Assignment 12

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adult =read.csv("C:/Users/student/Documents/MATH421/adult.csv", header=FALSE)  
titanic= read.csv("C:/Users/student/Documents/MATH421/titanics.csv")  
library(caret)

## Loading required package: lattice

## Loading required package: ggplot2

library(ggplot2)  
library(lattice)  
library(rpart)  
library(glmnet)

## Loading required package: Matrix

## Loading required package: foreach

## Loaded glmnet 2.0-16

# Question 1 adult

colnames(adult)[1] <- "Age"  
colnames(adult)[2] <- "Workclass"  
colnames(adult)[3] <- "fnlwgt"  
colnames(adult)[4] <- "Education"  
colnames(adult)[5] <- "Educationnum"  
colnames(adult)[6] <- "Maritalstatus"  
colnames(adult)[7] <- "Occupation"  
colnames(adult)[8] <- "Relationship"  
colnames(adult)[9] <- "Race"  
colnames(adult)[10] <- "Sex"  
colnames(adult)[11] <- "Capitalgain"  
colnames(adult)[12] <- "Capitalloss"  
colnames(adult)[13] <- "Hoursperweek"  
colnames(adult)[14] <- "Nativecountry"  
colnames(adult)[15] <- "Incomeclass"  
  
for(i in 1:ncol(adult)) {  
 adult[adult ==" ?"]= NA   
 blanks <- sum(is.na(adult[i]))  
 if(blanks > 0){  
 if(is.numeric(adult[[i]]) == TRUE) {  
 adult = preProcess(adult, method = "medianImpute")  
 }  
 else {  
 levels=unique(adult[,i])  
 adult[,i][is.na(adult[,i])]=levels[which.max(tabulate(match(adult[,i], x = levels)))]  
 }  
 }  
}

# Question 1 titanic

titanic$PassengerId = NULL  
titanic$Ticket = NULL  
titanic$Name = NULL  
titanic$Cabin = NULL  
titanic$Survived = factor(titanic$Survived)  
titanic$Pclass = factor(titanic$Pclass)  
titanic$Age[is.na(titanic$Age)] = mean(titanic$Age, na.rm = TRUE)  
levels(titanic$Embarked) = c("S","C","Q","S")  
   
for(i in 1:ncol(titanic)) {  
 titanic[titanic ==" ?"]= NA   
 blanks <- sum(is.na(titanic[i]))  
 if(blanks > 0){  
 if(is.numeric(titanic[[i]]) == TRUE) {  
 titanic = preProcess(df, method = "medianImpute")  
 }  
 else {  
 levels=unique(df[,i])  
 titanic[,i][is.na(df[,i])]=levels[which.max(tabulate(match(df[,i], x = levels)))]  
 }  
 }  
}

# Question 2

myGrid <- expand.grid(mtry = c(1:2), splitrule = c("gini"),  
 min.node.size = c(1:2))  
RandForestAdult <- train(  
 Incomeclass~.,   
 data = adult, method = "ranger",  
 trControl = trainControl(method = "cv", number = 7, verboseIter = TRUE),  
 tuneGrid = myGrid)

## + Fold1: mtry=1, splitrule=gini, min.node.size=1   
## - Fold1: mtry=1, splitrule=gini, min.node.size=1   
## + Fold1: mtry=2, splitrule=gini, min.node.size=1   
## - Fold1: mtry=2, splitrule=gini, min.node.size=1   
## + Fold1: mtry=1, splitrule=gini, min.node.size=2   
## - Fold1: mtry=1, splitrule=gini, min.node.size=2   
## + Fold1: mtry=2, splitrule=gini, min.node.size=2   
## - Fold1: mtry=2, splitrule=gini, min.node.size=2   
## + Fold2: mtry=1, splitrule=gini, min.node.size=1   
## - Fold2: mtry=1, splitrule=gini, min.node.size=1   
## + Fold2: mtry=2, splitrule=gini, min.node.size=1   
## - Fold2: mtry=2, splitrule=gini, min.node.size=1   
## + Fold2: mtry=1, splitrule=gini, min.node.size=2   
## - Fold2: mtry=1, splitrule=gini, min.node.size=2   
## + Fold2: mtry=2, splitrule=gini, min.node.size=2   
## - Fold2: mtry=2, splitrule=gini, min.node.size=2   
## + Fold3: mtry=1, splitrule=gini, min.node.size=1   
## - Fold3: mtry=1, splitrule=gini, min.node.size=1   
## + Fold3: mtry=2, splitrule=gini, min.node.size=1   
## - Fold3: mtry=2, splitrule=gini, min.node.size=1   
## + Fold3: mtry=1, splitrule=gini, min.node.size=2   
## - Fold3: mtry=1, splitrule=gini, min.node.size=2   
## + Fold3: mtry=2, splitrule=gini, min.node.size=2   
## - Fold3: mtry=2, splitrule=gini, min.node.size=2   
## + Fold4: mtry=1, splitrule=gini, min.node.size=1   
## - Fold4: mtry=1, splitrule=gini, min.node.size=1   
## + Fold4: mtry=2, splitrule=gini, min.node.size=1   
## - Fold4: mtry=2, splitrule=gini, min.node.size=1   
## + Fold4: mtry=1, splitrule=gini, min.node.size=2   
## - Fold4: mtry=1, splitrule=gini, min.node.size=2   
## + Fold4: mtry=2, splitrule=gini, min.node.size=2   
## - Fold4: mtry=2, splitrule=gini, min.node.size=2   
## + Fold5: mtry=1, splitrule=gini, min.node.size=1   
## - Fold5: mtry=1, splitrule=gini, min.node.size=1   
## + Fold5: mtry=2, splitrule=gini, min.node.size=1   
## - Fold5: mtry=2, splitrule=gini, min.node.size=1   
## + Fold5: mtry=1, splitrule=gini, min.node.size=2   
## - Fold5: mtry=1, splitrule=gini, min.node.size=2   
## + Fold5: mtry=2, splitrule=gini, min.node.size=2   
## - Fold5: mtry=2, splitrule=gini, min.node.size=2   
## + Fold6: mtry=1, splitrule=gini, min.node.size=1   
## - Fold6: mtry=1, splitrule=gini, min.node.size=1   
## + Fold6: mtry=2, splitrule=gini, min.node.size=1   
## - Fold6: mtry=2, splitrule=gini, min.node.size=1   
## + Fold6: mtry=1, splitrule=gini, min.node.size=2   
## - Fold6: mtry=1, splitrule=gini, min.node.size=2   
## + Fold6: mtry=2, splitrule=gini, min.node.size=2   
## - Fold6: mtry=2, splitrule=gini, min.node.size=2   
## + Fold7: mtry=1, splitrule=gini, min.node.size=1   
## - Fold7: mtry=1, splitrule=gini, min.node.size=1   
## + Fold7: mtry=2, splitrule=gini, min.node.size=1   
## - Fold7: mtry=2, splitrule=gini, min.node.size=1   
## + Fold7: mtry=1, splitrule=gini, min.node.size=2   
## - Fold7: mtry=1, splitrule=gini, min.node.size=2   
## + Fold7: mtry=2, splitrule=gini, min.node.size=2   
## - Fold7: mtry=2, splitrule=gini, min.node.size=2   
## Aggregating results  
## Selecting tuning parameters  
## Fitting mtry = 2, splitrule = gini, min.node.size = 1 on full training set

RandForestTitanic <- train(  
 Survived~.,   
 data = titanic, method = "ranger",  
 trControl = trainControl(method ="cv", number = 7, verboseIter = TRUE),  
 tuneGrid =myGrid)

## + Fold1: mtry=1, splitrule=gini, min.node.size=1   
## - Fold1: mtry=1, splitrule=gini, min.node.size=1   
## + Fold1: mtry=2, splitrule=gini, min.node.size=1   
## - Fold1: mtry=2, splitrule=gini, min.node.size=1   
## + Fold1: mtry=1, splitrule=gini, min.node.size=2   
## - Fold1: mtry=1, splitrule=gini, min.node.size=2   
## + Fold1: mtry=2, splitrule=gini, min.node.size=2   
## - Fold1: mtry=2, splitrule=gini, min.node.size=2   
## + Fold2: mtry=1, splitrule=gini, min.node.size=1   
## - Fold2: mtry=1, splitrule=gini, min.node.size=1   
## + Fold2: mtry=2, splitrule=gini, min.node.size=1   
## - Fold2: mtry=2, splitrule=gini, min.node.size=1   
## + Fold2: mtry=1, splitrule=gini, min.node.size=2   
## - Fold2: mtry=1, splitrule=gini, min.node.size=2   
## + Fold2: mtry=2, splitrule=gini, min.node.size=2   
## - Fold2: mtry=2, splitrule=gini, min.node.size=2   
## + Fold3: mtry=1, splitrule=gini, min.node.size=1   
## - Fold3: mtry=1, splitrule=gini, min.node.size=1   
## + Fold3: mtry=2, splitrule=gini, min.node.size=1   
## - Fold3: mtry=2, splitrule=gini, min.node.size=1   
## + Fold3: mtry=1, splitrule=gini, min.node.size=2   
## - Fold3: mtry=1, splitrule=gini, min.node.size=2   
## + Fold3: mtry=2, splitrule=gini, min.node.size=2   
## - Fold3: mtry=2, splitrule=gini, min.node.size=2   
## + Fold4: mtry=1, splitrule=gini, min.node.size=1   
## - Fold4: mtry=1, splitrule=gini, min.node.size=1   
## + Fold4: mtry=2, splitrule=gini, min.node.size=1   
## - Fold4: mtry=2, splitrule=gini, min.node.size=1   
## + Fold4: mtry=1, splitrule=gini, min.node.size=2   
## - Fold4: mtry=1, splitrule=gini, min.node.size=2   
## + Fold4: mtry=2, splitrule=gini, min.node.size=2   
## - Fold4: mtry=2, splitrule=gini, min.node.size=2   
## + Fold5: mtry=1, splitrule=gini, min.node.size=1   
## - Fold5: mtry=1, splitrule=gini, min.node.size=1   
## + Fold5: mtry=2, splitrule=gini, min.node.size=1   
## - Fold5: mtry=2, splitrule=gini, min.node.size=1   
## + Fold5: mtry=1, splitrule=gini, min.node.size=2   
## - Fold5: mtry=1, splitrule=gini, min.node.size=2   
## + Fold5: mtry=2, splitrule=gini, min.node.size=2   
## - Fold5: mtry=2, splitrule=gini, min.node.size=2   
## + Fold6: mtry=1, splitrule=gini, min.node.size=1   
## - Fold6: mtry=1, splitrule=gini, min.node.size=1   
## + Fold6: mtry=2, splitrule=gini, min.node.size=1   
## - Fold6: mtry=2, splitrule=gini, min.node.size=1   
## + Fold6: mtry=1, splitrule=gini, min.node.size=2   
## - Fold6: mtry=1, splitrule=gini, min.node.size=2   
## + Fold6: mtry=2, splitrule=gini, min.node.size=2   
## - Fold6: mtry=2, splitrule=gini, min.node.size=2   
## + Fold7: mtry=1, splitrule=gini, min.node.size=1   
## - Fold7: mtry=1, splitrule=gini, min.node.size=1   
## + Fold7: mtry=2, splitrule=gini, min.node.size=1   
## - Fold7: mtry=2, splitrule=gini, min.node.size=1   
## + Fold7: mtry=1, splitrule=gini, min.node.size=2   
## - Fold7: mtry=1, splitrule=gini, min.node.size=2   
## + Fold7: mtry=2, splitrule=gini, min.node.size=2   
## - Fold7: mtry=2, splitrule=gini, min.node.size=2   
## Aggregating results  
## Selecting tuning parameters  
## Fitting mtry = 2, splitrule = gini, min.node.size = 1 on full training set

RandForestAdult

## Random Forest   
##   
## 32561 samples  
## 14 predictor  
## 2 classes: ' <=50K', ' >50K'   
##   
## No pre-processing  
## Resampling: Cross-Validated (7 fold)   
## Summary of sample sizes: 27908, 27909, 27910, 27909, 27910, 27910, ...   
## Resampling results across tuning parameters:  
##   
## mtry min.node.size Accuracy Kappa   
## 1 1 0.7591904 0.0000000  
## 1 2 0.7591904 0.0000000  
## 2 1 0.8123216 0.3256640  
## 2 2 0.8114000 0.3175315  
##   
## Tuning parameter 'splitrule' was held constant at a value of gini  
## Accuracy was used to select the optimal model using the largest value.  
## The final values used for the model were mtry = 2, splitrule = gini  
## and min.node.size = 1.

RandForestTitanic

## Random Forest   
##   
## 891 samples  
## 7 predictor  
## 2 classes: '0', '1'   
##   
## No pre-processing  
## Resampling: Cross-Validated (7 fold)   
## Summary of sample sizes: 764, 764, 763, 763, 765, 764, ...   
## Resampling results across tuning parameters:  
##   
## mtry min.node.size Accuracy Kappa   
## 1 1 0.7878901 0.5110230  
## 1 2 0.7968980 0.5338037  
## 2 1 0.8205379 0.6023513  
## 2 2 0.8171723 0.5949330  
##   
## Tuning parameter 'splitrule' was held constant at a value of gini  
## Accuracy was used to select the optimal model using the largest value.  
## The final values used for the model were mtry = 2, splitrule = gini  
## and min.node.size = 1.

# Question 3

DecTreeAdult <- train(  
 Incomeclass~.,   
 data = adult, method = "rpart",  
 trControl = trainControl(method="cv",number=10,verboseIter = TRUE))

## + Fold01: cp=0.03686   
## - Fold01: cp=0.03686   
## + Fold02: cp=0.03686   
## - Fold02: cp=0.03686   
## + Fold03: cp=0.03686   
## - Fold03: cp=0.03686   
## + Fold04: cp=0.03686   
## - Fold04: cp=0.03686   
## + Fold05: cp=0.03686   
## - Fold05: cp=0.03686   
## + Fold06: cp=0.03686   
## - Fold06: cp=0.03686   
## + Fold07: cp=0.03686   
## - Fold07: cp=0.03686   
## + Fold08: cp=0.03686   
## - Fold08: cp=0.03686   
## + Fold09: cp=0.03686   
## - Fold09: cp=0.03686   
## + Fold10: cp=0.03686   
## - Fold10: cp=0.03686   
## Aggregating results  
## Selecting tuning parameters  
## Fitting cp = 0.0369 on full training set

DecTreeTitanic <- train(  
 Survived~.,  
 data =titanic, method ="rpart",  
 trControl =trainControl(method="cv",number=10,verboseIter = TRUE))

## + Fold01: cp=0.02339   
## - Fold01: cp=0.02339   
## + Fold02: cp=0.02339   
## - Fold02: cp=0.02339   
## + Fold03: cp=0.02339   
## - Fold03: cp=0.02339   
## + Fold04: cp=0.02339   
## - Fold04: cp=0.02339   
## + Fold05: cp=0.02339   
## - Fold05: cp=0.02339   
## + Fold06: cp=0.02339   
## - Fold06: cp=0.02339   
## + Fold07: cp=0.02339   
## - Fold07: cp=0.02339   
## + Fold08: cp=0.02339   
## - Fold08: cp=0.02339   
## + Fold09: cp=0.02339   
## - Fold09: cp=0.02339   
## + Fold10: cp=0.02339   
## - Fold10: cp=0.02339   
## Aggregating results  
## Selecting tuning parameters  
## Fitting cp = 0.0234 on full training set

DecTreeAdult

## CART   
##   
## 32561 samples  
## 14 predictor  
## 2 classes: ' <=50K', ' >50K'   
##   
## No pre-processing  
## Resampling: Cross-Validated (10 fold)   
## Summary of sample sizes: 29305, 29305, 29304, 29305, 29305, 29305, ...   
## Resampling results across tuning parameters:  
##   
## cp Accuracy Kappa   
## 0.03685754 0.8395933 0.5030498  
## 0.06453259 0.8274314 0.4541345  
## 0.12492029 0.7870774 0.2019452  
##   
## Accuracy was used to select the optimal model using the largest value.  
## The final value used for the model was cp = 0.03685754.

DecTreeTitanic

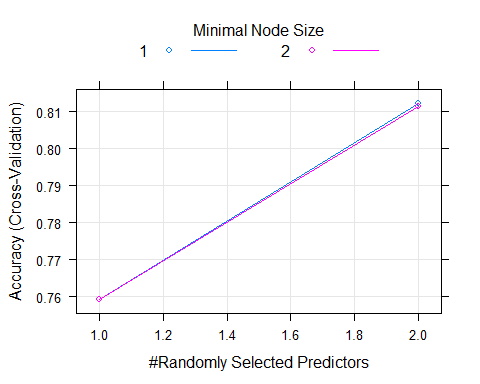
## CART   
##   
## 891 samples  
## 7 predictor  
## 2 classes: '0', '1'   
##   
## No pre-processing  
## Resampling: Cross-Validated (10 fold)   
## Summary of sample sizes: 802, 802, 802, 802, 802, 802, ...   
## Resampling results across tuning parameters:  
##   
## cp Accuracy Kappa   
## 0.02339181 0.8058512 0.5781642  
## 0.03070175 0.7901580 0.5463969  
## 0.44444444 0.6824623 0.2304958  
##   
## Accuracy was used to select the optimal model using the largest value.  
## The final value used for the model was cp = 0.02339181.

# Question 4

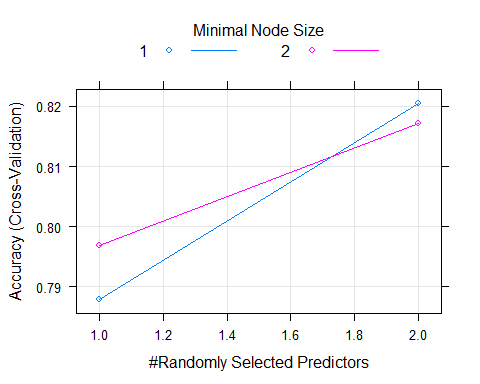
Fitting mtry = 2, splitrule = gini, min.node.size = 1 on full training set Fitting mtry = 2, splitrule = gini, min.node.size = 2 on full training set

# Question 5

plot(RandForestAdult)



plot(RandForestTitanic)



# Question 6

myGrid2 <- expand.grid(mtry = c(1:4), splitrule = c("gini","extratrees"),  
 min.node.size = c(1:5))  
set.seed(41)  
RandForestAdult2 <- train(Incomeclass ~.,data = adult, method = "ranger",  
 trControl = trainControl(method ="cv", number = 7, verboseIter = TRUE),  
 tuneGrid = myGrid2)

## + Fold1: mtry=1, splitrule=gini, min.node.size=1   
## - Fold1: mtry=1, splitrule=gini, min.node.size=1   
## + Fold1: mtry=2, splitrule=gini, min.node.size=1   
## - Fold1: mtry=2, splitrule=gini, min.node.size=1   
## + Fold1: mtry=3, splitrule=gini, min.node.size=1   
## - Fold1: mtry=3, splitrule=gini, min.node.size=1   
## + Fold1: mtry=4, splitrule=gini, min.node.size=1   
## - Fold1: mtry=4, splitrule=gini, min.node.size=1   
## + Fold1: mtry=1, splitrule=extratrees, min.node.size=1   
## - Fold1: mtry=1, splitrule=extratrees, min.node.size=1   
## + Fold1: mtry=2, splitrule=extratrees, min.node.size=1   
## - Fold1: mtry=2, splitrule=extratrees, min.node.size=1   
## + Fold1: mtry=3, splitrule=extratrees, min.node.size=1   
## - Fold1: mtry=3, splitrule=extratrees, min.node.size=1   
## + Fold1: mtry=4, splitrule=extratrees, min.node.size=1   
## - Fold1: mtry=4, splitrule=extratrees, min.node.size=1   
## + Fold1: mtry=1, splitrule=gini, min.node.size=2   
## - Fold1: mtry=1, splitrule=gini, min.node.size=2   
## + Fold1: mtry=2, splitrule=gini, min.node.size=2   
## - Fold1: mtry=2, splitrule=gini, min.node.size=2   
## + Fold1: mtry=3, splitrule=gini, min.node.size=2   
## - Fold1: mtry=3, splitrule=gini, min.node.size=2   
## + Fold1: mtry=4, splitrule=gini, min.node.size=2   
## - Fold1: mtry=4, splitrule=gini, min.node.size=2   
## + Fold1: mtry=1, splitrule=extratrees, min.node.size=2   
## - Fold1: mtry=1, splitrule=extratrees, min.node.size=2   
## + Fold1: mtry=2, splitrule=extratrees, min.node.size=2   
## - Fold1: mtry=2, splitrule=extratrees, min.node.size=2   
## + Fold1: mtry=3, splitrule=extratrees, min.node.size=2   
## - Fold1: mtry=3, splitrule=extratrees, min.node.size=2   
## + Fold1: mtry=4, splitrule=extratrees, min.node.size=2   
## - Fold1: mtry=4, splitrule=extratrees, min.node.size=2   
## + Fold1: mtry=1, splitrule=gini, min.node.size=3   
## - Fold1: mtry=1, splitrule=gini, min.node.size=3   
## + Fold1: mtry=2, splitrule=gini, min.node.size=3   
## - Fold1: mtry=2, splitrule=gini, min.node.size=3   
## + Fold1: mtry=3, splitrule=gini, min.node.size=3   
## - Fold1: mtry=3, splitrule=gini, min.node.size=3   
## + Fold1: mtry=4, splitrule=gini, min.node.size=3   
## - Fold1: mtry=4, splitrule=gini, min.node.size=3   
## + Fold1: mtry=1, splitrule=extratrees, min.node.size=3   
## - Fold1: mtry=1, splitrule=extratrees, min.node.size=3   
## + Fold1: mtry=2, splitrule=extratrees, min.node.size=3   
## - Fold1: mtry=2, splitrule=extratrees, min.node.size=3   
## + Fold1: mtry=3, splitrule=extratrees, min.node.size=3   
## - Fold1: mtry=3, splitrule=extratrees, min.node.size=3   
## + Fold1: mtry=4, splitrule=extratrees, min.node.size=3   
## - Fold1: mtry=4, splitrule=extratrees, min.node.size=3   
## + Fold1: mtry=1, splitrule=gini, min.node.size=4   
## - Fold1: mtry=1, splitrule=gini, min.node.size=4   
## + Fold1: mtry=2, splitrule=gini, min.node.size=4   
## - Fold1: mtry=2, splitrule=gini, min.node.size=4   
## + Fold1: mtry=3, splitrule=gini, min.node.size=4   
## - Fold1: mtry=3, splitrule=gini, min.node.size=4   
## + Fold1: mtry=4, splitrule=gini, min.node.size=4   
## - Fold1: mtry=4, splitrule=gini, min.node.size=4   
## + Fold1: mtry=1, splitrule=extratrees, min.node.size=4   
## - Fold1: mtry=1, splitrule=extratrees, min.node.size=4   
## + Fold1: mtry=2, splitrule=extratrees, min.node.size=4   
## - Fold1: mtry=2, splitrule=extratrees, min.node.size=4   
## + Fold1: mtry=3, splitrule=extratrees, min.node.size=4   
## - Fold1: mtry=3, splitrule=extratrees, min.node.size=4   
## + Fold1: mtry=4, splitrule=extratrees, min.node.size=4   
## - Fold1: mtry=4, splitrule=extratrees, min.node.size=4   
## + Fold1: mtry=1, splitrule=gini, min.node.size=5   
## - Fold1: mtry=1, splitrule=gini, min.node.size=5   
## + Fold1: mtry=2, splitrule=gini, min.node.size=5   
## - Fold1: mtry=2, splitrule=gini, min.node.size=5   
## + Fold1: mtry=3, splitrule=gini, min.node.size=5   
## - Fold1: mtry=3, splitrule=gini, min.node.size=5   
## + Fold1: mtry=4, splitrule=gini, min.node.size=5   
## - Fold1: mtry=4, splitrule=gini, min.node.size=5   
## + Fold1: mtry=1, splitrule=extratrees, min.node.size=5   
## - Fold1: mtry=1, splitrule=extratrees, min.node.size=5   
## + Fold1: mtry=2, splitrule=extratrees, min.node.size=5   
## - Fold1: mtry=2, splitrule=extratrees, min.node.size=5   
## + Fold1: mtry=3, splitrule=extratrees, min.node.size=5   
## - Fold1: mtry=3, splitrule=extratrees, min.node.size=5   
## + Fold1: mtry=4, splitrule=extratrees, min.node.size=5   
## - Fold1: mtry=4, splitrule=extratrees, min.node.size=5   
## + Fold2: mtry=1, splitrule=gini, min.node.size=1   
## - Fold2: mtry=1, splitrule=gini, min.node.size=1   
## + Fold2: mtry=2, splitrule=gini, min.node.size=1   
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## + Fold2: mtry=3, splitrule=gini, min.node.size=1   
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## - Fold2: mtry=4, splitrule=gini, min.node.size=1   
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## + Fold2: mtry=2, splitrule=extratrees, min.node.size=1   
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## + Fold2: mtry=3, splitrule=extratrees, min.node.size=1   
## - Fold2: mtry=3, splitrule=extratrees, min.node.size=1   
## + Fold2: mtry=4, splitrule=extratrees, min.node.size=1   
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## + Fold2: mtry=1, splitrule=gini, min.node.size=2   
## - Fold2: mtry=1, splitrule=gini, min.node.size=2   
## + Fold2: mtry=2, splitrule=gini, min.node.size=2   
## - Fold2: mtry=2, splitrule=gini, min.node.size=2   
## + Fold2: mtry=3, splitrule=gini, min.node.size=2   
## - Fold2: mtry=3, splitrule=gini, min.node.size=2   
## + Fold2: mtry=4, splitrule=gini, min.node.size=2   
## - Fold2: mtry=4, splitrule=gini, min.node.size=2   
## + Fold2: mtry=1, splitrule=extratrees, min.node.size=2   
## - Fold2: mtry=1, splitrule=extratrees, min.node.size=2   
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## + Fold2: mtry=4, splitrule=extratrees, min.node.size=2   
## - Fold2: mtry=4, splitrule=extratrees, min.node.size=2   
## + Fold2: mtry=1, splitrule=gini, min.node.size=3   
## - Fold2: mtry=1, splitrule=gini, min.node.size=3   
## + Fold2: mtry=2, splitrule=gini, min.node.size=3   
## - Fold2: mtry=2, splitrule=gini, min.node.size=3   
## + Fold2: mtry=3, splitrule=gini, min.node.size=3   
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## - Fold2: mtry=4, splitrule=gini, min.node.size=3   
## + Fold2: mtry=1, splitrule=extratrees, min.node.size=3   
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## - Fold2: mtry=3, splitrule=gini, min.node.size=4   
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## - Fold2: mtry=4, splitrule=extratrees, min.node.size=4   
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## - Fold2: mtry=1, splitrule=gini, min.node.size=5   
## + Fold2: mtry=2, splitrule=gini, min.node.size=5   
## - Fold2: mtry=2, splitrule=gini, min.node.size=5   
## + Fold2: mtry=3, splitrule=gini, min.node.size=5   
## - Fold2: mtry=3, splitrule=gini, min.node.size=5   
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## - Fold2: mtry=4, splitrule=gini, min.node.size=5   
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## - Fold3: mtry=2, splitrule=gini, min.node.size=4   
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## - Fold3: mtry=1, splitrule=gini, min.node.size=5   
## + Fold3: mtry=2, splitrule=gini, min.node.size=5   
## - Fold3: mtry=2, splitrule=gini, min.node.size=5   
## + Fold3: mtry=3, splitrule=gini, min.node.size=5   
## - Fold3: mtry=3, splitrule=gini, min.node.size=5   
## + Fold3: mtry=4, splitrule=gini, min.node.size=5   
## - Fold3: mtry=4, splitrule=gini, min.node.size=5   
## + Fold3: mtry=1, splitrule=extratrees, min.node.size=5   
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## - Fold3: mtry=4, splitrule=extratrees, min.node.size=5   
## + Fold4: mtry=1, splitrule=gini, min.node.size=1   
## - Fold4: mtry=1, splitrule=gini, min.node.size=1   
## + Fold4: mtry=2, splitrule=gini, min.node.size=1   
## - Fold4: mtry=2, splitrule=gini, min.node.size=1   
## + Fold4: mtry=3, splitrule=gini, min.node.size=1   
## - Fold4: mtry=3, splitrule=gini, min.node.size=1   
## + Fold4: mtry=4, splitrule=gini, min.node.size=1   
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## - Fold4: mtry=2, splitrule=gini, min.node.size=3   
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## - Fold4: mtry=2, splitrule=extratrees, min.node.size=4   
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## - Fold4: mtry=3, splitrule=extratrees, min.node.size=4   
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## - Fold5: mtry=1, splitrule=gini, min.node.size=1   
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## - Fold5: mtry=3, splitrule=gini, min.node.size=1   
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## - Fold5: mtry=2, splitrule=gini, min.node.size=2   
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## - Fold5: mtry=4, splitrule=extratrees, min.node.size=2   
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## - Fold5: mtry=1, splitrule=gini, min.node.size=3   
## + Fold5: mtry=2, splitrule=gini, min.node.size=3   
## - Fold5: mtry=2, splitrule=gini, min.node.size=3   
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## - Fold5: mtry=3, splitrule=gini, min.node.size=3   
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## - Fold5: mtry=4, splitrule=gini, min.node.size=3   
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## - Fold5: mtry=2, splitrule=gini, min.node.size=4   
## + Fold5: mtry=3, splitrule=gini, min.node.size=4   
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## - Fold5: mtry=3, splitrule=extratrees, min.node.size=4   
## + Fold5: mtry=4, splitrule=extratrees, min.node.size=4   
## - Fold5: mtry=4, splitrule=extratrees, min.node.size=4   
## + Fold5: mtry=1, splitrule=gini, min.node.size=5   
## - Fold5: mtry=1, splitrule=gini, min.node.size=5   
## + Fold5: mtry=2, splitrule=gini, min.node.size=5   
## - Fold5: mtry=2, splitrule=gini, min.node.size=5   
## + Fold5: mtry=3, splitrule=gini, min.node.size=5   
## - Fold5: mtry=3, splitrule=gini, min.node.size=5   
## + Fold5: mtry=4, splitrule=gini, min.node.size=5   
## - Fold5: mtry=4, splitrule=gini, min.node.size=5   
## + Fold5: mtry=1, splitrule=extratrees, min.node.size=5   
## - Fold5: mtry=1, splitrule=extratrees, min.node.size=5   
## + Fold5: mtry=2, splitrule=extratrees, min.node.size=5   
## - Fold5: mtry=2, splitrule=extratrees, min.node.size=5   
## + Fold5: mtry=3, splitrule=extratrees, min.node.size=5   
## - Fold5: mtry=3, splitrule=extratrees, min.node.size=5   
## + Fold5: mtry=4, splitrule=extratrees, min.node.size=5   
## - Fold5: mtry=4, splitrule=extratrees, min.node.size=5   
## + Fold6: mtry=1, splitrule=gini, min.node.size=1   
## - Fold6: mtry=1, splitrule=gini, min.node.size=1   
## + Fold6: mtry=2, splitrule=gini, min.node.size=1   
## - Fold6: mtry=2, splitrule=gini, min.node.size=1   
## + Fold6: mtry=3, splitrule=gini, min.node.size=1   
## - Fold6: mtry=3, splitrule=gini, min.node.size=1   
## + Fold6: mtry=4, splitrule=gini, min.node.size=1   
## - Fold6: mtry=4, splitrule=gini, min.node.size=1   
## + Fold6: mtry=1, splitrule=extratrees, min.node.size=1   
## - Fold6: mtry=1, splitrule=extratrees, min.node.size=1   
## + Fold6: mtry=2, splitrule=extratrees, min.node.size=1   
## - Fold6: mtry=2, splitrule=extratrees, min.node.size=1   
## + Fold6: mtry=3, splitrule=extratrees, min.node.size=1   
## - Fold6: mtry=3, splitrule=extratrees, min.node.size=1   
## + Fold6: mtry=4, splitrule=extratrees, min.node.size=1   
## - Fold6: mtry=4, splitrule=extratrees, min.node.size=1   
## + Fold6: mtry=1, splitrule=gini, min.node.size=2   
## - Fold6: mtry=1, splitrule=gini, min.node.size=2   
## + Fold6: mtry=2, splitrule=gini, min.node.size=2   
## - Fold6: mtry=2, splitrule=gini, min.node.size=2   
## + Fold6: mtry=3, splitrule=gini, min.node.size=2   
## - Fold6: mtry=3, splitrule=gini, min.node.size=2   
## + Fold6: mtry=4, splitrule=gini, min.node.size=2   
## - Fold6: mtry=4, splitrule=gini, min.node.size=2   
## + Fold6: mtry=1, splitrule=extratrees, min.node.size=2   
## - Fold6: mtry=1, splitrule=extratrees, min.node.size=2   
## + Fold6: mtry=2, splitrule=extratrees, min.node.size=2   
## - Fold6: mtry=2, splitrule=extratrees, min.node.size=2   
## + Fold6: mtry=3, splitrule=extratrees, min.node.size=2   
## - Fold6: mtry=3, splitrule=extratrees, min.node.size=2   
## + Fold6: mtry=4, splitrule=extratrees, min.node.size=2   
## - Fold6: mtry=4, splitrule=extratrees, min.node.size=2   
## + Fold6: mtry=1, splitrule=gini, min.node.size=3   
## - Fold6: mtry=1, splitrule=gini, min.node.size=3   
## + Fold6: mtry=2, splitrule=gini, min.node.size=3   
## - Fold6: mtry=2, splitrule=gini, min.node.size=3   
## + Fold6: mtry=3, splitrule=gini, min.node.size=3   
## - Fold6: mtry=3, splitrule=gini, min.node.size=3   
## + Fold6: mtry=4, splitrule=gini, min.node.size=3   
## - Fold6: mtry=4, splitrule=gini, min.node.size=3   
## + Fold6: mtry=1, splitrule=extratrees, min.node.size=3   
## - Fold6: mtry=1, splitrule=extratrees, min.node.size=3   
## + Fold6: mtry=2, splitrule=extratrees, min.node.size=3   
## - Fold6: mtry=2, splitrule=extratrees, min.node.size=3   
## + Fold6: mtry=3, splitrule=extratrees, min.node.size=3   
## - Fold6: mtry=3, splitrule=extratrees, min.node.size=3   
## + Fold6: mtry=4, splitrule=extratrees, min.node.size=3   
## - Fold6: mtry=4, splitrule=extratrees, min.node.size=3   
## + Fold6: mtry=1, splitrule=gini, min.node.size=4   
## - Fold6: mtry=1, splitrule=gini, min.node.size=4   
## + Fold6: mtry=2, splitrule=gini, min.node.size=4   
## - Fold6: mtry=2, splitrule=gini, min.node.size=4   
## + Fold6: mtry=3, splitrule=gini, min.node.size=4   
## - Fold6: mtry=3, splitrule=gini, min.node.size=4   
## + Fold6: mtry=4, splitrule=gini, min.node.size=4   
## - Fold6: mtry=4, splitrule=gini, min.node.size=4   
## + Fold6: mtry=1, splitrule=extratrees, min.node.size=4   
## - Fold6: mtry=1, splitrule=extratrees, min.node.size=4   
## + Fold6: mtry=2, splitrule=extratrees, min.node.size=4   
## - Fold6: mtry=2, splitrule=extratrees, min.node.size=4   
## + Fold6: mtry=3, splitrule=extratrees, min.node.size=4   
## - Fold6: mtry=3, splitrule=extratrees, min.node.size=4   
## + Fold6: mtry=4, splitrule=extratrees, min.node.size=4   
## - Fold6: mtry=4, splitrule=extratrees, min.node.size=4   
## + Fold6: mtry=1, splitrule=gini, min.node.size=5   
## - Fold6: mtry=1, splitrule=gini, min.node.size=5   
## + Fold6: mtry=2, splitrule=gini, min.node.size=5   
## - Fold6: mtry=2, splitrule=gini, min.node.size=5   
## + Fold6: mtry=3, splitrule=gini, min.node.size=5   
## - Fold6: mtry=3, splitrule=gini, min.node.size=5   
## + Fold6: mtry=4, splitrule=gini, min.node.size=5   
## - Fold6: mtry=4, splitrule=gini, min.node.size=5   
## + Fold6: mtry=1, splitrule=extratrees, min.node.size=5   
## - Fold6: mtry=1, splitrule=extratrees, min.node.size=5   
## + Fold6: mtry=2, splitrule=extratrees, min.node.size=5   
## - Fold6: mtry=2, splitrule=extratrees, min.node.size=5   
## + Fold6: mtry=3, splitrule=extratrees, min.node.size=5   
## - Fold6: mtry=3, splitrule=extratrees, min.node.size=5   
## + Fold6: mtry=4, splitrule=extratrees, min.node.size=5   
## - Fold6: mtry=4, splitrule=extratrees, min.node.size=5   
## + Fold7: mtry=1, splitrule=gini, min.node.size=1   
## - Fold7: mtry=1, splitrule=gini, min.node.size=1   
## + Fold7: mtry=2, splitrule=gini, min.node.size=1   
## - Fold7: mtry=2, splitrule=gini, min.node.size=1   
## + Fold7: mtry=3, splitrule=gini, min.node.size=1   
## - Fold7: mtry=3, splitrule=gini, min.node.size=1   
## + Fold7: mtry=4, splitrule=gini, min.node.size=1   
## - Fold7: mtry=4, splitrule=gini, min.node.size=1   
## + Fold7: mtry=1, splitrule=extratrees, min.node.size=1   
## - Fold7: mtry=1, splitrule=extratrees, min.node.size=1   
## + Fold7: mtry=2, splitrule=extratrees, min.node.size=1   
## - Fold7: mtry=2, splitrule=extratrees, min.node.size=1   
## + Fold7: mtry=3, splitrule=extratrees, min.node.size=1   
## - Fold7: mtry=3, splitrule=extratrees, min.node.size=1   
## + Fold7: mtry=4, splitrule=extratrees, min.node.size=1   
## - Fold7: mtry=4, splitrule=extratrees, min.node.size=1   
## + Fold7: mtry=1, splitrule=gini, min.node.size=2   
## - Fold7: mtry=1, splitrule=gini, min.node.size=2   
## + Fold7: mtry=2, splitrule=gini, min.node.size=2   
## - Fold7: mtry=2, splitrule=gini, min.node.size=2   
## + Fold7: mtry=3, splitrule=gini, min.node.size=2   
## - Fold7: mtry=3, splitrule=gini, min.node.size=2   
## + Fold7: mtry=4, splitrule=gini, min.node.size=2   
## - Fold7: mtry=4, splitrule=gini, min.node.size=2   
## + Fold7: mtry=1, splitrule=extratrees, min.node.size=2   
## - Fold7: mtry=1, splitrule=extratrees, min.node.size=2   
## + Fold7: mtry=2, splitrule=extratrees, min.node.size=2   
## - Fold7: mtry=2, splitrule=extratrees, min.node.size=2   
## + Fold7: mtry=3, splitrule=extratrees, min.node.size=2   
## - Fold7: mtry=3, splitrule=extratrees, min.node.size=2   
## + Fold7: mtry=4, splitrule=extratrees, min.node.size=2   
## - Fold7: mtry=4, splitrule=extratrees, min.node.size=2   
## + Fold7: mtry=1, splitrule=gini, min.node.size=3   
## - Fold7: mtry=1, splitrule=gini, min.node.size=3   
## + Fold7: mtry=2, splitrule=gini, min.node.size=3   
## - Fold7: mtry=2, splitrule=gini, min.node.size=3   
## + Fold7: mtry=3, splitrule=gini, min.node.size=3   
## - Fold7: mtry=3, splitrule=gini, min.node.size=3   
## + Fold7: mtry=4, splitrule=gini, min.node.size=3   
## - Fold7: mtry=4, splitrule=gini, min.node.size=3   
## + Fold7: mtry=1, splitrule=extratrees, min.node.size=3   
## - Fold7: mtry=1, splitrule=extratrees, min.node.size=3   
## + Fold7: mtry=2, splitrule=extratrees, min.node.size=3   
## - Fold7: mtry=2, splitrule=extratrees, min.node.size=3   
## + Fold7: mtry=3, splitrule=extratrees, min.node.size=3   
## - Fold7: mtry=3, splitrule=extratrees, min.node.size=3   
## + Fold7: mtry=4, splitrule=extratrees, min.node.size=3   
## - Fold7: mtry=4, splitrule=extratrees, min.node.size=3   
## + Fold7: mtry=1, splitrule=gini, min.node.size=4   
## - Fold7: mtry=1, splitrule=gini, min.node.size=4   
## + Fold7: mtry=2, splitrule=gini, min.node.size=4   
## - Fold7: mtry=2, splitrule=gini, min.node.size=4   
## + Fold7: mtry=3, splitrule=gini, min.node.size=4   
## - Fold7: mtry=3, splitrule=gini, min.node.size=4   
## + Fold7: mtry=4, splitrule=gini, min.node.size=4   
## - Fold7: mtry=4, splitrule=gini, min.node.size=4   
## + Fold7: mtry=1, splitrule=extratrees, min.node.size=4   
## - Fold7: mtry=1, splitrule=extratrees, min.node.size=4   
## + Fold7: mtry=2, splitrule=extratrees, min.node.size=4   
## - Fold7: mtry=2, splitrule=extratrees, min.node.size=4   
## + Fold7: mtry=3, splitrule=extratrees, min.node.size=4   
## - Fold7: mtry=3, splitrule=extratrees, min.node.size=4   
## + Fold7: mtry=4, splitrule=extratrees, min.node.size=4   
## - Fold7: mtry=4, splitrule=extratrees, min.node.size=4   
## + Fold7: mtry=1, splitrule=gini, min.node.size=5   
## - Fold7: mtry=1, splitrule=gini, min.node.size=5   
## + Fold7: mtry=2, splitrule=gini, min.node.size=5   
## - Fold7: mtry=2, splitrule=gini, min.node.size=5   
## + Fold7: mtry=3, splitrule=gini, min.node.size=5   
## - Fold7: mtry=3, splitrule=gini, min.node.size=5   
## + Fold7: mtry=4, splitrule=gini, min.node.size=5   
## - Fold7: mtry=4, splitrule=gini, min.node.size=5   
## + Fold7: mtry=1, splitrule=extratrees, min.node.size=5   
## - Fold7: mtry=1, splitrule=extratrees, min.node.size=5   
## + Fold7: mtry=2, splitrule=extratrees, min.node.size=5   
## - Fold7: mtry=2, splitrule=extratrees, min.node.size=5   
## + Fold7: mtry=3, splitrule=extratrees, min.node.size=5   
## - Fold7: mtry=3, splitrule=extratrees, min.node.size=5   
## + Fold7: mtry=4, splitrule=extratrees, min.node.size=5   
## - Fold7: mtry=4, splitrule=extratrees, min.node.size=5   
## Aggregating results  
## Selecting tuning parameters  
## Fitting mtry = 4, splitrule = gini, min.node.size = 2 on full training set

RandForestTitanic2 <- train(Survived ~.,data = titanic, method = "ranger",  
 trControl = trainControl(method ="cv", number = 7, verboseIter = TRUE),  
 tuneGrid = myGrid2)

## + Fold1: mtry=1, splitrule=gini, min.node.size=1   
## - Fold1: mtry=1, splitrule=gini, min.node.size=1   
## + Fold1: mtry=2, splitrule=gini, min.node.size=1   
## - Fold1: mtry=2, splitrule=gini, min.node.size=1   
## + Fold1: mtry=3, splitrule=gini, min.node.size=1   
## - Fold1: mtry=3, splitrule=gini, min.node.size=1   
## + Fold1: mtry=4, splitrule=gini, min.node.size=1   
## - Fold1: mtry=4, splitrule=gini, min.node.size=1   
## + Fold1: mtry=1, splitrule=extratrees, min.node.size=1   
## - Fold1: mtry=1, splitrule=extratrees, min.node.size=1   
## + Fold1: mtry=2, splitrule=extratrees, min.node.size=1   
## - Fold1: mtry=2, splitrule=extratrees, min.node.size=1   
## + Fold1: mtry=3, splitrule=extratrees, min.node.size=1   
## - Fold1: mtry=3, splitrule=extratrees, min.node.size=1   
## + Fold1: mtry=4, splitrule=extratrees, min.node.size=1   
## - Fold1: mtry=4, splitrule=extratrees, min.node.size=1   
## + Fold1: mtry=1, splitrule=gini, min.node.size=2   
## - Fold1: mtry=1, splitrule=gini, min.node.size=2   
## + Fold1: mtry=2, splitrule=gini, min.node.size=2   
## - Fold1: mtry=2, splitrule=gini, min.node.size=2   
## + Fold1: mtry=3, splitrule=gini, min.node.size=2   
## - Fold1: mtry=3, splitrule=gini, min.node.size=2   
## + Fold1: mtry=4, splitrule=gini, min.node.size=2   
## - Fold1: mtry=4, splitrule=gini, min.node.size=2   
## + Fold1: mtry=1, splitrule=extratrees, min.node.size=2   
## - Fold1: mtry=1, splitrule=extratrees, min.node.size=2   
## + Fold1: mtry=2, splitrule=extratrees, min.node.size=2   
## - Fold1: mtry=2, splitrule=extratrees, min.node.size=2   
## + Fold1: mtry=3, splitrule=extratrees, min.node.size=2   
## - Fold1: mtry=3, splitrule=extratrees, min.node.size=2   
## + Fold1: mtry=4, splitrule=extratrees, min.node.size=2   
## - Fold1: mtry=4, splitrule=extratrees, min.node.size=2   
## + Fold1: mtry=1, splitrule=gini, min.node.size=3   
## - Fold1: mtry=1, splitrule=gini, min.node.size=3   
## + Fold1: mtry=2, splitrule=gini, min.node.size=3   
## - Fold1: mtry=2, splitrule=gini, min.node.size=3   
## + Fold1: mtry=3, splitrule=gini, min.node.size=3   
## - Fold1: mtry=3, splitrule=gini, min.node.size=3   
## + Fold1: mtry=4, splitrule=gini, min.node.size=3   
## - Fold1: mtry=4, splitrule=gini, min.node.size=3   
## + Fold1: mtry=1, splitrule=extratrees, min.node.size=3   
## - Fold1: mtry=1, splitrule=extratrees, min.node.size=3   
## + Fold1: mtry=2, splitrule=extratrees, min.node.size=3   
## - Fold1: mtry=2, splitrule=extratrees, min.node.size=3   
## + Fold1: mtry=3, splitrule=extratrees, min.node.size=3   
## - Fold1: mtry=3, splitrule=extratrees, min.node.size=3   
## + Fold1: mtry=4, splitrule=extratrees, min.node.size=3   
## - Fold1: mtry=4, splitrule=extratrees, min.node.size=3   
## + Fold1: mtry=1, splitrule=gini, min.node.size=4   
## - Fold1: mtry=1, splitrule=gini, min.node.size=4   
## + Fold1: mtry=2, splitrule=gini, min.node.size=4   
## - Fold1: mtry=2, splitrule=gini, min.node.size=4   
## + Fold1: mtry=3, splitrule=gini, min.node.size=4   
## - Fold1: mtry=3, splitrule=gini, min.node.size=4   
## + Fold1: mtry=4, splitrule=gini, min.node.size=4   
## - Fold1: mtry=4, splitrule=gini, min.node.size=4   
## + Fold1: mtry=1, splitrule=extratrees, min.node.size=4   
## - Fold1: mtry=1, splitrule=extratrees, min.node.size=4   
## + Fold1: mtry=2, splitrule=extratrees, min.node.size=4   
## - Fold1: mtry=2, splitrule=extratrees, min.node.size=4   
## + Fold1: mtry=3, splitrule=extratrees, min.node.size=4   
## - Fold1: mtry=3, splitrule=extratrees, min.node.size=4   
## + Fold1: mtry=4, splitrule=extratrees, min.node.size=4   
## - Fold1: mtry=4, splitrule=extratrees, min.node.size=4   
## + Fold1: mtry=1, splitrule=gini, min.node.size=5   
## - Fold1: mtry=1, splitrule=gini, min.node.size=5   
## + Fold1: mtry=2, splitrule=gini, min.node.size=5   
## - Fold1: mtry=2, splitrule=gini, min.node.size=5   
## + Fold1: mtry=3, splitrule=gini, min.node.size=5   
## - Fold1: mtry=3, splitrule=gini, min.node.size=5   
## + Fold1: mtry=4, splitrule=gini, min.node.size=5   
## - Fold1: mtry=4, splitrule=gini, min.node.size=5   
## + Fold1: mtry=1, splitrule=extratrees, min.node.size=5   
## - Fold1: mtry=1, splitrule=extratrees, min.node.size=5   
## + Fold1: mtry=2, splitrule=extratrees, min.node.size=5   
## - Fold1: mtry=2, splitrule=extratrees, min.node.size=5   
## + Fold1: mtry=3, splitrule=extratrees, min.node.size=5   
## - Fold1: mtry=3, splitrule=extratrees, min.node.size=5   
## + Fold1: mtry=4, splitrule=extratrees, min.node.size=5   
## - Fold1: mtry=4, splitrule=extratrees, min.node.size=5   
## + Fold2: mtry=1, splitrule=gini, min.node.size=1   
## - Fold2: mtry=1, splitrule=gini, min.node.size=1   
## + Fold2: mtry=2, splitrule=gini, min.node.size=1   
## - Fold2: mtry=2, splitrule=gini, min.node.size=1   
## + Fold2: mtry=3, splitrule=gini, min.node.size=1   
## - Fold2: mtry=3, splitrule=gini, min.node.size=1   
## + Fold2: mtry=4, splitrule=gini, min.node.size=1   
## - Fold2: mtry=4, splitrule=gini, min.node.size=1   
## + Fold2: mtry=1, splitrule=extratrees, min.node.size=1   
## - Fold2: mtry=1, splitrule=extratrees, min.node.size=1   
## + Fold2: mtry=2, splitrule=extratrees, min.node.size=1   
## - Fold2: mtry=2, splitrule=extratrees, min.node.size=1   
## + Fold2: mtry=3, splitrule=extratrees, min.node.size=1   
## - Fold2: mtry=3, splitrule=extratrees, min.node.size=1   
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## - Fold2: mtry=4, splitrule=extratrees, min.node.size=1   
## + Fold2: mtry=1, splitrule=gini, min.node.size=2   
## - Fold2: mtry=1, splitrule=gini, min.node.size=2   
## + Fold2: mtry=2, splitrule=gini, min.node.size=2   
## - Fold2: mtry=2, splitrule=gini, min.node.size=2   
## + Fold2: mtry=3, splitrule=gini, min.node.size=2   
## - Fold2: mtry=3, splitrule=gini, min.node.size=2   
## + Fold2: mtry=4, splitrule=gini, min.node.size=2   
## - Fold2: mtry=4, splitrule=gini, min.node.size=2   
## + Fold2: mtry=1, splitrule=extratrees, min.node.size=2   
## - Fold2: mtry=1, splitrule=extratrees, min.node.size=2   
## + Fold2: mtry=2, splitrule=extratrees, min.node.size=2   
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## + Fold2: mtry=3, splitrule=extratrees, min.node.size=2   
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## + Fold2: mtry=1, splitrule=gini, min.node.size=3   
## - Fold2: mtry=1, splitrule=gini, min.node.size=3   
## + Fold2: mtry=2, splitrule=gini, min.node.size=3   
## - Fold2: mtry=2, splitrule=gini, min.node.size=3   
## + Fold2: mtry=3, splitrule=gini, min.node.size=3   
## - Fold2: mtry=3, splitrule=gini, min.node.size=3   
## + Fold2: mtry=4, splitrule=gini, min.node.size=3   
## - Fold2: mtry=4, splitrule=gini, min.node.size=3   
## + Fold2: mtry=1, splitrule=extratrees, min.node.size=3   
## - Fold2: mtry=1, splitrule=extratrees, min.node.size=3   
## + Fold2: mtry=2, splitrule=extratrees, min.node.size=3   
## - Fold2: mtry=2, splitrule=extratrees, min.node.size=3   
## + Fold2: mtry=3, splitrule=extratrees, min.node.size=3   
## - Fold2: mtry=3, splitrule=extratrees, min.node.size=3   
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## - Fold2: mtry=1, splitrule=gini, min.node.size=4   
## + Fold2: mtry=2, splitrule=gini, min.node.size=4   
## - Fold2: mtry=2, splitrule=gini, min.node.size=4   
## + Fold2: mtry=3, splitrule=gini, min.node.size=4   
## - Fold2: mtry=3, splitrule=gini, min.node.size=4   
## + Fold2: mtry=4, splitrule=gini, min.node.size=4   
## - Fold2: mtry=4, splitrule=gini, min.node.size=4   
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## - Fold2: mtry=1, splitrule=gini, min.node.size=5   
## + Fold2: mtry=2, splitrule=gini, min.node.size=5   
## - Fold2: mtry=2, splitrule=gini, min.node.size=5   
## + Fold2: mtry=3, splitrule=gini, min.node.size=5   
## - Fold2: mtry=3, splitrule=gini, min.node.size=5   
## + Fold2: mtry=4, splitrule=gini, min.node.size=5   
## - Fold2: mtry=4, splitrule=gini, min.node.size=5   
## + Fold2: mtry=1, splitrule=extratrees, min.node.size=5   
## - Fold2: mtry=1, splitrule=extratrees, min.node.size=5   
## + Fold2: mtry=2, splitrule=extratrees, min.node.size=5   
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## + Fold2: mtry=4, splitrule=extratrees, min.node.size=5   
## - Fold2: mtry=4, splitrule=extratrees, min.node.size=5   
## + Fold3: mtry=1, splitrule=gini, min.node.size=1   
## - Fold3: mtry=1, splitrule=gini, min.node.size=1   
## + Fold3: mtry=2, splitrule=gini, min.node.size=1   
## - Fold3: mtry=2, splitrule=gini, min.node.size=1   
## + Fold3: mtry=3, splitrule=gini, min.node.size=1   
## - Fold3: mtry=3, splitrule=gini, min.node.size=1   
## + Fold3: mtry=4, splitrule=gini, min.node.size=1   
## - Fold3: mtry=4, splitrule=gini, min.node.size=1   
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## - Fold3: mtry=3, splitrule=gini, min.node.size=2   
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## - Fold3: mtry=2, splitrule=gini, min.node.size=3   
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## - Fold3: mtry=4, splitrule=gini, min.node.size=3   
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## - Fold3: mtry=2, splitrule=gini, min.node.size=5   
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## + Fold4: mtry=3, splitrule=gini, min.node.size=3   
## - Fold4: mtry=3, splitrule=gini, min.node.size=3   
## + Fold4: mtry=4, splitrule=gini, min.node.size=3   
## - Fold4: mtry=4, splitrule=gini, min.node.size=3   
## + Fold4: mtry=1, splitrule=extratrees, min.node.size=3   
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## - Fold4: mtry=2, splitrule=gini, min.node.size=4   
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## - Fold4: mtry=2, splitrule=gini, min.node.size=5   
## + Fold4: mtry=3, splitrule=gini, min.node.size=5   
## - Fold4: mtry=3, splitrule=gini, min.node.size=5   
## + Fold4: mtry=4, splitrule=gini, min.node.size=5   
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## - Fold5: mtry=1, splitrule=gini, min.node.size=1   
## + Fold5: mtry=2, splitrule=gini, min.node.size=1   
## - Fold5: mtry=2, splitrule=gini, min.node.size=1   
## + Fold5: mtry=3, splitrule=gini, min.node.size=1   
## - Fold5: mtry=3, splitrule=gini, min.node.size=1   
## + Fold5: mtry=4, splitrule=gini, min.node.size=1   
## - Fold5: mtry=4, splitrule=gini, min.node.size=1   
## + Fold5: mtry=1, splitrule=extratrees, min.node.size=1   
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## - Fold5: mtry=3, splitrule=gini, min.node.size=2   
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## - Fold5: mtry=4, splitrule=gini, min.node.size=2   
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## - Fold5: mtry=3, splitrule=extratrees, min.node.size=2   
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## + Fold5: mtry=2, splitrule=gini, min.node.size=3   
## - Fold5: mtry=2, splitrule=gini, min.node.size=3   
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## - Fold5: mtry=2, splitrule=gini, min.node.size=4   
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## - Fold5: mtry=3, splitrule=extratrees, min.node.size=4   
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## + Fold5: mtry=1, splitrule=gini, min.node.size=5   
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## - Fold5: mtry=4, splitrule=extratrees, min.node.size=5   
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## - Fold6: mtry=1, splitrule=gini, min.node.size=1   
## + Fold6: mtry=2, splitrule=gini, min.node.size=1   
## - Fold6: mtry=2, splitrule=gini, min.node.size=1   
## + Fold6: mtry=3, splitrule=gini, min.node.size=1   
## - Fold6: mtry=3, splitrule=gini, min.node.size=1   
## + Fold6: mtry=4, splitrule=gini, min.node.size=1   
## - Fold6: mtry=4, splitrule=gini, min.node.size=1   
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## - Fold6: mtry=1, splitrule=extratrees, min.node.size=1   
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## - Fold6: mtry=3, splitrule=gini, min.node.size=2   
## + Fold6: mtry=4, splitrule=gini, min.node.size=2   
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## - Fold6: mtry=4, splitrule=extratrees, min.node.size=2   
## + Fold6: mtry=1, splitrule=gini, min.node.size=3   
## - Fold6: mtry=1, splitrule=gini, min.node.size=3   
## + Fold6: mtry=2, splitrule=gini, min.node.size=3   
## - Fold6: mtry=2, splitrule=gini, min.node.size=3   
## + Fold6: mtry=3, splitrule=gini, min.node.size=3   
## - Fold6: mtry=3, splitrule=gini, min.node.size=3   
## + Fold6: mtry=4, splitrule=gini, min.node.size=3   
## - Fold6: mtry=4, splitrule=gini, min.node.size=3   
## + Fold6: mtry=1, splitrule=extratrees, min.node.size=3   
## - Fold6: mtry=1, splitrule=extratrees, min.node.size=3   
## + Fold6: mtry=2, splitrule=extratrees, min.node.size=3   
## - Fold6: mtry=2, splitrule=extratrees, min.node.size=3   
## + Fold6: mtry=3, splitrule=extratrees, min.node.size=3   
## - Fold6: mtry=3, splitrule=extratrees, min.node.size=3   
## + Fold6: mtry=4, splitrule=extratrees, min.node.size=3   
## - Fold6: mtry=4, splitrule=extratrees, min.node.size=3   
## + Fold6: mtry=1, splitrule=gini, min.node.size=4   
## - Fold6: mtry=1, splitrule=gini, min.node.size=4   
## + Fold6: mtry=2, splitrule=gini, min.node.size=4   
## - Fold6: mtry=2, splitrule=gini, min.node.size=4   
## + Fold6: mtry=3, splitrule=gini, min.node.size=4   
## - Fold6: mtry=3, splitrule=gini, min.node.size=4   
## + Fold6: mtry=4, splitrule=gini, min.node.size=4   
## - Fold6: mtry=4, splitrule=gini, min.node.size=4   
## + Fold6: mtry=1, splitrule=extratrees, min.node.size=4   
## - Fold6: mtry=1, splitrule=extratrees, min.node.size=4   
## + Fold6: mtry=2, splitrule=extratrees, min.node.size=4   
## - Fold6: mtry=2, splitrule=extratrees, min.node.size=4   
## + Fold6: mtry=3, splitrule=extratrees, min.node.size=4   
## - Fold6: mtry=3, splitrule=extratrees, min.node.size=4   
## + Fold6: mtry=4, splitrule=extratrees, min.node.size=4   
## - Fold6: mtry=4, splitrule=extratrees, min.node.size=4   
## + Fold6: mtry=1, splitrule=gini, min.node.size=5   
## - Fold6: mtry=1, splitrule=gini, min.node.size=5   
## + Fold6: mtry=2, splitrule=gini, min.node.size=5   
## - Fold6: mtry=2, splitrule=gini, min.node.size=5   
## + Fold6: mtry=3, splitrule=gini, min.node.size=5   
## - Fold6: mtry=3, splitrule=gini, min.node.size=5   
## + Fold6: mtry=4, splitrule=gini, min.node.size=5   
## - Fold6: mtry=4, splitrule=gini, min.node.size=5   
## + Fold6: mtry=1, splitrule=extratrees, min.node.size=5   
## - Fold6: mtry=1, splitrule=extratrees, min.node.size=5   
## + Fold6: mtry=2, splitrule=extratrees, min.node.size=5   
## - Fold6: mtry=2, splitrule=extratrees, min.node.size=5   
## + Fold6: mtry=3, splitrule=extratrees, min.node.size=5   
## - Fold6: mtry=3, splitrule=extratrees, min.node.size=5   
## + Fold6: mtry=4, splitrule=extratrees, min.node.size=5   
## - Fold6: mtry=4, splitrule=extratrees, min.node.size=5   
## + Fold7: mtry=1, splitrule=gini, min.node.size=1   
## - Fold7: mtry=1, splitrule=gini, min.node.size=1   
## + Fold7: mtry=2, splitrule=gini, min.node.size=1   
## - Fold7: mtry=2, splitrule=gini, min.node.size=1   
## + Fold7: mtry=3, splitrule=gini, min.node.size=1   
## - Fold7: mtry=3, splitrule=gini, min.node.size=1   
## + Fold7: mtry=4, splitrule=gini, min.node.size=1   
## - Fold7: mtry=4, splitrule=gini, min.node.size=1   
## + Fold7: mtry=1, splitrule=extratrees, min.node.size=1   
## - Fold7: mtry=1, splitrule=extratrees, min.node.size=1   
## + Fold7: mtry=2, splitrule=extratrees, min.node.size=1   
## - Fold7: mtry=2, splitrule=extratrees, min.node.size=1   
## + Fold7: mtry=3, splitrule=extratrees, min.node.size=1   
## - Fold7: mtry=3, splitrule=extratrees, min.node.size=1   
## + Fold7: mtry=4, splitrule=extratrees, min.node.size=1   
## - Fold7: mtry=4, splitrule=extratrees, min.node.size=1   
## + Fold7: mtry=1, splitrule=gini, min.node.size=2   
## - Fold7: mtry=1, splitrule=gini, min.node.size=2   
## + Fold7: mtry=2, splitrule=gini, min.node.size=2   
## - Fold7: mtry=2, splitrule=gini, min.node.size=2   
## + Fold7: mtry=3, splitrule=gini, min.node.size=2   
## - Fold7: mtry=3, splitrule=gini, min.node.size=2   
## + Fold7: mtry=4, splitrule=gini, min.node.size=2   
## - Fold7: mtry=4, splitrule=gini, min.node.size=2   
## + Fold7: mtry=1, splitrule=extratrees, min.node.size=2   
## - Fold7: mtry=1, splitrule=extratrees, min.node.size=2   
## + Fold7: mtry=2, splitrule=extratrees, min.node.size=2   
## - Fold7: mtry=2, splitrule=extratrees, min.node.size=2   
## + Fold7: mtry=3, splitrule=extratrees, min.node.size=2   
## - Fold7: mtry=3, splitrule=extratrees, min.node.size=2   
## + Fold7: mtry=4, splitrule=extratrees, min.node.size=2   
## - Fold7: mtry=4, splitrule=extratrees, min.node.size=2   
## + Fold7: mtry=1, splitrule=gini, min.node.size=3   
## - Fold7: mtry=1, splitrule=gini, min.node.size=3   
## + Fold7: mtry=2, splitrule=gini, min.node.size=3   
## - Fold7: mtry=2, splitrule=gini, min.node.size=3   
## + Fold7: mtry=3, splitrule=gini, min.node.size=3   
## - Fold7: mtry=3, splitrule=gini, min.node.size=3   
## + Fold7: mtry=4, splitrule=gini, min.node.size=3   
## - Fold7: mtry=4, splitrule=gini, min.node.size=3   
## + Fold7: mtry=1, splitrule=extratrees, min.node.size=3   
## - Fold7: mtry=1, splitrule=extratrees, min.node.size=3   
## + Fold7: mtry=2, splitrule=extratrees, min.node.size=3   
## - Fold7: mtry=2, splitrule=extratrees, min.node.size=3   
## + Fold7: mtry=3, splitrule=extratrees, min.node.size=3   
## - Fold7: mtry=3, splitrule=extratrees, min.node.size=3   
## + Fold7: mtry=4, splitrule=extratrees, min.node.size=3   
## - Fold7: mtry=4, splitrule=extratrees, min.node.size=3   
## + Fold7: mtry=1, splitrule=gini, min.node.size=4   
## - Fold7: mtry=1, splitrule=gini, min.node.size=4   
## + Fold7: mtry=2, splitrule=gini, min.node.size=4   
## - Fold7: mtry=2, splitrule=gini, min.node.size=4   
## + Fold7: mtry=3, splitrule=gini, min.node.size=4   
## - Fold7: mtry=3, splitrule=gini, min.node.size=4   
## + Fold7: mtry=4, splitrule=gini, min.node.size=4   
## - Fold7: mtry=4, splitrule=gini, min.node.size=4   
## + Fold7: mtry=1, splitrule=extratrees, min.node.size=4   
## - Fold7: mtry=1, splitrule=extratrees, min.node.size=4   
## + Fold7: mtry=2, splitrule=extratrees, min.node.size=4   
## - Fold7: mtry=2, splitrule=extratrees, min.node.size=4   
## + Fold7: mtry=3, splitrule=extratrees, min.node.size=4   
## - Fold7: mtry=3, splitrule=extratrees, min.node.size=4   
## + Fold7: mtry=4, splitrule=extratrees, min.node.size=4   
## - Fold7: mtry=4, splitrule=extratrees, min.node.size=4   
## + Fold7: mtry=1, splitrule=gini, min.node.size=5   
## - Fold7: mtry=1, splitrule=gini, min.node.size=5   
## + Fold7: mtry=2, splitrule=gini, min.node.size=5   
## - Fold7: mtry=2, splitrule=gini, min.node.size=5   
## + Fold7: mtry=3, splitrule=gini, min.node.size=5   
## - Fold7: mtry=3, splitrule=gini, min.node.size=5   
## + Fold7: mtry=4, splitrule=gini, min.node.size=5   
## - Fold7: mtry=4, splitrule=gini, min.node.size=5   
## + Fold7: mtry=1, splitrule=extratrees, min.node.size=5   
## - Fold7: mtry=1, splitrule=extratrees, min.node.size=5   
## + Fold7: mtry=2, splitrule=extratrees, min.node.size=5   
## - Fold7: mtry=2, splitrule=extratrees, min.node.size=5   
## + Fold7: mtry=3, splitrule=extratrees, min.node.size=5   
## - Fold7: mtry=3, splitrule=extratrees, min.node.size=5   
## + Fold7: mtry=4, splitrule=extratrees, min.node.size=5   
## - Fold7: mtry=4, splitrule=extratrees, min.node.size=5   
## Aggregating results  
## Selecting tuning parameters  
## Fitting mtry = 3, splitrule = gini, min.node.size = 2 on full training set

RandForestAdult2

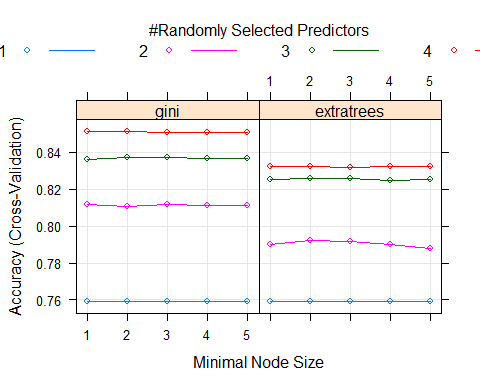
## Random Forest   
##   
## 32561 samples  
## 14 predictor  
## 2 classes: ' <=50K', ' >50K'   
##   
## No pre-processing  
## Resampling: Cross-Validated (7 fold)   
## Summary of sample sizes: 27910, 27910, 27910, 27909, 27910, 27909, ...   
## Resampling results across tuning parameters:  
##   
## mtry splitrule min.node.size Accuracy Kappa   
## 1 gini 1 0.7591904 0.0000000  
## 1 gini 2 0.7591904 0.0000000  
## 1 gini 3 0.7591904 0.0000000  
## 1 gini 4 0.7591904 0.0000000  
## 1 gini 5 0.7591904 0.0000000  
## 1 extratrees 1 0.7591904 0.0000000  
## 1 extratrees 2 0.7591904 0.0000000  
## 1 extratrees 3 0.7591904 0.0000000  
## 1 extratrees 4 0.7591904 0.0000000  
## 1 extratrees 5 0.7591904 0.0000000  
## 2 gini 1 0.8119224 0.3219103  
## 2 gini 2 0.8106935 0.3155876  
## 2 gini 3 0.8115229 0.3201292  
## 2 gini 4 0.8112156 0.3185479  
## 2 gini 5 0.8110932 0.3176958  
## 2 extratrees 1 0.7899945 0.1963723  
## 2 extratrees 2 0.7920825 0.2110316  
## 2 extratrees 3 0.7916218 0.2055159  
## 2 extratrees 4 0.7899632 0.1963854  
## 2 extratrees 5 0.7878446 0.1846385  
## 3 gini 1 0.8361845 0.4673706  
## 3 gini 2 0.8369523 0.4701343  
## 3 gini 3 0.8369523 0.4694515  
## 3 gini 4 0.8365838 0.4686853  
## 3 gini 5 0.8363688 0.4678398  
## 3 extratrees 1 0.8252514 0.4233156  
## 3 extratrees 2 0.8256507 0.4249114  
## 3 extratrees 3 0.8255277 0.4250817  
## 3 extratrees 4 0.8246984 0.4201666  
## 3 extratrees 5 0.8254970 0.4247012  
## 4 gini 1 0.8510182 0.5364157  
## 4 gini 2 0.8512025 0.5381419  
## 4 gini 3 0.8505884 0.5357759  
## 4 gini 4 0.8504654 0.5361749  
## 4 gini 5 0.8507418 0.5368785  
## 4 extratrees 1 0.8321307 0.4702788  
## 4 extratrees 2 0.8322535 0.4707548  
## 4 extratrees 3 0.8317927 0.4697471  
## 4 extratrees 4 0.8325299 0.4732126  
## 4 extratrees 5 0.8325606 0.4724195  
##   
## Accuracy was used to select the optimal model using the largest value.  
## The final values used for the model were mtry = 4, splitrule = gini  
## and min.node.size = 2.

RandForestTitanic2

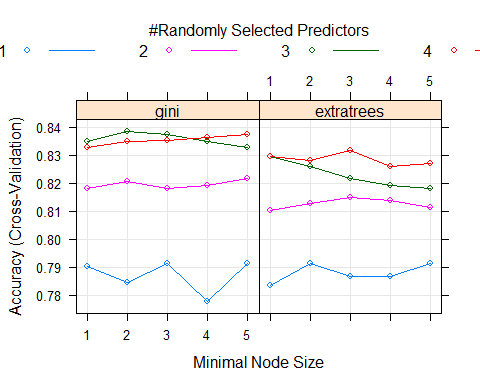
## Random Forest   
##   
## 891 samples  
## 7 predictor  
## 2 classes: '0', '1'   
##   
## No pre-processing  
## Resampling: Cross-Validated (7 fold)   
## Summary of sample sizes: 763, 764, 764, 764, 764, 763, ...   
## Resampling results across tuning parameters:  
##   
## mtry splitrule min.node.size Accuracy Kappa   
## 1 gini 1 0.7901874 0.5170405  
## 1 gini 2 0.7845367 0.5044745  
## 1 gini 3 0.7912419 0.5206432  
## 1 gini 4 0.7778139 0.4864488  
## 1 gini 5 0.7912859 0.5202206  
## 1 extratrees 1 0.7834206 0.5011067  
## 1 extratrees 2 0.7913034 0.5188650  
## 1 extratrees 3 0.7867864 0.5070492  
## 1 extratrees 4 0.7867864 0.5065802  
## 1 extratrees 5 0.7912595 0.5187859  
## 2 gini 1 0.8181682 0.5982639  
## 2 gini 2 0.8204355 0.6029681  
## 2 gini 3 0.8181770 0.5981905  
## 2 gini 4 0.8193107 0.6010409  
## 2 gini 5 0.8215340 0.6061496  
## 2 extratrees 1 0.8103294 0.5762137  
## 2 extratrees 2 0.8125791 0.5805530  
## 2 extratrees 3 0.8148200 0.5856423  
## 2 extratrees 4 0.8136864 0.5845584  
## 2 extratrees 5 0.8114279 0.5782465  
## 3 gini 1 0.8349972 0.6415488  
## 3 gini 2 0.8383806 0.6484400  
## 3 gini 3 0.8372645 0.6462871  
## 3 gini 4 0.8350060 0.6416451  
## 3 gini 5 0.8327738 0.6353937  
## 3 extratrees 1 0.8293905 0.6216885  
## 3 extratrees 2 0.8260247 0.6136793  
## 3 extratrees 3 0.8215340 0.6047550  
## 3 extratrees 4 0.8193019 0.5993812  
## 3 extratrees 5 0.8181682 0.5966943  
## 4 gini 1 0.8327475 0.6401354  
## 4 gini 2 0.8350236 0.6433447  
## 4 gini 3 0.8350323 0.6434496  
## 4 gini 4 0.8361308 0.6446631  
## 4 gini 5 0.8372645 0.6470560  
## 4 extratrees 1 0.8293729 0.6263352  
## 4 extratrees 2 0.8282480 0.6227082  
## 4 extratrees 3 0.8316226 0.6298649  
## 4 extratrees 4 0.8260071 0.6173850  
## 4 extratrees 5 0.8271407 0.6201357  
##   
## Accuracy was used to select the optimal model using the largest value.  
## The final values used for the model were mtry = 3, splitrule = gini  
## and min.node.size = 2.

# Question 7

plot(RandForestAdult2)

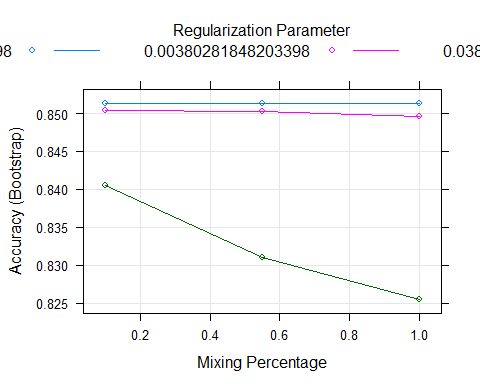


plot(RandForestTitanic2)

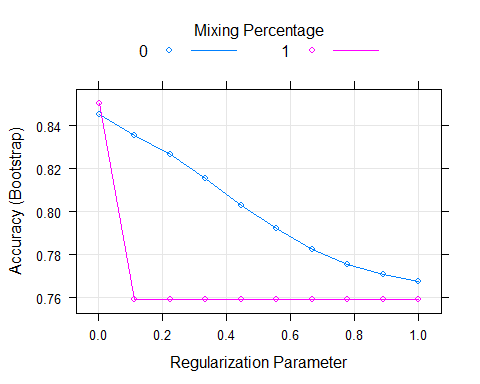


# Question 8

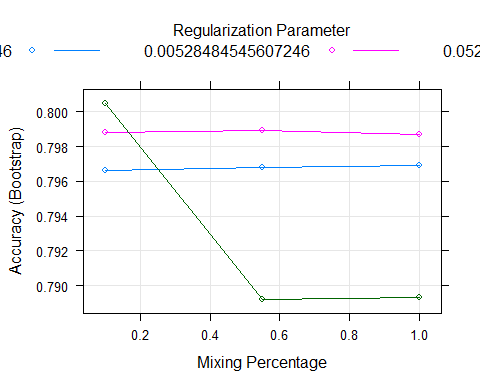
myGrid3=expand.grid(.alpha=0:1,.lambda=seq(0.001,1,length=10))  
   
GLMAdultModel<- train(Incomeclass~., data=adult, method="glmnet")  
GLMAdultModel2<- train(Incomeclass~., data=adult, method="glmnet", tuneGrid=myGrid3)  
  
GLMTitanicModel<- train(Survived~., data=titanic, method="glmnet")  
GLMTitanicModel2<- train(Survived~., data=titanic, method="glmnet", tuneGrid=myGrid3)  
  
plot(GLMAdultModel)



plot(GLMAdultModel2)



plot(GLMTitanicModel)



plot(GLMTitanicModel2)

