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

Loading Data

```python
df = pd.read_csv('Lab3_data_mod2.csv')
df
```

```
     CustomerID  Gender   Age    Income  Spending Score
0             1    Male  19.0   15000.0              39
1             2    Male  21.0   15000.0              81
2             3  Female  20.0   16000.0               6
3             4  Female  23.0   16000.0              77
4             5  Female  31.0   17000.0              40
..          ...     ...   ...       ...             ...
195         196  Female  35.0  120000.0              79
196         197  Female  45.0  126000.0              28
197         198    Male  32.0  126000.0              74
198         199    Male  32.0  137000.0              18
199         200    Male  30.0  137000.0              83

[200 rows x 5 columns]
```

Data Exploration and Visualisation

```python
df.columns
```

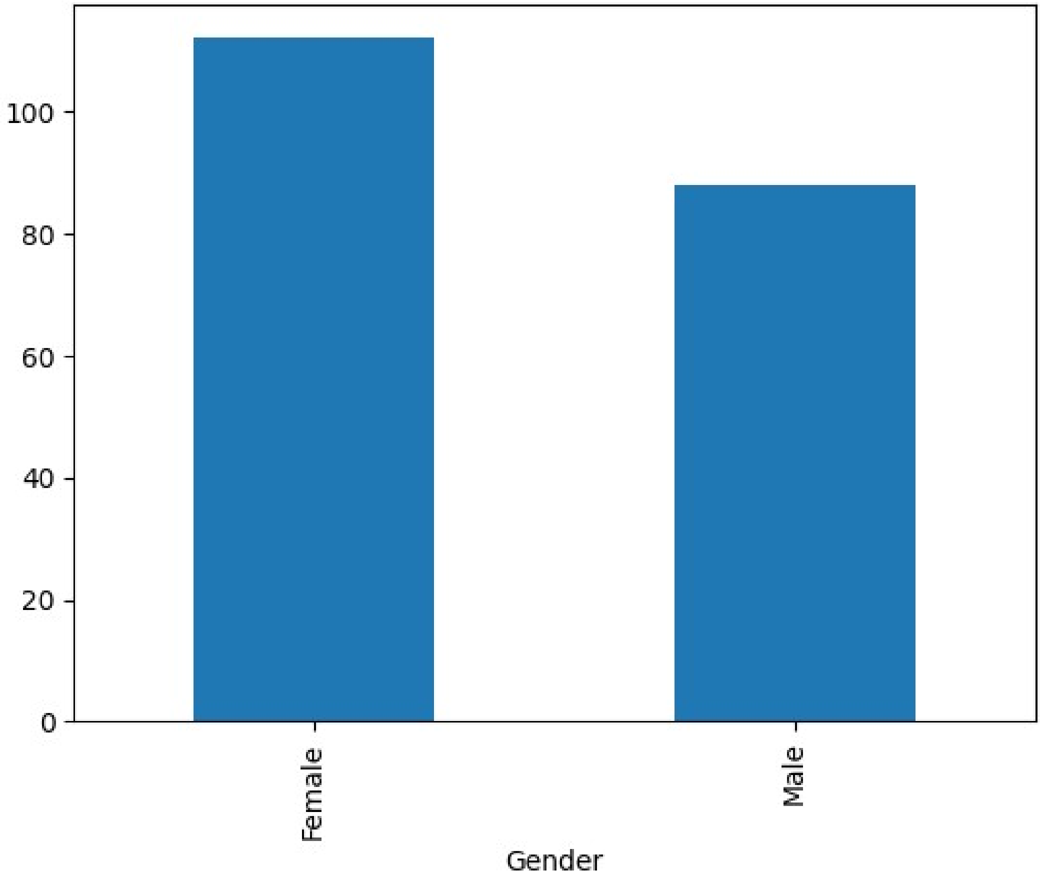
```
Index(['CustomerID', 'Gender', 'Age', 'Income', 'Spending Score'],
dtype='object')
```

```python
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             197 non-null    float64
 3   Income          197 non-null    float64
 4   Spending Score  200 non-null    int64
dtypes: float64(2), int64(2), object(1)
memory usage: 7.9+ KB
```

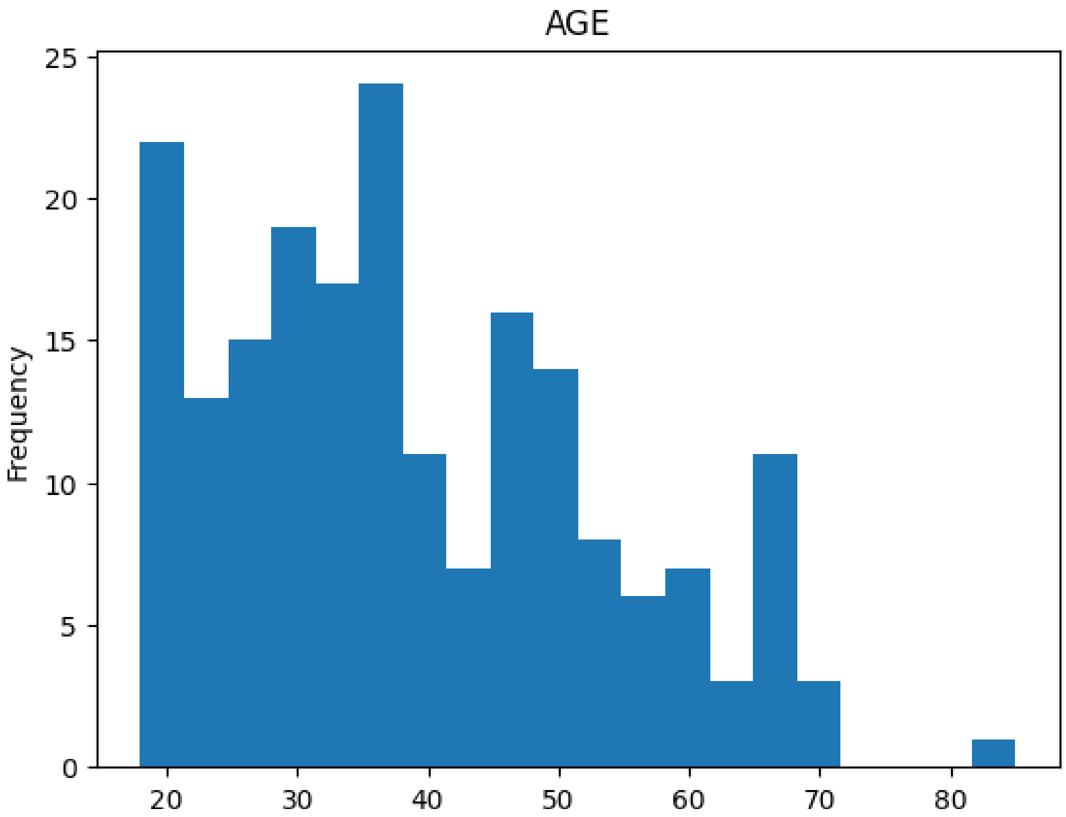
Gender Plot

```
df.groupby('Gender').size().plot(kind='bar')

<Axes: xlabel='Gender'>
```



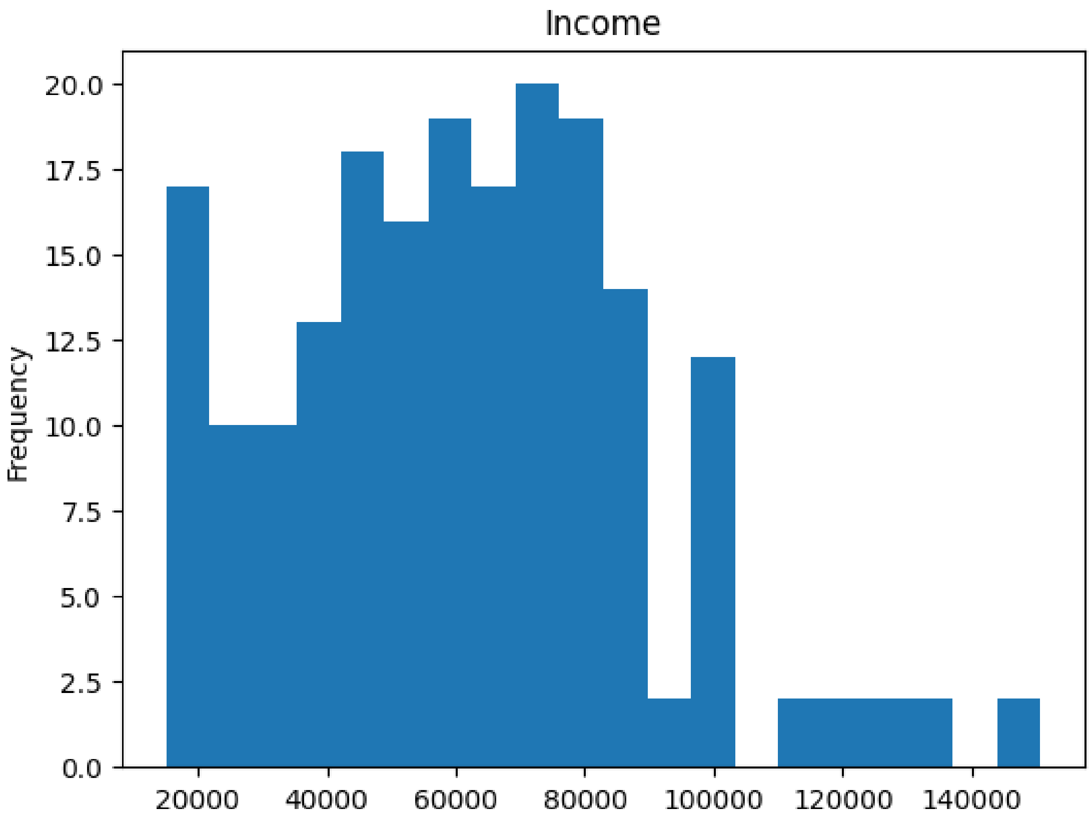
Age Plot

```
df['Age'].plot(kind='hist', bins=20)

plt.title('AGE')

Text(0.5, 1.0, 'AGE')
```



