

```
In [1]: import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

```
In [2]: A=pd.read_csv("C:/Users/HP/Downloads/Mall_Customers.csv")
A.head()
```

Out[2]:

	CustomerID	Genre	Age	Annual_Income_(k\$)	Spending_Score
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

```
In [3]: A.drop(['Genre'],axis=1,inplace=True)
A
```

Out[3]:

	CustomerID	Age	Annual_Income_(k\$)	Spending_Score
0	1	19	15	39
1	2	21	15	81
2	3	20	16	6
3	4	23	16	77
4	5	31	17	40
...
195	196	35	120	79
196	197	45	126	28
197	198	32	126	74
198	199	32	137	18
199	200	30	137	83

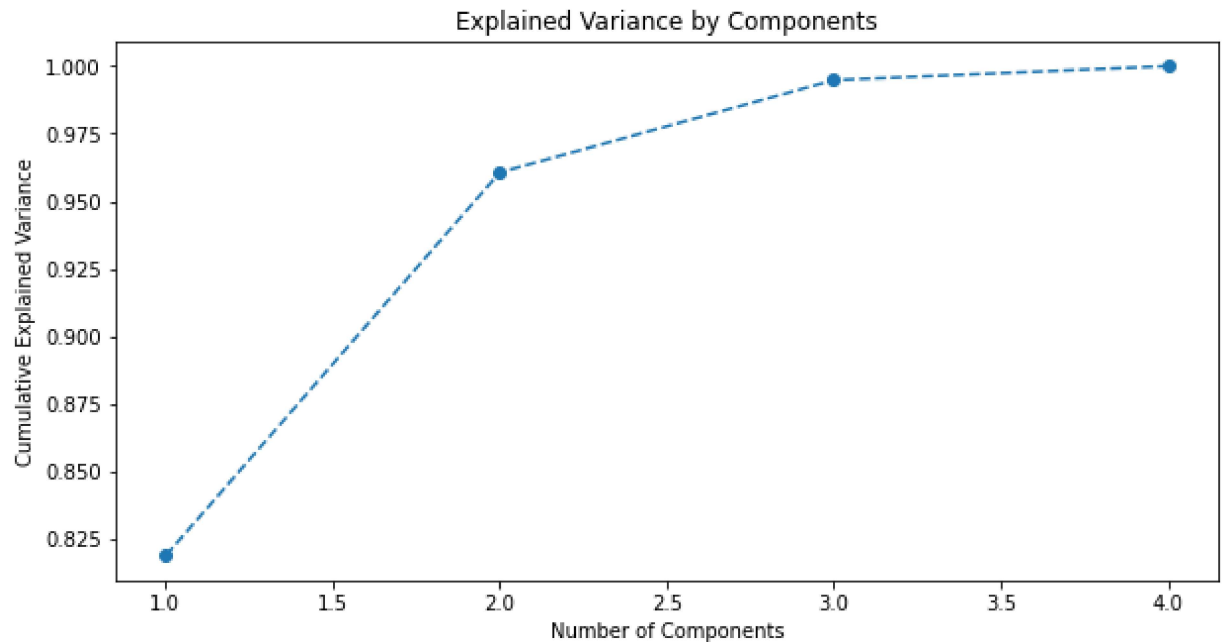
200 rows × 4 columns

```
In [4]: #define standard scaler
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
#transform data
scaled = scaler.fit_transform(A)
print(scaled)
```

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```

```
In [7]: plt.figure(figsize=(10,5))
plt.plot(range(1,5),pc.explained_variance_ratio_.cumsum(),marker='o',linestyle='-.')
plt.title('Explained Variance by Components')
plt.xlabel('Number of Components')
plt.ylabel('Cumulative Explained Variance')
```

Out[7]: Text(0, 0.5, 'Cumulative Explained Variance')



```
In [8]: pc=PCA(n_components=2)
pc.fit(A)
pc.explained_variance_ratio_
pc.explained_variance_ratio_.cumsum()
```

Out[8]: array([0.81899053, 0.96068389])

```
In [9]: df=pc.transform(A)
print(df)
```

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```

