ression-on-customer-travel-data-2

June 16, 2023

[ ]:
```
# Logistic Regression on Customer Travel Data

# importinf the necessary libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline

#reading the dataset
df = pd.read_csv('Customertravel.csv')
df.head()
```

[ ]:

	Age	FrequentFlyer	AnnualIncomeClass	ServicesOpted	AccountSyncedToSocialMedia	BookedHotelOrNot	Target
0	34	No	Middle Income	6	No	Yes	0
1	34	Yes	Low Income	5	Yes	No	1
2	37	No	Middle Income	3	Yes	No	0
3	30	No	Middle Income	2	No	No	0
4	30	No	Low Income	1	No	No	0

Understanding the statistical information

[ ]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 954 entries, 0 to 953
Data columns (total 7 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   Age                         954 non-null    int64
 1   FrequentFlyer               954 non-null    object
```

```
 2   AnnualIncomeClass           954 non-null    object
 3   ServicesOpted               954 non-null    int64
 4   AccountSyncedToSocialMedia  954 non-null    object
 5   BookedHotelOrNot            954 non-null    object
 6   Target                      954 non-null    int64
dtypes: int64(3), object(4)
memory usage: 52.3+ KB
```

[ ]:
```
df.shape  #dimensions of the dataset
```

[ ]:
```
(954, 7)
```

[ ]:
```
# observing the distribution of the response variable
df['AnnualIncomeClass'].value_counts()
```

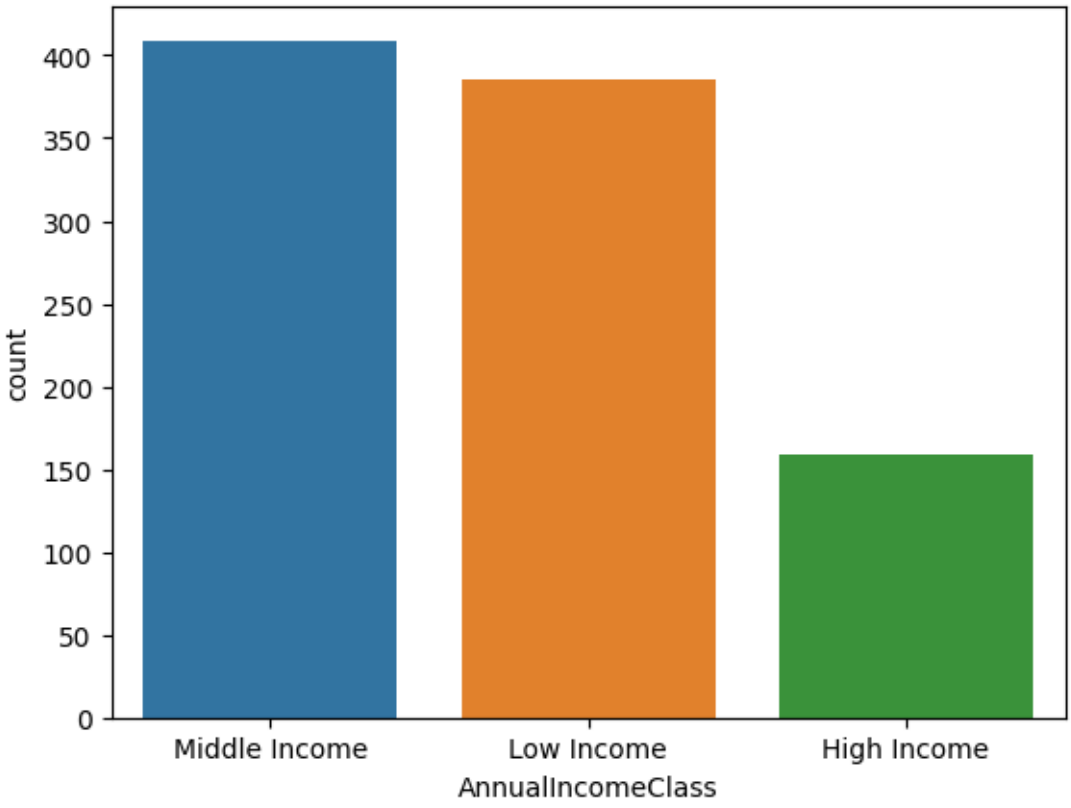
[ ]:
```
Middle Income    409
Low Income       386
High Income      159
Name: AnnualIncomeClass, dtype: int64
```

[ ]:
```
# observing distribution in percent format
round(df['AnnualIncomeClass'].value_counts(normalize = True)*100 , 2)
```

[ ]:
```
Middle Income    42.87
Low Income       40.46
High Income      16.67
Name: AnnualIncomeClass, dtype: float64
```

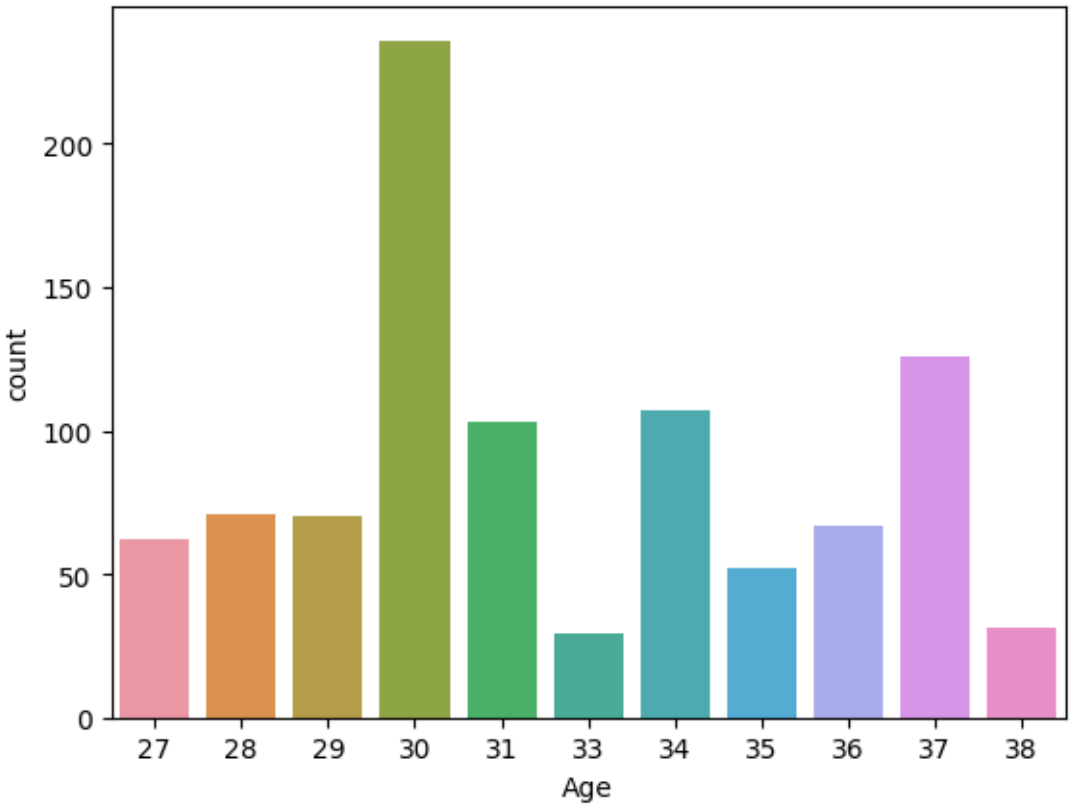
[ ]:
```
# observation using a count plot
sns.countplot(x = 'AnnualIncomeClass',data = df)
```

[ ]:
```
<Axes: xlabel='AnnualIncomeClass', ylabel='count'>
```



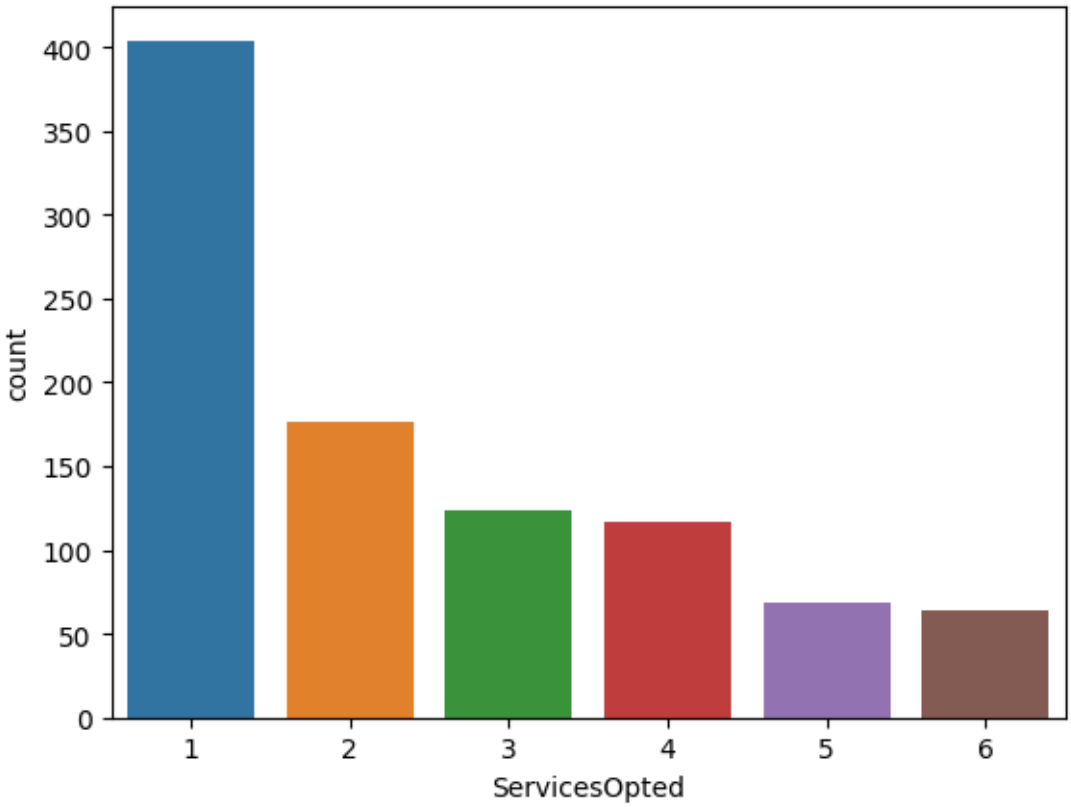
[ ]:
```
sns.countplot(x = 'Age',data = df)
```

[ ]:
```
<Axes: xlabel='Age', ylabel='count'>
```



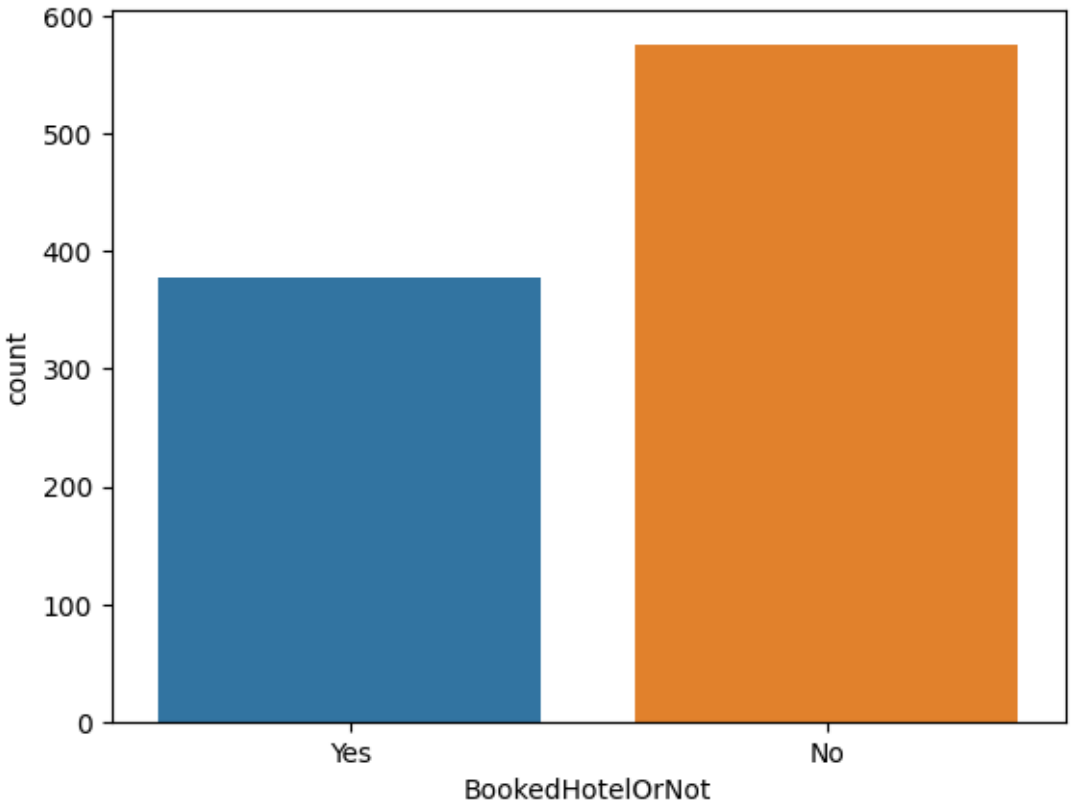
[ ]:
```
sns.countplot(x = 'ServicesOpted',data = df)
```

[ ]:
```
<Axes: xlabel='ServicesOpted', ylabel='count'>
```



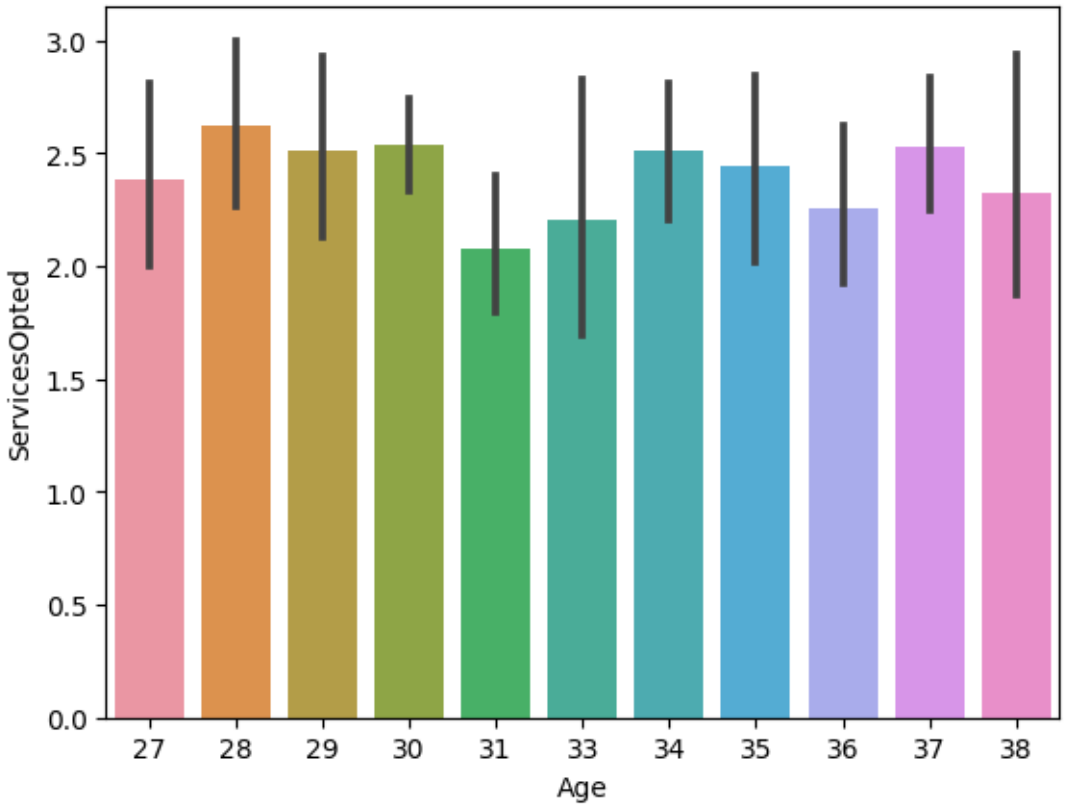
[ ]:
```
sns.countplot(x = 'BookedHotelOrNot',data = df)
```

[ ]:
```
<Axes: xlabel='BookedHotelOrNot', ylabel='count'>
```



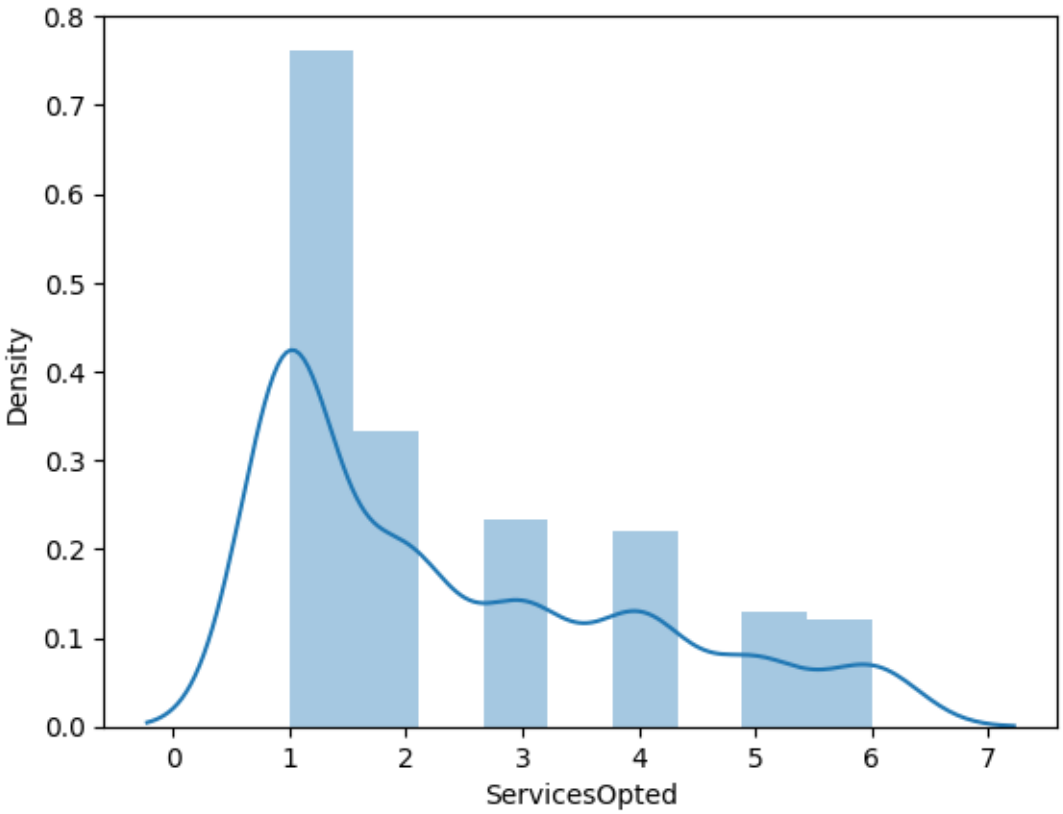
[ ]:
```
# observing with bar plot        # bar plot only takes numeric data
sns.barplot(x='Age' , y='ServicesOpted' , data = df)
```

[ ]: <Axes: xlabel='Age', ylabel='ServicesOpted'>



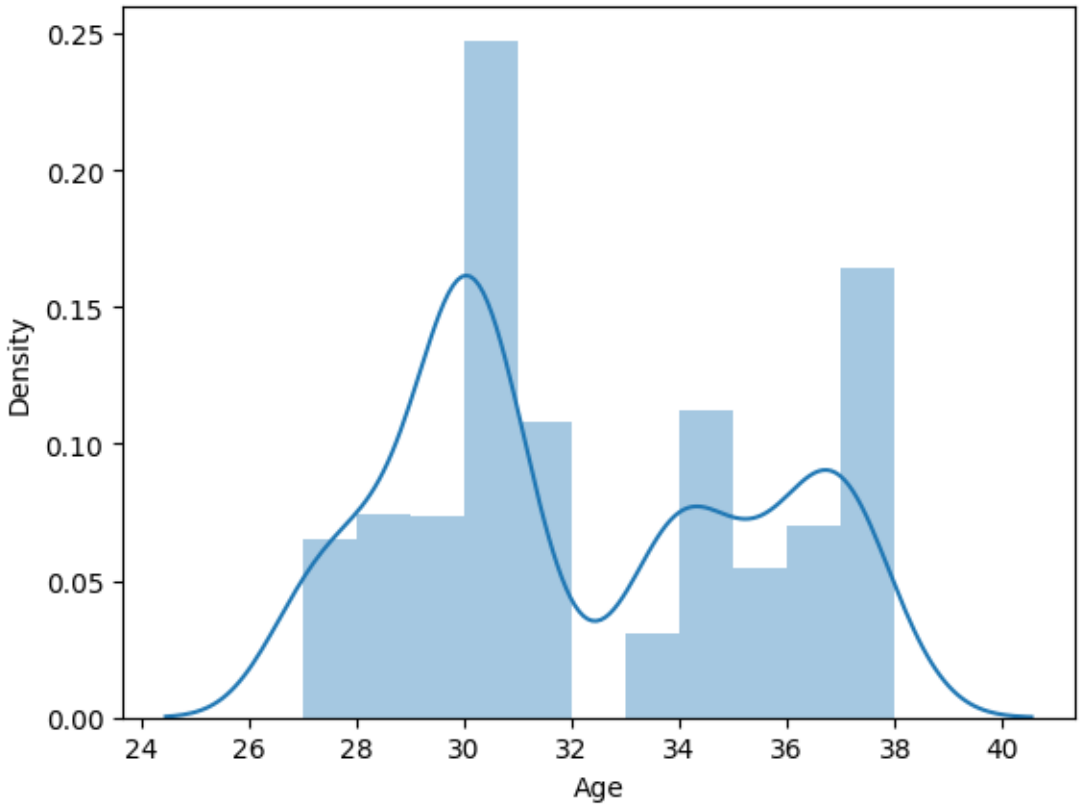
[ ]:
```
sns.distplot(df['ServicesOpted']);
```

