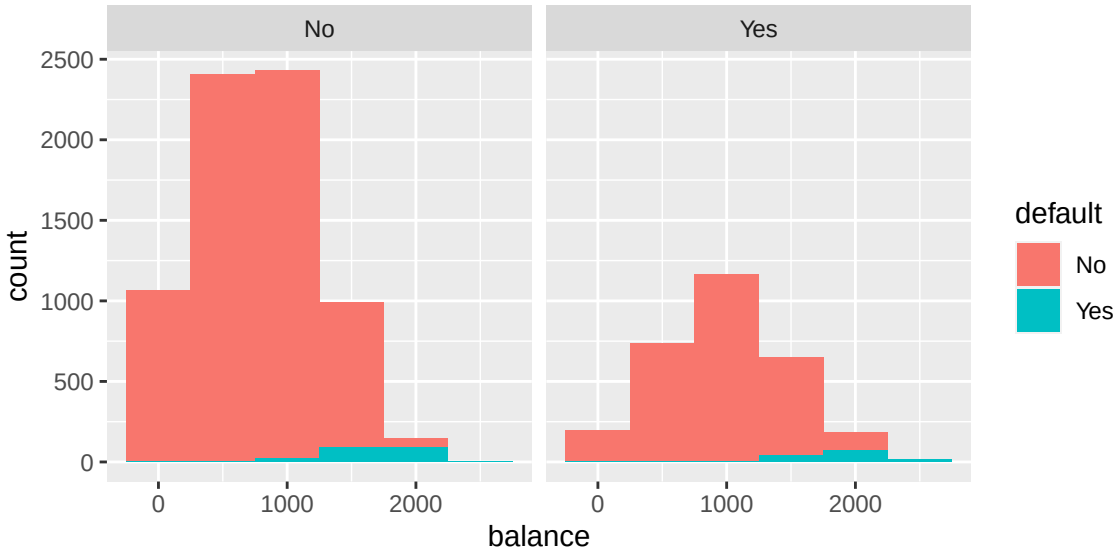
Classification 2 Homework

```
library(tidyverse)
library(MASS)
library(caret)
library(kableExtra)
library(e1071)
library(ISLR)
library(rpart)
library(DMwR)
```

Data

Using the Default data from ISLR



Comparison of Algorithms

Use the follwing template that compares algorithms and then adds a SMOTE section and compares again. Follow this template, except use the Employee Turnover data.

Logistic Regression

```
glModS <- glm(default ~ student + balance + income, data = xTrain, family = binomial)
glmPred <- predict(glModS, type = "response", newdata = xTest)
xTest$GLM = if_else(glmPred < .5, "No", "Yes")

CM = confusionMatrix(factor(xTest$GLM), factor(xTest$default),  positive = "Yes")

Summary = data.frame(Algorithm = "GLM",
```

```
                      Sensitivity = CM$byClass[1],
                      Specificity = CM$byClass[2],
                      PosPredVal =  CM$byClass[3],
                      NegPredVal =  CM$byClass[4],
                      Prevalence = CM$byClass[8])
```

Linear Discriminant Analysis

```
lda.fit <- lda(default ~ student + balance + income, xTrain)
lda.pred <- predict(lda.fit, xTest)

xTest$LDA =  lda.pred$class

CM = confusionMatrix(xTest$LDA, factor(xTest$default),   positive = "Yes")

Summaryadd = data.frame(Algorithm = "LDA",
                      Sensitivity = CM$byClass[1],
                      Specificity = CM$byClass[2],
                      PosPredVal =  CM$byClass[3],
                      NegPredVal =  CM$byClass[4],
                      Prevalence = CM$byClass[8])

Summary = bind_rows(Summary, Summaryadd)
```

Naive Bayes

```
NBmodel <- naiveBayes(default ~ student + balance + income,  data = xTrain)
xTest$NB <- predict(NBmodel, xTest, prob = TRUE)

CM = confusionMatrix( xTest$NB, factor(xTest$default),  positive = "Yes")

Summaryadd = data.frame(Algorithm = "NB",
                        Sensitivity = CM$byClass[1],
                        Specificity = CM$byClass[2],
                        PosPredVal =  CM$byClass[3],
                        NegPredVal =  CM$byClass[4],
                        Prevalence = CM$byClass[8])

Summary = bind_rows(Summary, Summaryadd)
```

Decision Tree

```
Treefit <- rpart(default ~ student + balance + income,
              data = xTrain,
             method="class")

xTest$Tree = predict(Treefit, type = "class", newdata = xTest)  # factor

CM = confusionMatrix(xTest$Tree, factor(xTest$default),   positive = "Yes")

Summaryadd = data.frame(Algorithm = "Tree",
                        Sensitivity = CM$byClass[1],
```

```
                        Specificity = CM$byClass[2],
                        PosPredVal =  CM$byClass[3],
                        NegPredVal =  CM$byClass[4],
                        Prevalence = CM$byClass[8])

Summary = bind_rows(Summary, Summaryadd)
```

Support Vector Machine

```
svmMod <- svm(default ~ student + balance + income, data = xTrain)
xTest$SVM <- predict(svmMod, xTest)

CM = confusionMatrix(xTest$SVM, factor(xTest$default), positive = "Yes")

Summaryadd = data.frame(Algorithm = "SVM",
                        Sensitivity = CM$byClass[1],
                        Specificity = CM$byClass[2],
                        PosPredVal =  CM$byClass[3],
                        NegPredVal =  CM$byClass[4],
                        Prevalence = CM$byClass[8])

Summary = bind_rows(Summary, Summaryadd)
```

SMOTE Sampling

Data Creation

```
smoteData <- SMOTE(default ~ student + balance + income, data = Default, perc.over = 350, perc.under=13
prop.table(table(smoteData$default))
```

Logistic Regression with SMOTE

```
glModSmote <- glm(default ~ student + balance + income, data = smoteData, family = binomial)
glmPredSmote <- predict(glModSmote, type = "response", newdata = xTest)
xTest$GLMSmote = if_else(glmPredSmote < .5, "No", "Yes")

CM = confusionMatrix(factor(xTest$GLMSmote), factor(xTest$default),   positive = "Yes")

Summaryadd = data.frame(Algorithm = "GLMSmote",
                        Sensitivity = CM$byClass[1],
                        Specificity = CM$byClass[2],
                        PosPredVal =  CM$byClass[3],
                        NegPredVal =  CM$byClass[4],
                        Prevalence = CM$byClass[8])

Summary = bind_rows(Summary, Summaryadd)
```

LDA with SMOTE

```
lda.fit <- lda(default ~ student + balance + income, smoteData)
lda.pred <- predict(lda.fit, xTest)
```

```
xTest$LDASmote =  lda.pred$class

CM = confusionMatrix(xTest$LDASmote,  factor(xTest$default), positive = "Yes")

Summaryadd = data.frame(Algorithm = "LDASmote",
                        Sensitivity = CM$byClass[1],
                        Specificity = CM$byClass[2],
                        PosPredVal =  CM$byClass[3],
                        NegPredVal =  CM$byClass[4],
                        Prevalence = CM$byClass[8])

Summary = bind_rows(Summary, Summaryadd)
```

Naive Bayes with SMOTE

```
model <- naiveBayes(default ~ student + balance + income,  data = smoteData)
xTest$NBSmote <- predict(model, xTest, prob = TRUE)

CM = confusionMatrix(xTest$NBSmote,  factor(xTest$default), positive = "Yes")

Summaryadd = data.frame(Algorithm = "NBSmote",
                        Sensitivity = CM$byClass[1],
                        Specificity = CM$byClass[2],
                        PosPredVal =  CM$byClass[3],
                        NegPredVal =  CM$byClass[4],
                        Prevalence = CM$byClass[8])

Summary = bind_rows(Summary, Summaryadd)
```

Decision Tree with SMOTE

```
TreefitSmote <- rpart(default ~ student + balance + income,
              data = xTrain,
             method="class")

xTest$TreeSmote = predict(TreefitSmote, type = "class", newdata = xTest)  # factor

CM = confusionMatrix( xTest$TreeSmote, factor(xTest$default),positive = "Yes")


Summaryadd = data.frame(Algorithm = "TreeSmote",
                        Sensitivity = CM$byClass[1],
                        Specificity = CM$byClass[2],
                        PosPredVal =  CM$byClass[3],
                        NegPredVal =  CM$byClass[4],
                        Prevalence = CM$byClass[8])

Summary = bind_rows(Summary, Summaryadd)
```

SVM with SMOTE

```
svmMod <- svm(default ~ student + balance + income, data = smoteData)
xTest$SVMSmote <- predict(svmMod, xTest)

CM = confusionMatrix(xTest$SVMSmote,  factor(xTest$default), positive = "Yes")

Summaryadd = data.frame(Algorithm = "SVMSmote",
                        Sensitivity = CM$byClass[1],
                        Specificity = CM$byClass[2],
                        PosPredVal =  CM$byClass[3],
                        NegPredVal =  CM$byClass[4],
                        Prevalence = CM$byClass[8])

Summary = bind_rows(Summary, Summaryadd)
```

Results and Review

```
knitr::kable(Summary) %>%
  kable_styling(full_width = F, bootstrap_options = "striped", font_size = 9)
```

Algorithm	Sensitivity	Specificity	PosPredVal	NegPredVal	Prevalence
GLM	0.2960526	0.9961019	0.7500000	0.9728426	0.038
LDA	0.2236842	0.9974012	0.7727273	0.9701719	0.038
NB	0.2171053	0.9945426	0.6111111	0.9698429	0.038
Tree	0.2960526	0.9963617	0.7627119	0.9728495	0.038
SVM	0.1250000	0.9989605	0.8260870	0.9665577	0.038
GLMSmote	0.8552632	0.8666840	0.2021773	0.9934465	0.038
LDASmote	0.8881579	0.8300416	0.1711027	0.9947057	0.038
NBSmote	0.8355263	0.8523909	0.1827338	0.9924357	0.038
TreeSmote	0.2960526	0.9963617	0.7627119	0.9728495	0.038
SVMSmote	0.8486842	0.8731809	0.2090762	0.9932013	0.038