Configuration Manual

MSc Research Project
Fintech

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PLEASE READ THE FOLLOWING INSTRUCTIONS AND CHECKLIST

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1 Software Tool

**R studio**: This is a software used for data analysis and machine learning purposes with statistical and visualisation capabilities. The R studio version used for this analysis is 948 bytes in size.

1.1. PC used to run the R program

- ✓ HP Pavilion 15 Laptop
- ✓ Intel Core i5 8th Generation
- ✓ 64-bit processor @ 1.60GHz 1.80GHz
- ✓ 8gb Ram
- ✓ Windows 10 home
- ✓ 1TB memory

2 Codes and Plots

```r
library(readxl)
library(caret)
library(glmnet)
library(mlbench)
library(psych)
library(dplyr)
library(mice)
library(VIM)
library(stargazer)
library(mctest)
library(ppcor)
library(GGally)
library(corpcor)

#READ DATA
Findex <- read_excel("~/Findex.xlsx")
View(Findex)
summary(Findex)
str(Findex)
fin<-Findex
```
# DECISION TO HAVE AN ACCOUNT WITH A FINANCIAL INSTITUTION

# FEMALES 15+
fe <- cbind(fin$own_financial_institution_account, female 15+, fin$Internet_bill_payment, female 15+, fin$Internet_purchase, female 15+, fin$Saved_business_or_farm, female 15+, fin$Saved_for_old_age, female 15+, fin$Saved_data_for_business_or_farming, female 15+, fin$Saved_for_education, female 15+)
colnames(fe) <- c("ownaccount", "Internet_BillPmt", "Internet_Purch", "Saved_BusinessFarm", "OldAge", "Savings", "Saved_Informal", "Education")

as.data.frame(fe) -> fe1
pairs.panels(fe1, cex = 2)

# IMPUTATION FEMALES 15+
impfe <- mice(fe1[,1:8], m = 3, seed = 123)
print(impfe)
complete(impfe, 1) -> fe1
View(fe1)

# Test for Multicollinearity
X1 <- fe1[,c(2:8)]
Y1 <- fe1[,c(1)]
ggpairs(X1)
cor2pcor(cov(X1))
omcdiag(X1, Y1)
imcdiag(X1, Y1)

# DATA PARTITIONING
set.seed(222)
ind1 <- sample(2, nrow(fe1), replace = T, prob = c(0.8, 0.2))
train1 <- subset(fe1, ind1 == 1)
test1 <- subset(fe1, ind1 == 2)

# custom control parameters
custom <- trainControl(method = "repeatedcv", number = 10, repeats = 5, verboseIter = T)

## MODEL FOR FEMALE 15+
set.seed(1234)
lm_fe <- train(ownaccount ~ ., train1, method = 'lm', trControl = custom)
lm_fe2 <- lm(ownaccount ~ ., train1)

# Forward Stepwise Regression
lm_fe3 <- lm(ownaccount ~ ., train1)
step(lm_fe3, direction = "forward", scope = formula(lm_fe2))
lm_fe <- train(ownaccount ~ Internet_BillPmt + Internet_Purch + Saved_BusinessFarm, train1, method = 'lm', trControl = custom)

# Results
lm_fe$results
lm_fe
summary(lm_fe)
#PLOT
plot(varImp(lm_fe, scale=T))

## RESIDUAL PLOT
lm_fe.res = resid(lm_fe)
plot(train1$ownaccount, lm_fe.res, ylab = "Residuals", xlab = "Own Account", main = "Female Residual Plot")
abline(0, 0)

#Prediction
p1 <- predict(lm_fe, test1)
sqrt(mean((test1$ownaccount - p1)^2))

#MALES
ma <- cbind(fin$`own financial institution account,male 15+`, fin$`Internet bill payment, male 15+`, fin$`Internet purchase, male 15+`, fin$`Saved for farm or business, male 15+`, fin$`Saved for old age, male 15+`, fin$`Informal Savings, male 15+`, fin$`Saved for education, male 15+`)
colnames(ma) <- c("ownaccount", "Internet_BillPmt", "Internet_Purch", "Saved_BusinessFarm", "OldAge", "Savings", "Saved_Informal", "Education")
as.data.frame(ma) -> ma1

#IMPUTATIONS FOR MALES
impma <- mice(ma[, 1:8], m = 3, seed = 123)
print(impma)
complete(impma, 1) -> ma1
View(ma1)

#Test for Multicollinearity
X2 <- ma1[, 2:8]
Y2 <- ma1[, 1]

ggpairs(X2)
cor2pcor(cov(X2))
omcdiag(X2, Y2)
imcdiag(X2, Y2)

#DATA PARTITIONING
set.seed(222)
ind2 <- sample(2, nrow(ma1), replace = T, prob = c(0.8, 0.2))
train2 <- subset(ma1, ind2 == 1)
test2 <- subset(ma1, ind2 == 2)

#Custom control parameters
custom <- trainControl(method = "repeatedcv", number = 10, repeats = 5, verboseIter = T)

##MODEL FOR MALE 15+
set.seed(1234)
lm_ma <- train(ownaccount ~ ., train2, method = 'lm', trControl = custom)
lm_ma2 <- lm(ownaccount ~ ., train2)
# Forward Stepwise Regression
```
lm_ma3<-lm(ownaccount~., train2)
step(lm_ma3, direction = "forward", scope = formula(lm_ma2))
lm_ma<-train(ownaccount~Internet_BillPmt+Internet_Purch+Saved_BusinessFarm, train2, method='lm', trControl=custom)
```

# Results
```
lm_ma$results
lm_ma
summary(lm_ma)
```

# PLOT
```
plot(varImp(lm_ma, scale=T))
```

## RESIDUAL PLOT
```
lm_ma.res=resid(lm_ma)
plot(train2$ownaccount, lm_ma.res, ylab="Residuals", xlab="Own Account", main="Male Residual Plot")
abline(0,0)
```

# Prediction
```
p2<-predict(lm_ma, test2)
sqrt(mean((test2$ownaccount - p2)^2))
```

### GENDER COMPARISON
```
#DETERMINANTS OF MOBILE BANKING
# MOBILE MONEY (FEMALE 15+)
mb_fe<-cbind(fin$`Mobile money account, female 15+`, fin$`Received digital payments, female 15+`, fin$`Made digital payments, female 15+`, fin$`Made or received digital payments, female 15+`, fin$`Own credit card, female 15+`, fin$`Debit card, female 15+`, fin$`Internet bill payment, female 15+`, fin$`Internet purchase, female 15+`)
colnames(mb_fe)<-c("mobileacct", "received_digital", "made_digital", "madeReceived_dig", "owncreditcard", "owndebitcard", "intern_bill", "intern_purch")
as.data.frame(mb_fe)->mb_fe1
```

# IMPUTATION FOR FEMALES 15+
```
impfe<-mice(mb_fe1[,1:8], m=3, seed = 123)
print(impfe)
complete(impfe, 1)->mb_fe2
View(mb_fe2)
summary(mb_fe2)
```

# Test for Multicollinearity
```
X3<-mb_fe2[,2:8]
Y3<-mb_fe2[,1]
ggpairs(X3)
cor2pcor(cov(X3))
omcdiag(X3, Y3)
```
#DATA PARTITIONING
set.seed(222)
ind3<-sample(2,nrow(mb_fe2),replace = T,prob = c(0.8,0.2))
train3<-subset(mb_fe2,ind3==1)
test3<-subset(mb_fe2,ind3==2)

#Custom control parameters
custom<-trainControl(method = "repeatedcv",number = 10,repeats = 5,verboseIter = T)

##MODEL FOR FEMALE 15+
set.seed(1234)

lm_mbfe<-train(mobileacct~.,train3,method='lm',trControl=custom)

lm_mbfe2<-lm(mobileacct~.,train3)

# Forward Stepwise Regression
lm_mbfe3<-lm(mobileacct~.,train3)
step(lm_mbfe3,direction = "forward",scope = formula(lm_mbfe2))

lm_mbfe<-train(mobileacct~received_digital+made_digital+madeReceived_dig+owncreditcard+owndebitcard+internet_bill+internet_purch,train3,method='lm',trControl=custom)

#Results
lm_mbfe$results
lm_mbfe
summary(lm_mbfe)

#PLOT
pairs.panels(mb_fe1)
plot(varImp(lm_mbfe, scale=T))

## RESIDUAL PLOT
lm_mbfe.res=resid(lm_mbfe)
plot(train3$mobileacct,lm_mbfe.res,ylab="Residuals",xlab="Own Mobile Account",main="Female Residual Plot")
abline(0,0)

#Prediction
p3<-predict(lm_mbfe,test3)
sqrt(mean((test3$mobileacct-p3)^2))

#MOBILE MONEY (MALES 15+)
mbma<-cbind(fin$'Mobile money account, male 15+',fin$'Received digital payments, male 15+',fin$'Made digital payments, male 15+',fin$'Made or received digital payments, male 15+',fin$'Own credit card, male 15+',fin$'Debit card, male 15+',fin$'Internet bill payment, male 15+',fin$'Internet purchase, male 15+')
colnames(mbma)<-c("mobileacct","received_digital","made_digital","madeReceived_dig","owncreditcard","owndebitcard","internet_bill","internet_purch")
as.data.frame(mbma)->mbma1
#IMPUTATION FOR MALES 15+
imp_ma <- mice(mbma[,1:8], m=3, seed = 123)
print(imp_ma)
complete(imp_ma,1) -> mb_ma2
View(mb_ma2)
summary(mb_ma2)

# Test for Multicollinearity
X4 <- mb_ma2[c(2:8)]
Y4 <- mb_ma2[c(1)]
ggpairs(X4)
cor2pcor(cov(X4))
omcdiag(X4,Y4)
imcdiag(X4,Y4)

# DATA PARTITIONING
set.seed(222)
ind4 <- sample(2,nrow(mb_ma2),replace = T, prob = c(0.8,0.2))
train4 <- subset(mb_ma2, ind4 == 1)
test4 <- subset(mb_ma2, ind4 == 2)

# Custom control parameters
custom <- trainControl(method = "repeatedcv", number = 10, repeats = 5, verboseIter = T)

## MODEL FOR MALE 15+
set.seed(1234)
lm_mbma <- train(mobileacct~., train4, method = 'lm', trControl = custom)
lm_mbma2 <- lm(mobileacct~., train4)

# Forward Stepwise Regression
lm_mbma3 <- lm(mobileacct~., train4)
step(lm_mbma3, direction = "forward", scope = formula(lm_mbma2))
lm_mbfe <-
train(mobileacct~received_digital+made_digital+madeReceived_dig+owncreditcard+owndebitcard+intern_bill+intern_purch, train4, method = 'lm', trControl = custom)

# Results
lm_mbma$results
lm_mbma
summary(lm_mbma)

# PLOT
pairs.panels(mbma1)
plot(varImp(lm_mbma, scale = T))

## RESIDUAL PLOT
lm_mbma.res = resid(lm_mbma)
plot(train4$mobileacct,lm_mbma.res,ylab="Residuals",xlab="Own Mobile Account",main="Male Residual Plot")
abline(0,0)

#Prediction
p4<-predict(lm_mbma,test4)
sqrt(mean((test4$mobileacct-p4)^2))

### ACROSS GENDER COMPARISON
stargazer(lm_mbfe3,lm_mbma3,type = "text",out = "mobile.txt",no.space = T)

Joint Output

=================================================================================================
Dependent variable: ownaccount

<table>
<thead>
<tr>
<th></th>
<th>females (1)</th>
<th>males (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet_BillPmt</td>
<td>0.038</td>
<td>-0.235**</td>
</tr>
<tr>
<td></td>
<td>(0.098)</td>
<td>(0.110)</td>
</tr>
<tr>
<td>Internet_Purch</td>
<td>0.291**</td>
<td>0.255*</td>
</tr>
<tr>
<td></td>
<td>(0.136)</td>
<td>(0.150)</td>
</tr>
<tr>
<td>Saved_BusinessFarm</td>
<td>-0.631***</td>
<td>-0.533***</td>
</tr>
<tr>
<td></td>
<td>(0.195)</td>
<td>(0.128)</td>
</tr>
<tr>
<td>OldAge</td>
<td>0.093</td>
<td>0.049</td>
</tr>
<tr>
<td></td>
<td>(0.134)</td>
<td>(0.126)</td>
</tr>
<tr>
<td>Savings</td>
<td>0.952***</td>
<td>1.280***</td>
</tr>
<tr>
<td></td>
<td>(0.142)</td>
<td>(0.117)</td>
</tr>
<tr>
<td>Saved_Informal</td>
<td>-0.359***</td>
<td>-0.279**</td>
</tr>
<tr>
<td></td>
<td>(0.105)</td>
<td>(0.125)</td>
</tr>
<tr>
<td>Education</td>
<td>0.258*</td>
<td>-0.180</td>
</tr>
<tr>
<td></td>
<td>(0.132)</td>
<td>(0.113)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.278***</td>
<td>0.396***</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.023)</td>
</tr>
</tbody>
</table>

Observations | 408 | 408
R2           | 0.771 | 0.749
Adjusted R2  | 0.767 | 0.744
Residual Std. Error (df = 400) | 0.154 | 0.151
F Statistic (df = 7; 400) | 192.851*** | 170.094***

=================================================================================================
Note: *p<0.1; **p<0.05; ***p<0.01

Fig.1: Own account before stepwise Regression