

Assignment 2

Nourah

2/21/2021

```
## First I Will Install Packages
library(caret)

## Loading required package: lattice

## Loading required package: ggplot2

library(class)
library(gmodels)
library(ggplot2)
library(FNN)

## Attaching package: 'FNN'

## The following objects are masked from 'package:class':
##   knn, knn.cv

library(dummies)

## dummies-1.5.6 provided by Decision Patterns

library(fastDummies)
df$Education<-as.factor(df$Education)
library(dplyr)

## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##   filter, lag

## The following objects are masked from 'package:base':
##   intersect, setdiff, setequal, union

##Second I will Import the CSV File
df <-read.csv(file="--/Desktop/spring 2021/ML/ML2/UniversalBank.csv")

##Perform a k-NN classification with all predictors except ID and ZIP code using k = 1
df<-df[,c(1,-5)]
str(df)

## 'data.frame':   5000 obs. of  12 variables:
## $ Age           : int  25 45 39 35 35 37 53 50 35 34 ...
## $ Experience     : int  1 19 15 9 8 13 27 24 10 9 ...
## $ Income         : int  49 34 11 100 45 29 72 22 81 180 ...
## $ Family         : int  4 3 1 1 4 2 1 3 1 ...
## $ CCAvg          : num  1.6 1.5 1 2 7 1 0 4 1.5 0.3 0.6 8.9 ...
## $ Education      : int  1 1 1 2 2 2 2 3 2 3 ...
## $ Mortgage       : int  0 0 0 0 0 155 0 0 104 0 ...
## $ Personal.Loan  : int  0 0 0 0 0 0 0 0 0 1 ...
## $ Securities.Account: int  1 0 0 0 0 0 0 0 0 0 ...
## $ CD.Account     : int  0 0 0 0 0 0 0 0 0 0 ...
## $ Online         : int  0 0 0 0 0 1 0 1 0 1 ...
## $ CreditCard     : int  0 0 0 0 1 0 1 0 0 0 ...

###Transform categorical predictors with more than two categories into dummy variables
dummymodel <- dummyVars(~Education,data=df)
head(predict(dummymodel,df))

##   Education
## 1         1
## 2         1
## 3         1
## 4         2
## 5         2
## 6         2

dummymodel <- dummyVars(~Family, data=df)
head(predict(dummymodel,df))

##   Family
## 1         4
## 2         3
## 3         1
## 4         1
## 5         4
## 6         4

###transform categorical predictors with more than two categories into dummy variables
df$Education<-as.factor(df$Education)
dummy_model<-dummyVars(~,data=df)
head(predict(dummy_model,df))

##   Age Experience Income Family.1 Family.2 Family.3 Family.4 CCAvg Education.1 Education.2 Education.3
## 1 25         1      49         1         1         0         0         1         0         0
## 2 45         19     34         3         1.5       1         0         1         0         0
## 3 39         15     11         1         1.0       1         0         0         1         0
## 4 35         9      100        1         2.7       0         0         0         1         0
## 5 35         8      45         0         0.0       0         0         0         1         0
## 6 37         13     29         4         1.4       0         0         1         1         0
##   Mortgage Personal.Loan Securities.Account CD.Account Online CreditCard
## 1         0         0         0         1         0         0         0
## 2         0         0         0         0         0         0         0
## 3         0         0         0         1         0         0         0
## 4         0         0         0         0         0         0         0
## 5         0         0         0         0         0         0         1
## 6        155         0         0         0         0         1         0

df1<-data.frame(predict(dummy_model, newdata=df))

df$Family<-as.factor(df$Family)
dummy_model<-dummyVars(~,data=df)
head(predict(dummy_model,df))

##   Age Experience Income Family.1 Family.2 Family.3 Family.4 CCAvg Education.1
## 1 25         1      49         0         0         0         1         1.6       1
## 2 45         19     34         0         0         0         1         0.15     1
## 3 39         15     11         1         0         0         0         0.1       1
## 4 35         9      100        1         0         0         0         2.7       0
## 5 35         8      45         0         0         0         0         1.0       0
## 6 37         13     29         0         0         0         0         1.4       0
##   Education.2 Education.3 Mortgage Personal.Loan Securities.Account CD.Account
## 1         0         0         0         0         0         1         0
## 2         0         0         0         0         0         1         0
## 3         0         0         0         0         0         0         0
## 4         1         0         0         0         0         0         0
## 5         1         0         0         0         0         0         0
## 6         1         0        155         0         0         0         0
##   Online CreditCard
## 1         0         0
## 2         0         0
## 3         0         0
## 4         0         0
## 5         0         1
## 6         1         0

df1<-data.frame(predict(dummy_model, newdata=df))

##Preparation for data splitting and validation
set.seed(2)
train.rows <-sample(rownames(df1), dim(df1)[1]*.6)
train.data <- df1[train.rows,]
valid.rows <- setdiff(rownames(df1), train.rows)
valid.data <- df1[valid.rows,]
summary(train.data)

##   Age Experience Income Family.1
## Min. :23.00 Min. :3.00 Min. : 8.00 Min. :0.0000
## 1st Qu.:35.00 1st Qu.:10.00 1st Qu.: 39.00 1st Qu.:0.0000
## Median :45.00 Median :20.00 Median : 64.00 Median :0.0000
## Mean :45.27 Mean :20.03 Mean : 74.27 Mean :0.2937
## 3rd Qu.:56.00 3rd Qu.:30.00 3rd Qu.:101.00 3rd Qu.:1.0000
## Max. :67.00 Max. :43.00 Max. :224.00 Max. :1.0000
##   Family.2 Family.3 Family.4 CCAvg
## Min. :0.000 Min. :0.000 Min. :0.0000 Min. : 0.000
## 1st Qu.:0.000 1st Qu.:0.000 1st Qu.:0.0000 1st Qu.: 0.700
## Median :0.000 Median :0.000 Median :0.2503 Median : 1.600
## Mean :0.259 Mean :0.197 Mean :0.2503 Mean : 1.963
## 3rd Qu.:1.000 3rd Qu.:0.000 3rd Qu.:1.0000 3rd Qu.: 2.600
## Max. :1.000 Max. :1.000 Max. :1.0000 Max. :10.000
##   Education.1 Education.2 Education.3 Mortgage
## Min. :0.0000 Min. :0.0000 Min. :0.000 Min. : 0.00
## 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.000 1st Qu.: 0.00
## Median :0.0000 Median :0.0000 Median :0.2238 Median : 0.00
## Mean :0.4183 Mean :0.2767 Mean :0.305 Mean : 56.67
## 3rd Qu.:1.0000 3rd Qu.:1.0000 3rd Qu.:1.000 3rd Qu.: 0.3628
## Max. :1.0000 Max. :1.0000 Max. :1.000 Max. :101.00
##   Personal.Loan Securities.Account CD.Account Online
## Min. :0.00000 