Compute performance metrics for the given Y and Y_score without sklearn

A. Compute performance metrics for the given data '5_a.csv'

Note 1: in this data you can see number of positive points >> number of negatives points
Note 2: use pandas or numpy to read the data from **5_a.csv**
Note 3: you need to derive the class labels from given score

y^{pred}
$= [0 \text{ if y\_score} < 0.5 \text{ else } 1]$

1. Compute Confusion Matrix
2. Compute F1 Score
3. Compute AUC Score, you need to compute different thresholds and for each threshold compute tpr, fpr and then use numpy.trapz(tpr_array, fpr_array)
   Note- Make sure that you arrange your probability scores in descending order while calculating AUC
4. Compute Accuracy Score

In [21]:

```
import numpy as np
import pandas as pd
```

In [22]:

```
df = pd.read_csv(r'C:\Users\NADEEM\Downloads\5_a.csv')
```

In [23]:

```
df.shape
```

Out[23]:

```
(10100, 2)
```

In [24]:

```
df.head()
```

Out[24]:

	y	proba
0	**1.0**	**0.637387**
1	**1.0**	**0.635165**
2	**1.0**	**0.766586**
3	**1.0**	**0.724564**
4	**1.0**	**0.889199**

In [25]:

```
t_hold = 0.5
df['y_pred'] = (df.proba >= 0.5).astype('int')
df.head()
```

Out[25]:

	y	proba	y_pred

	y	proba	y_pred
0	1.0	0.637387	1
1	1.0	0.635165	1
2	1.0	0.766586	1
3	1.0	0.724564	1
4	1.0	0.889199	1

Computing Confusion Matrix, F1 Score, Accuracy Score

In [26]:

```
def comp_TP_TN_FP_FN(y,y_pred):
    '''
    True Positive(TP): [actual,prediction]=[1,1]
    True Negetive(TN): [actual,prediction]=[0,0]
    False Positive(FP): [actual,prediction]=[0,1]
    False Negetive(FN): [actual,prediction]=[1,0]
    '''
    TP = sum((y == 1) &(y_pred==1))
    TN = sum((y == 0) &(y_pred==0))
    FP = sum((y == 0) &(y_pred==1))
    FN = sum((y == 1) &(y_pred==0))
    return TP, TN, FP, FN

def acc_score(TP, TN, FP, FN):
    '''
    ACCURACY = TP+TN/TP+TN+FP+FN
    '''
    return ((TP+TN)*100)/float(TP+TN+FP+FN)

def comp_precision(TP, FP):
    '''
    PRECISION : TP/TP+FP
    '''
    return TP/(TP+FP)

def comp_recall(TP, FN):
    '''
    RECALL: TP/TP+FN
    '''
    return TP/(TP+FN)

def f_score(y, y_pred):
    '''
    F1_Score : (2*Pr*Re)/(Pr+Re)
    '''
    TP, TN, FP, FN = comp_TP_TN_FP_FN(y,y_pred)
    Precision = comp_precision(TP, FP)
    Recall = comp_recall(TP, FN)
    F1_score = (2*Precision*Recall)/(Precision+Recall)
    return F1_score
```

In [27]:

```
TP_C, TN_C, FP_C, FN_C = comp_TP_TN_FP_FN(df.y, df.y_pred)
print('TP: ',TP_C)
print('TN: ',TN_C)
print('FP: ',FP_C)
print('FN: ',FN_C)
```

```
TP:  10000
TN:  0
FP:  100
FN:  0
```

In [28]:

```
print('Accuracy Score: ',acc_score(TP_C, TN_C, FP_C, FN_C))
```

```
Accuracy Score:  99.00990099009901
```

In [29]:

```
print('Precision: ',comp_precision(TP_C, FP_C))
```

```
Precision:  0.9900990099009901
```

In [30]:

```
print("Recall: ",comp_recall(TP_C, FN_C))
```

```
print('Recall: ',comp_recall(TP_C, FN_C))
```

```
Recall:  1.0
```

In [31]:

```
Pr = comp_precision(TP_C, FP_C)
Re = comp_recall(TP_C, FN_C)
```

In [32]:

```
print('F1_Score: ',f_score(df.y, df.y_pred))
```

```
F1_Score:  0.9950248756218906
```

In [33]:

```
def get_single_tpr_fpr(df):

    tp = ((df['y'] == 1.0 ) & (df['y_predicted'] == 1)).sum()
    fp = ((df['y'] == 0.0 ) & (df['y_predicted'] == 1)).sum()
    tn = ((df['y'] == 0.0 ) & (df['y_predicted'] == 0)).sum()
    fn = ((df['y'] == 1.0 ) & (df['y_predicted'] == 0)).sum()

    tpr = tp / (tp + fn )
    fpr = fp / (fp + tn)

    return [tpr, fpr]


# While computing AUC score we need to calculate "TP,"FP" at every threshold by using actual "y" and predi
cted "y_pred".

def calculate_all_thresholds_tpr_fpr_arr(df_original):

    tpr_arr_for_all_thresholds = []
    fpr_arr_for_all_thresholds = []

    sorted_df = df_original.sort_values(by=['proba'], ascending=False)

    unique_prob_thres = sorted_df['proba'].unique()

    for threshold in tqdm(unique_prob_thres):
        sorted_df['y_predicted'] = np.where(sorted_df['proba'] >= threshold, 1, 0)
        tpr_fpr_arr = get_single_tpr_fpr(sorted_df)
        tpr_arr_for_all_thresholds.append(tpr_fpr_arr[0])
        fpr_arr_for_all_thresholds.append(tpr_fpr_arr[1])

    return tpr_arr_for_all_thresholds, fpr_arr_for_all_thresholds
```

In [34]:

```
from tqdm import tqdm
all_tpr_together_5a, all_fpr_together_5a = calculate_all_thresholds_tpr_fpr_arr(df)
auc_score_5a = np.trapz(all_tpr_together_5a, all_fpr_together_5a)
print('My Custom function ROC-AUC Score for 5_a.csv: ', auc_score_5a)
print(1-auc_score_5a)
```

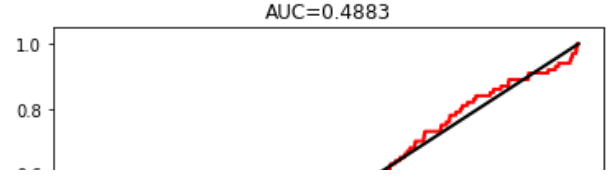
```
100%|██████████████████████████████████████████████████████████████████████████| 10100/10100 [01:10<00:00
, 142.69it/s]

My Custom function ROC-AUC Score for 5_a.csv:  0.48829900000000004
0.511701
```

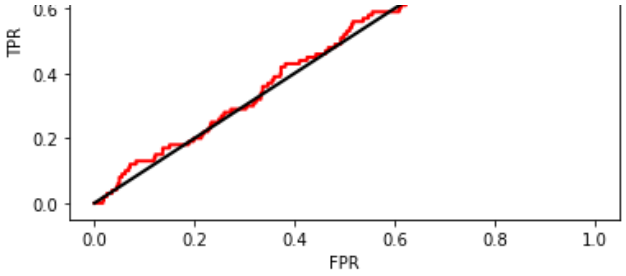
In [36]:

```
import matplotlib.pyplot as plt
plt.plot(all_tpr_together_5a, all_fpr_together_5a, 'r', lw=2)
plt.plot([0, 1], [0, 1], 'k-', lw=2)
plt.xlabel('FPR')
plt.ylabel('TPR')
plt.title('AUC={}'.format(round(auc_score_5a, 4)))
```

Out[36]:

```
Text(0.5,1,'AUC=0.4883')
```





B. Compute performance metrics for the given data '5_b.csv'

Note 1: in this data you can see number of positive points << number of negatives points
Note 2: use pandas or numpy to read the data from **5_b.csv**
Note 3: you need to derive the class labels from given score

y^{pred}
$= [0 \text{ if y\_score} < 0.5 \text{ else } 1]$

1. Compute Confusion Matrix
2. Compute F1 Score
3. Compute AUC Score, you need to compute different thresholds and for each threshold compute tpr, fpr and then use numpy.trapz(tpr_array, fpr_array)
   Note- Make sure that you arrange your probability scores in descending order while calculating AUC
4. Compute Accuracy Score

In [14]:
```
df_B = pd.read_csv(r'C:\Users\NADEEM\Music\Applied course\Module Notes\5_b.csv')
```

In [15]:
```
df_B.head()
```

Out[15]:

	y	proba
0	**0.0**	**0.281035**
1	**0.0**	**0.465152**
2	**0.0**	**0.352793**
3	**0.0**	**0.157818**
4	**0.0**	**0.276648**

In [16]:
```
t_hold = 0.5
df_B['y_pred_B'] = (df_B.proba >= 0.5).astype('int')
df_B.head()
```

Out[16]:

	y	proba	y_pred_B
0	**0.0**	**0.281035**	**0**
1	**0.0**	**0.465152**	**0**
2	**0.0**	**0.352793**	**0**
3	**0.0**	**0.157818**	**0**
4	**0.0**	**0.276648**	**0**

Computing Confusion Matrix, F1 Score, Accuracy Score

In [19]:

```
TP_C, TN_C, FP_C, FN_C = comp_TP_TN_FP_FN(df_B.y, df_B.y_pred_B)
print('TP: ',TP_C)
print('TN: ',TN_C)
print('FP: ',FP_C)
print('FN: ',FN_C)

print('Accuracy Score: ',acc_score(TP_C, TN_C, FP_C, FN_C))

print('Precision: ',comp_precision(TP_C, FP_C))

print("Recall: ",comp_recall(TP_C, FN_C))

print('F1_Score: ',f_score(df_B.y,df_B.y_pred_B))
```

```
TP:  55
TN:  9761
FP:  239
FN:  45
Accuracy Score:  97.18811881188118
Precision:  0.1870748299319728
Recall:  0.55
F1_Score:  0.2791878172588833
```

In [38]:

```
def get_single_tpr_fpr(df_B):

    tp = ((df_B['y'] == 1.0 ) & (df_B['y_pred_B'] == 1)).sum()
    fp = ((df_B['y'] == 0.0 ) & (df_B['y_pred_B'] == 1)).sum()
    tn = ((df_B['y'] == 0.0 ) & (df_B['y_pred_B'] == 0)).sum()
    fn = ((df_B['y'] == 1.0 ) & (df_B['y_pred_B'] == 0)).sum()

    tpr = tp / (tp + fn )
    fpr = fp / (fp + tn)

    return [tpr, fpr]


# While computing AUC score you need to calculate "TP,"FP" at every threshold by using actual "y" and pred
icted "y_pred".

def calculate_all_thresholds_tpr_fpr_arr(df_B_original):

    tpr_arr_for_all_thresholds = []
    fpr_arr_for_all_thresholds = []

    sorted_df_B = df_B_original.sort_values(by=['proba'], ascending=False)

    unique_prob_thres = sorted_df_B['proba'].unique()

    for threshold in tqdm(unique_prob_thres):
        sorted_df_B['y_pred_B'] = np.where(sorted_df_B['proba'] >= threshold, 1, 0)
        tpr_fpr_arr = get_single_tpr_fpr(sorted_df_B)
        tpr_arr_for_all_thresholds.append(tpr_fpr_arr[0])
        fpr_arr_for_all_thresholds.append(tpr_fpr_arr[1])

    return tpr_arr_for_all_thresholds, fpr_arr_for_all_thresholds
```

In [39]:

```
from tqdm import tqdm
all_tpr_together_5b, all_fpr_together_5b = calculate_all_thresholds_tpr_fpr_arr(df_B)
auc_score_5b = np.trapz(all_tpr_together_5b, all_fpr_together_5b)
print('My Custom function ROC-AUC Score for 5b.csv: ', auc_score_5b)
```

```
100%|██████████| 10100/10100 [01:10<00:00
, 143.61it/s]
```

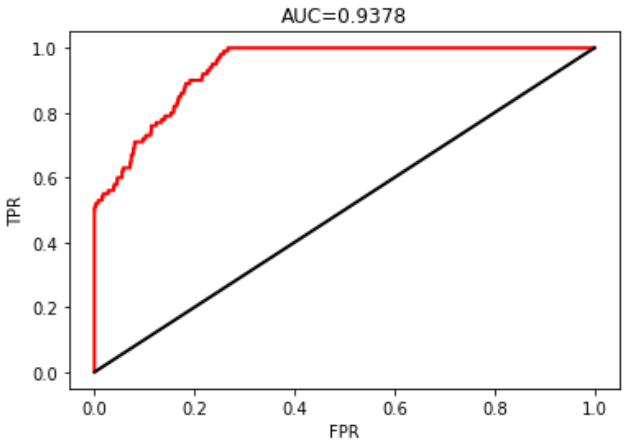
```
My Custom function ROC-AUC Score for 5b.csv:  0.9377570000000001
```

In [41]:

```
import matplotlib.pyplot as plt
plt.plot(all_fpr_together_5b, all_tpr_together_5b, 'r', lw=2)
plt.plot([0, 1], [0, 1], 'k-', lw=2)
plt.xlabel('FPR')
plt.ylabel('TPR')
plt.title('AUC={}'.format(round(auc_score_5b, 4)))
```

Out[41]:

```
Text(0.5,1,'AUC=0.9378')
```



C. Compute the best threshold (similarly to ROC curve computation) of probability which gives lowest values of metric A for the given data

you will be predicting label of a data points like this: y^{pred}

$$= [0 \text{ if y\_score} < \text{threshold else } 1]$$

$A = 500$
$\times$ number of false negative $+ 100 \times$ numebr of false positive

Note 1: in this data you can see number of negative points > number of positive points
Note 2: use pandas or numpy to read the data from **5_c.csv**

In [37]:

```
df_C = pd.read_csv(r"C:\Users\NADEEM\Music\Applied course\Module Notes\5_c.csv")
```

In [38]:

```
print(df_C.shape)
df_C.head()
```

```
(2852, 2)
```

Out[38]:

	y	prob
0	0	0.458521
1	0	0.505037
2	0	0.418652
3	0	0.412057
4	0	0.375579

In [39]:

```
actual_y_train= df_C.iloc[:, 0].values
print('actual_y_train ', actual_y_train)

y_prob_C = df_C.iloc[:, 1].values
print('y_prob_C ', y_prob_C)

unique_prob_thres_C = np.unique(df_C['prob'])
```

```
actual_y_train  [0 0 0 ... 1 1 1]
y_prob_C  [0.45852068 0.50503693 0.41865174 ... 0.65916054 0.45626546 0.65916054]
```

In [40]:

```
def get_A_metric(y_actual, y_probabilities, threshold):
    tp = 0
    fp = 0
    tn = 0
```

```
    fn = 0

    min_a = float('inf')

    for i in range(len(y_probabilities)):
        if y_probabilities[i] >= threshold :
            if y_actual[i] == 1:
                tp += 1
            else:
                fp += 1

        if y_probabilities[i] < threshold:
            if y_actual[i] == 0:
                tn += 1
            else:
                fn += 1

    A = (500 * fn) + (100 * fp)

    return A
```

In [41]:

```
def get_minimized_a(y_actual, y_probabilities, total_threshold ):
  min_a = float('inf')
  min_t = 0

  for threshold in total_threshold:
    a = get_A_metric(y_actual, y_probabilities, threshold)
    if a <= min_a:
        min_a = min(a, min_a)
        min_t = threshold

  return min_a, min_t
```

In [43]:

```
print(get_minimized_a(actual_y_train, y_prob_C, unique_prob_thres_C ))
```

```
(141000, 0.2300390278970873)
```

D. Compute performance metrics(for regression) for the given data 5_d.csv

Note 2: use pandas or numpy to read the data from **5_d.csv**
Note 1: **5_d.csv** will having two columns Y and predicted_Y both are real valued features

1. Compute Mean Square Error
2. Compute MAPE
3. Compute R^2 error

In [103]:

```
df_D = pd.read_csv(r"C:\Users\NADEEM\Music\Applied course\Module Notes\5_d.csv")
```

In [104]:

```
df_D.head()
```

Out[104]:

	y	pred
0	101.0	100.0
1	120.0	100.0
2	131.0	113.0
3	164.0	125.0
4	154.0	152.0

In [109]:

```
actual_value= df_D.iloc[:, 0].values
print('Actual Value: ', actual_value)

model_output = df_D.iloc[:, 1].values
print('Model Output: ', model_output)
```

```
Actual Value:  [101. 120. 131. ... 106. 105.  81.]
Model Output:  [100. 100. 113. ...  93. 101. 104.]
```

Calculation of Mean Squared Error (MSE)

In [110]:

```
def calc_MSE(y,pred):
    MSE = np.mean((y-pred)**2)
    return MSE
print(calc_MSE(actual_value,model_output))
```

```
177.16569974554707
```

Calculation of Mean Absolute Percentage Error (MAPE)

In [113]:

```
def calc_MAPE(y,pred):
    MAPE = np.mean(np.abs(y-pred)/np.mean(y))*100
    return MAPE
print(calc_MAPE(actual_value,model_output))
```

```
12.912029940096867
```

Calculation of R2_Error

In [114]:

```
def calc_R2_error(y,pred):
    actual_value_mean = y.mean()
    SS_res = ((actual_value - model_output)**2).sum()
    SS_tot = ((actual_value - actual_value_mean)**2).sum()
    R2_error = 1-(SS_res/SS_tot)
    return R2_error

print(calc_R2_error(actual_value,model_output))
```

```
0.9563582786990937
```