In [2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [3]:
```
ds= pd.read_csv('Mall_Customers.csv')
```

In [4]:
```
ds.head()
```

Out[4]:

	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

In [5]:
```
ds.tail()
```

Out[5]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
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

In [6]:
```
ds.describe()
```

Out[6]:

	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

In [7]:
```
ds.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
```

In [7]:
```
ds.columns
```

Out[7]:
```
Index(['CustomerID', 'Gender', 'Age', 'Annual Income (k$)',
       'Spending Score (1-100)'],
      dtype='object')
```

Categorical columns and perform encoding

In [8]:
```
ds['Gender'].unique()
```

Out[8]:
```
array(['Male', 'Female'], dtype=object)
```

In [9]:
```
ds['Gender']=ds['Gender'].replace(['Male', 'Female'],[0,1])
```

In [10]:
```
ds.head()
```

Out[10]:

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

In [11]:
```
ds.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    int64
 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(5)
memory usage: 7.9 KB
```

descriptive statistics on the dataset

In [12]:
```
ds.describe()
```

Out[12]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
count	200.000000	200.000000	200.000000	200.000000	200.000000
mean	100.500000	0.560000	38.850000	60.560000	50.200000
std	57.879185	0.497633	13.969007	26.264721	25.823522
min	1.000000	0.000000	18.000000	15.000000	1.000000
25%	50.750000	0.000000	28.750000	41.500000	34.750000
50%	100.500000	1.000000	36.000000	61.500000	50.000000
75%	150.250000	1.000000	49.000000	78.000000	73.000000
max	200.000000	1.000000	70.000000	137.000000	99.000000

In [13]:
```
ds.duplicated()
```

Out[13]:
```
0      False
1      False
2      False
3      False
4      False
       ...
195    False
196    False
197    False
```

```
198    False
199    False
Length: 200, dtype: bool
```

In [14]:
```
ds.duplicated().sum()
```

Out[14]:
```
0
```

In [15]:
```
ds.corr()
```

Out[15]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
CustomerID	1.000000	-0.057400	-0.026763	0.977548	0.013835
Gender	-0.057400	1.000000	-0.060867	-0.056410	0.058109
Age	-0.026763	-0.060867	1.000000	-0.012398	-0.327227
Annual Income (k$)	0.977548	-0.056410	-0.012398	1.000000	0.009903
Spending Score (1-100)	0.013835	0.058109	-0.327227	0.009903	1.000000

Bivariate analysis

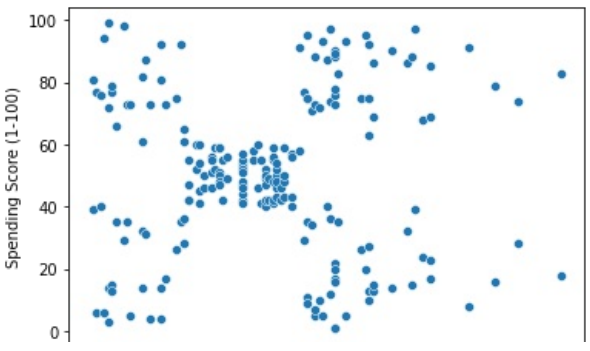
In [16]:
```
sns.heatmap(ds.corr(),annot=True)
```

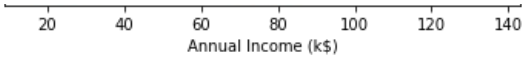
Out[16]:
```
<AxesSubplot:>
```

In [39]:
```
sns.scatterplot(ds["Annual Income (k$)"],ds["Spending Score (1-100)"])
```

```
C:\Users\Jagadeesan\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variables as keyword args: x, y. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```

Out[39]:
```
<AxesSubplot:xlabel='Annual Income (k$)', ylabel='Spending Score (1-100)'>
```

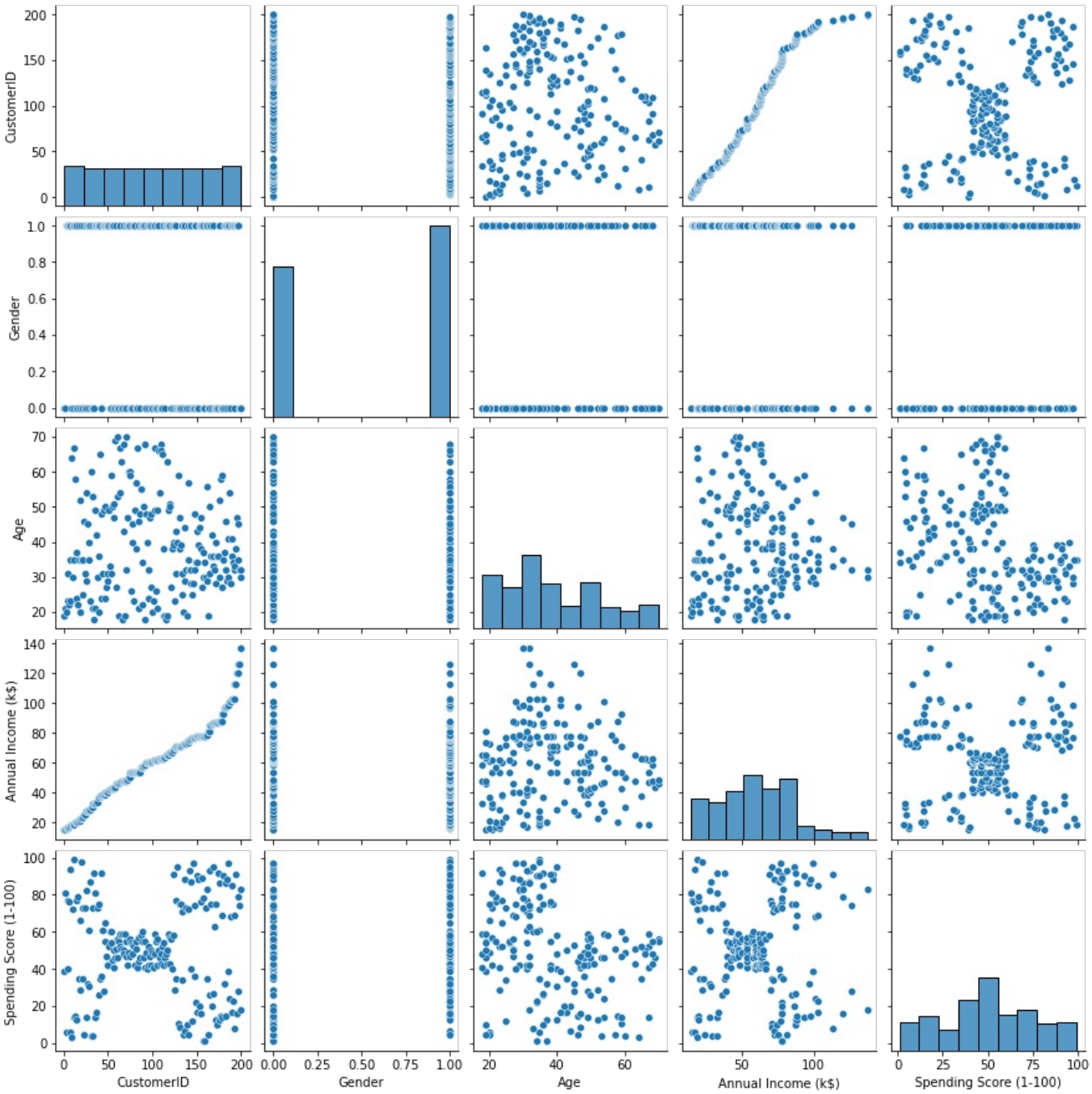




Multivarite Analysis

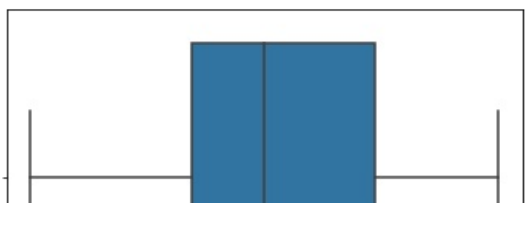
In [40]:
```
sns.pairplot(ds)
```

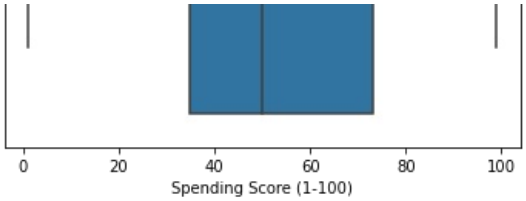
Out[40]:
```
<seaborn.axisgrid.PairGrid at 0x2f664944430>
```



In [24]:
```
sns.boxplot(ds['Spending Score (1-100)'])
```

Out[24]:
```
<AxesSubplot:xlabel='Spending Score (1-100)'>
```

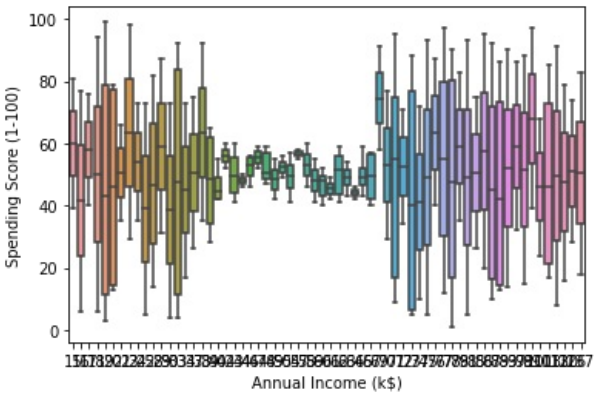




In [25]:
```
sns.boxplot(ds['Annual Income (k$)'],ds['Spending Score (1-100)'])
```

```
C:\Users\Jagadeesan\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following vari
ables as keyword args: x, y. From version 0.12, the only valid positional argument will be `data`, and passing ot
her arguments without an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```

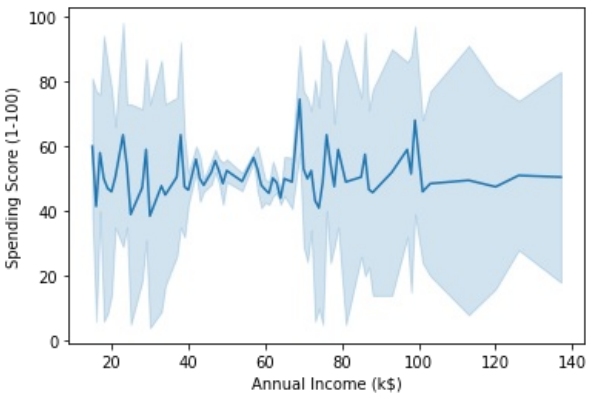
Out[25]:
```
<AxesSubplot:xlabel='Annual Income (k$)', ylabel='Spending Score (1-100)'>
```



In [27]:
```
sns.lineplot(ds['Annual Income (k$)'],ds['Spending Score (1-100)'])
```

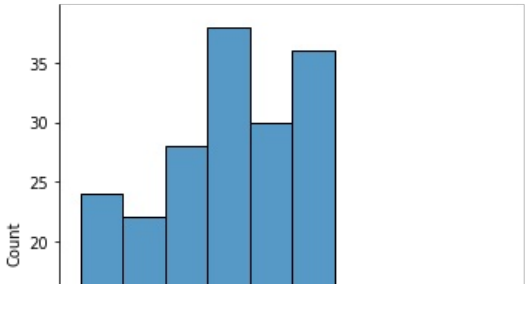
```
C:\Users\Jagadeesan\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following vari
ables as keyword args: x, y. From version 0.12, the only valid positional argument will be `data`, and passing ot
her arguments without an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```

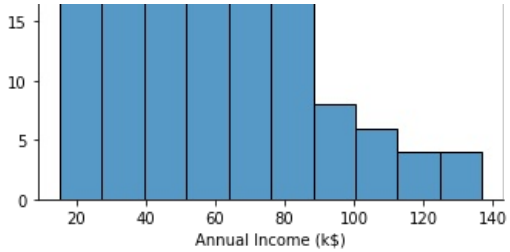
Out[27]:
```
<AxesSubplot:xlabel='Annual Income (k$)', ylabel='Spending Score (1-100)'>
```



In [28]:
```
sns.displot(ds['Annual Income (k$)'])
```

Out[28]:
```
<seaborn.axisgrid.FacetGrid at 0x155b6d43a00>
```

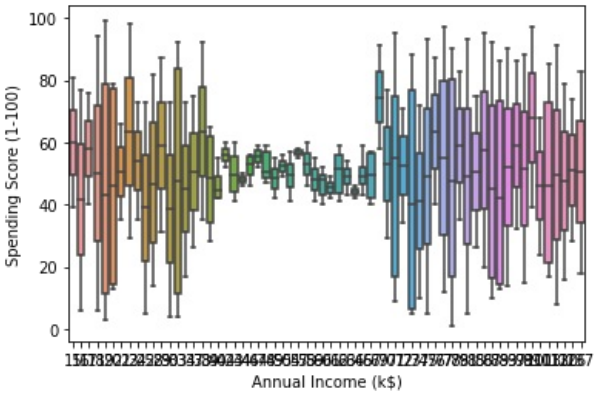




outliers

In [42]:
```
sns.boxplot(x='Annual Income (k$)',y='Spending Score (1-100)',data=ds)
```

Out[42]:
```
<AxesSubplot:xlabel='Annual Income (k$)', ylabel='Spending Score (1-100)'>
```



Missing Values

In [18]:
```
ds.isna()
```

Out[18]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	False	False	False	False	False
1	False	False	False	False	False
2	False	False	False	False	False
3	False	False	False	False	False
4	False	False	False	False	False
...	...	...	...	...	...
195	False	False	False	False	False
196	False	False	False	False	False
197	False	False	False	False	False
198	False	False	False	False	False
199	False	False	False	False	False

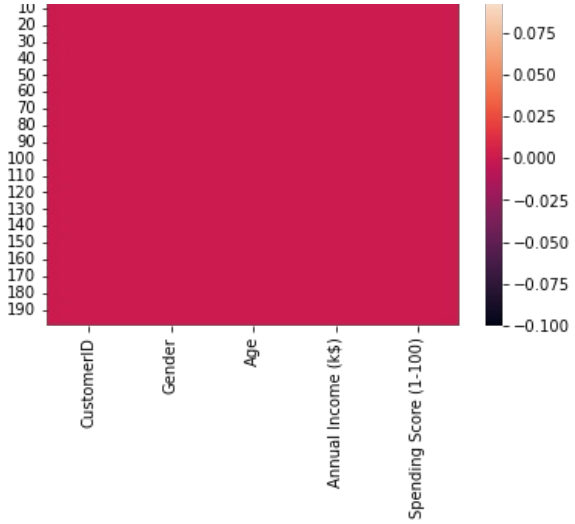
200 rows × 5 columns

In [43]:
```
ds.isna().any().sum()
```

Out[43]:
```
0
```

In [44]:
```
sns.heatmap(ds.isna())
```

Out[44]:
```
<AxesSubplot:>
```



Buliding Clustring

kmeans clustring

In [17]:

```
from sklearn.preprocessing import  StandardScaler
ss = StandardScaler().fit_transform(ds)
ss
```

Out[17]:

```
array([[-1.7234121 , -1.12815215, -1.42456879, -1.73899919, -0.43480148],
       [-1.70609137, -1.12815215, -1.28103541, -1.73899919,  1.19570407],
       [-1.68877065,  0.88640526, -1.3528021 , -1.70082976, -1.71591298],
       [-1.67144992,  0.88640526, -1.13750203, -1.70082976,  1.04041783],
       [-1.6541292 ,  0.88640526, -0.56336851, -1.66266033, -0.39597992],
       [-1.63680847,  0.88640526, -1.20926872, -1.66266033,  1.00159627],
       [-1.61948775,  0.88640526, -0.27630176, -1.62449091, -1.71591298],
       [-1.60216702,  0.88640526, -1.13750203, -1.62449091,  1.70038436],
       [-1.5848463 , -1.12815215,  1.80493225, -1.58632148, -1.83237767],
       [-1.56752558,  0.88640526, -0.6351352 , -1.58632148,  0.84631002],
       [-1.55020485, -1.12815215,  2.02023231, -1.58632148, -1.4053405 ],
       [-1.53288413,  0.88640526, -0.27630176, -1.58632148,  1.89449216],
       [-1.5155634 ,  0.88640526,  1.37433211, -1.54815205, -1.36651894],
       [-1.49824268,  0.88640526, -1.06573534, -1.54815205,  1.04041783],
       [-1.48092195, -1.12815215, -0.13276838, -1.54815205, -1.44416206],
       [-1.46360123, -1.12815215, -1.20926872, -1.54815205,  1.11806095],
       [-1.4462805 ,  0.88640526, -0.27630176, -1.50998262, -0.59008772],
       [-1.42895978, -1.12815215, -1.3528021 , -1.50998262,  0.61338066],
       [-1.41163905, -1.12815215,  0.94373197, -1.43364376, -0.82301709],
       [-1.39431833,  0.88640526, -0.27630176, -1.43364376,  1.8556706 ],
       [-1.3769976 , -1.12815215, -0.27630176, -1.39547433, -0.59008772],
       [-1.35967688, -1.12815215, -0.99396865, -1.39547433,  0.88513158],
       [-1.34235616,  0.88640526,  0.51313183, -1.3573049 , -1.75473454],
       [-1.32503543, -1.12815215, -0.56336851, -1.3573049 ,  0.88513158],
       [-1.30771471,  0.88640526,  1.08726535, -1.24279661, -1.4053405 ],
       [-1.29039398, -1.12815215, -0.70690189, -1.24279661,  1.23452563],
       [-1.27307326,  0.88640526,  0.44136514, -1.24279661, -0.7065524 ],
       [-1.25575253, -1.12815215, -0.27630176, -1.24279661,  0.41927286],
       [-1.23843181,  0.88640526,  0.08253169, -1.20462718, -0.74537397],
       [-1.22111108,  0.88640526, -1.13750203, -1.20462718,  1.42863343],
       [-1.20379036, -1.12815215,  1.51786549, -1.16645776, -1.7935561 ],
       [-1.18646963,  0.88640526, -1.28103541, -1.16645776,  0.88513158],
       [-1.16914891, -1.12815215,  1.01549866, -1.05194947, -1.7935561 ],
       [-1.15182818, -1.12815215, -1.49633548, -1.05194947,  1.62274124],
       [-1.13450746,  0.88640526,  0.7284319 , -1.05194947, -1.4053405 ],
       [-1.11718674,  0.88640526, -1.28103541, -1.05194947,  1.19570407],
       [-1.09986601,  0.88640526,  0.22606507, -1.01378004, -1.28887582],
       [-1.08254529,  0.88640526, -0.6351352 , -1.01378004,  0.88513158],
       [-1.06522456,  0.88640526, -0.20453507, -0.89927175, -0.93948177],
       [-1.04790384,  0.88640526, -1.3528021 , -0.89927175,  0.96277471],
       [-1.03058311,  0.88640526,  1.87669894, -0.86110232, -0.59008772],
       [-1.01326239, -1.12815215, -1.06573534, -0.86110232,  1.62274124],
       [-0.99594166, -1.12815215,  0.65666521, -0.82293289, -0.55126616],
       [-0.97862094,  0.88640526, -0.56336851, -0.82293289,  0.41927286],
       [-0.96130021,  0.88640526,  0.7284319 , -0.82293289, -0.86183865],
       [-0.94397949,  0.88640526, -1.06573534, -0.82293289,  0.5745591 ],
       [-0.92665877,  0.88640526,  0.80019859, -0.78476346,  0.18634349],
       [-0.90933804,  0.88640526, -0.85043527, -0.78476346, -0.12422899],
       [-0.89201732,  0.88640526, -0.70690189, -0.78476346, -0.3183368 ],
       [-0.87469659,  0.88640526, -0.56336851, -0.78476346, -0.3183368 ],
```

```
[-0.85737587,  0.88640526,  0.7284319 , -0.70842461,  0.06987881],
[-0.84005514, -1.12815215, -0.41983513, -0.70842461,  0.38045129],
[-0.82273442,  0.88640526, -0.56336851, -0.67025518,  0.14752193],
[-0.80541369, -1.12815215,  1.4460988 , -0.67025518,  0.38045129],
[-0.78809297,  0.88640526,  0.80019859, -0.67025518, -0.20187212],
[-0.77077224, -1.12815215,  0.58489852, -0.67025518, -0.35715836],
[-0.75345152,  0.88640526,  0.87196528, -0.63208575, -0.00776431],
[-0.73613079, -1.12815215,  2.16376569, -0.63208575, -0.16305055],
[-0.71881007,  0.88640526, -0.85043527, -0.55574689,  0.03105725],
[-0.70148935, -1.12815215,  1.01549866, -0.55574689, -0.16305055],
[-0.68416862, -1.12815215,  2.23553238, -0.55574689,  0.22516505],
[-0.6668479 , -1.12815215, -1.42456879, -0.55574689,  0.18634349],
[-0.64952717,  0.88640526,  2.02023231, -0.51757746,  0.06987881],
[-0.63220645,  0.88640526,  1.08726535, -0.51757746,  0.34162973],
[-0.61488572, -1.12815215,  1.73316556, -0.47940803,  0.03105725],
[-0.597565  , -1.12815215, -1.49633548, -0.47940803,  0.34162973],
[-0.58024427,  0.88640526,  0.29783176, -0.47940803, -0.00776431],
[-0.56292355,  0.88640526,  2.091999  , -0.47940803, -0.08540743],
[-0.54560282, -1.12815215, -1.42456879, -0.47940803,  0.34162973],
[-0.5282821 ,  0.88640526, -0.49160182, -0.47940803, -0.12422899],
[-0.51096138, -1.12815215,  2.23553238, -0.4412386 ,  0.18634349],
[-0.49364065,  0.88640526,  0.58489852, -0.4412386 , -0.3183368 ],
[-0.47631993,  0.88640526,  1.51786549, -0.40306917, -0.04658587],
[-0.4589992 ,  0.88640526,  1.51786549, -0.40306917,  0.22516505],
[-0.44167848, -1.12815215,  1.4460988 , -0.25039146, -0.12422899],
[-0.42435775, -1.12815215, -0.92220196, -0.25039146,  0.14752193],
[-0.40703703,  0.88640526,  0.44136514, -0.25039146,  0.10870037],
[-0.3897163 , -1.12815215,  0.08253169, -0.25039146, -0.08540743],
[-0.37239558,  0.88640526, -1.13750203, -0.25039146,  0.06987881],
[-0.35507485,  0.88640526,  0.7284319 , -0.25039146, -0.3183368 ],
[-0.33775413, -1.12815215,  1.30256542, -0.25039146,  0.03105725],
[-0.3204334 , -1.12815215, -0.06100169, -0.25039146,  0.18634349],
[-0.30311268, -1.12815215,  2.02023231, -0.25039146, -0.35715836],
[-0.28579196,  0.88640526,  0.51313183, -0.25039146, -0.24069368],
[-0.26847123,  0.88640526, -1.28103541, -0.25039146,  0.26398661],
[-0.25115051, -1.12815215,  0.65666521, -0.25039146, -0.16305055],
[-0.23382978,  0.88640526,  1.15903204, -0.13588317,  0.30280817],
[-0.21650906,  0.88640526, -1.20926872, -0.13588317,  0.18634349],
[-0.19918833,  0.88640526, -0.34806844, -0.09771374,  0.38045129],
[-0.18186761,  0.88640526,  0.80019859, -0.09771374, -0.16305055],
[-0.16454688,  0.88640526,  2.091999  , -0.05954431,  0.18634349],
[-0.14722616, -1.12815215, -1.49633548, -0.05954431, -0.35715836],
[-0.12990543, -1.12815215,  0.65666521, -0.02137488, -0.04658587],
[-0.11258471,  0.88640526,  0.08253169, -0.02137488, -0.39597992],
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```

In [19]:

```
from sklearn.cluster import KMeans
TWSS = []
k = list(range(2,9))

for i in k:
  kmeans = KMeans(n_clusters = i , init = 'k-means++')
  kmeans.fit(ds)
  TWSS.append(kmeans.inertia_)
```

In [24]:

```
TWSS
```

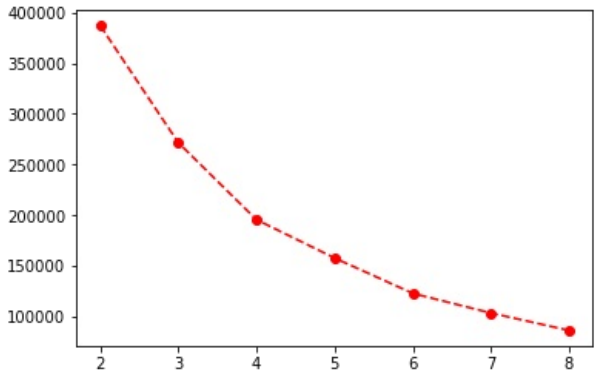
Out[24]:

```
[387065.7137713772,
 271384.50878286787,
 195401.19855991477,
 157505.7207247758,
 122630.44175335614,
 103233.09788480632,
 86026.5343045842]
```

In [25]:

```
plt.plot(k,TWSS, 'ro--')
```

Out[25]:
```
[<matplotlib.lines.Line2D at 0x1cbed668790>]
```



In [27]:
```
model = KMeans(n_clusters = 3)
model.fit(ds)
```

Out[27]:
```
KMeans(n_clusters=3)
```

In [28]:
```
mb = pd.Series(model.labels_)
```

In [30]:
```
ds['Cluster'] = mb
```

In [31]:
```
ds
```

Out[31]:

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

200 rows × 6 columns