Course Practical Assignment - 1st Delivery (17 de març del 2019)

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Bank client data

Description of input variables:

1. age (numeric)
2. job : type of job (categorical: 'admin', 'blue-collar', 'entrepreneur', 'housemaid', 'management', 'retired', 'self-employed', 'services', 'student', 'technician', 'unemployed', 'unknown')
3. marital : marital status (categorical: 'divorced','married','single','unknown'; note: 'divorced' means divorced or widowed)
4. education (categorical:'basic.4y', 'basic.6y', 'basic.9y', 'high.school', 'illiterate', 'professional.course', 'university.degree', 'unknown')
5. default: has credit in default? (categorical: 'no','yes','unknown')
6. housing: has housing loan? (categorical: 'no','yes','unknown')
7. loan: has personal loan? (categorical: 'no','yes','unknown')# related with the last contact of the current campaign:
8. contact: contact communication type (categorical:'cellular','telephone')
9. month: last contact month of year (categorical: 'jan', 'feb', 'mar',. . . , 'nov', 'dec')
10. day_of_week: last contact day of the week (categorical:'mon','tue','wed','thu','fri')
11. duration: last contact duration, in seconds (numeric). Important note: this attribute highly affects the output target (e.g., if duration=0 then y='no'). Yet, the duration is not known before a call is performed. Also, after the end of the call y is obviously known. Thus, this input should only be included for benchmark purposes and should be discarded if the intention is to have a realistic predictive model.
12. campaign: number of contacts performed during this campaign and for this client (numeric, includes last contact)
13. pdays: number of days that passed by after the client was last contacted from a previous campaign (numeric; 999 means client was not previously contacted)
14. previous: number of contacts performed before this campaign and for this client (numeric)
15. poutcome: outcome of the previous marketing campaign (categorical: 'failure','nonexistent','success')# social and economic context attributes
16. emp.var.rate: employment variation rate - quarterly indicator (numeric)
17. cons.price.idx: consumer price index - monthly indicator (numeric)
18. cons.conf.idx: consumer confidence index - monthly indicator (numeric)
19. euribor3m: euribor 3 month rate - daily indicator (numeric)
20. nr.employed: number of employees - quarterly indicator (numeric)
21. y - has the client subscribed a term deposit? (binary: 'yes','no')

Loading packages:

Loading data:

```
#dirwd<-"d:/Users/Usuari/Documents/ADEI"
dirwd<-"D:/Documents/GitHub/ADEI"
setwd(dirwd)

df<-read.table( paste0(dirwd, "/bank-additional/bank-additional-full.csv"),  header=TRUE, sep=";")

# General description of the bank data
```

```r
head(df)
```

```
##   age       job marital   education default housing loan   contact month
## 1  56 housemaid married    basic.4y      no      no   no telephone   may
## 2  57  services married high.school unknown      no   no telephone   may
## 3  37  services married high.school      no     yes   no telephone   may
## 4  40    admin. married    basic.6y      no      no   no telephone   may
## 5  56  services married high.school      no      no  yes telephone   may
## 6  45  services married    basic.9y unknown      no   no telephone   may
##   day_of_week duration campaign pdays previous    poutcome emp.var.rate
## 1         mon      261        1   999        0 nonexistent          1.1
## 2         mon      149        1   999        0 nonexistent          1.1
## 3         mon      226        1   999        0 nonexistent          1.1
## 4         mon      151        1   999        0 nonexistent          1.1
## 5         mon      307        1   999        0 nonexistent          1.1
## 6         mon      198        1   999        0 nonexistent          1.1
##   cons.price.idx cons.conf.idx euribor3m nr.employed  y
## 1         93.994         -36.4     4.857        5191 no
## 2         93.994         -36.4     4.857        5191 no
## 3         93.994         -36.4     4.857        5191 no
## 4         93.994         -36.4     4.857        5191 no
## 5         93.994         -36.4     4.857        5191 no
## 6         93.994         -36.4     4.857        5191 no
```

```r
nrow(df)
```

```
## [1] 41188
```

```r
ncol(df)
```

```
## [1] 21
```

```r
dim(df)
```

```
## [1] 41188    21
```

```r
# Selection of our 5000 samples with a specific seed value
set.seed(17041998)
llista<-sample(size=5000, x=1:nrow(df), replace=FALSE)
llista<-sort(llista)

# Overwrite the dataframe with our chosen sample and save the RData
df<-df[llista,]
save.image( paste0(dirwd, "/bank-additional/Bank5000_raw.RData") )
```

Our chosen sample:

```r
#load( paste0(dirwd, "/bank-additional/Bank5000_raw.RData") )
summary(df)
```

```
##       age                  job            marital
##  Min.   :18.00   admin.     :1234   divorced: 556
##  1st Qu.:32.00   blue-collar:1154   married :3053
##  Median :38.00   technician : 794   single  :1381
##  Mean   :40.07   services   : 500   unknown :  10
##  3rd Qu.:47.00   management : 413
```

```
##  Max.   :87.00   retired    : 205
##                  (Other)    : 700
##                education      default        housing          loan
##  university.degree  :1472   no     :3966   no     :2219   no     :4091
##  high.school        :1171   unknown:1034   unknown: 137   unknown: 137
##  basic.9y           : 716   yes    :   0   yes    :2644   yes    : 772
##  professional.course: 602
##  basic.4y           : 513
##  basic.6y           : 291
##  (Other)            : 235
##       contact          month      day_of_week    duration
##  cellular :3130   may    :1743   fri: 924    Min.   :   1.0
##  telephone:1870   jul    : 831   mon:1018    1st Qu.: 101.0
##                   aug    : 699   thu:1039    Median : 178.0
##                   jun    : 653   tue:1045    Mean   : 254.8
##                   nov    : 509   wed: 974    3rd Qu.: 317.0
##                   apr    : 310               Max.   :3785.0
##                   (Other): 255
##     campaign          pdays          previous            poutcome
##  Min.   : 1.000   Min.   :  0.0   Min.   :0.0000   failure    : 478
##  1st Qu.: 1.000   1st Qu.:999.0   1st Qu.:0.0000   nonexistent:4363
##  Median : 2.000   Median :999.0   Median :0.0000   success    : 159
##  Mean   : 2.583   Mean   :963.2   Mean   :0.1606
##  3rd Qu.: 3.000   3rd Qu.:999.0   3rd Qu.:0.0000
##  Max.   :33.000   Max.   :999.0   Max.   :4.0000
##
##   emp.var.rate      cons.price.idx  cons.conf.idx      euribor3m
##  Min.   :-3.40000   Min.   :92.20   Min.   :-50.80   Min.   :0.635
##  1st Qu.:-1.80000   1st Qu.:93.08   1st Qu.:-42.70   1st Qu.:1.334
##  Median : 1.10000   Median :93.77   Median :-41.80   Median :4.857
##  Mean   : 0.06326   Mean   :93.57   Mean   :-40.43   Mean   :3.613
##  3rd Qu.: 1.40000   3rd Qu.:93.99   3rd Qu.:-36.40   3rd Qu.:4.961
##  Max.   : 1.40000   Max.   :94.77   Max.   :-26.90   Max.   :5.000
##
##   nr.employed     y
##  Min.   :4964   no :4435
##  1st Qu.:5099   yes: 565
##  Median :5191
##  Mean   :5166
##  3rd Qu.:5228
##  Max.   :5228
##
```

Inicialització del control d'errors, missings i outliers:

```r
columnes <- names(df) #list of column names

# creem 3 dataframes inicialitzats a 0 d'una fila amb les columnes de la nostra mostra;
# en ells hi posarem el nombre d'errors, missings i outliers per a cada variable
errors <- data.frame(matrix(0, ncol = length(columnes), nrow = 1))
colnames(errors)<-columnes

missings <- data.frame(matrix(0, ncol = length(columnes), nrow = 1))
```

```
colnames(missings)<-columnes

outliers <- data.frame(matrix(0, ncol = length(columnes), nrow = 1))
colnames(outliers)<-columnes

# columnes que portaran el control per individu:
df$num_missings <- 0
df$num_outliers <- 0
df$num_errors   <- 0
```

UNIVARIATE DESCRIPTIVE ANALYSIS (to be included for each variable):

Aquí estudiem cada variable buscant missing values, outliers i possibles errors. En el cas que en trobem, els transformem en NAs i procedim a una imputació manual o els eliminem, o una imputació automàtica (en un chunck posterior d'Imputation).

QUALITATIVE VARIABLES:

També factoritzem aquí les categories (levels) de les variables qualitatives (discretes).

Job

Jobs "unknown" són considerats com a categoria.

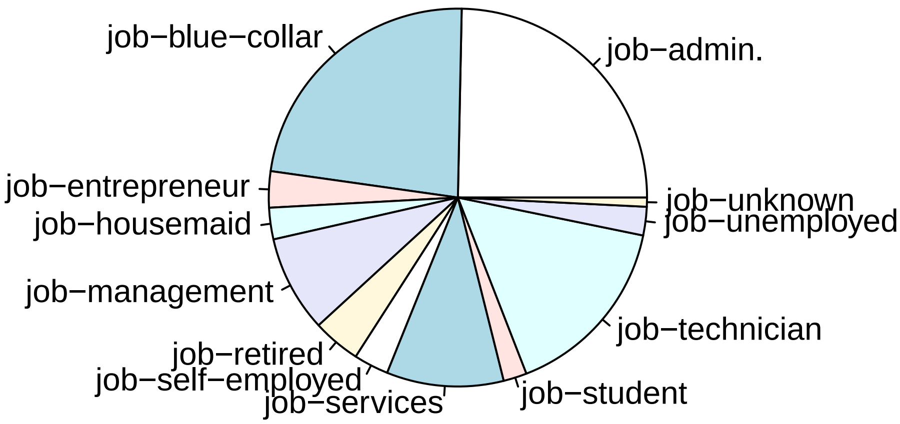
```
# Jobs "unknown" will be considered a category, not a missing value.
table(df$job, useNA="always")
```

```
##
##        admin.   blue-collar  entrepreneur     housemaid    management
##          1234          1154           155           135           413
##       retired self-employed      services       student    technician
##           205           149           500           100           794
##    unemployed       unknown          <NA>
##           122            39             0
```

```
# Missings:
miss<-which(is.na(df$job));
missings$job<-length(miss); length(miss)
```

```
## [1] 0
```

```
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

# Factoritzem les categories (levels) de la columna i afegim l'etiqueta "job-":
df$job<-factor(df$job)
levels(df$job)<-paste0("job-",levels(df$job))

pie(summary(df$job))
```



Marital

Els "unknowns" seran imputats més endavant automàticament.

```
# Marital "unknown" will be a missing value (set to NA):
sel<-which(df$marital=="unknown");length(sel)
```

```
## [1] 10
```

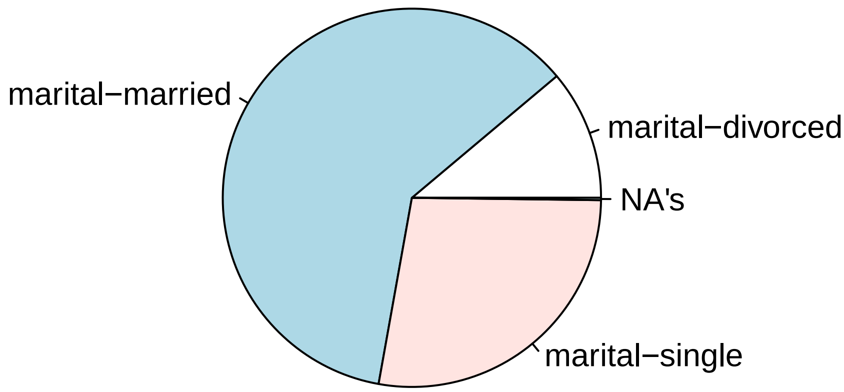
```
df$marital[sel]<-NA

# Missings:
miss<-which(is.na(df$marital));
missings$marital<-length(miss); length(miss)
```

```
## [1] 10
```

```
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

# Factoritzem les categories (levels) de la columna i afegim l'etiqueta "marital-":
df$marital<-factor(df$marital)
levels(df$marital)<-paste0("marital-",levels(df$marital))
summary(df$marital)
```

```
## marital-divorced  marital-married   marital-single             NA's
##              556             3053             1381               10
```

```
pie(summary(df$marital))
```



Education

Education “unknown” és considerada com a categoria. La categoria “illiterate” és inclosa manualment a “basic.4y”.

```
# Education "unknown" will be considered a category, not a missing value.
table(df$education, useNA="always")
```

```
##
##             basic.4y            basic.6y            basic.9y
##                  513                 291                 716
##          high.school          illiterate professional.course
##                 1171                   3                 602
##    university.degree             unknown                <NA>
##                 1472                 232                   0
```

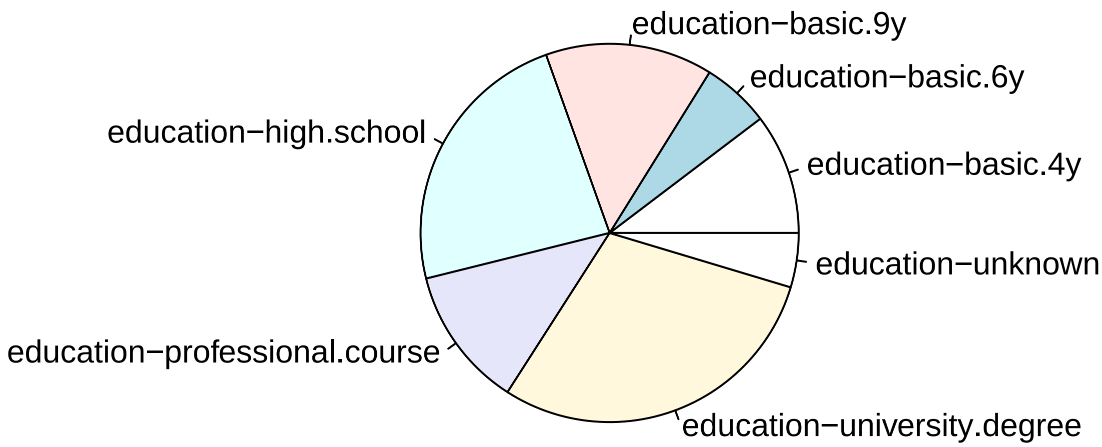
```
# Illiterates are consired as basic.4y.educated:
sel<-which(df$education=="illiterate");length(sel)
```

```
## [1] 3
```

```
df[sel, "education"]<-"basic.4y"

# Missings:
miss<-which(is.na(df$education));
missings$education<-length(miss); length(miss)
```

```
## [1] 0
```

```r
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

# Factoritzem les categories (levels) de la columna i afegim l'etiqueta "education-":
df$education<-factor(df$education)
levels(df$education)<-paste0("education-",levels(df$education))

pie(summary(df$education))
```



Default (has credit in default?)

Default (owes credit) "unknown" will be considered a category, not a missing value.

```r
table(df$default, useNA="always")
```

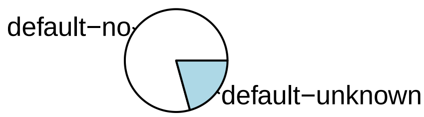
```
##
##      no unknown     yes    <NA>
##    3966    1034       0       0
```

```r
# Missings:
miss<-which(is.na(df$default));
missings$default<-length(miss); length(miss)
```

```
## [1] 0
```

```r
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

# Factoritzem les categories (levels) de la columna i afegim l'etiqueta "default-":
df$default<-factor(df$default)
```

```r
levels(df$default)<-paste0("default-",levels(df$default))

par(mfrow=c(2,2))
pie(summary(df$default))
```



Housing

Housing “unknown” will be considered a category, not a missing value.

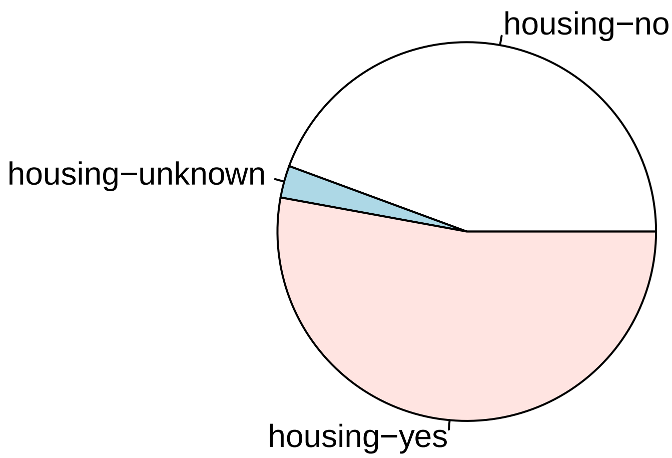
```r
table(df$housing, useNA="always")
```

```
##
##      no unknown     yes    <NA>
##    2219     137    2644       0
```

```r
# Missings:
miss<-which(is.na(df$housing));
missings$housing<-length(miss); length(miss)
```

```
## [1] 0
```

```r
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

# Factoritzem les categories (levels) de la columna i afegim l'etiqueta "housing-":
df$housing<-factor(df$housing)
levels(df$housing)<-paste0("housing-",levels(df$housing))

pie(summary(df$housing))
```



Loan (has personal loan?)

Loan "unknown" will be a missing value (set to NA) i serà imputat més endavant automàticament.