Min. :0.00000 Min. :0.00000 Min. :0.000
## 1st Qu.:0.00000 1st Qu.:0.00000 1st Qu.:0.00000 1st Qu.:0.000
## Median :0.00000 Median :0.00000 Median :0.00000 Median :1.000
## Mean :0.09733 Mean :0.1093 Mean :0.06267 Mean :0.604
## 3rd Qu.:0.00000 3rd Qu.:0.00000 3rd Qu.:0.00000 3rd Qu.:1.000
## Max. :1.00000 Max. :1.00000 Max. :1.00000 Max. :1.000
##   CreditCard
## Min. :0.0000
## 1st Qu.:0.0000
## Median :0.0000
## Mean :0.3023
## 3rd Qu.:1.0000
## Max. :1.0000

summary(valid.data)

##   Age Experience Income Family.1
## Min. :23.00 Min. :2.00 Min. : 8.00 Min. :0.0000
## 1st Qu.:36.00 1st Qu.:11.00 1st Qu.: 38.00 1st Qu.:0.0000
## Median :46.00 Median :20.00 Median : 63.00 Median :0.0000
## Mean :45.44 Mean :20.22 Mean : 73.04 Mean :0.2955
## 3rd Qu.:55.00 3rd Qu.:29.00 3rd Qu.: 94.25 3rd Qu.:1.0000
## Max. :67.00 Max. :43.00 Max. :205.00 Max. :1.0000
##   Family.2 Family.3 Family.4 CCAvg
## Min. :0.0000 Min. :0.0000 Min. :0.0000 Min. : 0.0
## 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.: 0.7
## Median :0.0000 Median :0.0000 Median :0.2238 Median : 1.5
## Mean :0.2595 Mean :0.2095 Mean :0.2503 Mean : 1.9
## 3rd Qu.:1.0005 3rd Qu.:0.0000 3rd Qu.:1.0000 3rd Qu.: 2.5
## Max. :1.0005 Max. :1.0000 Max. :1.0000 Max. :10.000
##   Education.1 Education.2 Education.3 Mortgage
## Min. :0.0000 Min. :0.0000 Min. :0.000 Min. : 0.00
## 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.000 1st Qu.: 0.00
## Median :0.0000 Median :0.0000 Median :0.2238 Median : 0.00
## Mean :0.4205 Mean :0.2865 Mean :0.293 Mean : 56.23
## 3rd Qu.:1.0000 3rd Qu.:1.0000 3rd Qu.:1.000 3rd Qu.:100.00
## Max. :1.0000 Max. :1.0000 Max. :1.000 Max. :1635.00
##   Personal.Loan Securities.Account CD.Account Online
## Min. :0.000 Min. :0.000 Min. :0.000 Min. :0.000
## 1st Qu.:0.000 1st Qu.:0.000 1st Qu.:0.000 1st Qu.:0.000
## Median :0.000 Median :0.000 Median :0.000 Median :1.000
## Mean :0.094 Mean :0.097 Mean :0.057 Mean :0.586
## 3rd Qu.:0.000 3rd Qu.:0.000 3rd Qu.:0.000 3rd Qu.:1.000
## Max. :1.000 Max. :1.000 Max. :1.000 Max. :1.000
##   CreditCard
## Min. :0.0000
## 1st Qu.:0.0000
## Median :0.0000
## Mean :0.2815
## 3rd Qu.:1.0000
## Max. :1.0000

###Normalizing
train_normalization <-train.data
valid_normalization <-valid.data
normalization.values <- preProcess(train.data[, c("Age","Experience","Income","CCAvg","Mortgage")
]), method=c("center", "scale"))
train_normalization[, c("Age","Experience","Income","CCAvg","Mortgage")] <- predict(normalization
n.values, train.data[, c("Age","Experience","Income","CCAvg","Mortgage")])
valid_normalization[, c("Age","Experience","Income","CCAvg","Mortgage")] <- predict(normalization
n.values, valid.data[, c("Age","Experience","Income","CCAvg","Mortgage")])
summary(train_normalization)

##   Age Experience Income Family.1
## Min. :-1.91217 Min. :-1.979430 Min. :-1.4449 Min. :0.0000
## 1st Qu.:-0.88170 1st Qu.:-0.861934 1st Qu.: -0.7689 1st Qu.:0.0000
## Median :-0.02298 Median :-0.002321 Median :-0.2238 Median :0.0000
## Mean : 0.00000 Mean : 0.0000000 Mean : 0.00000 Mean :0.2937
## 3rd Qu.: 0.92161 3rd Qu.: 0.857292 3rd Qu.: 0.5829 3rd Qu.:1.0000
## Max. : 1.86620 Max. : 1.974789 Max. : 3.2647 Max. :1.0000
##   Family.2 Family.3 Family.4 CCAvg
## Min. :0.000 Min. :0.000 Min. :0.0000 Min. :-1.1183
## 1st Qu.:0.000 1st Qu.:0.000 1st Qu.:0.0000 1st Qu.: -0.7196
## Median :0.000 Median :0.000 Median :0.0000 Median :-0.2069
## Mean :0.259 Mean :0.197 Mean :0.2503 Mean : 0.0000
## 3rd Qu.:1.000 3rd Qu.:0.000 3rd Qu.:1.0000 3rd Qu.: 0.3367
## Max. :1.000 Max. :1.000 Max. :1.0000 Max. : 4.5784
##   Education.1 Education.2 Education.3 Mortgage
## Min. :0.0000 Min. :0.0000 Min. :0.000 Min. : -0.5568
## 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.000 1st Qu.: -0.5568
## Median :0.0000 Median :0.0000 Median :0.0000 Median :-0.5568
## Mean :0.4183 Mean :0.2767 Mean :0.305 Mean : 0.0000
## 3rd Qu.:1.0000 3rd Qu.:1.0000 3rd Qu.:1.000 3rd Qu.: 0.4453
## Max. :1.0000 Max. :1.0000 Max. :1.000 Max. : 5.3481
##   Personal.Loan Securities.Account CD.Account Online
## Min. :0.00000 Min. :0.00000 Min. :0.00000 Min. :0.000
## 1st Qu.:0.00000 1st Qu.:0.00000 1st Qu.:0.00000 1st Qu.:0.000
## Median :0.00000 Median :0.00000 Median :0.00000 Median :1.000
## Mean :0.09733 Mean :0.1093 Mean :0.06267 Mean :0.604
## 3rd Qu.:0.00000 3rd Qu.:0.00000 3rd Qu.:0.00000 3rd Qu.:1.000
## Max. :1.00000 Max. :1.00000 Max. :1.00000 Max. :1.000
##   CreditCard
## Min. :0.0000
## 1st Qu.:0.0000
## Median :0.0000
## Mean :0.3023
## 3rd Qu.:1.0000
## Max. :1.0000

##Q1 - Age = 40, Experience = 10, Income = 84, Family = 2, CCAvg = 2, Education_1 = 0, Educatio
n_2 = 1, Education_3 = 0, Mortgage = 0, Securities Account = 0, CD Account = 0, Online = 1, and
Credit Card = 1. Perform a k-NN classification with all predictors except ID and ZIP code using
k = 1. Remember to transform categorical predictors with more than two categories into dummy var
iables first. Specify the success class as 1 (loan acceptance), and use the default cutoff value
of 0.5. How would this customer be classified?

df2 <- data.frame(Age = 40, Experience = 10, Income = 84, CCAvg = 2,
Mortgage = 0, Securities.Account = 0, CD.Account = 0,
Online = 1, CreditCard =1, Family_1 = 0, Family_2 = 1,
Family_3 = 0, Family_4 = 0, Education_1 = 0,
Education_2 = 1, Education_3 = 0)
df3 <- predict(normalization.values, df2)
print(df3)

##   Age Experience Income CCAvg Mortgage Securities.Account
## 1 -0.4523446 -0.8619338 0.2122216 0.02100374 -0.5568407 0
##   CD.Account Online CreditCard Family_1 Family_2 Family_3 Family_4 Education_1
##   0 0 1 0 1 0 1 0 0 0
##   Education_2 Education_3
## 1 1 0

###Predictors
predictors <- c(1:5,7:17)
nn <- knn(train=train_normalization[, predictors], test=df3, cl=train_normalization[, 6], k=1)
row.names(train_normalization)[attr(nn, "nn.index")]

## [1] "2736"

print(train_normalization[attr(nn, "nn.index"),])

##   Age Experience Income Family.1 Family.2 Family.3 Family.4
## 2736 -0.7958322 -0.6900112 -0.09302866 0 0 1 0
##   CCAvg Education.1 Education.2 Education.3 Mortgage Personal.Loan
## 2736 0.3628059 0 0 1 0 1.06432 0
##   Securities.Account CD.Account Online CreditCard
## 2736 0 0 1 0 0

nn[1]

## [1] 1
## Levels: 1

## No personal loan, it will be classified to nearest neighbor which is 0

##Q2 - What is a choice of k that balances between overfitting and ignoring the predictor infor
mation?

df4 <-data.frame(k=seq(1,14,1), accuracy= rep(0,14), sensitivity = rep(0,14), specificity = rep
(0,14), PPV=rep(0,14), NPV=rep(0,14), F1=rep(0,14))
for(i in 1:14)
{
  knn1 <- knn(train_normalization[,predictors], valid_normalization[,predictors], cl = as.factor
(train_normalization[, 6]), k = i)
  knn2 <- confusionMatrix(knn1, as.factor(valid_normalization[, 6]), positive="1")
  df4[i, 2] <- knn2$overall[1]$accuracy
  df4[i, 3] <- knn2$byClass[c("Sensitivity")]
  df4[i, 4] <- knn2$byClass[c("Specificity")]
  df4[i, 5] <- knn2$byClass[c("Precision")]
  df4[i, 6] <- knn2$byClass[c("Positive Predicted Value")]
  df4[i, 7] <- knn2$byClass[c("Negative Predicted Value")]
  df4[i, 8] <- knn2$byClass[c("F")]
}
df4

k accuracy sensitivity specificity PPV NPV F1 V8
<dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
1 0.9635 0.9212411 0.9746996 0.9061033 NA NA NA
2 0.9570 0.8162291 0.9943074 0.9743590 NA NA NA
3 0.9675 0.8926014 0.9873498 0.9492386 NA NA NA
4 0.9575 0.8114558 0.9962029 0.9826590 NA NA NA
5 0.9670 0.8782816 0.9905143 0.9608355 NA NA NA
6 0.9560 0.8066826 0.9955724 0.9797101 NA NA NA
7 0.9595 0.8424821 0.9905123 0.9592391 NA NA NA
8 0.9480 0.7684964 0.9955724 0.9787234 NA NA NA
9 0.9555 0.8162291 0.9924099 0.9661017 NA NA NA
10 0.9440 0.7446301 0.9968374 0.9842271 NA NA NA
1-10 of 14 rows Previous 1 2 Next

## as the result show, we have the highest sensitivity from K=3

knn1<-knn(train_normalization[, predictors], valid_normalization[, predictors], cl=as.factor(tr
ain_normalization[,6]),k=3)
knn4<- CrossTable(x=valid_normalization[,6], y=knn1, prob.chisq = FALSE)

##
##
## Cell Contents
## |-----|
## | N / Row Total |
## | N / Col Total |
## | N / Table Total |
## |-----|
##
## Total Observations in Table: 2000
##
##
## valid_normalization[, 6] | knn1 0 | 1 | Row Total |
## -----|-----|-----|
## 0 | 1561 | 20 | 1581 |
## | 0.987 | 0.013 | 0.790 |
## | 0.972 | 0.051 | |
## | 0.780 | 0.010 | |
## -----|-----|-----|
## 1 | 45 | 374 | 419 |
## | 0.107 | 0.893 | 0.209 |
## | 0.028 | 0.949 | |
## | 0.022 | 0.187 | |
## -----|-----|-----|
## Column Total | 1606 | 394 | 2000 |
## | 0.803 | 0.197 | |
## -----|-----|-----|
##
##
##Q4- Consider the following customer: 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 and Credit Card = 1. Classify the customer using the best k

knn5 <- knn(train=train_normalization[, predictors], test=df3, cl=train_normalization[, 6], k=3,
prob=TRUE)
print(train_normalization[attr(knn5, "knn5.index"),])

## [1] Age Experience Income Family.1
## [5] Family.2 Family.3 Family.4 CCAvg
## [9] Education.1 Education.2 Education.3 Mortgage
## [13] Personal.Loan Securities.Account CD.Account Online
## [17] CreditCard
## <0 rows> (or 0-length row.names)

knn5[1]

## [1] 1
## Levels: 1

## Using 1 because 0 will mean not accept loan

##Q5- Repartition the data, this time into training, validation, and test sets (50% : 30% : 20
%). Apply the k-NN method with the k chosen above. Compare the confusion matrix of the test set
with that of the training and validation sets. Comment on the differences and their reason.

set.seed(5)
test.index = createDataPartition(df1$Personal.Loan,p=0.2, list=FALSE)
test.data = df1[test.index,]
train.valid.data = df1[-test.index,]
train.index = createDataPartition(train.valid.data$Personal.Loan,p=0.625, list=FALSE)
train.data = train.valid.data[train.index,]
valid.data = train.valid.data[-train.index,]
Train.D <- colMeans(train.data)
Valid.D <- colMeans(valid.data)
sprintf("%.3f", Train.D)

## [1] "45.521" "20.304" "74.028" "0.288" "0.251" "0.196" "0.266" "1.921"
## [9] "0.420" "0.283" "0.296" "57.450" "0.093" "0.105" "0.060" "0.599"
## [17] "0.297"

sprintf("%.3f", Valid.D)

## [1] "45.182" "19.907" "73.820" "0.297" "0.271" "0.216" "0.217" "1.936"
## [9] "0.434" "0.256" "0.310" "52.753" "0.097" "0.101" "0.067" "0.586"
## [17] "0.299"

rm(Train.D)
rm(Valid.D)

###Normalizing
train_normalization <- train.data
valid_normalization <- valid.data
normalization.values <- preProcess(train.data[, c("Age","Experience","Income","CCAvg","Mortgage")
]), method=c("center", "scale"))
train_normalization[, c("Age","Experience","Income","CCAvg","Mortgage")] <- predict(normalization
n.values, train.data[, c("Age","Experience","Income","CCAvg","Mortgage")])
valid_normalization[, c("Age","Experience","Income","CCAvg","Mortgage")] <- predict(normalization
n.values, valid.data[, c("Age","Experience","Income","CCAvg","Mortgage")])
summary(train_normalization)

##   Age Experience Income Family.1
## Min. :-1.96834 Min. :-2.03822 Min. :-1.44201 Min. :0.000
## 1st Qu.:-0.91955 1st Qu.:-0.90123 1st Qu.: -0.786855 1st Qu.:0.0000
## Median : 0.04185 Median : 0.06084 Median : -0.2160 1st Qu.:0.000
## Mean : 0.00000 Mean : 0.00000 Mean : 0.00000 Mean :0.288
## 3rd Qu.: 0.82844 3rd Qu.: 0.84798 3rd Qu.: 0.5454 3rd Qu.:1.000
## Max. : 1.87723 Max. : 1.98497 Max. : 2.8604 Max. :1.000
##   Family.2 Family.3 Family.4 CCAvg
## Min. :0.0000 Min. :0.0000 Min. :0.0000 Min. : -1.1183
## 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.: -0.72837
## Median :0.0000 Median :0.0000 Median :0.0000 Median :-0.2582
## Mean :0.2707 Mean :0.216 Mean :0.2167 Mean : 0.008522
## 3rd Qu.:1.0000 3rd Qu.:0.0000 3rd Qu.:0.0000 3rd Qu.: 0.336744
## Max. :1.0000 Max. :1.0000 Max. :1.0000 Max. : 4.701974
##   Education.1 Education.2 Education.3 Mortgage
## Min. :0.000 Min. :0.000 Min. :0.000 Min. : -0.55821
## 1st Qu.:0.000 1st Qu.:0.000 1st Qu.:0.000 1st Qu.: -0.55821
## Median :0.000 Median :0.000 Median :0.000 Median :-0.55821
## Mean :0.434 Mean :0.256 Mean :0.131 Mean : 0.04564
## 3rd Qu.:1.000 3rd Qu.:1.000 3rd Qu.:1.000 3rd Qu.: 0.34785
## Max. :1.000 Max. :1.000 Max. :1.000 Max. : 5.28136
##   Personal.Loan Securities.Account CD.Account Online
## Min. :0.00000 Min. :0.00000 Min. :0.00000 Min. :0.000
## 1st Qu.:0.00000 1st Qu.:0.00000 1st Qu.:0.00000 1st Qu.:0.000
## Median :0.00000 Median :0.00000 Median :0.00000 Median :1.000
## Mean :0.09667 Mean :0.1013 Mean :0.06667 Mean :0.586
## 3rd Qu.:0.00000 3rd Qu.:0.00000 3rd Qu.:0.00000 3rd Qu.:1.000
## Max. :1.00000 Max. :1.00000 Max. :1.00000 Max. :1.000
##   CreditCard
## Min. :0.0000
## 1st Qu.:0.0000
## Median :0.0000
## Mean :0.2987
## 3rd Qu.:1.0000
## Max. :1.0000

summary(valid_normalization)

##   Age Experience Income Family.1
## Min. :-1.96834 Min. :-2.03822 Min. :-1.442057 Min. :0.0000
## 1st Qu.:-0.91955 1st Qu.:-0.90123 1st Qu.: -0.786855 1st Qu.:0.0000
## Median :-0.02955 Median :-0.02662 Median :-0.240852 Median :0.0000
## Mean :-0.02955 Mean :-0.03479 Mean :-0.040453 Mean :0.2987
## 3rd Qu.: 0.82844 3rd Qu.: 0.84798 3rd Qu.: 0.529011 3rd Qu.:1.0000
## Max. : 1.87723 Max. : 1.879751 Max. : 3.14360 Max. :1.0000
##   Family.2 Family.3 Family.4 CCAvg
## Min. :0.0000 Min. :0.000 Min. :0.0000 Min. :-1.11832
## 1st Qu.:0.0000 1st Qu.:0.000 1st Qu.:0.0000 1st Qu.: -0.72837
## Median :0.0000 Median :0.000 Median :0.0000 Median :-0.25826
## Mean :0.2707 Mean :0.216 Mean :0.2167 Mean : 0.008552
## 3rd Qu.:1.0000 3rd Qu.:0.0000 3rd Qu.:0.0000 3rd Qu.: 0.336744
## Max. :1.0000 Max. :1.0000 Max. :1.0000 Max. : 4.701974
##   Education.1 Education.2 Education.3 Mortgage
## Min. :0.000 Min. :0.000 Min. :0.000 Min. : -0.55821
## 1st Qu.:0.000 1st Qu.:0.000 1st Qu.:0.000 1st Qu.: -0.55821
## Median :0.000 Median :0.000 Median :0.000 Median :-0.55821
## Mean :0.434 Mean :0.256 Mean :0.131 Mean : 0.04564
## 3rd Qu.:1.000 3rd Qu.:1.000 3rd Qu.:1.000 3rd Qu.: 0.34785
## Max. :1.000 Max. :1.000 Max. :1.000 Max. : 5.28136
##   Personal.Loan Securities.Account CD.Account Online
## Min. :0.00000 Min. :0.00000 Min. :0.00000 Min. :0.000
## 1st Qu.:0.00000 1st Qu.:0.00000 1st Qu.:0.00000 1st Qu.:0.000
## Median :0.00000 Median :0.00000 Median :0.00000 Median :1.000
## Mean :0.09667 Mean :0.1013 Mean :0.06667 Mean :0.586
## 3rd Qu.:0.00000 3rd Qu.:0.00000 3rd Qu.:0.00000 3rd Qu.:1.000
## Max. :1.00000 Max. :1.00000 Max. :1.00000 Max. :1.000
##   CreditCard
## Min. :0.0000
## 1st Qu.:0.0000
## Median :0.0000
## Mean :0.2987
## 3rd Qu.:1.0000
## Max. :1.0000
```