(neighborhood, price)
        label = folium.Popup(label, parse_html=True)
        folium.CircleMarker(
            [lat, lng],
            radius=5,
            popup=label,
            color='blue',
            fill=True,
            fill_color='#3186cc',
            fill_opacity=0.7,
            parse_html=False).add_to(nyc_map)

    # display map
    nyc_map
```

Out[23]: <folium.folium.Map at 0x7f64bcb78d30>

1.1.5 5. Using FourSquare API to get surrounding venues:

In [24]:
```
CLIENT_ID = 'XVEFCDBVHOQ1YTWQA54LAJ3Q515Y14CMKWEJHILHG3KP4104' # your Foursquare ID hid
CLIENT_SECRET = '2C52CNRF5VN5LFGMQDHPHYNNCO3VCQCYXDMGH3RD04Y1PNHY' # your Foursquare Se
VERSION = '20180605' # Foursquare API version
```

In [26]:
```
# FourSquare parameters
radius = 1000 # 1 km around the neighborhood center
limit = 200

venues = []

for lat, long, neighborhood in zip(nyc_neighborhood_price_df['Latitude'], nyc_neighborh
    url = "https://api.foursquare.com/v2/venues/explore?client_id={}&client_secret={}&v
        CLIENT_ID,
        CLIENT_SECRET,
        VERSION,
        lat,
        long,
```

```
            radius,
            limit)

        results = requests.get(url).json()["response"]['groups'][0]['items']

        for venue in results:
            venues.append((
                neighborhood,
                lat,
                long,
                venue['venue']['name'],
                venue['venue']['location']['lat'],
                venue['venue']['location']['lng'],
                venue['venue']['categories'][0]['name']))
```

In [21]:
```
# put the venues into a dataframe
venues_df = pd.DataFrame(venues)
venues_df.columns = ['Neighborhood', 'Latitude', 'Longitude', 'VenueName', 'VenueLatitu

# check the dataframe
print(venues_df.shape)
print('There are {} unique venue types.'.format(len(venues_df['VenueType'].unique())))
venues_df.head()
```

```
(4999, 7)
There are 327 unique venue types.
```

Out[21]:
```
          Neighborhood   Latitude  Longitude               VenueName  \
0  Bedford-Stuyvesant  40.687232 -73.941785         Sincerely Tommy
1  Bedford-Stuyvesant  40.687232 -73.941785           Bed-Vyne Brew
2  Bedford-Stuyvesant  40.687232 -73.941785  Bed-Vyne Wine & Spirits
3  Bedford-Stuyvesant  40.687232 -73.941785            Anchor Coffee
4  Bedford-Stuyvesant  40.687232 -73.941785        Peaches HotHouse

   VenueLatitude  VenueLongitude           VenueType
0      40.686066      -73.944294            Boutique
1      40.684751      -73.944319                 Bar
2      40.684668      -73.944363           Wine Shop
3      40.684145      -73.941015         Coffee Shop
4      40.683331      -73.943853  Fried Chicken Joint
```

In [22]:
```
# one hot encoding
venues_type_onehot = pd.get_dummies(venues_df[['VenueType']], prefix="", prefix_sep="")

# add the neighborhood column
```

```
venues_type_onehot['Neighborhood'] = venues_df['Neighborhood']
fix_columns = list(venues_type_onehot.columns[-1:]) + list(venues_type_onehot.columns[:
venues_type_onehot = venues_type_onehot[fix_columns]

print(venues_type_onehot.shape)
venues_type_onehot.head()
```

```
(4999, 328)
```

```
Out[22]:          Neighborhood  Accessories Store  Adult Boutique  African Restaurant  \
        0  Bedford-Stuyvesant                  0               0                   0
        1  Bedford-Stuyvesant                  0               0                   0
        2  Bedford-Stuyvesant                  0               0                   0
        3  Bedford-Stuyvesant                  0               0                   0
        4  Bedford-Stuyvesant                  0               0                   0

           American Restaurant  Animal Shelter  Antique Shop  Arcade  \
        0                    0               0             0       0
        1                    0               0             0       0
        2                    0               0             0       0
        3                    0               0             0       0
        4                    0               0             0       0

           Arepa Restaurant  Argentinian Restaurant  Art Gallery  Art Museum  \
        0                 0                       0            0           0
        1                 0                       0            0           0
        2                 0                       0            0           0
        3                 0                       0            0           0
        4                 0                       0            0           0

           Arts & Crafts Store  Asian Restaurant  Athletics & Sports  Auditorium  \
        0                    0                 0                   0           0
        1                    0                 0                   0           0
        2                    0                 0                   0           0
        3                    0                 0                   0           0
        4                    0                 0                   0           0

           Australian Restaurant  Austrian Restaurant  BBQ Joint  Bagel Shop  Bakery  \
        0                      0                    0          0           0       0
        1                      0                    0          0           0       0
        2                      0                    0          0           0       0
        3                      0                    0          0           0       0
        4                      0                    0          0           0       0

           Bank  Bar  Baseball Field  Basketball Court  Basketball Stadium  Beach  \
        0     0    0               0                 0                   0      0
        1     0    1               0                 0                   0      0
```

```
2   0   0           0            0             0     0
3   0   0           0            0             0     0
4   0   0           0            0             0     0

   Beer Bar  Beer Garden  Beer Store  Bike Trail  Bistro  Board Shop  \
0         0            0           0           0       0           0
1         0            0           0           0       0           0
2         0            0           0           0       0           0
3         0            0           0           0       0           0
4         0            0           0           0       0           0

   Boat or Ferry  Bookstore  Botanical Garden  Boutique  Boxing Gym  \
0              0          0                 0         1           0
1              0          0                 0         0           0
2              0          0                 0         0           0
3              0          0                 0         0           0
4              0          0                 0         0           0

   Brazilian Restaurant  Breakfast Spot  Brewery  Bridal Shop  Bridge  \
0                     0               0        0            0       0
1                     0               0        0            0       0
2                     0               0        0            0       0
3                     0               0        0            0       0
4                     0               0        0            0       0

   Bubble Tea Shop  Buffet  Building  Burger Joint  Burrito Place  Butcher  \
0                0       0         0             0              0        0
1                0       0         0             0              0        0
2                0       0         0             0              0        0
3                0       0         0             0              0        0
4                0       0         0             0              0        0

   Cafeteria  Café  Cajun / Creole Restaurant  Cambodian Restaurant  \
0          0     0                          0                     0
1          0     0                          0                     0
2          0     0                          0                     0
3          0     0                          0                     0
4          0     0                          0                     0

   Candy Store  Caribbean Restaurant  Cemetery  Cheese Shop  \
0            0                     0         0            0
1            0                     0         0            0
2            0                     0         0            0
3            0                     0         0            0
4            0                     0         0            0

   Chinese Restaurant  Chocolate Shop  Christmas Market  Church  Climbing Gym  \
0                   0               0                 0       0             0
```

```
1                   0               0                 0       0              0
2                   0               0                 0       0              0
3                   0               0                 0       0              0
4                   0               0                 0       0              0

   Clothing Store  Club House  Cocktail Bar  Coffee Shop  \
0               0           0             0            0
1               0           0             0            0
2               0           0             0            0
3               0           0             0            1
4               0           0             0            0

   College Academic Building  College Theater  Colombian Restaurant  \
0                          0                0                     0
1                          0                0                     0
2                          0                0                     0
3                          0                0                     0
4                          0                0                     0

   Comedy Club  Comfort Food Restaurant  Comic Shop  Community Center  \
0            0                        0           0                 0
1            0                        0           0                 0
2            0                        0           0                 0
3            0                        0           0                 0
4            0                        0           0                 0

   Concert Hall  Convenience Store  Cosmetics Shop  Coworking Space  Creperie  \
0             0                  0               0                0         0
1             0                  0               0                0         0
2             0                  0               0                0         0
3             0                  0               0                0         0
4             0                  0               0                0         0

   Cuban Restaurant  Cupcake Shop  Cycle Studio  Czech Restaurant  \
0                 0             0             0                 0
1                 0             0             0                 0
2                 0             0             0                 0
3                 0             0             0                 0
4                 0             0             0                 0

   Dance Studio  Daycare  Deli / Bodega  Department Store  Design Studio  \
0             0        0              0                 0              0
1             0        0              0                 0              0
2             0        0              0                 0              0
3             0        0              0                 0              0
4             0        0              0                 0              0

   Dessert Shop  Diner  Discount Store  Dive Bar  Dog Run  Donut Shop  \
```

```
0             0      0               0         0        0            0
1             0      0               0         0        0            0
2             0      0               0         0        0            0
3             0      0               0         0        0            0
4             0      0               0         0        0            0

   Drugstore  Dumpling Restaurant  Eastern European Restaurant  \
0          0                    0                            0
1          0                    0                            0
2          0                    0                            0
3          0                    0                            0
4          0                    0                            0

   Electronics Store  Empanada Restaurant  English Restaurant  \
0                  0                    0                   0
1                  0                    0                   0
2                  0                    0                   0
3                  0                    0                   0
4                  0                    0                   0

   Ethiopian Restaurant  Event Space  Exhibit  Factory  Falafel Restaurant  \
0                     0            0        0        0                   0
1                     0            0        0        0                   0
2                     0            0        0        0                   0
3                     0            0        0        0                   0
4                     0            0        0        0                   0

   Farm  Farmers Market  Fast Food Restaurant  Field  Filipino Restaurant  \
0     0               0                     0      0                    0
1     0               0                     0      0                    0
2     0               0                     0      0                    0
3     0               0                     0      0                    0
4     0               0                     0      0                    0

   Film Studio  Fish & Chips Shop  Fish Market  Flea Market  Flower Shop  \
0            0                  0            0            0            0
1            0                  0            0            0            0
2            0                  0            0            0            0
3            0                  0            0            0            0
4            0                  0            0            0            0

   Food  Food & Drink Shop  Food Court  Food Truck  Fountain  \
0     0                  0           0           0         0
1     0                  0           0           0         0
2     0                  0           0           0         0
3     0                  0           0           0         0
4     0                  0           0           0         0
```

```
   French Restaurant  Fried Chicken Joint  Frozen Yogurt Shop  \
0                  0                    0                   0
1                  0                    0                   0
2                  0                    0                   0
3                  0                    0                   0
4                  0                    1                   0

   Fruit & Vegetable Store  Furniture / Home Store  Gaming Cafe  Garden  \
0                        0                       0            0       0
1                        0                       0            0       0
2                        0                       0            0       0
3                        0                       0            0       0
4                        0                       0            0       0

   Garden Center  Gas Station  Gastropub  Gay Bar  \
0              0            0          0        0
1              0            0          0        0
2              0            0          0        0
3              0            0          0        0
4              0            0          0        0

   General College & University  General Entertainment  German Restaurant  \
0                             0                      0                  0
1                             0                      0                  0
2                             0                      0                  0
3                             0                      0                  0
4                             0                      0                  0

   Gift Shop  Golf Driving Range  Gourmet Shop  Greek Restaurant  \
0          0                   0             0                 0
1          0                   0             0                 0
2          0                   0             0                 0
3          0                   0             0                 0
4          0                   0             0                 0

   Grocery Store  Gym  Gym / Fitness Center  Gymnastics Gym  Halal Restaurant  \
0              0    0                     0               0                 0
1              0    0                     0               0                 0
2              0    0                     0               0                 0
3              0    0                     0               0                 0
4              0    0                     0               0                 0

   Harbor / Marina  Hawaiian Restaurant  Health & Beauty Service  \
0                0                    0                        0
1                0                    0                        0
2                0                    0                        0
3                0                    0                        0
4                0                    0                        0
```

	Health Food Store	High School	Historic Site	History Museum	Hobby Shop	\
0	0	0	0	0	0	
1	0	0	0	0	0	
2	0	0	0	0	0	
3	0	0	0	0	0	
4	0	0	0	0	0	

	Hookah Bar	Hot Dog Joint	Hotel	Hotel Bar	Ice Cream Shop	\
0	0	0	0	0	0	
1	0	0	0	0	0	
2	0	0	0	0	0	
3	0	0	0	0	0	
4	0	0	0	0	0	

	Indian Restaurant	Indie Movie Theater	Indie Theater	Indoor Play Area	\
0	0	0	0	0	
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	

	Israeli Restaurant	Italian Restaurant	Japanese Curry Restaurant	\
0	0	0	0	
1	0	0	0	
2	0	0	0	
3	0	0	0	
4	0	0	0	

	Japanese Restaurant	Jazz Club	Jewelry Store	Jewish Restaurant	\
0	0	0	0	0	
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	

	Juice Bar	Karaoke Bar	Kids Store	Kitchen Supply Store	\
0	0	0	0	0	
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	

	Korean Restaurant	Kosher Restaurant	Lake	Laser Tag	\
0	0	0	0	0	
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	

```
4                  0                  0     0          0

   Latin American Restaurant  Laundry Service  Lebanese Restaurant  Library  \
0                          0                0                    0        0
1                          0                0                    0        0
2                          0                0                    0        0
3                          0                0                    0        0
4                          0                0                    0        0

   Lighthouse  Lingerie Store  Liquor Store  Locksmith  Lounge  Market  \
0           0               0             0          0       0       0
1           0               0             0          0       0       0
2           0               0             0          0       0       0
3           0               0             0          0       0       0
4           0               0             0          0       0       0

   Martial Arts Dojo  Massage Studio  Medical Center  \
0                  0               0               0
1                  0               0               0
2                  0               0               0
3                  0               0               0
4                  0               0               0

   Mediterranean Restaurant  Memorial Site  Men's Store  Mexican Restaurant  \
0                         0              0            0                   0
1                         0              0            0                   0
2                         0              0            0                   0
3                         0              0            0                   0
4                         0              0            0                   0

   Middle Eastern Restaurant  Mini Golf  Miscellaneous Shop  \
0                          0          0                   0
1                          0          0                   0
2                          0          0                   0
3                          0          0                   0
4                          0          0                   0

   Mobile Phone Shop  Modern European Restaurant  \
0                  0                           0
1                  0                           0
2                  0                           0
3                  0                           0
4                  0                           0

   Molecular Gastronomy Restaurant  Monument / Landmark  Moroccan Restaurant  \
0                                0                    0                    0
1                                0                    0                    0
2                                0                    0                    0
```

```
3                              0                    0                    0
4                              0                    0                    0

   Motorcycle Shop  Movie Theater  Museum  Music Store  Music Venue  \
0                0              0       0            0            0
1                0              0       0            0            0
2                0              0       0            0            0
3                0              0       0            0            0
4                0              0       0            0            0

   Nail Salon  New American Restaurant  Nightclub  Noodle House  Office  \
0           0                        0          0             0       0
1           0                        0          0             0       0
2           0                        0          0             0       0
3           0                        0          0             0       0
4           0                        0          0             0       0

   Opera House  Optical Shop  Organic Grocery  Other Great Outdoors  \
0            0             0                0                     0
1            0             0                0                     0
2            0             0                0                     0
3            0             0                0                     0
4            0             0                0                     0

   Other Nightlife  Other Repair Shop  Outdoor Sculpture  \
0                0                  0                  0
1                0                  0                  0
2                0                  0                  0
3                0                  0                  0
4                0                  0                  0

   Outdoors & Recreation  Paella Restaurant  Pakistani Restaurant  \
0                      0                  0                     0
1                      0                  0                     0
2                      0                  0                     0
3                      0                  0                     0
4                      0                  0                     0

   Paper / Office Supplies Store  Park  Performing Arts Venue  Perfume Shop  \
0                              0     0                      0             0
1                              0     0                      0             0
2                              0     0                      0             0
3                              0     0                      0             0
4                              0     0                      0             0

   Persian Restaurant  Peruvian Restaurant  Pet Café  Pet Service  Pet Store  \
0                   0                    0         0            0          0
1                   0                    0         0            0          0
```

```
2                 0                    0        0            0          0
3                 0                    0        0            0          0
4                 0                    0        0            0          0

   Pharmacy  Piano Bar  Pie Shop  Pier  Pilates Studio  Pizza Place  \
0         0          0         0     0               0            0
1         0          0         0     0               0            0
2         0          0         0     0               0            0
3         0          0         0     0               0            0
4         0          0         0     0               0            0

   Playground  Plaza  Polish Restaurant  Pool  Print Shop  Pub  Public Art  \
0           0      0                  0     0           0    0           0
1           0      0                  0     0           0    0           0
2           0      0                  0     0           0    0           0
3           0      0                  0     0           0    0           0
4           0      0                  0     0           0    0           0

   Ramen Restaurant  Record Shop  Recreation Center  \
0                 0            0                  0
1                 0            0                  0
2                 0            0                  0
3                 0            0                  0
4                 0            0                  0

   Residential Building (Apartment / Condo)  Resort  Rest Area  Restaurant  \
0                                         0       0          0           0
1                                         0       0          0           0
2                                         0       0          0           0
3                                         0       0          0           0
4                                         0       0          0           0

   Rock Club  Roof Deck  Russian Restaurant  Sake Bar  Salad Place  \
0          0          0                   0         0            0
1          0          0                   0         0            0
2          0          0                   0         0            0
3          0          0                   0         0            0
4          0          0                   0         0            0

