Assignment -4
Python Programming

Assignment Date	13 October 2022
Student Name	Mr. Naveen J
Student Roll Number	910619104052
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()
```

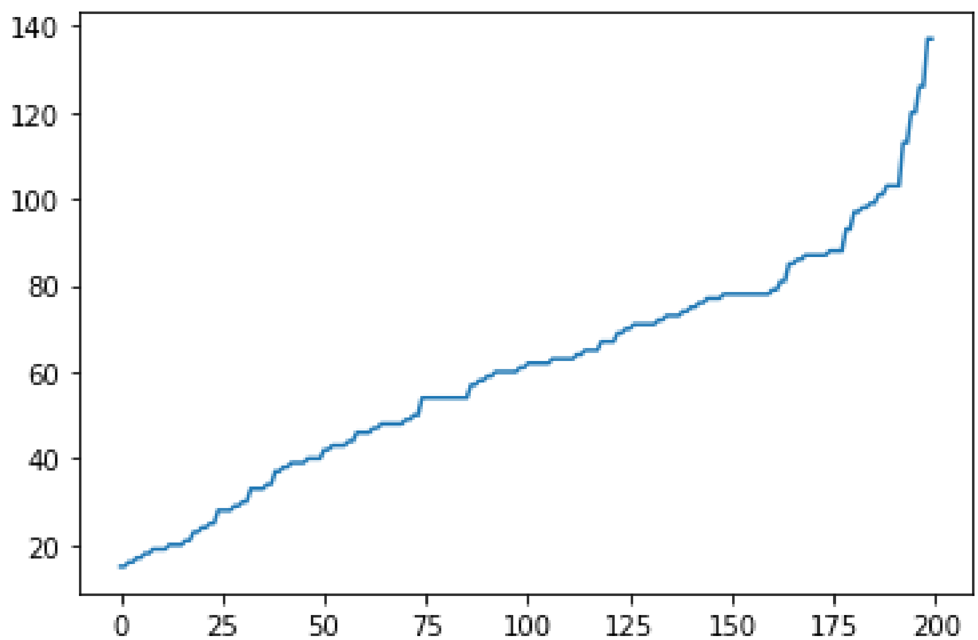
Out[8]:

	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()
```

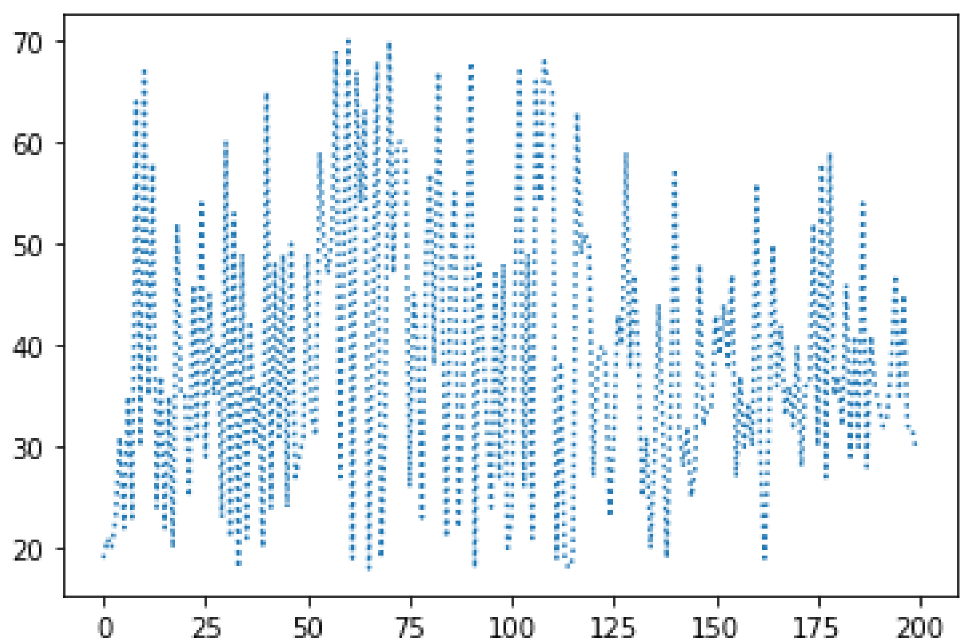


In [13]:

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

Out[13]:

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



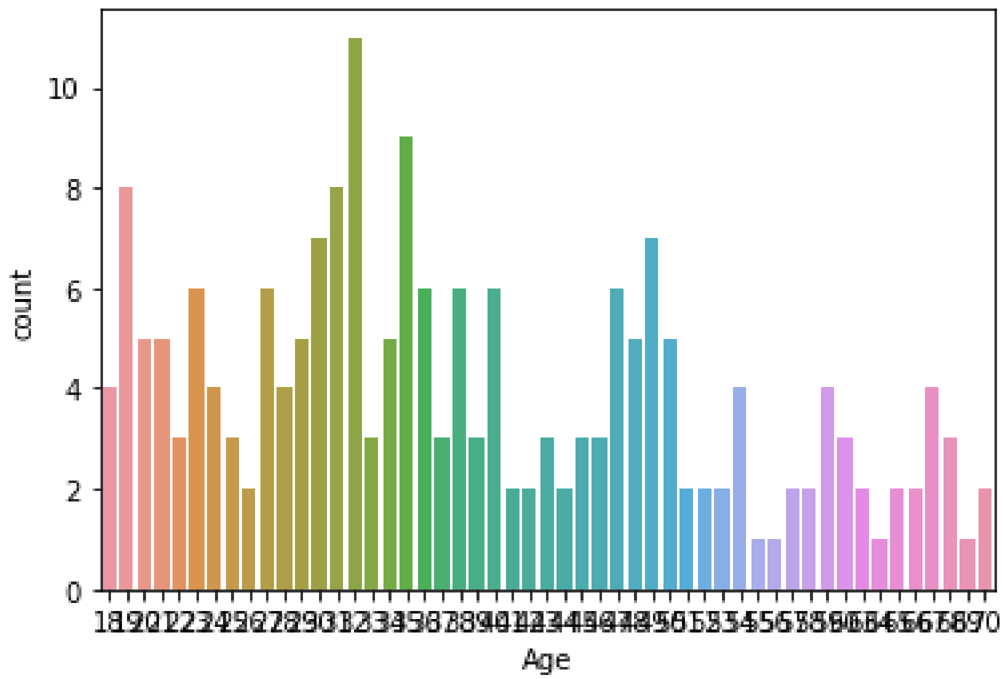
In [14]:

```
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'>
```

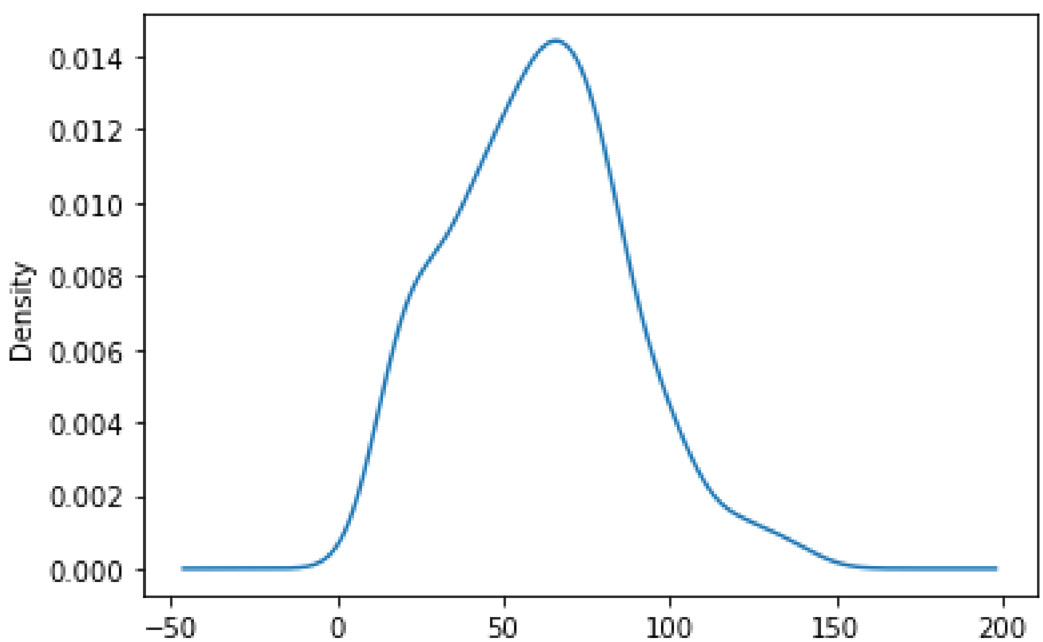


In [19]:

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

Out[19]:

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

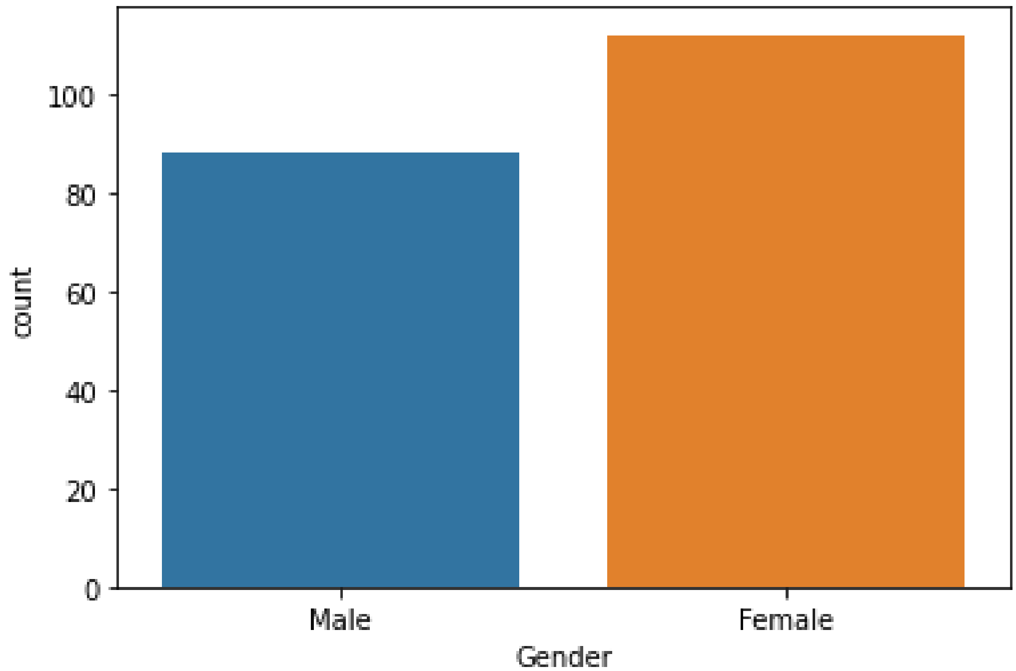


In [20]:

```
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'>
```

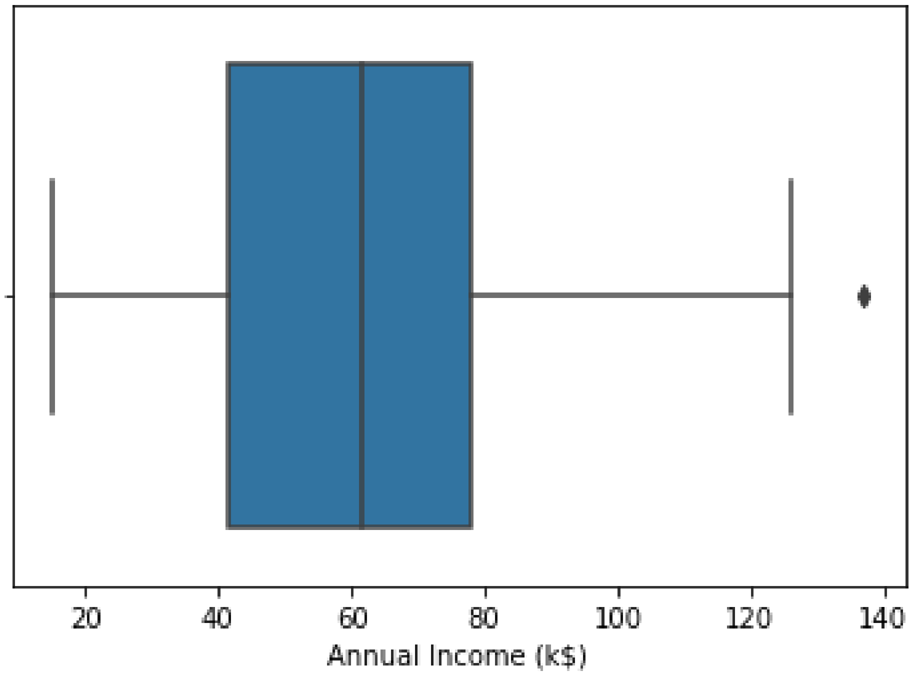


In [21]:

```
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$)'>
```

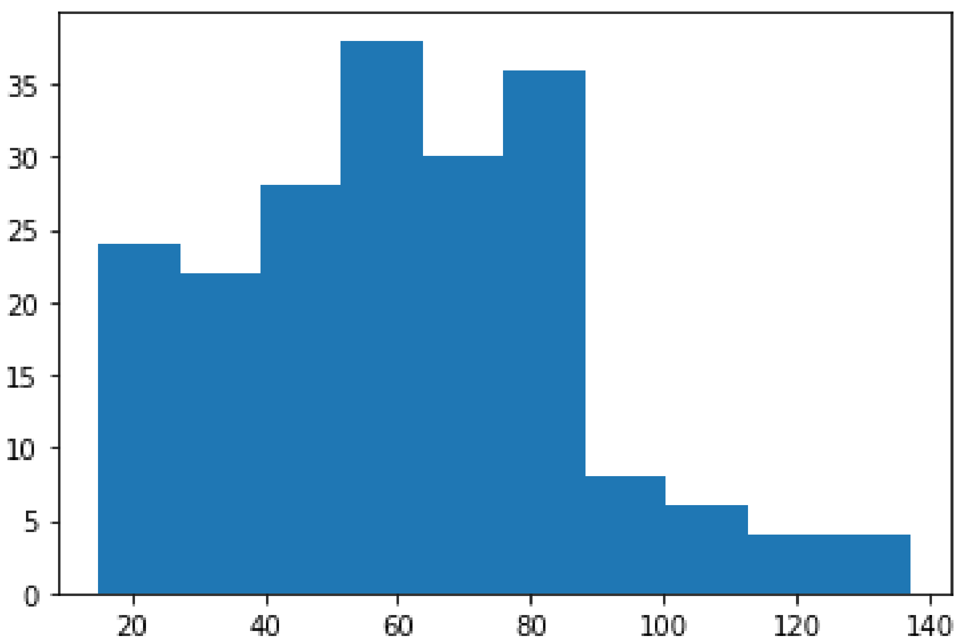


In [22]:

```
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>)
```



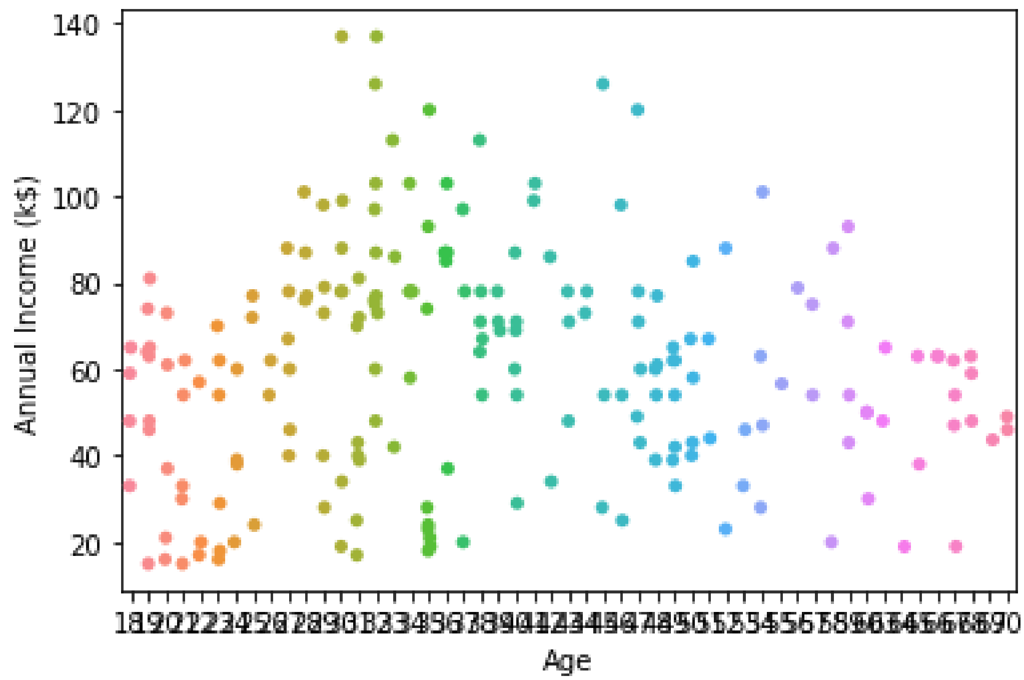
2. Bi-Variate Analysis

In [23]:

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

Out[23]:

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

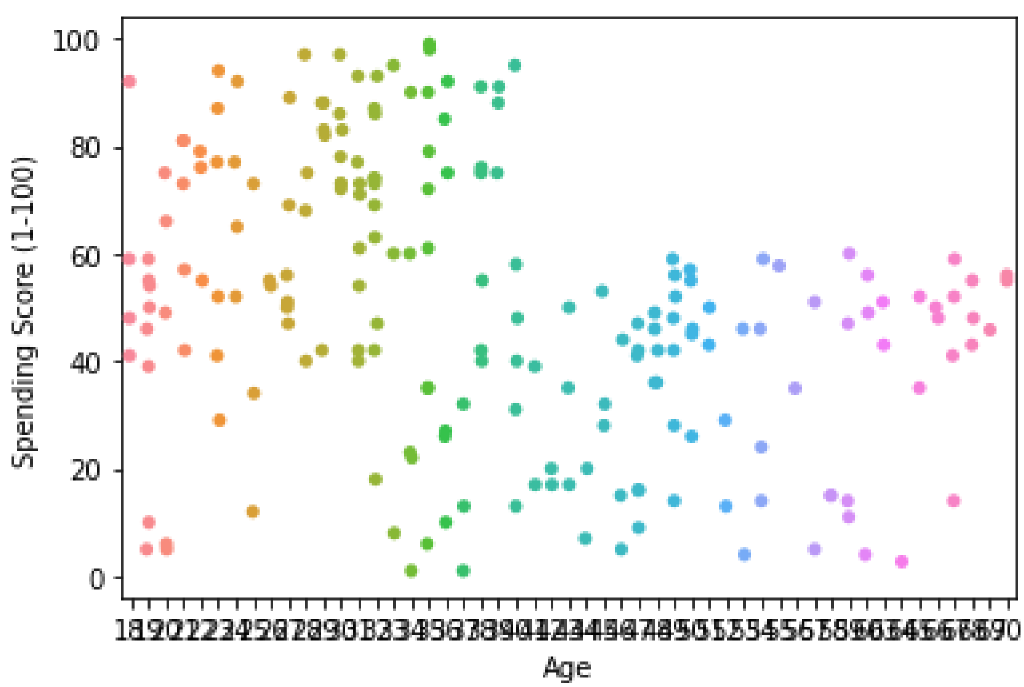


In [24]:

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

Out[24]:

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

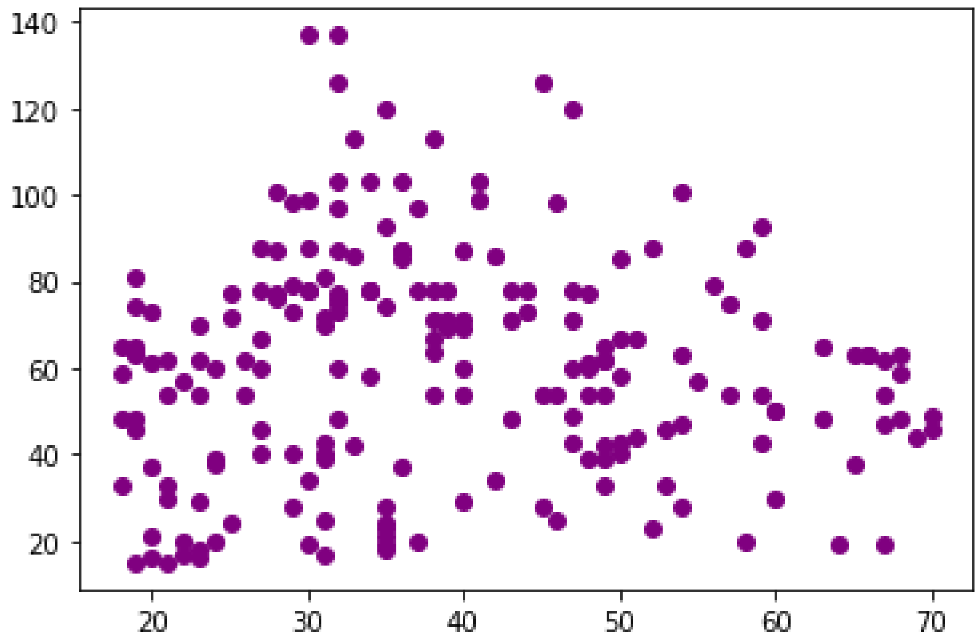


In [26]:

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

Out[26]:

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

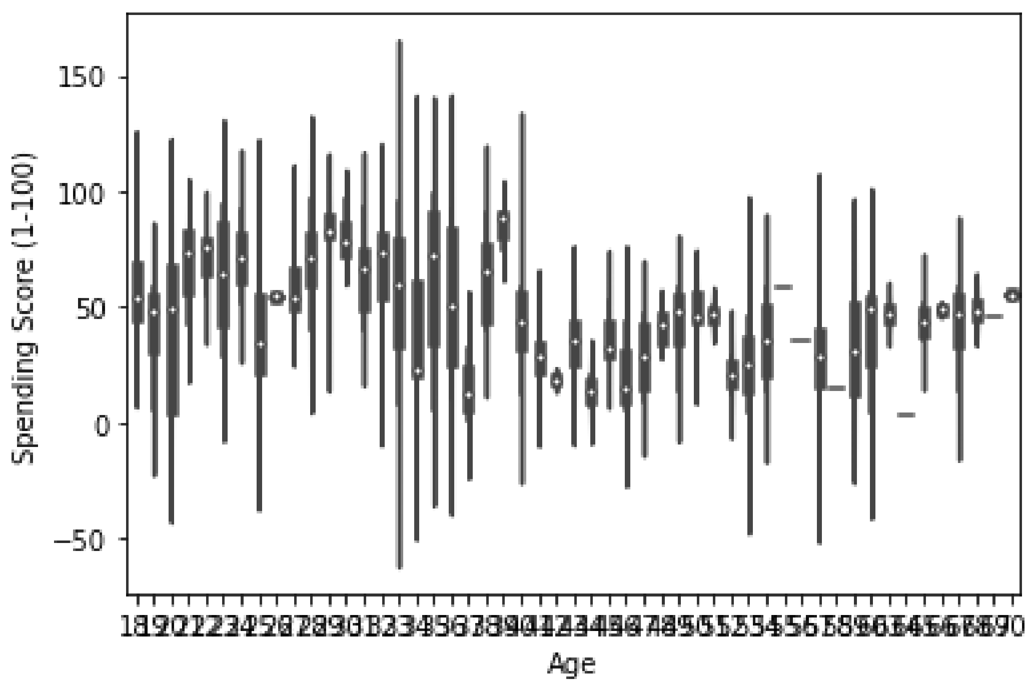


In [27]:

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

Out[27]:

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



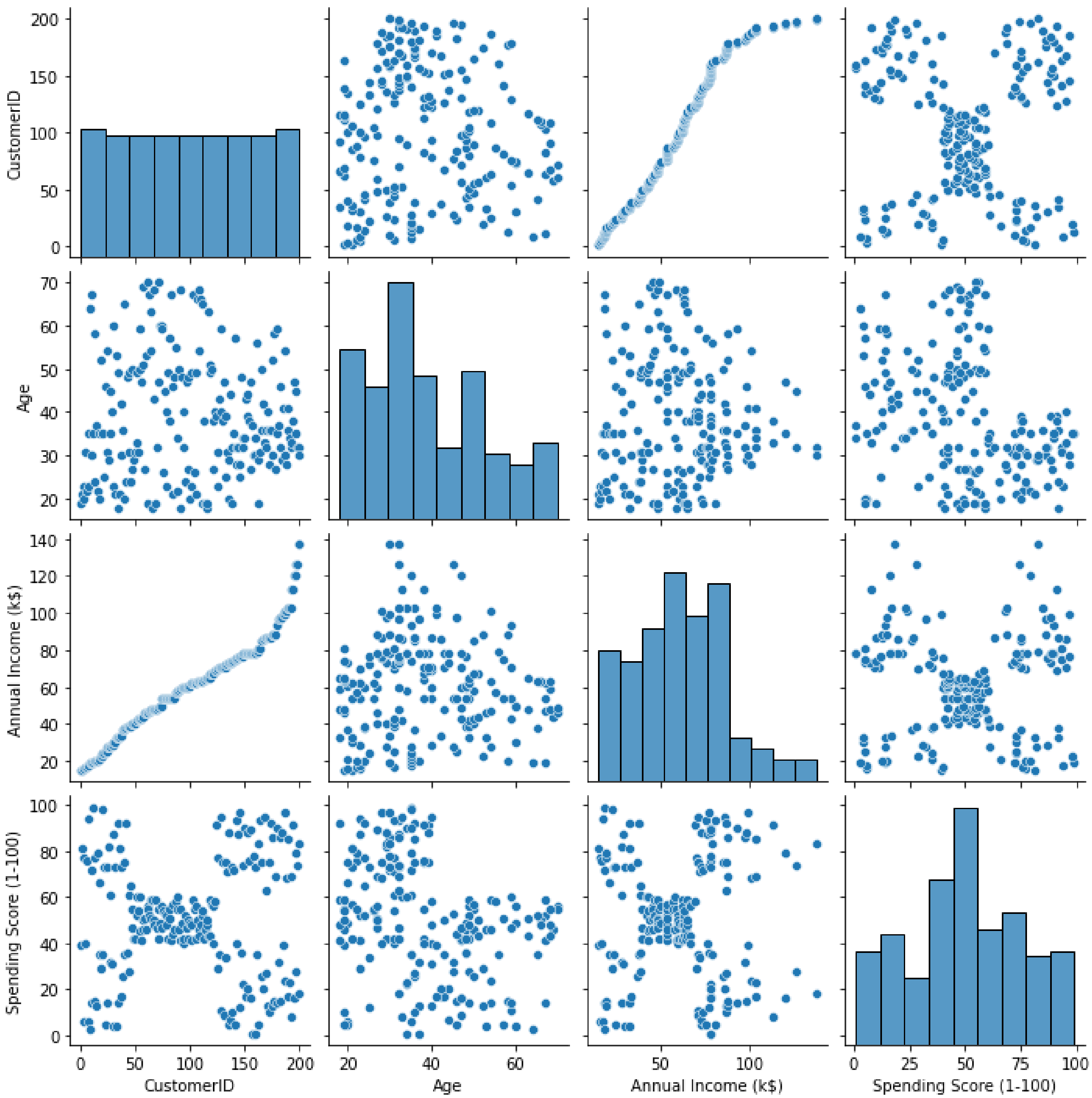
3. Multi-Variate Analysis

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                100.5
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
```

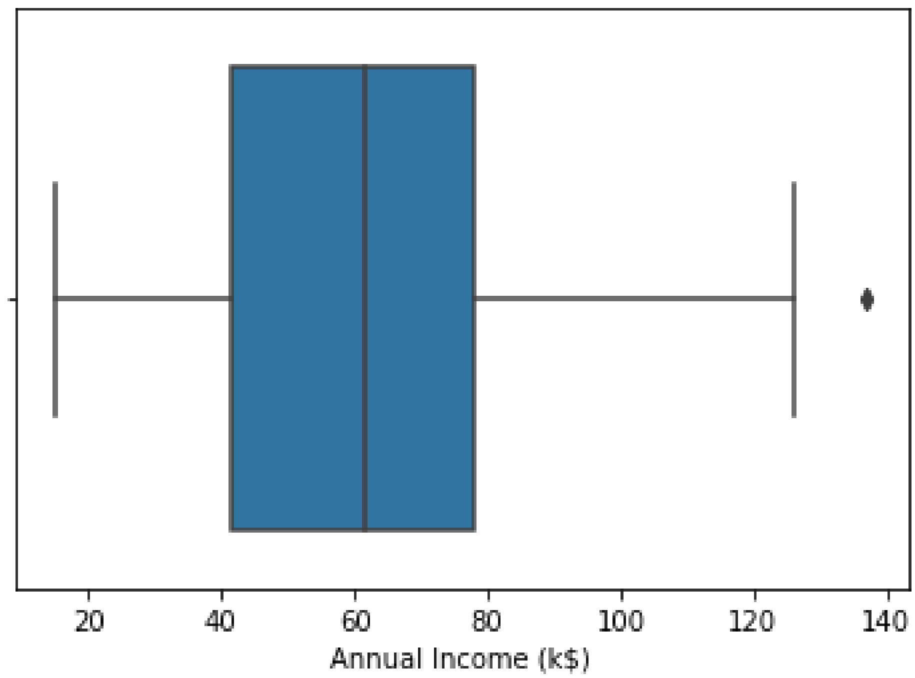
6. Handling outliners

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$)'] <
lower_whisker,lower_whisker,df['Annual Income (k$)']))
```

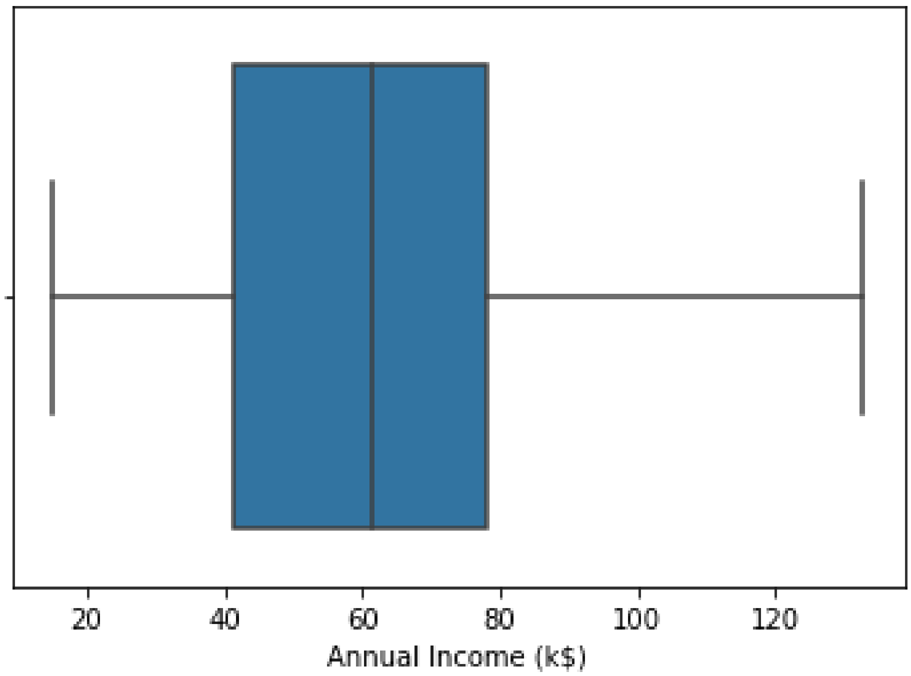
In [43]:

```
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]
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[ 0.94397949 -0.88640526  0.67038984 -1.32769738]
```

```
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[ 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]
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[ 1.46360123 -0.88640526  1.47566292 -0.43480148]
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[ 1.5155634   1.12815215  1.5523556   0.69102378]
[ 1.53288413 -0.88640526  1.62904827 -1.28887582]
[ 1.55020485 -0.88640526  1.62904827  1.35099031]
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[ 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]:

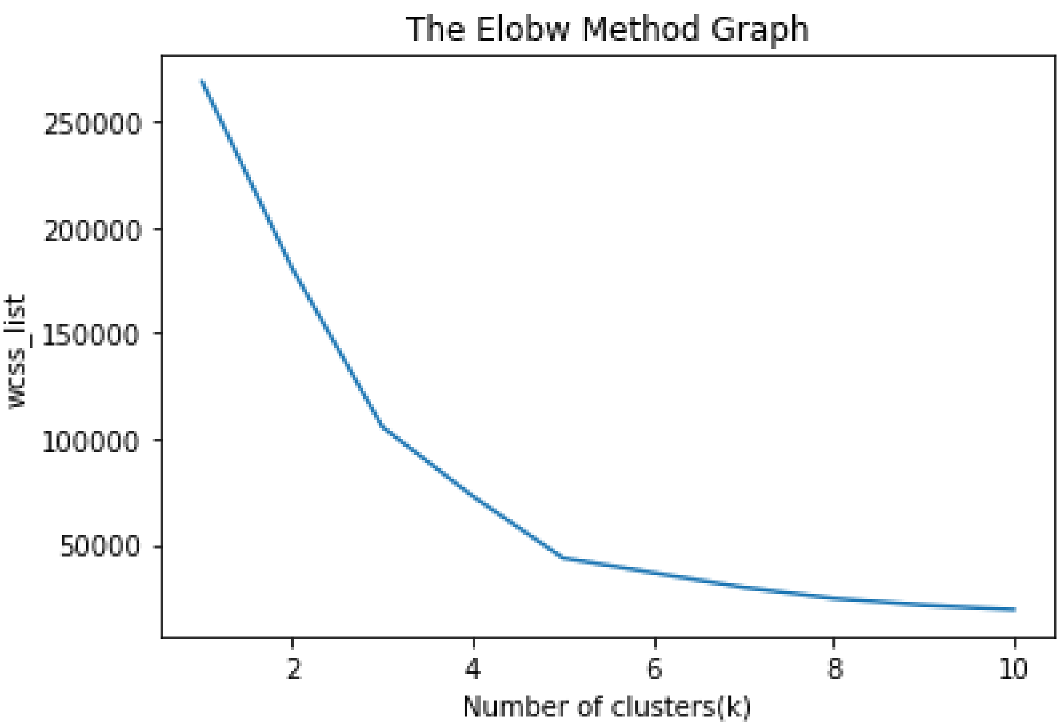
```
x = df.iloc[:, [3, 4]].values
```

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(
```



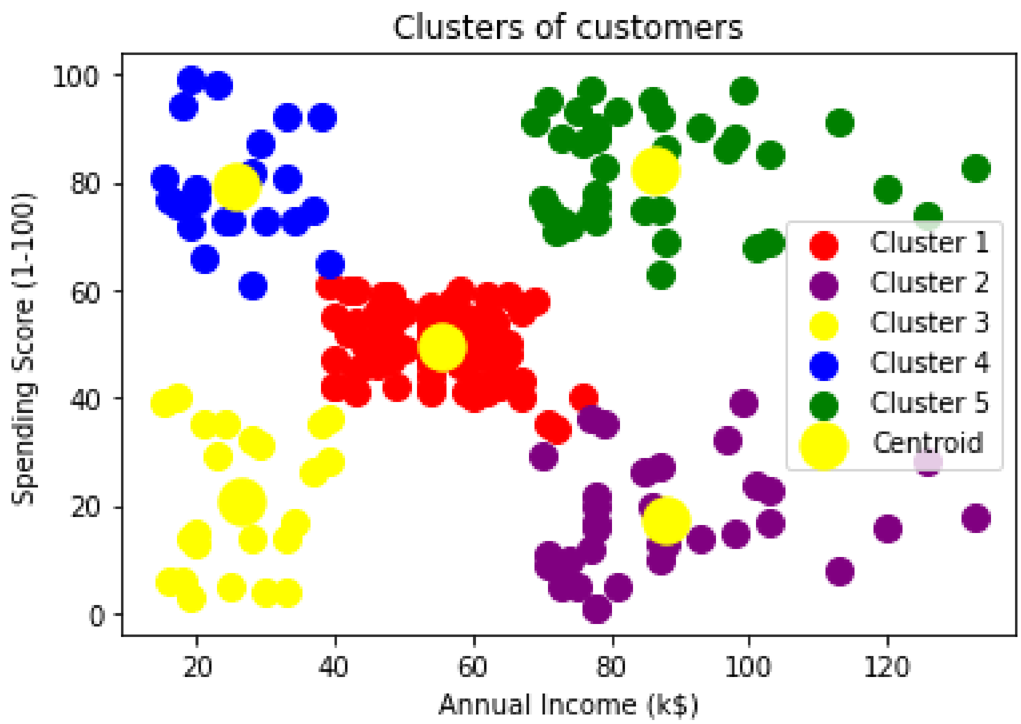
In [63]:

```
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 [ ]: