Assignment 2 - 2nd Attempt

Marella Murphy

2023-12-17

library(dplyr)

library(ISLR)

library(caret)

library(factoextra)

library(FNN)

UniversalBank <- read.csv("UniversalBank.csv")  
summary(UniversalBank)

## ID Age Experience Income ZIP.Code   
## Min. : 1 Min. :23.00 Min. :-3.0 Min. : 8.00 Min. : 9307   
## 1st Qu.:1251 1st Qu.:35.00 1st Qu.:10.0 1st Qu.: 39.00 1st Qu.:91911   
## Median :2500 Median :45.00 Median :20.0 Median : 64.00 Median :93437   
## Mean :2500 Mean :45.34 Mean :20.1 Mean : 73.77 Mean :93153   
## 3rd Qu.:3750 3rd Qu.:55.00 3rd Qu.:30.0 3rd Qu.: 98.00 3rd Qu.:94608   
## Max. :5000 Max. :67.00 Max. :43.0 Max. :224.00 Max. :96651   
## Family CCAvg Education Mortgage   
## Min. :1.000 Min. : 0.000 Min. :1.000 Min. : 0.0   
## 1st Qu.:1.000 1st Qu.: 0.700 1st Qu.:1.000 1st Qu.: 0.0   
## Median :2.000 Median : 1.500 Median :2.000 Median : 0.0   
## Mean :2.396 Mean : 1.938 Mean :1.881 Mean : 56.5   
## 3rd Qu.:3.000 3rd Qu.: 2.500 3rd Qu.:3.000 3rd Qu.:101.0   
## Max. :4.000 Max. :10.000 Max. :3.000 Max. :635.0   
## Personal.Loan Securities.Account CD.Account Online   
## Min. :0.000 Min. :0.0000 Min. :0.0000 Min. :0.0000   
## 1st Qu.:0.000 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.0000   
## Median :0.000 Median :0.0000 Median :0.0000 Median :1.0000   
## Mean :0.096 Mean :0.1044 Mean :0.0604 Mean :0.5968   
## 3rd Qu.:0.000 3rd Qu.:0.0000 3rd Qu.:0.0000 3rd Qu.:1.0000   
## Max. :1.000 Max. :1.0000 Max. :1.0000 Max. :1.0000   
## CreditCard   
## Min. :0.000   
## 1st Qu.:0.000   
## Median :0.000   
## Mean :0.294   
## 3rd Qu.:1.000   
## Max. :1.000

##remove the zip code and ID from the data, this will leave 12 columns to work with##  
  
UniversalBank <- UniversalBank[,-c(1,5)]  
summary(UniversalBank)

## Age Experience Income Family   
## Min. :23.00 Min. :-3.0 Min. : 8.00 Min. :1.000   
## 1st Qu.:35.00 1st Qu.:10.0 1st Qu.: 39.00 1st Qu.:1.000   
## Median :45.00 Median :20.0 Median : 64.00 Median :2.000   
## Mean :45.34 Mean :20.1 Mean : 73.77 Mean :2.396   
## 3rd Qu.:55.00 3rd Qu.:30.0 3rd Qu.: 98.00 3rd Qu.:3.000   
## Max. :67.00 Max. :43.0 Max. :224.00 Max. :4.000   
## CCAvg Education Mortgage Personal.Loan   
## Min. : 0.000 Min. :1.000 Min. : 0.0 Min. :0.000   
## 1st Qu.: 0.700 1st Qu.:1.000 1st Qu.: 0.0 1st Qu.:0.000   
## Median : 1.500 Median :2.000 Median : 0.0 Median :0.000   
## Mean : 1.938 Mean :1.881 Mean : 56.5 Mean :0.096   
## 3rd Qu.: 2.500 3rd Qu.:3.000 3rd Qu.:101.0 3rd Qu.:0.000   
## Max. :10.000 Max. :3.000 Max. :635.0 Max. :1.000   
## Securities.Account CD.Account Online CreditCard   
## Min. :0.0000 Min. :0.0000 Min. :0.0000 Min. :0.000   
## 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.000   
## Median :0.0000 Median :0.0000 Median :1.0000 Median :0.000   
## Mean :0.1044 Mean :0.0604 Mean :0.5968 Mean :0.294   
## 3rd Qu.:0.0000 3rd Qu.:0.0000 3rd Qu.:1.0000 3rd Qu.:1.000   
## Max. :1.0000 Max. :1.0000 Max. :1.0000 Max. :1.000

##checking to see how many levels there are, the output indicates there are 3.  
factor(UniversalBank$Education)

## [1] 1 1 1 2 2 2 2 3 2 3 3 2 3 2 1 3 3 1 3 2 2 3 1 1 1 1 3 1 3 2 3 2 3 3 3 1 1  
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## [741] 1 3 1 1 1 2 2 2 1 2 1 3 2 2 1 2 3 2 2 2 2 1 2 1 2 1 1 3 1 2 2 1 3 1 1 2 3  
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## [4996] 3 1 3 2 1  
## Levels: 1 2 3

##create dummy variables for Education  
UniversalBank$Education <- as.factor(UniversalBank$Education)  
dummy\_model <- dummyVars(~., data=UniversalBank)  
UniversalBank <- as.data.frame(predict(dummy\_model, UniversalBank))

##I can view the summary of the data frame to confirm that the Education variable has been converted into 3 factors, I see the Education.1, 2, and 3 so this step is correct.   
summary.data.frame(UniversalBank)

## Age Experience Income Family   
## Min. :23.00 Min. :-3.0 Min. : 8.00 Min. :1.000   
## 1st Qu.:35.00 1st Qu.:10.0 1st Qu.: 39.00 1st Qu.:1.000   
## Median :45.00 Median :20.0 Median : 64.00 Median :2.000   
## Mean :45.34 Mean :20.1 Mean : 73.77 Mean :2.396   
## 3rd Qu.:55.00 3rd Qu.:30.0 3rd Qu.: 98.00 3rd Qu.:3.000   
## Max. :67.00 Max. :43.0 Max. :224.00 Max. :4.000   
## CCAvg Education.1 Education.2 Education.3   
## Min. : 0.000 Min. :0.0000 Min. :0.0000 Min. :0.0000   
## 1st Qu.: 0.700 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.0000   
## Median : 1.500 Median :0.0000 Median :0.0000 Median :0.0000   
## Mean : 1.938 Mean :0.4192 Mean :0.2806 Mean :0.3002   
## 3rd Qu.: 2.500 3rd Qu.:1.0000 3rd Qu.:1.0000 3rd Qu.:1.0000   
## Max. :10.000 Max. :1.0000 Max. :1.0000 Max. :1.0000   
## Mortgage Personal.Loan Securities.Account CD.Account   
## Min. : 0.0 Min. :0.000 Min. :0.0000 Min. :0.0000   
## 1st Qu.: 0.0 1st Qu.:0.000 1st Qu.:0.0000 1st Qu.:0.0000   
## Median : 0.0 Median :0.000 Median :0.0000 Median :0.0000   
## Mean : 56.5 Mean :0.096 Mean :0.1044 Mean :0.0604   
## 3rd Qu.:101.0 3rd Qu.:0.000 3rd Qu.:0.0000 3rd Qu.:0.0000   
## Max. :635.0 Max. :1.000 Max. :1.0000 Max. :1.0000   
## Online CreditCard   
## Min. :0.0000 Min. :0.000   
## 1st Qu.:0.0000 1st Qu.:0.000   
## Median :1.0000 Median :0.000   
## Mean :0.5968 Mean :0.294   
## 3rd Qu.:1.0000 3rd Qu.:1.000   
## Max. :1.0000 Max. :1.000

## Next I am going to attempt to split the data 60/40 for training data  
set.seed(1)  
train.rows <- sample(rownames(UniversalBank),dim(UniversalBank)[1]\*0.6)  
train.data <- UniversalBank[train.rows, ]  
valid.rows <- setdiff(row.names(df), train.rows)  
valid.data <- UniversalBank[valid.rows, ]  
summary(train.data)

## Age Experience Income Family   
## Min. :23.00 Min. :-3.00 Min. : 8.00 Min. :1.000   
## 1st Qu.:36.00 1st Qu.:10.00 1st Qu.: 39.00 1st Qu.:1.000   
## Median :45.00 Median :20.00 Median : 63.00 Median :2.000   
## Mean :45.43 Mean :20.19 Mean : 73.08 Mean :2.388   
## 3rd Qu.:55.00 3rd Qu.:30.00 3rd Qu.: 98.00 3rd Qu.:3.000   
## Max. :67.00 Max. :43.00 Max. :224.00 Max. :4.000   
## CCAvg Education.1 Education.2 Education.3   
## Min. : 0.000 Min. :0.0000 Min. :0.000 Min. :0.0000   
## 1st Qu.: 0.700 1st Qu.:0.0000 1st Qu.:0.000 1st Qu.:0.0000   
## Median : 1.500 Median :0.0000 Median :0.000 Median :0.0000   
## Mean : 1.915 Mean :0.4173 Mean :0.285 Mean :0.2977   
## 3rd Qu.: 2.500 3rd Qu.:1.0000 3rd Qu.:1.000 3rd Qu.:1.0000   
## Max. :10.000 Max. :1.0000 Max. :1.000 Max. :1.0000   
## Mortgage Personal.Loan Securities.Account CD.Account   
## Min. : 0.00 Min. :0.00000 Min. :0.0000 Min. :0.00000   
## 1st Qu.: 0.00 1st Qu.:0.00000 1st Qu.:0.0000 1st Qu.:0.00000   
## Median : 0.00 Median :0.00000 Median :0.0000 Median :0.00000   
## Mean : 57.34 Mean :0.09167 Mean :0.1003 Mean :0.05367   
## 3rd Qu.:102.00 3rd Qu.:0.00000 3rd Qu.:0.0000 3rd Qu.:0.00000   
## Max. :635.00 Max. :1.00000 Max. :1.0000 Max. :1.00000   
## Online CreditCard   
## Min. :0.0000 Min. :0.0000   
## 1st Qu.:0.0000 1st Qu.:0.0000   
## Median :1.0000 Median :0.0000   
## Mean :0.5847 Mean :0.2927   
## 3rd Qu.:1.0000 3rd Qu.:1.0000   
## Max. :1.0000 Max. :1.0000

summary(valid.data)

## Age Experience Income Family CCAvg   
## Min. : NA Min. : NA Min. : NA Min. : NA Min. : NA   
## 1st Qu.: NA 1st Qu.: NA 1st Qu.: NA 1st Qu.: NA 1st Qu.: NA   
## Median : NA Median : NA Median : NA Median : NA Median : NA   
## Mean :NaN Mean :NaN Mean :NaN Mean :NaN Mean :NaN   
## 3rd Qu.: NA 3rd Qu.: NA 3rd Qu.: NA 3rd Qu.: NA 3rd Qu.: NA   
## Max. : NA Max. : NA Max. : NA Max. : NA Max. : NA   
## Education.1 Education.2 Education.3 Mortgage Personal.Loan  
## Min. : NA Min. : NA Min. : NA Min. : NA Min. : NA   
## 1st Qu.: NA 1st Qu.: NA 1st Qu.: NA 1st Qu.: NA 1st Qu.: NA   
## Median : NA Median : NA Median : NA Median : NA Median : NA   
## Mean :NaN Mean :NaN Mean :NaN Mean :NaN Mean :NaN   
## 3rd Qu.: NA 3rd Qu.: NA 3rd Qu.: NA 3rd Qu.: NA 3rd Qu.: NA   
## Max. : NA Max. : NA Max. : NA Max. : NA Max. : NA   
## Securities.Account CD.Account Online CreditCard   
## Min. : NA Min. : NA Min. : NA Min. : NA   
## 1st Qu.: NA 1st Qu.: NA 1st Qu.: NA 1st Qu.: NA   
## Median : NA Median : NA Median : NA Median : NA   
## Mean :NaN Mean :NaN Mean :NaN Mean :NaN   
## 3rd Qu.: NA 3rd Qu.: NA 3rd Qu.: NA 3rd Qu.: NA   
## Max. : NA Max. : NA Max. : NA Max. : NA

TraVal\_Data = UniversalBank  
  
##I am adding a chunk of code that I don't actually understand, but excluded from my first attempt. This was causing me an error when I did not include it originally.   
train.norm.df <- train.data  
valid.norm.df <- valid.data  
traval.norm.df <- TraVal\_Data  
  
## This next chunk I did apply without help, once I added the chunk above.   
norm.values <- preProcess(UniversalBank[, c(1:5, 9)], method = c("center", "scale"))  
train.norm.df[, c(1:5, 9)] <- predict(norm.values, train.data[, c(1:5, 9)])   
valid.norm.df[, c(1:5, 9)] <- predict(norm.values, valid.data[, c(1:5, 9)])

## Warning in `[<-.data.frame`(`\*tmp\*`, , object$method$center, value =  
## structure(list(: provided 36 variables to replace 6 variables

## Warning in `[<-.data.frame`(`\*tmp\*`, , object$method$scale, value =  
## structure(list(: provided 36 variables to replace 6 variables

## In this next section - I had to reference the answer sheet, I did NOT get this part correct the first attempt. But here is what I was able to duplicate using the example to create the new data frame.   
  
new\_customer <- data.frame(Age = 40, Experience = 10, Income = 84,Family = 2, CCAvg = 2, Education.1 = 0, Education.2 = 1, Education.3 = 0, Mortgage = 0, Securities.Account = 0, CD.Account = 0, Online = 1, CreditCard = 1)  
  
test.norm.df <- new\_customer  
test.norm.df[, c(1:5, 9)] <- predict(norm.values, new\_customer[, c(1:5, 9)])

##I will now try to copmlete the knn (nearest neighbor) calculation. I'm using the "FNN" library from the class example for classifiers.  
## I got stuck again with this line of code, I kept getting an error that the dims differ, so for my 2nd attempt I referenced the answer sheet. This is when I reazlied I omitted the traval.norm data alltogether above, and I had to go back to add it.   
### nn <- knn(train = train.norm.df[, 1:2], test = test.norm.df,  
 ### cl = train.norm.df[, 3], k=3, prob = TRUE)  
  
knn.pred.new <- knn ( train = subset(traval.norm.df, select=-Personal.Loan),  
 test = test.norm.df,   
 cl = traval.norm.df[, 10],  
 k = 1,  
 prob = TRUE )

##The next set of information in the answer sheet was not how I approached this to find the correct k, so I left my original work because I still reached k=3. I think we had not technically learned this yet in Assignment 2.  
 ## I receieved an error when knitting that this code cause the knit to stop scale.df <- scale(valid.data.df)  
 ## fviz\_nbclust(valid.norm.df, kmeans, method = "silhouette")

## I could not get the confusion matrix to print? I think I must have missed a step above. However, I do understand that the confusion matrix is meant to summarize the correct and incorrect classifications. So, perpahps I did no classify anything correct...? Taking note of this for the final to try to apply it correctly.  
 ## confusionMatrix(knn.pred.new, train.norm.df[, 10], positive = "1")  
 ## confusionMatrix(knn.pred.new, train.norm.df[, 10], positive = "1")$byClass["F1"]

```