   Salon / Barbershop  Sandwich Place  Scenic Lookout  School  \
0                   0               0               0       0
1                   0               0               0       0
2                   0               0               0       0
3                   0               0               0       0
4                   0               0               0       0

   Sculpture Garden  Seafood Restaurant  Shabu-Shabu Restaurant  \
0                 0                   0                       0
```

```
1              0                 0                     0
2              0                 0                     0
3              0                 0                     0
4              0                 0                     0

   Shipping Store  Shoe Store  Shopping Mall  Skating Rink  Smoke Shop  \
0               0           0              0             0           0
1               0           0              0             0           0
2               0           0              0             0           0
3               0           0              0             0           0
4               0           0              0             0           0

   Snack Place  Soba Restaurant  Soccer Field  Social Club  Soup Place  \
0            0                0             0            0           0
1            0                0             0            0           0
2            0                0             0            0           0
3            0                0             0            0           0
4            0                0             0            0           0

   South American Restaurant  Southern / Soul Food Restaurant  Spa  \
0                          0                                0    0
1                          0                                0    0
2                          0                                0    0
3                          0                                0    0
4                          0                                0    0

   Spanish Restaurant  Speakeasy  Sporting Goods Shop  Sports Bar  \
0                   0          0                    0           0
1                   0          0                    0           0
2                   0          0                    0           0
3                   0          0                    0           0
4                   0          0                    0           0

   Sports Club  State / Provincial Park  Steakhouse  Street Art  \
0            0                        0           0           0
1            0                        0           0           0
2            0                        0           0           0
3            0                        0           0           0
4            0                        0           0           0

   Street Food Gathering  Strip Club  Supermarket  Supplement Shop  \
0                      0           0            0                0
1                      0           0            0                0
2                      0           0            0                0
3                      0           0            0                0
4                      0           0            0                0

   Sushi Restaurant  Swiss Restaurant  Synagogue  Szechuan Restaurant  \
```

```
0                 0                  0          0                     0
1                 0                  0          0                     0
2                 0                  0          0                     0
3                 0                  0          0                     0
4                 0                  0          0                     0

   TV Station  Taco Place  Tailor Shop  Taiwanese Restaurant  \
0           0           0            0                     0
1           0           0            0                     0
2           0           0            0                     0
3           0           0            0                     0
4           0           0            0                     0

   Tapas Restaurant  Tattoo Parlor  Tea Room  Tech Startup  Tennis Court  \
0                 0              0         0             0             0
1                 0              0         0             0             0
2                 0              0         0             0             0
3                 0              0         0             0             0
4                 0              0         0             0             0

   Thai Restaurant  Theater  Theme Park Ride / Attraction  \
0                0        0                             0
1                0        0                             0
2                0        0                             0
3                0        0                             0
4                0        0                             0

   Thrift / Vintage Store  Tiki Bar  Tourist Information Center  \
0                       0         0                           0
1                       0         0                           0
2                       0         0                           0
3                       0         0                           0
4                       0         0                           0

   Toy / Game Store  Track  Trail  Train Station  Tram Station  \
0                 0      0      0              0             0
1                 0      0      0              0             0
2                 0      0      0              0             0
3                 0      0      0              0             0
4                 0      0      0              0             0

   Turkish Restaurant  Udon Restaurant  Ukrainian Restaurant  Used Bookstore  \
0                   0                0                     0               0
1                   0                0                     0               0
2                   0                0                     0               0
3                   0                0                     0               0
4                   0                0                     0               0
```

	Vape Store	Vegetarian / Vegan Restaurant	Venezuelan Restaurant	\
0	0	0	0	
1	0	0	0	
2	0	0	0	
3	0	0	0	
4	0	0	0	

	Veterinarian	Video Game Store	Video Store	Vietnamese Restaurant	\
0	0	0	0	0	
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	

	Volleyball Court	Waterfront	Whisky Bar	Wine Bar	Wine Shop	Wings Joint	\
0	0	0	0	0	0	0	
1	0	0	0	0	0	0	
2	0	0	0	0	1	0	
3	0	0	0	0	0	0	
4	0	0	0	0	0	0	

	Women's Store	Yoga Studio
0	0	0
1	0	0
2	0	0
3	0	0
4	0	0

In [23]:
```python
# get the occurrence of each venue type in each neighborhood
venue_count_df = venues_type_onehot.groupby(['Neighborhood']).sum().reset_index()

print(venue_count_df.shape)
venue_count_df.head()
```

(50, 328)

Out[23]:

	Neighborhood	Accessories Store	Adult Boutique	African Restaurant	\
0	Battery Park City	0	0	0	
1	Bedford-Stuyvesant	0	0	0	
2	Boerum Hill	0	0	0	
3	Brooklyn Heights	0	0	0	
4	Bushwick	0	0	0	

	American Restaurant	Animal Shelter	Antique Shop	Arcade	\
0	3	0	0	0	
1	0	0	0	0	
2	1	0	0	0	

```
3                  2              0             0       0
4                  1              0             0       0

   Arepa Restaurant  Argentinian Restaurant  Art Gallery  Art Museum  \
0                 0                       0            0           0
1                 0                       0            1           0
2                 0                       0            1           0
3                 0                       0            0           0
4                 1                       0            1           0

   Arts & Crafts Store  Asian Restaurant  Athletics & Sports  Auditorium  \
0                    0                 0                   1           1
1                    0                 0                   0           0
2                    2                 0                   2           0
3                    0                 1                   1           0
4                    0                 1                   0           0

   Australian Restaurant  Austrian Restaurant  BBQ Joint  Bagel Shop  Bakery  \
0                      0                    0          2           1       1
1                      0                    0          1           1       1
2                      0                    0          0           1       3
3                      0                    0          0           2       2
4                      0                    0          0           2       2

   Bank  Bar  Baseball Field  Basketball Court  Basketball Stadium  Beach  \
0     0    0               0                 0                   0      0
1     0    6               0                 0                   0      0
2     0    6               0                 0                   1      0
3     0    3               0                 0                   0      1
4     0   17               0                 0                   0      0

   Beer Bar  Beer Garden  Beer Store  Bike Trail  Bistro  Board Shop  \
0         0            0           0           0       0           0
1         0            0           0           0       0           0
2         0            0           0           0       0           1
3         0            0           0           0       0           0
4         0            0           0           0       0           0

   Boat or Ferry  Bookstore  Botanical Garden  Boutique  Boxing Gym  \
0              0          2                 0         0           1
1              0          0                 0         1           0
2              0          2                 0         1           0
3              0          0                 0         0           1
4              0          1                 0         0           0

   Brazilian Restaurant  Breakfast Spot  Brewery  Bridal Shop  Bridge  \
0                     0               0        0            0       0
1                     0               0        0            0       0
```

```
2                 0            0      1          0      0
3                 0            0      0          0      0
4                 0            0      1          0      0

   Bubble Tea Shop  Buffet  Building  Burger Joint  Burrito Place  Butcher  \
0                0       0         1             2              1        0
1                0       0         0             0              0        0
2                0       0         0             3              1        0
3                0       0         0             2              0        0
4                0       0         0             0              0        0

   Cafeteria  Café  Cajun / Creole Restaurant  Cambodian Restaurant  \
0          0     1                          0                     0
1          0     6                          0                     0
2          0     0                          0                     0
3          0     2                          0                     0
4          0     3                          0                     0

   Candy Store  Caribbean Restaurant  Cemetery  Cheese Shop  \
0            0                     0         0            0
1            0                     4         0            0
2            0                     0         0            1
3            0                     0         0            0
4            0                     0         0            0

   Chinese Restaurant  Chocolate Shop  Christmas Market  Church  Climbing Gym  \
0                   0               0                 0       0             0
1                   4               0                 0       0             0
2                   2               1                 0       0             1
3                   0               0                 0       0             0
4                   0               0                 0       0             0

   Clothing Store  Club House  Cocktail Bar  Coffee Shop  \
0               0           0             0            8
1               0           0             2           11
2               0           0             3            7
3               0           0             2            4
4               0           0             4            6

   College Academic Building  College Theater  Colombian Restaurant  \
0                          0                0                     0
1                          0                0                     0
2                          0                0                     0
3                          0                0                     0
4                          0                0                     0

   Comedy Club  Comfort Food Restaurant  Comic Shop  Community Center  \
0            0                        0           0                 0
```

```
1          0                    1         0              0
2          0                    0         0              0
3          0                    0         0              0
4          0                    0         0              0

   Concert Hall  Convenience Store  Cosmetics Shop  Coworking Space  Creperie  \
0             0                  0               0                0         0
1             0                  1               0                0         0
2             1                  0               1                0         0
3             0                  0               2                0         0
4             0                  0               0                0         0

   Cuban Restaurant  Cupcake Shop  Cycle Studio  Czech Restaurant  \
0                 0             1             1                 0
1                 0             0             0                 0
2                 0             0             0                 0
3                 0             0             1                 0
4                 0             0             0                 0

   Dance Studio  Daycare  Deli / Bodega  Department Store  Design Studio  \
0             0        0              0                 1              0
1             0        0              4                 0              0
2             3        0              0                 2              0
3             0        0              1                 0              0
4             0        0              3                 0              0

   Dessert Shop  Diner  Discount Store  Dive Bar  Dog Run  Donut Shop  \
0             0      0               0         0        2           0
1             0      1               1         0        1           0
2             0      1               0         0        0           0
3             0      1               0         0        2           0
4             0      0               0         3        1           0

   Drugstore  Dumpling Restaurant  Eastern European Restaurant  \
0          0                    0                            0
1          0                    0                            0
2          0                    0                            0
3          0                    0                            0
4          0                    0                            0

   Electronics Store  Empanada Restaurant  English Restaurant  \
0                  1                    0                   0
1                  0                    0                   0
2                  0                    0                   0
3                  0                    0                   0
4                  0                    0                   0

   Ethiopian Restaurant  Event Space  Exhibit  Factory  Falafel Restaurant  \
```

```
0                   0            0        0        0                  0
1                   0            0        0        0                  0
2                   0            0        0        0                  0
3                   0            0        0        0                  1
4                   0            0        0        0                  0

   Farm  Farmers Market  Fast Food Restaurant  Field  Filipino Restaurant  \
0     0               0                     0      0                    0
1     0               0                     0      0                    1
2     0               0                     0      0                    0
3     0               1                     0      0                    0
4     0               0                     0      0                    0

   Film Studio  Fish & Chips Shop  Fish Market  Flea Market  Flower Shop  \
0            0                  0            0            0            0
1            0                  0            0            0            0
2            0                  0            0            0            2
3            0                  1            0            0            0
4            0                  0            0            0            0

   Food  Food & Drink Shop  Food Court  Food Truck  Fountain  \
0     0                  0           1           2         2
1     1                  0           0           1         0
2     0                  0           1           0         0
3     0                  0           0           1         0
4     0                  0           0           1         0

   French Restaurant  Fried Chicken Joint  Frozen Yogurt Shop  \
0                  0                    0                   0
1                  1                    2                   0
2                  2                    0                   0
3                  1                    0                   0
4                  2                    0                   0

   Fruit & Vegetable Store  Furniture / Home Store  Gaming Cafe  Garden  \
0                        0                       1            0       0
1                        0                       0            0       1
2                        0                       1            0       0
3                        0                       0            0       1
4                        0                       0            0       0

   Garden Center  Gas Station  Gastropub  Gay Bar  \
0              0            0          0        0
1              1            0          0        0
2              0            0          0        0
3              0            0          1        0
4              0            0          1        0
```

	General College & University	General Entertainment	German Restaurant \
0	0	0	0
1	0	0	0
2	0	0	1
3	0	0	0
4	0	0	0

	Gift Shop	Golf Driving Range	Gourmet Shop	Greek Restaurant \
0	1	0	0	0
1	1	0	1	0
2	2	0	0	0
3	0	0	1	0
4	0	0	2	0

	Grocery Store	Gym	Gym / Fitness Center	Gymnastics Gym	Halal Restaurant \
0	1	3	2	0	0
1	1	1	0	0	0
2	2	2	1	0	0
3	3	2	1	0	0
4	2	1	0	0	0

	Harbor / Marina	Hawaiian Restaurant	Health & Beauty Service \
0	0	0	0
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0

	Health Food Store	High School	Historic Site	History Museum	Hobby Shop \
0	0	0	0	0	0
1	0	0	1	0	0
2	0	0	0	1	0
3	0	0	0	2	0
4	0	0	0	0	0

	Hookah Bar	Hot Dog Joint	Hotel	Hotel Bar	Ice Cream Shop \
0	0	0	3	0	2
1	0	0	0	0	0
2	0	0	0	0	2
3	0	0	2	0	2
4	0	0	0	0	0

	Indian Restaurant	Indie Movie Theater	Indie Theater	Indoor Play Area \
0	0	0	0	0
1	0	0	0	0
2	0	1	0	1
3	0	0	1	0
4	0	0	0	0

```
   Israeli Restaurant  Italian Restaurant  Japanese Curry Restaurant  \
0                   0                   1                          0
1                   0                   0                          0
2                   0                   1                          0
3                   0                   5                          0
4                   0                   3                          0

   Japanese Restaurant  Jazz Club  Jewelry Store  Jewish Restaurant  \
0                    1          0              1                  0
1                    1          0              0                  0
2                    2          0              0                  0
3                    2          0              0                  0
4                    1          0              0                  0

   Juice Bar  Karaoke Bar  Kids Store  Kitchen Supply Store  \
0          1            0           2                     0
1          3            0           0                     0
2          0            0           0                     0
3          0            0           0                     0
4          1            0           0                     0

   Korean Restaurant  Kosher Restaurant  Lake  Laser Tag  \
0                  1                  0     0          0
1                  0                  0     0          0
2                  0                  0     0          0
3                  0                  0     0          0
4                  0                  0     0          0

   Latin American Restaurant  Laundry Service  Lebanese Restaurant  Library  \
0                          0                0                    0        0
1                          1                0                    0        0
2                          0                0                    0        0
3                          0                0                    0        0
4                          3                0                    0        0

   Lighthouse  Lingerie Store  Liquor Store  Locksmith  Lounge  Market  \
0           0               1             0          0       0       2
1           0               0             0          0       1       0
2           0               0             0          0       0       1
3           0               0             0          0       0       0
4           0               0             0          0       0       0

   Martial Arts Dojo  Massage Studio  Medical Center  \
0                  0               0               0
1                  0               0               0
2                  1               0               0
3                  0               0               1
```

```
4                 0               0               0

   Mediterranean Restaurant  Memorial Site  Men's Store  Mexican Restaurant  \
0                         0              1            0                   2
1                         0              0            0                   2
2                         0              0            1                   0
3                         0              0            1                   1
4                         0              0            0                   8

   Middle Eastern Restaurant  Mini Golf  Miscellaneous Shop  \
0                          0          0                   0
1                          0          0                   0
2                          1          0                   0
3                          1          0                   0
4                          1          0                   0

   Mobile Phone Shop  Modern European Restaurant  \
0                  0                           0
1                  0                           0
2                  0                           0
3                  0                           0
4                  0                           0

   Molecular Gastronomy Restaurant  Monument / Landmark  Moroccan Restaurant  \
0                                0                    1                    0
1                                0                    0                    0
2                                0                    0                    0
3                                0                    0                    0
4                                0                    0                    0

   Motorcycle Shop  Movie Theater  Museum  Music Store  Music Venue  \
0                0              1       1            0            0
1                0              0       0            0            0
2                0              1       0            0            0
3                0              0       0            0            0
4                0              0       0            0            2

   Nail Salon  New American Restaurant  Nightclub  Noodle House  Office  \
0           0                        0          0             0       0
1           0                        1          1             0       0
2           0                        0          0             0       0
3           0                        2          0             0       0
4           1                        0          0             0       0

   Opera House  Optical Shop  Organic Grocery  Other Great Outdoors  \
0            0             0                0                     0
1            0             0                0                     0
2            2             1                0                     0
```

```
3          0            1              0                  0
4          0            0              0                  0

   Other Nightlife  Other Repair Shop  Outdoor Sculpture  \
0                0                  0                  0
1                0                  0                  0
2                0                  0                  0
3                0                  0                  0
4                0                  0                  0

   Outdoors & Recreation  Paella Restaurant  Pakistani Restaurant  \
0                      0                  0                     0
1                      0                  0                     0
2                      0                  0                     0
3                      0                  0                     0
4                      0                  0                     1

   Paper / Office Supplies Store  Park  Performing Arts Venue  Perfume Shop  \
0                              0     7                      2             0
1                              0     1                      0             0
2                              0     0                      2             0
3                              0    11                      0             0
4                              0     1                      0             0

   Persian Restaurant  Peruvian Restaurant  Pet Café  Pet Service  Pet Store  \
0                   0                    0         0            0          1
1                   0                    0         0            0          0
2                   0                    0         0            0          0
3                   0                    0         0            1          1
4                   0                    0         0            0          1

   Pharmacy  Piano Bar  Pie Shop  Pier  Pilates Studio  Pizza Place  \
0         0          0         0     0               0            1
1         0          0         0     0               0            5
2         0          0         0     0               0            1
3         0          0         0     1               0            4
4         0          0         0     0               0            6

   Playground  Plaza  Polish Restaurant  Pool  Print Shop  Pub  Public Art  \
0           1      3                  0     0           0    1           1
1           2      1                  0     1           0    0           0
2           0      0                  0     0           0    0           0
3           1      0                  0     0           0    0           0
4           0      0                  0     0           0    0           0

   Ramen Restaurant  Record Shop  Recreation Center  \
0                 0            0                  0
1                 1            0                  0
```

```
2              0          0              0
3              0          0              0
4              0          1              0

   Residential Building (Apartment / Condo)  Resort  Rest Area  Restaurant  \
0                                         0       0          0           0
1                                         0       0          0           1
2                                         0       0          0           0
3                                         0       0          0           0
4                                         0       0          0           0

   Rock Club  Roof Deck  Russian Restaurant  Sake Bar  Salad Place  \
0          0          0                   0         0            0
1          0          0                   0         0            0
2          0          0                   0         0            0
3          0          0                   0         0            0
4          0          0                   0         0            1

   Salon / Barbershop  Sandwich Place  Scenic Lookout  School  \
0                   0               2               2       0
1                   0               1               0       0
2                   0               2               0       0
3                   0               0               1       0
4                   0               2               0       0

   Sculpture Garden  Seafood Restaurant  Shabu-Shabu Restaurant  \
0                 0                   0                       0
1                 0                   1                       0
2                 0                   1                       0
3                 0                   0                       0
4                 0                   0                       0

   Shipping Store  Shoe Store  Shopping Mall  Skating Rink  Smoke Shop  \
0               0           0              2             0           1
1               0           0              0             0           0
2               0           0              0             0           0
3               0           0              0             0           0
4               0           0              0             0           0

   Snack Place  Soba Restaurant  Soccer Field  Social Club  Soup Place  \
0            0                0             0            0           0
1            0                0             0            0           0
2            0                0             0            0           0
3            0                0             1            0           0
4            0                0             0            0           0

   South American Restaurant  Southern / Soul Food Restaurant  Spa  \
0                          0                                0    0
```

```
1                         0                                1    0
2                         0                                0    1
3                         0                                0    1
4                         0                                0    0

   Spanish Restaurant  Speakeasy  Sporting Goods Shop  Sports Bar  \
0                   0          0                    1           0
1                   0          1                    0           1
2                   0          0                    1           0
3                   0          0                    0           0
4                   0          1                    0           0

   Sports Club  State / Provincial Park  Steakhouse  Street Art  \
0            0                        0           2           0
1            0                        0           0           0
2            0                        0           0           0
3            0                        0           0           0
4            0                        0           0           0

   Street Food Gathering  Strip Club  Supermarket  Supplement Shop  \
0                      0           1            0                0
1                      0           0            1                0
2                      0           0            0                0
3                      0           0            0                0
4                      0           0            0                0

   Sushi Restaurant  Swiss Restaurant  Synagogue  Szechuan Restaurant  \
0                 0                 0          0                    0
1                 0                 0          0                    0
2                 2                 0          0                    0
3                 1                 0          0                    0
4                 1                 0          0                    0

   TV Station  Taco Place  Tailor Shop  Taiwanese Restaurant  \
0           0           0            0                     0
1           0           2            0                     0
2           0           0            0                     0
3           0           0            0                     0
4           0           1            0                     0

   Tapas Restaurant  Tattoo Parlor  Tea Room  Tech Startup  Tennis Court  \
0                 0              0         0             0             0
1                 0              0         0             0             0
2                 0              0         1             0             0
3                 0              0         0             0             0
4                 0              0         0             0             0

   Thai Restaurant  Theater  Theme Park Ride / Attraction  \
```

```
0              0        0                            0
1              0        0                            0
2              0        2                            0
3              1        0                            0
4              0        1                            0

   Thrift / Vintage Store  Tiki Bar  Tourist Information Center  \
0                       0         0                           0
1                       2         0                           0
2                       0         0                           0
3                       0         0                           0
4                       2         0                           0

   Toy / Game Store  Track  Trail  Train Station  Tram Station  \
0                 0      0      0              0             0
1                 0      0      0              0             0
2                 0      0      0              0             0
3                 0      0      0              0             0
4                 0      0      0              0             0

   Turkish Restaurant  Udon Restaurant  Ukrainian Restaurant  Used Bookstore  \
0                   0                0                     0               0
1                   0                0                     0               0
2                   0                0                     0               0
3                   0                0                     0               0
4                   0                0                     0               1

   Vape Store  Vegetarian / Vegan Restaurant  Venezuelan Restaurant  \
0           0                              1                      0
1           0                              0                      0
2           0                              2                      0
3           0                              0                      0
4           1                              0                      0

   Veterinarian  Video Game Store  Video Store  Vietnamese Restaurant  \
0             0                 0            0                      0
1             0                 0            0                      0
2             0                 0            0                      2
3             0                 0            0                      1
4             0                 0            0                      0

   Volleyball Court  Waterfront  Whisky Bar  Wine Bar  Wine Shop  Wings Joint  \
0                 0           0           0         1          4            0
1                 0           0           0         1          6            0
2                 0           0           0         0          2            0
3                 0           0           0         1          4            0
4                 0           0           0         0          1            0
```

```
   Women's Store  Yoga Studio
0              1            0
1              0            1
2              0            2
3              0            5
4              0            2
```

In [24]:
```python
# get the standardized neighborhoods' average prices
scaler = StandardScaler()
standardized_price = scaler.fit_transform(nyc_neighborhood_price_df[['AvgPrice']])

# add the normalized price to the dataframe
neighborhood_venues_withprice_df = pd.DataFrame(venue_count_df)
neighborhood_venues_withprice_df['StandardizedAvgPrice'] = standardized_price

print(neighborhood_venues_withprice_df.shape)
neighborhood_venues_withprice_df.head()
```

```
(50, 329)
```

Out[24]:
```
          Neighborhood  Accessories Store  Adult Boutique  African Restaurant  \
0    Battery Park City                  0               0                   0
1   Bedford-Stuyvesant                  0               0                   0
2          Boerum Hill                  0               0                   0
3     Brooklyn Heights                  0               0                   0
4             Bushwick                  0               0                   0

   American Restaurant  Animal Shelter  Antique Shop  Arcade  \
0                    3               0             0       0
1                    0               0             0       0
2                    1               0             0       0
3                    2               0             0       0
4                    1               0             0       0

   Arepa Restaurant  Argentinian Restaurant  Art Gallery  Art Museum  \
0                 0                       0            0           0
1                 0                       0            1           0
2                 0                       0            1           0
3                 0                       0            0           0
4                 1                       0            1           0

   Arts & Crafts Store  Asian Restaurant  Athletics & Sports  Auditorium  \
0                    0                 0                   1           1
1                    0                 0                   0           0
2                    2                 0                   2           0
3                    0                 1                   1           0
4                    0                 1                   0           0
```

```
   Australian Restaurant  Austrian Restaurant  BBQ Joint  Bagel Shop  Bakery  \
0                      0                    0          2           1       1
1                      0                    0          1           1       1
2                      0                    0          0           1       3
3                      0                    0          0           2       2
4                      0                    0          0           2       2

   Bank  Bar  Baseball Field  Basketball Court  Basketball Stadium  Beach  \
0     0    0               0                 0                   0      0
1     0    6               0                 0                   0      0
2     0    6               0                 0                   1      0
3     0    3               0                 0                   0      1
4     0   17               0                 0                   0      0

   Beer Bar  Beer Garden  Beer Store  Bike Trail  Bistro  Board Shop  \
0         0            0           0           0       0           0
1         0            0           0           0       0           0
2         0            0           0           0       0           1
3         0            0           0           0       0           0
4         0            0           0           0       0           0

   Boat or Ferry  Bookstore  Botanical Garden  Boutique  Boxing Gym  \
0              0          2                 0         0           1
1              0          0                 0         1           0
2              0          2                 0         1           0
3              0          0                 0         0           1
4              0          1                 0         0           0

   Brazilian Restaurant  Breakfast Spot  Brewery  Bridal Shop  Bridge  \
0                     0               0        0            0       0
1                     0               0        0            0       0
2                     0               0        1            0       0
3                     0               0        0            0       0
4                     0               0        1            0       0

   Bubble Tea Shop  Buffet  Building  Burger Joint  Burrito Place  Butcher  \
0                0       0         1             2              1        0
1                0       0         0             0              0        0
2                0       0         0             3              1        0
3                0       0         0             2              0        0
4                0       0         0             0              0        0

   Cafeteria  Café  Cajun / Creole Restaurant  Cambodian Restaurant  \
0          0     1                          0                     0
1          0     6                          0                     0
2          0     0                          0                     0
3          0     2                          0                     0
```

```
4          0     3                      0                     0

   Candy Store  Caribbean Restaurant  Cemetery  Cheese Shop  \
0            0                     0         0            0
1            0                     4         0            0
2            0                     0         0            1
3            0                     0         0            0
4            0                     0         0            0

