Math 5365

Data Mining 1

Homework 10

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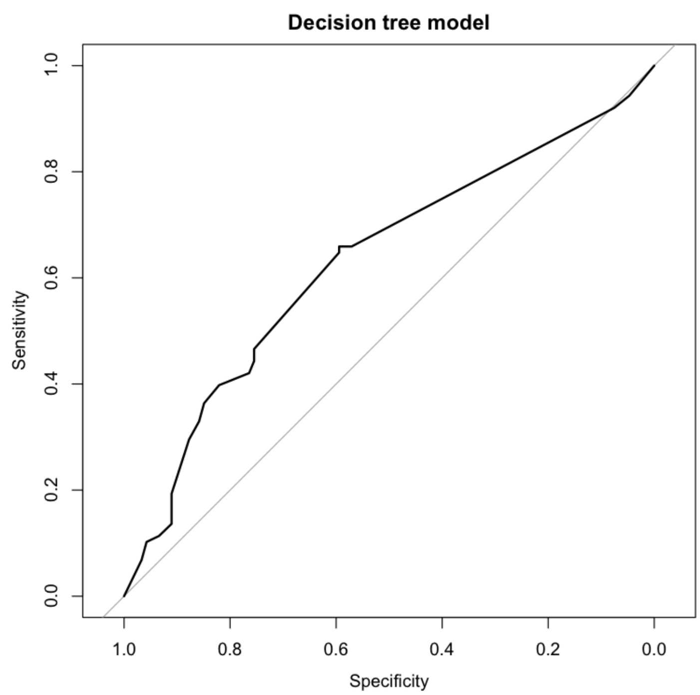
1. Split germancredit.csv into 70% training and 30% test data. Create models for predicting default using the following learning algorithms, and find the area under the ROC curve for each model.

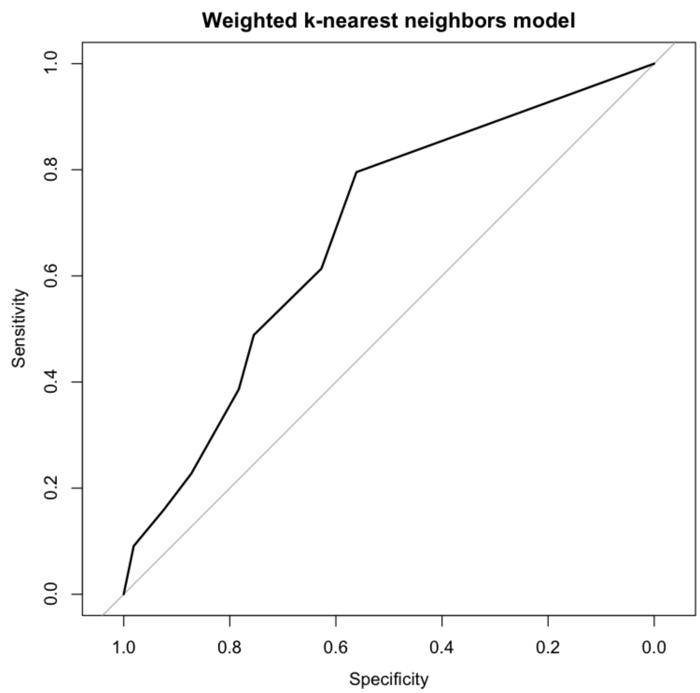
   (a) Decision tree

   The area under the curve for decision tree is 0.6309.



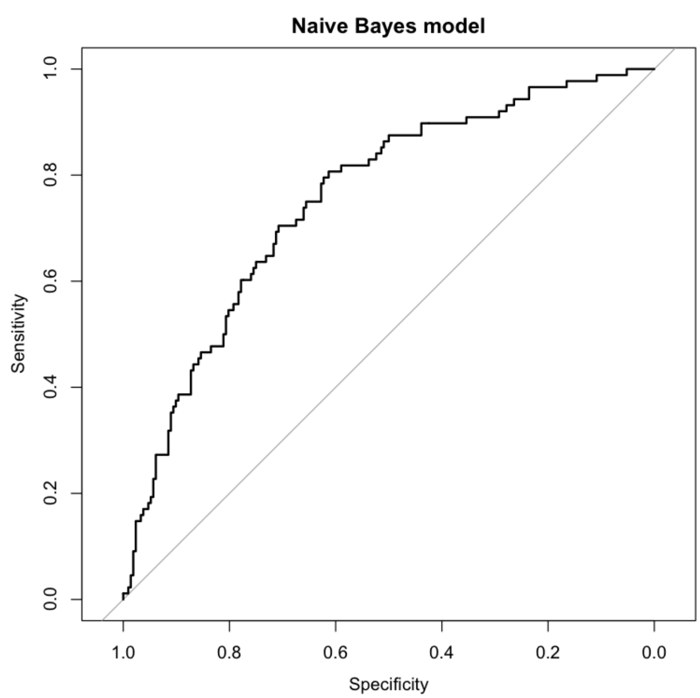
   (b) Weighted k-nearest neighbors

   The area under the curve for weighted k nearest neighbors with k = 3 is 0.6785



(c) Naive Bayes

The area under the curve for Naive Bayes is 0.7535.



By visual inspection and an evaluation of the area under each curve, the `naiveBayes` model gives the best results.

2. Consider the following cost structure

   - Predicting someone will default when they don't: \$5,000 in lost interest payments.
   - Predicting someone will not default when they do: \$20,000 in lost principle investement.

   (a) Given this cost structure, what is the optimal value for the probability threshold p0?

   The optimal value for p0 is 0.2

   (b) Calculate the total cost for each of the models in problem 1 on the test data using the optimal threshold.

Model	Cost
Decision Tree	1030000
Weighted knn	1075000
Naive Bayes	860000

   The cost is minimized using `naiveBayes`.

   (c) Calculate the total cost for each of the models in problem 1 on the test data using a threshold of 0.5.

Model	Cost
Decision Tree	1250000
Weighted knn	1310000
Naive Bayes	1120000

   The cost using $p_0 = 0.2$ is much better in each case than using the default $p_0 = 0.5$. Also, the lowest cost in each case is still `naiveBayes` which had the greatest area under the curve.

```
# Data Mining hw 10
library(e1071)
library(rpart)
library(kknn)
library(pROC)

gcred <- read.table('~/Dropbox/Tarleton/data_mining/dfiles/germancredit.csv',
                    header = T, sep = ',')

gcred$Default <- as.factor(gcred$Default)

# 1 Split germancredit.csv into 70% training and 30% test data.
#   Create models for predicting default using the following learning
#   algorithms, and find the area under the ROC curve for each model.

splitset <- splitdata(gcred, 0.7, F)

train <- splitset$train

# a. Decision tree
mytree <- rpart(Default~., gcred[train,])
treep <- predict(mytree, gcred[-train,])[,2]
gcredroc <- roc(gcred$Default[-train] == 1,treep)
plot(gcredroc, main='Decision tree model')

# b. Weighted k-nearest neighbors
gkknn <- kknn(Default~., gcred[train,], gcred[-train,], k = 3)
```

```
gkknnp <- gkknn$prob[,2]
gkknnroc <- roc(gcred$Default[-train] == 1, gkknnp)
plot(gkknnroc, main='Weighted k-nearest neighbors model')

# c. Naive Bayes

nb <- naiveBayes(Default~., gcred[train,])
nbp=predict(nb,gcred[-train,],type='raw')[,2]
gcredroc <- roc(gcred$Default[-train] == 1,nbp)
plot(gcredroc, main='Naive Bayes model')



# 2 Consider the following cost structure
#   Predicting someone will default when they don't: $5,000 in lost
#       interest payments.
#   Predicting someone will not default when they do: $20,000 in lost
#       principle investement.

Cpn = 20000
Cnp = 5000
Cpp = 0
Cnn = 0

# a. Given this cost structure, what is the optimal value for the
#    probability threshold p0?

p0 = (Cnp - Cnn) / (Cnp + Cpn - (Cnn + Cpp))
```

```
# b. Calculate the total cost for each of the models in problem 1 on
#    the test data using the optimal threshold.

predictedvaldt <- treep
predictedvaldt[treep >= p0] = 1
predictedvaldt[treep < p0] = 0
mat <- confmatrix(gcred$Default[-train],predictedvaldt)$matrix
costdt <- Cpp * mat[1, 1] + Cnn * mat[2, 2] +
          Cpn * mat[2, 1] + Cnp * mat[1, 2]
costdt

predictedvalkn <- gkknnp
predictedvalkn[gkknnp >= p0] = 1
predictedvalkn[gkknnp < p0] = 0
mat <- confmatrix(gcred$Default[-train],predictedvalkn)$matrix
costkn <- Cpp * mat[1, 1] + Cnn * mat[2, 2] +
          Cpn * mat[2, 1] + Cnp * mat[1, 2]
costkn


predictedvalnb <- nbp
predictedvalnb[nbp >= p0] = 1
predictedvalnb[nbp < p0] = 0
mat <- confmatrix(gcred$Default[-train],predictedvalnb)$matrix
costnb <- Cpp * mat[1, 1] + Cnn * mat[2, 2] +
```

```
          Cpn * mat[2, 1] + Cnp * mat[1, 2]
costnb

# c. Calculate the total cost for each of the models in problem 1
#    on the test data using a threshold of 0.5

p0 = 0.5

predictedvaldt <- treep
predictedvaldt[treep >= p0] = 1
predictedvaldt[treep < p0] = 0
mat <- confmatrix(gcred$Default[-train],predictedvaldt)$matrix
costdt <- Cpp * mat[1, 1] + Cnn * mat[2, 2] +
          Cpn * mat[2, 1] + Cnp * mat[1, 2]
costdt

predictedvalkn <- gkknnp
predictedvalkn[gkknnp >= p0] = 1
predictedvalkn[gkknnp < p0] = 0
mat <- confmatrix(gcred$Default[-train],predictedvalkn)$matrix
costkn <- Cpp * mat[1, 1] + Cnn * mat[2, 2] +
          Cpn * mat[2, 1] + Cnp * mat[1, 2]
costkn



predictedvalnb <- phat
predictedvalnb[phat >= p0] = 1
```

```
predictedvalnb[phat < p0] = 0
mat <- confmatrix(gcred$Default[-train],predictedvalnb)$matrix
costnb <- Cpp * mat[1, 1] + Cnn * mat[2, 2] +
          Cpn * mat[2, 1] + Cnp * mat[1, 2]
costnb
```