```
<ipython-input-160-a691f9ce8329>: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['ServicesOpted']);
```



[ ]:
```
sns.distplot(df['Age']);
```

```
<ipython-input-161-3cd339c99e47>: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['Age']);
```



[ ]:
```
df.isna()  # searching for any missing values
```

[ ]:
```
       Age  FrequentFlyer  AnnualIncomeClass  ServicesOpted  \
0    False          False              False          False
1    False          False              False          False
2    False          False              False          False
3    False          False              False          False
4    False          False              False          False
..     …              …                  …              …
949  False          False              False          False
950  False          False              False          False
951  False          False              False          False
952  False          False              False          False
953  False          False              False          False

     AccountSyncedToSocialMedia  BookedHotelOrNot  Target
0                         False             False   False
1                         False             False   False
2                         False             False   False
3                         False             False   False
4                         False             False   False
```

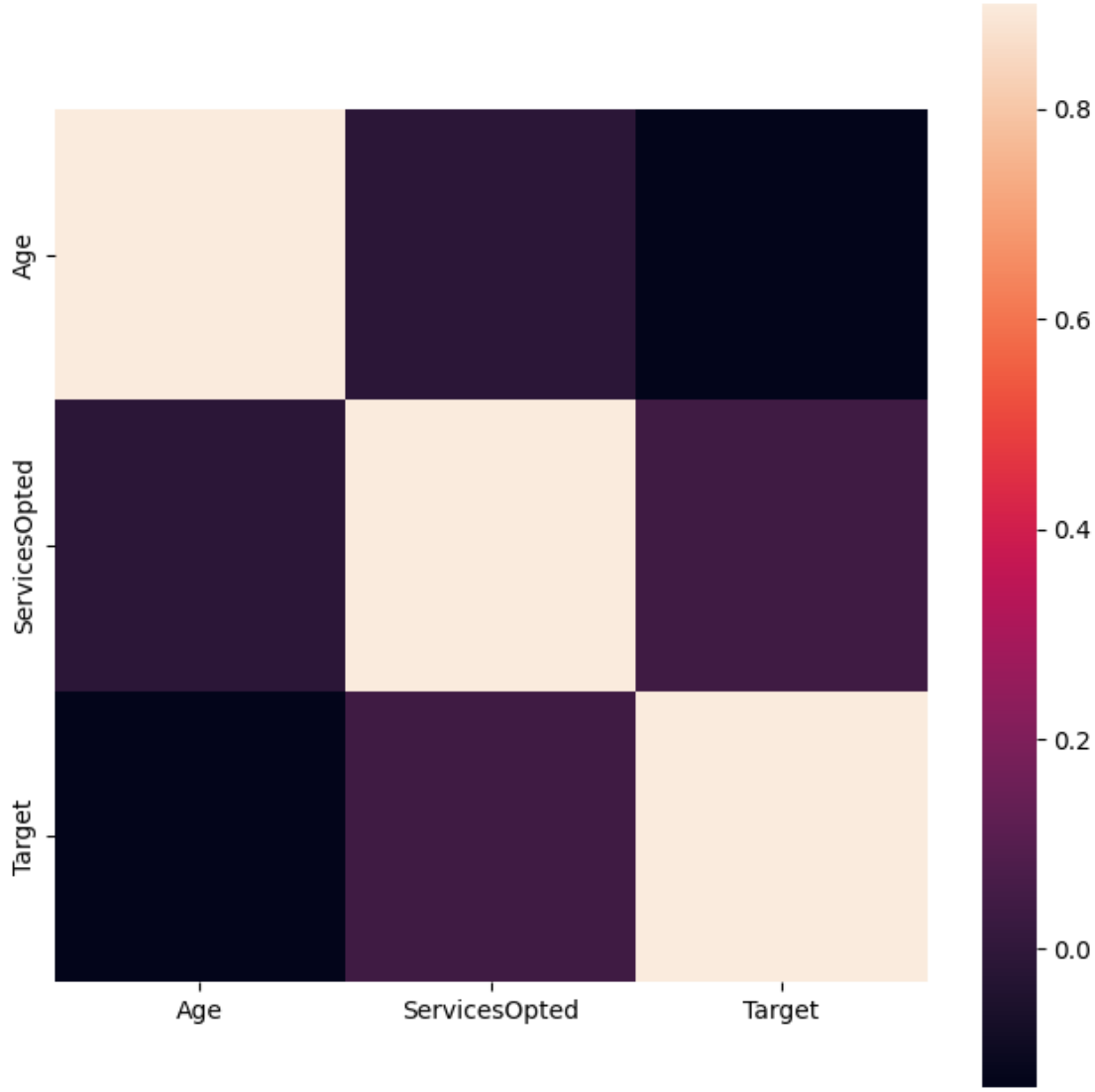
```
..                          …               …     …
949                       False           False   False
950                       False           False   False
951                       False           False   False
952                       False           False   False
953                       False           False   False

[954 rows x 7 columns]
```

understanding the correlation between features

[ ]:
```
#correlation_metrics = df.corr()
#fig = plt.figure(figsize = (10,8))
#sns.heatmap(correlation_metrics , square = True)
#plt.show()
```

[ ]:
```
from sklearn.metrics import confusion_matrix   #confusion matrix only displays␣
 ↪info of numeric data
correlation_metrics = df.corr()
fig = plt.figure(figsize = (8,8))
sns.heatmap(correlation_metrics , vmax = 0.9 , square = True)
plt.show()
```

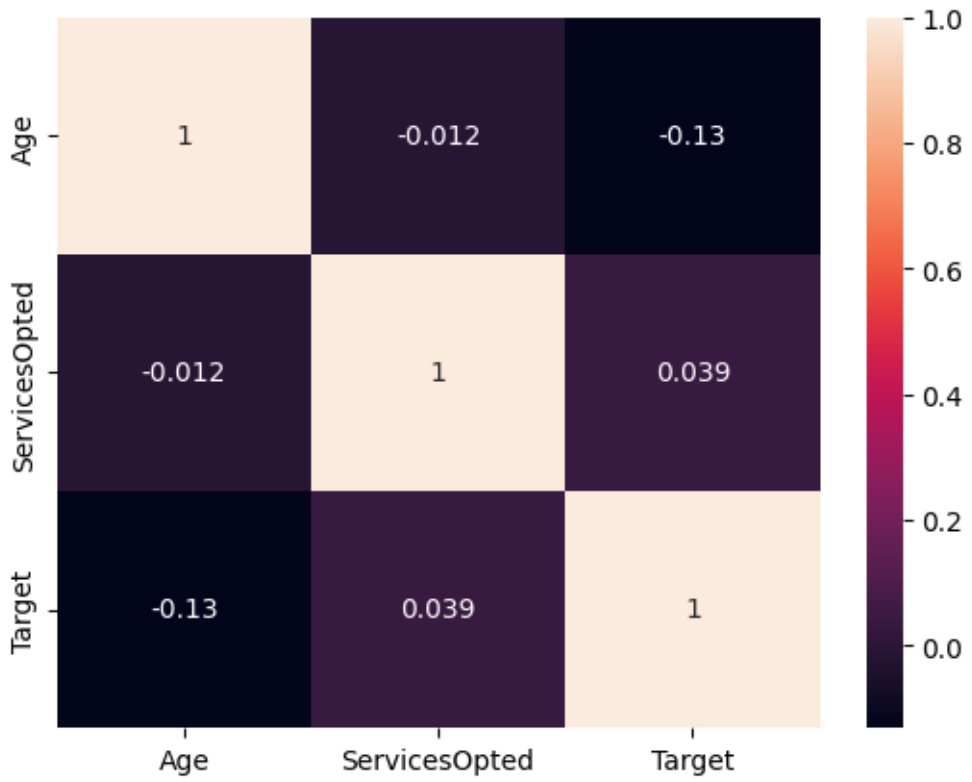
```
<ipython-input-171-81232a470a49>:2: FutureWarning: The default value of
numeric_only in DataFrame.corr is deprecated. In a future version, it will
default to False. Select only valid columns or specify the value of numeric_only
to silence this warning.
  correlation_metrics = df.corr()
```



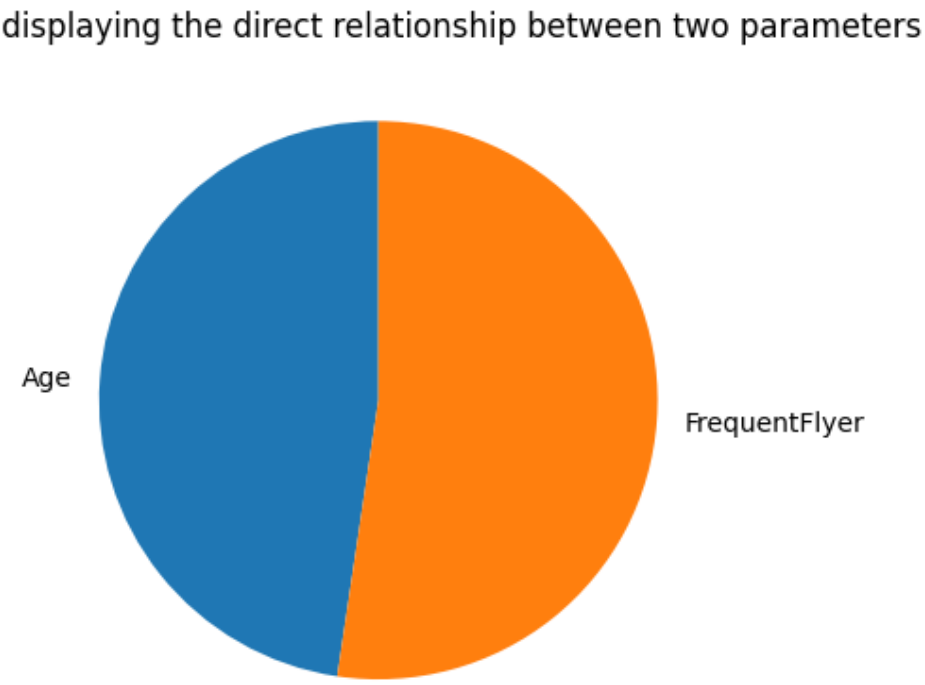
[ ]:
```
#corr_matrix = df.corr()
correlation_metrics = df.corr()
print(corr_matrix)
sns.heatmap(corr_matrix, annot=True)
plt.show()
```

```
<ipython-input-173-259c6b8bca2f>:2: FutureWarning: The default value of
numeric_only in DataFrame.corr 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.
  correlation_metrics = df.corr()

                   Age  ServicesOpted    Target
Age           1.000000      -0.012422 -0.131534
```

```
ServicesOpted -0.012422        1.000000  0.038646
Target        -0.131534        0.038646  1.000000
```

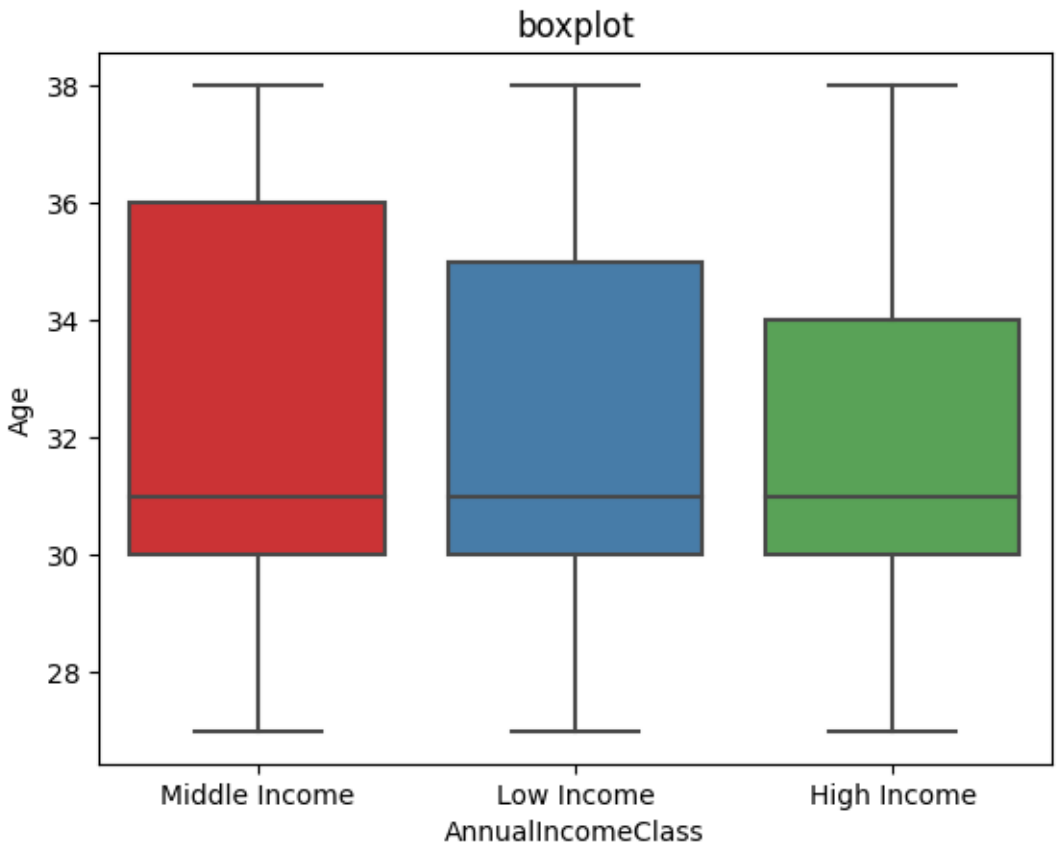


[ ]:
```
y = np.array([91, 100])
mylabels = ['Age', 'FrequentFlyer']

#myexplode = [0.2, 0]

plt.pie( y ,  labels = mylabels ,  startangle = 90 ) # , explode = myexplode ,␣
  ↪shadow = True)
#fig = plt.figure(figsize =(10, 7))
plt.title("Line chart displaying the direct relationship between two␣
  ↪parameters")
# show plot
plt.show()
```



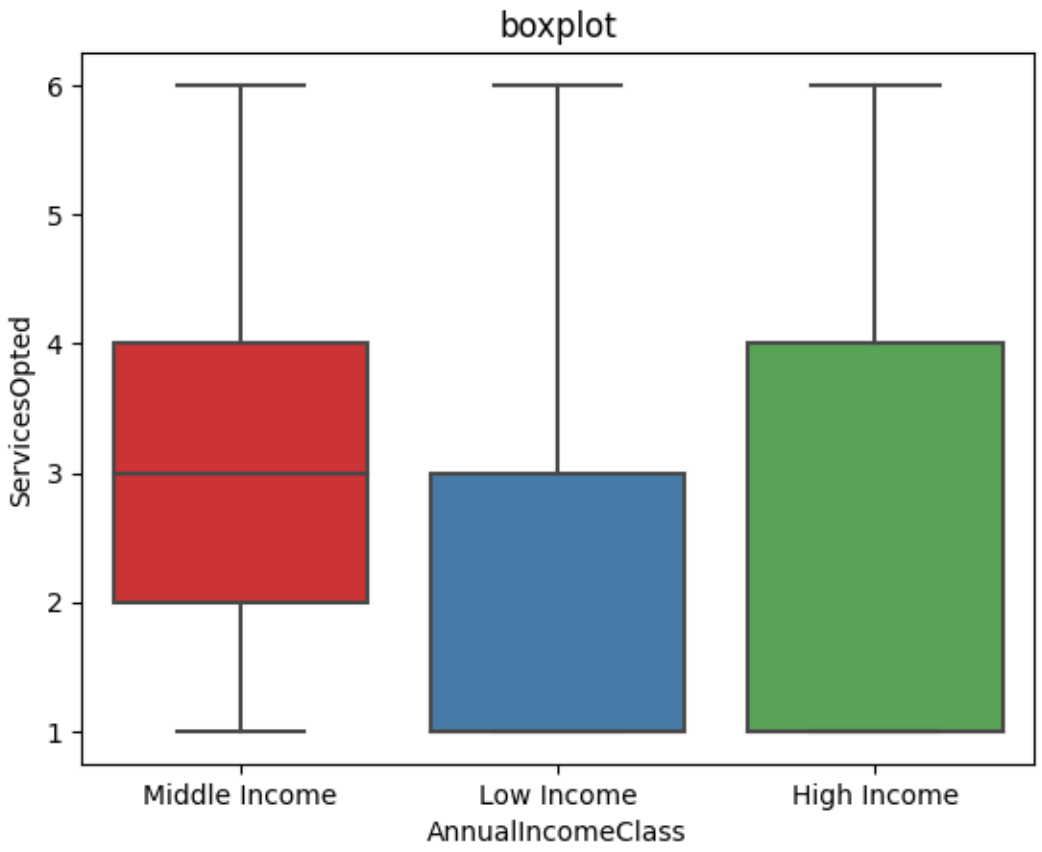
[ ]:
```
sns.boxplot(y='Age',x ='AnnualIncomeClass', data = df, palette = 'Set1').
↪set(title='boxplot')
```

[ ]:
```
[Text(0.5, 1.0, 'boxplot')]
```



[ ]:
```
sns.boxplot(y='ServicesOpted',x ='AnnualIncomeClass', data = df, palette =␣
↪'Set1').set(title='boxplot')
```

[ ]:
```
[Text(0.5, 1.0, 'boxplot')]
```



[ ]:
```
from sklearn import metrics
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
import seaborn as sns
sns,set()
```

[ ]:
```
(<module 'seaborn' from '/usr/local/lib/python3.10/dist-
packages/seaborn/__init__.py'>,
 set())
```

[ ]:
```
df['AnnualIncomeClass'].value_counts(dropna=False)
```

[ ]:
```
Middle Income    409
Low Income       386
High Income      159
Name: AnnualIncomeClass, dtype: int64
```

[ ]:
```
df['FrequentFlyer'].value_counts(dropna=False)
```

[ ]:
```
No           608
Yes          286
No Record     60
Name: FrequentFlyer, dtype: int64
```

[ ]:
```
df['BookedHotelOrNot'].value_counts(dropna=False)
```

[ ]:
```
No     576
Yes    378
Name: BookedHotelOrNot, dtype: int64
```

[ ]:
```
df['AccountSyncedToSocialMedia'].value_counts(dropna=False)
```

[ ]:
```
No     594
Yes    360
Name: AccountSyncedToSocialMedia, dtype: int64
```

Converting categorical data into numeric values

[ ]:
```
df['FrequentFlyer'] = df['FrequentFlyer'].replace({'Yes':2,'No':1, 'No Record':
 ↪0})
df
df['AccountSyncedToSocialMedia'] = df['AccountSyncedToSocialMedia'].
 ↪replace({'Yes':1,'No':0})
df
df['BookedHotelOrNot'] = df['BookedHotelOrNot'].replace({'Yes':1,'No':0})
df
df['AnnualIncomeClass'] = df['AnnualIncomeClass'].replace({'Low Income':
 ↪0,'Middle Income':1, 'High Income':2})
df
```

[ ]:
```
      Age  FrequentFlyer  AnnualIncomeClass  ServicesOpted  \
0      34              0                  1              6
1      34              1                  0              5
2      37              0                  1              3
3      30              0                  1              2
4      30              0                  0              1
..    …              …                  …              …
949    31              1                  0              1
950    30              0                  1              5
951    37              0                  1              4
952    30              0                  0              1
953    31              1                  2              1

      AccountSyncedToSocialMedia  BookedHotelOrNot  Target
0                              0                 1       0
1                              1                 0       1
```

```
2                                1                 0       0
3                                0                 0       0
4                                0                 0       0
..                             ...               ...     ...
949                              0                 0       0
950                              0                 1       0
951                              0                 0       0
952                              1                 1       0
953                              0                 0       0

[954 rows x 7 columns]
```

Training the model

[ ]:
```
#importing the libraries for training the model
from sklearn.model_selection import train_test_split

#from sklearn.metrics import log_loss, roc_auc_score, recall_score,␣
 ↪precision_score, average_precision_score, f1_score, classification_report,␣
 ↪accuracy_score, plot_roc_curve, plot_precision_recall_curve,␣
 ↪plot_confusion_matrix

from sklearn.metrics import classification_report , accuracy_score
from sklearn.metrics import confusion_matrix
from sklearn.linear_model import LogisticRegression
from sklearn import metrics
import seaborn as sns
```

[ ]:
```
x = df.drop(['AnnualIncomeClass'] , axis = 1)
y = df['AnnualIncomeClass']
# splitting for 30 % test and 70% training
xtrain , xtest , ytrain , ytest = train_test_split(x,y, test_size = 0.30 ,␣
 ↪random_state =42)
xtest.shape
logisticreg = LogisticRegression()
logisticreg.fit(xtrain , ytrain)
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/linear_model/_logistic.py:458:
ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-
regression
  n_iter_i = _check_optimize_result(
```

[ ]:
```
LogisticRegression()
```

Scaling for better accuracy during training

[ ]:
```
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
scaler.fit(xtrain)
sc = StandardScaler()
X_train = sc.fit_transform(xtrain)
X_test = sc.transform(xtest)
```

Predicting the test dataset

[ ]:
```
y_pred = logisticreg.predict(xtest)
logisticsreg = LogisticRegression()
y_pred
```

[ ]:
```
array([0, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 2, 1, 2, 1, 1, 2, 1, 0, 1, 1, 2,
       2, 2, 1, 1, 0, 0, 1, 1, 1, 2, 2, 1, 0, 0, 1, 1, 2, 1, 1, 2, 2, 2,
       1, 1, 2, 1, 1, 2, 1, 0, 1, 1, 1, 0, 1, 0, 2, 2, 0, 0, 1, 1, 1, 1,
       1, 2, 1, 1, 1, 0, 1, 0, 1, 2, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 1,
       1, 2, 1, 1, 2, 2, 1, 0, 0, 1, 1, 2, 0, 1, 1, 0, 1, 1, 2, 0, 1, 1,
       0, 2, 1, 1, 1, 1, 2, 1, 1, 0, 1, 1, 2, 1, 0, 0, 1, 1, 0, 1, 1, 1,
       1, 1, 1, 1, 0, 1, 1, 2, 0, 1, 1, 0, 2, 0, 0, 1, 0, 0, 1, 0, 1, 1,
       2, 0, 0, 0, 2, 1, 1, 1, 0, 1, 1, 2, 2, 1, 0, 1, 0, 2, 0, 0, 1, 2,
       2, 0, 1, 1, 1, 1, 1, 1, 2, 1, 2, 1, 0, 2, 0, 0, 1, 0, 0, 0, 0, 0,
       0, 1, 2, 0, 0, 1, 2, 0, 1, 0, 0, 2, 1, 0, 1, 1, 1, 0, 0, 2, 1, 0,
       1, 2, 1, 1, 0, 1, 0, 1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 0, 1, 2,
       1, 0, 2, 0, 0, 0, 0, 0, 0, 2, 0, 1, 1, 2, 0, 2, 0, 0, 1, 2, 1, 0,
       1, 0, 0, 1, 2, 0, 0, 0, 0, 1, 1, 1, 1, 1, 2, 2, 1, 1, 2, 0, 1, 0,
       1])
```

Evaluation through Classification metrics

[ ]:
```
accuracy = logisticreg.score(xtest , ytest)
cm = metrics.confusion_matrix(ytest , y_pred)
print(cm)
```

