In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

2.Loading the DataSet

In [2]:
```
df=pd.read_csv("Mall_Customers.csv")
df
```

Out[2]:

	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
...	...	...	...	...	...
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

200 rows × 5 columns

In [3]:
```
df.drop(["CustomerID"],axis="columns",inplace=True)
```

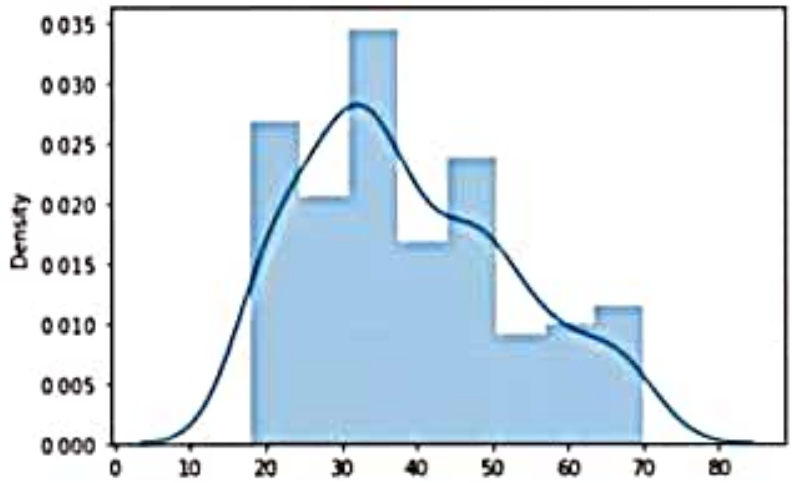
3. Performing Visualizations

3.1 Univarient Analysis

In [4]:
```
sns.distplot(df.Age)
```

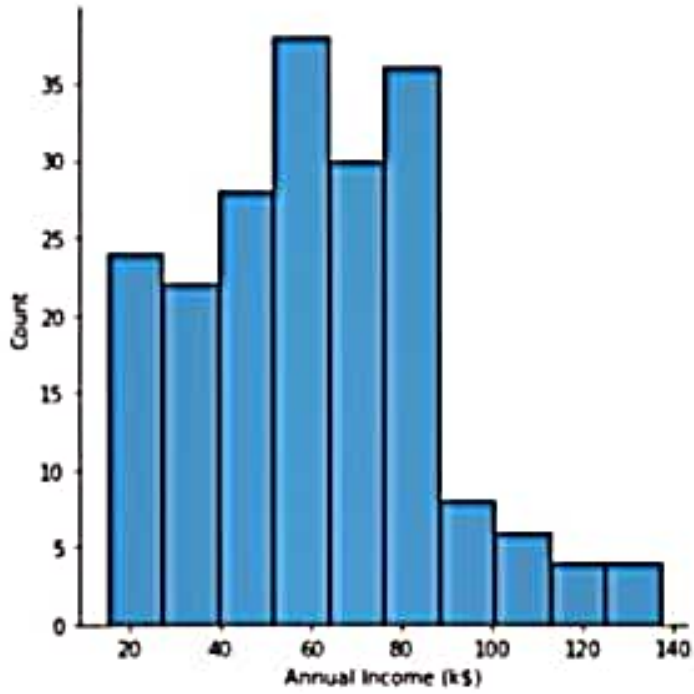
```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\distributions.py:2619: FutureW
arning: `distplot` is a deprecated function and will be removed in a future versi
on. Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

Out[4]:



In [5]:
```
sns.displot(df["Annual Income (k$)"])
```

Out[5]:

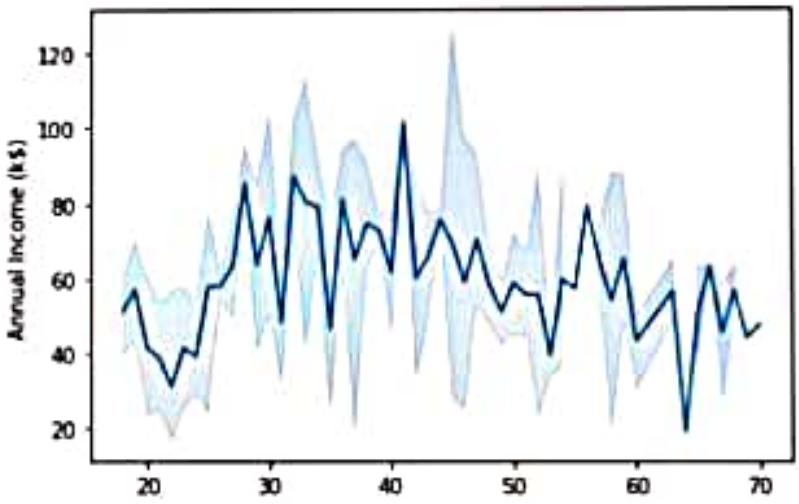


3.2 Bi-variant Analysis

In [6]:
```
sns.lineplot(df.Age,df["Annual Income (k$)"])
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarni
ng: Pass the following variables as keyword args: x, y. From version 0.12, the on
ly valid positional argument will be `data`, and passing other arguments without
an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```

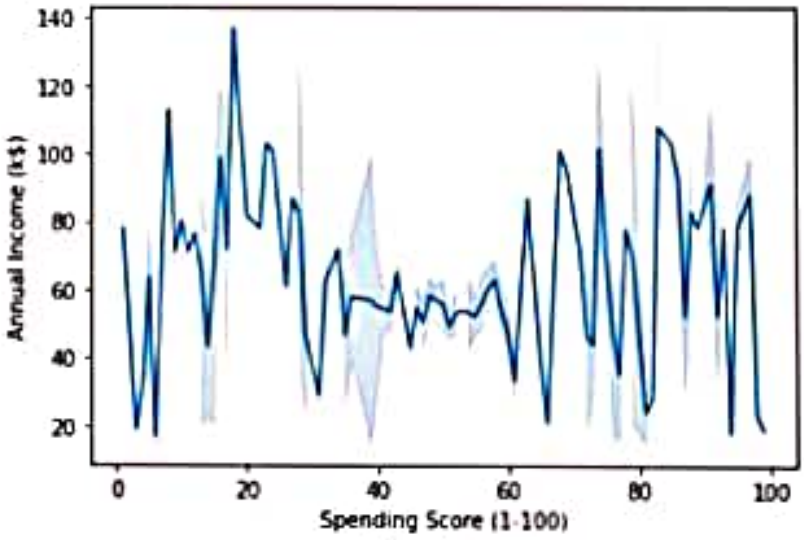
Out[6]:



In [7]:
```
sns.lineplot(df["Spending Score (1-100)"],df["Annual Income (k$)"])
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarni
ng: Pass the following variables as keyword args: x, y. From version 0.12, the on
ly valid positional argument will be `data`, and passing other arguments without
an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```

Out[7]:



4. Perform descriptive statistics on the dataset.

In [8]:
```
df.describe()
```

Out[8]:

	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

	Age	Annual Income (k$)	Spending Score (1-100)
25%	28.750000	41.500000	34.750000
50%	36.000000	61.500000	50.000000
75%	49.000000	78.000000	73.000000

5. Check for Missing values and deal with them.

In [9]:
```
df.isnull().any()
```

Out[9]:
```
Gender                  False
Age                     False
Annual Income (k$)      False
Spending Score (1-100)  False
dtype: bool
```

In [10]:
```
df.isnull().sum()
```

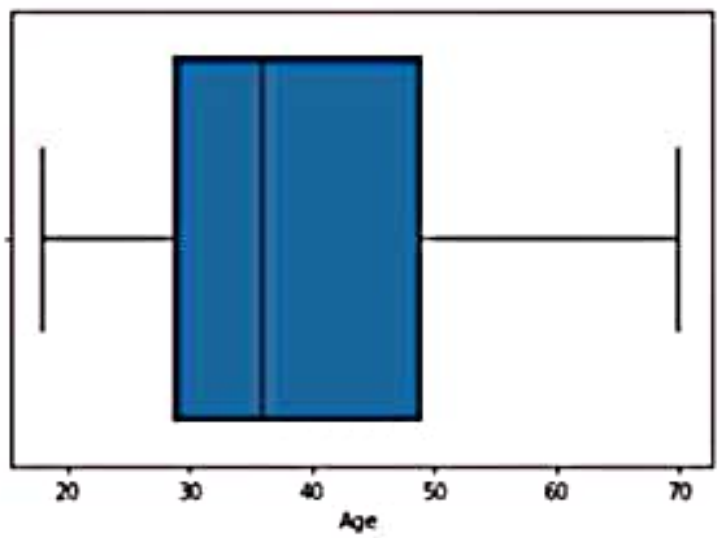
Out[10]:
```
Gender                  0
Age                     0
Annual Income (k$)      0
Spending Score (1-100)  0
dtype: int64
```

6. Find the outliers and replace the outliers

In [11]:
```
sns.boxplot(df.Age)
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarni
ng: 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(
```

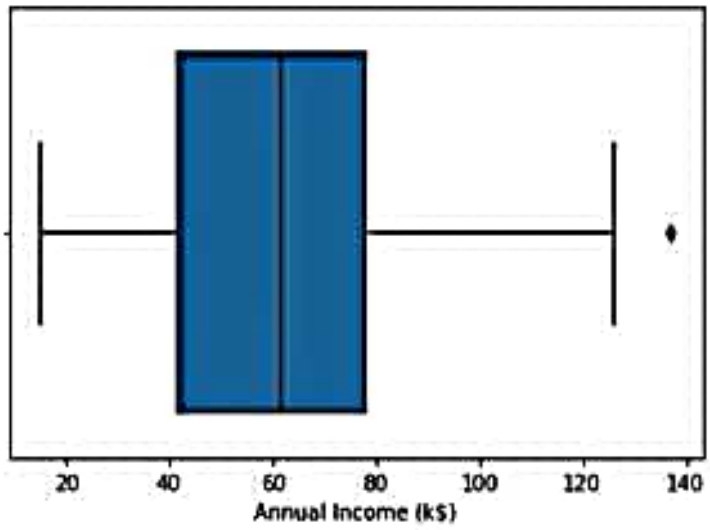
Out[11]:



In [12]:
```
sns.boxplot(df["Annual Income (k$)"])
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarni
ng: 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[12]:



In [13]:
```
a99=df["Annual Income (k$)"].quantile(0.99)
a99
```

Out[13]: 126.1099999999999

In [14]:
```
df["Annual Income (k$)"]=np.where(df["Annual Income (k$)"]>=a99,df["Annual Income
```

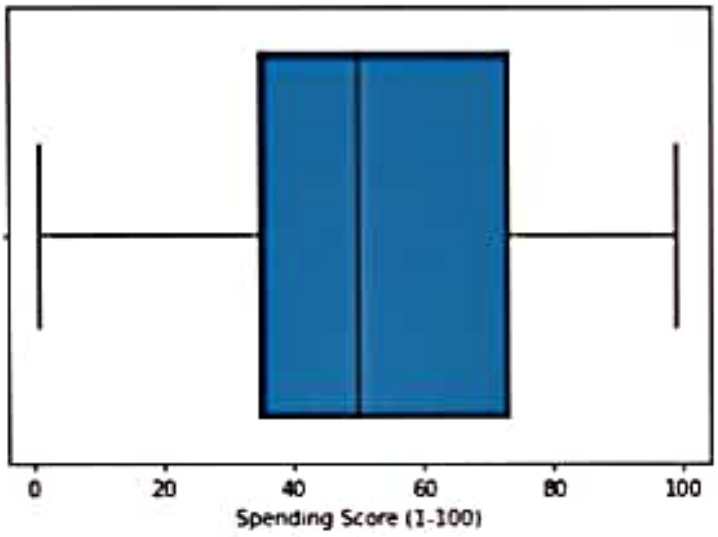
In [15]:
```
sns.boxplot(df["Annual Income (k$)"])
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarni
ng: 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(
```

In [16]:
```
sns.boxplot(df["Spending Score (1-100)"])
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarni
ng: 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[16]:



7. Check for Categorical columns and perform encoding.

In [17]:
```
from sklearn.preprocessing import LabelEncoder
le=LabelEncoder()
df.Gender=le.fit_transform(df.Gender)
```

In [18]:
```
df.head()
```

Out[18]:

	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

8. Scaling the data

In [19]:
```
from sklearn.preprocessing import scale
df=pd.DataFrame(scale(df),columns=df.columns)
```

In [22]:
```
df.head()
```

Out[22]:

	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1.128152	-1.424569	-1.788777	-0.434801
1	1.128152	-1.281035	-1.788777	1.195704
2	-0.886405	-1.352802	-1.748853	-1.715913
3	-0.886405	-1.137502	-1.748853	1.040418
4	-0.886405	-0.563369	-1.708930	-0.395980

9. Perform any of the clustering algorithms

In [25]:
```
from sklearn.cluster import KMeans
model=KMeans(n_clusters=2)
model
```

Out[25]:
```
KMeans(n_clusters=2)
```
In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [26]:
```
y_predicted=model.fit_predict(df)
y_predicted
```

```
C:\Users\Arjun\AppData\Roaming\Python\Python39\site-packages\sklearn\cluster\_kmeans.py:1334: 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(
```

Out[26]:
```
array([0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0,
       1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0,
       1, 0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 0,
       1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0,
       0, 1, 1, 0, 1, 1, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0, 1, 0, 1, 1, 1, 1,
       1, 0, 1, 0, 0, 0, 1, 1, 1, 1, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0,
       0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0,
       1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0,
       1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0,
       1, 0])
```

10. Add the cluster data with the primary dataset

In [27]:
```
df["clusters"]=y_predicted
df
```

Out[27]:

	Gender	Age	Annual Income (k$)	Spending Score (1-100)	clusters
0	1.128152	-1.424569	-1.788777	-0.434801	0
1	1.128152	-1.281035	-1.788777	1.195704	0
2	-0.886405	-1.352802	-1.748853	-1.715913	1
3	-0.886405	-1.137502	-1.748853	1.040418	0
4	-0.886405	-0.563369	-1.708930	-0.395980	0
...	...	...	...	...	...
195	-0.886405	-0.276302	2.403201	1.118061	0
196	-0.886405	0.441365	2.642742	-0.861839	1
197	1.128152	-0.491602	2.642742	0.923953	0
198	1.128152	-0.491602	0.067670	-1.250054	1
199	1.128152	-0.635135	0.067670	1.273347	0

200 rows × 5 columns

11. Split the data into dependent and independent variables.

In [28]:
```
x=df.drop("clusters",axis="columns")
x
```

Out[28]:

	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1.128152	-1.424569	-1.788777	-0.434801
1	1.128152	-1.281035	-1.788777	1.195704
2	-0.886405	-1.352802	-1.748853	-1.715913
3	-0.886405	-1.137502	-1.748853	1.040418
4	-0.886405	-0.563369	-1.708930	-0.395980
...	...	...	...	...
195	-0.886405	-0.276302	2.403201	1.118061
196	-0.886405	0.441365	2.642742	-0.861839
197	1.128152	-0.491602	2.642742	0.923953
198	1.128152	-0.491602	0.067670	-1.250054
199	1.128152	-0.635135	0.067670	1.273347

200 rows × 4 columns

In [29]:
```
y=df.clusters
y
```

Out[29]:
```
0      0
1      0
2      1
3      0
4      0
      ..
195    0
196    1
197    0
198    1
199    0
Name: clusters, Length: 200, dtype: int32
```

12. Split the data into training and testing

In [30]:
```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2,random_state=23)
```

In [31]:
```
x_train.shape
```

Out[31]:
```
(160, 4)
```

In [32]:
```
x_test.shape
```

Out[32]: (40, 4)

13. Build the Model

In [33]:
```
from sklearn.linear_model import LogisticRegression
lr=LogisticRegression()
```

14. Train the Model

In [34]:
```
lr.fit(x_train,y_train)
```

Out[34]: LogisticRegression()

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

15. Test the Model

In [35]:
```
lr.score(x_test,y_test)
```

Out[35]: 1.0

In [36]:
```
lr.score(x_train,y_train)
```

Out[36]: 1.0

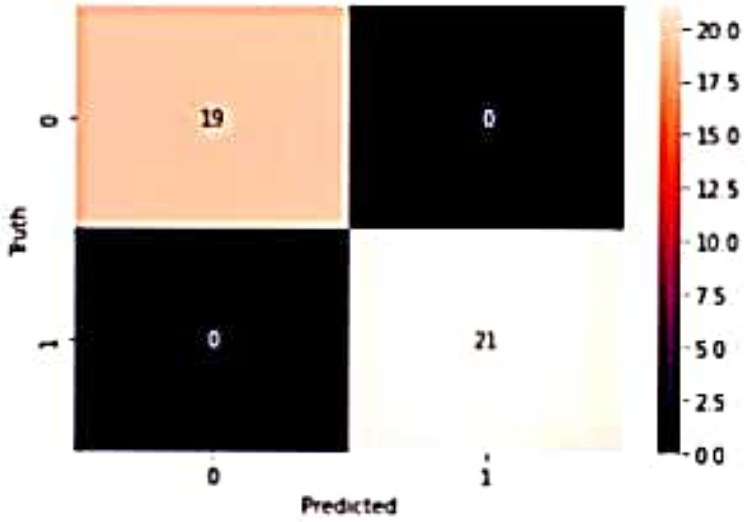
16. Measure the performance using Evaluation Metrics.

In [37]:
```
from sklearn.metrics import confusion_matrix
y_pred = lr.predict(x_test)
cm = confusion_matrix(y_test, y_pred)
cm
```

Out[37]:
```
array([[19,  0],
       [ 0, 21]], dtype=int64)
```

In [38]:
```
sns.heatmap(cm, annot=True)
plt.xlabel('Predicted')
plt.ylabel('Truth')
```

Out[38]: Text(33.0, 0.5, 'Truth')



In [39]:
```
from sklearn.metrics import classification_report
print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        19
           1       1.00      1.00      1.00        21

    accuracy                           1.00        40
   macro avg       1.00      1.00      1.00        40
weighted avg       1.00      1.00      1.00        40
```