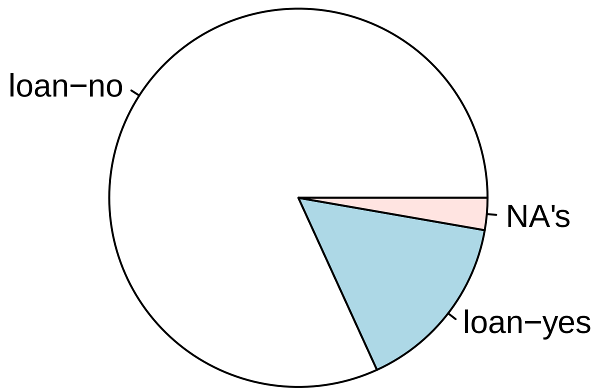
```
sel<-which(df$loan=="unknown");length(sel)
```

```
## [1] 137
```

```
df$loan[sel]<-NA

# Missings:
miss<-which(is.na(df$loan));
missings$loan<-length(miss); length(miss)
```

```
## [1] 137
```

```
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

# Factoritzem les categories (levels) de la columna i afegim l'etiqueta "loan-":
df$loan<-factor(df$loan)
levels(df$loan)<-paste0("loan-",levels(df$loan))

pie(summary(df$loan))
```



Contact

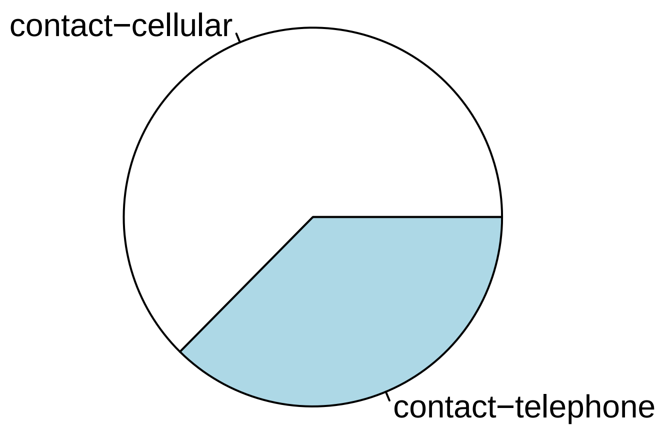
```
summary(df$contact)
```

```
##  cellular telephone
##      3130      1870
```

```
# Missings:
miss<-which(is.na(df$contact));
missings$contact<-length(miss); length(miss)
```

```
## [1] 0
```

```
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

# Factoritzem les categories (levels) de la columna i afegim l'etiqueta "contact-":
df$contact<-factor(df$contact)
levels(df$contact)<-paste0("contact-",levels(df$contact))

pie(summary(df$contact))
```

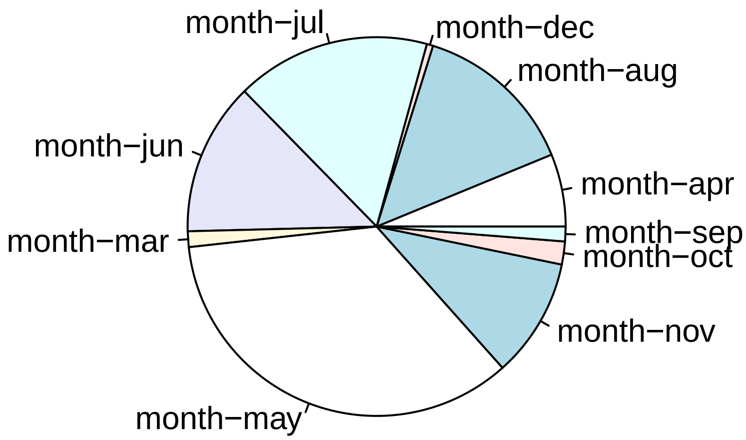


Month

```
miss<-which(is.na(df$month));
missings$month<-length(miss); length(miss)
```

```
## [1] 0
```

```
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

# Factoritzem les categories (levels) de la columna i afegim l'etiqueta "month-":
df$month<-factor(df$month)
levels(df$month)<-paste0("month-",levels(df$month))

par(mfrow=c(1,1))
pie(summary(df$month))
```

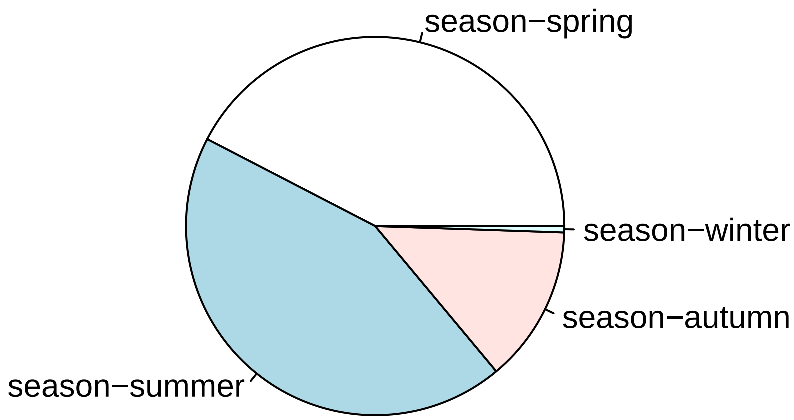


Month -> definim noves factor categories per Season.

New factors grouping original levels will be considered very positively.

```r
# Define new factor categories: 1- Spring 2-Summer 3-Autumn, 4-Winter
df$f.season <- 4
# 1 level - spring
sel<-which(df$month %in% c("month-mar","month-apr","month-may"))
df$f.season[sel] <-1

# 2 level - summer
sel<-which(df$month %in% c("month-jun","month-jul","month-aug"))
df$f.season[sel] <-2

# 3 level - autumn
sel<-which(df$month %in% c("month-sep","month-oct","month-nov"))
df$f.season[sel] <-3

df$f.season<-factor(df$f.season, levels=1:4, labels=c("season-spring","season-summer","season-autumn",

summary(df$f.season);pie(summary(df$f.season))
```

```
## season-spring season-summer season-autumn season-winter
##          2120          2183           670            27
```

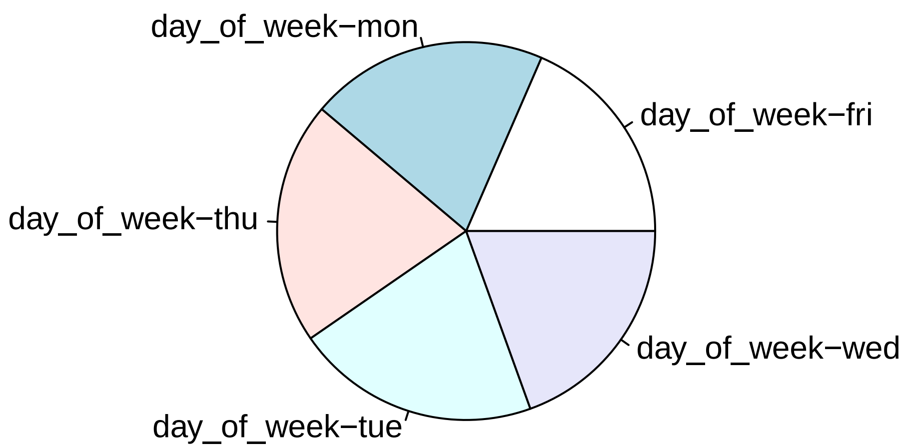


Day_of_week

```
miss<-which(is.na(df$day_of_week));
missings$day_of_week<-length(miss); length(miss)
```

```
## [1] 0
```

```
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

# Factoritzem les categories (levels) de la columna i afegim l'etiqueta "day_of_week-":
df$day_of_week<-factor(df$day_of_week)
levels(df$day_of_week)<-paste0("day_of_week-",levels(df$day_of_week))

pie(summary(df$day_of_week))
```



Poutcome (outcome of previous marketing campaign)

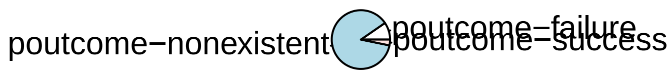
```
# Poutcome "nonexistent" will be considered a category, not a missing value.
table(df$poutcome, useNA="always")
```

```
##
##     failure nonexistent     success        <NA>
##         478        4363         159           0
```

```
# All missing data indicated as NA:
miss<-which(is.na(df$poutcome));
missings$poutcome<-length(miss); length(miss)
```

```
## [1] 0
```

```
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

# Factoritzem les categories (levels) de la columna i afegim l'etiqueta "poutcome-":
df$poutcome<-factor(df$poutcome)
levels(df$poutcome)<-paste0("poutcome-",levels(df$poutcome))

par(mfrow=c(2,1))
pie(summary(df$poutcome))
```

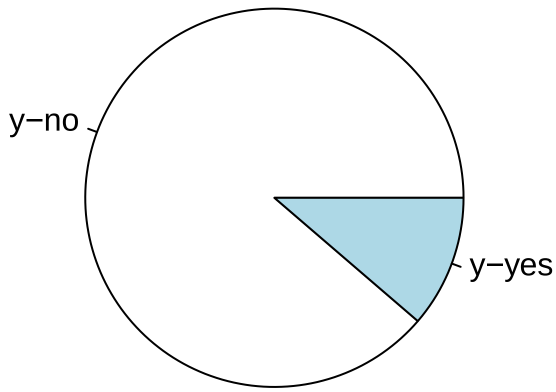


y (has the client subscribed a term deposit?)

```
miss<-which(is.na(df$y));
missings$y<-length(miss); length(miss)
```

```
## [1] 0
```

```
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

# Factoritzem les categories (levels) de la columna i afegim l'etiqueta "y-":
df$y<-factor(df$y)
levels(df$y)<-paste0("y-",levels(df$y))

pie(summary(df$y))
```



QUANTITATIVES VARIABLES:

Defining some useful function for outliers detection:

```
calcQ <- function(x){

  # summary(df$duration)
  #  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  #   0.0   102.0   180.0   258.3   319.0  4918.0

  s.x <- summary(x)

  iqr <- s.x[5]-s.x[2] # IQR = Q3([5]) -  Q1([2])

  list(souti=s.x[2]-3*iqr, mouti=s.x[2]-1.5*iqr, min=s.x[1], q1=s.x[2],
       q2=s.x[3], q3=s.x[5], max=s.x[6], mouts=s.x[5]+1.5*iqr, souts=s.x[5]+3*iqr)
}
```

Age

```
summary(df$age)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   18.00   32.00   38.00   40.07   47.00   87.00
```

```r
# No tenim cap missing NA!
miss<-which(is.na(df$age))
missings$age<-length(miss); length(miss)
```

```
## [1] 0
```

```r
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

par(mfrow=c(1,2))
hist(df$age, breaks=10, main="age - histogram")
Boxplot(df$age)
```

```
##  [1] 4570 4634 3623 3628 3631 4755 4612 4734 4740 4512
```

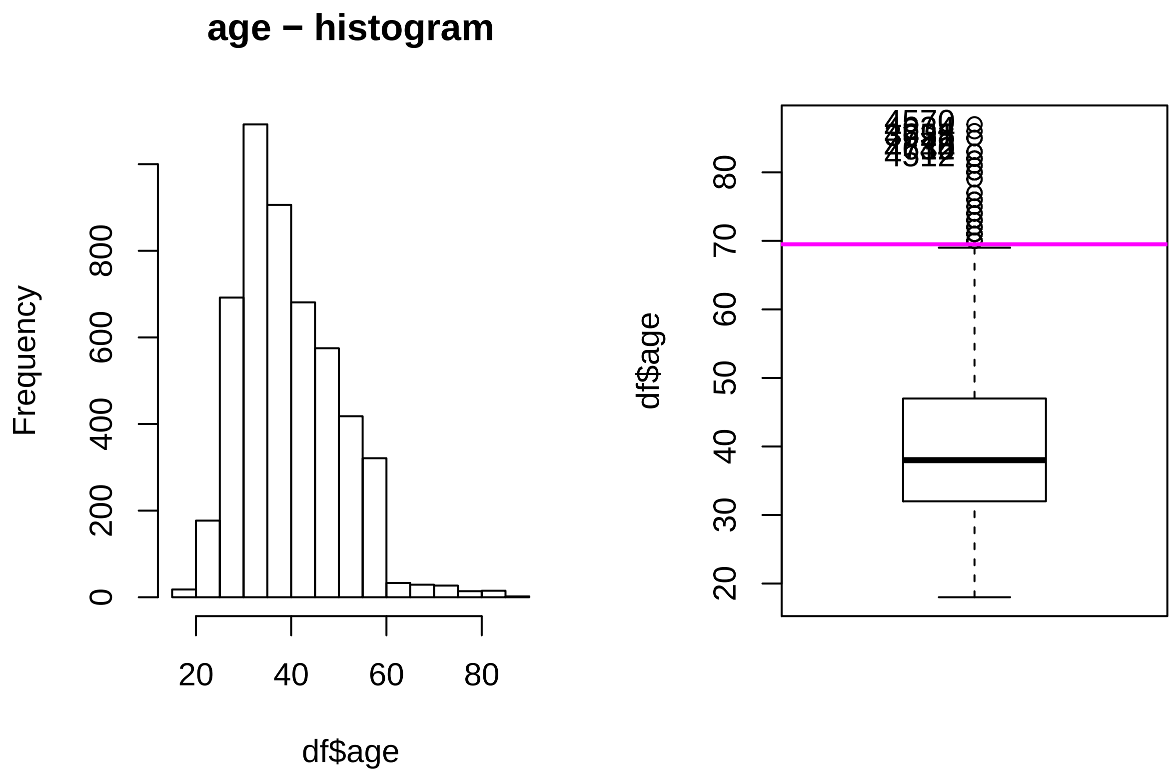
```r
# Errors are under aged people:
err<-which(df$age < 18)
errors$age<-length(err); length(err)
```

```
## [1] 0
```

```r
if(length(err)>0) df<-df[-err,]

# Outliers:
out.var <- calcQ(df$age)
abline(h=out.var[["mouts"]], col="magenta", lwd=2); out.var[["mouts"]]
```

```
## 3rd Qu.
##    69.5
```

```r
# But our outliers will be the ones above 100 years (there is none):
abline(h=100, col="red", lwd=2)
```




```
out<-which(df$age > 100)
outliers$age<-length(out); length(out)
```

```
## [1] 0
```

```
if(length(out)>0) df<-df[-out,]
```

Duration

Els outliers en la variable duració han estat eliminats. Corresponen a duracions per sota els 5 segons (trucada massa curta a un client que potser no podia parlar en aquell moment o penja per error) i per sobre dels 1600 segon s (26 minuts).

```
summary(df$duration)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     1.0   101.0   178.0   254.8   317.0  3785.0
```

```
# No tenim cap missing NA!
miss<-which(is.na(df$duration));
missings$duration<-length(miss); length(miss)
```

```
## [1] 0
```

```
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

par(mfrow=c(1,2))
hist(df$duration, breaks=20, main="duration - histogram")
Boxplot(df$duration)
```

```
##  [1] 4929 3368 2817 4759 1285 2907 2033 3815 4998 3280
```

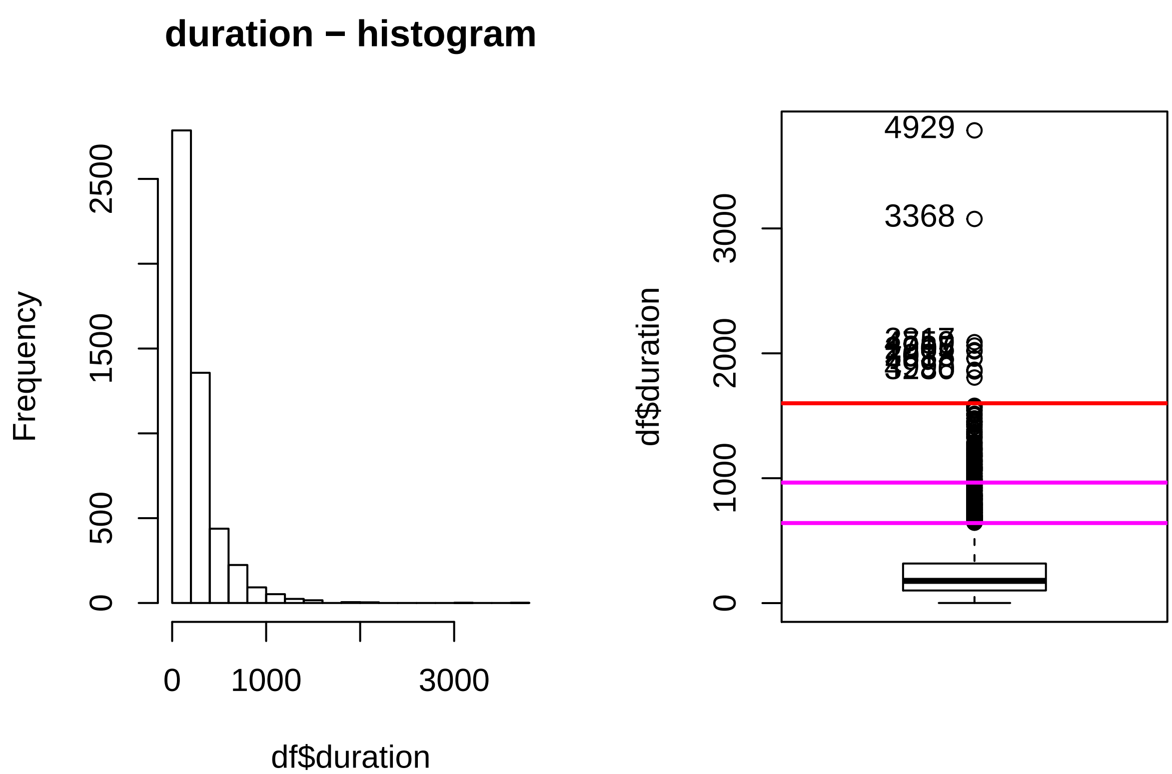
```r
# Outliers:
out.var <- calcQ(df$duration)
abline(h=out.var[["mouts"]], col="magenta", lwd=2); out.var[["mouts"]]
```

```
## 3rd Qu.
##     641
```

```r
abline(h=out.var[["souts"]], col="magenta", lwd=2); out.var[["souts"]]
```

```
## 3rd Qu.
##     965
```

```r
# But our outliers will be the ones above 1600 and below 5 seconds:
abline(h=1600, col="red", lwd=2)
```




```r
out<-which( (df$duration < 5) | (df$duration > 1600) )
outliers$duration=length(out); length(out)
```

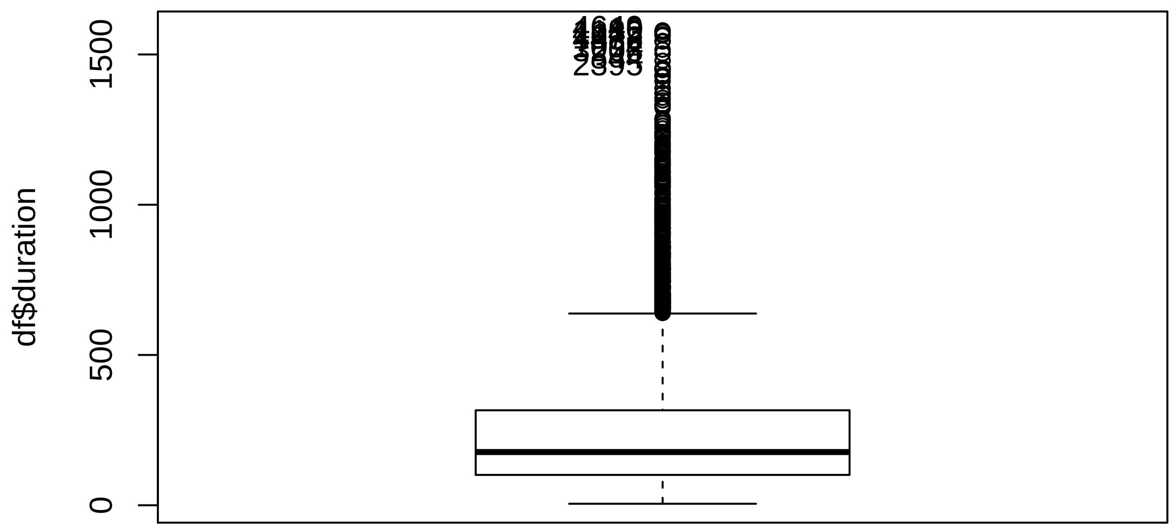
```
## [1] 14
```

```r
df[out, "num_outliers"]<- df[out, "num_outliers"]+1
df[out, "duration"]<-NA

# Eliminem els outliers:
if(length(out)>0) df<-df[-out,]

# Final summary of duration variable:
```

```r
par(mfrow=c(1,1))
summary(df$duration)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     5.0   101.0   177.0   250.6   316.0  1580.0
```

```r
Boxplot(df$duration)
```




```
##  [1] 4649   10 1182 4843 1972 4438 1094 3208  844 2395
```

Duration -> creem una columna de duració en minuts:

```r
df$minutes<-df$duration/60
summary(df$minutes)
```

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
##  0.08333  1.68333  2.95000  4.17703  5.26667 26.33333
```

Campaign

```r
summary(df$campaign)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   1.000   1.000   2.000   2.584   3.000  33.000
```

```r
# No tenim cap missing NA!
miss<-which(is.na(df$campaign));
missings$campaign<-length(miss); length(miss)
```

```
## [1] 0
```

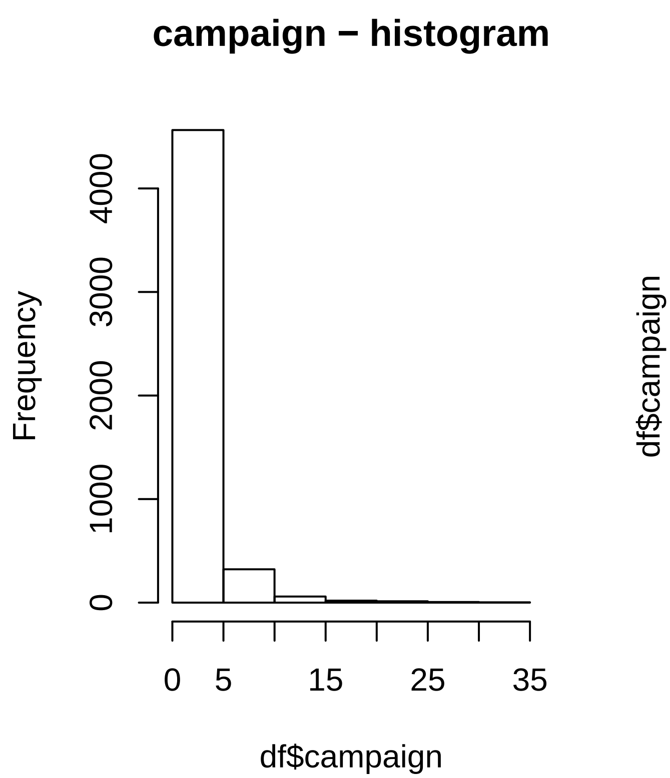
```r
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

par(mfrow=c(1,2))
hist(df$campaign, breaks=10, main="campaign - histogram")
Boxplot(df$campaign)
```

```
##  [1] 1589 2285  707 2308 1158 1474 2149 2301 1604 2303
```

```r
# Outliers:
out.var <- calcQ(df$campaign)
abline(h=out.var[["souts"]], col="magenta", lwd=2); out.var[["souts"]]
```

```
## 3rd Qu.
##       9
```

```r
# But our outliers will be the ones contacted more than 25 times:
abline(h=25, col="red", lwd=2)
```




```r
out<-which(df$campaign > 25)
df[out, "num_outliers"]<- df[out, "num_outliers"]+1
outliers$campaign=length(out); length(out)
```

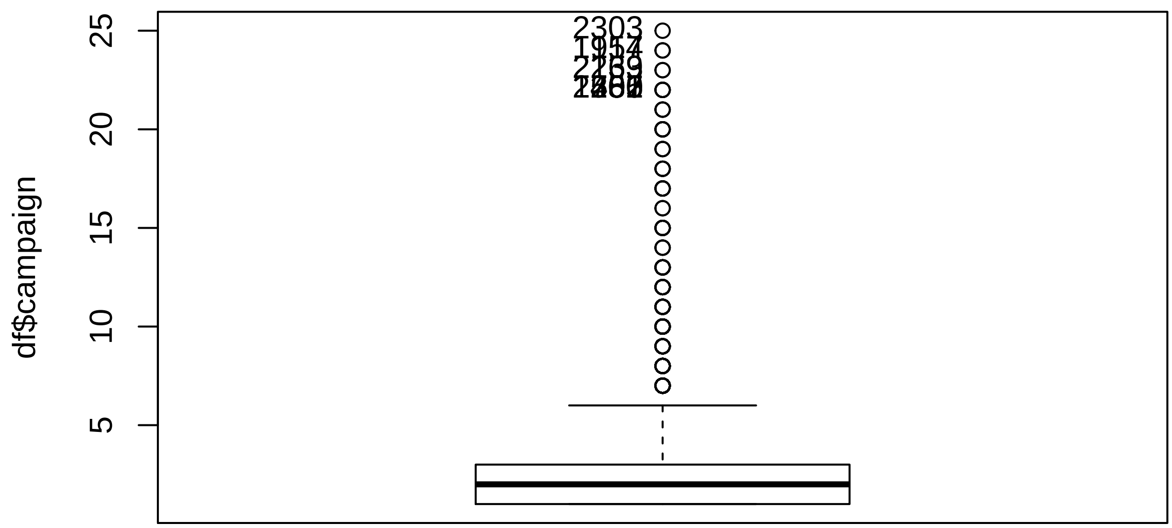
```
## [1] 9
```

```r
df[out, "campaign"]<-NA

# Final summary of campaign variable:
```

```
par(mfrow=c(1,1))
summary(df$campaign)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's 
##   1.000   1.000   2.000   2.535   3.000  25.000       9
```

```
Boxplot(df$campaign)
```




```
##  [1] 2303 1157 1914 2139 2263  401  502  755 1280 2267
```

Pdays

```
# No tenim cap missing NA!
miss<-which(is.na(df$pdays));
missings$pdays<-length(miss); length(miss)
```

```
## [1] 0
```

```
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

# Values that are 999 mean never contacted before:
never<-which(df$pdays==999); length(never)/5000*100
```

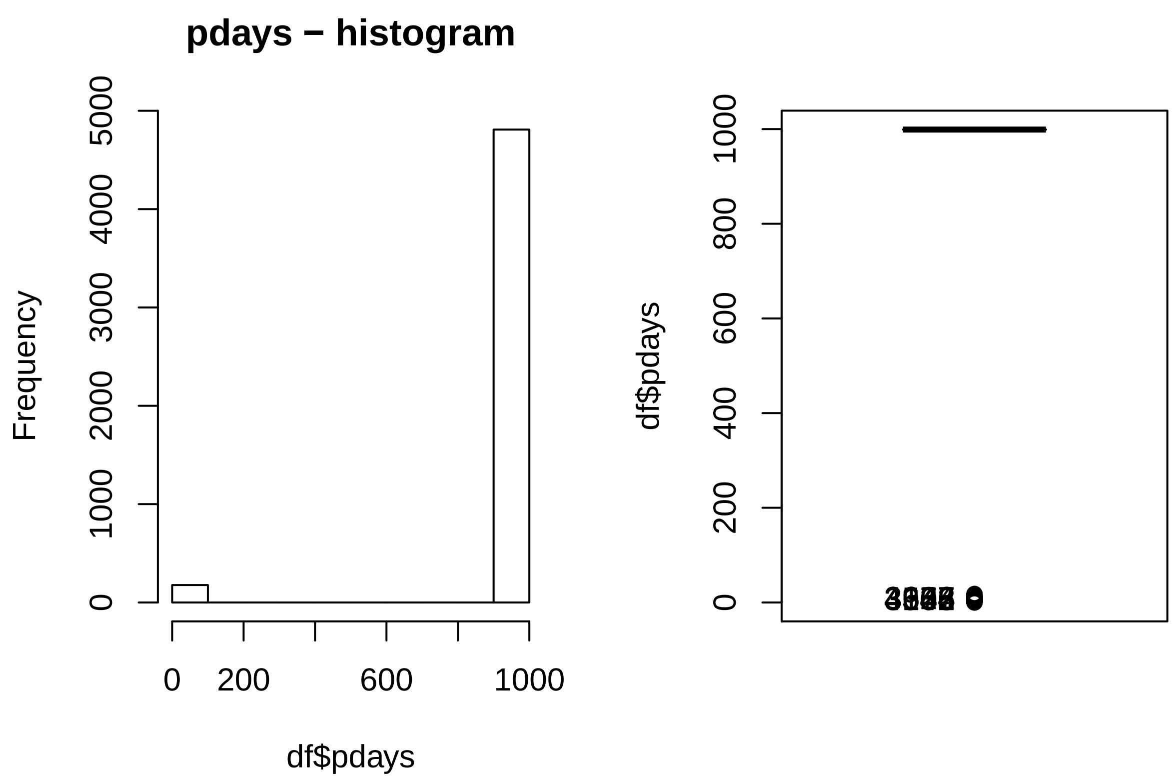
```
## [1] 96.18
```

```
# No outliers!

# Final summary of pdays variable:
```

```r
summary(df$pdays)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     0.0   999.0   999.0   963.7   999.0   999.0
```

```r
par(mfrow=c(1,2))
hist(df$pdays, breaks=10, main="pdays - histogram")
Boxplot(df$pdays)
```




```
##  [1] 3148 4902 3576 4135 4366 3627 3642 3644 3646 4352
```

Previous

```r
# No tenim cap missing NA!
miss<-which(is.na(df$previous));
missings$previous<-length(miss); length(miss)
```

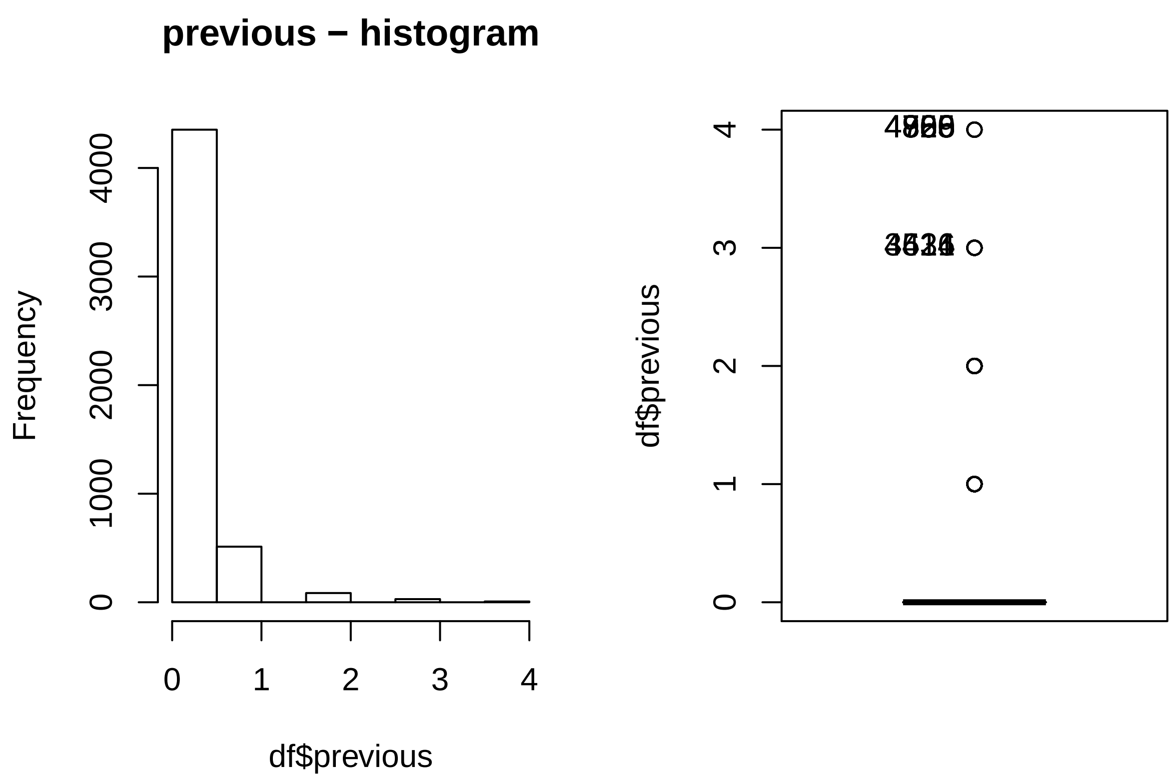
```
## [1] 0
```

```r
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

par(mfrow=c(1,2))
hist(df$previous,  main="previous - histogram")

# Final summary of previous variable:
summary(df$previous)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
```

```
## 0.0000 0.0000 0.0000 0.1598 0.0000 4.0000
```

```r
Boxplot(df$previous)
```



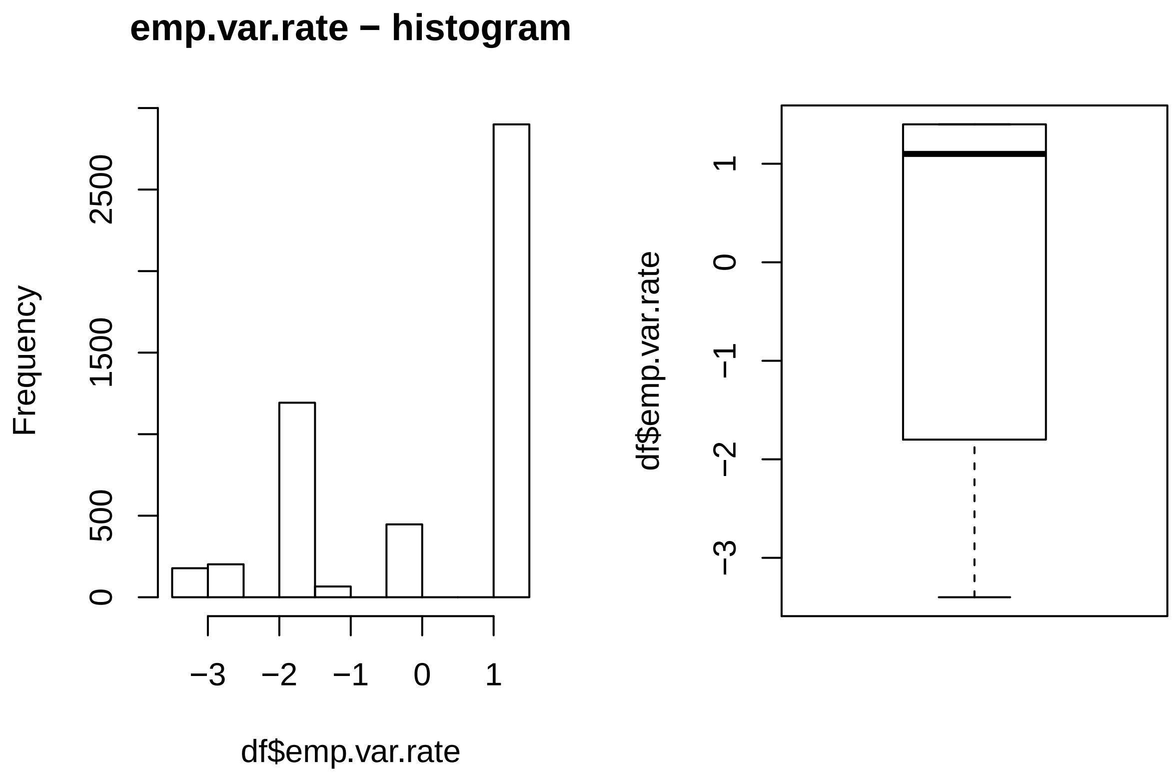

```
## [1] 4769 4786 4805 4826 4850 4888 4925 3431 4516 4624
```

emp.var.rate

```r
# Neither missing, outliers nor error values.
par(mfrow=c(1,2))

hist(df$emp.var.rate,  main="emp.var.rate - histogram")
summary(df$emp.var.rate)
```

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
## -3.40000 -1.80000  1.10000  0.06446  1.40000  1.40000
```

```r
Boxplot(df$emp.var.rate)
```

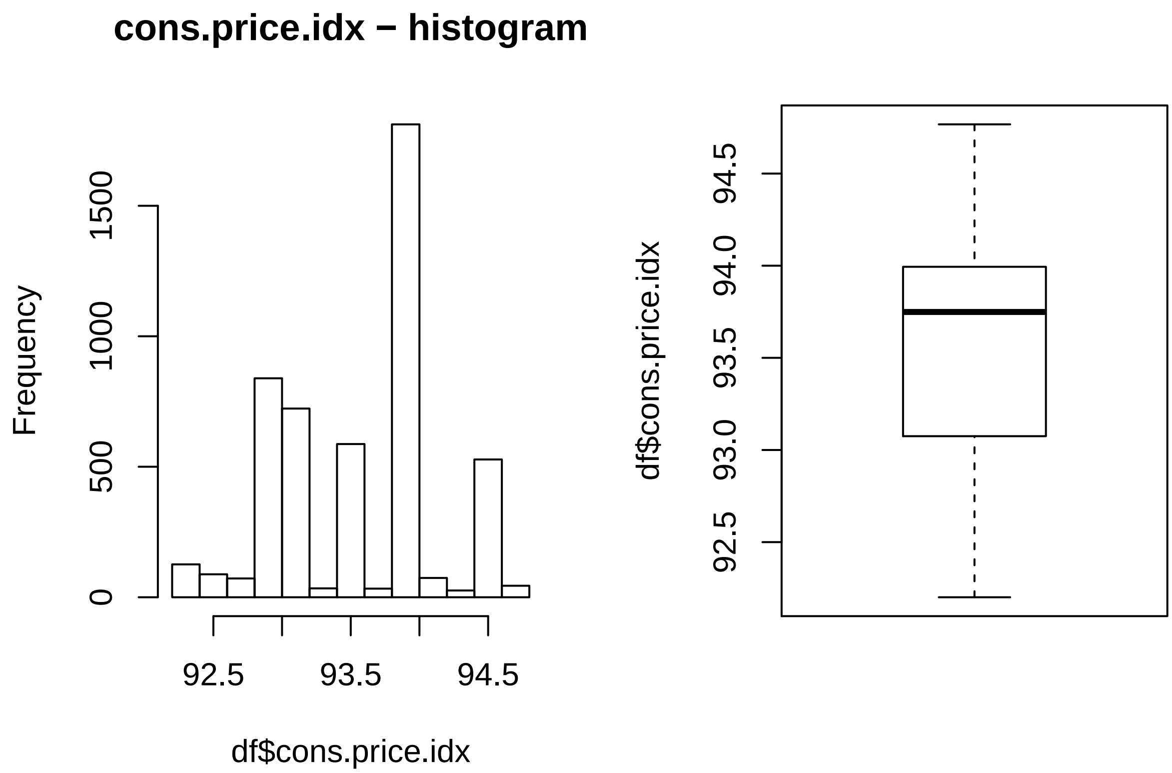


cons.price.idx

```
# Neither missing, outliers nor error values.
par(mfrow=c(1,2))

hist(df$cons.price.idx,  main="cons.price.idx - histogram")
summary(df$cons.price.idx)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   92.20   93.08   93.75   93.57   93.99   94.77
```

```
Boxplot(df$cons.price.idx)
```