```
[[56 51 17]
 [22 92  0]
 [11  0 38]]
```

Accuracy

[ ]:
```
print('accuracy score of the logistic regression model for AnuualIncomeClass is␣
  ↪:', accuracy*100,'%')
```

```
accuracy score of the logistic regression model for AnuualIncomeClass is :
64.80836236933798 %
```

[ ]:
```
x = df.drop(['FrequentFlyer'] , axis = 1)
y = df['FrequentFlyer']
xtrain , xtest , ytrain , ytest = train_test_split(x,y, test_size = 0.2 ,␣
 ↪random_state =42)
xtest.shape
logisticreg = LogisticRegression()
logisticreg.fit(xtrain , ytrain)
```

[ ]:
```
LogisticRegression()
```

[ ]:
```
y_pred = logisticreg.predict(xtest)
logisticsreg = LogisticRegression()
y_pred
```

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

[ ]:
```
accuracy = logisticreg.score(xtest , ytest)
cm = metrics.confusion_matrix(ytest , y_pred)
print(cm)
```

```
[[130   6]
 [ 27  28]]
```

[ ]:
```
print('accuracy score of the logistic regression model for AnuualIncomeClass is␣
 ↪:', accuracy*100,'%')
```

```
accuracy score of the logistic regression model for AnuualIncomeClass is :
82.72251308900523 %
```

Accuracy of model

[ ]:
```
logreg=accuracy_score(ytest,y_pred)
logreg
```

[ ]:
```
0.8272251308900523
```

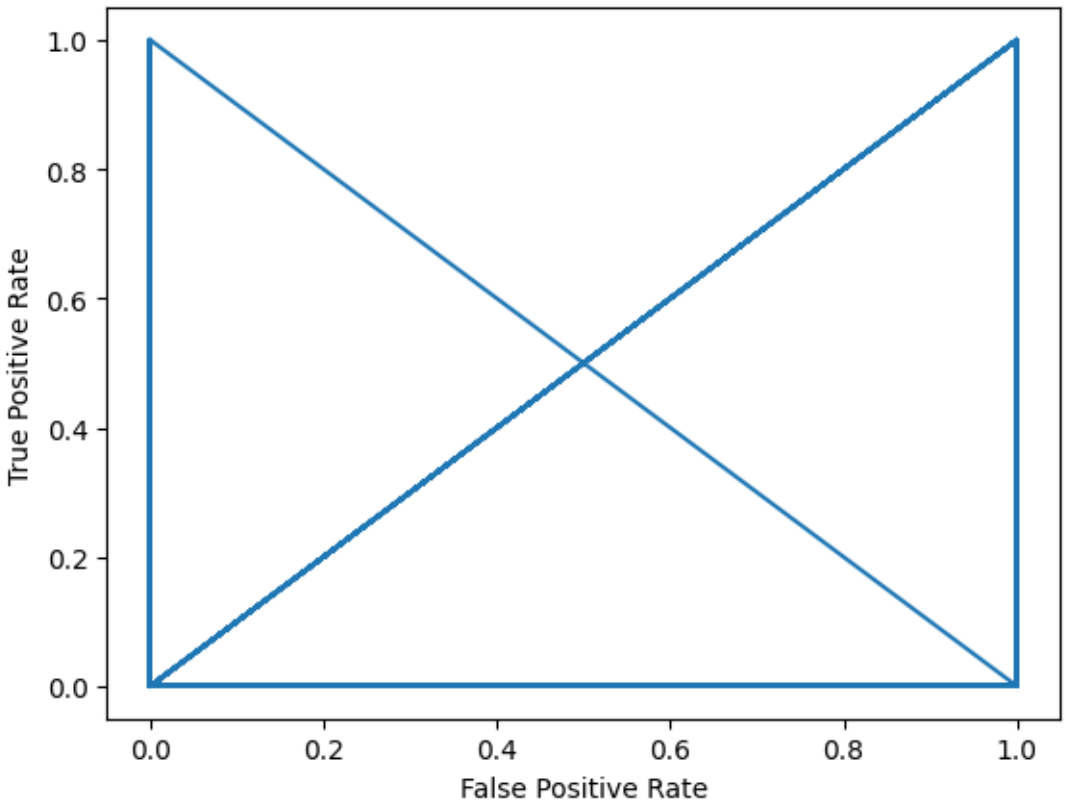
ROC AUC score

[ ]:
```
from sklearn.metrics import confusion_matrix, accuracy_score, roc_auc_score
roc_auc_score(ytest, y_pred)
```

[ ]: 0.7324866310160428

[ ]:
```
plt.plot(ytest, y_pred)
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
```

[ ]: Text(0, 0.5, 'True Positive Rate')



Classification report

[ ]:
```
print(metrics.classification_report(ytest, y_pred))
```

```
              precision    recall  f1-score   support

           0       0.83      0.96      0.89       136
           1       0.82      0.51      0.63        55

    accuracy                           0.83       191
   macro avg       0.83      0.73      0.76       191
weighted avg       0.83      0.83      0.81       191
```

ADVANTAGES of Logistic regression

Overfitting is verry less

Training time is less