   Chinese Restaurant  Chocolate Shop  Christmas Market  Church  Climbing Gym  \
0                   0               0                 0       0             0
1                   4               0                 0       0             0
2                   2               1                 0       0             1
3                   0               0                 0       0             0
4                   0               0                 0       0             0

   Clothing Store  Club House  Cocktail Bar  Coffee Shop  \
0               0           0             0            8
1               0           0             2           11
2               0           0             3            7
3               0           0             2            4
4               0           0             4            6

   College Academic Building  College Theater  Colombian Restaurant  \
0                          0                0                     0
1                          0                0                     0
2                          0                0                     0
3                          0                0                     0
4                          0                0                     0

   Comedy Club  Comfort Food Restaurant  Comic Shop  Community Center  \
0            0                        0           0                 0
1            0                        1           0                 0
2            0                        0           0                 0
3            0                        0           0                 0
4            0                        0           0                 0

   Concert Hall  Convenience Store  Cosmetics Shop  Coworking Space  Creperie  \
0             0                  0               0                0         0
1             0                  1               0                0         0
2             1                  0               1                0         0
3             0                  0               2                0         0
4             0                  0               0                0         0

   Cuban Restaurant  Cupcake Shop  Cycle Studio  Czech Restaurant  \
0                 0             1             1                 0
1                 0             0             0                 0
2                 0             0             0                 0
```

```
3                0             0             1                 0
4                0             0             0                 0

   Dance Studio  Daycare  Deli / Bodega  Department Store  Design Studio  \
0             0        0              0                 1              0
1             0        0              4                 0              0
2             3        0              0                 2              0
3             0        0              1                 0              0
4             0        0              3                 0              0

   Dessert Shop  Diner  Discount Store  Dive Bar  Dog Run  Donut Shop  \
0             0      0               0         0        2           0
1             0      1               1         0        1           0
2             0      1               0         0        0           0
3             0      1               0         0        2           0
4             0      0               0         3        1           0

   Drugstore  Dumpling Restaurant  Eastern European Restaurant  \
0          0                    0                            0
1          0                    0                            0
2          0                    0                            0
3          0                    0                            0
4          0                    0                            0

   Electronics Store  Empanada Restaurant  English Restaurant  \
0                  1                    0                   0
1                  0                    0                   0
2                  0                    0                   0
3                  0                    0                   0
4                  0                    0                   0

   Ethiopian Restaurant  Event Space  Exhibit  Factory  Falafel Restaurant  \
0                     0            0        0        0                   0
1                     0            0        0        0                   0
2                     0            0        0        0                   0
3                     0            0        0        0                   1
4                     0            0        0        0                   0

   Farm  Farmers Market  Fast Food Restaurant  Field  Filipino Restaurant  \
0     0               0                     0      0                    0
1     0               0                     0      0                    1
2     0               0                     0      0                    0
3     0               1                     0      0                    0
4     0               0                     0      0                    0

   Film Studio  Fish & Chips Shop  Fish Market  Flea Market  Flower Shop  \
0            0                  0            0            0            0
1            0                  0            0            0            0
```

```
2           0                   0           0           0            2
3           0                   1           0           0            0
4           0                   0           0           0            0

   Food  Food & Drink Shop  Food Court  Food Truck  Fountain  \
0     0                  0           1           2         2
1     1                  0           0           1         0
2     0                  0           1           0         0
3     0                  0           0           1         0
4     0                  0           0           1         0

   French Restaurant  Fried Chicken Joint  Frozen Yogurt Shop  \
0                  0                    0                   0
1                  1                    2                   0
2                  2                    0                   0
3                  1                    0                   0
4                  2                    0                   0

   Fruit & Vegetable Store  Furniture / Home Store  Gaming Cafe  Garden  \
0                        0                       1            0       0
1                        0                       0            0       1
2                        0                       1            0       0
3                        0                       0            0       1
4                        0                       0            0       0

   Garden Center  Gas Station  Gastropub  Gay Bar  \
0              0            0          0        0
1              1            0          0        0
2              0            0          0        0
3              0            0          1        0
4              0            0          1        0

   General College & University  General Entertainment  German Restaurant  \
0                             0                      0                  0
1                             0                      0                  0
2                             0                      0                  1
3                             0                      0                  0
4                             0                      0                  0

   Gift Shop  Golf Driving Range  Gourmet Shop  Greek Restaurant  \
0          1                   0             0                 0
1          1                   0             1                 0
2          2                   0             0                 0
3          0                   0             1                 0
4          0                   0             2                 0

   Grocery Store  Gym  Gym / Fitness Center  Gymnastics Gym  Halal Restaurant  \
0              1    3                     2               0                 0
```

```
1            1   1                  0             0               0
2            2   2                  1             0               0
3            3   2                  1             0               0
4            2   1                  0             0               0

  Harbor / Marina  Hawaiian Restaurant  Health & Beauty Service  \
0               0                    0                        0
1               0                    0                        0
2               0                    0                        0
3               0                    0                        0
4               0                    0                        0

  Health Food Store  High School  Historic Site  History Museum  Hobby Shop  \
0                 0            0              0               0           0
1                 0            0              1               0           0
2                 0            0              0               1           0
3                 0            0              0               2           0
4                 0            0              0               0           0

  Hookah Bar  Hot Dog Joint  Hotel  Hotel Bar  Ice Cream Shop  \
0          0              0      3          0               2
1          0              0      0          0               0
2          0              0      0          0               2
3          0              0      2          0               2
4          0              0      0          0               0

  Indian Restaurant  Indie Movie Theater  Indie Theater  Indoor Play Area  \
0                 0                    0              0                 0
1                 0                    0              0                 0
2                 0                    1              0                 1
3                 0                    0              1                 0
4                 0                    0              0                 0

  Israeli Restaurant  Italian Restaurant  Japanese Curry Restaurant  \
0                  0                   1                          0
1                  0                   0                          0
2                  0                   1                          0
3                  0                   5                          0
4                  0                   3                          0

  Japanese Restaurant  Jazz Club  Jewelry Store  Jewish Restaurant  \
0                   1          0              1                  0
1                   1          0              0                  0
2                   2          0              0                  0
3                   2          0              0                  0
4                   1          0              0                  0

  Juice Bar  Karaoke Bar  Kids Store  Kitchen Supply Store  \
```

```
0         1           0           2                   0
1         3           0           0                   0
2         0           0           0                   0
3         0           0           0                   0
4         1           0           0                   0

   Korean Restaurant  Kosher Restaurant  Lake  Laser Tag  \
0                  1                  0     0          0
1                  0                  0     0          0
2                  0                  0     0          0
3                  0                  0     0          0
4                  0                  0     0          0

   Latin American Restaurant  Laundry Service  Lebanese Restaurant  Library  \
0                          0                0                    0        0
1                          1                0                    0        0
2                          0                0                    0        0
3                          0                0                    0        0
4                          3                0                    0        0

   Lighthouse  Lingerie Store  Liquor Store  Locksmith  Lounge  Market  \
0           0               1             0          0       0       2
1           0               0             0          0       1       0
2           0               0             0          0       0       1
3           0               0             0          0       0       0
4           0               0             0          0       0       0

   Martial Arts Dojo  Massage Studio  Medical Center  \
0                  0               0               0
1                  0               0               0
2                  1               0               0
3                  0               0               1
4                  0               0               0

   Mediterranean Restaurant  Memorial Site  Men's Store  Mexican Restaurant  \
0                         0              1            0                   2
1                         0              0            0                   2
2                         0              0            1                   0
3                         0              0            1                   1
4                         0              0            0                   8

   Middle Eastern Restaurant  Mini Golf  Miscellaneous Shop  \
0                          0          0                   0
1                          0          0                   0
2                          1          0                   0
3                          1          0                   0
4                          1          0                   0
```

```
   Mobile Phone Shop  Modern European Restaurant  \
0                  0                           0
1                  0                           0
2                  0                           0
3                  0                           0
4                  0                           0

   Molecular Gastronomy Restaurant  Monument / Landmark  Moroccan Restaurant  \
0                                0                    1                    0
1                                0                    0                    0
2                                0                    0                    0
3                                0                    0                    0
4                                0                    0                    0

   Motorcycle Shop  Movie Theater  Museum  Music Store  Music Venue  \
0                0              1       1            0            0
1                0              0       0            0            0
2                0              1       0            0            0
3                0              0       0            0            0
4                0              0       0            0            2

   Nail Salon  New American Restaurant  Nightclub  Noodle House  Office  \
0           0                        0          0             0       0
1           0                        1          1             0       0
2           0                        0          0             0       0
3           0                        2          0             0       0
4           1                        0          0             0       0

   Opera House  Optical Shop  Organic Grocery  Other Great Outdoors  \
0            0             0                0                     0
1            0             0                0                     0
2            2             1                0                     0
3            0             1                0                     0
4            0             0                0                     0

   Other Nightlife  Other Repair Shop  Outdoor Sculpture  \
0                0                  0                  0
1                0                  0                  0
2                0                  0                  0
3                0                  0                  0
4                0                  0                  0

   Outdoors & Recreation  Paella Restaurant  Pakistani Restaurant  \
0                      0                  0                     0
1                      0                  0                     0
2                      0                  0                     0
3                      0                  0                     0
4                      0                  0                     1
```

	Paper / Office Supplies Store	Park	Performing Arts Venue	Perfume Shop	\
0	0	7	2	0	
1	0	1	0	0	
2	0	0	2	0	
3	0	11	0	0	
4	0	1	0	0	

	Persian Restaurant	Peruvian Restaurant	Pet Café	Pet Service	Pet Store	\
0	0	0	0	0	1	
1	0	0	0	0	0	
2	0	0	0	0	0	
3	0	0	0	1	1	
4	0	0	0	0	1	

	Pharmacy	Piano Bar	Pie Shop	Pier	Pilates Studio	Pizza Place	\
0	0	0	0	0	0	1	
1	0	0	0	0	0	5	
2	0	0	0	0	0	1	
3	0	0	0	1	0	4	
4	0	0	0	0	0	6	

	Playground	Plaza	Polish Restaurant	Pool	Print Shop	Pub	Public Art	\
0	1	3	0	0	0	1	1	
1	2	1	0	1	0	0	0	
2	0	0	0	0	0	0	0	
3	1	0	0	0	0	0	0	
4	0	0	0	0	0	0	0	

	Ramen Restaurant	Record Shop	Recreation Center	\
0	0	0	0	
1	1	0	0	
2	0	0	0	
3	0	0	0	
4	0	1	0	

	Residential Building (Apartment / Condo)	Resort	Rest Area	Restaurant	\
0	0	0	0	0	
1	0	0	0	1	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	

	Rock Club	Roof Deck	Russian Restaurant	Sake Bar	Salad Place	\
0	0	0	0	0	0	
1	0	0	0	0	0	
2	0	0	0	0	0	
3	0	0	0	0	0	

```
4          0          0                   0         0            1

   Salon / Barbershop  Sandwich Place  Scenic Lookout  School  \
0                   0               2               2       0
1                   0               1               0       0
2                   0               2               0       0
3                   0               0               1       0
4                   0               2               0       0

   Sculpture Garden  Seafood Restaurant  Shabu-Shabu Restaurant  \
0                 0                   0                       0
1                 0                   1                       0
2                 0                   1                       0
3                 0                   0                       0
4                 0                   0                       0

   Shipping Store  Shoe Store  Shopping Mall  Skating Rink  Smoke Shop  \
0               0           0              2             0           1
1               0           0              0             0           0
2               0           0              0             0           0
3               0           0              0             0           0
4               0           0              0             0           0

   Snack Place  Soba Restaurant  Soccer Field  Social Club  Soup Place  \
0            0                0             0            0           0
1            0                0             0            0           0
2            0                0             0            0           0
3            0                0             1            0           0
4            0                0             0            0           0

   South American Restaurant  Southern / Soul Food Restaurant  Spa  \
0                          0                                0    0
1                          0                                1    0
2                          0                                0    1
3                          0                                0    1
4                          0                                0    0

   Spanish Restaurant  Speakeasy  Sporting Goods Shop  Sports Bar  \
0                   0          0                    1           0
1                   0          1                    0           1
2                   0          0                    1           0
3                   0          0                    0           0
4                   0          1                    0           0

   Sports Club  State / Provincial Park  Steakhouse  Street Art  \
0            0                        0           2           0
1            0                        0           0           0
2            0                        0           0           0
```

```
3           0                        0           0           0
4           0                        0           0           0

   Street Food Gathering  Strip Club  Supermarket  Supplement Shop  \
0                      0           1            0                0
1                      0           0            1                0
2                      0           0            0                0
3                      0           0            0                0
4                      0           0            0                0

   Sushi Restaurant  Swiss Restaurant  Synagogue  Szechuan Restaurant  \
0                 0                 0          0                    0
1                 0                 0          0                    0
2                 2                 0          0                    0
3                 1                 0          0                    0
4                 1                 0          0                    0

   TV Station  Taco Place  Tailor Shop  Taiwanese Restaurant  \
0           0           0            0                     0
1           0           2            0                     0
2           0           0            0                     0
3           0           0            0                     0
4           0           1            0                     0

   Tapas Restaurant  Tattoo Parlor  Tea Room  Tech Startup  Tennis Court  \
0                 0              0         0             0             0
1                 0              0         0             0             0
2                 0              0         1             0             0
3                 0              0         0             0             0
4                 0              0         0             0             0

   Thai Restaurant  Theater  Theme Park Ride / Attraction  \
0                0        0                             0
1                0        0                             0
2                0        2                             0
3                1        0                             0
4                0        1                             0

   Thrift / Vintage Store  Tiki Bar  Tourist Information Center  \
0                       0         0                           0
1                       2         0                           0
2                       0         0                           0
3                       0         0                           0
4                       2         0                           0

   Toy / Game Store  Track  Trail  Train Station  Tram Station  \
0                 0      0      0              0             0
1                 0      0      0              0             0
```

```
2                 0       0       0                 0               0
3                 0       0       0                 0               0
4                 0       0       0                 0               0

   Turkish Restaurant  Udon Restaurant  Ukrainian Restaurant  Used Bookstore  \
0                   0                0                     0               0
1                   0                0                     0               0
2                   0                0                     0               0
3                   0                0                     0               0
4                   0                0                     0               1

   Vape Store  Vegetarian / Vegan Restaurant  Venezuelan Restaurant  \
0           0                              1                      0
1           0                              0                      0
2           0                              2                      0
3           0                              0                      0
4           1                              0                      0

   Veterinarian  Video Game Store  Video Store  Vietnamese Restaurant  \
0             0                 0            0                      0
1             0                 0            0                      0
2             0                 0            0                      2
3             0                 0            0                      1
4             0                 0            0                      0

   Volleyball Court  Waterfront  Whisky Bar  Wine Bar  Wine Shop  Wings Joint  \
0                 0           0           0         1          4            0
1                 0           0           0         1          6            0
2                 0           0           0         0          2            0
3                 0           0           0         1          4            0
4                 0           0           0         0          1            0

   Women's Store  Yoga Studio  StandardizedAvgPrice
0              1            0             -1.303912
1              0            1             -0.418350
2              0            2              0.015011
3              0            5             -1.099479
4              0            2             -0.587926
```

This is the end of data collecting and preprocessing
***neighborhood_venues_withprice_df* will be the dataframe that will be used in the analyzing step below**

1.2 III. Analyze the dataframe:

1.2.1 1. Check for correlation between *occurrence of surrounding venues* with *real estate average price*:

```
In [25]: # Using LinearRegression, we can get the list of coefficient correlations between each
         lreg = LinearRegression(normalize=True)

         X = neighborhood_venues_withprice_df.drop(columns=['Neighborhood', 'StandardizedAvgPric
         y = neighborhood_venues_withprice_df['StandardizedAvgPrice']
         X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=0

         model = lreg.fit(X_train, y_train)
```

```
In [26]: # let's see how well Linear Regression fit the problem
         y_pred = lreg.predict(X_test)

         print('R2-score:', r2_score(y_test, y_pred)) # r2 score
         print('Mean Squared Error:', mean_squared_error(y_test, y_pred)) # mse

         print('Max positive coefs:', lreg.coef_[np.argsort(-lreg.coef_)[:10]])
         print('Venue types with most postive effect:', X.columns[np.argsort(-lreg.coef_)[:10]].
         print('Max negative coefs:', lreg.coef_[np.argsort(lreg.coef_)[:10]])
         print('Venue types with most negative effect:', X.columns[np.argsort(lreg.coef_)[:10]].
         coef_abs = abs(lreg.coef_)
         print('Min coefs:', lreg.coef_[np.argsort(coef_abs)[:10]])
         print('Venue types with least effect:', X.columns[np.argsort(coef_abs)[:10]].values)
```

```
R2-score: 0.273792308888
Mean Squared Error: 0.254179706388
Max positive coefs: [ 0.26348338  0.26213799  0.26213799  0.26213799  0.25818747  0.25818747
  0.25135936  0.24564842  0.23349638  0.22658134]
Venue types with most postive effect: ['Design Studio' 'Train Station' 'Jewish Restaurant' 'Reso
 'Cafeteria' 'Colombian Restaurant' 'Dumpling Restaurant' 'Other Nightlife'
 'Botanical Garden']
Max negative coefs: [-0.20813947 -0.20763403 -0.1798399  -0.1798399  -0.1798399  -0.17776278
 -0.17776278 -0.17776278 -0.17776278 -0.17776278]
Venue types with most negative effect: ['Board Shop' 'Gay Bar' 'Supplement Shop' 'Rest Area' 'Li
 'Flea Market' 'Golf Driving Range' 'Recreation Center'
 'General Entertainment']
Min coefs: [ 0.  0.  0.  0.  0.  0.  0.  0.  0.  0.]
Venue types with least effect: ['TV Station' 'Gas Station' 'Pakistani Restaurant' 'Volleyball Co
 'Hookah Bar' 'Indoor Play Area' 'Laser Tag' 'Christmas Market' 'Cemetery'
 'Mini Golf']
```

Looking back to our dataset, we can see that the features is much bigger than the samples. **PCR** (Principal Component Regression) will be used to reduce the number of features.

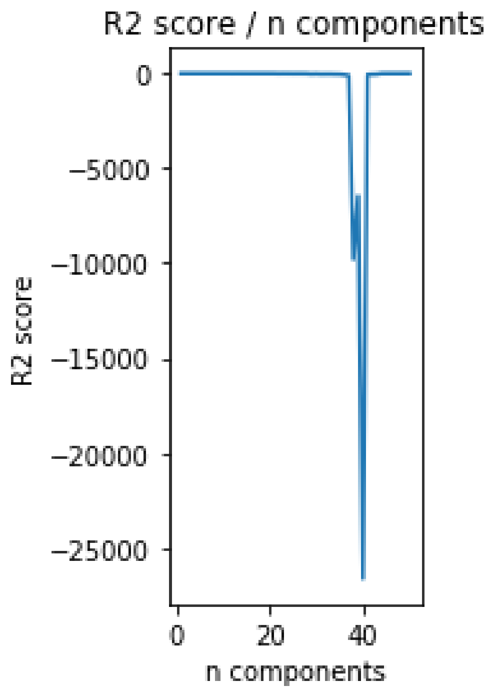
1.2.2 2. Applying PCR for better result:

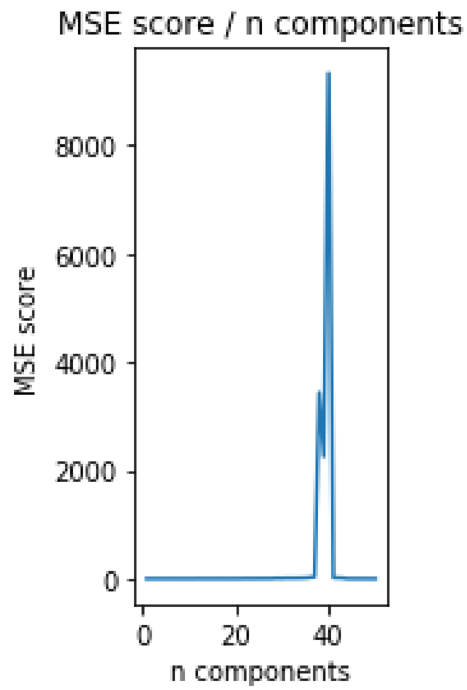
PCR is a regression technique which is based on PCA (Principle Component Analysis).
It's a two steps process:
- First, perform PCA on the features set to obtain the principle components. Then select a subset for the next step. - Second, use regression on the previous subset of principal components to get a list of coefficient correlations. (Linear Regression will be used)

In [27]:
```
X = neighborhood_venues_withprice_df.drop(columns=['Neighborhood', 'StandardizedAvgPric
y = neighborhood_venues_withprice_df['StandardizedAvgPrice']

# First, apply PCA
pca = PCA(svd_solver='auto', random_state=0)
X_pca = pca.fit_transform(scale(X))
```

In [28]:
```
n_component_list = range(1, 51)
r2_list = []
mse_list = []

# Second, Linear Regression
for i in n_component_list:
    lreg = LinearRegression()
    X_train, X_test, y_train, y_test = train_test_split(X_pca[:,:i], y, test_size=0.2,
    model = lreg.fit(X_train, y_train)
    # check the result
    y_pred = lreg.predict(X_test)
    r2 = r2_score(y_test, y_pred) # r2 score
    mse = mean_squared_error(y_test, y_pred) # mse
    r2_list.append(r2)
    mse_list.append(mse)

scores_df = pd.DataFrame.from_dict(dict([('NComponents', n_component_list),
                                         ('R2', r2_list),
                                         ('MSE', mse_list)]))
scores_df.set_index('NComponents', inplace=True)
```

In [29]:
```
# plot the scores to see the best n_components
plt.subplot(1, 3, 1)
scores_df['R2'].plot(kind='line')
plt.title('R2 score / n components')
plt.ylabel('R2 score')
plt.xlabel('n components')

plt.subplot(1, 3, 3)
scores_df['MSE'].plot(kind='line')
plt.title('MSE score / n components')
plt.ylabel('MSE score')
plt.xlabel('n components')

plt.show()
```






```
In [30]: r2_max = scores_df['R2'].idxmax()
         print("Best n:", r2_max, "R2 score:", scores_df['R2'][r2_max])

         mse_min = scores_df['MSE'].idxmin()
         print("Best n:", mse_min, "MSE:", scores_df['MSE'][mse_min])
```

```
Best n: 50 R2 score: 0.454460324852
Best n: 50 MSE: 0.190944155714
```

```
In [31]: # Use the best n_components parameter
         lreg = LinearRegression()
         X_train, X_test, y_train, y_test = train_test_split(X_pca[:,:r2_max], y, test_size=0.2,
         model = lreg.fit(X_train, y_train)

         # check the result
         y_pred = lreg.predict(X_test)
         r2 = r2_score(y_test, y_pred) # r2 score
         mse = mean_squared_error(y_test, y_pred) # mse
         print("R2 score:", r2)
         print("MSE:", mse)
```

```
R2 score: 0.454460324852
MSE: 0.190944155714
```

The result seems to improved compared to just using simple Linear Regression.

In [32]:
```
# Let's try to project the coefs back to the original number of features
eigenvectors = pca.components_
pcr_coefs = eigenvectors[:r2_max, :].T @ lreg.coef_

pcr_coefs.shape
```

Out[32]: (327,)

In [33]:
```
# Let's check which venue types effect the most and least
print('Max positive coefs:', pcr_coefs[np.argsort(-pcr_coefs)[:10]])
print('Venue types with most positive effect:', X.columns[np.argsort(-pcr_coefs)[:10]].
print('Max negative coefs:', pcr_coefs[np.argsort(pcr_coefs)[:10]])
print('Venue types with most negative effect:', X.columns[np.argsort(pcr_coefs)[:10]].v
coef_abs = abs(pcr_coefs)
print('Min coefs:', pcr_coefs[np.argsort(coef_abs)[:10]])
print('Venue types with least effect:', X.columns[np.argsort(coef_abs)[:10]].values)
```

```
Max positive coefs: [ 0.07212567  0.0696754   0.06052737  0.0582199   0.05228078  0.05222561
  0.04901431  0.04597368  0.04465698  0.04399769]
Venue types with most positive effect: ['Dumpling Restaurant' 'Pilates Studio' 'Design Studio' '
 'Southern / Soul Food Restaurant' 'Library' 'Sushi Restaurant' 'Resort'
 'Korean Restaurant' 'Buffet']
Max negative coefs: [-0.05116074 -0.03897274 -0.03710211 -0.03457056 -0.03452567 -0.0345195
 -0.03414522 -0.03304223 -0.03284579 -0.03284275]
Venue types with most negative effect: ['Market' 'Lingerie Store' 'Gay Bar' 'Kosher Restaurant'
 'Food' 'Food Truck' 'Wine Bar' 'Food & Drink Shop' 'Climbing Gym']
Min coefs: [ -8.90366289e-06  -8.90366289e-06   4.09236430e-05  -4.99918920e-05
  -5.87234477e-05   1.27322576e-04   1.27322576e-04   1.27322576e-04
   1.27322576e-04   1.41722883e-04]
Venue types with least effect: ['Christmas Market' 'TV Station' 'Cemetery' 'Event Space'
 'Indoor Play Area' 'Modern European Restaurant' 'Mini Golf'
 'Volleyball Court' 'Molecular Gastronomy Restaurant' 'Community Center']
```

1.3 IV. Conclusion:

Based on the observed coefficient correlations, fancy places like restaurants seem to boost real estate's value around the area the most.
In some ways, it's a logical conclusion. Neighborhoods that have many restaurants are most likely business areas such as downtown. It's where lots of people go to, lots of activities to enjoy, lots of other businesses cite their offices there. The kind of places that people like to live and work and as a result of high demand, the price will be higher than other cities away from the city center.

In [ ]: