Homework2

Soumith

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#install.packages(‘caTools’) #library(caTools) #cereal\_data=read.csv(file = ‘cereal.csv’) #cereal\_data #split= sample.split(cereal\_data, SplitRatio = 0.8) #training\_data = subset(cereal\_data,split == TRUE) #test\_set = subset(cereal\_data, split == FALSE)

rm(list=ls())  
setwd('C:/Users/Soumith/Desktop/rr/Assignment 2')  
cereal\_data=read.csv(file = 'cereal.csv')  
sum(is.na(cereal\_data))

## [1] 0

cereal\_data$carbo[cereal\_data$carbo < 0] <- 0  
cereal\_data$sugars[cereal\_data$sugars < 0] <- 0  
cereal\_data$potass[cereal\_data$potass < 0] <- 0  
cereal\_1 = cereal\_data[,4:16]  
set.seed(1)  
split = sample(1:nrow(cereal\_1), 1/5\*nrow(cereal\_1))  
test = cereal\_1[split,]  
train = cereal\_1[-split,]  
training = lm(rating ~ ., train)  
p=predict(training,newdata = test)  
err = test$rating - p  
MSE = mean(err\*\*2)  
MSE

## [1] 0.0009675376

#### 1b #######  
library(leaps)

## Warning: package 'leaps' was built under R version 4.1.1

?regsubsets

## starting httpd help server ... done

f\_subset = regsubsets(rating ~ ., data = train,method = "forward",nvmax=13,nbest = 1)  
with(summary(f\_subset), data.frame(adjr2))

## adjr2  
## 1 0.5519381  
## 2 0.7928761  
## 3 0.8938994  
## 4 0.9612709  
## 5 0.9678830  
## 6 0.9739418  
## 7 0.9905745  
## 8 0.9959260  
## 9 0.9999977  
## 10 0.9999978  
## 11 0.9999978  
## 12 0.9999978

##### 1c

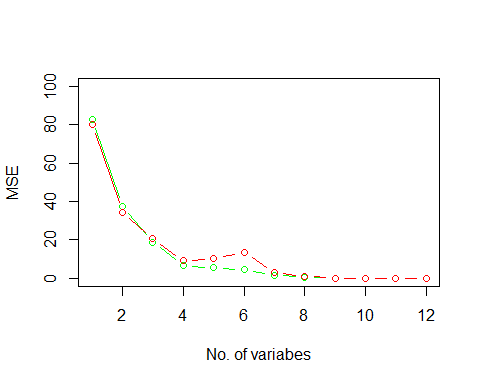
train\_m = regsubsets(rating ~ ., data = train,method="exhaustive",nvmax=13)  
with(summary(train\_m), data.frame(adjr2))

## adjr2  
## 1 0.5519381  
## 2 0.7928761  
## 3 0.8938994  
## 4 0.9612709  
## 5 0.9733921  
## 6 0.9838712  
## 7 0.9905745  
## 8 0.9959260  
## 9 0.9999977  
## 10 0.9999978  
## 11 0.9999978  
## 12 0.9999978

predict.regsubsets = function(object, newdata, id) {  
 form = as.formula(object$call[[2]])  
 mat = model.matrix(form, newdata)  
 coefi = coef(object, id = id)  
 mat[, names(coefi)] %\*% coefi  
}  
  
train\_r = train$rating  
test\_r = test$rating  
train\_error\_f = matrix(rep(NA,12))  
test\_error\_f = matrix(rep(NA,12))  
  
for(i in 1:12){  
 rp\_train = predict(f\_subset,train,id=i)  
 rp\_test = predict(f\_subset,test,id=i)  
   
 train\_error\_f[i] = (sum((train\_r-rp\_train)^2)/length(train\_r))  
 test\_error\_f[i] = (sum((test\_r-rp\_test)^2)/length(test\_r))  
}  
?regsubsets  
min(train\_error\_f)

## [1] 0.0003337237

plot(train\_error\_f,col = "green", type= "b", xlab = "No. of variabes",ylab = "MSE", ylim = c(0,100))  
lines(test\_error\_f,col="red",type="b")



test\_error\_f = na.omit(test\_error\_f)  
which(test\_error\_f == min(test\_error\_f))

## [1] 12

train\_error\_e = matrix(rep(NA,12))  
test\_error\_e = matrix(rep(NA,12))  
for(i in 1:12){  
 rpt\_train = predict(train\_m,train,id=i)  
 rpt\_test = predict(train\_m,test,id=i)  
   
 train\_error\_e[i] = (sum((train\_r-rpt\_train)^2)/length(train\_r))  
 test\_error\_e[i] = (sum((test\_r-rpt\_test)^2)/length(test\_r))  
}  
  
min(train\_error\_e)

## [1] 0.0003337237

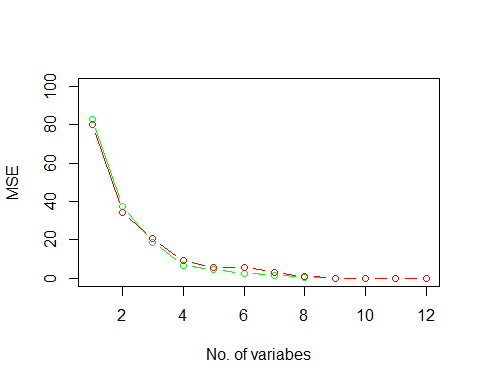
plot(train\_error\_e,col = "green", type= "b", xlab = "No. of variabes",ylab = "MSE", ylim = c(0,100))  
lines(test\_error\_e,col="red",type="b")  
  
library(caret)

## Warning: package 'caret' was built under R version 4.1.1

## Loading required package: ggplot2

## Warning: package 'ggplot2' was built under R version 4.1.1

## Loading required package: lattice



load('zip.train.rdata')  
load('zip.test.rdata')  
trainzip = zip.train[which(zip.train[,1] == 4 | zip.train[,1] == 7),]  
testzip = zip.test[which(zip.test[,1] == 4 | zip.test[,1] == 7),]  
  
trainzip[which(trainzip[,1] == 4),1] = 0  
trainzip[which(trainzip[,1] == 7),1] = 1  
testzip[which(testzip[,1] == 7),1] = 1  
testzip[which(testzip[,1] == 4),1] = 0  
train.zip = data.frame(trainzip)  
test.zip = data.frame(testzip)  
m = as.factor(test.zip[,1])  
linear = lm(X1~.,train.zip)  
  
pre=predict(linear,newdata = test.zip)

## Warning in predict.lm(linear, newdata = test.zip): prediction from a rank-  
## deficient fit may be misleading

pre[pre<0]=0  
n = as.factor(round(pre))  
cf = confusionMatrix(data=n,reference = m)  
cf$overall[1]

## Accuracy   
## 0.9711816

#2Q #Accuracy(cf)

library(class)  
acc = c()  
km =c()  
k = c(1,3,5,7,9,11,13,15)  
for(i in 1:8){  
 i  
 knn\_model = knn(train.zip[,-c(1)],test.zip[,-c(1)],as.factor(trainzip[,1]),k =k[i])  
 c =confusionMatrix(data=m,knn\_model)  
 acc[i]=c$overall[1]  
 km[i]=i  
}  
  
acc

## [1] 0.9769452 0.9798271 0.9798271 0.9740634 0.9711816 0.9711816 0.9682997  
## [8] 0.9740634

km

## [1] 1 2 3 4 5 6 7 8

################################3########################################  
  
  
rm(list = ls())  
  
## installing 'ISLR' package  
#install.packages('ISLR')  
  
library(ISLR)

## Warning: package 'ISLR' was built under R version 4.1.1

##loading College dataset  
data(College)  
College$Private <- as.numeric(College$Private)  
  
  
  
## print first 6 rows of dataset  
head(College)

## Private Apps Accept Enroll Top10perc Top25perc  
## Abilene Christian University 2 1660 1232 721 23 52  
## Adelphi University 2 2186 1924 512 16 29  
## Adrian College 2 1428 1097 336 22 50  
## Agnes Scott College 2 417 349 137 60 89  
## Alaska Pacific University 2 193 146 55 16 44  
## Albertson College 2 587 479 158 38 62  
## F.Undergrad P.Undergrad Outstate Room.Board Books  
## Abilene Christian University 2885 537 7440 3300 450  
## Adelphi University 2683 1227 12280 6450 750  
## Adrian College 1036 99 11250 3750 400  
## Agnes Scott College 510 63 12960 5450 450  
## Alaska Pacific University 249 869 7560 4120 800  
## Albertson College 678 41 13500 3335 500  
## Personal PhD Terminal S.F.Ratio perc.alumni Expend  
## Abilene Christian University 2200 70 78 18.1 12 7041  
## Adelphi University 1500 29 30 12.2 16 10527  
## Adrian College 1165 53 66 12.9 30 8735  
## Agnes Scott College 875 92 97 7.7 37 19016  
## Alaska Pacific University 1500 76 72 11.9 2 10922  
## Albertson College 675 67 73 9.4 11 9727  
## Grad.Rate  
## Abilene Christian University 60  
## Adelphi University 56  
## Adrian College 54  
## Agnes Scott College 59  
## Alaska Pacific University 15  
## Albertson College 55

## split cereal dataset into training(70%) and testing(30%) dataset  
  
set.seed(123) ##set seed so that we get different test and training dataset in future  
train <- sample(c(0,1:length(College$Apps)), size = 0.7\*length(College$Apps))  
train\_dataset <- College[train, ]  
dim(train\_dataset)

## [1] 543 18

test\_dataset <- College[-train, ]  
dim(test\_dataset)

## [1] 234 18

## 3a)   
  
linear\_model <- lm(Apps ~ ., data = train\_dataset)  
summary\_train\_dataset <- summary(linear\_model)  
mean(summary\_train\_dataset$residuals^2)

## [1] 940159.2

Apps\_predicted <- predict(linear\_model, test\_dataset, se.fit = TRUE)  
mean((Apps\_predicted$fit - test\_dataset$Apps)^2)

## [1] 1769742

## b)   
  
#installing gnmlet library which used for ridge regression  
#install.packages("glmnet")  
  
library(glmnet)

## Warning: package 'glmnet' was built under R version 4.1.1

## Loading required package: Matrix

## Loaded glmnet 4.1-2

#eliminating last column from training dataset and testing dataset   
x\_train <- train\_dataset[, -c(2)]  
x\_test <- test\_dataset[, -c(2)]  
  
  
##converting dataset into martix  
x\_test <- data.matrix(x\_test)  
x\_train <- data.matrix(x\_train)  
  
y\_train <- train\_dataset[, 2]  
y\_test <- test\_dataset[, 2]  
  
## Implementing ridge regression model using glmnet  
ridge\_model = glmnet(x\_train, y\_train, alpha=0, nlambda = 150)  
  
coef(ridge\_model)

## 18 x 150 sparse Matrix of class "dgCMatrix"

## [[ suppressing 150 column names 's0', 's1', 's2' ... ]]

##   
## (Intercept) 2.837492e+03 2.799069e+03 2.796635e+03 2.794048e+03  
## Private -3.238197e-33 -3.663144e+00 -3.895469e+00 -4.142444e+00  
## Accept 1.484746e-36 1.680827e-03 1.787512e-03 1.900937e-03  
## Enroll 3.500881e-36 3.962107e-03 4.213516e-03 4.480795e-03  
## Top10perc 8.748202e-35 9.891011e-02 1.051797e-01 1.118442e-01  
## Top25perc 7.147988e-35 8.076692e-02 8.588305e-02 9.132099e-02  
## F.Undergrad 6.277718e-37 7.104086e-04 7.554817e-04 8.033994e-04  
## P.Undergrad 8.412354e-37 9.511961e-04 1.011494e-03 1.075590e-03  
## Outstate 9.907567e-38 1.118932e-04 1.189774e-04 1.265067e-04  
## Room.Board 7.071396e-37 7.997286e-04 8.504356e-04 9.043384e-04  
## Books 2.892120e-36 3.266491e-03 3.473311e-03 3.693127e-03  
## Personal 9.112234e-37 1.030220e-03 1.095519e-03 1.164931e-03  
## PhD 8.434219e-35 9.522329e-02 1.012499e-01 1.076550e-01  
## Terminal 9.109618e-35 1.028346e-01 1.093421e-01 1.162579e-01  
## S.F.Ratio 4.467012e-35 5.065865e-02 5.388004e-02 5.730567e-02  
## perc.alumni -1.259497e-35 -1.439152e-02 -1.531397e-02 -1.629586e-02  
## Expend 2.259861e-37 2.555809e-04 2.717865e-04 2.890134e-04  
## Grad.Rate 3.428791e-35 3.877784e-02 4.123660e-02 4.385032e-02  
##   
## (Intercept) 2.791298e+03 2.788376e+03 2.785270e+03 2.781969e+03  
## Private -4.404982e+00 -4.684051e+00 -4.980677e+00 -5.295949e+00  
## Accept 2.021522e-03 2.149713e-03 2.285986e-03 2.430843e-03  
## Enroll 4.764935e-03 5.066986e-03 5.388064e-03 5.729352e-03  
## Top10perc 1.189282e-01 1.264576e-01 1.344601e-01 1.429649e-01  
## Top25perc 9.710067e-02 1.032432e-01 1.097710e-01 1.167079e-01  
## F.Undergrad 8.543392e-04 9.084893e-04 9.660495e-04 1.027232e-03  
## P.Undergrad 1.143721e-03 1.216137e-03 1.293103e-03 1.374901e-03  
## Outstate 1.345086e-04 1.430124e-04 1.520488e-04 1.616507e-04  
## Room.Board 9.616358e-04 1.022539e-03 1.087271e-03 1.156070e-03  
## Books 3.926743e-03 4.175010e-03 4.438831e-03 4.719161e-03  
## Personal 1.238711e-03 1.317130e-03 1.400475e-03 1.489050e-03  
## PhD 1.144617e-01 1.216950e-01 1.293809e-01 1.375472e-01  
## Terminal 1.236074e-01 1.314172e-01 1.397156e-01 1.485325e-01  
## S.F.Ratio 6.094839e-02 6.482190e-02 6.894069e-02 7.332018e-02  
## perc.alumni -1.734106e-02 -1.845370e-02 -1.963817e-02 -2.089918e-02  
## Expend 3.073253e-04 3.267895e-04 3.474776e-04 3.694654e-04  
## Grad.Rate 4.662866e-02 4.958184e-02 5.272071e-02 5.605676e-02  
##   
## (Intercept) 2.778462e+03 2.774736e+03 2.770777e+03 2.766571e+03  
## Private -5.631022e+00 -5.987118e+00 -6.365533e+00 -6.767640e+00  
## Accept 2.584818e-03 2.748477e-03 2.922420e-03 3.107284e-03  
## Enroll 6.092105e-03 6.477651e-03 6.887402e-03 7.322850e-03  
## Top10perc 1.520030e-01 1.616072e-01 1.718124e-01 1.826553e-01  
## Top25perc 1.240788e-01 1.319106e-01 1.402313e-01 1.490707e-01  
## F.Undergrad 1.092261e-03 1.161375e-03 1.234826e-03 1.312882e-03  
## P.Undergrad 1.461829e-03 1.554203e-03 1.652358e-03 1.756648e-03  
## Outstate 1.718527e-04 1.826915e-04 1.942059e-04 2.064371e-04  
## Room.Board 1.229186e-03 1.306887e-03 1.389453e-03 1.477185e-03  
## Books 5.017013e-03 5.333457e-03 5.669628e-03 6.026724e-03  
## Personal 1.583179e-03 1.683202e-03 1.789483e-03 1.902403e-03  
## PhD 1.462234e-01 1.554405e-01 1.652315e-01 1.756310e-01  
## Terminal 1.578997e-01 1.678505e-01 1.784206e-01 1.896474e-01  
## S.F.Ratio 7.797674e-02 8.292775e-02 8.819165e-02 9.378801e-02  
## perc.alumni -2.224172e-02 -2.367114e-02 -2.519316e-02 -2.681384e-02  
## Expend 3.928332e-04 4.176661e-04 4.440544e-04 4.720935e-04  
## Grad.Rate 5.960220e-02 6.336993e-02 6.737364e-02 7.162783e-02  
##   
## (Intercept) 2.762104e+03 2.757358e+03 2.752318e+03 2.746965e+03  
## Private -7.194893e+00 -7.648831e+00 -8.131084e+00 -8.643375e+00  
## Accept 3.303742e-03 3.512509e-03 3.734341e-03 3.970039e-03  
## Enroll 7.785579e-03 8.277265e-03 8.799684e-03 9.354715e-03  
## Top10perc 1.941749e-01 2.064125e-01 2.194118e-01 2.332189e-01  
## Top25perc 1.584605e-01 1.684340e-01 1.790265e-01 1.902752e-01  
## F.Undergrad 1.395827e-03 1.483960e-03 1.577599e-03 1.677082e-03  
## P.Undergrad 1.867448e-03 1.985156e-03 2.110190e-03 2.242996e-03  
## Outstate 2.194283e-04 2.332257e-04 2.478777e-04 2.634356e-04  
## Room.Board 1.570398e-03 1.669428e-03 1.774629e-03 1.886376e-03  
## Books 6.406015e-03 6.808840e-03 7.236616e-03 7.690840e-03  
## Personal 2.022369e-03 2.149810e-03 2.285180e-03 2.428959e-03  
## PhD 1.866759e-01 1.984050e-01 2.108593e-01 2.240823e-01  
## Terminal 2.015705e-01 2.142317e-01 2.276755e-01 2.419483e-01  
## S.F.Ratio 9.973762e-02 1.060625e-01 1.127861e-01 1.199331e-01  
## perc.alumni -2.853969e-02 -3.037765e-02 -3.233511e-02 -3.442000e-02  
## Expend 5.018847e-04 5.335350e-04 5.671577e-04 6.028727e-04  
## Grad.Rate 7.614785e-02 8.094995e-02 8.605131e-02 9.147014e-02  
##   
## (Intercept) 2.741282e+03 2.735247e+03 2.728841e+03 2.722041e+03  
## Private -9.187528e+00 -9.765469e+00 -1.037924e+01 -1.103098e+01  
## Accept 4.220451e-03 4.486476e-03 4.769063e-03 5.069215e-03  
## Enroll 9.944347e-03 1.057068e-02 1.123595e-02 1.194250e-02  
## Top10perc 2.478825e-01 2.634542e-01 2.799886e-01 2.975430e-01  
## Top25perc 2.022195e-01 2.149010e-01 2.283636e-01 2.426536e-01  
## F.Undergrad 1.782762e-03 1.895019e-03 2.014248e-03 2.140872e-03  
## P.Undergrad 2.384043e-03 2.533827e-03 2.692872e-03 2.861731e-03  
## Outstate 2.799535e-04 2.974885e-04 3.161009e-04 3.358542e-04  
## Room.Board 2.005065e-03 2.131116e-03 2.264972e-03 2.407100e-03  
## Books 8.173091e-03 8.685034e-03 9.228429e-03 9.805126e-03  
## Personal 2.581654e-03 2.743801e-03 2.915966e-03 3.098747e-03  
## PhD 2.381196e-01 2.530194e-01 2.688325e-01 2.856125e-01  
## Terminal 2.570995e-01 2.731809e-01 2.902473e-01 3.083563e-01  
## S.F.Ratio 1.275299e-01 1.356043e-01 1.441860e-01 1.533061e-01  
## perc.alumni -3.664077e-02 -3.900644e-02 -4.152666e-02 -4.421176e-02  
## Expend 6.408068e-04 6.810940e-04 7.238759e-04 7.693020e-04  
## Grad.Rate 9.722568e-02 1.033382e-01 1.098293e-01 1.167217e-01  
##   
## (Intercept) 2.714824e+03 2.707165e+03 2.699039e+03 2.690418e+03  
## Private -1.172298e+01 -1.245762e+01 -1.323745e+01 -1.406512e+01  
## Accept 5.387996e-03 5.726527e-03 6.085993e-03 6.467646e-03  
## Enroll 1.269283e-02 1.348954e-02 1.433543e-02 1.523341e-02  
## Top10perc 3.161781e-01 3.359579e-01 3.569498e-01 3.792249e-01  
## Top25perc 2.578196e-01 2.739131e-01 2.909882e-01 3.091018e-01  
## F.Undergrad 2.275336e-03 2.418108e-03 2.569685e-03 2.730589e-03  
## P.Undergrad 3.040987e-03 3.231257e-03 3.433189e-03 3.647467e-03  
## Outstate 3.568153e-04 3.790546e-04 4.026464e-04 4.276685e-04  
## Room.Board 2.557995e-03 2.718178e-03 2.888197e-03 3.068633e-03  
## Books 1.041708e-02 1.106633e-02 1.175506e-02 1.248552e-02  
## Personal 3.292774e-03 3.498710e-03 3.717257e-03 3.949152e-03  
## PhD 3.034157e-01 3.223014e-01 3.423318e-01 3.635724e-01  
## Terminal 3.275686e-01 3.479479e-01 3.695611e-01 3.924787e-01  
## S.F.Ratio 1.629980e-01 1.732966e-01 1.842393e-01 1.958653e-01  
## perc.alumni -4.707274e-02 -5.012142e-02 -5.337038e-02 -5.683313e-02  
## Expend 8.175303e-04 8.687273e-04 9.230689e-04 9.807402e-04  
## Grad.Rate 1.240392e-01 1.318072e-01 1.400524e-01 1.488029e-01  
##   
## (Intercept) 2.681274e+03 2.671578e+03 2.661297e+03 2.650398e+03  
## Private -1.494344e+01 -1.587539e+01 -1.686406e+01 -1.791273e+01  
## Accept 6.872808e-03 7.302871e-03 7.759304e-03 8.243656e-03  
## Enroll 1.618657e-02 1.719817e-02 1.827163e-02 1.941055e-02  
## Top10perc 4.028579e-01 4.279276e-01 4.545165e-01 4.827116e-01  
## Top25perc 3.283136e-01 3.486866e-01 3.702866e-01 3.931829e-01  
## F.Undergrad 2.901373e-03 3.082617e-03 3.274935e-03 3.478971e-03  
## P.Undergrad 3.874809e-03 4.115973e-03 4.371754e-03 4.642987e-03  
## Outstate 4.542028e-04 4.823353e-04 5.121562e-04 5.437600e-04  
## Room.Board 3.260097e-03 3.463230e-03 3.678708e-03 3.907244e-03  
## Books 1.326010e-02 1.408131e-02 1.495176e-02 1.587420e-02  
## Personal 4.195169e-03 4.456126e-03 4.732878e-03 5.026326e-03  
## PhD 3.860918e-01 4.099620e-01 4.352583e-01 4.620595e-01  
## Terminal 4.167745e-01 4.425258e-01 4.698134e-01 4.987222e-01  
## S.F.Ratio 2.082163e-01 2.213363e-01 2.352719e-01 2.500721e-01  
## perc.alumni -6.052410e-02 -6.445872e-02 -6.865353e-02 -7.312623e-02  
## Expend 1.041936e-03 1.106863e-03 1.175736e-03 1.248783e-03  
## Grad.Rate 1.580883e-01 1.679398e-01 1.783903e-01 1.894743e-01  
##   
## (Intercept) 2.638848e+03 2.626609e+03 2.613644e+03 2.599914e+03  
## Private -1.902498e+01 -2.020418e+01 -2.145423e+01 -2.277909e+01  
## Accept 8.757611e-03 9.302785e-03 9.881027e-03 1.049423e-02  
## Enroll 2.061880e-02 2.190027e-02 2.325919e-02 2.469998e-02  
## Top10perc 5.126092e-01 5.442956e-01 5.778753e-01 6.134533e-01  
## Top25perc 4.174504e-01 4.431604e-01 4.703942e-01 4.992345e-01  
## F.Undergrad 3.695401e-03 3.924941e-03 4.168338e-03 4.426377e-03  
## P.Undergrad 4.930542e-03 5.235350e-03 5.558369e-03 5.900604e-03  
## Outstate 5.772550e-04 6.127278e-04 6.502944e-04 6.900677e-04  
## Room.Board 4.149599e-03 4.406529e-03 4.678868e-03 4.967479e-03  
## Books 1.685151e-02 1.788667e-02 1.898283e-02 2.014325e-02  
## Personal 5.337405e-03 5.667118e-03 6.016495e-03 6.386616e-03  
## PhD 4.904487e-01 5.205106e-01 5.523354e-01 5.860161e-01  
## Terminal 5.293407e-01 5.617606e-01 5.960782e-01 6.323934e-01  
## S.F.Ratio 2.657877e-01 2.824757e-01 3.001928e-01 3.189999e-01  
## perc.alumni -7.789571e-02 -8.298235e-02 -8.840782e-02 -9.419541e-02  
## Expend 1.326242e-03 1.408365e-03 1.495413e-03 1.587663e-03  
## Grad.Rate 2.012280e-01 2.136895e-01 2.268989e-01 2.408980e-01  
##   
## (Intercept) 2.585378e+03 2.569991e+03 2.553710e+03 2.536489e+03  
## Private -2.418293e+01 -2.567009e+01 -2.724510e+01 -2.891270e+01  
## Accept 1.114440e-02 1.183360e-02 1.256404e-02 1.333800e-02  
## Enroll 2.622724e-02 2.784583e-02 2.956080e-02 3.137745e-02  
## Top10perc 6.511390e-01 6.910470e-01 7.332968e-01 7.780126e-01  
## Top25perc 5.297678e-01 5.620837e-01 5.962757e-01 6.324407e-01  
## F.Undergrad 4.699882e-03 4.989716e-03 5.296781e-03 5.622022e-03  
## P.Undergrad 6.263108e-03 6.646979e-03 7.053362e-03 7.483447e-03  
## Outstate 7.321652e-04 7.767094e-04 8.238277e-04 8.736520e-04  
## Room.Board 5.273264e-03 5.597166e-03 5.940171e-03 6.303308e-03  
## Books 2.137131e-02 2.267055e-02 2.404462e-02 2.549731e-02  
## Personal 6.778612e-03 7.193660e-03 7.632988e-03 8.097870e-03  
## PhD 6.216497e-01 6.593365e-01 6.991804e-01 7.412887e-01  
## Terminal 6.708098e-01 7.114349e-01 7.543797e-01 7.997589e-01  
## S.F.Ratio 3.389610e-01 3.601437e-01 3.826188e-01 4.064609e-01  
## perc.alumni -1.003701e-01 -1.069584e-01 -1.139892e-01 -1.214930e-01  
## Expend 1.685403e-03 1.788935e-03 1.898572e-03 2.014646e-03  
## Grad.Rate 2.557307e-01 2.714428e-01 2.880823e-01 3.056993e-01  
##   
## (Intercept) 2.518279e+03 2.499031e+03 2.478692e+03 2.457212e+03  
## Private -3.067783e+01 -3.254560e+01 -3.452135e+01 -3.661059e+01  
## Accept 1.415788e-02 1.502618e-02 1.594553e-02 1.691865e-02  
## Enroll 3.330133e-02 3.533820e-02 3.749407e-02 3.977522e-02  
## Top10perc 8.253239e-01 8.753649e-01 9.282749e-01 9.841981e-01  
## Top25perc 6.706792e-01 7.110950e-01 7.537954e-01 7.988908e-01  
## F.Undergrad 5.966421e-03 6.331008e-03 6.716850e-03 7.125060e-03  
## P.Undergrad 7.938473e-03 8.419722e-03 8.928524e-03 9.466253e-03  
## Outstate 9.263192e-04 9.819707e-04 1.040753e-03 1.102816e-03  
## Room.Board 6.687647e-03 7.094305e-03 7.524440e-03 7.979255e-03  
## Books 2.703252e-02 2.865428e-02 3.036673e-02 3.217411e-02  
## Personal 8.589631e-03 9.109641e-03 9.659319e-03 1.024013e-02  
## PhD 7.857719e-01 8.327438e-01 8.823209e-01 9.346222e-01  
## Terminal 8.476906e-01 8.982960e-01 9.516991e-01 1.008027e+00  
## S.F.Ratio 4.317480e-01 4.585621e-01 4.869889e-01 5.171181e-01  
## perc.alumni -1.295027e-01 -1.380534e-01 -1.471829e-01 -1.569315e-01  
## Expend 2.137496e-03 2.267481e-03 2.404971e-03 2.550349e-03  
## Grad.Rate 3.243461e-01 3.440768e-01 3.649482e-01 3.870188e-01  
##   
## (Intercept) 2.434534e+03 2.410603e+03 2.385363e+03 2.358755e+03  
## Private -3.881903e+01 -4.115258e+01 -4.361730e+01 -4.621944e+01  
## Accept 1.794837e-02 1.903764e-02 2.018953e-02 2.140721e-02  
## Enroll 4.218814e-02 4.473957e-02 4.743650e-02 5.028615e-02  
## Top10perc 1.043283e+00 1.105684e+00 1.171558e+00 1.241067e+00  
## Top25perc 8.464944e-01 8.967224e-01 9.496935e-01 1.005528e+00  
## F.Undergrad 7.556792e-03 8.013241e-03 8.495646e-03 9.005283e-03  
## P.Undergrad 1.003432e-02 1.063419e-02 1.126736e-02 1.193535e-02  
## Outstate 1.168315e-03 1.237408e-03 1.310258e-03 1.387030e-03  
## Room.Board 8.459997e-03 8.967953e-03 9.504456e-03 1.007087e-02  
## Books 3.408076e-02 3.609109e-02 3.820960e-02 4.044080e-02  
## Personal 1.085357e-02 1.150120e-02 1.218459e-02 1.290535e-02  
## PhD 9.897691e-01 1.047885e+00 1.109093e+00 1.173520e+00  
## Terminal 1.067407e+00 1.129972e+00 1.195852e+00 1.265179e+00  
## S.F.Ratio 5.490431e-01 5.828614e-01 6.186744e-01 6.565872e-01  
## perc.alumni -1.673426e-01 -1.784623e-01 -1.903404e-01 -2.030296e-01  
## Expend 2.704014e-03 2.866377e-03 3.037864e-03 3.218912e-03  
## Grad.Rate 4.103497e-01 4.350037e-01 4.610461e-01 4.885440e-01  
##   
## (Intercept) 2.330720e+03 2.301198e+03 2.270130e+03 2.237455e+03  
## Private -4.896541e+01 -5.186175e+01 -5.491511e+01 -5.813227e+01  
## Accept 2.269397e-02 2.405319e-02 2.548836e-02 2.700308e-02  
## Enroll 5.329596e-02 5.647360e-02 5.982692e-02 6.336399e-02  
## Top10perc 1.314377e+00 1.391657e+00 1.473079e+00 1.558817e+00  
## Top25perc 1.064350e+00 1.126281e+00 1.191446e+00 1.259971e+00  
## F.Undergrad 9.543468e-03 1.011155e-02 1.071093e-02 1.134301e-02  
## P.Undergrad 1.263971e-02 1.338205e-02 1.416395e-02 1.498703e-02  
## Outstate 1.467894e-03 1.553019e-03 1.642580e-03 1.736750e-03  
## Room.Board 1.066862e-02 1.129913e-02 1.196390e-02 1.266442e-02  
## Books 4.278925e-02 4.525952e-02 4.785613e-02 5.058356e-02  
## Personal 1.366513e-02 1.446559e-02 1.530840e-02 1.619524e-02  
## PhD 1.241289e+00 1.312527e+00 1.387355e+00 1.465893e+00  
## Terminal 1.338086e+00 1.414703e+00 1.495158e+00 1.579577e+00  
## S.F.Ratio 6.967089e-01 7.391519e-01 7.840322e-01 8.314689e-01  
## perc.alumni -2.165869e-01 -2.310729e-01 -2.465522e-01 -2.630941e-01  
## Expend 3.409969e-03 3.611499e-03 3.823972e-03 4.047869e-03  
## Grad.Rate 5.175667e-01 5.481852e-01 5.804723e-01 6.145027e-01  
##   
## (Intercept) 2.203113e+03 2.167045e+03 2.129190e+03 2.089493e+03  
## Private -6.152008e+01 -6.508542e+01 -6.883520e+01 -7.277632e+01  
## Accept 2.860104e-02 3.028601e-02 3.206183e-02 3.393243e-02  
## Enroll 6.709303e-02 7.102243e-02 7.516068e-02 7.951640e-02  
## Top10perc 1.649048e+00 1.743948e+00 1.843695e+00 1.948465e+00  
## Top25perc 1.331979e+00 1.407592e+00 1.486932e+00 1.570115e+00  
## F.Undergrad 1.200924e-02 1.271109e-02 1.345006e-02 1.422763e-02  
## P.Undergrad 1.585292e-02 1.676323e-02 1.771956e-02 1.872348e-02  
## Outstate 1.835704e-03 1.939617e-03 2.048663e-03 2.163013e-03  
## Room.Board 1.340224e-02 1.417891e-02 1.499602e-02 1.585514e-02  
## Books 5.344621e-02 5.644833e-02 5.959400e-02 6.288708e-02  
## Personal 1.712778e-02 1.810768e-02 1.913657e-02 2.021604e-02  
## PhD 1.548259e+00 1.634564e+00 1.724914e+00 1.819406e+00  
## Terminal 1.668081e+00 1.760784e+00 1.857795e+00 1.959213e+00  
## S.F.Ratio 8.815840e-01 9.345016e-01 9.903479e-01 1.049250e+00  
## perc.alumni -2.807722e-01 -2.996653e-01 -3.198571e-01 -3.414365e-01  
## Expend 4.283679e-03 4.531898e-03 4.793029e-03 5.067574e-03  
## Grad.Rate 6.503525e-01 6.880990e-01 7.278209e-01 7.695977e-01  
##   
## (Intercept) 2.047898e+03 2.004351e+03 1.958802e+03 1.911204e+03  
## Private -7.691558e+01 -8.125970e+01 -8.581521e+01 -9.058845e+01  
## Accept 3.590179e-02 3.797392e-02 4.015287e-02 4.244272e-02  
## Enroll 8.409824e-02 8.891490e-02 9.397506e-02 9.928732e-02  
## Top10perc 2.058433e+00 2.173772e+00 2.294649e+00 2.421228e+00  
## Top25perc 1.657254e+00 1.748456e+00 1.843821e+00 1.943444e+00  
## F.Undergrad 1.504533e-02 1.590465e-02 1.680710e-02 1.775416e-02  
## P.Undergrad 1.977653e-02 2.088020e-02 2.203590e-02 2.324495e-02  
## Outstate 2.282838e-03 2.408303e-03 2.539570e-03 2.676793e-03  
## Room.Board 1.675788e-02 1.770582e-02 1.870055e-02 1.974365e-02  
## Books 6.633117e-02 6.992951e-02 7.368498e-02 7.759997e-02  
## Personal 2.134762e-02 2.253275e-02 2.377280e-02 2.506902e-02  
## PhD 1.918129e+00 2.021160e+00 2.128564e+00 2.240391e+00  
## Terminal 2.065125e+00 2.175607e+00 2.290719e+00 2.410505e+00  
## S.F.Ratio 1.111337e+00 1.176735e+00 1.245571e+00 1.317970e+00  
## perc.alumni -3.644982e-01 -3.891426e-01 -4.154758e-01 -4.436105e-01  
## Expend 5.356041e-03 5.658934e-03 5.976755e-03 6.310000e-03  
## Grad.Rate 8.135095e-01 8.596371e-01 9.080611e-01 9.588623e-01  
##   
## (Intercept) 1.861516e+03 1.809699e+03 1.755721e+03 1.699558e+03  
## Private -9.558544e+01 -1.008119e+02 -1.062730e+02 -1.119736e+02  
## Accept 4.484752e-02 4.737131e-02 5.001809e-02 5.279179e-02  
## Enroll 1.048602e-01 1.107020e-01 1.168209e-01 1.232247e-01  
## Top10perc 2.553665e+00 2.692107e+00 2.836694e+00 2.987553e+00  
## Top25perc 2.047405e+00 2.155777e+00 2.268619e+00 2.385976e+00  
## F.Undergrad 1.874729e-02 1.978790e-02 2.087736e-02 2.201699e-02  
## P.Undergrad 2.450858e-02 2.582789e-02 2.720383e-02 2.863719e-02  
## Outstate 2.820123e-03 2.969699e-03 3.125656e-03 3.288116e-03  
## Room.Board 2.083666e-02 2.198109e-02 2.317843e-02 2.443007e-02  
## Books 8.167636e-02 8.591541e-02 9.031770e-02 9.488305e-02  
## Personal 2.642251e-02 2.783421e-02 2.930488e-02 3.083507e-02  
## PhD 2.356672e+00 2.477421e+00 2.602630e+00 2.732264e+00  
## Terminal 2.534989e+00 2.664173e+00 2.798036e+00 2.936526e+00  
## S.F.Ratio 1.394050e+00 1.473929e+00 1.557713e+00 1.645504e+00  
## perc.alumni -4.736652e-01 -5.057652e-01 -5.400418e-01 -5.766331e-01  
## Expend 6.659156e-03 7.024699e-03 7.407091e-03 7.806773e-03  
## Grad.Rate 1.012121e+00 1.067916e+00 1.126325e+00 1.187426e+00  
##   
## (Intercept) 1.641190e+03 1.580608e+03 1.517809e+03 1.452803e+03  
## Private -1.179178e+02 -1.241091e+02 -1.305503e+02 -1.372432e+02  
## Accept 5.569624e-02 5.873517e-02 6.191216e-02 6.523062e-02  
## Enroll 1.299209e-01 1.369164e-01 1.442178e-01 1.518310e-01  
## Top10perc 3.144798e+00 3.308528e+00 3.478828e+00 3.655762e+00  
## Top25perc 2.507876e+00 2.634329e+00 2.765325e+00 2.900833e+00  
## F.Undergrad 2.320802e-02 2.445160e-02 2.574877e-02 2.710047e-02  
## P.Undergrad 3.012855e-02 3.167830e-02 3.328657e-02 3.495320e-02  
## Outstate 3.457192e-03 3.632985e-03 3.815584e-03 4.005065e-03  
## Room.Board 2.573740e-02 2.710168e-02 2.852413e-02 3.000587e-02  
## Books 9.961042e-02 1.044978e-01 1.095423e-01 1.147397e-01  
## Personal 3.242506e-02 3.407488e-02 3.578425e-02 3.755254e-02  
## PhD 2.866265e+00 3.004544e+00 3.146980e+00 3.293417e+00  
## Terminal 3.079566e+00 3.227041e+00 3.378805e+00 3.534669e+00  
## S.F.Ratio 1.737391e+00 1.833450e+00 1.933746e+00 2.038322e+00  
## perc.alumni -6.156836e-01 -6.573440e-01 -7.017714e-01 -7.491286e-01  
## Expend 8.224169e-03 8.659676e-03 9.113662e-03 9.586467e-03  
## Grad.Rate 1.251292e+00 1.317996e+00 1.387608e+00 1.460193e+00  
##   
## (Intercept) 1.385607e+03 1.316251e+03 1.244773e+03 1.171234e+03  
## Private -1.441888e+02 -1.513869e+02 -1.588358e+02 -1.665341e+02  
## Accept 6.869376e-02 7.230457e-02 7.606553e-02 7.997959e-02  
## Enroll 1.597614e-01 1.680133e-01 1.765911e-01 1.854968e-01  
## Top10perc 3.839375e+00 4.029692e+00 4.226662e+00 4.430361e+00  
## Top25perc 3.040798e+00 3.185140e+00 3.333759e+00 3.486509e+00  
## F.Undergrad 2.850749e-02 2.997049e-02 3.149008e-02 3.306634e-02  
## P.Undergrad 3.667777e-02 3.845952e-02 4.029743e-02 4.218980e-02  
## Outstate 4.201492e-03 4.404916e-03 4.615449e-03 4.832993e-03  
## Room.Board 3.154789e-02 3.315110e-02 3.481658e-02 3.654446e-02  
## Books 1.200847e-01 1.255707e-01 1.311902e-01 1.369331e-01  
## Personal 3.937875e-02 4.126148e-02 4.319869e-02 4.518842e-02  
## PhD 3.443665e+00 3.597492e+00 3.754642e+00 3.914769e+00  
## Terminal 3.694407e+00 3.857746e+00 4.024381e+00 4.193923e+00  
## S.F.Ratio 2.147204e+00 2.260395e+00 2.377810e+00 2.499508e+00  
## perc.alumni -7.995843e-01 -8.533122e-01 -9.104789e-01 -9.712885e-01  
## Expend 1.007839e-02 1.058971e-02 1.112064e-02 1.167137e-02  
## Grad.Rate 1.535816e+00 1.614536e+00 1.696407e+00 1.781481e+00  
##   
## (Intercept) 1.095697e+03 1018.24370679 9.389688e+02 8.579815e+02  
## Private -1.744776e+02 -182.66109403 -1.910779e+02 -1.997200e+02  
## Accept 8.404864e-02 0.08827449 9.265860e-02 9.720201e-02  
## Enroll 1.947324e-01 0.20429885 2.141957e-01 2.244213e-01  
## Top10perc 4.640692e+00 4.85758116 5.080924e+00 5.310591e+00  
## Top25perc 3.643229e+00 3.80372033 3.967754e+00 4.135067e+00  
## F.Undergrad 3.469951e-02 0.03638949 3.813598e-02 3.993844e-02  
## P.Undergrad 4.413482e-02 0.04613018 4.817308e-02 5.026028e-02  
## Outstate 5.057613e-03 0.00528931 5.528074e-03 5.773883e-03  
## Room.Board 3.833550e-02 0.04019006 4.210837e-02 4.409051e-02  
## Books 1.427889e-01 0.14874516 1.547879e-01 1.609015e-01  
## Personal 4.722771e-02 0.04931322 5.144107e-02 5.360682e-02  
## PhD 4.077526e+00 4.24250393 4.409248e+00 4.577254e+00  
## Terminal 4.365964e+00 4.54003639 4.715617e+00 4.892131e+00  
## S.F.Ratio 2.625358e+00 2.75524460 2.889016e+00 3.026481e+00  
## perc.alumni -1.035917e+00 -1.10455400 -1.177389e+00 -1.254615e+00  
## Expend 1.224203e-02 0.01283272 1.344348e-02 1.407429e-02  
## Grad.Rate 1.869804e+00 1.96141916 2.056362e+00 2.154665e+00  
##   
## (Intercept) 7.754053e+02 6.913784e+02 6.060531e+02 5.195957e+02  
## Private -2.085776e+02 -2.176394e+02 -2.268925e+02 -2.363223e+02  
## Accept 1.019054e-01 1.067690e-01 1.117927e-01 1.169758e-01  
## Enroll 2.349729e-01 2.458464e-01 2.570363e-01 2.685358e-01  
## Top10perc 5.546420e+00 5.788225e+00 6.035788e+00 6.288865e+00  
## Top25perc 4.305362e+00 4.478309e+00 4.653540e+00 4.830658e+00  
## F.Undergrad 4.179609e-02 4.370789e-02 4.567255e-02 4.768852e-02  
## P.Undergrad 5.238803e-02 5.455212e-02 5.674778e-02 5.896978e-02  
## Outstate 6.026709e-03 6.286514e-03 6.553254e-03 6.826882e-03  
## Room.Board 4.613639e-02 4.824577e-02 5.041826e-02 5.265331e-02  
## Books 1.670689e-01 1.732712e-01 1.794881e-01 1.856977e-01  
## Personal 5.580541e-02 5.803122e-02 6.027800e-02 6.253893e-02  
## PhD 4.745969e+00 4.914794e+00 5.083080e+00 5.250136e+00  
## Terminal 5.068948e+00 5.245385e+00 5.420708e+00 5.594130e+00  
## S.F.Ratio 3.167408e+00 3.311525e+00 3.458511e+00 3.608004e+00  
## perc.alumni -1.336422e+00 -1.423001e+00 -1.514538e+00 -1.611219e+00  
## Expend 1.472512e-02 1.539585e-02 1.608632e-02 1.679635e-02  
## Grad.Rate 2.256355e+00 2.361454e+00 2.469977e+00 2.581936e+00  
##   
## (Intercept) 4.321858e+02 3.440159e+02 2.552902e+02 1.662236e+02  
## Private -2.459126e+02 -2.556457e+02 -2.655023e+02 -2.754617e+02  
## Accept 1.223173e-01 1.278157e-01 1.334691e-01 1.392752e-01  
## Enroll 2.803366e-01 2.924291e-01 3.048023e-01 3.174438e-01  
## Top10perc 6.547185e+00 6.810453e+00 7.078350e+00 7.350534e+00  
## Top25perc 5.009229e+00 5.188789e+00 5.368843e+00 5.548866e+00  
## F.Undergrad 4.975395e-02 5.186676e-02 5.402458e-02 5.622479e-02  
## P.Undergrad 6.121236e-02 6.346924e-02 6.573370e-02 6.799853e-02  
## Outstate 7.107345e-03 7.394591e-03 7.688565e-03 7.989212e-03  
## Room.Board 5.495020e-02 5.730808e-02 5.972594e-02 6.220264e-02  
## Books 1.918768e-01 1.980008e-01 2.040438e-01 2.099790e-01  
## Personal 6.480657e-02 6.707295e-02 6.932952e-02 7.156724e-02  
## PhD 5.415225e+00 5.577573e+00 5.736368e+00 5.890767e+00  
## Terminal 5.764820e+00 5.931900e+00 6.094455e+00 6.251534e+00  
## S.F.Ratio 3.759595e+00 3.912830e+00 4.067212e+00 4.222202e+00  
## perc.alumni -1.713222e+00 -1.820720e+00 -1.933878e+00 -2.052853e+00  
## Expend 1.752568e-02 1.827403e-02 1.904109e-02 1.982649e-02  
## Grad.Rate 2.697338e+00 2.816183e+00 2.938467e+00 3.064181e+00  
##   
## (Intercept) 7.704039e+01 -1.202694e+01 -1.007396e+02 -1.888541e+02  
## Private -2.855020e+02 -2.955998e+02 -3.057310e+02 -3.158705e+02  
## Accept 1.452312e-01 1.513340e-01 1.575801e-01 1.639659e-01  
## Enroll 3.303398e-01 3.434755e-01 3.568345e-01 3.703995e-01  
## Top10perc 7.626647e+00 7.906315e+00 8.189149e+00 8.474753e+00  
## Top25perc 5.728308e+00 5.906595e+00 6.083130e+00 6.257301e+00  
## F.Undergrad 5.846450e-02 6.074059e-02 6.304969e-02 6.538824e-02  
## P.Undergrad 7.025607e-02 7.249827e-02 7.471673e-02 7.690269e-02  
## Outstate 8.296479e-03 8.610314e-03 8.930663e-03 9.257475e-03  
## Room.Board 6.473689e-02 6.732726e-02 6.997223e-02 7.267014e-02  
## Books 2.157787e-01 2.214146e-01 2.268579e-01 2.320796e-01  
## Personal 7.377662e-02 7.594776e-02 7.807041e-02 8.013407e-02  
## PhD 6.039902e+00 6.182883e+00 6.318808e+00 6.446767e+00  
## Terminal 6.402157e+00 6.545323e+00 6.680017e+00 6.805215e+00  
## S.F.Ratio 4.377223e+00 4.531663e+00 4.684880e+00 4.836207e+00  
## perc.alumni -2.177790e+00 -2.308825e+00 -2.446079e+00 -2.589661e+00  
## Expend 2.062985e-02 2.145077e-02 2.228882e-02 2.314356e-02  
## Grad.Rate 3.193312e+00 3.325839e+00 3.461738e+00 3.600979e+00  
##   
## (Intercept) -2.761240e+02 -3.623021e+02 -447.14231208 -530.40163873  
## Private -3.259925e+02 -3.360707e+02 -346.07883763 -355.99030687  
## Accept 1.704870e-01 1.771393e-01 0.18391824 0.19081900  
## Enroll 3.841520e-01 3.980727e-01 0.41214126 0.42633668  
## Top10perc 8.762725e+00 9.052661e+00 9.34415872 9.63682384  
## Top25perc 6.428479e+00 6.596026e+00 6.75929564 6.91763983  
## F.Undergrad 6.775245e-02 7.013836e-02 0.07254186 0.07495869  
## P.Undergrad 7.904718e-02 8.114098e-02 0.08317476 0.08513908  
## Outstate 9.590696e-03 9.930268e-03 0.01027613 0.01062820  
## Room.Board 7.541920e-02 7.821754e-02 0.08106316 0.08395398  
## Books 2.370509e-01 2.417432e-01 0.24612890 0.25018100  
## Personal 8.212806e-02 8.404159e-02 0.08586389 0.08758428  
## PhD 6.565854e+00 6.675170e+00 6.77383522 6.86099794  
## Terminal 6.919898e+00 7.023057e+00 7.11370490 7.19088380  
## S.F.Ratio 4.984962e+00 5.130452e+00 5.27198401 5.40887186  
## perc.alumni -2.739664e+00 -2.896167e+00 -3.05922892 -3.22889359  
## Expend 2.401454e-02 2.490132e-02 0.02580345 0.02672049  
## Grad.Rate 3.743525e+00 3.889335e+00 4.03835945 4.19054225  
##   
## (Intercept) -611.84239861 -691.23417350 -768.35579646 -842.99722563  
## Private -365.77892576 -375.41896975 -384.88545584 -394.15439029  
## Accept 0.19783678 0.20496663 0.21220360 0.21954270  
## Enroll 0.44063725 0.45502077 0.46946461 0.48394586  
## Top10perc 9.93027123 10.22413076 10.51805093 10.81170279  
## Top25perc 7.07041085 7.21696625 7.35667268 7.48890969  
## F.Undergrad 0.07738447 0.07981474 0.08224495 0.08467051  
## P.Undergrad 0.08702454 0.08882178 0.09052162 0.09211508  
## Outstate 0.01098640 0.01135062 0.01172074 0.01209659  
## Room.Board 0.08688779 0.08986229 0.09287508 0.09592364  
## Books 0.25387398 0.25718383 0.26008843 0.26256778  
## Personal 0.08919233 0.09067787 0.09203123 0.09324322  
## PhD 6.93584103 6.99759249 7.04553362 7.07900730  
## Terminal 7.25367725 7.30121881 7.33270181 7.34738855  
## S.F.Ratio 5.54044855 5.66607520 5.78515184 5.89712809  
## perc.alumni -3.40518475 -3.58810690 -3.77764414 -3.97375944  
## Expend 0.02765202 0.02859762 0.02955690 0.03052949  
## Grad.Rate 4.34581909 4.50411687 4.66535284 4.82943366  
##   
## (Intercept) -914.96128635 -984.06525029 -1.050142e+03 -1.113042e+03  
## Private -403.20301104 -412.01002196 -4.205558e+02 -4.288227e+02  
## Accept 0.22697904 0.23450779 2.421243e-01 2.498240e-01  
## Enroll 0.49844141 0.51292810 5.273828e-01 5.417824e-01  
## Top10perc 11.10478364 11.39702051 1.168817e+01 1.197804e+01  
## Top25perc 7.61307342 7.72858002 7.834869e+00 7.931404e+00  
## F.Undergrad 0.08708682 0.08948924 9.187316e-02 9.423399e-02  
## P.Undergrad 0.09359350 0.09494861 9.617257e-02 9.725810e-02  
## Outstate 0.01247799 0.01286470 1.325643e-02 1.365286e-02  
## Room.Board 0.09900532 0.10211737 1.052569e-01 1.084208e-01  
## Books 0.26460430 0.26618302 2.672918e-01 2.679216e-01  
## Personal 0.09430533 0.09520979 9.594967e-02 9.651897e-02  
## PhD 7.09742574 7.10027754 7.087134e+00 7.057654e+00  
## Terminal 7.34461901 7.32381881 7.284506e+00 7.226300e+00  
## S.F.Ratio 6.00151370 6.09788861 6.185912e+00 6.265333e+00  
## perc.alumni -4.17639379 -4.38546540 -4.600869e+00 -4.822474e+00  
## Expend 0.03151504 0.03251322 3.352371e-02 3.454623e-02  
## Grad.Rate 4.99625446 5.16569793 5.337633e+00 5.511917e+00  
##   
## (Intercept) -1.172634e+03 -1.228803e+03 -1.281189e+03 -1.330182e+03  
## Private -4.367950e+02 -4.444594e+02 -4.519416e+02 -4.589898e+02  
## Accept 2.576028e-01 2.654565e-01 2.734205e-01 2.814192e-01  
## Enroll 5.561042e-01 5.703255e-01 5.844288e-01 5.983727e-01  
## Top10perc 1.226645e+01 1.255327e+01 1.283825e+01 1.312166e+01  
## Top25perc 8.017680e+00 8.093219e+00 8.157766e+00 8.210485e+00  
## F.Undergrad 9.656718e-02 9.886822e-02 1.011274e-01 1.033492e-01  
## P.Undergrad 9.819848e-02 9.898767e-02 9.961105e-02 1.000804e-01  
## Outstate 1.405357e-02 1.445810e-02 1.487098e-02 1.528221e-02  
## Room.Board 1.116059e-01 1.148088e-01 1.180320e-01 1.212599e-01  
## Books 2.680663e-01 2.677232e-01 2.668733e-01 2.655534e-01  
## Personal 9.691270e-02 9.712694e-02 9.714300e-02 9.698915e-02  
## PhD 7.011590e+00 6.948788e+00 6.868386e+00 6.771878e+00  
## Terminal 7.148921e+00 7.052202e+00 6.936020e+00 6.800676e+00  
## S.F.Ratio 6.335995e+00 6.397843e+00 6.446582e+00 6.490335e+00  
## perc.alumni -5.050124e+00 -5.283638e+00 -5.522132e+00 -5.766626e+00  
## Expend 3.558050e-02 3.662625e-02 3.768219e-02 3.875010e-02  
## Grad.Rate 5.688388e+00 5.866873e+00 6.046975e+00 6.228885e+00  
##   
## (Intercept) -1.375526e+03 -1.417187e+03 -1.455155e+03 -1.489436e+03  
## Private -4.657073e+02 -4.720902e+02 -4.781367e+02 -4.838476e+02  
## Accept 2.894822e-01 2.976067e-01 3.057897e-01 3.140289e-01  
## Enroll 6.121464e-01 6.257281e-01 6.390965e-01 6.522306e-01  
## Top10perc 1.340335e+01 1.368334e+01 1.396174e+01 1.423866e+01  
## Top25perc 8.251217e+00 8.279622e+00 8.295396e+00 8.298269e+00  
## F.Undergrad 1.055256e-01 1.076523e-01 1.097252e-01 1.117405e-01  
## P.Undergrad 1.003849e-01 1.005215e-01 1.004885e-01 1.002848e-01  
## Outstate 1.569546e-02 1.610991e-02 1.652466e-02 1.693872e-02  
## Room.Board 1.244943e-01 1.277312e-01 1.309663e-01 1.341949e-01  
## Books 2.637566e-01 2.614932e-01 2.587768e-01 2.556236e-01  
## Personal 9.665114e-02 9.612991e-02 9.542761e-02 9.454765e-02  
## PhD 6.658780e+00 6.529352e+00 6.383949e+00 6.223022e+00  
## Terminal 6.646231e+00 6.472987e+00 6.281362e+00 6.071883e+00  
## S.F.Ratio 6.525696e+00 6.553057e+00 6.572930e+00 6.585940e+00  
## perc.alumni -6.016267e+00 -6.270760e+00 -6.529779e+00 -6.792969e+00  
## Expend 3.982878e-02 4.091795e-02 4.201735e-02 4.312668e-02  
## Grad.Rate 6.412192e+00 6.596658e+00 6.782029e+00 6.968039e+00  
##   
## (Intercept) -1.520055e+03 -1.547054e+03 -1.570492e+03 -1.590444e+03  
## Private -4.892259e+02 -4.942771e+02 -4.990086e+02 -5.034300e+02  
## Accept 3.223224e-01 3.306684e-01 3.390659e-01 3.475141e-01  
## Enroll 6.651101e-01 6.777148e-01 6.900251e-01 7.020215e-01  
## Top10perc 1.451429e+01 1.478884e+01 1.506256e+01 1.533575e+01  
## Top25perc 8.288006e+00 8.264406e+00 8.227301e+00 8.176551e+00  
## F.Undergrad 1.136940e-01 1.155820e-01 1.174007e-01 1.191465e-01  
## P.Undergrad 9.991047e-02 9.936638e-02 9.865447e-02 9.777759e-02  
## Outstate 1.735096e-02 1.776016e-02 1.816498e-02 1.856399e-02  
## Room.Board 1.374125e-01 1.406142e-01 1.437947e-01 1.469489e-01  
## Books 2.520530e-01 2.480864e-01 2.437480e-01 2.390634e-01  
## Personal 9.349462e-02 9.227428e-02 9.089350e-02 8.936015e-02  
## PhD 6.047111e+00 5.856837e+00 5.652898e+00 5.436062e+00  
## Terminal 5.845183e+00 5.601997e+00 5.343156e+00 5.069581e+00  
## S.F.Ratio 6.592816e+00 6.594385e+00 6.591564e+00 6.585341e+00  
## perc.alumni -7.059941e+00 -7.330271e+00 -7.603502e+00 -7.879141e+00  
## Expend 4.424562e-02 4.537382e-02 4.651090e-02 4.765641e-02  
## Grad.Rate 7.154411e+00 7.340855e+00 7.527076e+00 7.712771e+00  
##   
## (Intercept) -1.606995e+03 -1.620247e+03 -1.630309e+03 -1.637302e+03  
## Private -5.075530e+02 -5.113911e+02 -5.149592e+02 -5.182738e+02  
## Accept 3.560127e-01 3.645619e-01 3.731621e-01 3.818143e-01  
## Enroll 7.136850e-01 7.249966e-01 7.359375e-01 7.464886e-01  
## Top10perc 1.560873e+01 1.588187e+01 1.615553e+01 1.643013e+01  
## Top25perc 8.112048e+00 8.033711e+00 7.941487e+00 7.835347e+00  
## F.Undergrad 1.208156e-01 1.224047e-01 1.239102e-01 1.253289e-01  
## P.Undergrad 9.673956e-02 9.554511e-02 9.419988e-02 9.271040e-02  
## Outstate 1.895561e-02 1.933818e-02 1.970996e-02 2.006910e-02  
## Room.Board 1.500715e-01 1.531569e-01 1.561996e-01 1.591941e-01  
## Books 2.340602e-01 2.287674e-01 2.232148e-01 2.174332e-01  
## Personal 8.768310e-02 8.587206e-02 8.393753e-02 8.189068e-02  
## PhD 5.207156e+00 4.967060e+00 4.716700e+00 4.457038e+00  
## Terminal 4.782275e+00 4.482316e+00 4.170850e+00 3.849079e+00  
## S.F.Ratio 6.576768e+00 6.566942e+00 6.556991e+00 6.548056e+00  
## perc.alumni -8.156658e+00 -8.435489e+00 -8.715036e+00 -8.994666e+00  
## Expend 4.880989e-02 4.997081e-02 5.113861e-02 5.231264e-02  
## Grad.Rate 7.897636e+00 8.081364e+00 8.263650e+00 8.444194e+00  
##   
## (Intercept) -1.641356e+03 -1.641990e+03 -1.640639e+03 -1.636798e+03  
## Private -5.213526e+02 -5.245822e+02 -5.272531e+02 -5.297331e+02  
## Accept 3.905199e-01 3.993098e-01 4.081147e-01 4.169763e-01  
## Enroll 7.566312e-01 7.661644e-01 7.754039e-01 7.841810e-01  
## Top10perc 1.670610e+01 1.698035e+01 1.726053e+01 1.754368e+01  
## Top25perc 7.715291e+00 7.580786e+00 7.433405e+00 7.272314e+00  
## F.Undergrad 1.266576e-01 1.278897e-01 1.290321e-01 1.300766e-01  
## P.Undergrad 9.108401e-02 8.931500e-02 8.744026e-02 8.545562e-02  
## Outstate 2.041369e-02 2.075691e-02 2.107065e-02 2.136382e-02  
## Room.Board 1.621350e-01 1.650373e-01 1.678603e-01 1.706135e-01  
## Books 2.114538e-01 2.052921e-01 1.990087e-01 1.926197e-01  
## Personal 7.974325e-02 7.748352e-02 7.517099e-02 7.279612e-02  
## PhD 4.189064e+00 3.913913e+00 3.632987e+00 3.346857e+00  
## Terminal 3.518257e+00 3.182793e+00 2.838278e+00 2.488596e+00  
## S.F.Ratio 6.541280e+00 6.522236e+00 6.522193e+00 6.528064e+00  
## perc.alumni -9.273719e+00 -9.549107e+00 -9.825345e+00 -1.009907e+01  
## Expend 5.349220e-02 5.467600e-02 5.586246e-02 5.705159e-02  
## Grad.Rate 8.622697e+00 8.798287e+00 8.971383e+00 9.141552e+00  
##   
## (Intercept) -1.630621e+03 -1.622261e+03 -1.611870e+03 -1.599600e+03  
## Private -5.320407e+02 -5.341939e+02 -5.362105e+02 -5.381076e+02  
## Accept 4.258969e-01 4.348793e-01 4.439269e-01 4.530431e-01  
## Enroll 7.924779e-01 8.002773e-01 8.075617e-01 8.143137e-01  
## Top10perc 1.783032e+01 1.812099e+01 1.841620e+01 1.871652e+01  
## Top25perc 7.097649e+00 6.909523e+00 6.708071e+00 6.493449e+00  
## F.Undergrad 1.310205e-01 1.318615e-01 1.325975e-01 1.332267e-01  
## P.Undergrad 8.337112e-02 8.119736e-02 7.894538e-02 7.662653e-02  
## Outstate 2.163461e-02 2.188086e-02 2.210038e-02 2.229106e-02  
## Room.Board 1.732924e-01 1.758923e-01 1.784087e-01 1.808376e-01  
## Books 1.861546e-01 1.796420e-01 1.731094e-01 1.665826e-01  
## Personal 7.037142e-02 6.790974e-02 6.542381e-02 6.292609e-02  
## PhD 3.056559e+00 2.763077e+00 2.467369e+00 2.170362e+00  
## Terminal 2.135076e+00 1.779034e+00 1.421773e+00 1.064573e+00  
## S.F.Ratio 6.540818e+00 6.561454e+00 6.590882e+00 6.629912e+00  
## perc.alumni -1.036957e+01 -1.063611e+01 -1.089796e+01 -1.115437e+01  
## Expend 5.824219e-02 5.943316e-02 6.062331e-02 6.181137e-02  
## Grad.Rate 9.308496e+00 9.471972e+00 9.631757e+00 9.787639e+00  
##   
## (Intercept) -1.585600e+03 -1.570017e+03 -1.552998e+03 -1.534680e+03  
## Private -5.399018e+02 -5.416088e+02 -5.432428e+02 -5.448170e+02  
## Accept 4.622313e-01 4.714952e-01 4.808385e-01 4.902646e-01  
## Enroll 8.205164e-01 8.261529e-01 8.312069e-01 8.356627e-01  
## Top10perc 1.902247e+01 1.933461e+01 1.965345e+01 1.997956e+01  
## Top25perc 6.265834e+00 6.025425e+00 5.772443e+00 5.507128e+00  
## F.Undergrad 1.337474e-01 1.341585e-01 1.344591e-01 1.346485e-01  
## P.Undergrad 7.425243e-02 7.183483e-02 6.938552e-02 6.691625e-02  
## Outstate 2.245080e-02 2.257757e-02 2.266944e-02 2.272454e-02  
## Room.Board 1.831753e-01 1.854185e-01 1.875644e-01 1.896107e-01  
## Books 1.600863e-01 1.536429e-01 1.472733e-01 1.409961e-01  
## Personal 6.042874e-02 5.794346e-02 5.548146e-02 5.305338e-02  
## PhD 1.872946e+00 1.575965e+00 1.280216e+00 9.864397e-01  
## Terminal 7.086871e-01 3.553268e-01 5.657118e-03 -3.392105e-01  
## S.F.Ratio 6.679253e+00 6.739505e+00 6.811159e+00 6.894595e+00  
## perc.alumni -1.140462e+01 -1.164799e+01 -1.188379e+01 -1.211137e+01  
## Expend 6.299599e-02 6.417571e-02 6.534903e-02 6.651433e-02  
## Grad.Rate 9.939425e+00 1.008694e+01 1.023001e+01 1.036850e+01  
##   
## (Intercept) -1.515201e+03 -1.494689e+03 -1.473267e+03 -1.451054e+03  
## Private -5.463427e+02 -5.478302e+02 -5.492878e+02 -5.507225e+02  
## Accept 4.997774e-01 5.093801e-01 5.190763e-01 5.288692e-01  
## Enroll 8.395055e-01 8.427212e-01 8.452969e-01 8.472207e-01  
## Top10perc 2.031346e+01 2.065567e+01 2.100672e+01 2.136708e+01  
## Top25perc 5.229739e+00 4.940553e+00 4.639860e+00 4.327965e+00  
## F.Undergrad 1.347266e-01 1.346936e-01 1.345499e-01 1.342964e-01  
## P.Undergrad 6.443862e-02 6.196396e-02 5.950328e-02 5.706717e-02  
## Outstate 2.274112e-02 2.271753e-02 2.265224e-02 2.254381e-02  
## Room.Board 1.915554e-01 1.933971e-01 1.951346e-01 1.967674e-01  
## Books 1.348282e-01 1.287840e-01 1.228760e-01 1.171146e-01  
## Personal 5.066920e-02 4.833823e-02 4.606903e-02 4.386942e-02  
## PhD 6.953152e-01 4.074596e-01 1.234231e-01 -1.563120e-01  
## Terminal -6.782244e-01 -1.010397e+00 -1.334807e+00 -1.650606e+00  
## S.F.Ratio 6.990084e+00 7.097789e+00 7.217764e+00 7.349957e+00  
## perc.alumni -1.233011e+01 -1.253942e+01 -1.273876e+01 -1.292764e+01  
## Expend 6.766995e-02 6.881415e-02 6.994519e-02 7.106127e-02  
## Grad.Rate 1.050228e+01 1.063124e+01 1.075527e+01 1.087431e+01  
##   
## (Intercept) -1.428157e+03 -1.404679e+03 -1.380716e+03 -1.356354e+03  
## Private -5.521399e+02 -5.535440e+02 -5.549378e+02 -5.563232e+02  
## Accept 5.387619e-01 5.487574e-01 5.588581e-01 5.690666e-01  
## Enroll 8.484819e-01 8.490710e-01 8.489798e-01 8.482013e-01  
## Top10perc 2.173724e+01 2.211764e+01 2.250868e+01 2.291074e+01  
## Top25perc 4.005184e+00 3.671846e+00 3.328285e+00 2.974850e+00  
## F.Undergrad 1.339345e-01 1.334656e-01 1.328918e-01 1.322153e-01  
## P.Undergrad 5.466571e-02 5.230842e-02 5.000418e-02 4.776122e-02  
## Outstate 2.239096e-02 2.219252e-02 2.194746e-02 2.165491e-02  
## Room.Board 1.982952e-01 1.997181e-01 2.010366e-01 2.022516e-01  
## Books 1.115081e-01 1.060630e-01 1.007839e-01 9.567369e-02  
## Personal 4.174642e-02 3.970628e-02 3.775444e-02 3.589556e-02  
## PhD -4.313320e-01 -7.012906e-01 -9.659077e-01 -1.224966e+00  
## Terminal -1.957012e+00 -2.253318e+00 -2.538888e+00 -2.813155e+00  
## S.F.Ratio 7.494214e+00 7.650278e+00 7.817800e+00 7.996339e+00  
## perc.alumni -1.310561e+01 -1.327229e+01 -1.342734e+01 -1.357045e+01  
## Expend 7.216061e-02 7.324143e-02 7.430198e-02 7.534057e-02  
## Grad.Rate 1.098830e+01 1.109720e+01 1.120100e+01 1.129968e+01  
##   
## (Intercept) -1.331673e+03 -1.306746e+03 -1.281639e+03 -1.256411e+03  
## Private -5.577010e+02 -5.590712e+02 -5.604331e+02 -5.617854e+02  
## Accept 5.793848e-01 5.898142e-01 6.003559e-01 6.110104e-01  
## Enroll 8.467299e-01 8.445611e-01 8.416919e-01 8.381203e-01  
## Top10perc 2.332413e+01 2.374912e+01 2.418593e+01 2.463471e+01  
## Top25perc 2.611895e+00 2.239785e+00 1.858897e+00 1.469616e+00  
## F.Undergrad 1.314389e-01 1.305655e-01 1.295987e-01 1.285420e-01  
## P.Undergrad 4.558704e-02 4.348839e-02 4.147126e-02 3.954088e-02  
## Outstate 2.131415e-02 2.092464e-02 2.048601e-02 1.999807e-02  
## Room.Board 2.033644e-01 2.043763e-01 2.052892e-01 2.061052e-01  
## Books 9.073387e-02 8.596439e-02 8.136399e-02 7.693033e-02  
## Personal 3.413352e-02 3.247146e-02 3.091178e-02 2.945618e-02  
## PhD -1.478310e+00 -1.725839e+00 -1.967503e+00 -2.203301e+00  
## Terminal -3.075623e+00 -3.325865e+00 -3.563522e+00 -3.788297e+00  
## S.F.Ratio 8.185370e+00 8.384293e+00 8.592439e+00 8.809082e+00  
## perc.alumni -1.370139e+01 -1.381997e+01 -1.392606e+01 -1.401959e+01  
## Expend 7.635557e-02 7.734543e-02 7.830868e-02 7.924398e-02  
## Grad.Rate 1.139327e+01 1.148180e+01 1.156532e+01 1.164389e+01  
##   
## (Intercept) -1.231115e+03 -1.205800e+03 -1.180507e+03 -1.155597e+03  
## Private -5.631264e+02 -5.644539e+02 -5.657655e+02 -5.666566e+02  
## Accept 6.217775e-01 6.326565e-01 6.436457e-01 6.548593e-01  
## Enroll 8.338459e-01 8.288694e-01 8.231931e-01 8.170210e-01  
## Top10perc 2.509554e+01 2.556846e+01 2.605340e+01 2.657777e+01  
## Top25perc 1.072339e+00 6.674776e-01 2.554543e-01 -1.626975e-01  
## F.Undergrad 1.273997e-01 1.261761e-01 1.248760e-01 1.234116e-01  
## P.Undergrad 3.770167e-02 3.595730e-02 3.431065e-02 3.275428e-02  
## Outstate 1.946085e-02 1.887456e-02 1.823962e-02 1.758636e-02  
## Room.Board 2.068265e-01 2.074559e-01 2.079959e-01 2.084383e-01  
## Books 7.266012e-02 6.854925e-02 6.459299e-02 6.052828e-02  
## Personal 2.810570e-02 2.686074e-02 2.572112e-02 2.468433e-02  
## PhD -2.433273e+00 -2.657496e+00 -2.876078e+00 -3.088876e+00  
## Terminal -3.999961e+00 -4.198346e+00 -4.383341e+00 -4.553927e+00  
## S.F.Ratio 9.033448e+00 9.264724e+00 9.502068e+00 9.754307e+00  
## perc.alumni -1.410050e+01 -1.416884e+01 -1.422466e+01 -1.427874e+01  
## Expend 8.015009e-02 8.102589e-02 8.187042e-02 8.262541e-02  
## Grad.Rate 1.171760e+01 1.178653e+01 1.185079e+01 1.189891e+01  
##   
## (Intercept) -1.130422e+03 -1.105359e+03 -1.080436e+03 -1.055681e+03  
## Private -5.679132e+02 -5.691421e+02 -5.703477e+02 -5.715267e+02  
## Accept 6.660745e-01 6.774122e-01 6.888488e-01 7.003768e-01  
## Enroll 8.100119e-01 8.022642e-01 7.938353e-01 7.847339e-01  
## Top10perc 2.708729e+01 2.760943e+01 2.814266e+01 2.868660e+01  
## Top25perc -5.885938e-01 -1.020286e+00 -1.457358e+00 -1.899296e+00  
## F.Undergrad 1.219620e-01 1.204501e-01 1.188830e-01 1.172678e-01  
## P.Undergrad 3.131015e-02 2.996862e-02 2.872943e-02 2.759207e-02  
## Outstate 1.684938e-02 1.606854e-02 1.524241e-02 1.437278e-02  
## Room.Board 2.088070e-01 2.090911e-01 2.092984e-01 2.094323e-01  
## Books 5.686868e-02 5.333148e-02 4.992710e-02 4.664867e-02  
## Personal 2.375531e-02 2.292961e-02 2.220367e-02 2.157483e-02  
## PhD -3.296928e+00 -3.500097e+00 -3.698309e+00 -3.891744e+00  
## Terminal -4.712163e+00 -4.856727e+00 -4.987997e+00 -5.106120e+00  
## S.F.Ratio 1.000149e+01 1.025326e+01 1.050745e+01 1.076329e+01  
## perc.alumni -1.430901e+01 -1.432795e+01 -1.433495e+01 -1.433039e+01  
## Expend 8.340586e-02 8.415078e-02 8.486210e-02 8.553946e-02  
## Grad.Rate 1.195432e+01 1.200503e+01 1.205158e+01 1.209412e+01  
##   
## (Intercept) -1.031116e+03 -1.006461e+03 -982.30706455 -958.38474280  
## Private -5.726765e+02 -5.735953e+02 -574.66389689 -575.70013170  
## Accept 7.119891e-01 7.239213e-01 0.73568643 0.74752870  
## Enroll 7.749704e-01 7.646710e-01 0.75370648 0.74202649  
## Top10perc 2.924074e+01 2.983075e+01 30.40462838 30.98741094  
## Top25perc -2.345582e+00 -2.797714e+00 -3.25157475 -3.70841328  
## F.Undergrad 1.156108e-01 1.137913e-01 0.11205427 0.11030214  
## P.Undergrad 2.655539e-02 2.561464e-02 0.02477480 0.02403068  
## Outstate 1.346132e-02 1.252758e-02 0.01153367 0.01050466  
## Room.Board 2.094962e-01 2.094738e-01 0.20940879 0.20927920  
## Books 4.349006e-02 4.022320e-02 0.03728334 0.03444042  
## Personal 2.104021e-02 2.060190e-02 0.02024738 0.01997924  
## PhD -4.080590e+00 -4.268811e+00 -4.44944211 -4.62612722  
## Terminal -5.211309e+00 -5.301184e+00 -5.38125462 -5.44902564  
## S.F.Ratio 1.101995e+01 1.127977e+01 11.53591811 11.79148396  
## perc.alumni -1.431461e+01 -1.429302e+01 -14.25538089 -14.20801537  
## Expend 8.618280e-02 8.673981e-02 0.08731473 0.08785605  
## Grad.Rate 1.213281e+01 1.215726e+01 12.18853988 12.21651092  
##   
## (Intercept) -9.347145e+02 -9.107433e+02  
## Private -5.766985e+02 -5.775983e+02  
## Accept 7.594235e-01 7.716262e-01  
## Enroll 7.297321e-01 7.168950e-01  
## Top10perc 3.157780e+01 3.219708e+01  
## Top25perc -4.167421e+00 -4.630787e+00  
## F.Undergrad 1.085355e-01 1.066351e-01  
## P.Undergrad 2.337795e-02 2.281496e-02  
## Outstate 9.441899e-03 8.360389e-03  
## Room.Board 2.090930e-01 2.088373e-01  
## Books 3.169454e-02 2.887163e-02  
## Personal 1.979155e-02 1.968710e-02  
## PhD -4.798958e+00 -4.973162e+00  
## Terminal -5.505134e+00 -5.546721e+00  
## S.F.Ratio 1.204491e+01 1.229322e+01  
## perc.alumni -1.415099e+01 -1.408618e+01  
## Expend 8.836446e-02 8.879552e-02  
## Grad.Rate 1.224129e+01 1.225400e+01

dim(coef(ridge\_model))

## [1] 18 150

# Checking coef value and calculating l2\_norm for different lambdas  
ridge\_model$lambda[20]

## [1] 986900.5

coef(ridge\_model)[,20]

## (Intercept) Private Accept Enroll Top10perc   
## 2.722041e+03 -1.103098e+01 5.069215e-03 1.194250e-02 2.975430e-01   
## Top25perc F.Undergrad P.Undergrad Outstate Room.Board   
## 2.426536e-01 2.140872e-03 2.861731e-03 3.358542e-04 2.407100e-03   
## Books Personal PhD Terminal S.F.Ratio   
## 9.805126e-03 3.098747e-03 2.856125e-01 3.083563e-01 1.533061e-01   
## perc.alumni Expend Grad.Rate   
## -4.421176e-02 7.693020e-04 1.167217e-01

l2\_norm <- sqrt(sum(coef(ridge\_model)[2:17,20]^2))  
l2\_norm

## [1] 11.04683

## 11.04683  
  
  
#checking for lambda = 100   
ridge\_model$lambda[100]

## [1] 7024.612

coef(ridge\_model)[,100]

## (Intercept) Private Accept Enroll Top10perc   
## -1.330182e+03 -4.589898e+02 2.814192e-01 5.983727e-01 1.312166e+01   
## Top25perc F.Undergrad P.Undergrad Outstate Room.Board   
## 8.210485e+00 1.033492e-01 1.000804e-01 1.528221e-02 1.212599e-01   
## Books Personal PhD Terminal S.F.Ratio   
## 2.655534e-01 9.698915e-02 6.771878e+00 6.800676e+00 6.490335e+00   
## perc.alumni Expend Grad.Rate   
## -5.766626e+00 3.875010e-02 6.228885e+00

l2\_norm <- sqrt(sum(coef(ridge\_model)[2:17,100]^2))  
l2\_norm

## [1] 459.4337

## 459.4337  
  
  
#checking for lambda = 150   
ridge\_model$lambda[150]

## [1] 319.4041

coef(ridge\_model)[,150]

## (Intercept) Private Accept Enroll Top10perc   
## -9.107433e+02 -5.775983e+02 7.716262e-01 7.168950e-01 3.219708e+01   
## Top25perc F.Undergrad P.Undergrad Outstate Room.Board   
## -4.630787e+00 1.066351e-01 2.281496e-02 8.360389e-03 2.088373e-01   
## Books Personal PhD Terminal S.F.Ratio   
## 2.887163e-02 1.968710e-02 -4.973162e+00 -5.546721e+00 1.229322e+01   
## perc.alumni Expend Grad.Rate   
## -1.408618e+01 8.879552e-02 1.225400e+01

l2\_norm <- sqrt(sum(coef(ridge\_model)[2:17,150]^2))  
l2\_norm

## [1] 578.8645

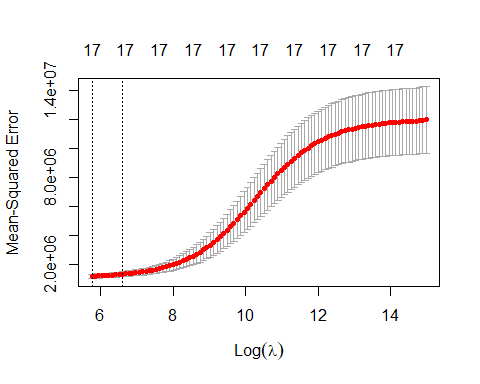
## 578.8645  
  
  
## predict response for value of lambda value  
y\_pred <- predict(ridge\_model, newx = x\_test, s = ridge\_model$lambda[20])  
  
## MSE error  
mean((y\_pred - y\_test)^2)

## [1] 21741647

### Checking for different value of lambda   
  
## predict response for value of lambda value  
y\_pred <- predict(ridge\_model, newx = x\_test, s = ridge\_model$lambda[10])  
  
## MSE error  
mean((y\_pred - y\_test)^2)

## [1] 21936238

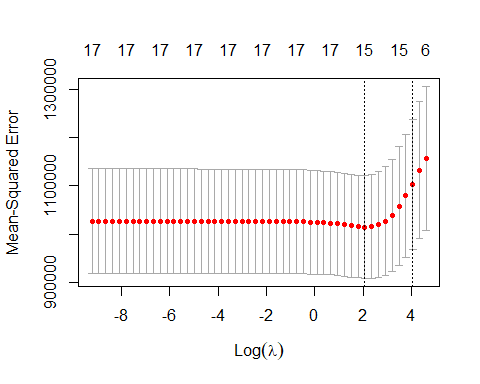
## Implementing K - Cross Validation  
  
ridge\_model\_best <- cv.glmnet(x\_train, y\_train, alpha = 0, standardize = TRUE, nfolds = 4)  
  
plot(ridge\_model\_best)



## predict response for value of minimum lambda value  
y\_pred <- predict(ridge\_model\_best, newx = x\_test, s = ridge\_model\_best$lambda.min, type = "response")  
  
## predicting coefficients of features using predict function  
coef <- predict(ridge\_model, s = ridge\_model$lambda.min, type = "coefficients")  
  
  
## calculating MSE   
mean((y\_pred - y\_test)^2)

## [1] 2999423

## c)  
  
  
##Implementing Lasso regression model  
lasso\_model <- glmnet(x\_train, y\_train, alpha = 1, lambda = 10^seq(2,-4, length = 50))  
  
  
  
## Implemeting lasso model with k-cross validation  
  
lasso\_model\_best <- cv.glmnet(x\_train, y\_train, alpha = 1,standardize = TRUE, nfolds = 6,lambda = 10^seq(2,-4, length = 50))  
plot(lasso\_model\_best)



predict(lasso\_model, s = lasso\_model$lambda.min, type = "coefficients")

## 18 x 50 sparse Matrix of class "dgCMatrix"

## [[ suppressing 50 column names 's0', 's1', 's2' ... ]]

##   
## (Intercept) -676.11935050 -724.04635186 -5.355533e+02 -3.717435e+02  
## Private -212.10020499 -288.43783660 -3.944003e+02 -4.711347e+02  
## Accept 1.20768045 1.19609415 1.190141e+00 1.187417e+00  
## Enroll . . . .   
## Top10perc 25.98029600 26.78720228 2.823276e+01 2.958240e+01  
## Top25perc . . . .   
## F.Undergrad 0.06151196 0.06520837 6.769118e-02 6.748729e-02  
## P.Undergrad . . 6.293495e-04 8.872444e-03  
## Outstate . . . -3.173857e-03  
## Room.Board 0.01178438 0.03188282 5.807068e-02 8.148632e-02  
## Books . . . .   
## Personal . . . .   
## PhD . . -2.371529e+00 -4.236855e+00  
## Terminal . . -1.284502e+00 -2.807235e+00  
## S.F.Ratio . . . .   
## perc.alumni . -3.90776510 -6.292067e+00 -7.765688e+00  
## Expend 0.06443747 0.06908066 7.423129e-02 7.904262e-02  
## Grad.Rate . 1.91012454 3.789225e+00 5.418165e+00  
##   
## (Intercept) -3.069888e+02 -284.63341365 -268.00923613 -254.51155916  
## Private -4.979859e+02 -518.42592934 -533.76486457 -545.52142487  
## Accept 1.192198e+00 1.19485629 1.19697955 1.19848319  
## Enroll . . . .   
## Top10perc 3.586713e+01 40.73147559 44.39155765 47.18986544  
## Top25perc -5.120922e+00 -9.08788458 -12.07091837 -14.35089415  
## F.Undergrad 6.480626e-02 0.06298973 0.06156605 0.06053313  
## P.Undergrad 1.487103e-02 0.01928341 0.02261705 0.02513907  
## Outstate -1.280684e-02 -0.01964830 -0.02482257 -0.02871133  
## Room.Board 1.060559e-01 0.12482475 0.13896809 0.14966003  
## Books . . . .   
## Personal 7.186357e-03 0.01489758 0.02073121 0.02510462  
## PhD -5.492746e+00 -6.56010728 -7.36419008 -7.97665652  
## Terminal -2.930915e+00 -2.93886265 -2.94675400 -2.94480017  
## S.F.Ratio 3.260381e+00 6.99499352 9.81676938 11.93463502  
## perc.alumni -7.977830e+00 -8.09079532 -8.17491675 -8.23800105  
## Expend 8.198880e-02 0.08454245 0.08647639 0.08790048  
## Grad.Rate 7.026960e+00 8.26251674 9.19282331 9.89593138  
##   
## (Intercept) -245.25320131 -238.42302088 -232.34030023 -228.23835288  
## Private -554.23754342 -560.82857795 -565.96766131 -569.88861904  
## Accept 1.19963632 1.20050011 1.20111575 1.20155612  
## Enroll . . . .   
## Top10perc 49.26466812 50.81849302 52.02553332 52.89873942  
## Top25perc -16.04342457 -17.31255134 -18.29688461 -19.01411700  
## F.Undergrad 0.05975233 0.05917039 0.05874116 0.05843669  
## P.Undergrad 0.02702634 0.02844307 0.02952512 0.03032205  
## Outstate -0.03165102 -0.03386814 -0.03553181 -0.03677944  
## Room.Board 0.15771563 0.16379130 0.16838436 0.17183591  
## Books . . . .   
## Personal 0.02841994 0.03092493 0.03279638 0.03421678  
## PhD -8.43354614 -8.77798533 -9.04297361 -9.24052572  
## Terminal -2.95073493 -2.95713145 -2.95461479 -2.95899006  
## S.F.Ratio 13.54143637 14.75532743 15.66117246 16.34648821  
## perc.alumni -8.28630337 -8.32234614 -8.34900167 -8.36951460  
## Expend 0.08900895 0.08985712 0.09046380 0.09095721  
## Grad.Rate 10.42593287 10.82638831 11.12917209 11.35929519  
##   
## (Intercept) -2.227096e+02 -196.72328574 -187.81097794 -181.76642614  
## Private -5.728705e+02 -578.68390147 -579.81778141 -580.55056686  
## Accept 1.201888e+00 1.21038130 1.21614072 1.22032938  
## Enroll -4.842957e-04 -0.04021801 -0.07401663 -0.09924681  
## Top10perc 5.358891e+01 54.57816100 55.11726051 55.50668850  
## Top25perc -1.957242e+01 -20.28299082 -20.68326307 -20.97370040  
## F.Undergrad 5.828203e-02 0.06153871 0.06512291 0.06785259  
## P.Undergrad 3.094317e-02 0.03165976 0.03204585 0.03232401  
## Outstate -3.772795e-02 -0.03905053 -0.04008316 -0.04085136  
## Room.Board 1.744395e-01 0.17574129 0.17649419 0.17706994  
## Books -5.163816e-03 -0.01403930 -0.02024823 -0.02491206  
## Personal 3.548782e-02 0.03713950 0.03837783 0.03930265  
## PhD -9.389235e+00 -9.58815572 -9.68408572 -9.75359494  
## Terminal -2.952588e+00 -2.87832644 -2.86288424 -2.85410990  
## S.F.Ratio 1.686004e+01 17.14487542 17.43259543 17.65418515  
## perc.alumni -8.388585e+00 -8.24797680 -8.16067997 -8.09818186  
## Expend 9.130956e-02 0.09136813 0.09165613 0.09188902  
## Grad.Rate 1.153244e+01 11.67450045 11.79464930 11.88612621  
##   
## (Intercept) -177.27648627 -173.91605087 -171.43047168 -169.78968710  
## Private -581.15696344 -581.70262677 -582.06901929 -582.28875221  
## Accept 1.22339270 1.22557179 1.22720994 1.22834271  
## Enroll -0.11778899 -0.13106645 -0.14116878 -0.14840775  
## Top10perc 55.79422277 56.00410045 56.16406862 56.28017640  
## Top25perc -21.18855553 -21.34612595 -21.46636899 -21.55345782  
## F.Undergrad 0.06986356 0.07130633 0.07241329 0.07322407  
## P.Undergrad 0.03253055 0.03268372 0.03280006 0.03288493  
## Outstate -0.04142067 -0.04183572 -0.04214786 -0.04237078  
## Room.Board 0.17751769 0.17787129 0.17813271 0.17833797  
## Books -0.02841973 -0.03105633 -0.03305893 -0.03458710  
## Personal 0.03999397 0.04050686 0.04089121 0.04116808  
## PhD -9.80608610 -9.84613755 -9.87609056 -9.89782088  
## Terminal -2.84830493 -2.84446221 -2.84083676 -2.83801933  
## S.F.Ratio 17.82180609 17.94795956 18.04217691 18.11223662  
## perc.alumni -8.05273613 -8.02086616 -7.99741874 -7.98266964  
## Expend 0.09206756 0.09220461 0.09230615 0.09238121  
## Grad.Rate 11.95516698 12.00738656 12.04681684 12.07576177  
##   
## (Intercept) -168.62648681 -167.99001990 -167.88059367 -167.46466755  
## Private -582.37556492 -582.33287091 -582.16981985 -582.13270942  
## Accept 1.22924180 1.22989140 1.23029962 1.23071965  
## Enroll -0.15423427 -0.15869329 -0.16188090 -0.16498362  
## Top10perc 56.37174117 56.44023685 56.48801315 56.53240416  
## Top25perc -21.62165904 -21.67241569 -21.70786972 -21.74190500  
## F.Undergrad 0.07388586 0.07441344 0.07482212 0.07520419  
## P.Undergrad 0.03294806 0.03299185 0.03301786 0.03304298  
## Outstate -0.04254585 -0.04267673 -0.04276978 -0.04285513  
## Room.Board 0.17848799 0.17860090 0.17869111 0.17874788  
## Books -0.03574707 -0.03663297 -0.03730812 -0.03780982  
## Personal 0.04137880 0.04153336 0.04164449 0.04173835  
## PhD -9.91395219 -9.92536400 -9.93294293 -9.93955322  
## Terminal -2.83541359 -2.83311792 -2.83132525 -2.82965000  
## S.F.Ratio 18.16594342 18.20680344 18.23793160 18.26296772  
## perc.alumni -7.97051868 -7.96199947 -7.95681780 -7.95056038  
## Expend 0.09243650 0.09247761 0.09250884 0.09253553  
## Grad.Rate 12.09747376 12.11339006 12.12474360 12.13567246  
##   
## (Intercept) -167.99698589 -168.09257701 -168.02666365 -167.92058625  
## Private -581.77156030 -581.62222755 -581.52987695 -581.44283877  
## Accept 1.23089721 1.23107988 1.23127900 1.23148819  
## Enroll -0.16691148 -0.16881292 -0.17065518 -0.17241911  
## Top10perc 56.55778475 56.58243749 56.60517798 56.62582273  
## Top25perc -21.76148574 -21.78076215 -21.79877402 -21.81508520  
## F.Undergrad 0.07549725 0.07576855 0.07601999 0.07625296  
## P.Undergrad 0.03305048 0.03305905 0.03306769 0.03307568  
## Outstate -0.04291010 -0.04295833 -0.04300139 -0.04304023  
## Room.Board 0.17879643 0.17883170 0.17884902 0.17885265  
## Books -0.03820913 -0.03851072 -0.03873356 -0.03890079  
## Personal 0.04180729 0.04185495 0.04189506 0.04192989  
## PhD -9.94236692 -9.94510192 -9.94748683 -9.94934447  
## Terminal -2.82829119 -2.82706753 -2.82593485 -2.82484894  
## S.F.Ratio 18.28280397 18.29914076 18.31175698 18.32165705  
## perc.alumni -7.94754111 -7.94518551 -7.94222221 -7.93882136  
## Expend 0.09255413 0.09257152 0.09258551 0.09259625  
## Grad.Rate 12.14188461 12.14845904 12.15440102 12.15939136  
##   
## (Intercept) -167.81584068 -167.72435109 -167.64887191 -167.58943320  
## Private -581.34887649 -581.24824510 -581.14392890 -581.03876471  
## Accept 1.23169987 1.23190824 1.23210939 1.23230087  
## Enroll -0.17409231 -0.17566758 -0.17714179 -0.17851487  
## Top10perc 56.64435124 56.66082409 56.67536204 56.68812338  
## Top25perc -21.82961066 -21.84242641 -21.85367129 -21.86350415  
## F.Undergrad 0.07646867 0.07666826 0.07685275 0.07702312  
## P.Undergrad 0.03308279 0.03308899 0.03309431 0.03309883  
## Outstate -0.04307527 -0.04310688 -0.04313537 -0.04316109  
## Room.Board 0.17884656 0.17883376 0.17881653 0.17879657  
## Books -0.03902826 -0.03912636 -0.03920226 -0.03926117  
## Personal 0.04196012 0.04198634 0.04200915 0.04202909  
## PhD -9.95069612 -9.95164022 -9.95227631 -9.95268193  
## Terminal -2.82377910 -2.82272333 -2.82169791 -2.82072350  
## S.F.Ratio 18.32942936 18.33550000 18.34024060 18.34396730  
## perc.alumni -7.93524052 -7.93164356 -7.92812623 -7.92474608  
## Expend 0.09260435 0.09261052 0.09261534 0.09261926  
## Grad.Rate 12.16347443 12.16680408 12.16953842 12.17180885  
##   
## (Intercept) -167.54507063 -167.51431835 -167.49544621 -167.48663470  
## Private -580.93488903 -580.83380227 -580.73652477 -580.64372525  
## Accept 1.23248128 1.23264997 1.23280678 1.23295190  
## Enroll -0.17978890 -0.18096742 -0.18205488 -0.18305630  
## Top10perc 56.69928353 56.70902031 56.71750449 56.72489447  
## Top25perc -21.87208512 -21.87956666 -21.88608920 -21.89177920  
## F.Undergrad 0.07718028 0.07732511 0.07745845 0.07758108  
## P.Undergrad 0.03310262 0.03310578 0.03310839 0.03311055  
## Outstate -0.04318433 -0.04320537 -0.04322444 -0.04324174  
## Room.Board 0.17877512 0.17875310 0.17873113 0.17870966  
## Books -0.03930697 -0.03934265 -0.03937048 -0.03939222  
## Personal 0.04204663 0.04206214 0.04207593 0.04208824  
## PhD -9.95291332 -9.95301161 -9.95300807 -9.95292728  
## Terminal -2.81981697 -2.81898865 -2.81824259 -2.81757802  
## S.F.Ratio 18.34693183 18.34932528 18.35128912 18.35292703  
## perc.alumni -7.92153775 -7.91852053 -7.91570298 -7.91308607  
## Expend 0.09262258 0.09262551 0.09262818 0.09263066  
## Grad.Rate 12.17371715 12.17534033 12.17673645 12.17794946  
##   
## (Intercept) -167.48610505 -167.49220446 -167.50345354 -167.51856583  
## Private -580.55581290 -580.47300342 -580.39536803 -580.32287084  
## Accept 1.23308573 1.23320884 1.23332184 1.23342540  
## Enroll -0.18397694 -0.18482218 -0.18559732 -0.18630750  
## Top10perc 56.73133370 56.73694985 56.74185513 56.74614727  
## Top25perc -21.89674874 -21.90109598 -21.90490617 -21.90825288  
## F.Undergrad 0.07769378 0.07779726 0.07789219 0.07797924  
## P.Undergrad 0.03311231 0.03311375 0.03311492 0.03311587  
## Outstate -0.04325745 -0.04327173 -0.04328472 -0.04329655  
## Room.Board 0.17868899 0.17866929 0.17865069 0.17863324  
## Books -0.03940922 -0.03942255 -0.03943302 -0.03944125  
## Personal 0.04209928 0.04210920 0.04211815 0.04212623  
## PhD -9.95278903 -9.95260934 -9.95240113 -9.95217475  
## Terminal -2.81699097 -2.81647553 -2.81602489 -2.81563200  
## S.F.Ratio 18.35431485 18.35550813 18.35654768 18.35746366  
## perc.alumni -7.91066564 -7.90843420 -7.90638215 -7.90449878  
## Expend 0.09263301 0.09263524 0.09263738 0.09263942  
## Grad.Rate 12.17901285 12.17995232 12.18078780 12.18153489  
##   
## (Intercept) -167.53644898 -167.55619439 -167.57706076 -167.59845448  
## Private -580.25539765 -580.19277846 -580.13480492 -580.08124385  
## Accept 1.23352019 1.23360687 1.23368608 1.23375841  
## Enroll -0.18695767 -0.18755251 -0.18809645 -0.18859361  
## Top10perc 56.74991074 56.75321821 56.75613196 56.75870523  
## Top25perc -21.91119932 -21.91379965 -21.91610014 -21.91814036  
## F.Undergrad 0.07805899 0.07813203 0.07819888 0.07826004  
## P.Undergrad 0.03311664 0.03311726 0.03311776 0.03311816  
## Outstate -0.04330732 -0.04331713 -0.04332607 -0.04333422  
## Room.Board 0.17861694 0.17860180 0.17858776 0.17857480  
## Books -0.03944774 -0.03945288 -0.03945695 -0.03946019  
## Personal 0.04213355 0.04214019 0.04214621 0.04215169  
## PhD -9.95193837 -9.95169837 -9.95145964 -9.95122581  
## Terminal -2.81529001 -2.81499249 -2.81473361 -2.81450816  
## S.F.Ratio 18.35827847 18.35900893 18.35966780 18.36026491  
## perc.alumni -7.90277287 -7.90119316 -7.89974860 -7.89842859  
## Expend 0.09264138 0.09264324 0.09264500 0.09264667  
## Grad.Rate 12.18220598 12.18281100 12.18335807 12.18385388  
##   
## (Intercept) -167.61990957 -167.64106811 -167.66166230 -167.68149835  
## Private -580.03184775 -579.98636278 -579.94453476 -579.90611367  
## Accept 1.23382445 1.23388470 1.23393967 1.23398981  
## Enroll -0.18904786 -0.18946276 -0.18984163 -0.19018751  
## Top10perc 56.76098349 56.76300553 56.76480447 56.76640862  
## Top25perc -21.91995409 -21.92157019 -21.92301338 -21.92430485  
## F.Undergrad 0.07831597 0.07836711 0.07841384 0.07845653  
## P.Undergrad 0.03311848 0.03311873 0.03311894 0.03311910  
## Outstate -0.04334164 -0.04334841 -0.04335459 -0.04336022  
## Room.Board 0.17856284 0.17855184 0.17854173 0.17853246  
## Books -0.03946278 -0.03946486 -0.03946654 -0.03946790  
## Personal 0.04215666 0.04216120 0.04216532 0.04216908  
## PhD -9.95099954 -9.95078270 -9.95057650 -9.95038169  
## Terminal -2.81431156 -2.81413982 -2.81398946 -2.81385754  
## S.F.Ratio 18.36080799 18.36130320 18.36175560 18.36216941  
## perc.alumni -7.89722306 -7.89612256 -7.89511826 -7.89420199  
## Expend 0.09264824 0.09264972 0.09265111 0.09265240  
## Grad.Rate 12.18430405 12.18471335 12.18508589 12.18542524  
##   
## (Intercept) -167.70044245 -167.71840869  
## Private -579.87085689 -579.83853143  
## Accept 1.23403554 1.23407725  
## Enroll -0.19050324 -0.19079138  
## Top10perc 56.76784219 56.76912594  
## Top25perc -21.92546279 -21.92650288  
## F.Undergrad 0.07849553 0.07853114  
## P.Undergrad 0.03311924 0.03311934  
## Outstate -0.04336535 -0.04337004  
## Room.Board 0.17852395 0.17851616  
## Books -0.03946901 -0.03946991  
## Personal 0.04217250 0.04217562  
## PhD -9.95019860 -9.95002730  
## Terminal -2.81374149 -2.81363916  
## S.F.Ratio 18.36254820 18.36289511  
## perc.alumni -7.89336618 -7.89260388  
## Expend 0.09265360 0.09265472  
## Grad.Rate 12.18573454 12.18601657

## Predicting value and finding test error  
  
y\_pred <- predict(lasso\_model\_best, newx = x\_test, type = "response", s = min(lasso\_model$lambda))  
lasso\_model\_coef <- predict(lasso\_model\_best, type = "coefficients", s = min(lasso\_model$lambda))  
  
  
## calculating MSE   
mean((y\_pred - y\_test)^2)

## [1] 1770462