**Assignment -4**
Python Programming

| | |
|---|---|
| Assignment Date | 13 October 2022 |
| Student Name | Mr. Lavan R P |
| Student Roll Number | 910619104045 |
| Maximum Marks | 2 Marks |

# Customer Segmentation Analysis

In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

## Importing Dataset

In [6]:

```
df = pd.read_csv('Mall_Customers.csv')
```

In [8]:

```
df.head()
```

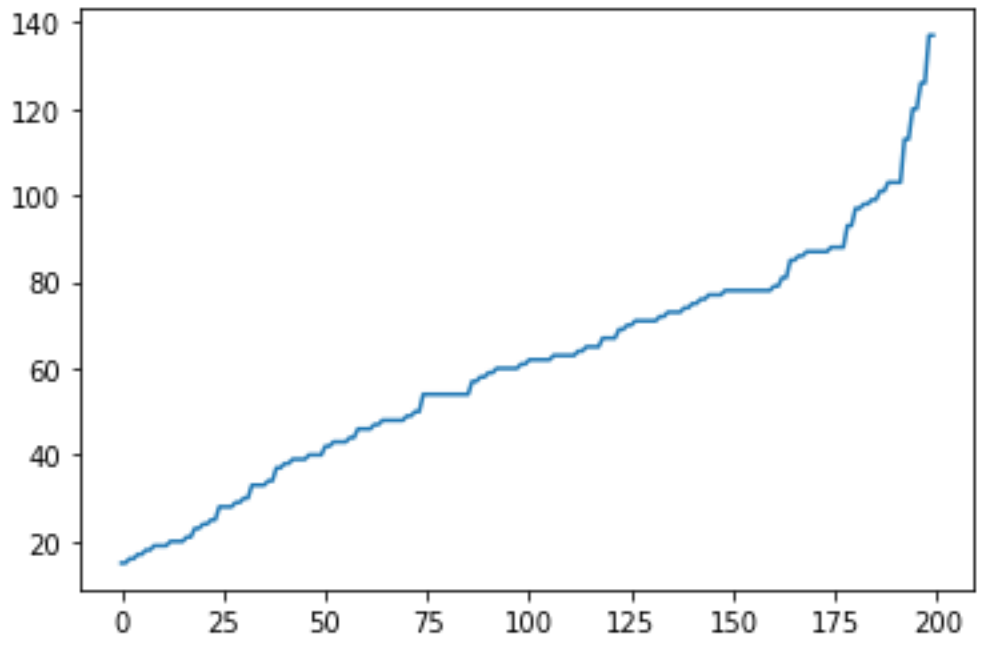
Out[8]:

| | 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 |

## 1. Univariate Analysis

In [11]:

```
plt.plot(df['Annual Income (k$)'])
plt.show()
```

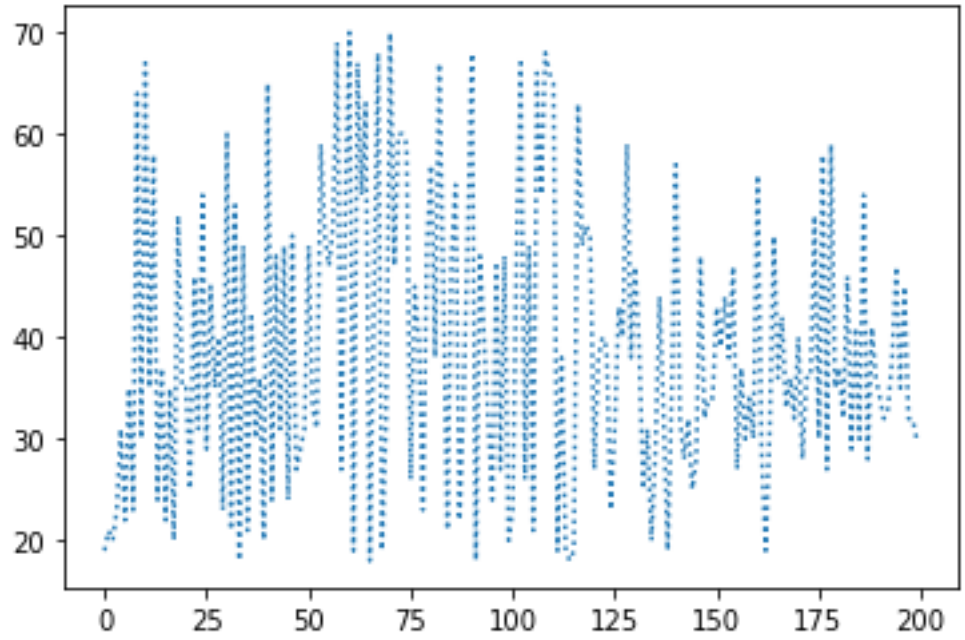



In [13]:

```
data=np.array(df['Age'])
plt.plot(data,linestyle='dotted')
```

Out[13]:

```
[<matplotlib.lines.Line2D at 0x173eeaf9ac0>]
```



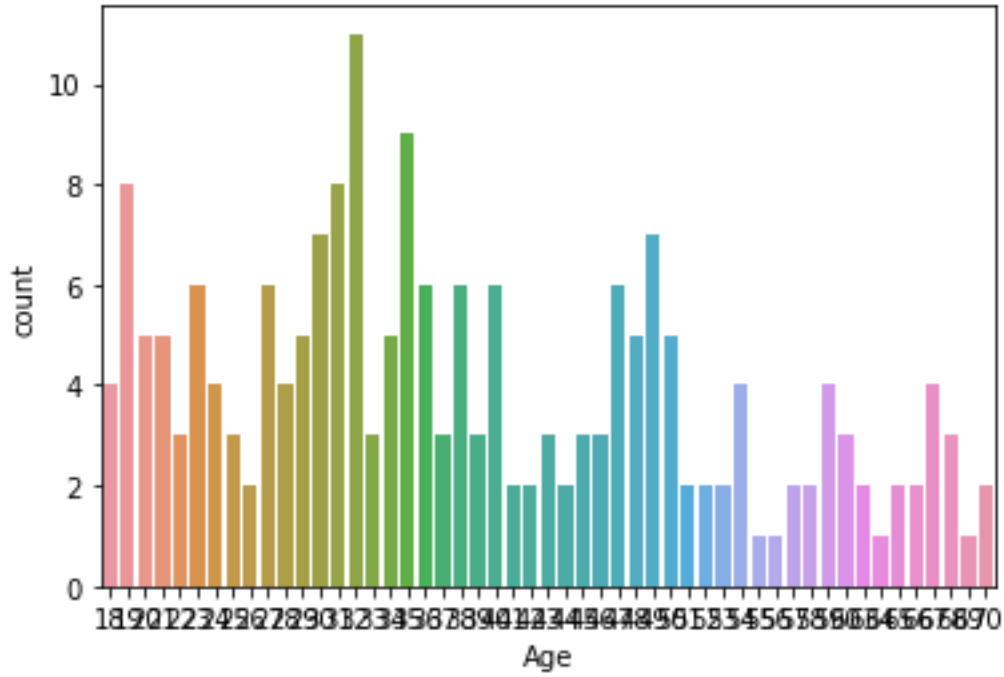

In [14]:

```
sns.countplot(df['Age'])
C:\Users\Ilyas\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. 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[14]:

```
<AxesSubplot:xlabel='Age', ylabel='count'>
```

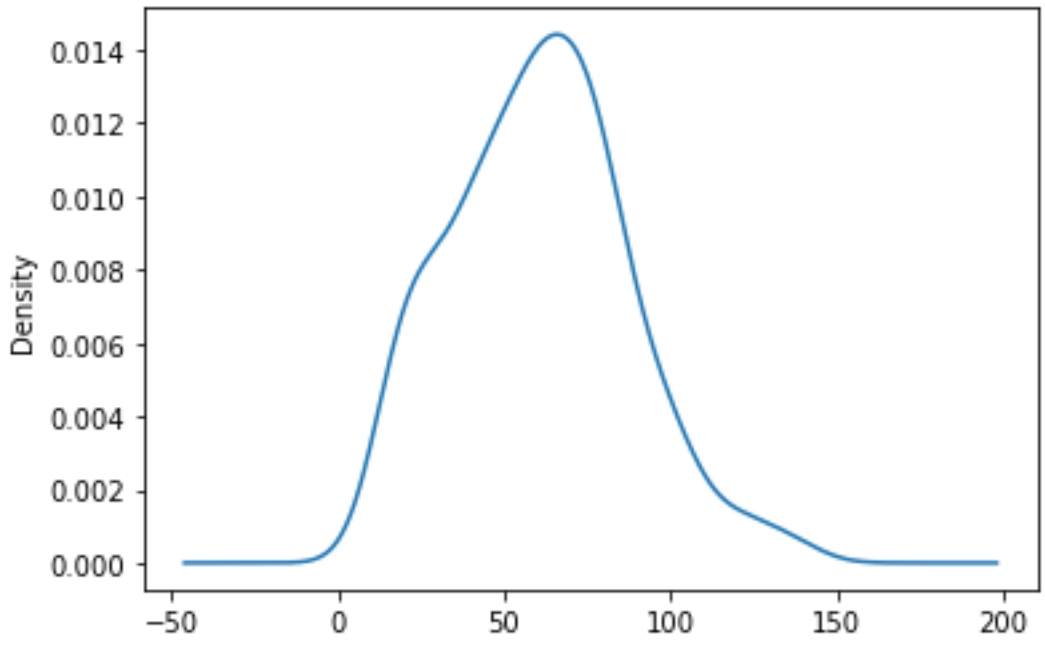



In [19]:

```
df['Annual Income (k$)'].plot(kind ='density')
```

Out[19]:

```
<AxesSubplot:ylabel='Density'>
```

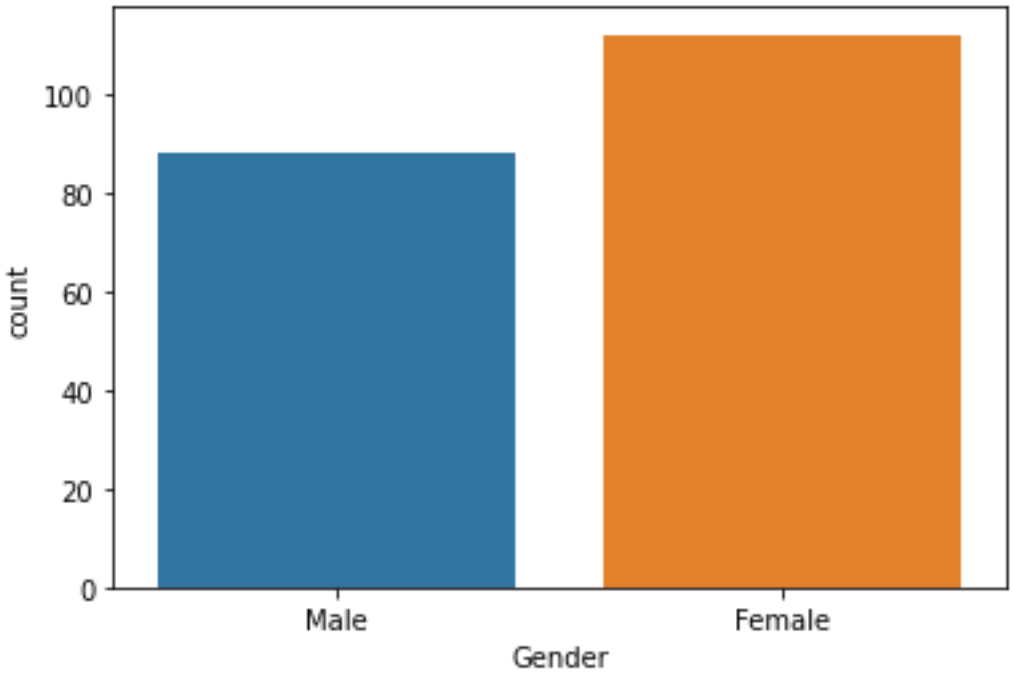



In [20]:

```
sns.countplot(df['Gender'])
C:\Users\Ilyas\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. 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[20]:

```
<AxesSubplot:xlabel='Gender', ylabel='count'>
```

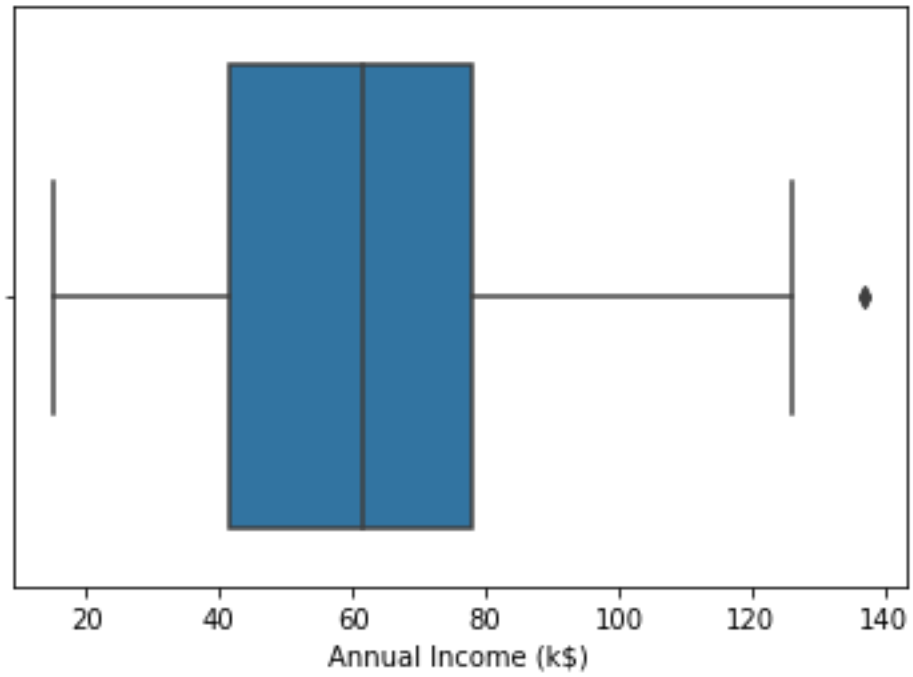



In [21]:

```
sns.boxplot(df['Annual Income (k$)'])
C:\Users\Ilyas\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. 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[21]:

```
<AxesSubplot:xlabel='Annual Income (k$)'>
```

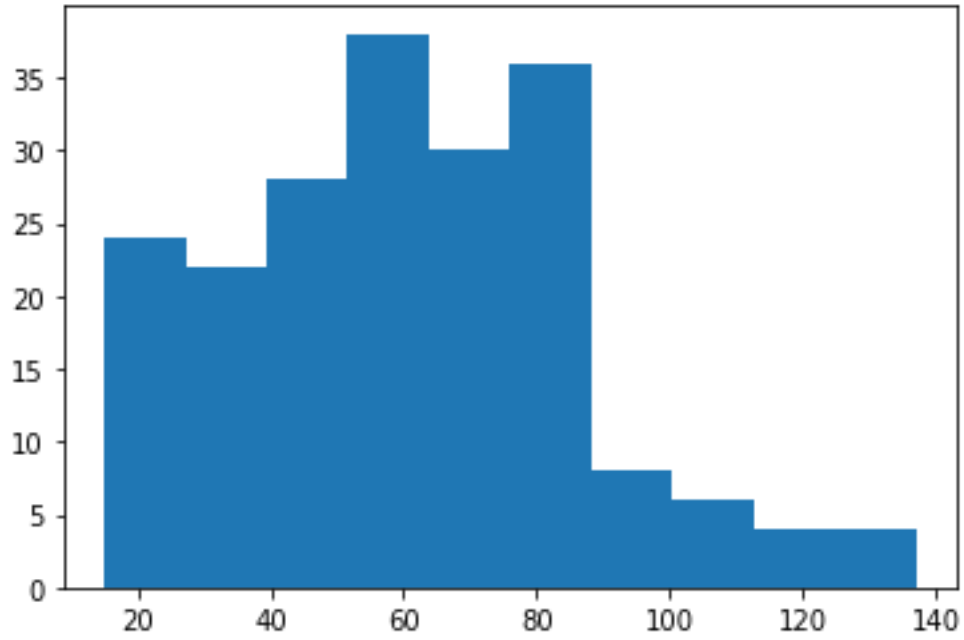



In [22]:

```
plt.hist(df['Annual Income (k$)'])
```

Out[22]:

```
(array([24., 22., 28., 38., 30., 36.,  8.,  6.,  4.,  4.]),
 array([ 15. ,  27.2,  39.4,  51.6,  63.8,  76. ,  88.2, 100.4, 112.6,
        124.8, 137. ]),
 <BarContainer object of 10 artists>)
```



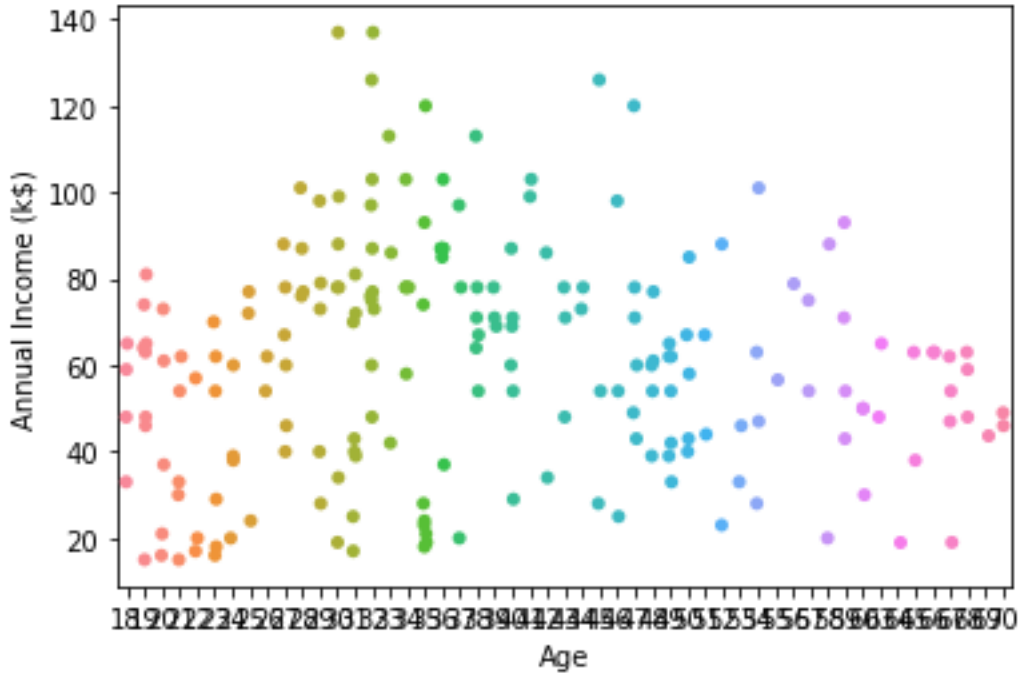

## 2. Bi-Variate Analysis

In [23]:

```
sns.stripplot(x=df['Age'],y=df['Annual Income (k$)'])
```

Out[23]:

```
<AxesSubplot:xlabel='Age', ylabel='Annual Income (k$)'>
```

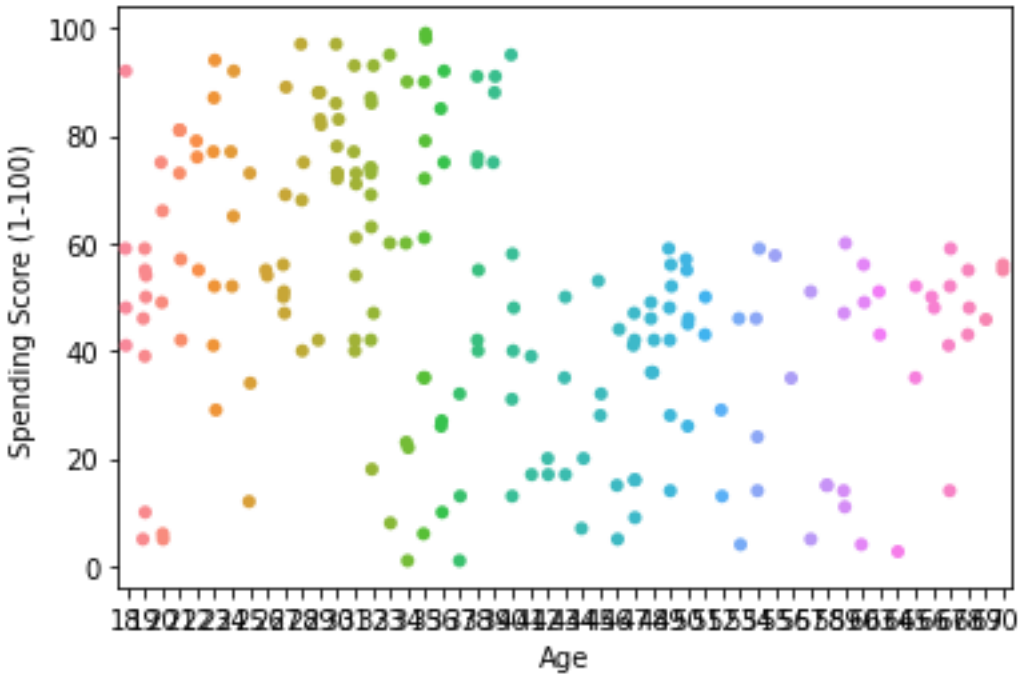



In [24]:

```
sns.stripplot(x=df['Age'],y=df['Spending Score (1-100)'])
```

Out[24]:

```
<AxesSubplot:xlabel='Age', ylabel='Spending Score (1-100)'>
```

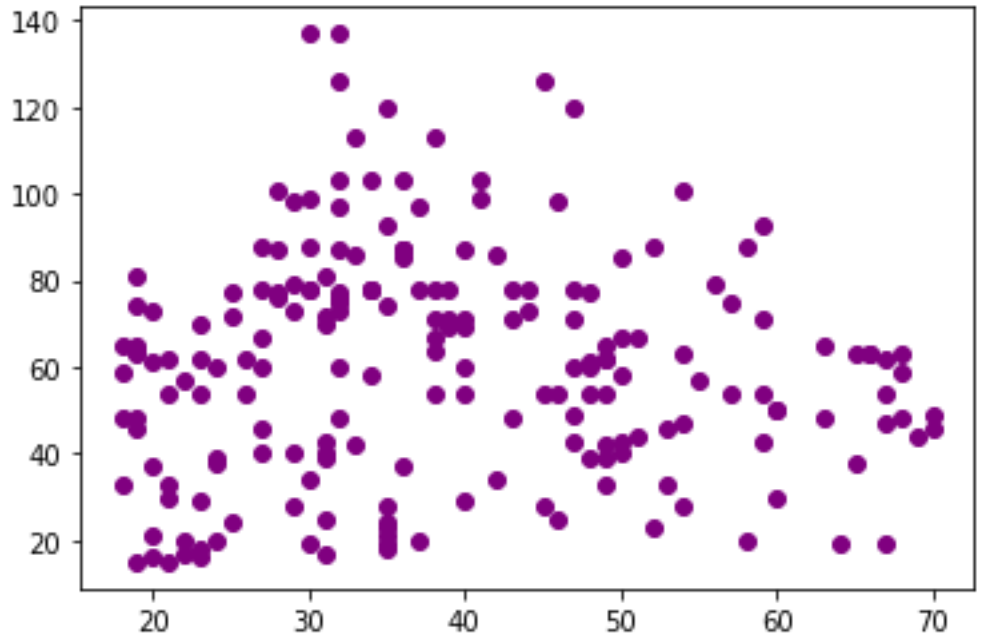



In [26]:

```
plt.scatter(df['Age'],df['Annual Income (k$)'],color='purple')
```

Out[26]:

```
<matplotlib.collections.PathCollection at 0x173f184f4c0>
```

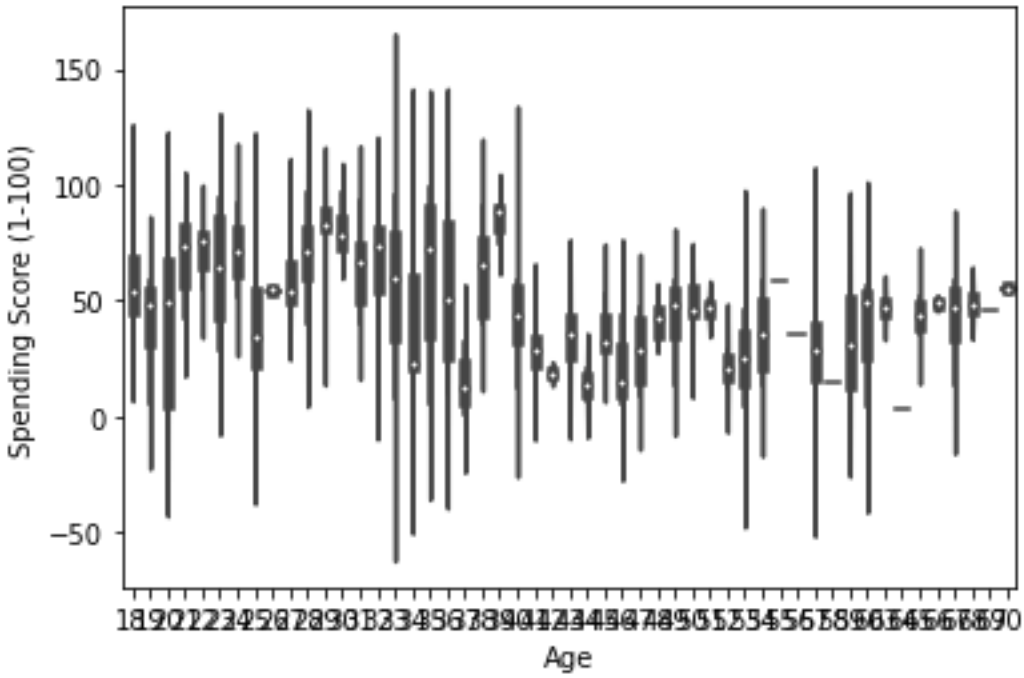



In [27]:

```
sns.violinplot(x='Age',y='Spending Score (1-100)',data=df)
```

Out[27]:

```
<AxesSubplot:xlabel='Age', ylabel='Spending Score (1-100)'>
```



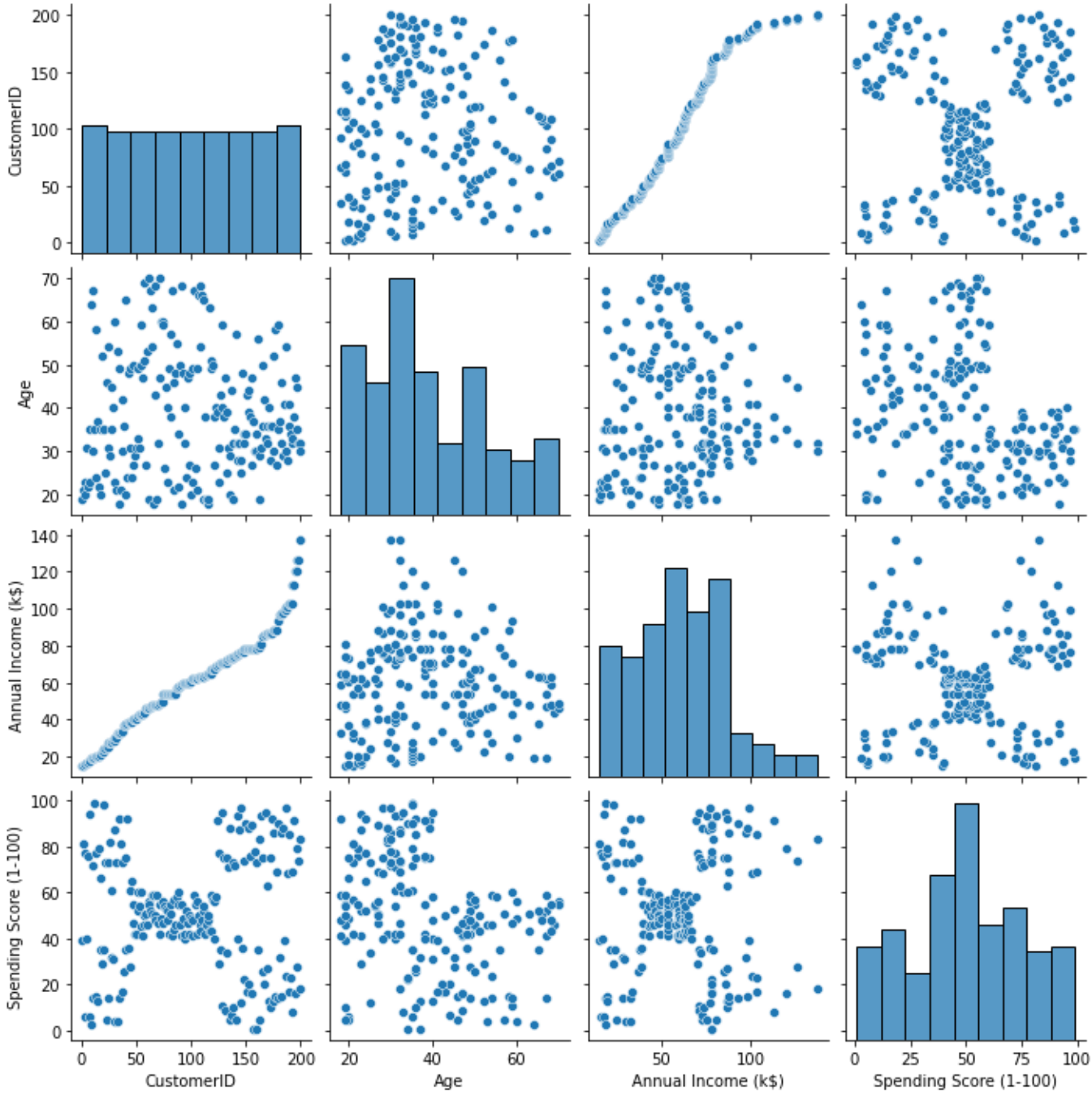

## 3. Multi-Variate Analysis

In [28]:

```
sns.pairplot(df)
```

Out[28]:

```
<seaborn.axisgrid.PairGrid at 0x173f167d430>
```



## 4. Discriptive Statistics

In [30]:

```
sns.heatmap(df.corr(),annot=True)
```

Out[30]:

```
<AxesSubplot:>
```


In [31]:

```
df.shape
```

Out[31]:

```
(200, 5)
```

In [32]:

```
df.isnull().sum()
```

Out[32]:

```
CustomerID                0
Gender                    0
Age                       0
Annual Income (k$)        0
Spending Score (1-100)    0
dtype: int64
```

In [33]:

```
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
```

In [34]:

```
df.describe()
```

Out[34]:

| | 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 [35]:

```
df.mean()
C:\Users\Ilyas\AppData\Local\Temp\ipykernel_10368\3698961737.py:1:
FutureWarning: Dropping of nuisance columns in DataFrame reductions (with
'numeric_only=None') is deprecated; in a future version this will raise
TypeError.  Select only valid columns before calling the reduction.
  df.mean()
```

Out[35]:

```
CustomerID              100.50
Age                      38.85
Annual Income (k$)       60.56
Spending Score (1-100)   50.20
dtype: float64
```

In [36]:

```
df.median()
C:\Users\Ilyas\AppData\Local\Temp\ipykernel_10368\530051474.py:1:
FutureWarning: Dropping of nuisance columns in DataFrame reductions (with
'numeric_only=None') is deprecated; in a future version this will raise
TypeError.  Select only valid columns before calling the reduction.
  df.median()
```

Out[36]:

```
CustomerID                200.5
Age                        36.0
Annual Income (k$)         61.5
Spending Score (1-100)     50.0
dtype: float64
```

In [37]:

```
df.mode()
```

Out[37]:

| | CustomerID | Gender | Age | Annual Income (k$) | Spending Score (1-100) |
|---|---|---|---|---|---|
| **0** | 1 | Female | 32.0 | 54.0 | 42.0 |
| **1** | 2 | NaN | NaN | 78.0 | NaN |
| **2** | 3 | NaN | NaN | NaN | NaN |
| **3** | 4 | NaN | NaN | NaN | NaN |
| **4** | 5 | NaN | NaN | NaN | NaN |
| **...** | ... | ... | ... | ... | ... |
| **195** | 196 | NaN | NaN | NaN | NaN |
| **196** | 197 | NaN | NaN | NaN | NaN |
| **197** | 198 | NaN | NaN | NaN | NaN |
| **198** | 199 | NaN | NaN | NaN | NaN |
| **199** | 200 | NaN | NaN | NaN | NaN |

200 rows × 5 columns

In [38]:

```
df['Gender'].value_counts()
```

Out[38]:

```
Female    112
Male       88
Name: Gender, dtype: int64
```

## 5. Missing Values

In [39]:

```
df.isna().sum()
```

Out[39]:

```
CustomerID                0
Gender                    0
Age                       0
Annual Income (k$)        0
Spending Score (1-100)    0
dtype: int64
```

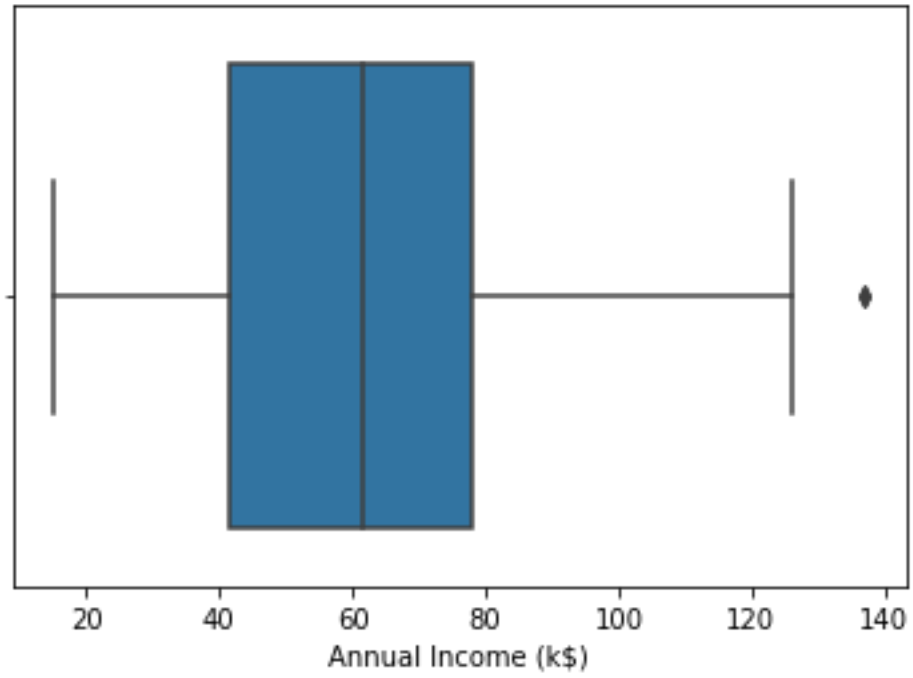
## 6. Handling outliners

In [40]:

```
sns.boxplot(df['Annual Income (k$)'])
C:\Users\Ilyas\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. 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[40]:

```
<AxesSubplot:xlabel='Annual Income (k$)'>
```




In [41]:

```
Q1 = df['Annual Income (k$)'].quantile(0.25)
Q3 = df['Annual Income (k$)'].quantile(0.75)
IQR = Q3 - Q1

whisker_width = 1.5
lower_whisker = Q1 -(whisker_width*IQR)
upper_whisker = Q3 +(whisker_width*IQR)
df['Annual Income (k$)']= np.where(df['Annual Income (k$)'] > upper_whisker,
upper_whisker, np.where(df['Annual Income (k$)'] <
lower_whisker,lower_whisker,df['Annual Income (k$)']))
```

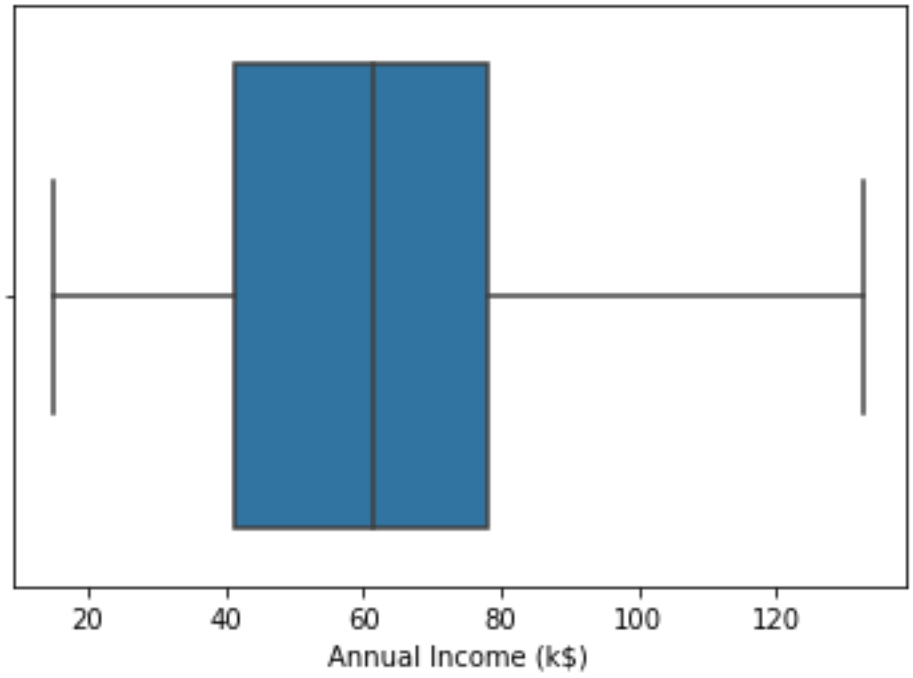
In [43]:

```
sns.boxplot(df['Annual Income (k$)'])
C:\Users\Ilyas\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. 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[43]:

```
<AxesSubplot:xlabel='Annual Income (k$)'>
```




## 7. Encoading Categorical Values

In [44]:

```
numeric_data = df.select_dtypes(include = [np.number])
categorical_data = df.select_dtypes(exclude = [np.number])

print("The number of numerical variables: ", numeric_data.shape[1])
print("The number of categorical variables: ", categorical_data.shape[1])
The number of numerical variables:  4
The number of categorical variables:  1
```

In [45]:

```
print("The number of categorical variables: ", categorical_data.shape[1])

Categorical_variables = list(categorical_data.columns)
Categorical_variables
The number of categorical variables:  1
```

Out[45]:

```
['Gender']
```

In [47]:

```
df['Gender'].value_counts()
```

Out[47]:

```
Female    112
Male       88
Name: Gender, dtype: int64
```

In [50]:

```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
label = le.fit_transform(df['Gender'])
df["Gender"] = label
```

In [51]:

```
df['Gender'].value_counts()
```

Out[51]:

```
0    112
1     88
Name: Gender, dtype: int64
```

## 8. Scaling the datas

In [52]:

```
X = df.drop("Age", axis=1)
Y = df['Age']
```

In [53]:

```
from sklearn.preprocessing import StandardScaler
object= StandardScaler()
scale = object.fit_transform(X)
print(scale)
```

```
[[-1.7234121   1.12815215 -1.74542941 -0.43480148]
 [-1.70609137  1.12815215 -1.74542941  1.19570407]
 [-1.68877065 -0.88640526 -1.70708307 -1.71591298]
 [-1.67144992 -0.88640526 -1.70708307  1.04041783]
 [-1.6541292  -0.88640526 -1.66873673 -0.39597992]
 [-1.63680847 -0.88640526 -1.66873673  1.00159627]
 [-1.61948775 -0.88640526 -1.6303904  -1.71591298]
 [-1.60216702 -0.88640526 -1.6303904   1.70038436]
 [-1.5848463   1.12815215 -1.59204406 -1.83237767]
 [-1.56752558 -0.88640526 -1.59204406  0.84631002]
 [-1.55020485  1.12815215 -1.59204406 -1.4053405 ]
 [-1.53288413 -0.88640526 -1.59204406  1.89449216]
 [-1.5155634  -0.88640526 -1.55369772 -1.36651894]
 [-1.49824268 -0.88640526 -1.55369772  1.04041783]
 [-1.48092195  1.12815215 -1.55369772 -1.44416206]
 [-1.46360123  1.12815215 -1.55369772  1.11806095]
 [-1.4462805  -0.88640526 -1.51535138 -0.59008772]
 [-1.42895978  1.12815215 -1.51535138  0.61338066]
 [-1.41163905  1.12815215 -1.43865871 -0.82301709]
 [-1.39431833 -0.88640526 -1.43865871  1.8556706 ]
```

```
[-1.3769976   1.12815215 -1.40031237 -0.59008772]
[-1.35967688  1.12815215 -1.40031237  0.88513158]
[-1.34235616 -0.88640526 -1.36196603 -1.75473454]
[-1.32503543  1.12815215 -1.36196603  0.88513158]
[-1.30771471 -0.88640526 -1.24692702 -1.4053405 ]
[-1.29039398  1.12815215 -1.24692702  1.23452563]
[-1.27307326 -0.88640526 -1.24692702 -0.7065524 ]
[-1.25575253  1.12815215 -1.24692702  0.41927286]
[-1.23843181 -0.88640526 -1.20858069 -0.74537397]
[-1.22111108 -0.88640526 -1.20858069  1.42863343]
[-1.20379036  1.12815215 -1.17023435 -1.7935561 ]
[-1.18646963 -0.88640526 -1.17023435  0.88513158]
[-1.16914891  1.12815215 -1.05519534 -1.7935561 ]
[-1.15182818  1.12815215 -1.05519534  1.62274124]
[-1.13450746 -0.88640526 -1.05519534 -1.4053405 ]
[-1.11718674 -0.88640526 -1.05519534  1.19570407]
[-1.09986601 -0.88640526 -1.016849   -1.28887582]
[-1.08254529 -0.88640526 -1.016849    0.88513158]
[-1.06522456 -0.88640526 -0.90180999 -0.93948177]
[-1.04790384 -0.88640526 -0.90180999  0.96277471]
[-1.03058311 -0.88640526 -0.86346365 -0.59008772]
[-1.01326239  1.12815215 -0.86346365  1.62274124]
[-0.99594166  1.12815215 -0.82511731 -0.55126616]
[-0.97862094 -0.88640526 -0.82511731  0.41927286]
[-0.96130021 -0.88640526 -0.82511731 -0.86183865]
[-0.94397949 -0.88640526 -0.82511731  0.5745591 ]
[-0.92665877 -0.88640526 -0.78677098  0.18634349]
[-0.90933804 -0.88640526 -0.78677098 -0.12422899]
[-0.89201732 -0.88640526 -0.78677098 -0.3183368 ]
[-0.87469659 -0.88640526 -0.78677098 -0.3183368 ]
[-0.85737587 -0.88640526 -0.7100783   0.06987881]
[-0.84005514  1.12815215 -0.7100783   0.38045129]
[-0.82273442 -0.88640526 -0.67173196  0.14752193]
[-0.80541369  1.12815215 -0.67173196  0.38045129]
[-0.78809297 -0.88640526 -0.67173196 -0.20187212]
[-0.77077224  1.12815215 -0.67173196 -0.35715836]
[-0.75345152 -0.88640526 -0.63338563 -0.00776431]
[-0.73613079  1.12815215 -0.63338563 -0.16305055]
[-0.71881007 -0.88640526 -0.55669295  0.03105725]
[-0.70148935  1.12815215 -0.55669295 -0.16305055]
[-0.68416862  1.12815215 -0.55669295  0.22516505]
[-0.6668479   1.12815215 -0.55669295  0.18634349]
[-0.64952717 -0.88640526 -0.51834661  0.06987881]
[-0.63220645 -0.88640526 -0.51834661  0.34162973]
[-0.61488572  1.12815215 -0.48000028  0.03105725]
```

```
[-0.597565    1.12815215 -0.48000028  0.34162973]
[-0.58024427 -0.88640526 -0.48000028 -0.00776431]
[-0.56292355 -0.88640526 -0.48000028 -0.08540743]
[-0.54560282  1.12815215 -0.48000028  0.34162973]
[-0.5282821  -0.88640526 -0.48000028 -0.12422899]
[-0.51096138  1.12815215 -0.44165394  0.18634349]
[-0.49364065 -0.88640526 -0.44165394 -0.3183368 ]
[-0.47631993 -0.88640526 -0.4033076  -0.04658587]
[-0.4589992  -0.88640526 -0.4033076   0.22516505]
[-0.44167848  1.12815215 -0.24992225 -0.12422899]
[-0.42435775  1.12815215 -0.24992225  0.14752193]
[-0.40703703 -0.88640526 -0.24992225  0.10870037]
[-0.3897163   1.12815215 -0.24992225 -0.08540743]
[-0.37239558 -0.88640526 -0.24992225  0.06987881]
[-0.35507485 -0.88640526 -0.24992225 -0.3183368 ]
[-0.33775413  1.12815215 -0.24992225  0.03105725]
[-0.3204334   1.12815215 -0.24992225  0.18634349]
[-0.30311268  1.12815215 -0.24992225 -0.35715836]
[-0.28579196 -0.88640526 -0.24992225 -0.24069368]
[-0.26847123 -0.88640526 -0.24992225  0.26398661]
[-0.25115051  1.12815215 -0.24992225 -0.16305055]
[-0.23382978 -0.88640526 -0.13488324  0.30280817]
[-0.21650906 -0.88640526 -0.13488324  0.18634349]
[-0.19918833 -0.88640526 -0.0965369   0.38045129]
[-0.18186761 -0.88640526 -0.0965369  -0.16305055]
[-0.16454688 -0.88640526 -0.05819057  0.18634349]
[-0.14722616  1.12815215 -0.05819057 -0.35715836]
[-0.12990543  1.12815215 -0.01984423 -0.04658587]
[-0.11258471 -0.88640526 -0.01984423 -0.39597992]
[-0.09526399 -0.88640526 -0.01984423 -0.3183368 ]
[-0.07794326  1.12815215 -0.01984423  0.06987881]
[-0.06062254 -0.88640526 -0.01984423 -0.12422899]
[-0.04330181 -0.88640526 -0.01984423 -0.00776431]
[-0.02598109  1.12815215  0.01850211 -0.3183368 ]
[-0.00866036  1.12815215  0.01850211 -0.04658587]
[ 0.00866036 -0.88640526  0.05684845 -0.35715836]
[ 0.02598109 -0.88640526  0.05684845 -0.08540743]
[ 0.04330181  1.12815215  0.05684845  0.34162973]
[ 0.06062254  1.12815215  0.05684845  0.18634349]
[ 0.07794326  1.12815215  0.05684845  0.22516505]
[ 0.09526399 -0.88640526  0.05684845 -0.3183368 ]
[ 0.11258471 -0.88640526  0.09519478 -0.00776431]
[ 0.12990543  1.12815215  0.09519478 -0.16305055]
[ 0.14722616  1.12815215  0.09519478 -0.27951524]
[ 0.16454688  1.12815215  0.09519478 -0.08540743]
```

```
[ 0.18186761  1.12815215  0.09519478  0.06987881]
[ 0.19918833 -0.88640526  0.09519478  0.14752193]
[ 0.21650906 -0.88640526  0.13354112 -0.3183368 ]
[ 0.23382978  1.12815215  0.13354112 -0.16305055]
[ 0.25115051 -0.88640526  0.17188746 -0.08540743]
[ 0.26847123 -0.88640526  0.17188746 -0.00776431]
[ 0.28579196 -0.88640526  0.17188746 -0.27951524]
[ 0.30311268 -0.88640526  0.17188746  0.34162973]
[ 0.3204334  -0.88640526  0.24858013 -0.27951524]
[ 0.33775413 -0.88640526  0.24858013  0.26398661]
[ 0.35507485  1.12815215  0.24858013  0.22516505]
[ 0.37239558 -0.88640526  0.24858013 -0.39597992]
[ 0.3897163  -0.88640526  0.32527281  0.30280817]
[ 0.40703703  1.12815215  0.32527281  1.58391968]
[ 0.42435775 -0.88640526  0.36361914 -0.82301709]
[ 0.44167848 -0.88640526  0.36361914  1.04041783]
[ 0.4589992   1.12815215  0.40196548 -0.59008772]
[ 0.47631993  1.12815215  0.40196548  1.73920592]
[ 0.49364065  1.12815215  0.40196548 -1.52180518]
[ 0.51096138  1.12815215  0.40196548  0.96277471]
[ 0.5282821   1.12815215  0.40196548 -1.5994483 ]
[ 0.54560282  1.12815215  0.40196548  0.96277471]
[ 0.56292355 -0.88640526  0.44031182 -0.62890928]
[ 0.58024427 -0.88640526  0.44031182  0.80748846]
[ 0.597565    1.12815215  0.47865816 -1.75473454]
[ 0.61488572 -0.88640526  0.47865816  1.46745499]
[ 0.63220645 -0.88640526  0.47865816 -1.67709142]
[ 0.64952717  1.12815215  0.47865816  0.88513158]
[ 0.6668479   1.12815215  0.51700449 -1.56062674]
[ 0.68416862 -0.88640526  0.51700449  0.84631002]
[ 0.70148935 -0.88640526  0.55535083 -1.75473454]
[ 0.71881007  1.12815215  0.55535083  1.6615628 ]
[ 0.73613079 -0.88640526  0.59369717 -0.39597992]
[ 0.75345152 -0.88640526  0.59369717  1.42863343]
[ 0.77077224  1.12815215  0.6320435  -1.48298362]
[ 0.78809297  1.12815215  0.6320435   1.81684904]
[ 0.80541369  1.12815215  0.6320435  -0.55126616]
[ 0.82273442 -0.88640526  0.6320435   0.92395314]
[ 0.84005514 -0.88640526  0.67038984 -1.09476801]
[ 0.85737587  1.12815215  0.67038984  1.54509812]
[ 0.87469659  1.12815215  0.67038984 -1.28887582]
[ 0.89201732  1.12815215  0.67038984  1.46745499]
[ 0.90933804 -0.88640526  0.67038984 -1.17241113]
[ 0.92665877 -0.88640526  0.67038984  1.00159627]
[ 0.94397949 -0.88640526  0.67038984 -1.32769738]
```

```
[ 0.96130021 -0.88640526  0.67038984  1.50627656]
[ 0.97862094  1.12815215  0.67038984 -1.91002079]
[ 0.99594166 -0.88640526  0.67038984  1.07923939]
[ 1.01326239  1.12815215  0.67038984 -1.91002079]
[ 1.03058311 -0.88640526  0.67038984  0.88513158]
[ 1.04790384 -0.88640526  0.70873618 -0.59008772]
[ 1.06522456 -0.88640526  0.70873618  1.27334719]
[ 1.08254529  1.12815215  0.78542885 -1.75473454]
[ 1.09986601 -0.88640526  0.78542885  1.6615628 ]
[ 1.11718674  1.12815215  0.9388142  -0.93948177]
[ 1.13450746 -0.88640526  0.9388142   0.96277471]
[ 1.15182818  1.12815215  0.97716054 -1.17241113]
[ 1.16914891 -0.88640526  0.97716054  1.73920592]
[ 1.18646963 -0.88640526  1.01550688 -0.90066021]
[ 1.20379036  1.12815215  1.01550688  0.49691598]
[ 1.22111108  1.12815215  1.01550688 -1.44416206]
[ 1.23843181  1.12815215  1.01550688  0.96277471]
[ 1.25575253  1.12815215  1.01550688 -1.56062674]
[ 1.27307326  1.12815215  1.01550688  1.62274124]
[ 1.29039398 -0.88640526  1.05385321 -1.44416206]
[ 1.30771471 -0.88640526  1.05385321  1.38981187]
[ 1.32503543  1.12815215  1.05385321 -1.36651894]
[ 1.34235616  1.12815215  1.05385321  0.72984534]
[ 1.35967688  1.12815215  1.2455849  -1.4053405 ]
[ 1.3769976   1.12815215  1.2455849   1.54509812]
[ 1.39431833 -0.88640526  1.39897025 -0.7065524 ]
[ 1.41163905 -0.88640526  1.39897025  1.38981187]
[ 1.42895978  1.12815215  1.43731659 -1.36651894]
[ 1.4462805  -0.88640526  1.43731659  1.46745499]
[ 1.46360123 -0.88640526  1.47566292 -0.43480148]
[ 1.48092195  1.12815215  1.47566292  1.81684904]
[ 1.49824268 -0.88640526  1.5523556  -1.01712489]
[ 1.5155634   1.12815215  1.5523556   0.69102378]
[ 1.53288413 -0.88640526  1.62904827 -1.28887582]
[ 1.55020485 -0.88640526  1.62904827  1.35099031]
[ 1.56752558 -0.88640526  1.62904827 -1.05594645]
[ 1.5848463  -0.88640526  1.62904827  0.72984534]
[ 1.60216702  1.12815215  2.01251165 -1.63826986]
[ 1.61948775 -0.88640526  2.01251165  1.58391968]
[ 1.63680847 -0.88640526  2.28093601 -1.32769738]
[ 1.6541292  -0.88640526  2.28093601  1.11806095]
[ 1.67144992 -0.88640526  2.51101403 -0.86183865]
[ 1.68877065  1.12815215  2.51101403  0.92395314]
[ 1.70609137  1.12815215  2.76985181 -1.25005425]
[ 1.7234121   1.12815215  2.76985181  1.27334719]]
```

In [54]:

```
X_scaled  = pd.DataFrame(scale, columns = X.columns)
X_scaled
```

Out[54]:

| | CustomerID | Gender | Annual Income (k$) | Spending Score (1-100) |
|---|---|---|---|---|
| **0** | -1.723412 | 1.128152 | -1.745429 | -0.434801 |
| **1** | -1.706091 | 1.128152 | -1.745429 | 1.195704 |
| **2** | -1.688771 | -0.886405 | -1.707083 | -1.715913 |
| **3** | -1.671450 | -0.886405 | -1.707083 | 1.040418 |
| **4** | -1.654129 | -0.886405 | -1.668737 | -0.395980 |
| **...** | ... | ... | ... | ... |
| **195** | 1.654129 | -0.886405 | 2.280936 | 1.118061 |
| **196** | 1.671450 | -0.886405 | 2.511014 | -0.861839 |
| **197** | 1.688771 | 1.128152 | 2.511014 | 0.923953 |
| **198** | 1.706091 | 1.128152 | 2.769852 | -1.250054 |
| **199** | 1.723412 | 1.128152 | 2.769852 | 1.273347 |

200 rows × 4 columns

# Train test split

In [55]:

```
from sklearn.model_selection import train_test_split
```

## Split the dataset

In [56]:

```
X_train, X_test, Y_train, Y_test = train_test_split(X_scaled, Y, test_size
=0.20, random_state = 0)
X_train.shape
```

Out[56]:

```
(160, 4)
```

In [57]:

```
X_test.shape
```

Out[57]:

```
(40, 4)
```

In [58]:

```
Y_train.shape
```

Out[58]:

```
(160,)
```

In [59]:

```
Y_test.shape
```

Out[59]:

```
(40,)
```

## CLustering Algorithms

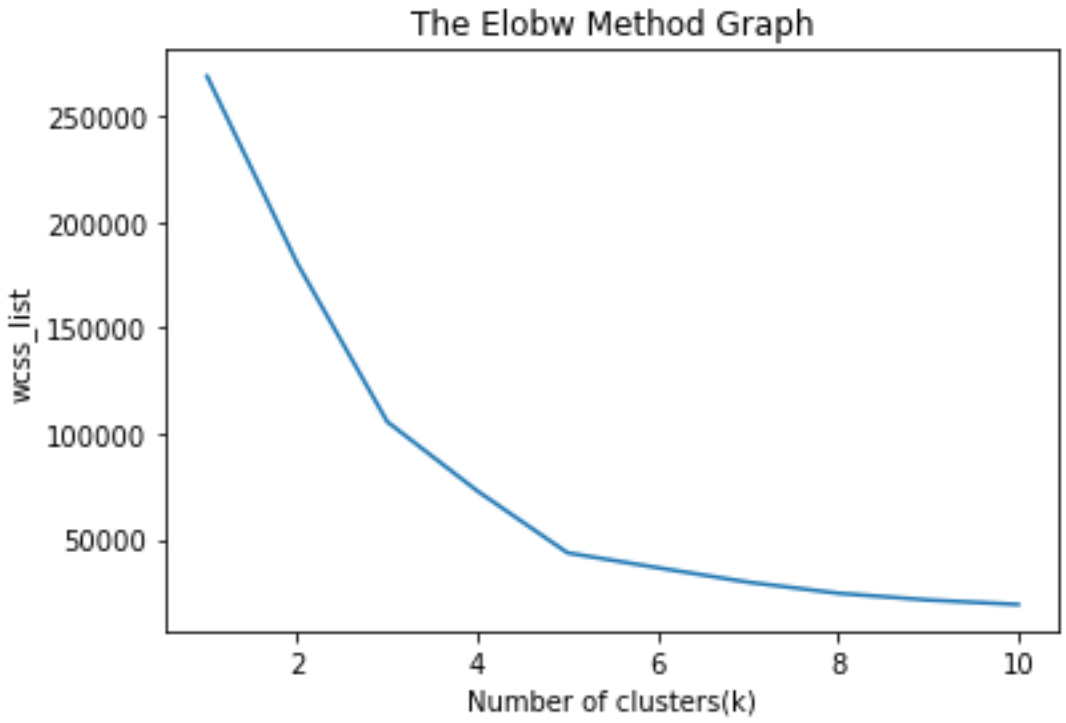
In [61]:

```
x = df.iloc[:, [3, 4]].values
```

In [62]:

```
from sklearn.cluster import KMeans
wcss_list= []
for i in range(1, 11):
    kmeans = KMeans(n_clusters=i, init='k-means++', random_state= 42)
    kmeans.fit(x)
    wcss_list.append(kmeans.inertia_)

plt.plot(range(1, 11), wcss_list)
plt.title('The Elobw Method Graph')
plt.xlabel('Number of clusters(k)')
plt.ylabel('wcss_list')
plt.show()
C:\Users\Ilyas\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:1036:
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(
```



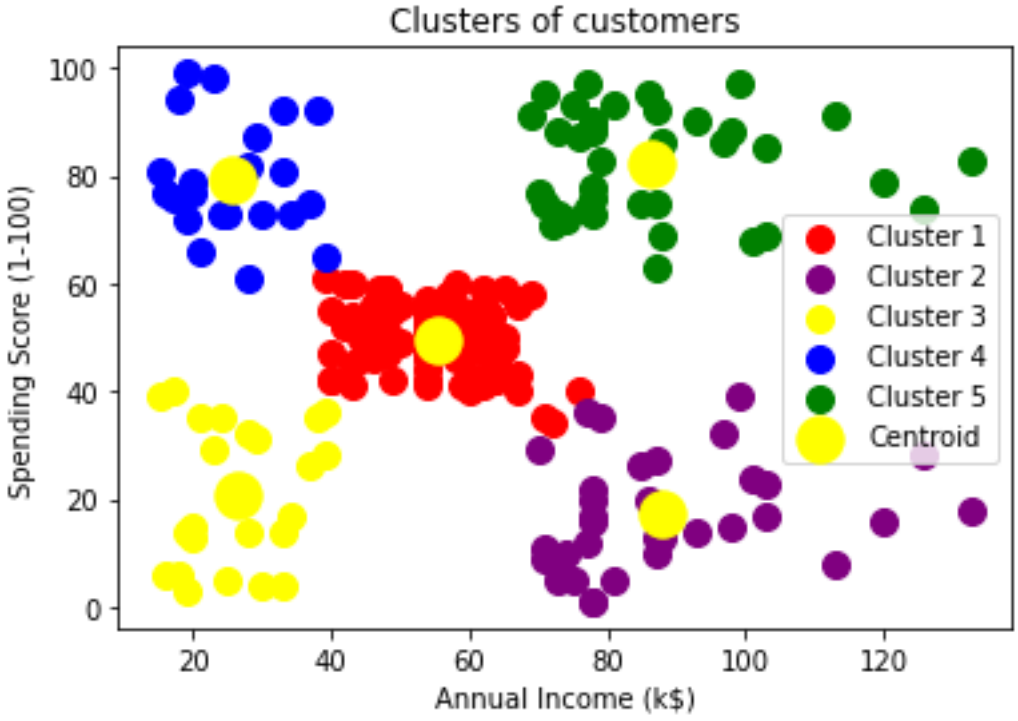

In [63]:

```
kmeans = KMeans(n_clusters=5, init = 'k-means++', random_state = 42)
y_predict = kmeans.fit_predict(x)
```

In [64]:

```
# Visualizing the clusters

plt.scatter(x[y_predict == 0, 0], x[y_predict == 0, 1], s = 100, c = 'red',
label = 'Cluster 1') #for first cluster
plt.scatter(x[y_predict == 1, 0], x[y_predict == 1, 1], s = 100, c =
'purple', label = 'Cluster 2') #for second cluster
plt.scatter(x[y_predict== 2, 0], x[y_predict == 2, 1], s = 100, c = 'yellow',
label = 'Cluster 3') #for third cluster
plt.scatter(x[y_predict == 3, 0], x[y_predict == 3, 1], s = 100, c = 'blue',
label = 'Cluster 4') #for fourth cluster
plt.scatter(x[y_predict == 4, 0], x[y_predict == 4, 1], s = 100, c = 'green',
label = 'Cluster 5') #for fifth cluster
plt.scatter(kmeans.cluster_centers_[:, 0], kmeans.cluster_centers_[:, 1], s =
300, c = 'yellow', label = 'Centroid')
plt.title('Clusters of customers')
plt.xlabel('Annual Income (k$)')
plt.ylabel('Spending Score (1-100)')
plt.legend()
plt.show()
```




In [ ]: