

# famd

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## Librerias

```
library("FactoMineR")
library("factoextra")
```

```
## Loading required package: ggplot2
```

```
## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa
```

```
load("~/Documents/GitHub/Mineria/DATA/dataaaaaaaaaaaaaa.RData")
data<-data_imputado
data <- data[data$group == "train", ]
data<- subset(data, select = -c(ID,Surname,group))
#Ahora dividimos la base de datos en train i test
train_index <- sample(1:nrow(data), 0.7 * nrow(data))
train <- data[train_index, ]
test  <- data[-train_index, ]
summary(train)
```

```
##      Exited      Tenure      Gender      EducationLevel
## 0:3886   Min.    : 0.000   Female:2229   High School :1631
## 1:1014   1st Qu.: 2.000   Male  :2671   Other       : 224
##          Median    : 5.000                      Postgraduate: 757
##          Mean      : 4.973                      University  :2288
##          3rd Qu.   : 7.000
##          Max.      :10.000
##      LoanStatus   NetPromoterScore TransactionFrequency      Age
## Active loan :1418   Min.    : 0.000   Min.    :13.00   Min.    :18.00
## Default risk: 501   1st Qu.: 4.000   1st Qu.:26.00   1st Qu.:32.00
## No loan      :2981   Median : 8.000   Median :30.00   Median :37.00
##          Mean      : 6.477   Mean    :30.03   Mean    :39.27
##          3rd Qu.   : 9.000   3rd Qu.:34.00   3rd Qu.:44.00
##          Max.      :10.000   Max.     :52.00   Max.     :92.00
##      Geography   ComplaintsCount HasCrCard EstimatedSalary   IsActiveMember
## France :2444     Min.    :0.0000   0:1455   Min.    : 11.58   0:2350
## Germany:1256     1st Qu.:0.0000   1:3445   1st Qu.: 49952.08 1:2550
## Spain   :1200     Median :0.0000                      Median : 99649.59
##          Mean      :0.3624                      Mean    :100216.05
##          3rd Qu.   :0.0000                      3rd Qu.:149808.93
```

```
##           Max.      :5.0000           Max.      :199862.75
## AvgTransactionAmount      CustomerSegment  MaritalStatus
## Min.      : 19.60      Affluent      :1445      Divorced: 712
## 1st Qu.: 70.53      High Net Worth: 924      Married :2519
## Median : 99.55      Mass Market      :2531      Single  :1434
## Mean      :112.09                               Widowed : 235
## 3rd Qu.:138.14
## Max.      :581.79
## DigitalEngagementScore  CreditScore      SavingsAccountFlag      Balance
## Min.      : 5.00      Min.      :350.0      0:1660      Min.      : 0
## 1st Qu.: 50.00      1st Qu.:584.0      1:3240      1st Qu.: 0
## Median : 60.00      Median :651.0                               Median : 98725
## Mean      : 59.64      Mean      :650.5                               Mean      : 77717
## 3rd Qu.: 70.00      3rd Qu.:718.0                               3rd Qu.:128428
## Max.      :100.00      Max.      :850.0                               Max.      :250898
## NumOfProducts
## Min.      :1.000
## 1st Qu.:1.000
## Median :1.000
## Mean      :1.524
## 3rd Qu.:2.000
## Max.      :4.000
```

El análisis de datos mixtos mediante el método de Análisis Factorial de Datos Mixtos (FAMD, por sus siglas en inglés) es una técnica que permite analizar conjuntos de datos que contienen tanto variables cuantitativas como cualitativas. El FAMD combina elementos del Análisis de Componentes Principales (PCA) y el Análisis de Correspondencias Múltiples (MCA) para realizar esta tarea. Durante el análisis, se normalizan las variables cuantitativas y cualitativas para equilibrar su influencia. En este capítulo se presenta cómo realizar y visualizar el análisis factorial de datos mixtos utilizando los paquetes FactoMineR (para el análisis) y factoextra (para la visualización) en el entorno de programación R.

## Data format

```
head(train)
```

```
##      Exited Tenure Gender EducationLevel      LoanStatus NetPromoterScore
## 2463      0      4   Male      University      No loan              10
## 2511      1      5   Male      University Default risk              2
## 2227      0      1   Male      University      No loan              9
## 526       0      5 Female      High School      Active loan          6
## 4291      0      7 Female      University      No loan              9
## 2986      0      1   Male      High School      Active loan          5
##      TransactionFrequency Age Geography ComplaintsCount HasCrCard
## 2463                    37 20      Spain              0          1
## 2511                    30 32      Spain              0          1
## 2227                    33 33      Spain              0          0
## 526                     34 49      Germany            0          0
## 4291                    35 40      Germany            0          1
## 2986                    28 36      France             0          0
##      EstimatedSalary IsActiveMember AvgTransactionAmount CustomerSegment
## 2463      179291.85              1      104.50087      Affluent
```

```
## 2511      192127.22      1      99.91607      Affluent
## 2227      117834.91      0      78.31016      Mass Market
## 526       59748.19      1      183.89511      High Net Worth
## 4291      172629.67      1      167.07649      Mass Market
## 2986      133141.34      0      209.98678      Affluent
##      MaritalStatus DigitalEngagementScore CreditScore SavingsAccountFlag
## 2463      Single      62      729      1
## 2511      Married      49      743      0
## 2227      Married      86      495      1
## 526       Single      66      850      0
## 4291      Widowed      73      554      1
## 2986      Single      69      621      0
##      Balance NumOfProducts
## 2463  97268.1      2
## 2511 145729.7      1
## 2227      0.0      1
## 526      0.0      1
## 4291 137654.0      1
## 2986      0.0      2
```

```
str(train)
```

```
## 'data.frame': 4900 obs. of 21 variables:
## $ Exited : Factor w/ 2 levels "0","1": 1 2 1 1 1 1 1 1 2 ...
## $ Tenure : num 4 5 1 5 7 1 6 9 4 3 ...
## $ Gender : Factor w/ 2 levels "Female","Male": 2 2 2 1 1 2 2 2 2 2 ...
## $ EducationLevel : Factor w/ 4 levels "High School",...: 4 4 4 1 4 1 3 4 4 1 ...
## $ LoanStatus : Factor w/ 3 levels "Active loan",...: 3 2 3 1 3 1 1 3 2 3 ...
## $ NetPromoterScore : num 10 2 9 6 9 5 3 8 1 9 ...
## $ TransactionFrequency : num 37 30 33 34 35 28 36 27 32 36 ...
## $ Age : num 20 32 33 49 40 36 37 35 34 49 ...
## $ Geography : Factor w/ 3 levels "France","Germany",...: 3 3 3 2 2 1 2 3 1 1 ...
## $ ComplaintsCount : num 0 0 0 0 0 0 1 0 2 0 ...
## $ HasCrCard : Factor w/ 2 levels "0","1": 2 2 1 1 2 1 2 1 2 2 ...
## $ EstimatedSalary : num 179292 192127 117835 59748 172630 ...
## $ IsActiveMember : Factor w/ 2 levels "0","1": 2 2 1 2 2 1 2 1 1 1 ...
## $ AvgTransactionAmount : num 104.5 99.9 78.3 183.9 167.1 ...
## $ CustomerSegment : Factor w/ 3 levels "Affluent","High Net Worth",...: 1 1 3 2 3 1 2 3 2 1 ..
## $ MaritalStatus : Factor w/ 4 levels "Divorced","Married",...: 3 2 2 3 4 3 2 2 1 3 ...
## $ DigitalEngagementScore: num 62 49 86 66 73 69 73 61 64 35 ...
## $ CreditScore : num 729 743 495 850 554 621 825 665 774 789 ...
## $ SavingsAccountFlag : Factor w/ 2 levels "0","1": 2 1 2 1 2 1 2 2 1 2 ...
## $ Balance : num 97268 145730 0 0 137654 ...
## $ NumOfProducts : num 2 1 1 1 1 2 1 1 1 1 ...
```

Este data frame contiene 4900 observaciones y 24 variables que describen clientes bancarios, incluyendo características demográficas, financieras y de comportamiento.

En total tenemos un nuemro de 13 variables de tipo factor i 11 de tipo numerica.

## FAMD

```
res.famd <- FAMD(train,ncp = 20, graph = FALSE)
print(res.famd)
```

```
## *The results are available in the following objects:
##
##   name          description
## 1 "$eig"         "eigenvalues and inertia"
## 2 "$var"         "Results for the variables"
## 3 "$ind"         "results for the individuals"
## 4 "$quali.var"   "Results for the qualitative variables"
## 5 "$quanti.var"  "Results for the quantitative variables"
```

El 80% se explica con 18 dimensiones.

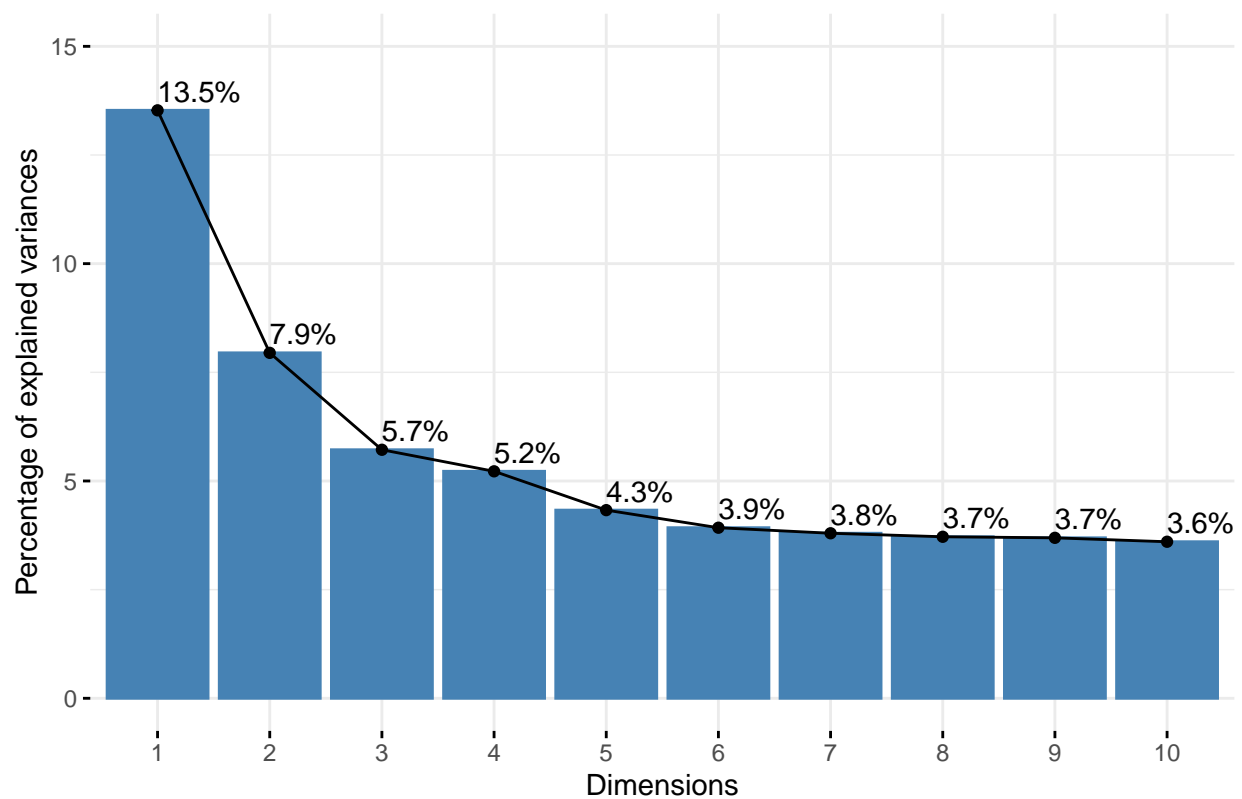
## Visualization & Results

```
eig.val <- get_eigenvalue(res.famd)
eig.val
```

##	eigenvalue	variance.percent	cumulative.variance.percent
## Dim.1	3.7877449	13.527660	13.52766
## Dim.2	2.2253033	7.947512	21.47517
## Dim.3	1.6011134	5.718262	27.19343
## Dim.4	1.4623322	5.222615	32.41605
## Dim.5	1.2121456	4.329091	36.74514
## Dim.6	1.0989087	3.924674	40.66981
## Dim.7	1.0632721	3.797400	44.46721
## Dim.8	1.0405597	3.716285	48.18350
## Dim.9	1.0338009	3.692146	51.87565
## Dim.10	1.0085385	3.601923	55.47757
## Dim.11	1.0007440	3.574086	59.05165
## Dim.12	0.9812376	3.504420	62.55607
## Dim.13	0.9573674	3.419169	65.97524
## Dim.14	0.9385781	3.352065	69.32731
## Dim.15	0.9358939	3.342478	72.66979
## Dim.16	0.9157290	3.270461	75.94025
## Dim.17	0.7759848	2.771374	78.71162
## Dim.18	0.7352201	2.625786	81.33741
## Dim.19	0.6492771	2.318847	83.65625
## Dim.20	0.6322305	2.257966	85.91422

```
fviz_screplot(res.famd, addlabels = TRUE, ylim = c(0, 15)) +
  ggtitle("Varianza explicada por dimensión (FAMD)")
```

## Varianza explicada por dimensión (FAMD)



```
var <- get_famd_var(res.famd)
var
```

```
## FAMD results for variables
## =====
##   Name      Description
## 1 "$coord"   "Coordinates"
## 2 "$cos2"    "Cos2, quality of representation"
## 3 "$contrib" "Contributions"
```

```
head(var$coord)
```

```
##           Dim.1      Dim.2      Dim.3      Dim.4
## Tenure      0.0002842749 3.605791e-05 8.795493e-04 1.204783e-03
## NetPromoterScore 0.6412978745 7.628251e-03 6.081897e-03 5.953704e-05
## TransactionFrequency 0.0007705017 1.249224e-03 1.445843e-04 1.470969e-03
## Age         0.0005750231 4.707800e-05 1.313992e-03 8.111065e-02
## ComplaintsCount 0.6510655290 1.149389e-01 3.368562e-02 1.145063e-04
## EstimatedSalary 0.0007361672 2.883752e-05 4.578369e-05 1.189368e-02
##           Dim.5      Dim.6      Dim.7      Dim.8
## Tenure      1.468769e-03 4.260647e-02 2.509994e-01 0.0314053449
## NetPromoterScore 3.980658e-04 6.937753e-05 1.315703e-04 0.0013655753
## TransactionFrequency 7.414020e-04 6.254980e-02 3.567523e-01 0.0016267623
## Age         2.477417e-01 7.123816e-02 3.279381e-02 0.0002454775
## ComplaintsCount 4.095133e-04 9.337024e-06 2.215917e-05 0.0008438769
```

```
## EstimatedSalary      9.605078e-05 1.610474e-02 1.614636e-01 0.0646815044
##                      Dim.9      Dim.10      Dim.11      Dim.12
## Tenure               3.616834e-02 1.062684e-01 1.342804e-03 0.1484964104
## NetPromoterScore     4.867756e-05 7.799997e-05 7.492707e-04 0.0003401170
## TransactionFrequency  6.356712e-02 2.495166e-03 5.417322e-03 0.0520039530
## Age                 2.558007e-01 1.480394e-02 4.901132e-05 0.0043619396
## ComplaintsCount      1.453686e-04 3.411538e-07 2.287322e-04 0.0003227599
## EstimatedSalary      2.853146e-02 3.093362e-02 2.808212e-01 0.2525189666
##                      Dim.13      Dim.14      Dim.15      Dim.16
## Tenure               3.323345e-01 8.363498e-03 0.0219731164 1.183819e-02
## NetPromoterScore     1.075964e-06 2.136361e-04 0.0036298727 9.394148e-06
## TransactionFrequency  2.444336e-01 8.013761e-02 0.0353551322 8.406161e-02
## Age                 9.343939e-04 8.074112e-03 0.0211681414 4.357825e-02
## ComplaintsCount      1.146990e-05 2.300572e-06 0.0008664298 2.384685e-04
## EstimatedSalary      5.227879e-03 7.825947e-03 0.0595081909 7.648775e-02
##                      Dim.17      Dim.18      Dim.19      Dim.20
## Tenure               0.0006617790 4.429114e-04 1.793069e-03 3.598804e-05
## NetPromoterScore     0.0335790374 2.378473e-04 2.056600e-03 2.416273e-03
## TransactionFrequency  0.0027620052 1.743629e-03 8.828980e-06 7.218063e-04
## Age                 0.0022732836 2.068786e-01 1.118322e-04 1.031742e-03
## ComplaintsCount      0.0029370466 2.359690e-04 8.625731e-04 5.332941e-08
## EstimatedSalary      0.0002008315 9.701832e-06 6.075149e-04 2.747137e-06
```

```
head(var$cos2)
```

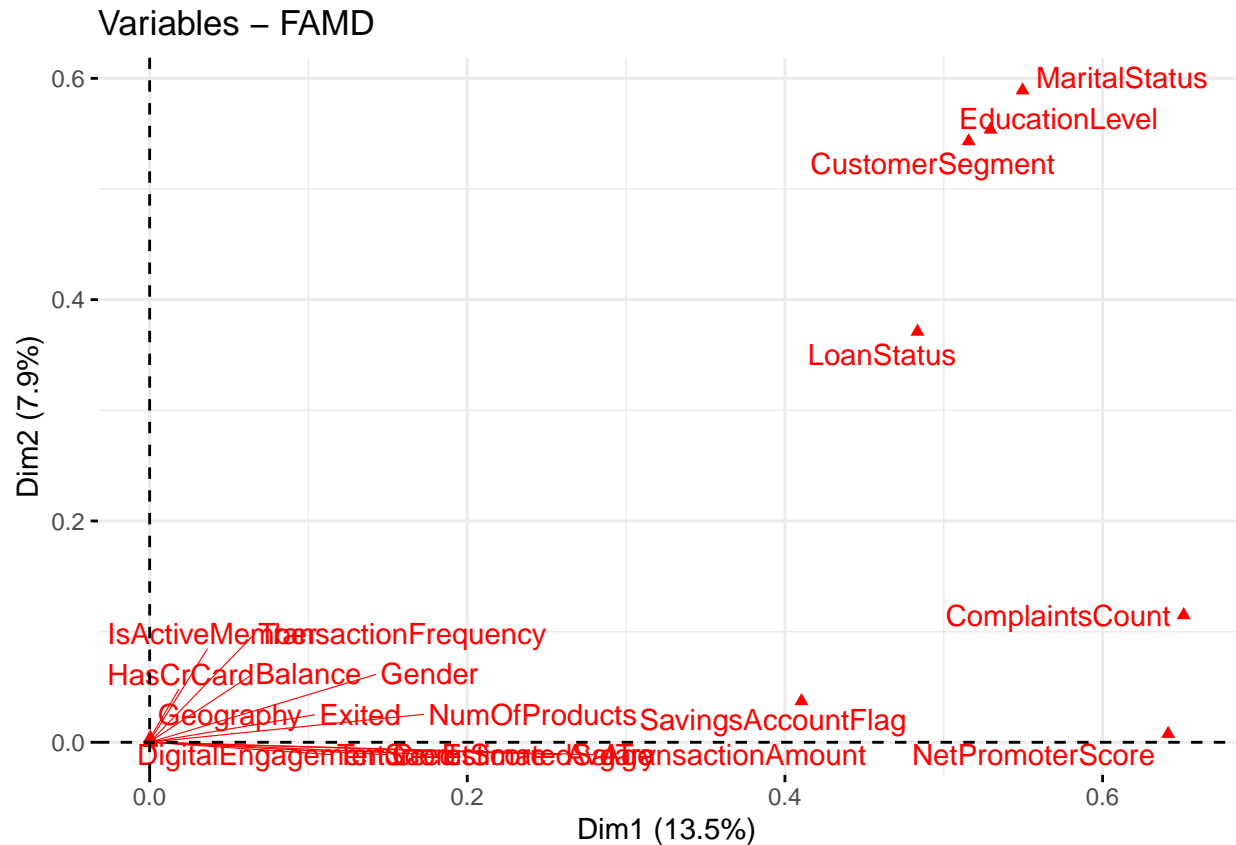
```
##                      Dim.1      Dim.2      Dim.3      Dim.4
## Tenure               8.081223e-08 1.300173e-09 7.736070e-07 1.451503e-06
## NetPromoterScore     4.112630e-01 5.819021e-05 3.698947e-05 3.544659e-09
## TransactionFrequency  5.936729e-07 1.560562e-06 2.090463e-08 2.163751e-06
## Age                 3.306516e-07 2.216338e-09 1.726574e-06 6.578938e-03
## ComplaintsCount      4.238863e-01 1.321094e-02 1.134721e-03 1.311170e-08
## EstimatedSalary      5.419422e-07 8.316028e-10 2.096147e-09 1.414597e-04
##                      Dim.5      Dim.6      Dim.7      Dim.8
## Tenure               2.157283e-06 1.815312e-03 6.300072e-02 9.862957e-04
## NetPromoterScore     1.584564e-07 4.813242e-09 1.731075e-08 1.864796e-06
## TransactionFrequency  5.496769e-07 3.912477e-03 1.272722e-01 2.646355e-06
## Age                 6.137594e-02 5.074875e-03 1.075434e-03 6.025919e-08
## ComplaintsCount      1.677011e-07 8.718003e-11 4.910287e-10 7.121283e-07
## EstimatedSalary      9.225751e-09 2.593625e-04 2.607049e-02 4.183697e-03
##                      Dim.9      Dim.10      Dim.11      Dim.12
## Tenure               1.308149e-03 1.129296e-02 1.803121e-06 2.205118e-02
## NetPromoterScore     2.369505e-09 6.083995e-09 5.614065e-07 1.156796e-07
## TransactionFrequency  4.040779e-03 6.225853e-06 2.934738e-05 2.704411e-03
## Age                 6.543401e-02 2.191566e-04 2.402110e-09 1.902652e-05
## ComplaintsCount      2.113202e-08 1.163859e-13 5.231842e-08 1.041740e-07
## EstimatedSalary      8.140443e-04 9.568890e-04 7.886055e-02 6.376583e-02
##                      Dim.13      Dim.14      Dim.15      Dim.16
## Tenure               1.104462e-01 6.994810e-05 4.828178e-04 1.401427e-04
## NetPromoterScore     1.157698e-12 4.564038e-08 1.317598e-05 8.825002e-11
## TransactionFrequency  5.974779e-02 6.422037e-03 1.249985e-03 7.066354e-03
## Age                 8.730919e-07 6.519128e-05 4.480902e-04 1.899064e-03
## ComplaintsCount      1.315587e-10 5.292633e-12 7.507006e-07 5.686724e-08
## EstimatedSalary      2.733072e-05 6.124545e-05 3.541225e-03 5.850376e-03
##                      Dim.17      Dim.18      Dim.19      Dim.20
```

```
## Tenure 4.379515e-07 1.961705e-07 3.215098e-06 1.295139e-09
## NetPromoterScore 1.127552e-03 5.657134e-08 4.229605e-06 5.838376e-06
## TransactionFrequency 7.628673e-06 3.040242e-06 7.795090e-11 5.210043e-07
## Age 5.167818e-06 4.279877e-02 1.250643e-08 1.064493e-06
## ComplaintsCount 8.626243e-06 5.568138e-08 7.440323e-07 2.844026e-15
## EstimatedSalary 4.033327e-08 9.412555e-11 3.690744e-07 7.546760e-12
```

```
head(var$contrib)
```

```
##          Dim.1      Dim.2      Dim.3      Dim.4
## Tenure 0.007505123 0.001620359 0.054933602 0.082387805
## NetPromoterScore 16.930862306 0.342795996 0.379854198 0.004071376
## TransactionFrequency 0.020341965 0.056137265 0.009030237 0.100590642
## Age 0.015181147 0.002115577 0.082067362 5.546663904
## ComplaintsCount 17.188737501 5.165087367 2.103887205 0.007830392
## EstimatedSalary 0.019435501 0.001295892 0.002859491 0.813336537
##          Dim.5      Dim.6      Dim.7      Dim.8
## Tenure 0.12117104 3.8771621662 23.606323678 3.01812036
## NetPromoterScore 0.03283977 0.0063133119 0.012374097 0.13123469
## TransactionFrequency 0.06116444 5.6919922510 33.552301411 0.15633531
## Age 20.43827759 6.4826275794 3.084235258 0.02359091
## ComplaintsCount 0.03378417 0.0008496633 0.002084054 0.08109837
## EstimatedSalary 0.00792403 1.4655207537 15.185537867 6.21602998
##          Dim.9      Dim.10      Dim.11      Dim.12
## Tenure 3.498579105 1.053687e+01 0.134180522 15.13358284
## NetPromoterScore 0.004708601 7.733961e-03 0.074871365 0.03466204
## TransactionFrequency 6.148874958 2.474041e-01 0.541329465 5.29983270
## Age 24.743711758 1.467861e+00 0.004897488 0.44453448
## ComplaintsCount 0.014061562 3.382655e-05 0.022856216 0.03289314
## EstimatedSalary 2.759860465 3.067173e+00 28.061243457 25.73474127
##          Dim.13      Dim.14      Dim.15      Dim.16
## Tenure 3.471337e+01 0.8910817473 2.34782122 1.292761191
## NetPromoterScore 1.123878e-04 0.0227616748 0.38785086 0.001025866
## TransactionFrequency 2.553185e+01 8.5381931711 3.77768578 9.179748096
## Age 9.760034e-02 0.8602493290 2.26180987 4.758858869
## ComplaintsCount 1.198067e-03 0.0002451125 0.09257778 0.026041389
## EstimatedSalary 5.460682e-01 0.8338088812 6.35843321 8.352663023
##          Dim.17      Dim.18      Dim.19      Dim.20
## Tenure 0.08528247 0.060242018 0.276163982 5.692234e-03
## NetPromoterScore 4.32728018 0.032350490 0.316752351 3.821823e-01
## TransactionFrequency 0.35593547 0.237157396 0.001359817 1.141682e-01
## Age 0.29295464 28.138325923 0.017224104 1.631909e-01
## ComplaintsCount 0.37849279 0.032095017 0.132851304 8.435121e-06
## EstimatedSalary 0.02588085 0.001319582 0.093567896 4.345151e-04
```

```
fviz_famd_var(res.famd, repel = TRUE)
```



```
''' r
var <- get_famd_var(res.famd)
var
```

```
## FAMD results for variables
## =====
##   Name      Description
## 1 "$coord"   "Coordinates"
## 2 "$cos2"    "Cos2, quality of representation"
## 3 "$contrib" "Contributions"
```

```
head(var$coord)
```

```
##           Dim.1      Dim.2      Dim.3      Dim.4
## Tenure      0.0002842749 3.605791e-05 8.795493e-04 1.204783e-03
## NetPromoterScore 0.6412978745 7.628251e-03 6.081897e-03 5.953704e-05
## TransactionFrequency 0.0007705017 1.249224e-03 1.445843e-04 1.470969e-03
## Age         0.0005750231 4.707800e-05 1.313992e-03 8.111065e-02
## ComplaintsCount 0.6510655290 1.149389e-01 3.368562e-02 1.145063e-04
## EstimatedSalary 0.0007361672 2.883752e-05 4.578369e-05 1.189368e-02
##           Dim.5      Dim.6      Dim.7      Dim.8
## Tenure      1.468769e-03 4.260647e-02 2.509994e-01 0.0314053449
## NetPromoterScore 3.980658e-04 6.937753e-05 1.315703e-04 0.0013655753
```



```
## TransactionFrequency 7.414020e-04 6.254980e-02 3.567523e-01 0.0016267623
## Age 2.477417e-01 7.123816e-02 3.279381e-02 0.0002454775
## ComplaintsCount 4.095133e-04 9.337024e-06 2.215917e-05 0.0008438769
## EstimatedSalary 9.605078e-05 1.610474e-02 1.614636e-01 0.0646815044
## Dim.9 Dim.10 Dim.11 Dim.12
## Tenure 3.616834e-02 1.062684e-01 1.342804e-03 0.1484964104
## NetPromoterScore 4.867756e-05 7.799997e-05 7.492707e-04 0.0003401170
## TransactionFrequency 6.356712e-02 2.495166e-03 5.417322e-03 0.0520039530
## Age 2.558007e-01 1.480394e-02 4.901132e-05 0.0043619396
## ComplaintsCount 1.453686e-04 3.411538e-07 2.287322e-04 0.0003227599
## EstimatedSalary 2.853146e-02 3.093362e-02 2.808212e-01 0.2525189666
## Dim.13 Dim.14 Dim.15 Dim.16
## Tenure 3.323345e-01 8.363498e-03 0.0219731164 1.183819e-02
## NetPromoterScore 1.075964e-06 2.136361e-04 0.0036298727 9.394148e-06
## TransactionFrequency 2.444336e-01 8.013761e-02 0.0353551322 8.406161e-02
## Age 9.343939e-04 8.074112e-03 0.0211681414 4.357825e-02
## ComplaintsCount 1.146990e-05 2.300572e-06 0.0008664298 2.384685e-04
## EstimatedSalary 5.227879e-03 7.825947e-03 0.0595081909 7.648775e-02
## Dim.17 Dim.18 Dim.19 Dim.20
## Tenure 0.0006617790 4.429114e-04 1.793069e-03 3.598804e-05
## NetPromoterScore 0.0335790374 2.378473e-04 2.056600e-03 2.416273e-03
## TransactionFrequency 0.0027620052 1.743629e-03 8.828980e-06 7.218063e-04
## Age 0.0022732836 2.068786e-01 1.118322e-04 1.031742e-03
## ComplaintsCount 0.0029370466 2.359690e-04 8.625731e-04 5.332941e-08
## EstimatedSalary 0.0002008315 9.701832e-06 6.075149e-04 2.747137e-06
```

```
head(var$cos2)
```

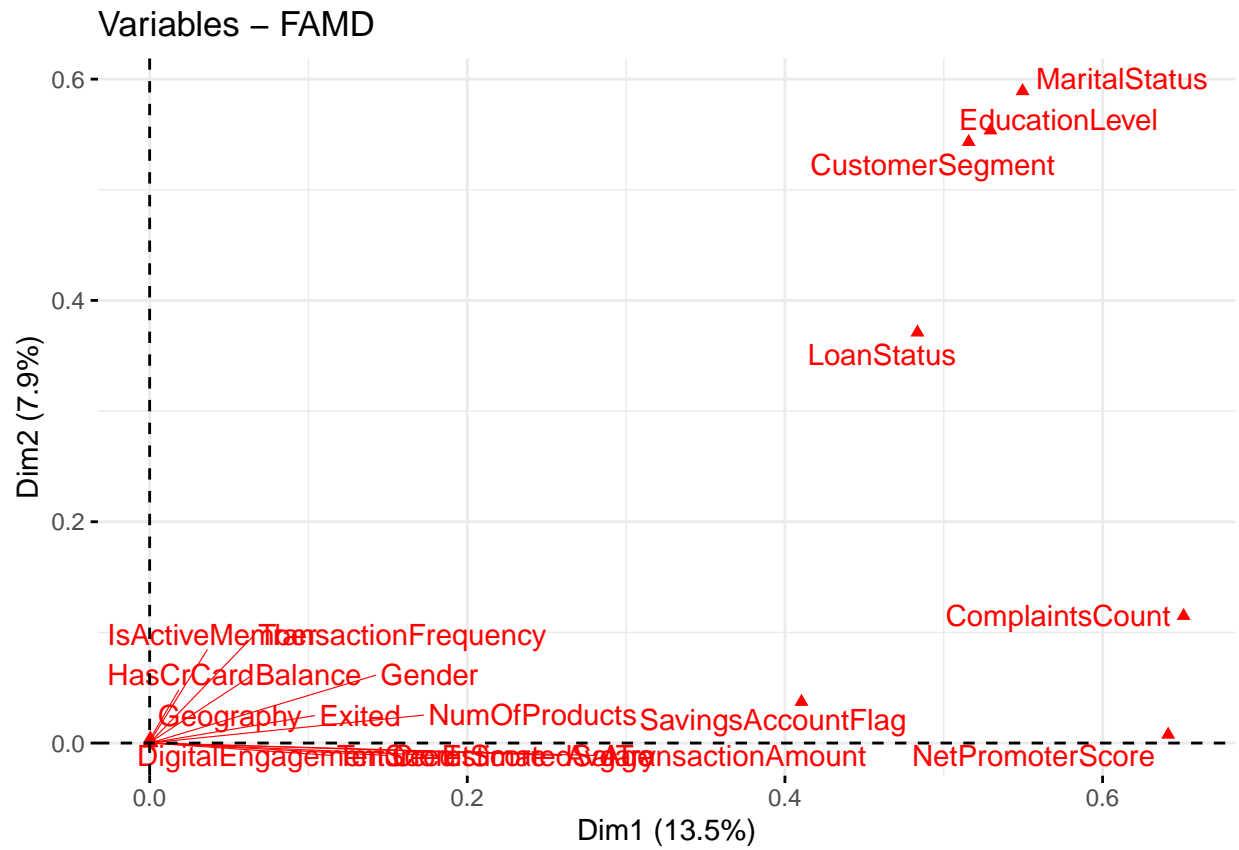
```
## Dim.1 Dim.2 Dim.3 Dim.4
## Tenure 8.081223e-08 1.300173e-09 7.736070e-07 1.451503e-06
## NetPromoterScore 4.112630e-01 5.819021e-05 3.698947e-05 3.544659e-09
## TransactionFrequency 5.936729e-07 1.560562e-06 2.090463e-08 2.163751e-06
## Age 3.306516e-07 2.216338e-09 1.726574e-06 6.578938e-03
## ComplaintsCount 4.238863e-01 1.321094e-02 1.134721e-03 1.311170e-08
## EstimatedSalary 5.419422e-07 8.316028e-10 2.096147e-09 1.414597e-04
## Dim.5 Dim.6 Dim.7 Dim.8
## Tenure 2.157283e-06 1.815312e-03 6.300072e-02 9.862957e-04
## NetPromoterScore 1.584564e-07 4.813242e-09 1.731075e-08 1.864796e-06
## TransactionFrequency 5.496769e-07 3.912477e-03 1.272722e-01 2.646355e-06
## Age 6.137594e-02 5.074875e-03 1.075434e-03 6.025919e-08
## ComplaintsCount 1.677011e-07 8.718003e-11 4.910287e-10 7.121283e-07
## EstimatedSalary 9.225751e-09 2.593625e-04 2.607049e-02 4.183697e-03
## Dim.9 Dim.10 Dim.11 Dim.12
## Tenure 1.308149e-03 1.129296e-02 1.803121e-06 2.205118e-02
## NetPromoterScore 2.369505e-09 6.083995e-09 5.614065e-07 1.156796e-07
## TransactionFrequency 4.040779e-03 6.225853e-06 2.934738e-05 2.704411e-03
## Age 6.543401e-02 2.191566e-04 2.402110e-09 1.902652e-05
## ComplaintsCount 2.113202e-08 1.163859e-13 5.231842e-08 1.041740e-07
## EstimatedSalary 8.140443e-04 9.568890e-04 7.886055e-02 6.376583e-02
## Dim.13 Dim.14 Dim.15 Dim.16
## Tenure 1.104462e-01 6.994810e-05 4.828178e-04 1.401427e-04
## NetPromoterScore 1.157698e-12 4.564038e-08 1.317598e-05 8.825002e-11
## TransactionFrequency 5.974779e-02 6.422037e-03 1.249985e-03 7.066354e-03
## Age 8.730919e-07 6.519128e-05 4.480902e-04 1.899064e-03
```

```
## ComplaintsCount      1.315587e-10 5.292633e-12 7.507006e-07 5.686724e-08
## EstimatedSalary      2.733072e-05 6.124545e-05 3.541225e-03 5.850376e-03
##                      Dim.17      Dim.18      Dim.19      Dim.20
## Tenure                4.379515e-07 1.961705e-07 3.215098e-06 1.295139e-09
## NetPromoterScore      1.127552e-03 5.657134e-08 4.229605e-06 5.838376e-06
## TransactionFrequency  7.628673e-06 3.040242e-06 7.795090e-11 5.210043e-07
## Age                   5.167818e-06 4.279877e-02 1.250643e-08 1.064493e-06
## ComplaintsCount      8.626243e-06 5.568138e-08 7.440323e-07 2.844026e-15
## EstimatedSalary      4.033327e-08 9.412555e-11 3.690744e-07 7.546760e-12
```

```
head(var$contrib)
```

```
##                      Dim.1      Dim.2      Dim.3      Dim.4
## Tenure                0.007505123 0.001620359 0.054933602 0.082387805
## NetPromoterScore      16.930862306 0.342795996 0.379854198 0.004071376
## TransactionFrequency  0.020341965 0.056137265 0.009030237 0.100590642
## Age                   0.015181147 0.002115577 0.082067362 5.546663904
## ComplaintsCount      17.188737501 5.165087367 2.103887205 0.007830392
## EstimatedSalary      0.019435501 0.001295892 0.002859491 0.813336537
##                      Dim.5      Dim.6      Dim.7      Dim.8
## Tenure                0.12117104 3.8771621662 23.606323678 3.01812036
## NetPromoterScore      0.03283977 0.0063133119 0.012374097 0.13123469
## TransactionFrequency  0.06116444 5.6919922510 33.552301411 0.15633531
## Age                   20.43827759 6.4826275794 3.084235258 0.02359091
## ComplaintsCount      0.03378417 0.0008496633 0.002084054 0.08109837
## EstimatedSalary      0.00792403 1.4655207537 15.185537867 6.21602998
##                      Dim.9      Dim.10      Dim.11      Dim.12
## Tenure                3.498579105 1.053687e+01 0.134180522 15.13358284
## NetPromoterScore      0.004708601 7.733961e-03 0.074871365 0.03466204
## TransactionFrequency  6.148874958 2.474041e-01 0.541329465 5.29983270
## Age                   24.743711758 1.467861e+00 0.004897488 0.44453448
## ComplaintsCount      0.014061562 3.382655e-05 0.022856216 0.03289314
## EstimatedSalary      2.759860465 3.067173e+00 28.061243457 25.73474127
##                      Dim.13      Dim.14      Dim.15      Dim.16
## Tenure                3.471337e+01 0.8910817473 2.34782122 1.292761191
## NetPromoterScore      1.123878e-04 0.0227616748 0.38785086 0.001025866
## TransactionFrequency  2.553185e+01 8.5381931711 3.77768578 9.179748096
## Age                   9.760034e-02 0.8602493290 2.26180987 4.758858869
## ComplaintsCount      1.198067e-03 0.0002451125 0.09257778 0.026041389
## EstimatedSalary      5.460682e-01 0.8338088812 6.35843321 8.352663023
##                      Dim.17      Dim.18      Dim.19      Dim.20
## Tenure                0.08528247 0.060242018 0.276163982 5.692234e-03
## NetPromoterScore      4.32728018 0.032350490 0.316752351 3.821823e-01
## TransactionFrequency  0.35593547 0.237157396 0.001359817 1.141682e-01
## Age                   0.29295464 28.138325923 0.017224104 1.631909e-01
## ComplaintsCount      0.37849279 0.032095017 0.132851304 8.435121e-06
## EstimatedSalary      0.02588085 0.001319582 0.093567896 4.345151e-04
```

```
fviz_famd_var(res.famd, repel = TRUE)
```



```
fviz_contrib(res.famd, "var", axes = 1)
```