```
In [10]: from sklearn.cluster import KMeans
sse=[]
Kmeans=range(1,15)
for k in (Kmeans):
    km=KMeans(n_clusters=k)
    km.fit(df)
    sse.append(km.inertia_)
    print(sse)
```

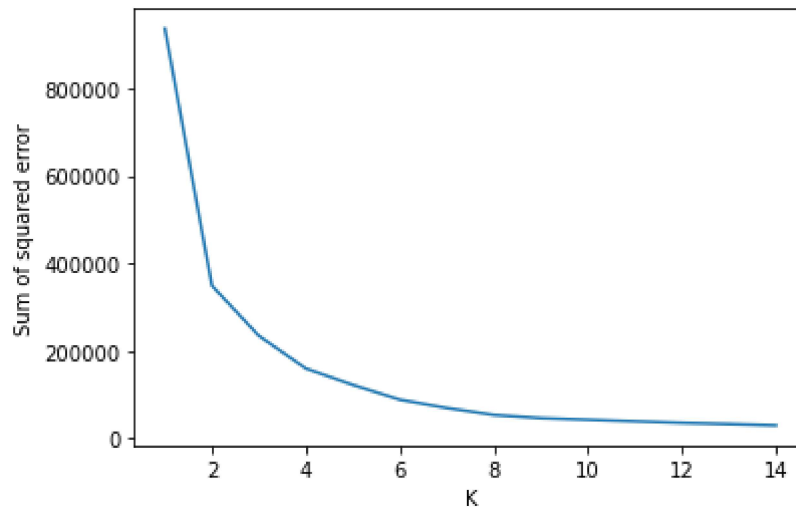
C:\Users\HP\anaconda3\lib\site-packages\sklearn\cluster_kmeans.py:881: UserWarning: KMeans is known to have a memory leak on Windows with MKL, when there are less chunks than available threads. You can avoid it by setting the environment variable OMP_NUM_THREADS=1.

warnings.warn(

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78.096626255596, 42212.563183440136, 38534.38533089137, 35049.71844414756]
[937111.3767673883, 349085.5582349874, 234127.1293450116, 159578.12984974362, 1
21982.05019190397, 88087.06076189269, 69054.84353621714, 53145.22976830189, 458
78.096626255596, 42212.563183440136, 38534.38533089137, 35049.71844414756, 3237
1.733303339537]
[937111.3767673883, 349085.5582349874, 234127.1293450116, 159578.12984974362, 1
21982.05019190397, 88087.06076189269, 69054.84353621714, 53145.22976830189, 458
78.096626255596, 42212.563183440136, 38534.38533089137, 35049.71844414756, 3237
1.733303339537, 29169.223009163215]
```

```
In [11]: plt.xlabel('K')
plt.ylabel('Sum of squared error')
plt.plot(Kmeans,sse)
```

```
Out[11]: []
```



```
In [12]: km=KMeans(n_clusters=4)
          y_predicted=km.fit_predict(df)
          y_predicted
```

[illegible]

```
In [13]: km.cluster_centers_
```

```
Out[13]: array([[ 66.99373894, -31.97145841],
                 [-75.76706574, -0.40743488],
                 [-7.36859761,  1.62813171],
                 [ 68.90626218,  32.43166601]])
```

```
In [14]: A2=np.transpose(df)
pca1=A2[0]
pca2=A2[1]
```

```
In [15]: df_plot=pd.DataFrame()
df_plot['pca1']=np.transpose(pca1)
df_plot['pca2']=np.transpose(pca2)
df_plot['cluster']=y_predicted
df_plot
```

Out[15]:

	pca1	pca2	cluster
0	-109.384203	5.477723	1
1	-108.203115	-34.932531	1
2	-107.376109	37.841376	1
3	-106.007616	-30.562252	1
4	-104.980136	7.297221	1
...
195	111.652786	-27.964063	0
196	114.615565	24.018448	3
197	115.911268	-23.730584	0
198	120.939693	30.859322	3
199	122.297518	-32.853688	0

200 rows × 3 columns

```
In [16]: df_plot1=df_plot[df_plot.cluster==0]
df_plot2=df_plot[df_plot.cluster==1]
df_plot3=df_plot[df_plot.cluster==2]
df_plot4=df_plot[df_plot.cluster==3]
```

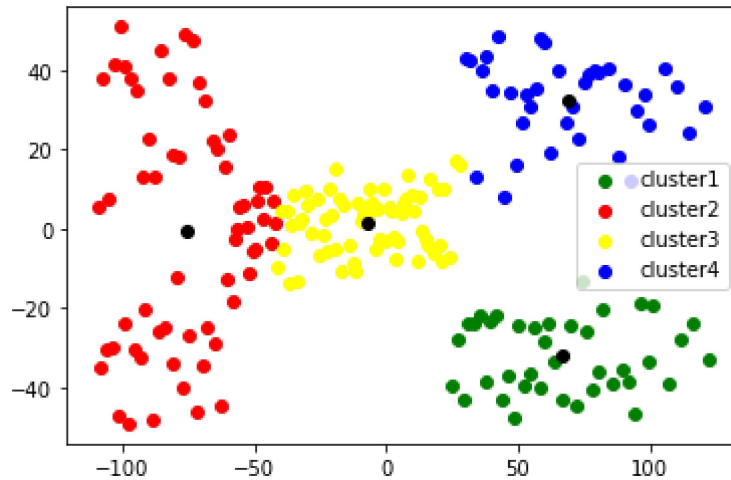
```
In [17]: df_plot1['pca1']
```

```
Out[17]: 123      25.168475
125      27.355968
127      29.657038
129      31.361296
131      33.181251
133      35.435388
135      37.794296
137      39.502557
139      41.712185
141      44.103614
143      46.297512
145      48.621497
147      50.270578
149      52.599366
151      54.382536
153      56.134246
155      58.111205
157      59.846123
159      61.638620
161      63.945012
163      66.641879
165      69.950682
167      72.335447
169      74.361933
171      76.291181
173      78.183384
175      80.412465
177      82.142580
179      86.101769
181      89.550785
183      91.815590
185      94.103591
187      96.564000
189      99.272335
191     101.014978
193     107.032888
195     111.652786
197     115.911268
199     122.297518
Name: pca1, dtype: float64
```



```
In [18]: plt.scatter(df_plot1['pca1'],df_plot1['pca2'],color='green',label='cluster1')
plt.scatter(df_plot2['pca1'],df_plot2['pca2'],color='red',label='cluster2')
plt.scatter(df_plot3['pca1'],df_plot3['pca2'],color='yellow',label='cluster3')
plt.scatter(df_plot4['pca1'],df_plot4['pca2'],color='blue',label='cluster4')
plt.scatter(km.cluster_centers_[0],km.cluster_centers_[1],color='black')
plt.legend()
```

Out[18]: <matplotlib.legend.Legend at 0x1f4ca9e7af0>



In []: