DataVis2_andrew

June 11, 2020

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import folium
from folium import plugins
from sklearn.cluster import KMeans
import matplotlib
from scipy import stats
import math
from mpl_toolkits.mplot3d import Axes3D
```

[2]:
```
df = pd.read_csv('AB_NYC_2019.csv')

# drops rows with price = 0
df = df[df.price != 0]

df = df[:]
print(df.shape)
df.head()
```

```
(48884, 16)
```

[2]:

	id	name	host_id	host_name	neighbourhood_group	neighbourhood	latitude	longitude	room_type	price	minimum_nights	number_of_reviews	last_review
0	2539	Clean & quiet apt home by the park	2787	John	Brooklyn	Kensington	40.64749	-73.97237	Private room	149	1	9	2018-10-19
1	2595	Skylit Midtown Castle	2845	Jennifer	Manhattan	Midtown	40.75362	-73.98377					
2	3647	THE VILLAGE OF HARLEM…NEW YORK !	4632	Elisabeth	Manhattan	Harlem	40.80902	-73.94190					
3	3831	Cozy Entire Floor of Brownstone	4869	LisaRoxanne	Brooklyn	Clinton Hill	40.68514	-73.95976					
4	5022	Entire Apt: Spacious Studio/Loft by central park	7192	Laura	Manhattan	East Harlem	40.79851	-73.94399					

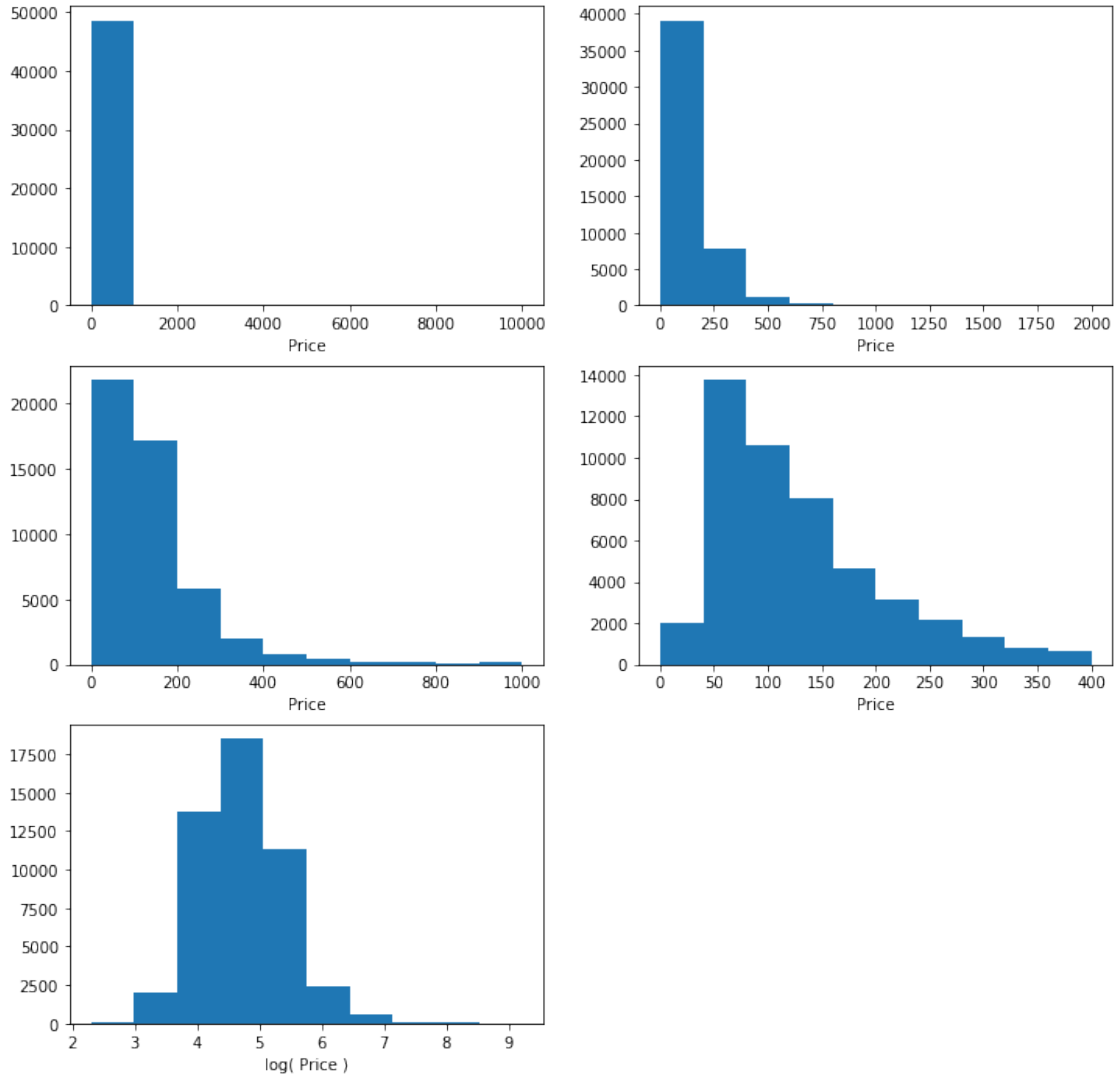
```
1  Entire home/apt    225                1                  45  2019-05-21
2     Private room    150                3                   0         NaN
3  Entire home/apt     89                1                 270  2019-07-05
4  Entire home/apt     80               10                   9  2018-11-19

   reviews_per_month  calculated_host_listings_count  availability_365
0               0.21                               6               365
1               0.38                               2               355
2                NaN                               1               365
3               4.64                               1               194
4               0.10                               1                 0
```

[3]:
```
#useful to consider unique neigborhoods for the number of k clusters to do
print(df.neighbourhood_group.unique().size)

print(df.neighbourhood_group.unique())
```

```
5
['Brooklyn' 'Manhattan' 'Queens' 'Staten Island' 'Bronx']
```

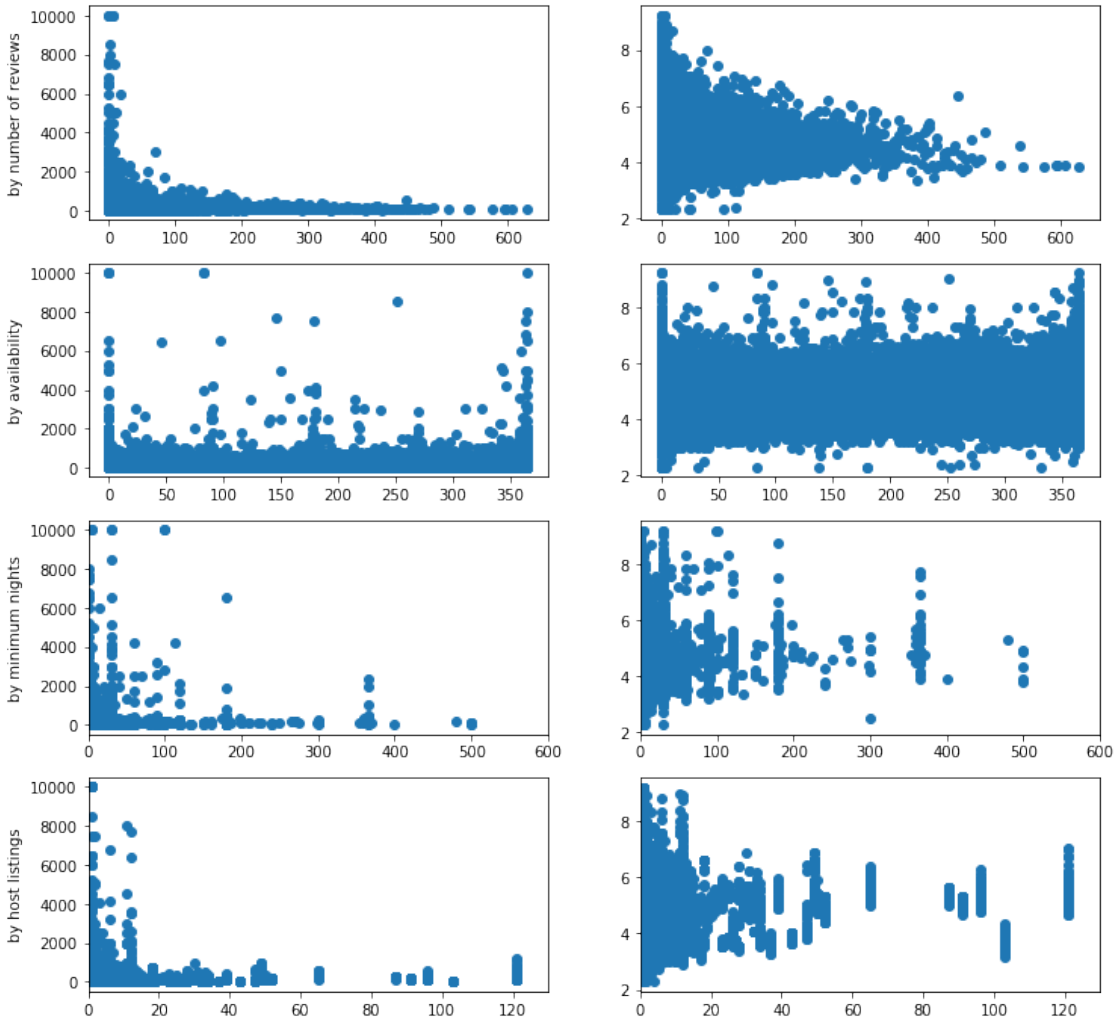
[4]:
```
price = df['price'].to_numpy()
minimum_nights  = df['minimum_nights'].to_numpy()
number_of_reviews = df['number_of_reviews'].to_numpy()
reviews_per_month = df['reviews_per_month'].to_numpy()
host_listings = df['calculated_host_listings_count'].to_numpy()
availability = df['availability_365'].to_numpy()

log_price = np.log(price)
```

[5]:
```
plt.figure(figsize=(12,12))
for i in enumerate([10000, 2000, 1000, 400]):
    plt.subplot(3,2, i[0]+1)
    plt.hist(price, range=(0,i[1]))
    plt.xlabel('Price')

plt.subplot(3,2,5)
plt.hist(log_price)
plt.xlabel('log( Price )')
plt.show()

#Shows histograms of price data here,
# see bottom historgram groups the log(price), approximates normal distribution
```



[20]:
```
plt.figure(figsize=(12,12))

plt.subplot(4,2,1)
plt.scatter(number_of_reviews, price)
plt.ylabel('by number of reviews')

plt.subplot(4,2,2)
plt.scatter(number_of_reviews, log_price)

plt.subplot(4,2,3)
plt.scatter(availability, price)
plt.ylabel('by availability')

plt.subplot(4,2,4)
```

```
plt.scatter(availability, log_price)

plt.subplot(4,2,5)
plt.scatter(minimum_nights, price)
plt.xlim(0,600)
plt.ylabel('by minimum nights')

plt.subplot(4,2,6)
plt.scatter(minimum_nights, log_price)
plt.xlim(0,600)

plt.subplot(4,2,7)
plt.scatter(host_listings, price)
plt.xlim(0,130)
plt.ylabel('by host listings')

plt.subplot(4,2,8)
plt.scatter(host_listings, log_price)
plt.xlim(0,130)

plt.show()
```



[7]:
```
#create array of coordinates and a center to use for folium maps
coords = df[['latitude', 'longitude']].to_numpy()
center = np.mean(coords, axis=0)
print(np.max(coords, axis=0))
print(np.min(coords, axis=0))
```

```
[ 40.91306 -73.71299]
[ 40.49979 -74.24442]
```

[8]:
```
color_set = ['red', 'orange', 'yellow', 'green', 'blue']

# k means clustering algoritm for inputted data, and maps coordinates onto␣
 ↪folium map
# color cooresponding to cluster label
def map_data(data, m, c=5):
```

```
    km = KMeans(n_clusters = c, random_state = 0).fit(data)

    for i in range(len(data)):
        folium.CircleMarker((coords[i,0], coords[i,1]), radius = 1,color =␣
↪color_set[km.labels_[i]]).add_to(m)

    return m, km

# creates dataframe to display some stats for each cluster
def label_describe(labels):
    desc = pd.DataFrame(data={'avg price':['','','','',''],
                              'avg minimum nights':['','','','',''],
                              'avg number of reviews':['','','','',''],
                              'avg host listings':['','','','',''],
                              'avg availability':['','','','','']})
    desc.index = ['{}: {}'.format(i[0],i[1]) for i in enumerate(color_set)]
    for i in range(5):
        desc.iat[i, 0] = '{:.2f}, (std={:.1f})'.format(np.mean(price[:
↪][labels==i]),
                                                       np.std(price[:
↪][labels==i]))
        desc.iat[i, 1] = '{:.2f}, (std={:.1f})'.format(np.mean(minimum_nights[:
↪][labels==i]),
                                                       np.std(minimum_nights[:
↪][labels==i]))
        desc.iat[i, 2] = '{:.2f}, (std={:.1f})'.format(np.
↪mean(number_of_reviews[:][labels==i]),
                                                       np.
↪std(number_of_reviews[:][labels==i]))
        desc.iat[i, 3] = '{:.2f}, (std={:.1f})'.format(np.mean(host_listings[:
↪][labels==i]),
                                                       np.std(host_listings[:
↪][labels==i]))
        desc.iat[i, 4] = '{:.2f}, (std={:.1f})'.format(np.mean(availability[:
↪][labels==i]),
                                                       np.std(availability[:
↪][labels==i]))

    return desc
```

[9]:
```
# k means cluster based on just the location data (coordinates)
m = folium.Map(center, zoom_start = 1)
m, km = map_data(coords[:], m)
m
```

[9]:
```
<folium.folium.Map at 0x16ec2c16808>
```

[10]:
```
label_describe(km.labels_)
```

[10]:
```
                     avg price avg minimum nights avg number of reviews  \
0: red     114.75, (std=169.7)   6.02, (std=16.5)     24.38, (std=44.8)
1: orange  227.92, (std=327.6)   9.28, (std=26.4)     19.56, (std=41.1)
2: yellow  126.53, (std=210.2)   6.56, (std=18.5)     24.26, (std=46.2)
3: green    98.66, (std=117.4)   3.69, (std=11.1)     32.15, (std=56.0)
4: blue    130.81, (std=171.3)   6.21, (std=18.7)     24.19, (std=42.8)

           avg host listings     avg availability
0: red       2.86, (std=8.4)  103.75, (std=127.9)
1: orange  17.05, (std=57.1)  116.13, (std=134.9)
2: yellow   3.29, (std=12.4)  110.17, (std=129.8)
3: green     3.56, (std=8.1)  172.38, (std=133.7)
4: blue      1.85, (std=2.6)  106.70, (std=128.2)
```

[11]:
```
#no k means clustering here, colors the points by the neigborhood group its␣
 ↪associated with
m = folium.Map(center, zoom_start = 11)
color_set = ['red', 'orange', 'yellow', 'green', 'blue']
group_label = np.argmax(pd.get_dummies(df.neighbourhood_group).to_numpy(),␣
 ↪axis=1)
for i in range(len(coords)):
        folium.CircleMarker((coords[i,0], coords[i,1]), radius = 1,color =␣
 ↪color_set[group_label[i]]).add_to(m)
m
```

[11]:
```
<folium.folium.Map at 0x16ed5541208>
```

[12]:
```
label_describe(group_label)
```

[12]:
```
                     avg price avg minimum nights avg number of reviews  \
0: red      87.58, (std=106.7)   4.56, (std=15.6)     25.98, (std=42.2)
1: orange  124.44, (std=186.9)   6.06, (std=17.6)     24.20, (std=44.3)
2: yellow  196.88, (std=291.4)   8.58, (std=24.1)     20.99, (std=42.6)
3: green    99.52, (std=167.1)   5.18, (std=15.0)     27.70, (std=52.0)
4: blue    114.81, (std=277.2)   4.83, (std=19.7)     30.94, (std=44.8)

           avg host listings     avg availability
0: red       2.23, (std=2.4)  165.79, (std=135.2)
1: orange    2.28, (std=5.3)  100.22, (std=126.3)
2: yellow  12.79, (std=48.2)  111.98, (std=132.7)
3: green    4.06, (std=12.4)  144.45, (std=135.5)
4: blue      2.32, (std=1.9)  199.68, (std=131.7)
```

[13]:
```
#k means cluster by the other numerical features, not location
data = np.vstack((log_price, minimum_nights, number_of_reviews, host_listings,␣
 ↪availability)).T

#scales each feature to between 0 and 1 for consistency in clustering
for i in range(5):
    data[:,i] = np.interp(data[:,i], (data[:,i].min(), data[:,i].max()), (0, 1))

m = folium.Map(center, zoom_start = 11)
m, km = map_data(data[:], m)
m
```

[13]:
```
<folium.folium.Map at 0x16ee7b93fc8>
```

[14]:
```
label_describe(km.labels_)
```

[14]:
```
                     avg price avg minimum nights avg number of reviews  \
0: red     136.73, (std=190.3)   4.83, (std=13.2)     12.28, (std=26.8)
1: orange  178.29, (std=311.3)  11.84, (std=33.4)     28.70, (std=49.9)
2: yellow  146.36, (std=251.1)   6.10, (std=16.8)     34.98, (std=51.2)
3: green   170.97, (std=271.2)   7.95, (std=20.4)     43.86, (std=64.6)
4: blue    273.57, (std=101.7)  20.96, (std=16.0)       2.39, (std=3.8)

             avg host listings    avg availability
0: red        1.66, (std=6.5)    5.20, (std=10.9)
1: orange    9.73, (std=21.3)  330.53, (std=29.8)
2: yellow     2.54, (std=6.3)   87.18, (std=26.9)
3: green     5.50, (std=16.3)  202.18, (std=36.1)
4: blue    288.79, (std=46.6)  287.76, (std=72.7)
```

[15]:
```
#for each cluster identified above, maps the cluster center onto the map with a␣
 ↪circle size more or less
# cooresponding to how spread out the points in that cluster are
m = folium.Map(center, zoom_start = 12) #zoomed in a bit on the center of the␣
 ↪city

c_centers = np.array([np.mean(coords[:][km.labels_==i], axis=0) for i in␣
 ↪range(5)])
c_sizes = np.array([np.median(np.linalg.norm(c_centers[i] - coords[:][km.
 ↪labels_==i], axis=1)) for i in range(5)])

for i in range(len(c_centers)):
    folium.CircleMarker((c_centers[i,0], c_centers[i,1]),
                        radius = c_sizes[i]*2000, color = color_set[i],␣
 ↪fill_color = color_set[i]).add_to(m)

m
```

[15]: <folium.folium.Map at 0x16efa82f388>

[ ]: