Importing the Libraries

+ Code + Text

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

1. Load the Dataset

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

	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

```
df = df.drop(columns=['CustomerID'])
df.head()
```

	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

```
df.shape
```

```
(200, 4)
```

```
df['Spending Score (1-100)'].value_counts()
```

```
42    8
55    7
46    6
73    6
35    5
     ..
31    1
44    1
53    1
65    1
18    1
Name: Spending Score (1-100), Length: 84, dtype: int64
```

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

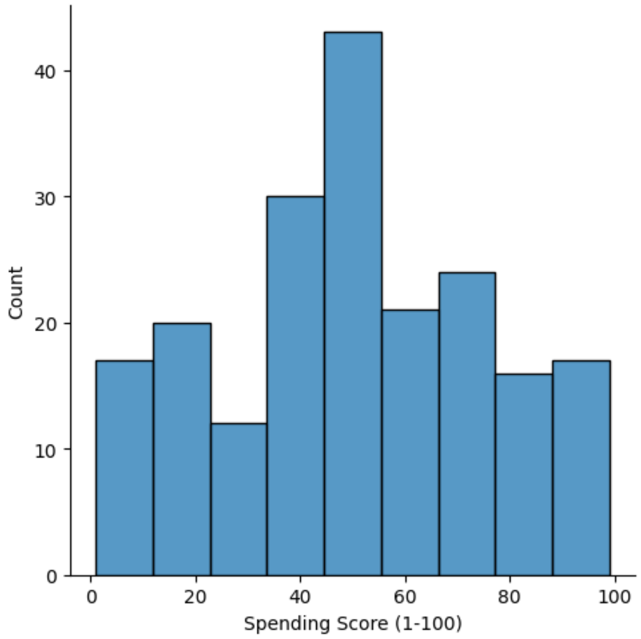
```
54     12
78     12
48      6
71      6
63      6
       ..
58      2
59      2
16      2
64      2
137     2
Name: Annual Income (k$), Length: 64, dtype: int64
```

2. Data PreProcessing including Visualizations

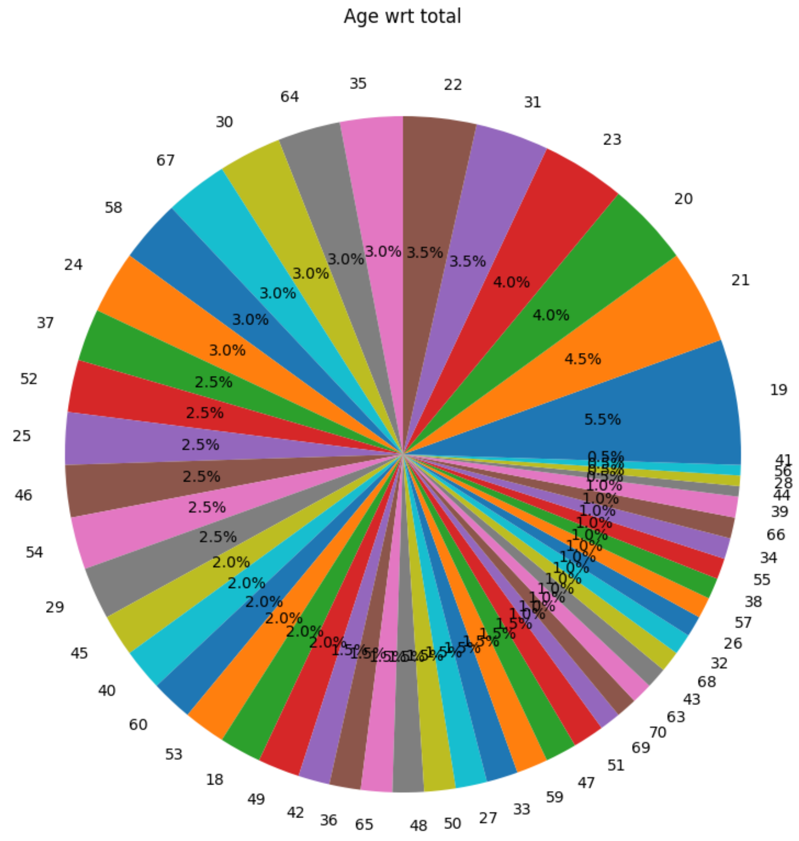
Univariate

```
sns.displot(df['Spending Score (1-100)'])
```

```
<seaborn.axisgrid.FacetGrid at 0x7ad0ce0c9f00>
```

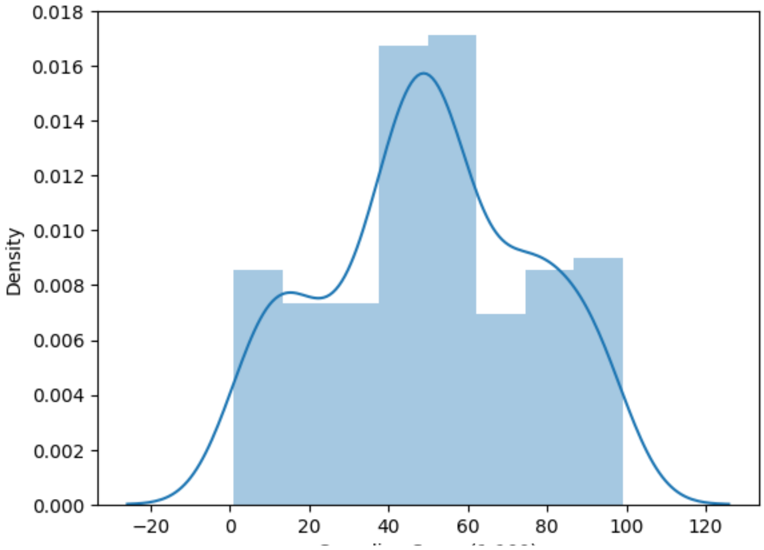


```
plt.figure(figsize=(10,10))
plt.pie(df["Age"].value_counts(), labels = df["Age"].unique(),autopct ='%1.1f%%')
plt.title('Age wrt total')
plt.show()
```



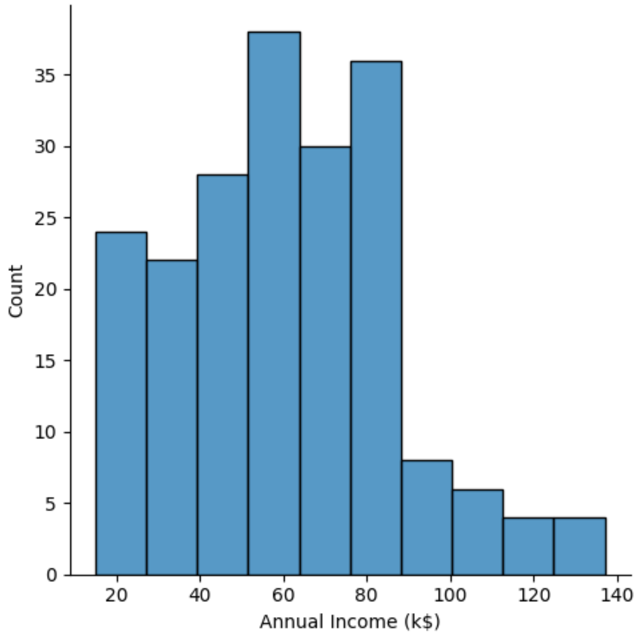
```
sns.distplot(df['Spending Score (1-100)'])
```

```
<ipython-input-9-beed7b40d5ab>:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df['Spending Score (1-100)'])
<Axes: xlabel='Spending Score (1-100)', ylabel='Density'>
```



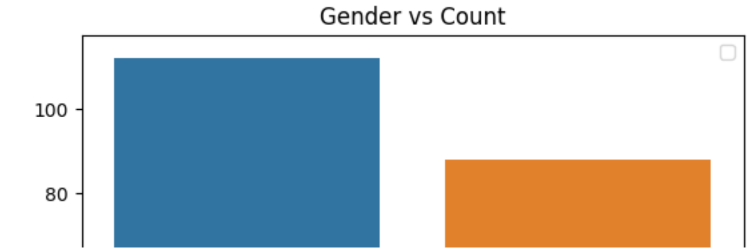
```
sns.displot(df['Annual Income (k$)'])
```

```
<seaborn.axisgrid.FacetGrid at 0x7ad095dc50c0>
```



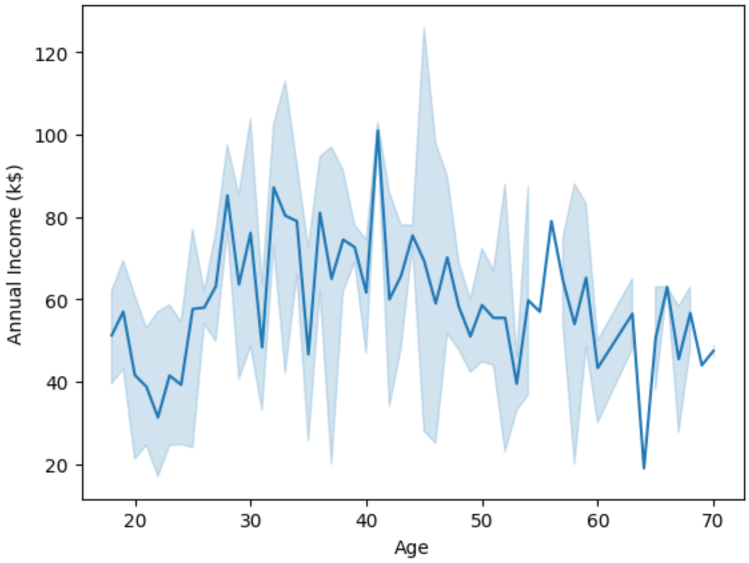
```
sns.barplot(x =df["Gender"].value_counts().index,y =df["Gender"].value_counts())
plt.title('Gender vs Count')
plt.legend()
plt.show()
```

```
WARNING:matplotlib.legend:No artists with labels found to put in legend.  Note that artists whose label start with an underscore ar
```

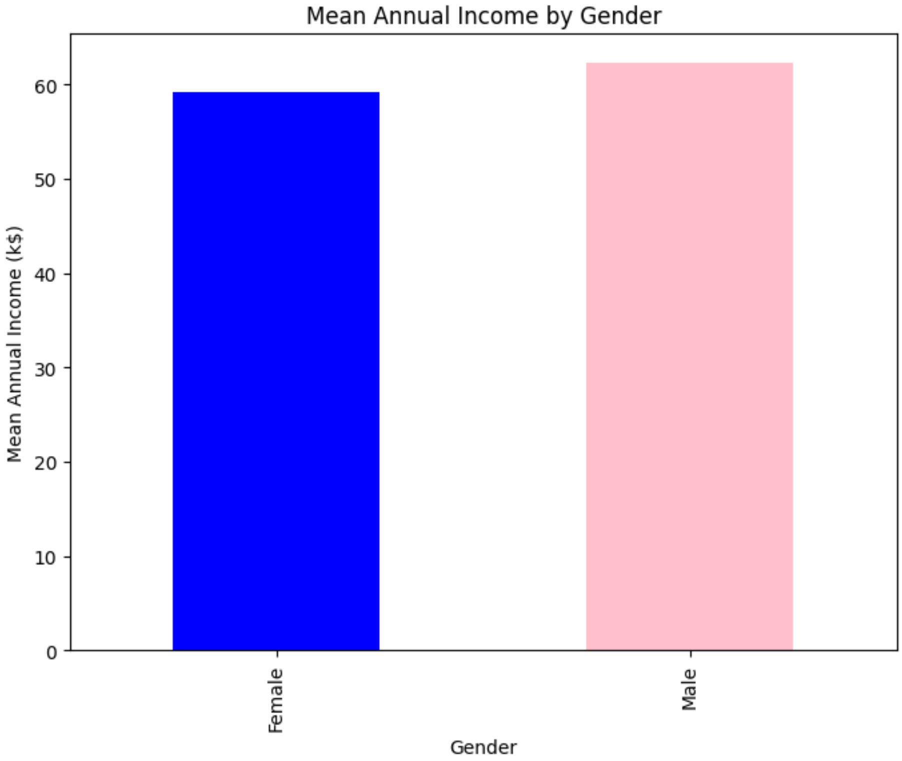


Bivariate

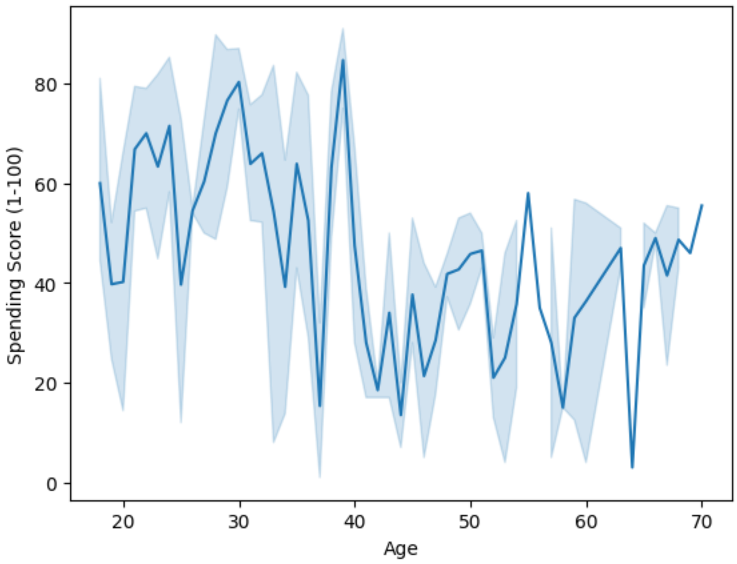
```
sns.lineplot(x='Age', y='Annual Income (k$)', data=df)
plt.show()
```



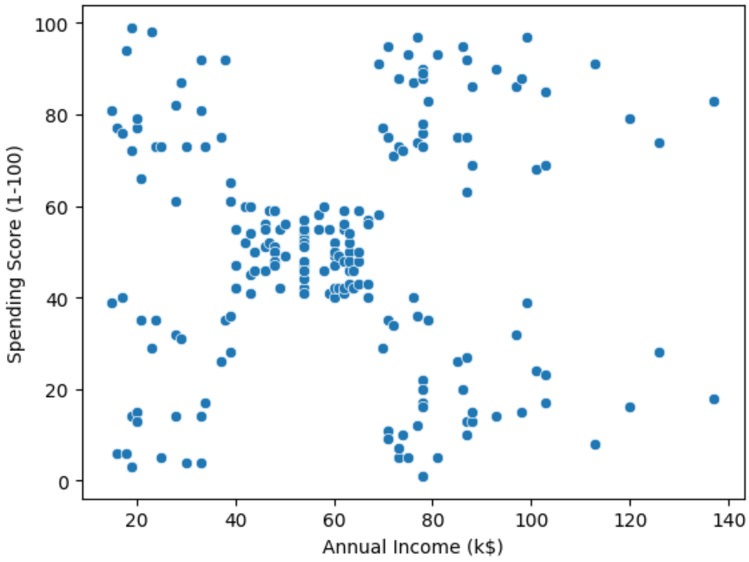
```
grouped_data = df.groupby('Gender')['Annual Income (k$)'].mean()
plt.figure(figsize=(8, 6))
grouped_data.plot(kind='bar', color=['blue', 'pink'])
plt.xlabel('Gender')
plt.ylabel('Mean Annual Income (k$)')
plt.title('Mean Annual Income by Gender')
plt.show()
```



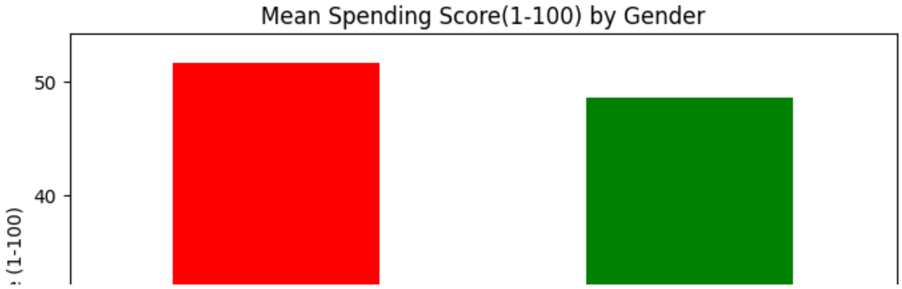
```
sns.lineplot(x='Age', y='Spending Score (1-100)', data=df)
plt.show()
```



```
sns.scatterplot(x='Annual Income (k$)', y='Spending Score (1-100)', data=df)
plt.show()
```



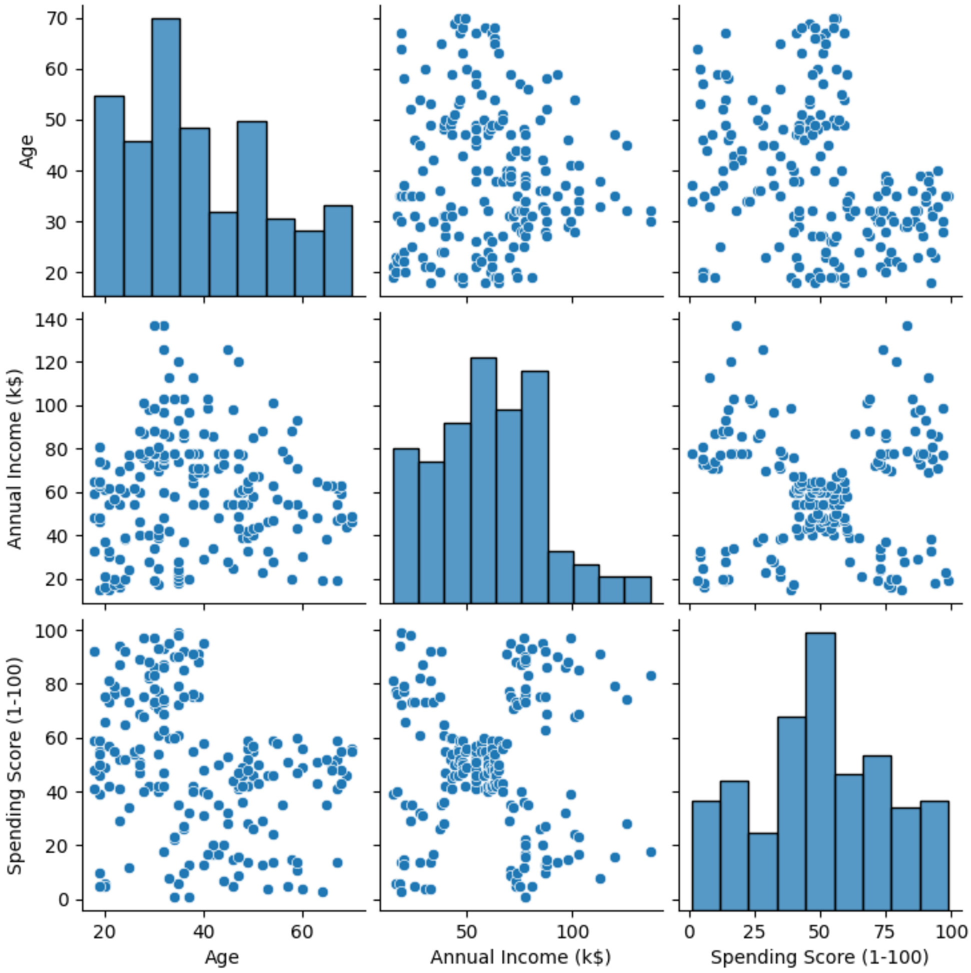
```
grouped_data = df.groupby('Gender')['Spending Score (1-100)'].mean()
plt.figure(figsize=(8, 6))
grouped_data.plot(kind='bar', color=['red', 'green'])
plt.xlabel('Gender')
plt.ylabel('Mean Spending Score (1-100)')
plt.title('Mean Spending Score(1-100) by Gender')
plt.show()
```



Multivariate

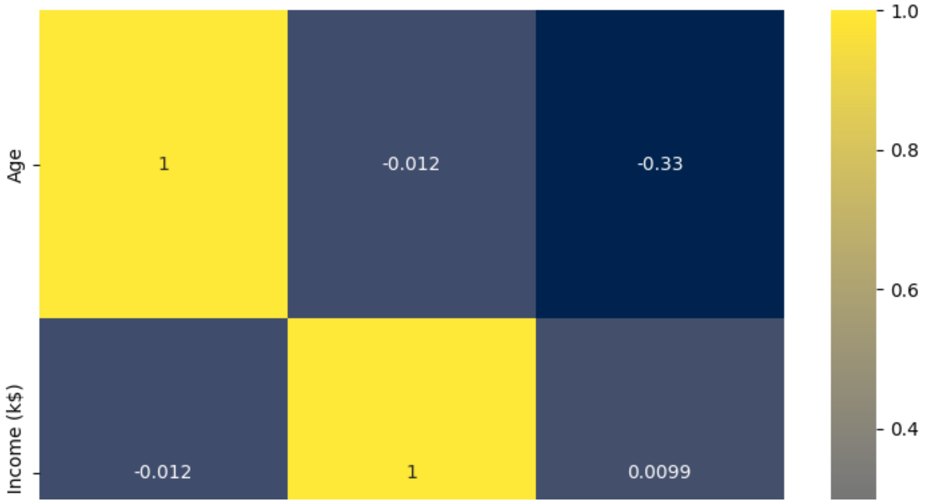
```
sns.pairplot(df)
```

```
    <seaborn.axisgrid.PairGrid at 0x7ad09630b280>
```



```
plt.figure(figsize=(9,9))
sns.heatmap(df.corr(), annot=True, cmap='cividis')
```

```
<ipython-input-18-33e39629df90>:2: FutureWarning: The default value of numeric_only in DataFrame.corr is deprecated. In a future ve
  sns.heatmap(df.corr(), annot=True, cmap='cividis')
<Axes: >
```



Preprocessing

```
df.describe()
```

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

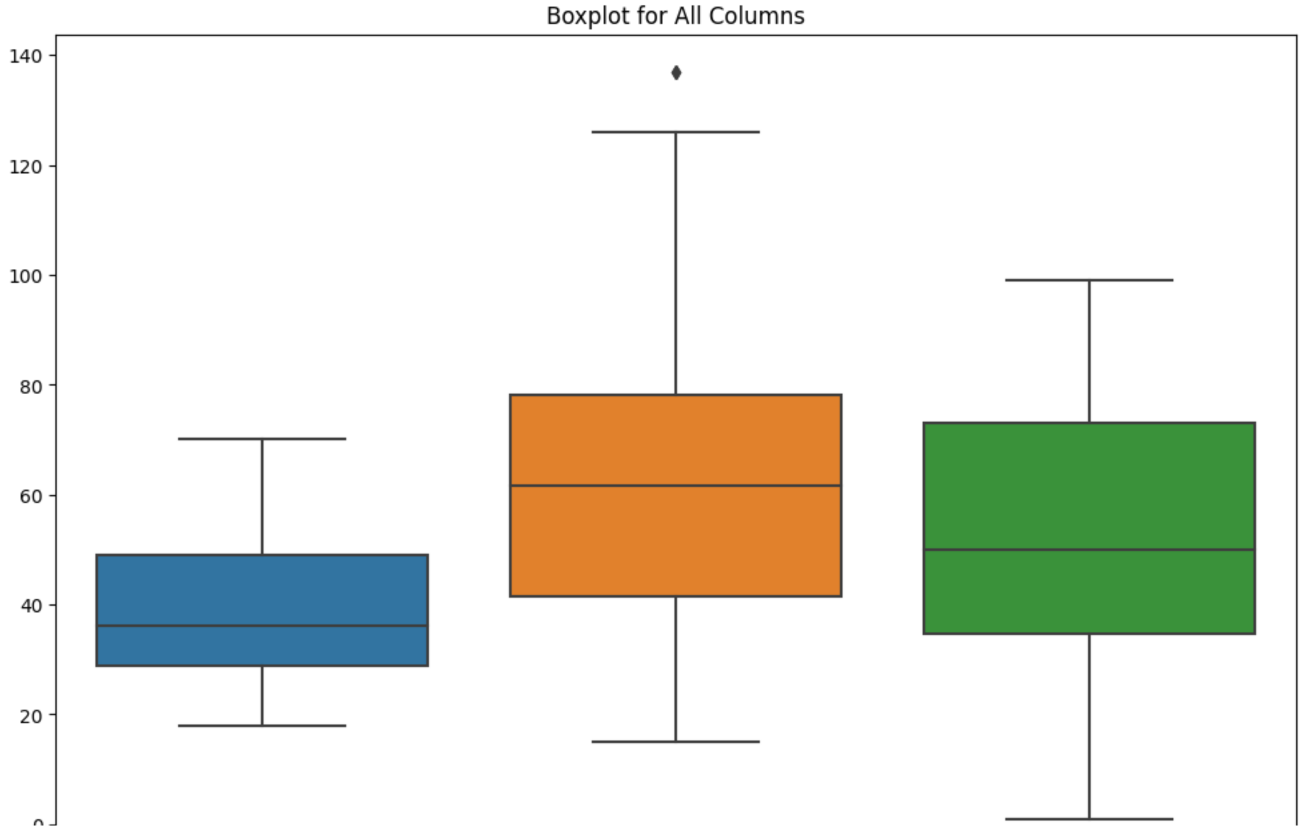
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 4 columns):
 #   Column                  Non-Null Count  Dtype 
---  ------                  --------------  ----- 
 0   Gender                  200 non-null    object
 1   Age                     200 non-null    int64 
 2   Annual Income (k$)      200 non-null    int64 
 3   Spending Score (1-100)  200 non-null    int64 
dtypes: int64(3), object(1)
memory usage: 6.4+ KB
```

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

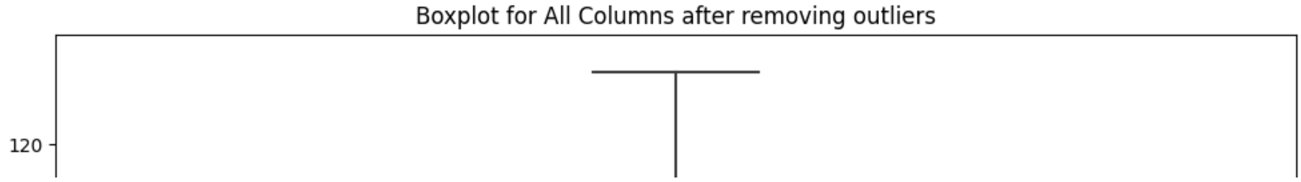
```
Gender                    0
Age                       0
Annual Income (k$)        0
Spending Score (1-100)    0
dtype: int64
```

```
plt.figure(figsize=(12, 8))
sns.boxplot(data=df)
plt.xticks(rotation=45)
plt.title('Boxplot for All Columns')
plt.show()
```



```
q1=df['Annual Income (k$)'].quantile(0.25)
q3=df['Annual Income (k$)'].quantile(0.75)
iqr=q3-q1
upperL=q3+1.5*iqr
lowerL=q1-1.5*iqr
df['Annual Income (k$)']=np.where(df['Annual Income (k$)']>upperL,upperL,np.where(df['Annual Income (k$)']<lowerL,lowerL,df['Annual Incom
```

```
plt.figure(figsize=(12, 8))
sns.boxplot(data=df)
plt.xticks(rotation=45)
plt.title('Boxplot for All Columns after removing outliers')
plt.show()
```



```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
df['Gender'] = le.fit_transform(df['Gender'])
df.head(10)
```

	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1	19	15.0	39
1	1	21	15.0	81
2	0	20	16.0	6
3	0	23	16.0	77
4	0	31	17.0	40
5	0	22	17.0	76
6	0	35	18.0	6
7	0	23	18.0	94
8	1	64	19.0	3
9	0	30	19.0	72

```
from sklearn.preprocessing import MinMaxScaler
scale = MinMaxScaler()
df_scaled= pd.DataFrame(scale.fit_transform(df),columns=df.columns)
df_scaled.head()
```

	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1.0	0.019231	0.000000	0.387755
1	1.0	0.057692	0.000000	0.816327
2	0.0	0.038462	0.008493	0.051020
3	0.0	0.096154	0.008493	0.775510
4	0.0	0.250000	0.016985	0.397959

3. ML Model Building, optimising

Clustering based by considering all columns -> Gender, Age, Annual Income, Spending Score and creating Clusters(Groups)

```
from sklearn.cluster import KMeans
wcss = []
for i in range(1, 11):
    kmeans = KMeans(n_clusters = i, init = 'k-means++', random_state = 42)
    kmeans.fit(df_scaled)
    wcss.append(kmeans.inertia_)
plt.plot(range(1, 11), wcss, marker="o")
plt.title('The Elbow Method')
plt.xlabel('Number of clusters')
plt.ylabel('WCSS')
plt.show()
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
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  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
```

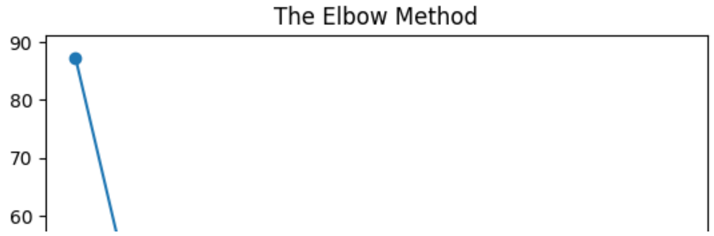

```
kmeans = KMeans(n_clusters=4,init = 'k-means++',random_state=0)
pred = kmeans.fit(df_scaled)
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
```

4. Test with random Observation

```
kmeans.predict([[1,23,17,40]])
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439: UserWarning: X does not have valid feature names, but KMeans was fitte
  warnings.warn(
array([3], dtype=int32)
```

```
kmeans.predict([[0,25,10,23]])
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439: UserWarning: X does not have valid feature names, but KMeans was fitte
  warnings.warn(
array([2], dtype=int32)
```

```
kmeans.predict([[0,20,20,10]])
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439: UserWarning: X does not have valid feature names, but KMeans was fitte
  warnings.warn(
array([0], dtype=int32)
```