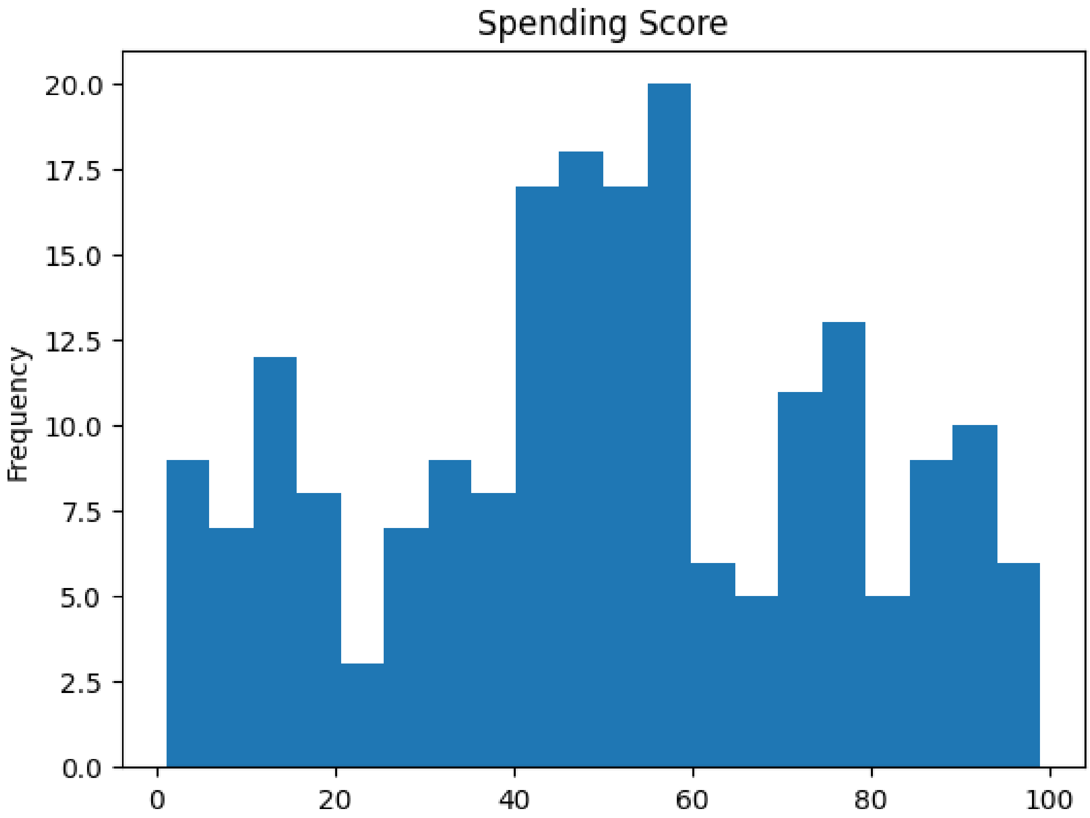
Income Plot

```
df['Income'].plot(kind='hist', bins=20)

plt.title('Income')

Text(0.5, 1.0, 'Income')
```



Spending Score Plot

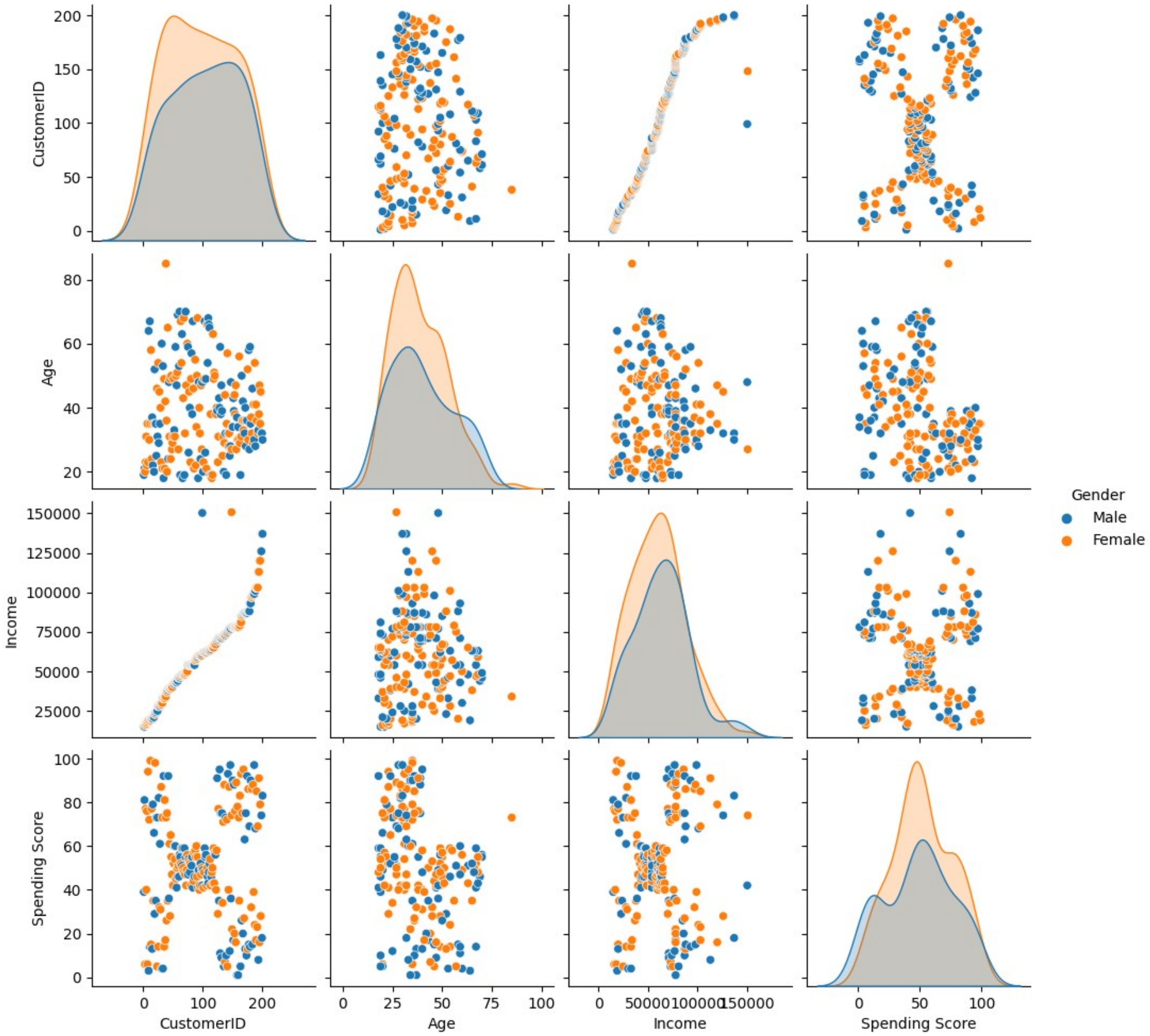
```
df['Spending Score'].plot(kind='hist', bins=20)

plt.title('Spending Score')

Text(0.5, 1.0, 'Spending Score')
```



Pairplot to visualize distribution of data with respect to the other features

```
sns.pairplot(df, hue="Gender")
```

```
<seaborn.axisgrid.PairGrid at 0x7afa53f3ac20>
```



Filling missing values

```
df['Income']=df['Income'].interpolate()
y = df["Age"].median()
df["Age"].fillna(y, inplace = True)
df

     CustomerID  Gender   Age    Income  Spending Score
0             1    Male  19.0   15000.0              39
1             2    Male  21.0   15000.0              81
2             3  Female  20.0   16000.0               6
3             4  Female  23.0   16000.0              77
4             5  Female  31.0   17000.0              40
..          ...     ...   ...       ...             ...
195         196  Female  35.0  120000.0              79
196         197  Female  45.0  126000.0              28
```

```
197         198    Male  32.0  126000.0              74
198         199    Male  32.0  137000.0              18
199         200    Male  30.0  137000.0              83

[200 rows x 5 columns]
```

```
(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    float64
 3   Income          200 non-null    float64
 4   Spending Score  200 non-null    int64  
dtypes: float64(2), int64(2), object(1)
memory usage: 7.9+ KB
```

Finding Outliers

```
df_normal=(df-df.mean())/df.std()
quart1=df_normal.quantile(0.25)
quart3=df_normal.quantile(0.75)
IQR=quart3-quart1
lower=quart1-1.5*IQR
upper=quart3+1.5*IQR
```

```
<ipython-input-176-dca7091be136>:1: FutureWarning: The default value
of numeric_only in DataFrame.mean is deprecated. In a future version,
it will default to False. In addition, specifying 'numeric_only=None'
is deprecated. Select only valid columns or specify the value of
numeric_only to silence this warning.
  df_normal=(df-df.mean())/df.std()
<ipython-input-176-dca7091be136>:1: FutureWarning: The default value
of numeric_only in DataFrame.std is deprecated. In a future version,
it will default to False. In addition, specifying 'numeric_only=None'
is deprecated. Select only valid columns or specify the value of
numeric_only to silence this warning.
  df_normal=(df-df.mean())/df.std()
<ipython-input-176-dca7091be136>:2: FutureWarning: The default value
of numeric_only in DataFrame.quantile is deprecated. In a future
version, it will default to False. Select only valid columns or
specify the value of numeric_only to silence this warning.
  quart1=df_normal.quantile(0.25)
<ipython-input-176-dca7091be136>:3: FutureWarning: The default value
of numeric_only in DataFrame.quantile is deprecated. In a future
version, it will default to False. Select only valid columns or
```

```
specify the value of numeric_only to silence this warning.
  quart3=df_normal.quantile(0.75)
```

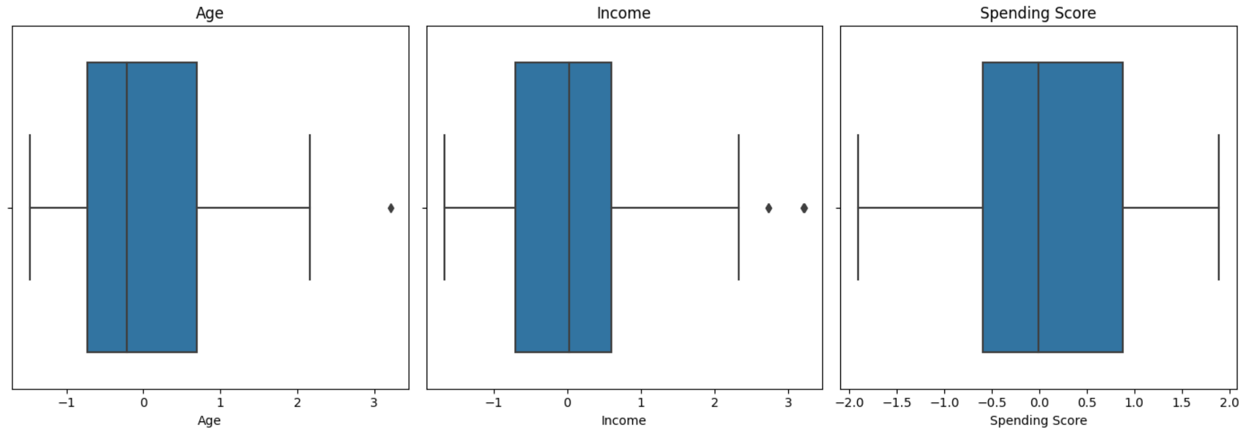
```
x=(df_normal<lower)
y=(df_normal>upper)
```

```
<ipython-input-177-389e19404377>:1: FutureWarning: Automatic
reindexing on DataFrame vs Series comparisons is deprecated and will
raise ValueError in a future version. Do `left, right =
left.align(right, axis=1, copy=False)` before e.g. `left == right`
  x=(df_normal<lower)
<ipython-input-177-389e19404377>:2: FutureWarning: Automatic
reindexing on DataFrame vs Series comparisons is deprecated and will
raise ValueError in a future version. Do `left, right =
left.align(right, axis=1, copy=False)` before e.g. `left == right`
  y=(df_normal>upper)
```

```
outliers=(x|y)
no_of_outliers=(x|y).sum().sum()
print("No.of outliers :",no_of_outliers)
```

```
No.of outliers : 5
```

```
fig, axes = plt.subplots(1, 3,figsize=(14,5))

sns.boxplot(x=df_normal['Age'], ax=axes[0])
sns.boxplot(x=df_normal['Income'], ax=axes[1])
sns.boxplot(x=df_normal['Spending Score'], ax=axes[2])

axes[0].set_title('Age')
axes[1].set_title('Income')
axes[2].set_title('Spending Score')

plt.tight_layout()
plt.show()
```

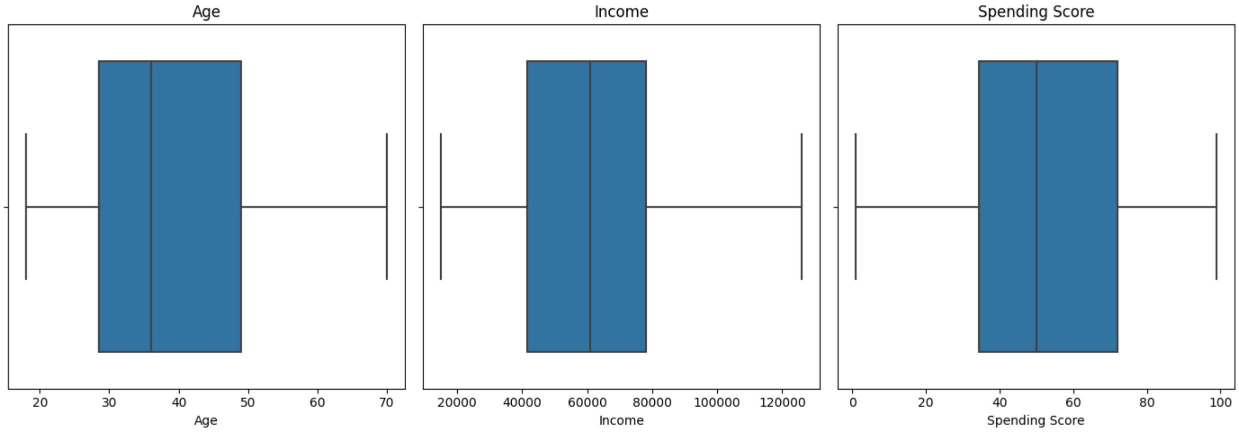


```
new_df=df[~outliers]

new_df
```

```
     CustomerID  Gender   Age    Income   Spending Score
0             1    Male  19.0   15000.0               39
1             2    Male  21.0   15000.0               81
2             3  Female  20.0   16000.0                6
3             4  Female  23.0   16000.0               77
4             5  Female  31.0   17000.0               40
..          ...     ...   ...       ...              ...
195         196  Female  35.0  120000.0               79
196         197  Female  45.0  126000.0               28
197         198    Male  32.0  126000.0               74
198         199    Male  32.0       NaN               18
199         200    Male  30.0       NaN               83

[200 rows x 5 columns]
```

Removing Outliers

```
new_df.dropna(thresh=5,inplace=True)

fig, axes = plt.subplots(1, 3,figsize=(14,5))

sns.boxplot(x=new_df['Age'], ax=axes[0])
sns.boxplot(x=new_df['Income'], ax=axes[1])
sns.boxplot(x=new_df['Spending Score'], ax=axes[2])

axes[0].set_title('Age')
axes[1].set_title('Income')
axes[2].set_title('Spending Score')

plt.tight_layout()
plt.show()
```



Encoding(One Hot)

```
new_df['Income']=new_df['Income']//1000
new_df

     CustomerID  Gender   Age  Income  Spending Score
0             1    Male  19.0    15.0              39
1             2    Male  21.0    15.0              81
2             3  Female  20.0    16.0               6
3             4  Female  23.0    16.0              77
4             5  Female  31.0    17.0              40
..          ...     ...   ...     ...             ...
193         194  Female  38.0   113.0              91
194         195  Female  47.0   120.0              16
195         196  Female  35.0   120.0              79
196         197  Female  45.0   126.0              28
197         198    Male  32.0   126.0              74

[195 rows x 5 columns]

new_df = pd.get_dummies(new_df, columns=['Gender'])
new_df

     CustomerID   Age  Income  Spending Score  Gender_Female
Gender_Male
0             1  19.0    15.0              39              0
1
1             2  21.0    15.0              81              0
1
2             3  20.0    16.0               6              1
0
3             4  23.0    16.0              77              1
0
4             5  31.0    17.0              40              1
0
..          ...   ...     ...             ...            ...
...
193         194  38.0   113.0              91              1
0
194         195  47.0   120.0              16              1
0
195         196  35.0   120.0              79              1
0
196         197  45.0   126.0              28              1
0
197         198  32.0   126.0              74              0
1

[195 rows x 6 columns]
```

DBSCAN

```
from sklearn.cluster import DBSCAN
from sklearn.metrics import silhouette_score as ss
```

Finding Silhouette Scores and Clustering

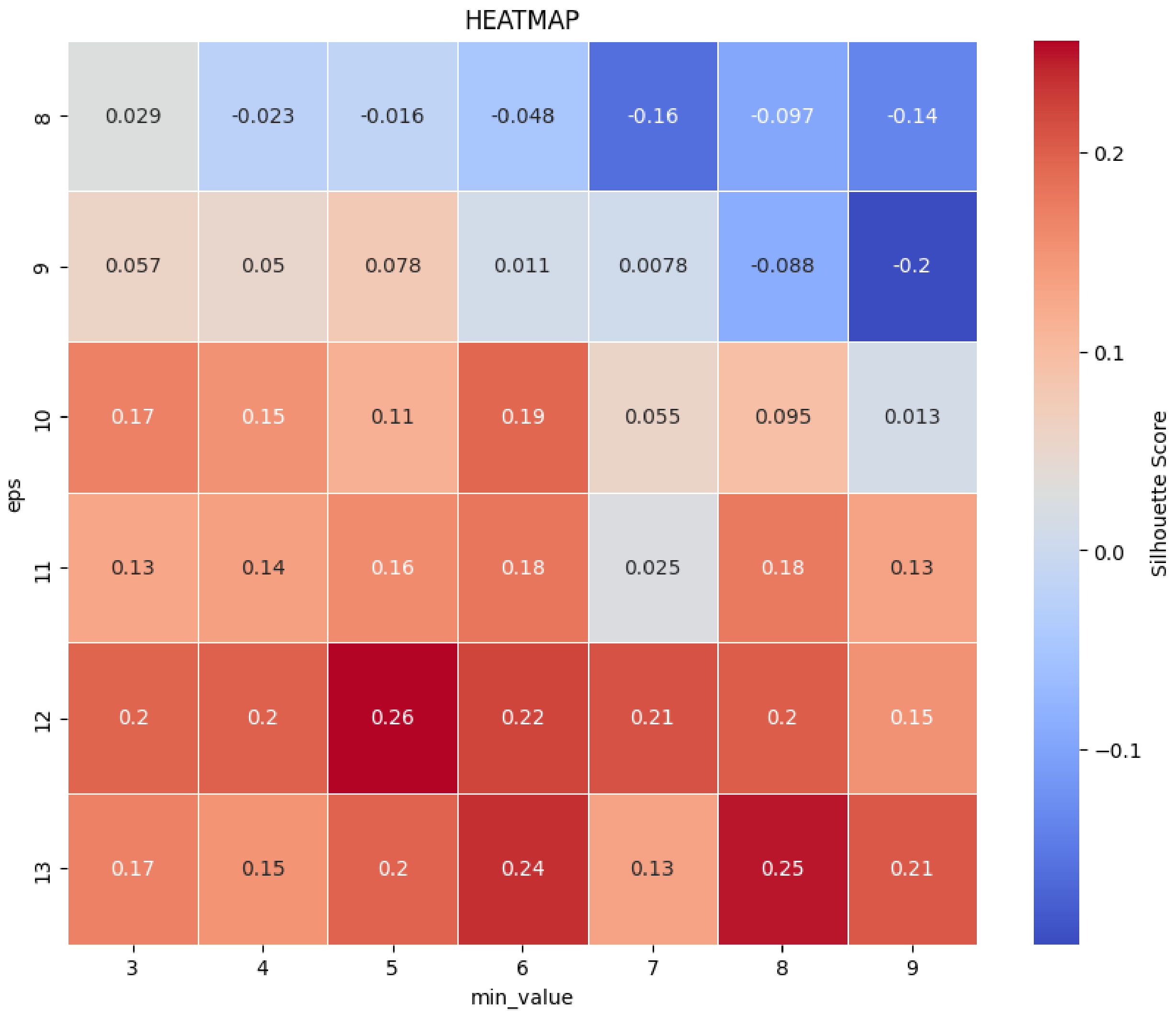
```
X=new_df[['Income','Age','Spending
Score','Gender_Female','Gender_Male']]

ss_={'eps':[],'min_value':[],'ss':[]}
for eps in range(8,14):
  for min_value in range(3,10):
    db = DBSCAN(eps=eps, min_samples=min_value).fit(X)
    labels = db.labels_

    sil_score = ss(X, labels)

    ss_['eps'].append(eps)
    ss_['min_value'].append(min_value)
    ss_['ss'].append(sil_score)

ss_df = pd.DataFrame(ss_)
ss_df.head()
```

```
   eps  min_value        ss
0    8          3  0.029151
1    8          4 -0.022733
2    8          5 -0.016430
3    8          6 -0.047921
4    8          7 -0.162110
```

Heatmap

```
clmns=['eps','min_value','ss']
hm_data=ss_df.pivot('eps', 'min_value','ss')

plt.figure(figsize=(10, 8))
sns.heatmap(data=hm_data,cmap='coolwarm',annot=True,
linewidths=.5,cbar_kws={'label':'Silhouette Score'})
plt.title('HEATMAP')
plt.show()
```

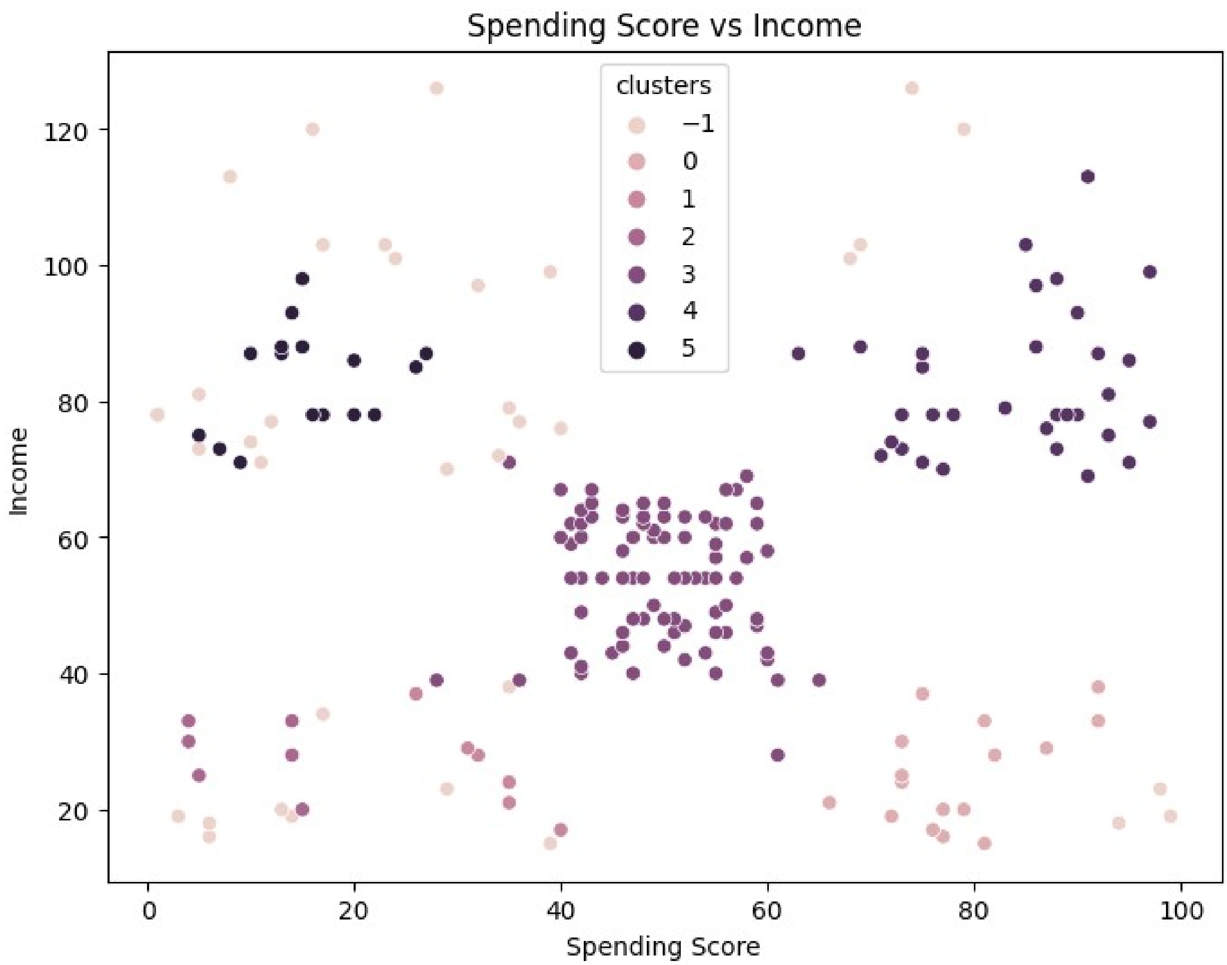
```
<ipython-input-188-96e46c527a23>:2: FutureWarning: In a future version
of pandas all arguments of DataFrame.pivot will be keyword-only.
  hm_data=ss_df.pivot('eps', 'min_value','ss')
```



```
db_new = DBSCAN(eps=12, min_samples=5).fit(X)
X['clusters'] = db_new.labels_
```

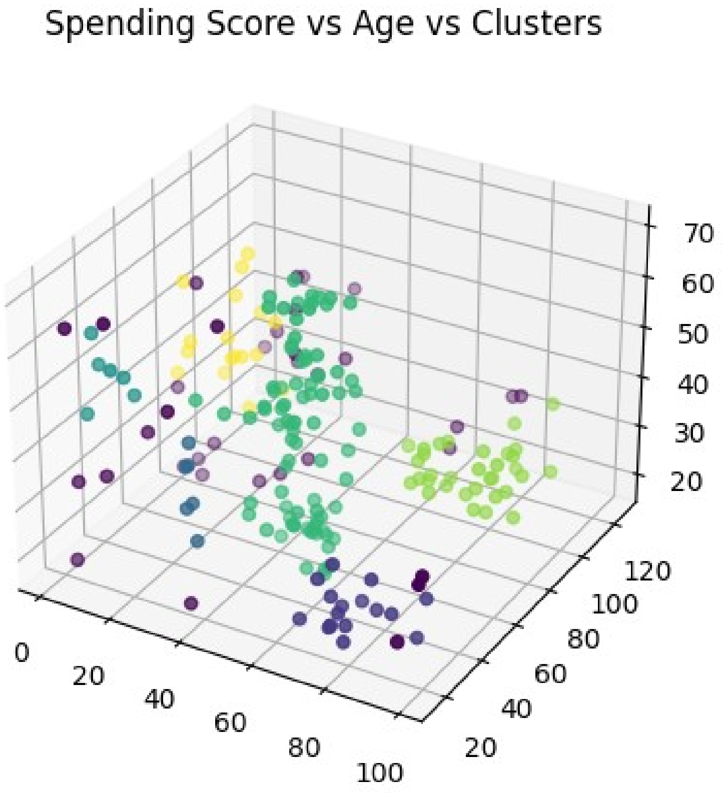
CLUSTER BY 2D

```
plt.figure(figsize=(8,6))
sns.scatterplot(x=X['Spending Score'], y=X['Income'],hue = 'clusters',
data=X)
plt.title('Spending Score vs Income')
plt.show()
```



CLUSTER BY 3D

```
fig = plt.figure()
ax = plt.axes(projection ='3d')
ax.scatter(X['Spending Score'], X['Income'], X['Age'], c =
X['clusters'])
ax.set_title('Spending Score vs Age vs Clusters')
plt.show()
```


Spending Score vs Age vs Clusters
70
60
50
40
30
20
120
100
80
60
40
20
0
20
40
60
80
100