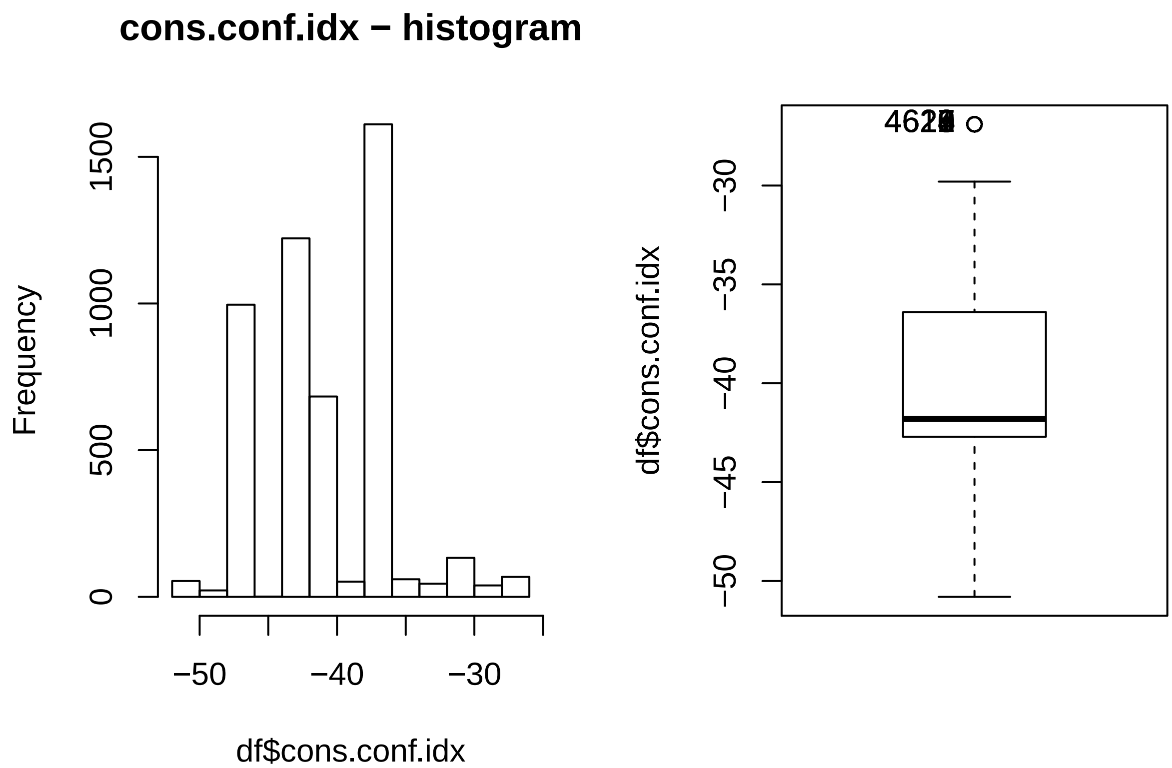


cons.conf.idx

```
# Neither missing, outliers nor error values.
par(mfrow=c(1,2))

hist(df$cons.conf.idx,  main="cons.conf.idx - histogram")
summary(df$cons.conf.idx)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  -50.80  -42.70  -41.80  -40.43  -36.40  -26.90
```

```
Boxplot(df$cons.conf.idx)
```




```
##  [1] 4617 4618 4619 4620 4621 4622 4623 4624 4625 4626
```

euribor3m

```
# Neither missing, outliers nor error values.
par(mfrow=c(1,2))

hist(df$euribor3m,  main="euribor3m - histogram")
summary(df$euribor3m)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.635   1.334   4.857   3.614   4.961   5.000
```

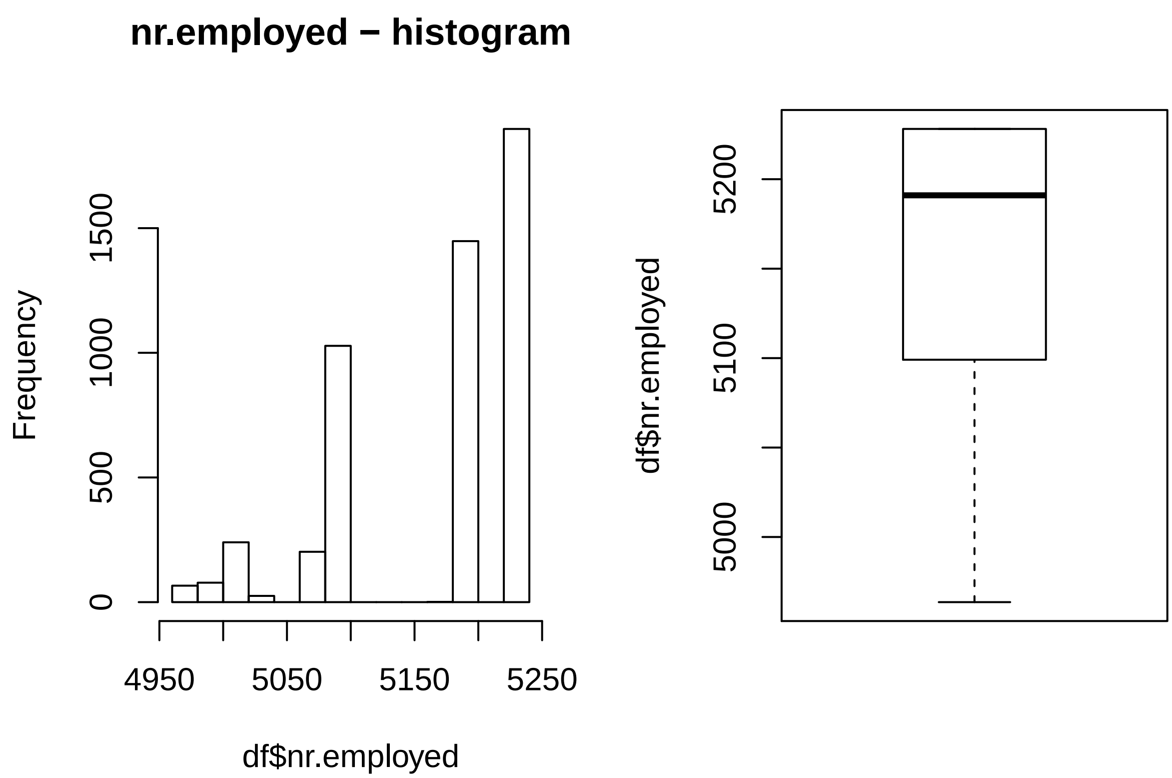
```
Boxplot(df$euribor3m)
```

nr.employed

```
# Neither missing, outliers nor error values.
par(mfrow=c(1,2))

hist(df$nr.employed,  main="nr.employed - histogram")
summary(df$nr.employed)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    4964    5099    5191    5166    5228    5228
```

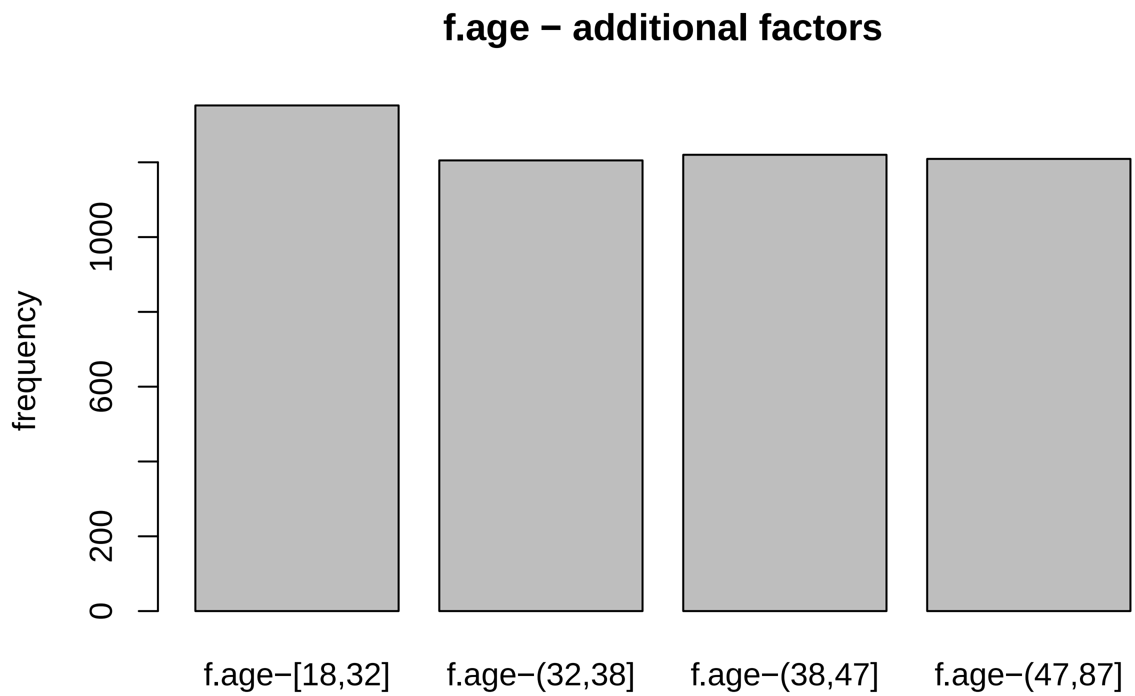
```
Boxplot(df$nr.employed)
```



DISCRETITZACIÓ DE VARIABLES NUMÈRIQUES:

Original numeric variables corresponding to real quantitative concepts are kept as numeric but additional factors should also be created as a discretization of each numeric variable.

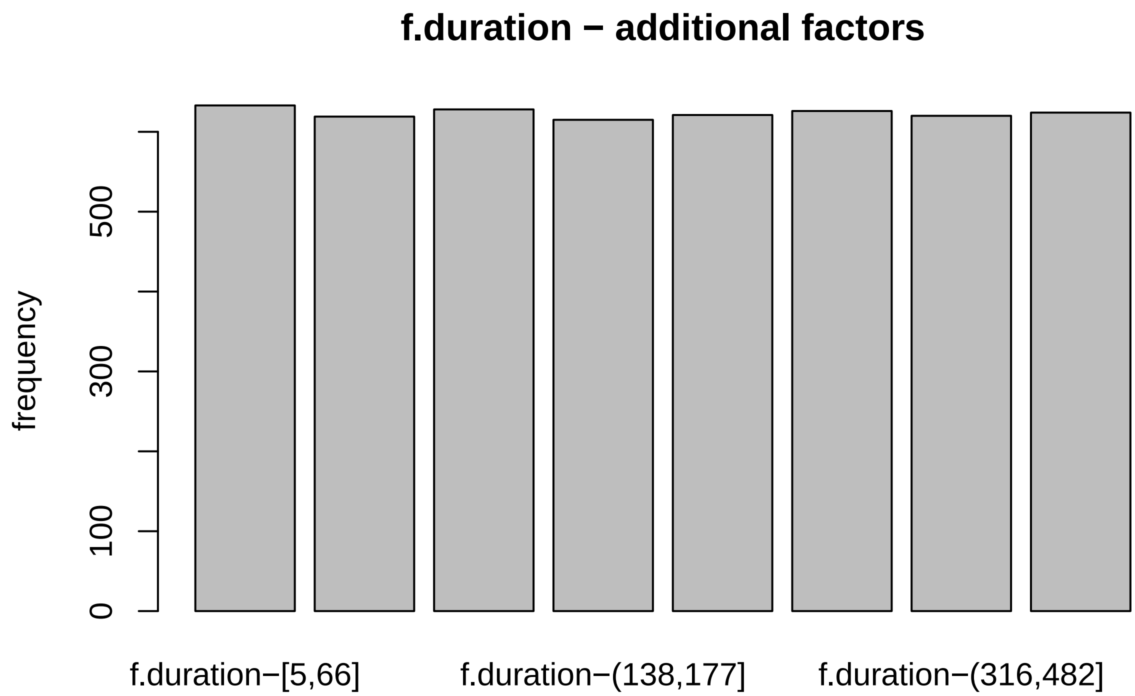
```
par(mfrow=c(1,1))

# AGE
qulist<-quantile(df$age, seq(0,1,0.25), na.rm=TRUE)

df$f.age<-factor( cut(df$age, breaks=qulist, include.lowest=T) )
levels(df$f.age)<-paste0("f.age-", levels(df$f.age) )

# Es mostra una distribució d'edats equitativa amb aquesta factorització:
barplot(table(df$f.age), main="f.age - additional factors", ylab="frequency")
```




```r
summary(df$f.age)
```

```
## f.age-[18,32] f.age-(32,38] f.age-(38,47] f.age-(47,87]
##          1352          1205          1220          1209
```

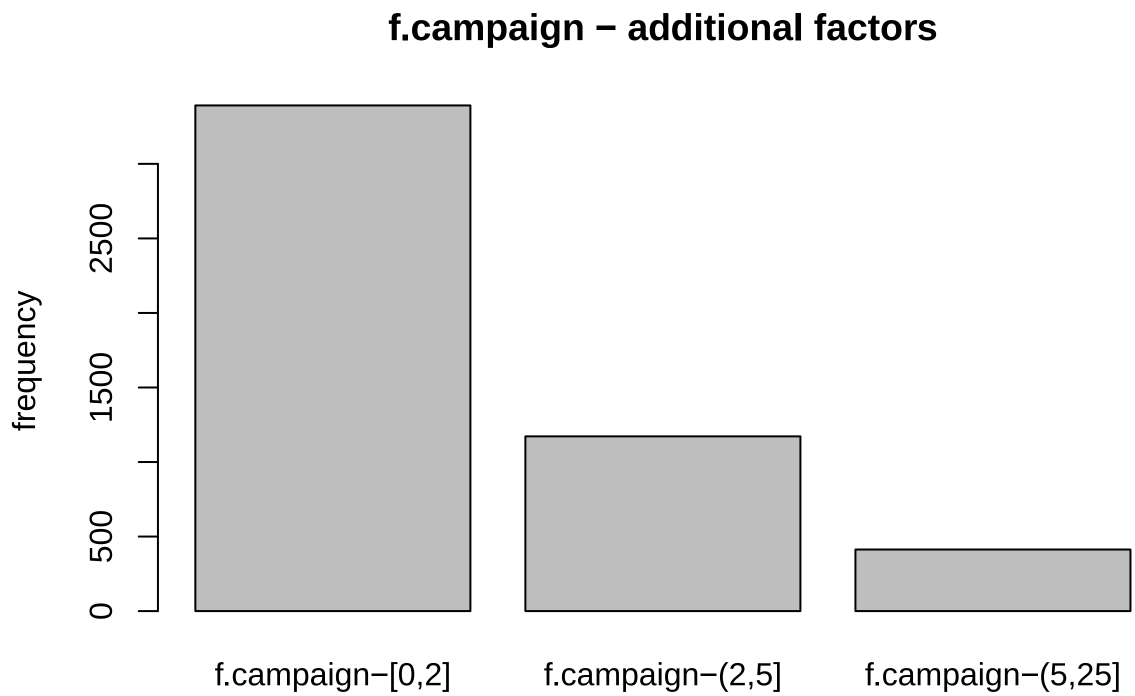
```r
# DURATION
qulist<-quantile(df$duration, seq(0,1,0.125), na.rm=TRUE)

df$f.duration<-factor( cut(df$duration, breaks=qulist, include.lowest=T) )
levels(df$f.duration)<-paste0("f.duration-", levels(df$f.duration) )

# Es mostra una distribució de duracions de la trucada equitativa amb aquesta factorització:
barplot(table(df$f.duration), main="f.duration - additional factors", ylab="frequency")
```




```
summary(df$f.duration)
```

```
##          f.duration-[5,66]        f.duration-(66,101]
##                        633                        619
##       f.duration-(101,138]       f.duration-(138,177]
##                        628                        615
##       f.duration-(177,235]       f.duration-(235,316]
##                        621                        626
##       f.duration-(316,482] f.duration-(482,1.58e+03]
##                        620                        624
```

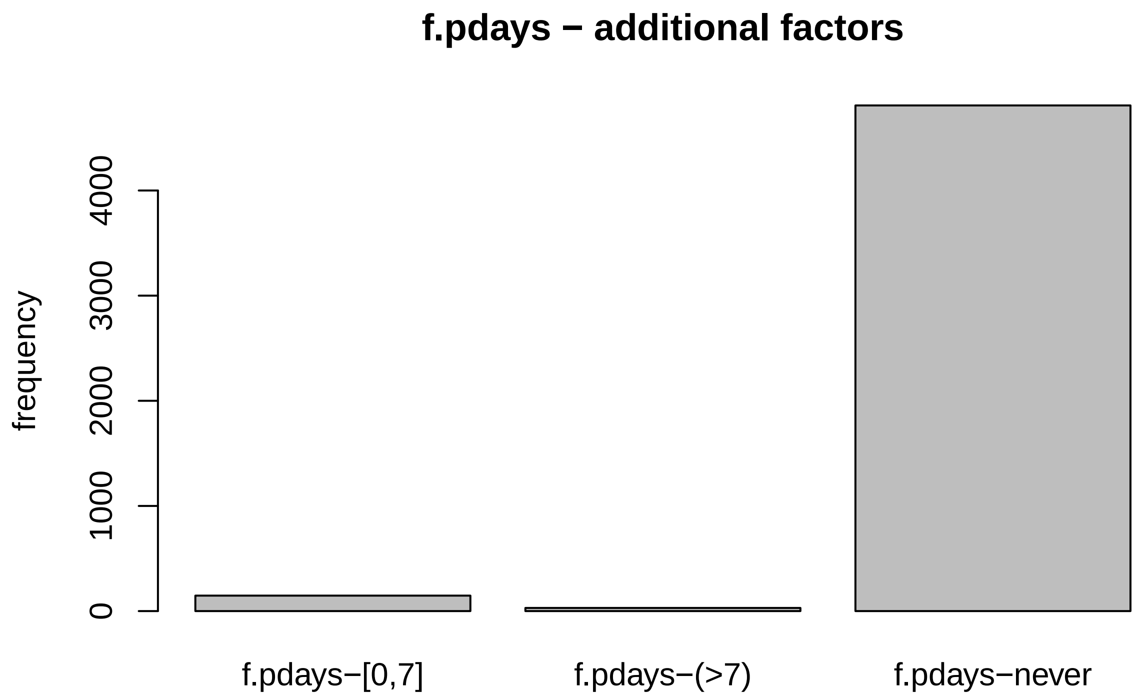
```
# CAMPAIGN
qulist<-quantile(df$campaign, seq(0,1,0.5), na.rm=TRUE)

df$f.campaign<-factor( cut(df$campaign, breaks=c(0,2,5,25), include.lowest=T) )
levels(df$f.campaign)<-paste0("f.campaign-", levels(df$f.campaign) )

# Resultat de la factorització de cops que s'ha contactat al client en la campanya actual:
barplot(table(df$f.campaign), main="f.campaign - additional factors", ylab="frequency")
```




```
summary(df$f.campaign)
```

```
##  f.campaign-[0,2]  f.campaign-(2,5] f.campaign-(5,25]              NA's
##              3392              1172               413                 9
```

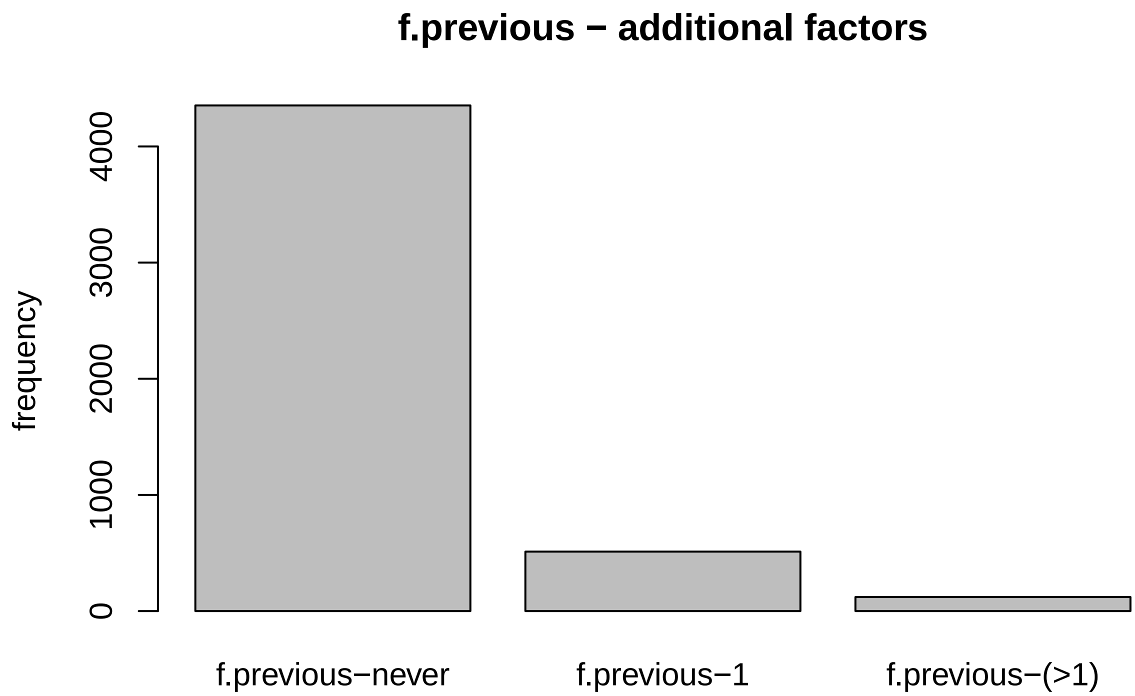
```
# PDAYS
df$f.pdays<-factor( cut(df$pdays, breaks=c(0, 7, 998, 999), include.lowest=T) )
levels(df$f.pdays)<-paste0("f.pdays-", levels(df$f.pdays) )

levels(df$f.pdays)<-c("f.pdays-[0,7]", "f.pdays-(>7)", "f.pdays-never")

# Resultat de la factorització? dels dies que fa que s'ha contactat al client en una altra campanya:
barplot(table(df$f.pdays), main="f.pdays - additional factors", ylab="frequency")
```




```r
summary(df$f.pdays)
```

```
## f.pdays-[0,7]  f.pdays-(>7) f.pdays-never
##           147            30          4809
```

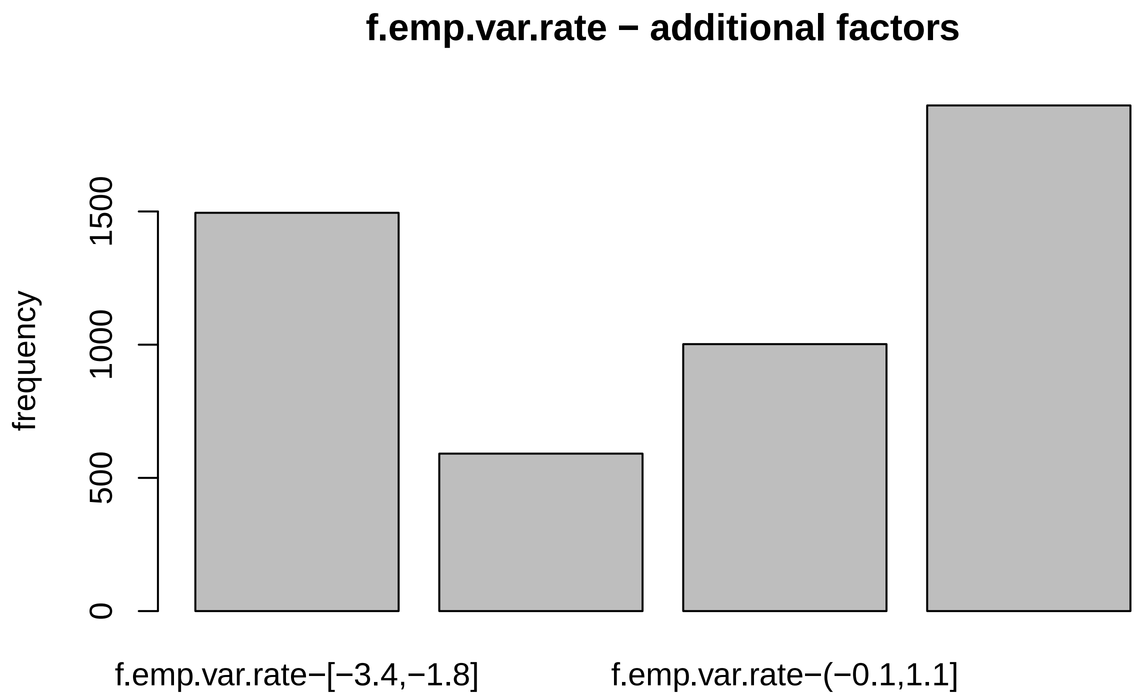
```r
# PREVIOUS
df$f.previous<-factor( cut(df$previous, breaks=c(-Inf, 0, 1, +Inf), include.lowest=T) )
levels(df$f.previous)<-paste0("f.previous-", levels(df$f.previous) )

levels(df$f.previous)<-c("f.previous-never", "f.previous-1", "f.previous-(>1)")

# Resultat de la factorització de number of contacts performed before this campaign and for this client
barplot(table(df$f.previous), main="f.previous - additional factors", ylab="frequency")
```




```r
summary(df$f.previous)
```

```
## f.previous-never     f.previous-1  f.previous-(>1)
##             4353              512              121
```

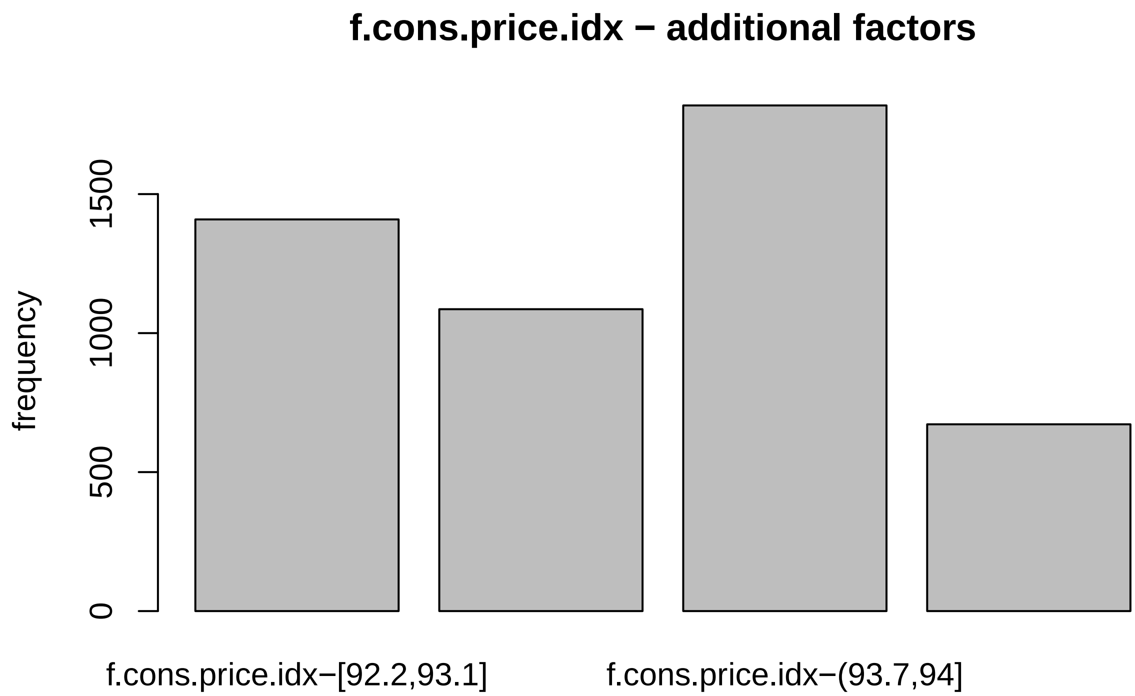
```r
# EMP.VAR.RATE
qulist<-quantile(df$emp.var.rate, seq(0,1,0.125), na.rm=TRUE)

df$f.emp.var.rate <-factor( cut(df$emp.var.rate  , breaks=unique(qulist), include.lowest=T) )
levels(df$f.emp.var.rate)<-paste0("f.emp.var.rate-", levels(df$f.emp.var.rate) )

barplot(table(df$f.emp.var.rate), main="f.emp.var.rate - additional factors", ylab="frequency")
```




```
summary(df$f.emp.var.rate)
```

```
## f.emp.var.rate-[-3.4,-1.8] f.emp.var.rate-(-1.8,-0.1]
##                       1495                        591
##  f.emp.var.rate-(-0.1,1.1]   f.emp.var.rate-(1.1,1.4]
##                       1002                       1898
```

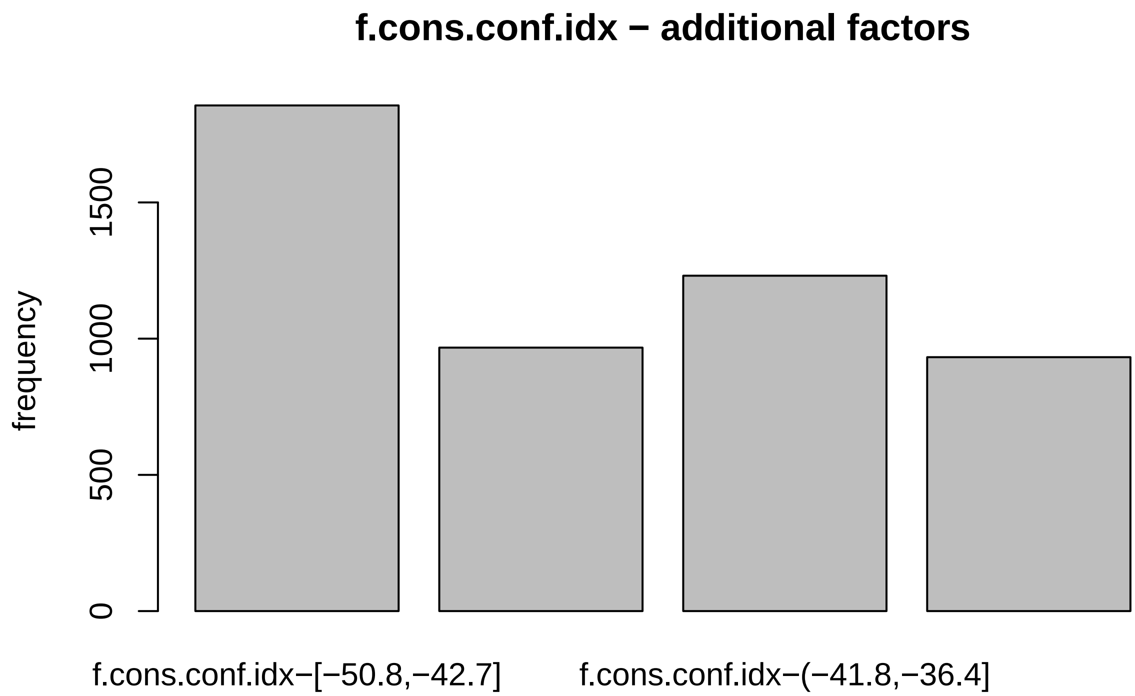
```
# CONS.PRICE.IDX
qulist<-quantile(df$cons.price.idx, seq(0,1,0.25), na.rm=TRUE)

df$f.cons.price.idx <-factor( cut(df$cons.price.idx  , breaks=unique(qulist), include.lowest=T) )
levels(df$f.cons.price.idx)<-paste0("f.cons.price.idx-", levels(df$f.cons.price.idx) )

barplot(table(df$f.cons.price.idx), main="f.cons.price.idx - additional factors", ylab="frequency")
```




```r
summary(df$f.cons.price.idx)
```

```
## f.cons.price.idx-[92.2,93.1] f.cons.price.idx-(93.1,93.7]
##                         1409                         1086
##   f.cons.price.idx-(93.7,94]   f.cons.price.idx-(94,94.8]
##                         1819                          672
```

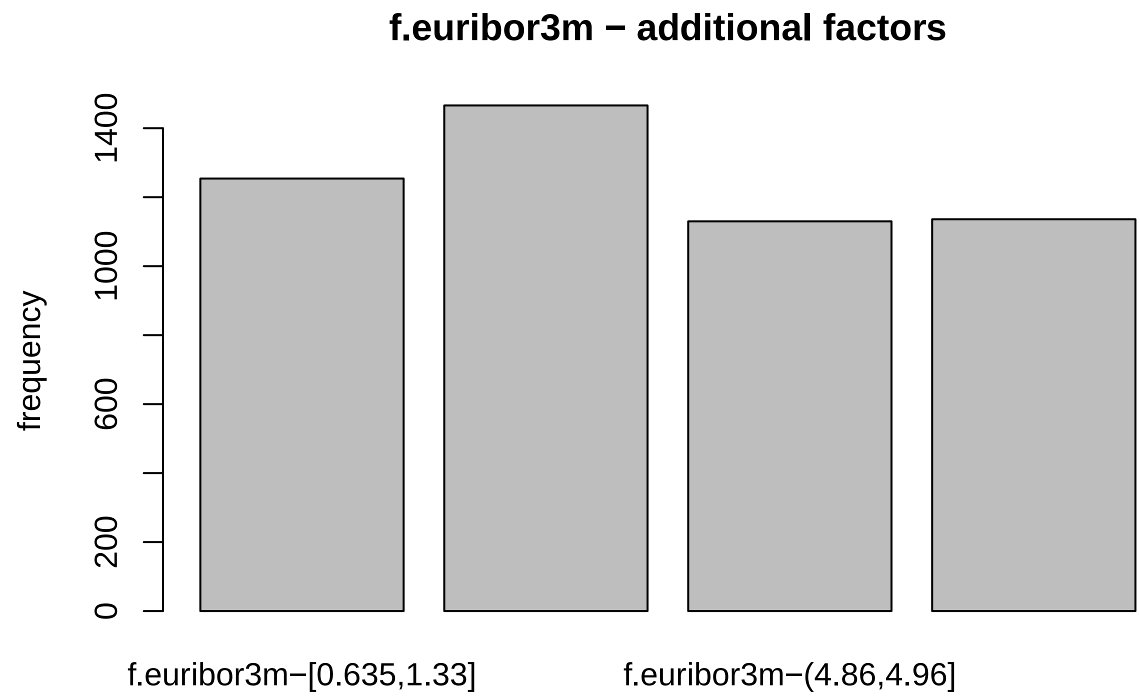
```r
# CONS.CONF.IDX
qulist<-quantile(df$cons.conf.idx, seq(0,1,0.25), na.rm=TRUE)

df$f.cons.conf.idx <-factor( cut(df$cons.conf.idx  , breaks=unique(qulist), include.lowest=T) )
levels(df$f.cons.conf.idx)<-paste0("f.cons.conf.idx-", levels(df$f.cons.conf.idx) )

barplot(table(df$f.cons.conf.idx), main="f.cons.conf.idx - additional factors", ylab="frequency")
```




```r
summary(df$f.cons.conf.idx)
```

```
## f.cons.conf.idx-[-50.8,-42.7] f.cons.conf.idx-(-42.7,-41.8]
##                          1856                           967
## f.cons.conf.idx-(-41.8,-36.4] f.cons.conf.idx-(-36.4,-26.9]
##                          1231                           932
```

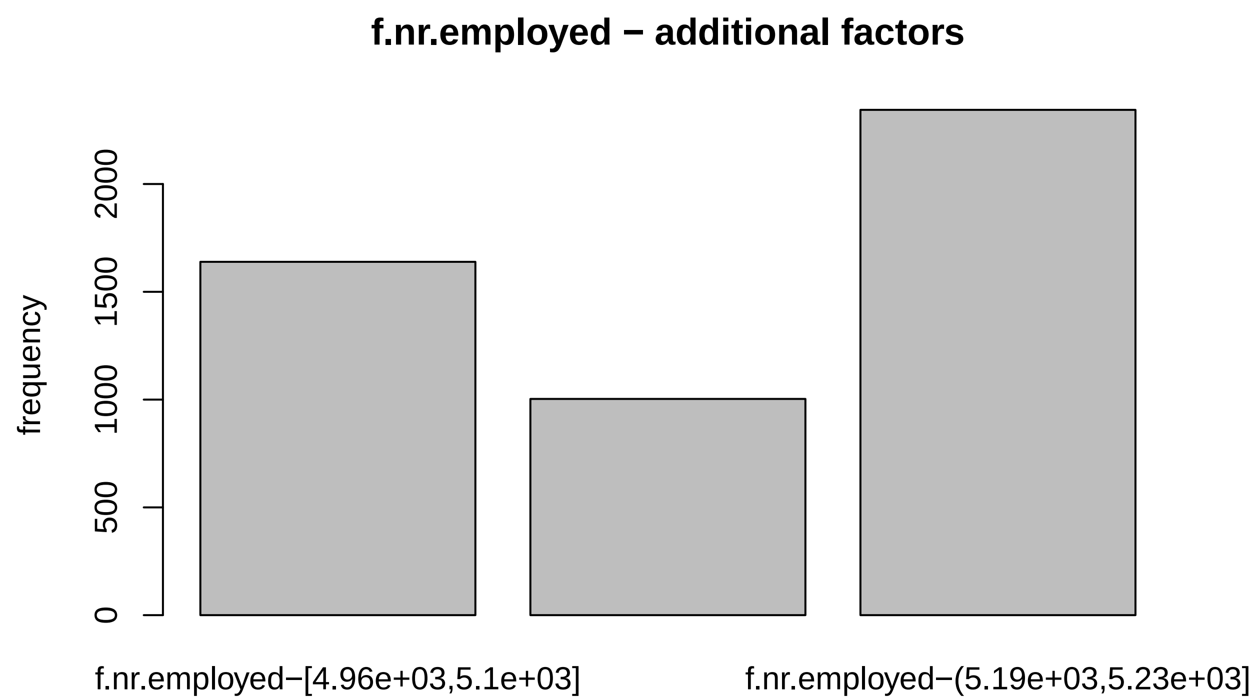
```r
# EURIBOR3M
qulist<-quantile(df$euribor3m, seq(0,1,0.25), na.rm=TRUE)

df$f.euribor3m <-factor( cut(df$euribor3m  , breaks=unique(qulist), include.lowest=T) )
levels(df$f.euribor3m)<-paste0("f.euribor3m-", levels(df$f.euribor3m) )

barplot(table(df$f.euribor3m), main="f.euribor3m - additional factors", ylab="frequency")
```




```r
summary(df$f.euribor3m)
```

```
## f.euribor3m-[0.635,1.33]  f.euribor3m-(1.33,4.86]  f.euribor3m-(4.86,4.96]
##                     1254                     1466                     1130
##     f.euribor3m-(4.96,5]
##                     1136
```

```r
# NR.EMPLOYED
qulist<-quantile(df$nr.employed, seq(0,1,0.25), na.rm=TRUE)

df$f.nr.employed <-factor( cut(df$nr.employed  , breaks=unique(qulist), include.lowest=T) )
levels(df$f.nr.employed)<-paste0("f.nr.employed-", levels(df$f.nr.employed) )

barplot(table(df$f.nr.employed), main="f.nr.employed - additional factors", ylab="frequency")
```




```r
summary(df$f.nr.employed)
```

```
##  f.nr.employed-[4.96e+03,5.1e+03]  f.nr.employed-(5.1e+03,5.19e+03]
##                              1639                              1003
## f.nr.employed-(5.19e+03,5.23e+03]
##                              2344
```

Llistat de variables contínues i discretes:

```r
vars<-names(df); vars
```

```
##  [1] "age"             "job"             "marital"
##  [4] "education"       "default"         "housing"
##  [7] "loan"            "contact"         "month"
## [10] "day_of_week"     "duration"        "campaign"
## [13] "pdays"           "previous"        "poutcome"
## [16] "emp.var.rate"    "cons.price.idx"  "cons.conf.idx"
## [19] "euribor3m"       "nr.employed"     "y"
## [22] "num_missings"    "num_outliers"    "num_errors"
## [25] "f.season"        "minutes"         "f.age"
## [28] "f.duration"      "f.campaign"      "f.pdays"
## [31] "f.previous"      "f.emp.var.rate"  "f.cons.price.idx"
## [34] "f.cons.conf.idx" "f.euribor3m"     "f.nr.employed"
```

```r
# Variables contínues
vars_con<-names(df)[c(1, 11:14, 16:20)]; vars_con
```

```
##  [1] "age"             "duration"        "campaign"        "pdays"
##  [5] "previous"        "emp.var.rate"    "cons.price.idx" "cons.conf.idx"
##  [9] "euribor3m"       "nr.employed"
```

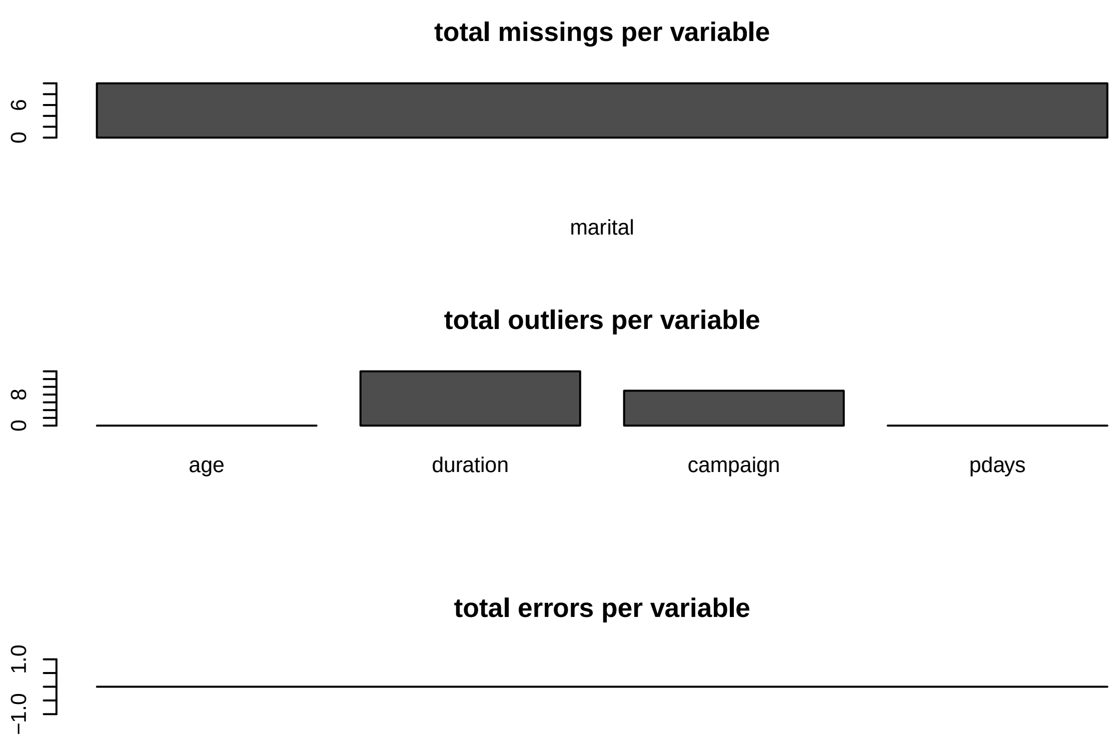
```
# Variables discretes
vars_dis<-names(df)[c(2:10, 15, 21, 25, 27:36)]; vars_dis
```

```
##  [1] "job"               "marital"           "education"
##  [4] "default"           "housing"           "loan"
##  [7] "contact"           "month"             "day_of_week"
## [10] "poutcome"          "y"                 "f.season"
## [13] "f.age"             "f.duration"        "f.campaign"
## [16] "f.pdays"           "f.previous"        "f.emp.var.rate"
## [19] "f.cons.price.idx" "f.cons.conf.idx"   "f.euribor3m"
## [22] "f.nr.employed"
```

DATA QUALITY REPORT:

Per variable:

```
par(mfrow=c(3,1))
barplot( t(c(missings[, 3])), main="total missings per variable", xlab="marital")
barplot( t(c(outliers[, c(1, 11, 12, 13)])), main="total outliers per variable")
barplot( t(c(errors[, 13])), main="total errors per variable")
```



Per individu:

Cap individu en té més d'un. Es mostra en format taula el número d'individus que tenen 0 i/o 1(o més) missings, errors i outliers. Per últim, es mostren els individus que han tingut algun outlier i que aquest ha estat imputat.

```
par(mfrow=c(1,1))
table(df$num_missings)
```

```
##
##    0    1
## 4839  147
```

```
table(df$num_errors)
```

```
##
##    0
## 4986
```

```
table(df$num_outliers)
```

```
##
##    0    1
## 4977    9
```

```
df[which(df$num_outliers>0), ] #individus amb algun outlier
```

```
##       age             job         marital                   education
## 5565   39      job-admin. marital-married education-university.degree
## 9014   30 job-blue-collar marital-married         education-basic.9y
## 11631  31      job-admin.  marital-single education-university.degree
## 12643  54    job-services marital-married       education-high.school
## 12751  30    job-services marital-married       education-high.school
## 17524  46 job-blue-collar marital-married       education-high.school
## 18568  53      job-admin. marital-married education-university.degree
## 18686  25      job-admin.  marital-single          education-basic.9y
## 18759  25      job-admin.  marital-single          education-basic.9y
##               default     housing     loan           contact     month
## 5565       default-no housing-yes  loan-no contact-telephone month-may
## 9014       default-no  housing-no  loan-no contact-telephone month-jun
## 11631      default-no  housing-no  loan-no contact-telephone month-jun
## 12643 default-unknown housing-yes  loan-no  contact-cellular month-jul
## 12751      default-no housing-yes  loan-no  contact-cellular month-jul
## 17524 default-unknown  housing-no  loan-no  contact-cellular month-jul
## 18568      default-no housing-yes  loan-no  contact-cellular month-jul
## 18686      default-no housing-yes  loan-no  contact-cellular month-jul
## 18759      default-no housing-yes loan-yes  contact-cellular month-jul
##           day_of_week duration campaign pdays previous
## 5565  day_of_week-mon       14       NA   999        0
## 9014  day_of_week-thu       53       NA   999        0
## 11631 day_of_week-fri       34       NA   999        0
## 12643 day_of_week-mon       36       NA   999        0
## 12751 day_of_week-tue       24       NA   999        0
## 17524 day_of_week-mon       33       NA   999        0
## 18568 day_of_week-thu       51       NA   999        0
## 18686 day_of_week-thu       14       NA   999        0
## 18759 day_of_week-thu       14       NA   999        0
```

```
##                  poutcome emp.var.rate cons.price.idx cons.conf.idx
## 5565  poutcome-nonexistent          1.1         93.994         -36.4
## 9014  poutcome-nonexistent          1.4         94.465         -41.8
## 11631 poutcome-nonexistent          1.4         94.465         -41.8
## 12643 poutcome-nonexistent          1.4         93.918         -42.7
## 12751 poutcome-nonexistent          1.4         93.918         -42.7
## 17524 poutcome-nonexistent          1.4         93.918         -42.7
## 18568 poutcome-nonexistent          1.4         93.918         -42.7
## 18686 poutcome-nonexistent          1.4         93.918         -42.7
## 18759 poutcome-nonexistent          1.4         93.918         -42.7
##       euribor3m nr.employed    y num_missings num_outliers num_errors
## 5565      4.857      5191.0 y-no            0            1          0
## 9014      4.866      5228.1 y-no            0            1          0
## 11631     4.959      5228.1 y-no            0            1          0
## 12643     4.960      5228.1 y-no            0            1          0
## 12751     4.962      5228.1 y-no            0            1          0
## 17524     4.962      5228.1 y-no            0            1          0
## 18568     4.968      5228.1 y-no            0            1          0
## 18686     4.968      5228.1 y-no            0            1          0
## 18759     4.968      5228.1 y-no            0            1          0
##            f.season   minutes         f.age        f.duration f.campaign
## 5565  season-spring 0.2333333 f.age-(38,47] f.duration-[5,66]       <NA>
## 9014  season-summer 0.8833333 f.age-[18,32] f.duration-[5,66]       <NA>
## 11631 season-summer 0.5666667 f.age-[18,32] f.duration-[5,66]       <NA>
## 12643 season-summer 0.6000000 f.age-(47,87] f.duration-[5,66]       <NA>
## 12751 season-summer 0.4000000 f.age-[18,32] f.duration-[5,66]       <NA>
## 17524 season-summer 0.5500000 f.age-(38,47] f.duration-[5,66]       <NA>
## 18568 season-summer 0.8500000 f.age-(47,87] f.duration-[5,66]       <NA>
## 18686 season-summer 0.2333333 f.age-[18,32] f.duration-[5,66]       <NA>
## 18759 season-summer 0.2333333 f.age-[18,32] f.duration-[5,66]       <NA>
##             f.pdays       f.previous           f.emp.var.rate
## 5565  f.pdays-never f.previous-never f.emp.var.rate-(-0.1,1.1]
## 9014  f.pdays-never f.previous-never  f.emp.var.rate-(1.1,1.4]
## 11631 f.pdays-never f.previous-never  f.emp.var.rate-(1.1,1.4]
## 12643 f.pdays-never f.previous-never  f.emp.var.rate-(1.1,1.4]
## 12751 f.pdays-never f.previous-never  f.emp.var.rate-(1.1,1.4]
## 17524 f.pdays-never f.previous-never  f.emp.var.rate-(1.1,1.4]
## 18568 f.pdays-never f.previous-never  f.emp.var.rate-(1.1,1.4]
## 18686 f.pdays-never f.previous-never  f.emp.var.rate-(1.1,1.4]
## 18759 f.pdays-never f.previous-never  f.emp.var.rate-(1.1,1.4]
##                 f.cons.price.idx              f.cons.conf.idx
## 5565  f.cons.price.idx-(93.7,94] f.cons.conf.idx-(-41.8,-36.4]
## 9014  f.cons.price.idx-(94,94.8] f.cons.conf.idx-(-42.7,-41.8]
## 11631 f.cons.price.idx-(94,94.8] f.cons.conf.idx-(-42.7,-41.8]
## 12643 f.cons.price.idx-(93.7,94] f.cons.conf.idx-[-50.8,-42.7]
## 12751 f.cons.price.idx-(93.7,94] f.cons.conf.idx-[-50.8,-42.7]
## 17524 f.cons.price.idx-(93.7,94] f.cons.conf.idx-[-50.8,-42.7]
## 18568 f.cons.price.idx-(93.7,94] f.cons.conf.idx-[-50.8,-42.7]
## 18686 f.cons.price.idx-(93.7,94] f.cons.conf.idx-[-50.8,-42.7]
## 18759 f.cons.price.idx-(93.7,94] f.cons.conf.idx-[-50.8,-42.7]
##                  f.euribor3m                     f.nr.employed
## 5565  f.euribor3m-(1.33,4.86]  f.nr.employed-(5.1e+03,5.19e+03]
## 9014  f.euribor3m-(4.86,4.96] f.nr.employed-(5.19e+03,5.23e+03]
## 11631 f.euribor3m-(4.86,4.96] f.nr.employed-(5.19e+03,5.23e+03]
```

```
## 12643 f.euribor3m-(4.86,4.96] f.nr.employed-(5.19e+03,5.23e+03]
## 12751    f.euribor3m-(4.96,5] f.nr.employed-(5.19e+03,5.23e+03]
## 17524    f.euribor3m-(4.96,5] f.nr.employed-(5.19e+03,5.23e+03]
## 18568    f.euribor3m-(4.96,5] f.nr.employed-(5.19e+03,5.23e+03]
## 18686    f.euribor3m-(4.96,5] f.nr.employed-(5.19e+03,5.23e+03]
## 18759    f.euribor3m-(4.96,5] f.nr.employed-(5.19e+03,5.23e+03]
```

Outliers Multivariants:

No hem aconseguit trobar una configuració del aq.plot que ens doni una bona gràfica per a veure les distàncies de Mahalanobis i detecter outliers multivariants.

```r
# Consider subset of numeric variables:
summary(df[,vars_con])
```

```
##       age           duration          campaign          pdays      
##  Min.   :18.00   Min.   :   5.0   Min.   : 1.000   Min.   :  0.0  
##  1st Qu.:32.00   1st Qu.: 101.0   1st Qu.: 1.000   1st Qu.:999.0  
##  Median :38.00   Median : 177.0   Median : 2.000   Median :999.0  
##  Mean   :40.07   Mean   : 250.6   Mean   : 2.535   Mean   :963.7  
##  3rd Qu.:47.00   3rd Qu.: 316.0   3rd Qu.: 3.000   3rd Qu.:999.0  
##  Max.   :87.00   Max.   :1580.0   Max.   :25.000   Max.   :999.0  
##                                   NA's   :9                       
##     previous        emp.var.rate      cons.price.idx  cons.conf.idx  
##  Min.   :0.0000   Min.   :-3.40000   Min.   :92.20   Min.   :-50.80  
##  1st Qu.:0.0000   1st Qu.:-1.80000   1st Qu.:93.08   1st Qu.:-42.70  
##  Median :0.0000   Median : 1.10000   Median :93.75   Median :-41.80  
##  Mean   :0.1598   Mean   : 0.06446   Mean   :93.57   Mean   :-40.43  
##  3rd Qu.:0.0000   3rd Qu.: 1.40000   3rd Qu.:93.99   3rd Qu.:-36.40  
##  Max.   :4.0000   Max.   : 1.40000   Max.   :94.77   Max.   :-26.90  
##                                                                      
##    euribor3m      nr.employed  
##  Min.   :0.635   Min.   :4964  
##  1st Qu.:1.334   1st Qu.:5099  
##  Median :4.857   Median :5191  
##  Mean   :3.614   Mean   :5166  
##  3rd Qu.:4.961   3rd Qu.:5228  
##  Max.   :5.000   Max.   :5228  
## 
```

```r
vars_con_sub<-vars_con[c(1,2,3,6:10)]
x<-df[,vars_con_sub]
#aq.plot(x, delta=qchisq(0.995, df=ncol(x)) )
```

IMPUTATION:

Factors:

