In [23]:
```
import pandas as pd
import numpy as np
```

In [27]:
```
df=pd.read_csv("Social_Network_Ads.csv")
```

In [28]:
```
print(df)
```

```
      User ID  Gender  Age  EstimatedSalary  Purchased
0    15624510    Male   19            19000          0
1    15810944    Male   35            20000          0
2    15668575  Female   26            43000          0
3    15603246  Female   27            57000          0
4    15804002    Male   19            76000          0
..        ...     ...  ...              ...        ...
395  15691863  Female   46            41000          1
396  15706071    Male   51            23000          1
397  15654296  Female   50            20000          1
398  15755018    Male   36            33000          0
399  15594041  Female   49            36000          1

[400 rows x 5 columns]
```

In [29]:
```
df.describe()
```

Out[29]:

	User ID	Age	EstimatedSalary	Purchased
count	4.000000e+02	400.000000	400.000000	400.000000
mean	1.569154e+07	37.655000	69742.500000	0.357500
std	7.165832e+04	10.482877	34096.960282	0.479864
min	1.556669e+07	18.000000	15000.000000	0.000000
25%	1.562676e+07	29.750000	43000.000000	0.000000
50%	1.569434e+07	37.000000	70000.000000	0.000000
75%	1.575036e+07	46.000000	88000.000000	1.000000
max	1.581524e+07	60.000000	150000.000000	1.000000

In [30]:
```
df.shape
```

Out[30]:
```
(400, 5)
```

In [31]:
```
df.isnull().sum()
```

Out[31]:
```
User ID            0
Gender             0
Age                0
EstimatedSalary    0
Purchased          0
dtype: int64
```

In [32]:
```
df_x=df[['Age','EstimatedSalary']]
df_y=df['Purchased']
```

In [33]:
```
df_x
```

Out[33]:

	Age	EstimatedSalary
0	19	19000
1	35	20000
2	26	43000
3	27	57000
4	19	76000
...	...	...
395	46	41000
396	51	23000
397	50	20000
398	36	33000
399	49	36000

400 rows × 2 columns

In [34]:
```
df_y
```

Out[34]:
```
0      0
1      0
2      0
3      0
4      0
      ..
395    1
396    1
397    1
398    0
399    1
Name: Purchased, Length: 400, dtype: int64
```

In [35]:
```
df_x.values
```

Out[35]:
```
array([[    19,  19000],
       [    35,  20000],
       [    26,  43000],
       [    27,  57000],
       [    19,  76000],
       [    27,  58000],
       [    27,  84000],
       [    32, 150000],
       [    25,  33000],
       [    35,  65000],
       [    26,  80000],
       [    26,  52000],
       [    20,  86000],
       [    32,  18000],
       [    18,  82000],
       [    29,  80000],
       [    47,  25000],
       [    45,  26000],
       [    46,  28000],
       [    48,  29000],
       [    45,  22000],
       [    47,  49000],
       [    48,  41000],
       [    45,  22000],
       [    46,  23000],
       [    47,  20000],
       [    49,  28000],
       [    47,  30000],
       [    29,  43000],
       [    31,  18000],
       [    31,  74000],
       [    27, 137000],
       [    21,  16000],
       [    28,  44000],
       [    27,  90000],
       [    35,  27000],
       [    33,  28000],
       [    30,  49000],
       [    26,  72000],
       [    27,  31000],
       [    27,  17000],
       [    33,  51000],
       [    35, 108000],
       [    30,  15000],
       [    28,  84000],
       [    23,  20000],
       [    25,  79000],
       [    27,  54000],
       [    30, 135000],
       [    31,  89000],
       [    24,  32000],
       [    18,  44000],
       [    29,  83000],
       [    35,  23000],
       [    27,  58000],
       [    24,  55000],
       [    23,  48000],
       [    28,  79000],
       [    22,  18000],
       [    32, 117000],
```

```
[    27,  20000],
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[    23,  66000],
[    32, 120000],
[    59,  83000],
[    24,  58000],
[    24,  19000],
[    23,  82000],
[    22,  63000],
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[    25,  80000],
[    24,  27000],
[    20,  23000],
[    33, 113000],
[    32,  18000],
[    34, 112000],
[    18,  52000],
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[    26,  17000],
[    30,  80000],
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[    20,  49000],
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[    24,  55000],
[    28,  85000],
[    26,  81000],
[    35,  50000],
[    22,  81000],
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[    28,  37000],
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[    36,  52000],
[    40,  59000],
[    41,  59000],
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[    45,  45000],
[    60,  42000],
[    39,  59000],
[    46,  41000],
[    51,  23000],
[    50,  20000],
[    36,  33000],
[    49,  36000]], dtype=int64)
```

In [36]:
```
df_y.values
```

Out[36]:
```
array([0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 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, 1, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 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, 1, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 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, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 1,
       0, 1, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 0, 0, 0, 1, 1, 0,
       1, 1, 0, 1, 0, 1, 0, 1, 0, 0, 1, 1, 0, 1, 0, 0, 1, 1, 0, 1, 1, 0,
       1, 1, 0, 0, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 0, 1,
       0, 1, 0, 1, 1, 1, 1, 0, 0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 0, 0, 0, 1,
       1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 1, 0, 0, 0, 1, 1,
       0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 0, 1, 0,
       1, 0, 1, 1, 1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1,
       0, 1, 0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1,
       1, 1, 0, 1], dtype=int64)
```

In [37]:
```
x_train,x_test,y_train,y_test=train_test_split(df_x, df_y, test_size= 0.33, random_sta
```

In [38]:
```
from sklearn.preprocessing import StandardScaler
```

In [39]:
```
scaler=StandardScaler()
```

In [40]:
```
scaler.fit(x_train)
```

Out[40]:
```
▾ StandardScaler
StandardScaler()
```

In [41]:
```
x_train=scaler.transform(x_train)
```

In [42]:
```
x_test=scaler.transform(x_test)
```

In [77]:
```
reg=linear_model.LogisticRegression()
```

In [78]:
```
reg.fit(x_train,y_train)
```

Out[78]:
```
▾ LogisticRegression
LogisticRegression()
```

In [79]:
```
y_pred = reg.predict(x_test)
print(y_pred)
```

```
[0 1 0 1 0 0 1 0 0 0 0 1 0 0 0 0 1 1 0 1 0 0 0 1 0 0 0 0 1 0 0 0 1 0 1 0 0
 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 1 0 0 0 1 1 0 0 1 0 0 0
 0 0 1 1 0 0 0 0 1 0 1 0 0 1 0 0 1 0 0 0 0 0 1 0 1 0 1 0 0 0 0 1 0 0 1 0 0
 0 1 0 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0]
```

In [80]:
```
a_pred=reg.predict([[20,300000]])
```

In [81]:
```
print(a_pred)
```

```
[1]
```

In [82]:
```
print( np.mean((y_pred - y_test)**2 ))
```

```
0.1590909090909091
```

In [83]:
```
from sklearn.metrics import mean_squared_error
print( mean_squared_error(y_test, y_pred))
```

```
0.1590909090909091
```

In [84]:
```
from sklearn import metrics
mse = metrics.mean_squared_error(y_test,y_pred)
mae = metrics.mean_absolute_error(y_test,y_pred)
rmse = np.sqrt(metrics.mean_squared_error(y_test,y_pred))
print(f'Mean Squared Error: {mse}',f'Mean Absolute Error: {mae}',f'Root Mean Squared E
```

```
Mean Squared Error: 0.1590909090909091
Mean Absolute Error: 0.1590909090909091
Root Mean Squared Error: 0.3988620176087328
```

In [85]:
```
print(reg.coef_)
```

```
[[1.83257149 1.0898586 ]]
```

In [86]:
```
from sklearn.metrics import confusion_matrix, f1_score,precision_score,recall_score,ac
cm = metrics.confusion_matrix(y_test,y_pred)
cm
tn, fp, fn, tp = cm.ravel()
(tn, fp, fn, tp)
```

Out[86]:
```
(79, 1, 20, 32)
```

In [87]:
```
cm_df = pd.DataFrame(cm,
            columns = ['Predicted Negative', 'Predicted Positive'],
            index = ['Actual Negative', 'Actual Positive'])
# Showing the confusion matrix
cm_df
```

Out[87]:

	Predicted Negative	Predicted Positive
Actual Negative	79	1
Actual Positive	20	32

In [90]:
```
p=metrics.precision_score(y_test, y_pred)
r=metrics.recall_score(y_test, y_pred)
a=metrics.accuracy_score(y_test, y_pred)
f1=metrics.f1_score(y_test, y_pred)
print("precision_score:",p)
print("recall_score:",r)
print("accuracy_score:",a)
print("f1_score:",f1)
metrics.roc_curve(y_)
```

```
precision_score: 0.9696969696969697
recall_score: 0.6153846153846154
accuracy_score: 0.8409090909090909
f1_score: 0.7529411764705882
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
Cell In[90], line 9
      7 print("accuracy_score:",a)
      8 print("f1_score:",f1)
----> 9 metrics.RocCurveDisplay(a_pred,x_test,y_test)

TypeError: RocCurveDisplay.__init__() takes 1 positional argument but 4 were given
```

In [91]:
```
print(y_test)
```

```
209    0
280    1
33     0
210    1
93     0
      ..
332    0
167    0
245    1
311    1
145    0
Name: Purchased, Length: 132, dtype: int64
```

In [92]:
```
p=metrics.precision_score(y_test, y_pred)
r=metrics.recall_score(y_test, y_pred)
a=metrics.accuracy_score(y_test, y_pred)
f1=metrics.f1_score(y_test, y_pred)
print("precision_score:",p)
print("recall_score:",r)
print("accuracy_score:",a)
print("f1_score:",f1)
metrics.roc_curve(y_pred,y_test)
```

```
precision_score: 0.9696969696969697
recall_score: 0.6153846153846154
accuracy_score: 0.8409090909090909
f1_score: 0.7529411764705882
```

Out[92]:
```
(array([0.       , 0.2020202, 1.       ]),
 array([0.        , 0.96969697, 1.        ]),
 array([inf,  1.,  0.]))
```

In [93]:
```
fpr,tpr,th=metrics.roc_curve(y_pred,y_test)
```

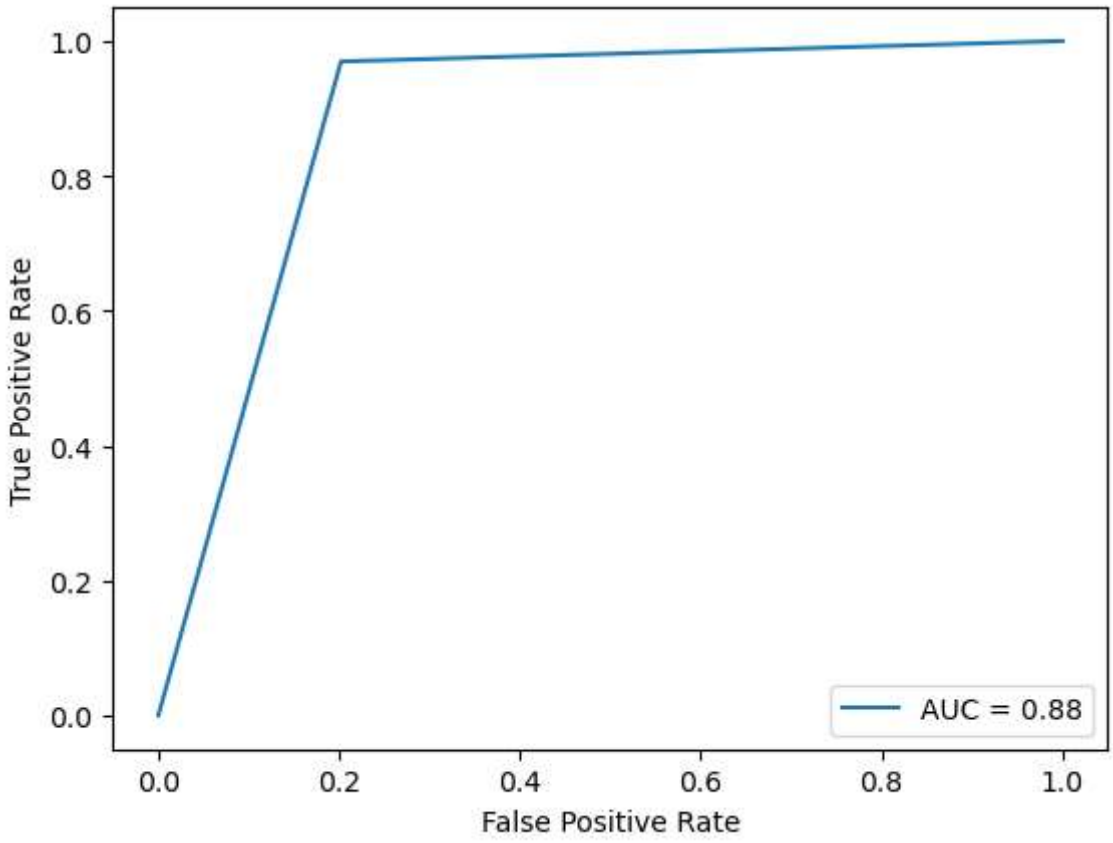
In [96]:
```
import matplotlib.pyplot as plt
```

In [97]:
```
roc_auc=metrics.auc(fpr,tpr)
```

In [98]:
```
display=metrics.RocCurveDisplay(fpr=fpr,tpr=tpr,roc_auc=roc_auc)
```

In [100…
```
display.plot()
```

Out[100]:
```
<sklearn.metrics._plot.roc_curve.RocCurveDisplay at 0x18b068d4410>
```


True Positive Rate
False Positive Rate
AUC = 0.88
0.0
0.2
0.4
0.6
0.8
1.0

In [ ]: