Problem statement: The main aim of this project is to apply Machine learning in the field of business. I considered **the bank-additional-full.csv** file as the data collected from the past year and the bank-additional.csv as the present year's file. I used the **bank-additional-full.csv** file for training purpose and the **bank-additional.csv** file for test purpose. In this project, I showed what is the profit of calling selective potential customers instead of calling all the customers.

Data description and model selection: There are 20 input features and 1 output feature. This is a classification problem statement with 2 possible outputs i.e., either yes or no. Based on my observation on the data I noticed that the data is **Biased** i.e., there are too many 'no' outputs compared to 'yes' outputs. The total number of 'yes' in training data is around 4000 and the total number of 'no' in the training set is around 38000. These figures tell that the data is biased towards 'no'.

Because of this biased data, I chose the **Decision tree classifier**. The read in a publication that the Decision tree classifier is much better for training and testing in biased data.

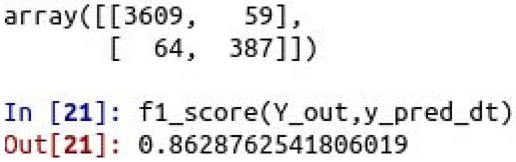
Performance:

F1 score is the best measure for performance when we have biased data.

F1 score=(2*precision*recall)/(precision+recall)

The F1-score for my model is 86.8%.

The confusion matrix and F1 score for my model are attached below.



```
array([[3609,   59],
       [  64,  387]])

In [21]: f1_score(Y_out,y_pred_dt)
Out[21]: 0.8628762541806019
```

In testing data
Total cutomers=4120

Total yes's=451

Total no's= 3668

If we consider a cost of 10 units per call and 100 units if the customer says 'yes' then if we call all the people for the test data then the

We earn a total of 45100 units but we spent a total of 41200 units

So we lose a total of 36680 units. (useless calls)

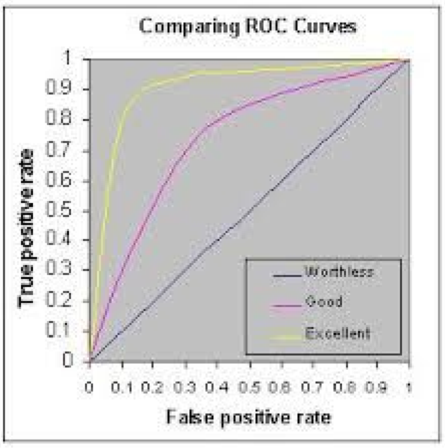
But if you make calls based on my model you will earn a total of

38700 units but you spent a total of 4460 units so the loss is only 590 units(useless calls).

So the profit percentage if you call all the customers is 9.4%. [(45100-41200)/41200]

But the profit percentage for my model is 767%. [(38700-4460)/4460)

This problem can be explained better with the help of the ROC Curve. Consider the following curve



The curve which is in Yellow color is called perfect model, there is no error in these models. The curve which is in Blue color is called average model. If we can find the area under these curves we find that the area under the perfect model is far greater than the area under the average model. So when we are trying to predict the results of a model please try to make its curve look similar to the perfect model. The more the area of the curve for your model the better will be the model.

This problem doesn't have much scope to explain more about it analytically.
Thank you
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