**We list every calculation in every step below.**

**Step 2:**

To consider LEAVE to be the Negative Class and STAY to be the Positive class, we could label the table that I output in R code in such a following form:

stay.pred

stay.actual LEAVE STAY

LEAVE TN FP

STAY FN TP

To calculate FNR, FPR and Accuracy, we write several functions in R:

R script codes:

> #Treating LEAVE as Negative and STAY as positive

> # now make a function for computing the accuracy

> accuracy = function(cm){ # input confusion matrix

+ return(sum(diag(cm))/sum(cm)) # accuracy

+ }

> # now make a function for computing FPR

> FPR = function(cm){ # input confusion matrix

+ return((cm[1,2])/(cm[1,2]+cm[1,1])) #FPR

+ }

> # now make a function for computing FNR

> FNR = function(cm){# input confusion matrix

+ return((cm[2,1])/(cm[2,1]+cm[2,2])) # FNR

+ }

We also use these functions to calculate FNR, FPR and Accuracy in step 3 and step 4.

**Step 3:** we use the following R code to find the CP which provides the lowest error:

lowestcp=fit.large$cptable[which.min(fit.large$cptable[,"xerror"]),"CP"]

**Step 4:** we use ROCR to find the best threshold at cut= 0.4359949, given cost.fn=490000\*400, cost.fp=510000\*600\*0.5.

**Step 5**: Here is our idea to calculate expected value: the goal of our prediction model is to predict whether the customers leave or stay next year. So we only consider the influence of TN and FN.

For those customers who must stay in next year, we could get

For those customers who plan to leave in next year, we construct a prediction model to predict whether a customer will leave or stay and use the prediction model to offer the discount only to the customers who are predicted to leave. Offered the discount, a customer who was likely to leave will now stay with a 0.50 probability.

Add profit1 and profit2 together, we could get

Since and , we could get Expected value in the required form:

where v = , a = and b=.

**The result table:**

FPR FNR Accuracy Expected Value

BigTree 0.4052 0.3561 0.6194 450533759

Pruned Tree 0.2771 0.3456 0.6886 459122172

Best Threshold Pruned tree 0.9459 0.0123 0.5213 490348201

Also, for strategy a: the expected value = 490000\*1000 = 490.0 million

For strategy b: the expected value = (490000+510000\*0.5)\*1000-400\*1000000 = 345.0 million