UL-TakeHome-1

March 11, 2020

[1]:
```
import pandas as pd
import numpy as np
from sklearn.cluster import KMeans
from scipy.stats import zscore
import matplotlib.pyplot as plt
%matplotlib inline
```

[2]:
```
df=pd.read_csv('Data01.csv')
df.head()
```

[2]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1	Male	19	15	39
1	2	Male	21	15	81
2	3	Female	20	16	6
3	4	Female	23	16	77
4	5	Female	31	17	40

[3]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 5 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   CustomerID              200 non-null    int64
 1   Gender                  200 non-null    object
 2   Age                     200 non-null    int64
 3   Annual Income (k$)      200 non-null    int64
 4   Spending Score (1-100)  200 non-null    int64
dtypes: int64(4), object(1)
memory usage: 7.9+ KB
```

[4]:
```
df.describe()
```

[4]:

	CustomerID	Age	Annual Income (k$)	Spending Score (1-100)
count	200.000000	200.000000	200.000000	200.000000
mean	100.500000	38.850000	60.560000	50.200000
std	57.879185	13.969007	26.264721	25.823522

```
min      1.000000   18.000000          15.000000                1.000000
25%     50.750000   28.750000          41.500000               34.750000
50%    100.500000   36.000000          61.500000               50.000000
75%    150.250000   49.000000          78.000000               73.000000
max    200.000000   70.000000         137.000000               99.000000
```

[5]:
```
df
```

[5]:
```
     CustomerID  Gender  Age  Annual Income (k$)  Spending Score (1-100)
0             1    Male   19                  15                      39
1             2    Male   21                  15                      81
2             3  Female   20                  16                       6
3             4  Female   23                  16                      77
4             5  Female   31                  17                      40
..          …     …  …                 …                       …
195         196  Female   35                 120                      79
196         197  Female   45                 126                      28
197         198    Male   32                 126                      74
198         199    Male   32                 137                      18
199         200    Male   30                 137                      83

[200 rows x 5 columns]
```

[6]:
```
df1=df.copy()
df1.head()
```

[6]:
```
   CustomerID  Gender  Age  Annual Income (k$)  Spending Score (1-100)
0           1    Male   19                  15                      39
1           2    Male   21                  15                      81
2           3  Female   20                  16                       6
3           4  Female   23                  16                      77
4           5  Female   31                  17                      40
```

[7]:
```
df1.drop('CustomerID', axis=1, inplace=True)
```

[8]:
```
df1.head()
```

[8]:
```
   Gender  Age  Annual Income (k$)  Spending Score (1-100)
0    Male   19                  15                      39
1    Male   21                  15                      81
2  Female   20                  16                       6
3  Female   23                  16                      77
4  Female   31                  17                      40
```

[9]:
```
df1['Gender'].value_counts()
```

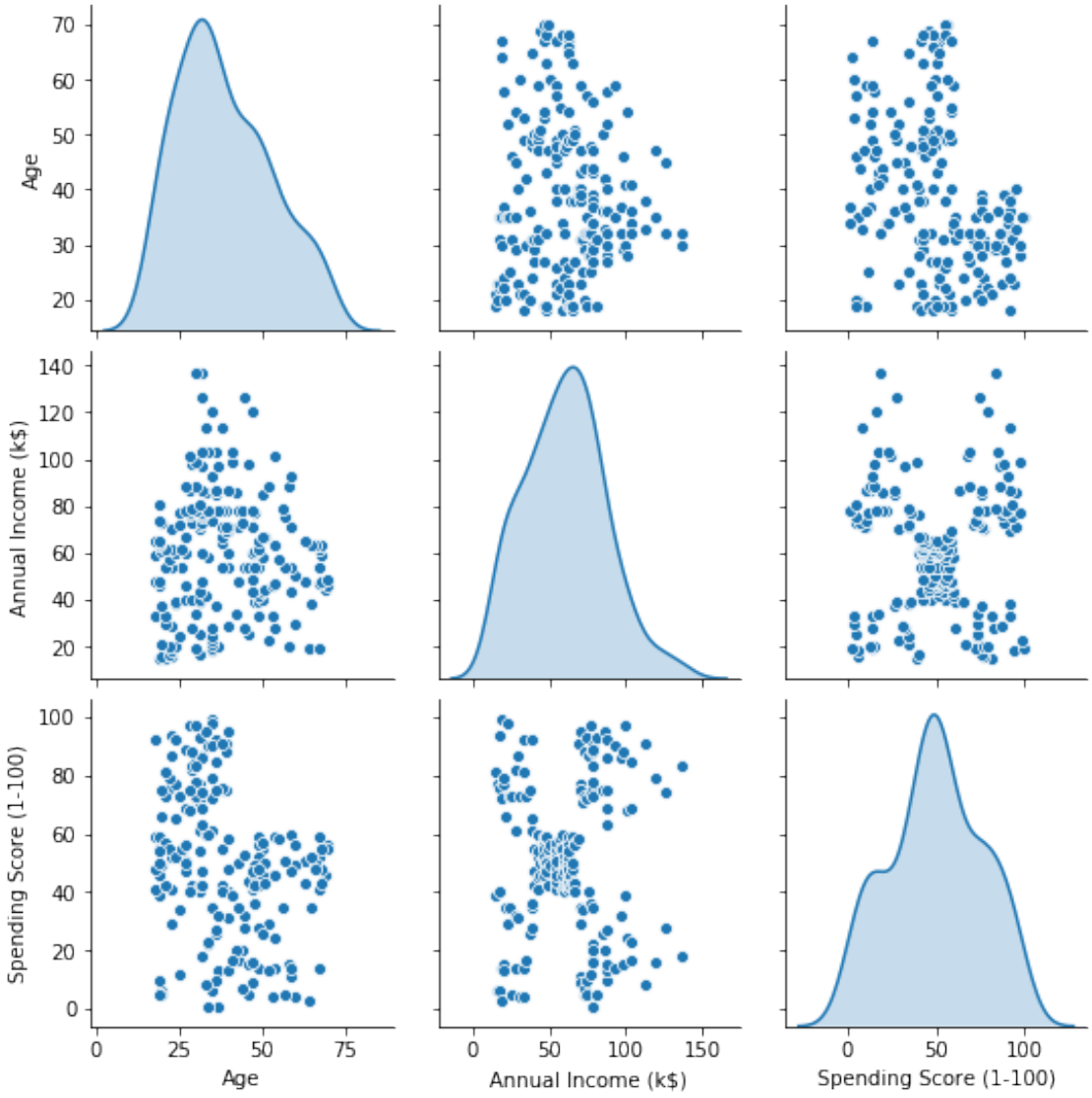
[9]:
```
Female    112
Male       88
Name: Gender, dtype: int64
```

[10]:
```
df_rows , df_cols = df1.shape
print(df_rows)
print(df_cols)
```

```
200
4
```

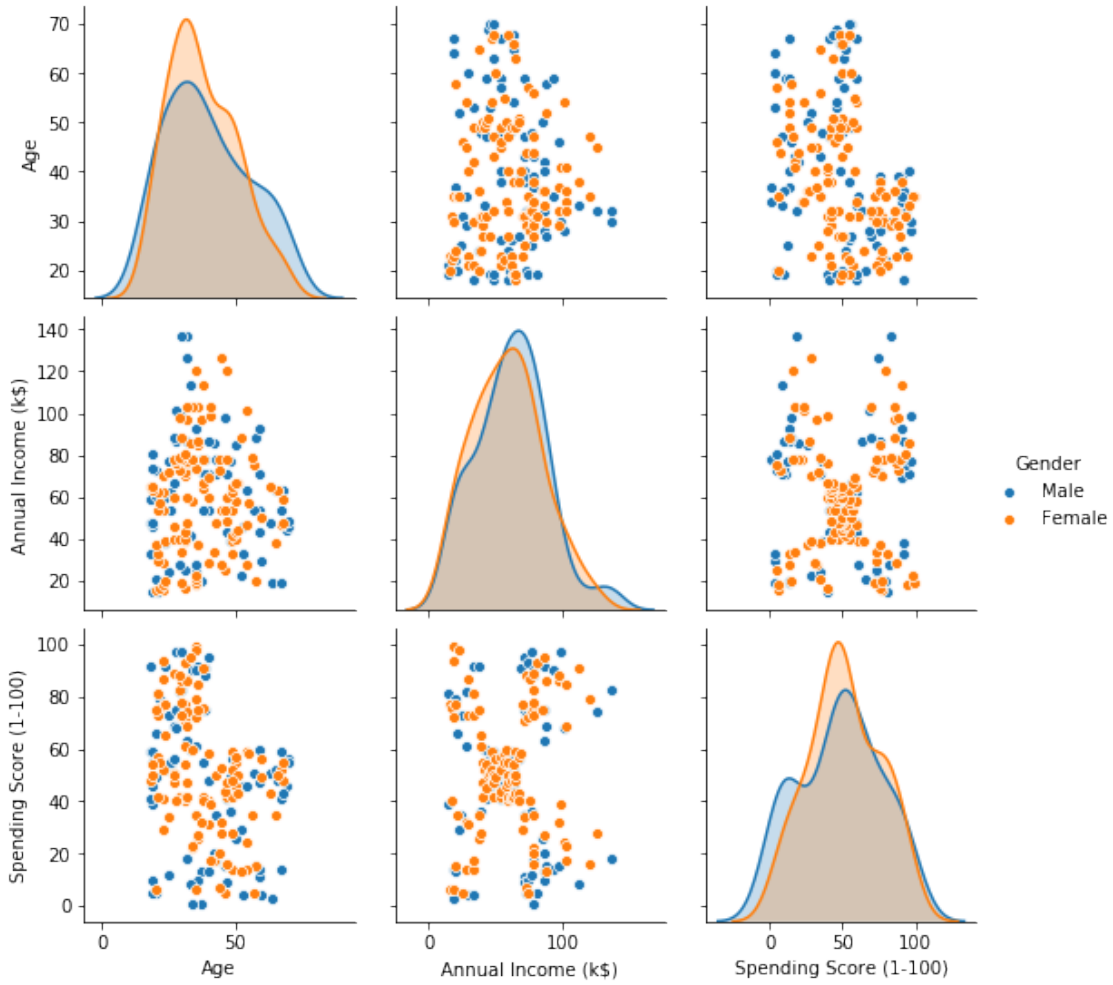
[11]:
```
import seaborn as sns
sns.pairplot(df1,diag_kind='kde')
```

[11]:
```
<seaborn.axisgrid.PairGrid at 0x1be1db94668>
```



[12]:
```
sns.pairplot(df1,diag_kind='kde', hue='Gender')
```

[12]:
```
<seaborn.axisgrid.PairGrid at 0x1be1e61efd0>
```



[14]:
```
df1.drop('Gender', axis=1, inplace=True)
```

[15]:
```
df1_scaled = df1.apply(zscore)
```

[16]:
```
df1_scaled
```

[16]:

	Age	Annual Income (k$)	Spending Score (1-100)
0	-1.424569	-1.738999	-0.434801
1	-1.281035	-1.738999	1.195704
2	-1.352802	-1.700830	-1.715913

```
3   -1.137502           -1.700830            1.040418
4   -0.563369           -1.662660           -0.395980
..        …                   …                   …
195 -0.276302            2.268791            1.118061
196  0.441365            2.497807           -0.861839
197 -0.491602            2.497807            0.923953
198 -0.491602            2.917671           -1.250054
199 -0.635135            2.917671            1.273347

[200 rows x 3 columns]
```

[17]:
```
model = KMeans(n_clusters = 3)
model
```

[17]:
```
KMeans(algorithm='auto', copy_x=True, init='k-means++', max_iter=300,
       n_clusters=3, n_init=10, n_jobs=None, precompute_distances='auto',
       random_state=None, tol=0.0001, verbose=0)
```

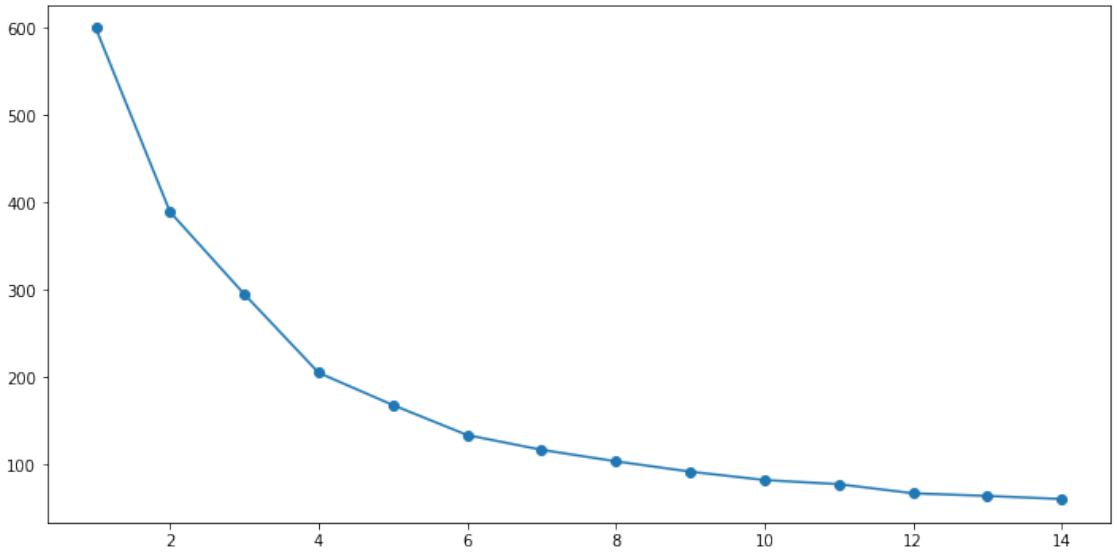
[32]:
```
cluster_range = range( 1, 15 )
cluster_errors = []
for num_clusters in cluster_range:
  clusters = KMeans( num_clusters, n_init = 10 )
  clusters.fit(df1_scaled)
  labels = clusters.labels_
  centroids = clusters.cluster_centers_
  cluster_errors.append( clusters.inertia_ )
clusters_df = pd.DataFrame( { "num_clusters":cluster_range, "cluster_errors":␣
 ↪cluster_errors } )
clusters_df[0:15]
```

[32]:
```
    num_clusters  cluster_errors
0              1      600.000000
1              2      389.386189
2              3      295.212246
3              4      205.225147
4              5      168.247580
5              6      133.868421
6              7      117.011555
7              8      103.825861
8              9       92.013131
9             10       82.430804
10            11       77.648153
11            12       67.224900
12            13       64.196795
13            14       60.659554
```

[33]:
```
# Elbow plot

plt.figure(figsize=(12,6))
plt.plot( clusters_df.num_clusters, clusters_df.cluster_errors, marker = "o" )
```

[33]:
```
[<matplotlib.lines.Line2D at 0x1be20c16e48>]
```



here we are taking the value of k as 6

[34]:
```
kmeans = KMeans(n_clusters=6, n_init = 15, random_state=2345)
```

[35]:
```
kmeans.fit(df1_scaled)
```

[35]:
```
KMeans(algorithm='auto', copy_x=True, init='k-means++', max_iter=300,
       n_clusters=6, n_init=15, n_jobs=None, precompute_distances='auto',
       random_state=2345, tol=0.0001, verbose=0)
```

[36]:
```
centroids = kmeans.cluster_centers_
centroids
```

[36]:
```
array([[ 0.47895722, -1.30822992, -1.19644353],
       [-0.44191719,  0.99158305,  1.23950275],
       [-0.87309844, -0.11378508, -0.09358039],
       [ 0.22171558,  1.08322527, -1.29005223],
       [ 1.25472096, -0.24021294, -0.04399777],
       [-0.97602698, -1.32549704,  1.0371827 ]])
```

[37]:
```
centroid_df = pd.DataFrame(centroids, columns = list(df1_scaled) )
centroid_df
```

[37]:

	Age	Annual Income (k$)	Spending Score (1-100)
0	0.478957	-1.308230	-1.196444
1	-0.441917	0.991583	1.239503
2	-0.873098	-0.113785	-0.093580
3	0.221716	1.083225	-1.290052
4	1.254721	-0.240213	-0.043998
5	-0.976027	-1.325497	1.037183

[38]:
```
df_labels = pd.DataFrame(kmeans.labels_ , columns = list(['labels']))

df_labels['labels'] = df_labels['labels'].astype('category')
```

[39]:
```
df_labeled = df1.join(df_labels)
```

[40]:
```
df_analysis = (df_labeled.groupby(['labels'] , axis=0)).head(4177)  # the␣
↪groupby creates a groupeddataframe that needs
# to be converted back to dataframe. I am using .head(30000) for that
df_analysis
```

[40]:

	Age	Annual Income (k$)	Spending Score (1-100)	labels
0	19	15	39	5
1	21	15	81	5
2	20	16	6	0
3	23	16	77	5
4	31	17	40	0
..	…	…	…	…
195	35	120	79	1
196	45	126	28	3
197	32	126	74	1
198	32	137	18	3
199	30	137	83	1

[200 rows x 4 columns]

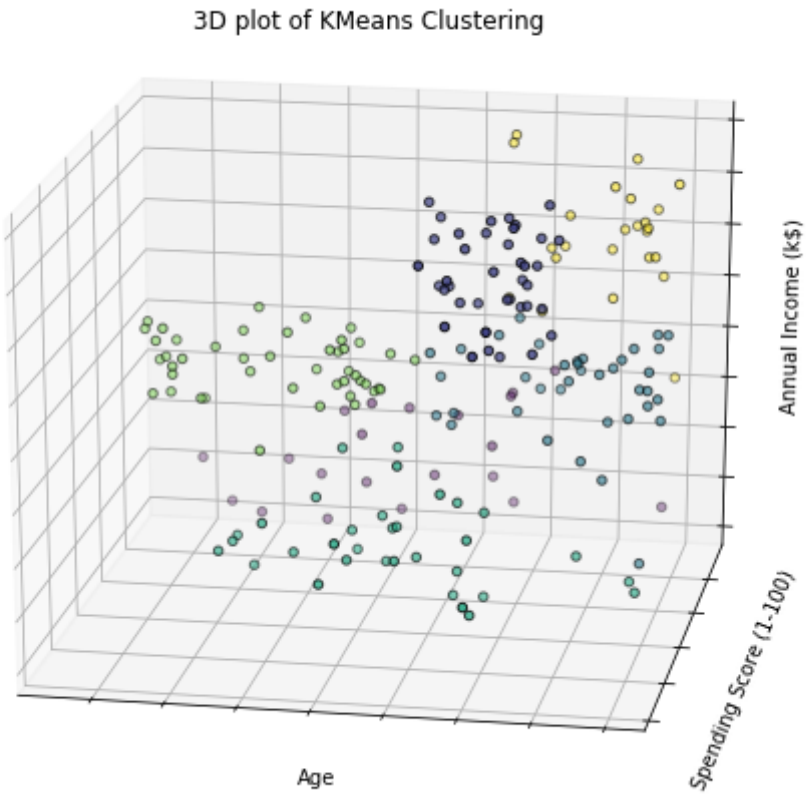
[41]:
```
df_labeled['labels'].value_counts()
```

[41]:
```
4    45
1    39
2    38
3    33
5    24
0    21
Name: labels, dtype: int64
```

[42]:
```
from mpl_toolkits.mplot3d import Axes3D
```

[48]:
```
fig = plt.figure(figsize=(8, 6))
ax = Axes3D(fig, rect=[0, 0, .95, 1], elev=20, azim=100)
kmeans.fit(df1_scaled)
labels = kmeans.labels_
ax.scatter(df1_scaled.iloc[:, 0], df1_scaled.iloc[:, 1], df1_scaled.iloc[:,␣
↪2],c=labels.astype(np.float), edgecolor='k')
ax.w_xaxis.set_ticklabels([])
ax.w_yaxis.set_ticklabels([])
ax.w_zaxis.set_ticklabels([])
ax.set_xlabel('Age')
ax.set_ylabel('Spending Score (1-100)')
ax.set_zlabel('Annual Income (k$)')
ax.set_title('3D plot of KMeans Clustering')
```

[48]:
```
Text(0.5, 0.92, '3D plot of KMeans Clustering')
```



[ ]:
```
```