De totes les variables discretes que hem analitzat, hem vist que el "marital" status es podria imputar fàcilment amb imputeMCA(), ja que els unknown (passats prèviament a NA) corresponen només una petita part de la mostra. El mateix fem amb la variable "loan". Com hem vist prèviament, els unknowns han estat considerats categoria pròpia en altres variables.

```r
res.impf<-imputeMCA(df[,vars_dis], ncp=10)
```

```r
# Original:
summary(df$marital)
```

```
## marital-divorced  marital-married   marital-single             NA's
##              554             3046             1376               10
```

```r
summary(df$loan)
```

```
##  loan-no loan-yes     NA's
##     4080      769      137
```

```r
# Amb dades imputades:
summary(res.impf$completeObs$marital)
```

```
## marital-divorced  marital-married   marital-single
##              554             3055             1377
```

```r
summary(res.impf$completeObs$loan)
```

```
##  loan-no loan-yes
##     4217      769
```

```r
# Acceptem la imputació:
df$loan<-res.impf$completeObs[,"marital"]
df$loan<-res.impf$completeObs[,"loan"]
summary(df[,vars_dis])
```

```
##                job                     marital
##  job-admin.     :1231   marital-divorced: 554
##  job-blue-collar:1151   marital-married :3046
##  job-technician : 793   marital-single  :1376
##  job-services   : 498   NA's            :  10
##  job-management : 411
##  job-retired    : 204
##  (Other)        : 698
##                              education                 default
##  education-basic.4y           : 516   default-no     :3954
##  education-basic.6y           : 289   default-unknown:1032
##  education-basic.9y           : 715
##  education-high.school        :1168
##  education-professional.course: 599
##  education-university.degree  :1468
##  education-unknown            : 231
##            housing           loan                    contact
##  housing-no     :2212   loan-no :4217   contact-cellular :3122
##  housing-unknown: 137   loan-yes: 769   contact-telephone:1864
##  housing-yes    :2637
##
##
##
##
##       month               day_of_week                      poutcome
##  month-may:1741   day_of_week-fri: 922   poutcome-failure    : 477
##  month-jul: 829   day_of_week-mon:1016   poutcome-nonexistent:4353
##  month-aug: 697   day_of_week-thu:1034   poutcome-success    : 156
##  month-jun: 652   day_of_week-tue:1043
##  month-nov: 507   day_of_week-wed: 971
```

```
## month-apr: 310
## (Other)  : 250
##      y                f.season              f.age
## y-no :4429   season-spring:2117   f.age-[18,32]:1352
## y-yes: 557   season-summer:2178   f.age-(32,38]:1205
##              season-autumn: 665   f.age-(38,47]:1220
##              season-winter:  26   f.age-(47,87]:1209
##
##
##
##                     f.duration              f.campaign
## f.duration-[5,66]        : 633   f.campaign-[0,2] :3392
## f.duration-(101,138]     : 628   f.campaign-(2,5] :1172
## f.duration-(235,316]     : 626   f.campaign-(5,25]: 413
## f.duration-(482,1.58e+03]: 624   NA's             :   9
## f.duration-(177,235]     : 621
## f.duration-(316,482]     : 620
## (Other)                  :1234
##          f.pdays              f.previous
## f.pdays-[0,7]: 147   f.previous-never:4353
## f.pdays-(>7) :  30   f.previous-1    : 512
## f.pdays-never:4809   f.previous-(>1) : 121
##
##
##
##
##                    f.emp.var.rate                     f.cons.price.idx
## f.emp.var.rate-[-3.4,-1.8]:1495   f.cons.price.idx-[92.2,93.1]:1409
## f.emp.var.rate-(-1.8,-0.1]: 591   f.cons.price.idx-(93.1,93.7]:1086
## f.emp.var.rate-(-0.1,1.1] :1002   f.cons.price.idx-(93.7,94]  :1819
## f.emp.var.rate-(1.1,1.4]  :1898   f.cons.price.idx-(94,94.8]  : 672
##
##
##
##                      f.cons.conf.idx                   f.euribor3m
## f.cons.conf.idx-[-50.8,-42.7]:1856   f.euribor3m-[0.635,1.33]:1254
## f.cons.conf.idx-(-42.7,-41.8]: 967   f.euribor3m-(1.33,4.86] :1466
## f.cons.conf.idx-(-41.8,-36.4]:1231   f.euribor3m-(4.86,4.96] :1130
## f.cons.conf.idx-(-36.4,-26.9]: 932   f.euribor3m-(4.96,5]    :1136
##
##
##
##                           f.nr.employed
## f.nr.employed-[4.96e+03,5.1e+03] :1639
## f.nr.employed-(5.1e+03,5.19e+03] :1003
## f.nr.employed-(5.19e+03,5.23e+03]:2344
##
##
##
##
```

Numeric Variables:

La variable numèrica campaign té certs individus que han estat considerats outliers prèviament. Aquí els imputem mitjaçant la imputació automàtica imputePCA().

```
res.imp<-imputePCA(df[,vars_con], ncp=8)

# Original:
summary(df$campaign)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   1.000   1.000   2.000   2.535   3.000  25.000       9
```

```
# Amb dades imputades:

# Acceptem la imputació:
df$campaign<-res.imp$completeObs[,"campaign"]
summary(df[,vars_con])
```

```
##       age           duration         campaign          pdays
##  Min.   :18.00   Min.   :   5.0   Min.   : 1.000   Min.   :  0.0
##  1st Qu.:32.00   1st Qu.: 101.0   1st Qu.: 1.000   1st Qu.:999.0
##  Median :38.00   Median : 177.0   Median : 2.000   Median :999.0
##  Mean   :40.07   Mean   : 250.6   Mean   : 2.535   Mean   :963.7
##  3rd Qu.:47.00   3rd Qu.: 316.0   3rd Qu.: 3.000   3rd Qu.:999.0
##  Max.   :87.00   Max.   :1580.0   Max.   :25.000   Max.   :999.0
##     previous        emp.var.rate      cons.price.idx  cons.conf.idx
##  Min.   :0.0000   Min.   :-3.40000   Min.   :92.20   Min.   :-50.80
##  1st Qu.:0.0000   1st Qu.:-1.80000   1st Qu.:93.08   1st Qu.:-42.70
##  Median :0.0000   Median : 1.10000   Median :93.75   Median :-41.80
##  Mean   :0.1598   Mean   : 0.06446   Mean   :93.57   Mean   :-40.43
##  3rd Qu.:0.0000   3rd Qu.: 1.40000   3rd Qu.:93.99   3rd Qu.:-36.40
##  Max.   :4.0000   Max.   : 1.40000   Max.   :94.77   Max.   :-26.90
##    euribor3m      nr.employed
##  Min.   :0.635   Min.   :4964
##  1st Qu.:1.334   1st Qu.:5099
##  Median :4.857   Median :5191
##  Mean   :3.614   Mean   :5166
##  3rd Qu.:4.961   3rd Qu.:5228
##  Max.   :5.000   Max.   :5228
```

PROFILING:

CONTINOUS DESCRIPTION - Numeric Target (Duration):

```
pos_duration<-which(names(df)=="duration"); pos_duration
```

```
## [1] 11
```

```
condes(df, num.var=pos_duration, proba = 0.05)
```

```
## $quanti
##               correlation      p.value
## <NA>                   NA           NA
## minutes        1.00000000 0.000000e+00
## pdays         -0.03478274 1.404179e-02
```

```
## euribor3m    -0.03512962 1.311237e-02
## num_outliers -0.04065979 4.085021e-03
## nr.employed  -0.04831097 6.438109e-04
## campaign     -0.07479201 1.241577e-07
##
## $quali
##                          R2       p.value
## f.duration       0.855794028  0.000000e+00
## y                0.164777620 3.759496e-197
## f.campaign       0.006187857  8.807648e-07
## f.cons.conf.idx  0.004067507  1.465565e-04
## f.nr.employed    0.002912867  6.975062e-04
## f.cons.price.idx 0.003246051  1.031905e-03
## month            0.005064462  2.674014e-03
## f.euribor3m      0.002462249  6.473152e-03
## f.season         0.002391458  7.627865e-03
## poutcome         0.001851161  9.887924e-03
## day_of_week      0.002352912  1.942616e-02
## f.pdays          0.001214169  4.846375e-02
## f.emp.var.rate   0.001574759  4.916221e-02
##
## $category
##                                     Estimate       p.value
## f.duration-(482,1.58e+03]          493.613665  0.000000e+00
## y-yes                              148.441504 3.759496e-197
## f.duration-(316,482]               134.394010  8.476109e-56
## f.campaign-(5,25]                   14.794426  2.638343e-06
## season-spring                       17.952283  5.877554e-04
## poutcome-success                    38.359032  5.480212e-03
## f.campaign-[0,2]                    71.765001  7.136472e-03
## f.nr.employed-[4.96e+03,5.1e+03]     9.017147  8.355482e-03
## f.duration-(235,316]                22.169724  9.317648e-03
## f.cons.conf.idx-[-50.8,-42.7]       14.076002  1.238528e-02
## NA                                 132.886872  1.491425e-02
## month-may                            9.867780  1.599295e-02
## f.cons.price.idx-(93.7,94]          11.621760  2.081111e-02
## f.pdays-[0,7]                       16.460640  2.262020e-02
## f.cons.conf.idx-(-41.8,-36.4]       16.349262  2.392080e-02
## month-apr                           27.731238  2.403940e-02
## education-high.school                9.358222  4.228302e-02
## day_of_week-wed                     13.376659  4.495212e-02
## month-nov                          -20.376410  4.421467e-02
## education-university.degree        -14.109465  2.294239e-02
## f.emp.var.rate-(1.1,1.4]           -10.129703  2.036833e-02
## day_of_week-mon                    -15.133836  1.838350e-02
## season-summer                       -3.899443  1.752241e-02
## f.pdays-never                      -27.755294  1.396985e-02
## f.cons.conf.idx-(-36.4,-26.9]      -14.862166  7.024095e-03
## f.cons.conf.idx-(-42.7,-41.8]      -15.563098  4.192506e-03
## NA                                -154.540521  4.085021e-03
## f.euribor3m-(4.96,5]               -19.423787  1.079935e-03
## month-aug                          -28.383026  6.707022e-04
## f.nr.employed-(5.19e+03,5.23e+03]  -16.466612  1.395228e-04
## f.cons.price.idx-(93.1,93.7]       -22.699701  8.027710e-05
```

```
## f.duration-(177,235]              -47.149040  5.572506e-08
## f.duration-(138,177]              -94.204089  1.668437e-27
## f.duration-(101,138]             -131.656740  5.328783e-54
## f.duration-(66,101]              -167.038569  1.102835e-85
## f.duration-[5,66]                -210.128961 1.924209e-141
## y-no                             -148.441504 3.759496e-197
```

```r
#crea un llistat de les quantitatives-> assossiació global:
#     les variables que dóna estan relacionades amb duration.
#     llista les variables que tinguin un p-value per sota del 5%

#crea un llistat de les qualitatives->

##crea un llistat de les categories->
#     #Estimate: unitats que està per sobre la duració global quan el registre pertany a la categoria e

# el p-valor ens diu si l'estimació que f.duration-(484,1.58e+03] sigui 494 per sobre la mitja és per u

tapply(df$duration, df$f.duration, mean) #mitjana de la duració per categoria de la duració
```

```
##        f.duration-[5,66]       f.duration-(66,101]
##                 40.71090                  83.80129
##      f.duration-(101,138]      f.duration-(138,177]
##                119.18312                 156.63577
##      f.duration-(177,235]      f.duration-(235,316]
##                203.69082                 273.00958
##      f.duration-(316,482] f.duration-(482,1.58e+03]
##                385.23387                 744.45353
```

```r
summary(df$duration) #duració global
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     5.0   101.0   177.0   250.6   316.0  1580.0
```

```r
tapply(df$duration, df$y, mean) #mitjana de la duració per categoria de la y
```

```
##     y-no    y-yes
## 217.4563 514.3393
```

```r
oneway.test(df$duration~df$y)
```

```
##
##  One-way analysis of means (not assuming equal variances)
##
## data:  df$duration and df$y
## F = 447.7, num df = 1.00, denom df = 605.83, p-value < 2.2e-16
```

CATEGORICAL DESCRIPTION - Factor (Y, Final Decision):

```r
pos_y<-which(names(df)=="y"); pos_y
```

```
## [1] 21
```

```r
catdes(df, num.var=pos_y, proba = 0.05)
```

```
##
## Link between the cluster variable and the categorical variables (chi-square test)
## =================================================================================
```

```
##                        p.value df
## f.duration       2.794524e-159  7
## f.pdays          9.362887e-100  2
## poutcome          3.053387e-95  2
## f.nr.employed     1.703080e-89  2
## f.euribor3m       5.470503e-79  3
## month             1.690776e-65  9
## f.emp.var.rate    7.969229e-62  3
## f.previous        5.590487e-45  2
## f.cons.price.idx  5.572278e-38  3
## f.cons.conf.idx   4.786677e-23  3
## contact           2.110136e-21  1
## job               8.420857e-16 11
## default           9.768051e-13  1
## f.season          1.176664e-10  3
## f.age             7.936723e-09  3
## education         6.361426e-06  6
## marital           1.452705e-04  3
## f.campaign        1.037416e-03  3
##
## Description of each cluster by the categories
## =============================================
## $`y-no`
##                                                  Cla/Mod    Mod/Cla
## f.pdays=f.pdays-never                           90.64255 98.4195078
## f.nr.employed=f.nr.employed-(5.19e+03,5.23e+03] 94.70990 50.1241815
## f.previous=f.previous-never                     91.01769 89.4558591
## poutcome=poutcome-nonexistent                   91.01769 89.4558591
## f.duration=f.duration-[5,66]                    99.52607 14.2244299
## f.emp.var.rate=f.emp.var.rate-(1.1,1.4]         94.52055 40.5057575
## contact=contact-telephone                       94.31330 39.6929329
## f.duration=f.duration-(66,101]                  98.38449 13.7502822
## f.cons.price.idx=f.cons.price.idx-(93.7,94]     94.11765 38.6543238
## f.nr.employed=f.nr.employed-(5.1e+03,5.19e+03]  96.11167 21.7656356
## f.emp.var.rate=f.emp.var.rate-(-0.1,1.1]        96.10778 21.7430571
## f.cons.conf.idx=f.cons.conf.idx-(-42.7,-41.8]   96.07032 20.9753895
## default=default-unknown                         95.05814 22.1494694
## month=month-may                                 93.33716 36.6899977
## f.euribor3m=f.euribor3m-(4.86,4.96]             94.51327 24.1137954
## f.euribor3m=f.euribor3m-(4.96,5]                94.36620 24.2041093
## f.duration=f.duration-(101,138]                 96.01911 13.6148115
## job=job-blue-collar                             93.74457 24.3621585
## f.euribor3m=f.euribor3m-(1.33,4.86]             92.70123 30.6841273
## f.duration=f.duration-(138,177]                 94.79675 13.1632423
## f.cons.price.idx=f.cons.price.idx-(93.1,93.7]   92.90976 22.7816663
## f.age=f.age-(38,47]                             92.54098 25.4910815
## f.campaign=f.campaign-(5,25]                    94.18886  8.7830210
## education=education-basic.9y                    92.72727 14.9695191
## marital=marital-married                         89.92121 61.8424023
## month=month-jul                                 91.31484 17.0918943
## education=education-basic.6y                    93.07958  6.0736058
## f.season=season-spring                          90.08030 43.0571235
## f.age=f.age-(32,38]                             90.62241 24.6556785
## f.season=season-summer                          89.89899 44.2086250
```

```
## f.age=f.age-(47,87]                              87.17949 23.7976970
## poutcome=poutcome-failure                        85.53459  9.2120117
## education=education-unknown                      82.68398  4.3124859
## f.cons.price.idx=f.cons.price.idx-(94,94.8]      85.41667 12.9600361
## f.campaign=f.campaign-[0,2]                      87.94222 67.3515466
## f.season=season-winter                           65.38462  0.3838338
## month=month-dec                                  65.38462  0.3838338
## education=education-university.degree            86.51226 28.6746444
## f.emp.var.rate=f.emp.var.rate-(-1.8,-0.1]        84.09475 11.2214947
## f.duration=f.duration-(316,482]                  83.87097 11.7407993
## job=job-retired                                  78.92157  3.6351321
## marital=marital-single                           85.68314 26.6200045
## f.age=f.age-[18,32]                              85.35503 26.0555430
## f.pdays=f.pdays-(>7)                             53.33333  0.3612554
## job=job-student                                  70.00000  1.5804922
## month=month-apr                                  78.70968  5.5091443
## f.season=season-autumn                           82.25564 12.3504177
## month=month-sep                                  57.37705  0.7902461
## month=month-mar                                  57.57576  0.8579815
## f.cons.conf.idx=f.cons.conf.idx-(-36.4,-26.9]    81.22318 17.0918943
## default=default-no                               87.20283 77.8505306
## f.previous=f.previous-1                          77.53906  8.9636487
## month=month-oct                                  54.63918  1.1966584
## f.previous=f.previous-(>1)                       57.85124  1.5804922
## contact=contact-cellular                         85.55413 60.3070671
## f.cons.price.idx=f.cons.price.idx-[92.2,93.1]    80.48261 25.6039738
## f.emp.var.rate=f.emp.var.rate-[-3.4,-1.8]        78.59532 26.5296907
## f.pdays=f.pdays-[0,7]                            36.73469  1.2192368
## poutcome=poutcome-success                        37.82051  1.3321291
## f.euribor3m=f.euribor3m-[0.635,1.33]             74.16268 20.9979679
## f.nr.employed=f.nr.employed-[4.96e+03,5.1e+03]   75.96095 28.1101829
## f.duration=f.duration-(482,1.58e+03]             59.13462  8.3314518
##                                                      Global      p.value
## f.pdays=f.pdays-never                            96.4500602 2.410684e-59
## f.nr.employed=f.nr.employed-(5.19e+03,5.23e+03] 47.0116326 2.158488e-37
## f.previous=f.previous-never                      87.3044525 1.438650e-30
## poutcome=poutcome-nonexistent                    87.3044525 1.438650e-30
## f.duration=f.duration-[5,66]                     12.6955475 1.487124e-30
## f.emp.var.rate=f.emp.var.rate-(1.1,1.4]          38.0665864 1.340920e-25
## contact=contact-telephone                        37.3846771 3.447929e-23
## f.duration=f.duration-(66,101]                   12.4147613 7.696941e-22
## f.cons.price.idx=f.cons.price.idx-(93.7,94]      36.4821500 7.057265e-21
## f.nr.employed=f.nr.employed-(5.1e+03,5.19e+03]   20.1163257 1.424235e-19
## f.emp.var.rate=f.emp.var.rate-(-0.1,1.1]         20.0962696 1.574618e-19
## f.cons.conf.idx=f.cons.conf.idx-(-42.7,-41.8]    19.3943041 1.401017e-18
## default=default-unknown                          20.6979543 1.230324e-14
## month=month-may                                  34.9177698 1.726364e-14
## f.euribor3m=f.euribor3m-(4.86,4.96]              22.6634577 1.693548e-13
## f.euribor3m=f.euribor3m-(4.96,5]                 22.7837946 6.639818e-13
## f.duration=f.duration-(101,138]                  12.5952667 1.010774e-11
## job=job-blue-collar                              23.0846370 1.884818e-10
## f.euribor3m=f.euribor3m-(1.33,4.86]              29.4023265 6.796806e-09
## f.duration=f.duration-(138,177]                  12.3345367 5.342775e-08
## f.cons.price.idx=f.cons.price.idx-(93.1,93.7]    21.7809868 4.701642e-07
```

```
## f.age=f.age-(38,47]                             24.4685118  9.135370e-07
## f.campaign=f.campaign-(5,25]                     8.2831929  1.084374e-04
## education=education-basic.9y                    14.3401524  1.876745e-04
## marital=marital-married                         61.0910550  2.314946e-03
## month=month-jul                                 16.6265544  1.093857e-02
## education=education-basic.6y                     5.7962294  1.335614e-02
## f.season=season-spring                          42.4588849  1.562952e-02
## f.age=f.age-(32,38]                             24.1676695  2.153346e-02
## f.season=season-summer                          43.6823105  3.428174e-02
## f.age=f.age-(47,87]                             24.2478941  3.872210e-02
## poutcome=poutcome-failure                        9.5667870  1.986516e-02
## education=education-unknown                      4.6329723  4.270710e-03
## f.cons.price.idx=f.cons.price.idx-(94,94.8]     13.4777377  3.445794e-03
## f.campaign=f.campaign-[0,2]                     68.0304854  3.359672e-03
## f.season=season-winter                           0.5214601  1.657365e-03
## month=month-dec                                  0.5214601  1.657365e-03
## education=education-university.degree           29.4424388  9.565525e-04
## f.emp.var.rate=f.emp.var.rate-(-1.8,-0.1]       11.8531889  1.984797e-04
## f.duration=f.duration-(316,482]                 12.4348175  6.392065e-05
## job=job-retired                                  4.0914561  2.982842e-05
## marital=marital-single                          27.5972724  2.055013e-05
## f.age=f.age-[18,32]                             27.1159246  3.567657e-06
## f.pdays=f.pdays-(>7)                             0.6016847  1.202754e-06
## job=job-student                                  2.0056157  2.508620e-07
## month=month-apr                                  6.2174087  1.047741e-07
## f.season=season-autumn                          13.3373446  5.062563e-08
## month=month-sep                                  1.2234256  3.276634e-10
## month=month-mar                                  1.3237064  7.597160e-11
## f.cons.conf.idx=f.cons.conf.idx-(-36.4,-26.9]   18.6923385  1.352020e-14
## default=default-no                              79.3020457  1.230324e-14
## f.previous=f.previous-1                         10.2687525  7.464256e-15
## month=month-oct                                  1.9454473  8.959508e-18
## f.previous=f.previous-(>1)                       2.4267950  1.002106e-18
## contact=contact-cellular                        62.6153229  3.447929e-23
## f.cons.price.idx=f.cons.price.idx-[92.2,93.1]   28.2591256  3.335427e-29
## f.emp.var.rate=f.emp.var.rate-[-3.4,-1.8]       29.9839551  1.289177e-46
## f.pdays=f.pdays-[0,7]                            2.9482551  6.682675e-54
## poutcome=poutcome-success                        3.1287605  2.946325e-55
## f.euribor3m=f.euribor3m-[0.635,1.33]            25.1504212  3.042037e-70
## f.nr.employed=f.nr.employed-[4.96e+03,5.1e+03]  32.8720417  1.759629e-84
## f.duration=f.duration-(482,1.58e+03]            12.5150421 4.894928e-100
##                                                     v.test
## f.pdays=f.pdays-never                            16.245323
## f.nr.employed=f.nr.employed-(5.19e+03,5.23e+03]  12.778626
## f.previous=f.previous-never                      11.492513
## poutcome=poutcome-nonexistent                    11.492513
## f.duration=f.duration-[5,66]                     11.489650
## f.emp.var.rate=f.emp.var.rate-(1.1,1.4]          10.458406
## contact=contact-telephone                         9.918824
## f.duration=f.duration-(66,101]                    9.603908
## f.cons.price.idx=f.cons.price.idx-(93.7,94]       9.372891
## f.nr.employed=f.nr.employed-(5.1e+03,5.19e+03]    9.050417
## f.emp.var.rate=f.emp.var.rate-(-0.1,1.1]          9.039450
## f.cons.conf.idx=f.cons.conf.idx-(-42.7,-41.8]     8.797336
```

```
## default=default-unknown                              7.712857
## month=month-may                                      7.669524
## f.euribor3m=f.euribor3m-(4.86,4.96]                  7.370998
## f.euribor3m=f.euribor3m-(4.96,5]                     7.186654
## f.duration=f.duration-(101,138]                      6.804960
## job=job-blue-collar                                  6.370444
## f.euribor3m=f.euribor3m-(1.33,4.86]                  5.795870
## f.duration=f.duration-(138,177]                      5.439509
## f.cons.price.idx=f.cons.price.idx-(93.1,93.7]        5.038105
## f.age=f.age-(38,47]                                  4.909404
## f.campaign=f.campaign-(5,25]                         3.870893
## education=education-basic.9y                         3.735055
## marital=marital-married                              3.046536
## month=month-jul                                      2.544655
## education=education-basic.6y                         2.474129
## f.season=season-spring                               2.417454
## f.age=f.age-(32,38]                                  2.298498
## f.season=season-summer                               2.116742
## f.age=f.age-(47,87]                                 -2.067128
## poutcome=poutcome-failure                           -2.328885
## education=education-unknown                         -2.857442
## f.cons.price.idx=f.cons.price.idx-(94,94.8]         -2.924889
## f.campaign=f.campaign-[0,2]                         -2.932757
## f.season=season-winter                              -3.145618
## month=month-dec                                     -3.145618
## education=education-university.degree               -3.303003
## f.emp.var.rate=f.emp.var.rate-(-1.8,-0.1]           -3.720944
## f.duration=f.duration-(316,482]                     -3.997849
## job=job-retired                                     -4.174772
## marital=marital-single                              -4.258828
## f.age=f.age-[18,32]                                 -4.635100
## f.pdays=f.pdays-(>7)                                -4.855183
## job=job-student                                     -5.157057
## month=month-apr                                     -5.318243
## f.season=season-autumn                              -5.449099
## month=month-sep                                     -6.285090
## month=month-mar                                     -6.508368
## f.cons.conf.idx=f.cons.conf.idx-(-36.4,-26.9]       -7.700814
## default=default-no                                  -7.712857
## f.previous=f.previous-1                             -7.776358
## month=month-oct                                     -8.586582
## f.previous=f.previous-(>1)                          -8.834875
## contact=contact-cellular                            -9.918824
## f.cons.price.idx=f.cons.price.idx-[92.2,93.1]      -11.217779
## f.emp.var.rate=f.emp.var.rate-[-3.4,-1.8]          -14.336770
## f.pdays=f.pdays-[0,7]                              -15.457815
## poutcome=poutcome-success                          -15.657639
## f.euribor3m=f.euribor3m-[0.635,1.33]               -17.718064
## f.nr.employed=f.nr.employed-[4.96e+03,5.1e+03]     -19.475855
## f.duration=f.duration-(482,1.58e+03]               -21.231431
##
## $`y-yes`
##                                                      Cla/Mod    Mod/Cla
## f.duration=f.duration-(482,1.58e+03]              40.8653846 45.7809695
```

```
## f.nr.employed=f.nr.employed-[4.96e+03,5.1e+03]  24.0390482 70.7360862
## f.euribor3m=f.euribor3m-[0.635,1.33]             25.8373206 58.1687612
## poutcome=poutcome-success                        62.1794872 17.4147217
## f.pdays=f.pdays-[0,7]                            63.2653061 16.6965889
## f.emp.var.rate=f.emp.var.rate-[-3.4,-1.8]        21.4046823 57.4506284
## f.cons.price.idx=f.cons.price.idx-[92.2,93.1]    19.5173882 49.3716338
## contact=contact-cellular                         14.4458680 80.9694794
## f.previous=f.previous-(>1)                       42.1487603  9.1561939
## month=month-oct                                  45.3608247  7.8994614
## f.previous=f.previous-1                          22.4609375 20.6463196
## default=default-no                               12.7971674 90.8438061
## f.cons.conf.idx=f.cons.conf.idx-(-36.4,-26.9]    18.7768240 31.4183124
## month=month-mar                                  42.4242424  5.0269300
## month=month-sep                                  42.6229508  4.6678636
## f.season=season-autumn                           17.7443609 21.1849192
## month=month-apr                                  21.2903226 11.8491921
## job=job-student                                  30.0000000  5.3859964
## f.pdays=f.pdays-(>7)                             46.6666667  2.5134650
## f.age=f.age-[18,32]                              14.6449704 35.5475763
## marital=marital-single                           14.3168605 35.3680431
## job=job-retired                                  21.0784314  7.7199282
## f.duration=f.duration-(316,482]                  16.1290323 17.9533214
## f.emp.var.rate=f.emp.var.rate-(-1.8,-0.1]        15.9052453 16.8761221
## education=education-university.degree           13.4877384 35.5475763
## f.season=season-winter                           34.6153846  1.6157989
## month=month-dec                                  34.6153846  1.6157989
## f.campaign=f.campaign-[0,2]                      12.0577830 73.4290844
## f.cons.price.idx=f.cons.price.idx-(94,94.8]      14.5833333 17.5942549
## education=education-unknown                      17.3160173  7.1813285
## poutcome=poutcome-failure                        14.4654088 12.3877917
## f.age=f.age-(47,87]                              12.8205128 27.8276481
## f.season=season-summer                           10.1010101 39.4973070
## f.age=f.age-(32,38]                               9.3775934 20.2872531
## f.season=season-spring                            9.9196977 37.7019749
## education=education-basic.6y                      6.9204152  3.5906643
## month=month-jul                                   8.6851628 12.9263914
## marital=marital-married                          10.0787919 55.1166966
## education=education-basic.9y                      7.2727273  9.3357271
## f.campaign=f.campaign-(5,25]                      5.8111380  4.3087971
## f.age=f.age-(38,47]                               7.4590164 16.3375224
## f.cons.price.idx=f.cons.price.idx-(93.1,93.7]     7.0902394 13.8240575
## f.duration=f.duration-(138,177]                   5.2032520  5.7450628
## f.euribor3m=f.euribor3m-(1.33,4.86]               7.2987722 19.2100539
## job=job-blue-collar                               6.2554301 12.9263914
## f.duration=f.duration-(101,138]                   3.9808917  4.4883303
## f.euribor3m=f.euribor3m-(4.96,5]                  5.6338028 11.4901257
## f.euribor3m=f.euribor3m-(4.86,4.96]               5.4867257 11.1310592
## month=month-may                                   6.6628374 20.8258528
## default=default-unknown                           4.9418605  9.1561939
## f.cons.conf.idx=f.cons.conf.idx-(-42.7,-41.8]     3.9296794  6.8222621
## f.emp.var.rate=f.emp.var.rate-(-0.1,1.1]          3.8922156  7.0017953
## f.nr.employed=f.nr.employed-(5.1e+03,5.19e+03]    3.8883350  7.0017953
## f.cons.price.idx=f.cons.price.idx-(93.7,94]       5.8823529 19.2100539
## f.duration=f.duration-(66,101]                    1.6155089  1.7953321
```

```
## contact=contact-telephone                         5.6866953 19.0305206
## f.emp.var.rate=f.emp.var.rate-(1.1,1.4]          5.4794521 18.6714542
## f.duration=f.duration-[5,66]                      0.4739336  0.5385996
## f.previous=f.previous-never                       8.9823110 70.1974865
## poutcome=poutcome-nonexistent                     8.9823110 70.1974865
## f.nr.employed=f.nr.employed-(5.19e+03,5.23e+03]  5.2901024 22.2621185
## f.pdays=f.pdays-never                             9.3574548 80.7899461
##                                                      Global       p.value
## f.duration=f.duration-(482,1.58e+03]             12.5150421 4.894928e-100
## f.nr.employed=f.nr.employed-[4.96e+03,5.1e+03]   32.8720417  1.759629e-84
## f.euribor3m=f.euribor3m-[0.635,1.33]             25.1504212  3.042037e-70
## poutcome=poutcome-success                         3.1287605  2.946325e-55
## f.pdays=f.pdays-[0,7]                             2.9482551  6.682675e-54
## f.emp.var.rate=f.emp.var.rate-[-3.4,-1.8]        29.9839551  1.289177e-46
## f.cons.price.idx=f.cons.price.idx-[92.2,93.1]    28.2591256  3.335427e-29
## contact=contact-cellular                         62.6153229  3.447929e-23
## f.previous=f.previous-(>1)                        2.4267950  1.002106e-18
## month=month-oct                                   1.9454473  8.959508e-18
## f.previous=f.previous-1                          10.2687525  7.464256e-15
## default=default-no                               79.3020457  1.230324e-14
## f.cons.conf.idx=f.cons.conf.idx-(-36.4,-26.9]    18.6923385  1.352020e-14
## month=month-mar                                   1.3237064  7.597160e-11
## month=month-sep                                   1.2234256  3.276634e-10
## f.season=season-autumn                           13.3373446  5.062563e-08
## month=month-apr                                   6.2174087  1.047741e-07
## job=job-student                                   2.0056157  2.508620e-07
## f.pdays=f.pdays-(>7)                              0.6016847  1.202754e-06
## f.age=f.age-[18,32]                              27.1159246  3.567657e-06
## marital=marital-single                           27.5972724  2.055013e-05
## job=job-retired                                   4.0914561  2.982842e-05
## f.duration=f.duration-(316,482]                  12.4348175  6.392065e-05
## f.emp.var.rate=f.emp.var.rate-(-1.8,-0.1]        11.8531889  1.984797e-04
## education=education-university.degree            29.4424388  9.565525e-04
## f.season=season-winter                            0.5214601  1.657365e-03
## month=month-dec                                   0.5214601  1.657365e-03
## f.campaign=f.campaign-[0,2]                      68.0304854  3.359672e-03
## f.cons.price.idx=f.cons.price.idx-(94,94.8]      13.4777377  3.445794e-03
## education=education-unknown                       4.6329723  4.270710e-03
## poutcome=poutcome-failure                         9.5667870  1.986516e-02
## f.age=f.age-(47,87]                              24.2478941  3.872210e-02
## f.season=season-summer                           43.6823105  3.428174e-02
## f.age=f.age-(32,38]                              24.1676695  2.153346e-02
## f.season=season-spring                           42.4588849  1.562952e-02
## education=education-basic.6y                      5.7962294  1.335614e-02
## month=month-jul                                  16.6265544  1.093857e-02
## marital=marital-married                          61.0910550  2.314946e-03
## education=education-basic.9y                     14.3401524  1.876745e-04
## f.campaign=f.campaign-(5,25]                      8.2831929  1.084374e-04
## f.age=f.age-(38,47]                              24.4685118  9.135370e-07
## f.cons.price.idx=f.cons.price.idx-(93.1,93.7]    21.7809868  4.701642e-07
## f.duration=f.duration-(138,177]                  12.3345367  5.342775e-08
## f.euribor3m=f.euribor3m-(1.33,4.86]              29.4023265  6.796806e-09
## job=job-blue-collar                              23.0846370  1.884818e-10
## f.duration=f.duration-(101,138]                  12.5952667  1.010774e-11
```

```
## f.euribor3m=f.euribor3m-(4.96,5]              22.7837946  6.639818e-13
## f.euribor3m=f.euribor3m-(4.86,4.96]           22.6634577  1.693548e-13
## month=month-may                               34.9177698  1.726364e-14
## default=default-unknown                       20.6979543  1.230324e-14
## f.cons.conf.idx=f.cons.conf.idx-(-42.7,-41.8]  19.3943041  1.401017e-18
## f.emp.var.rate=f.emp.var.rate-(-0.1,1.1]      20.0962696  1.574618e-19
## f.nr.employed=f.nr.employed-(5.1e+03,5.19e+03] 20.1163257  1.424235e-19
## f.cons.price.idx=f.cons.price.idx-(93.7,94]   36.4821500  7.057265e-21
## f.duration=f.duration-(66,101]                12.4147613  7.696941e-22
## contact=contact-telephone                     37.3846771  3.447929e-23
## f.emp.var.rate=f.emp.var.rate-(1.1,1.4]       38.0665864  1.340920e-25
## f.duration=f.duration-[5,66]                  12.6955475  1.487124e-30
## f.previous=f.previous-never                   87.3044525  1.438650e-30
## poutcome=poutcome-nonexistent                 87.3044525  1.438650e-30
## f.nr.employed=f.nr.employed-(5.19e+03,5.23e+03] 47.0116326  2.158488e-37
## f.pdays=f.pdays-never                         96.4500602  2.410684e-59
##                                                  v.test
## f.duration=f.duration-(482,1.58e+03]           21.231431
## f.nr.employed=f.nr.employed-[4.96e+03,5.1e+03]  19.475855
## f.euribor3m=f.euribor3m-[0.635,1.33]           17.718064
## poutcome=poutcome-success                      15.657639
## f.pdays=f.pdays-[0,7]                          15.457815
## f.emp.var.rate=f.emp.var.rate-[-3.4,-1.8]      14.336770
## f.cons.price.idx=f.cons.price.idx-[92.2,93.1]   11.217779
## contact=contact-cellular                        9.918824
## f.previous=f.previous-(>1)                      8.834875
## month=month-oct                                 8.586582
## f.previous=f.previous-1                         7.776358
## default=default-no                              7.712857
## f.cons.conf.idx=f.cons.conf.idx-(-36.4,-26.9]    7.700814
## month=month-mar                                 6.508368
## month=month-sep                                 6.285090
## f.season=season-autumn                          5.449099
## month=month-apr                                 5.318243
## job=job-student                                 5.157057
## f.pdays=f.pdays-(>7)                            4.855183
## f.age=f.age-[18,32]                             4.635100
## marital=marital-single                          4.258828
## job=job-retired                                 4.174772
## f.duration=f.duration-(316,482]                 3.997849
## f.emp.var.rate=f.emp.var.rate-(-1.8,-0.1]       3.720944
## education=education-university.degree           3.303003
## f.season=season-winter                          3.145618
## month=month-dec                                 3.145618
## f.campaign=f.campaign-[0,2]                     2.932757
## f.cons.price.idx=f.cons.price.idx-(94,94.8]     2.924889
## education=education-unknown                     2.857442
## poutcome=poutcome-failure                       2.328885
## f.age=f.age-(47,87]                             2.067128
## f.season=season-summer                         -2.116742
## f.age=f.age-(32,38]                            -2.298498
## f.season=season-spring                         -2.417454
## education=education-basic.6y                   -2.474129
## month=month-jul                                -2.544655
```

```
## marital=marital-married                            -3.046536
## education=education-basic.9y                       -3.735055
## f.campaign=f.campaign-(5,25]                       -3.870893
## f.age=f.age-(38,47]                                -4.909404
## f.cons.price.idx=f.cons.price.idx-(93.1,93.7]      -5.038105
## f.duration=f.duration-(138,177]                    -5.439509
## f.euribor3m=f.euribor3m-(1.33,4.86]                -5.795870
## job=job-blue-collar                                -6.370444
## f.duration=f.duration-(101,138]                    -6.804960
## f.euribor3m=f.euribor3m-(4.96,5]                   -7.186654
## f.euribor3m=f.euribor3m-(4.86,4.96]                -7.370998
## month=month-may                                    -7.669524
## default=default-unknown                            -7.712857
## f.cons.conf.idx=f.cons.conf.idx-(-42.7,-41.8]      -8.797336
## f.emp.var.rate=f.emp.var.rate-(-0.1,1.1]           -9.039450
## f.nr.employed=f.nr.employed-(5.1e+03,5.19e+03]     -9.050417
## f.cons.price.idx=f.cons.price.idx-(93.7,94]        -9.372891
## f.duration=f.duration-(66,101]                     -9.603908
## contact=contact-telephone                          -9.918824
## f.emp.var.rate=f.emp.var.rate-(1.1,1.4]           -10.458406
## f.duration=f.duration-[5,66]                      -11.489650
## f.previous=f.previous-never                       -11.492513
## poutcome=poutcome-nonexistent                     -11.492513
## f.nr.employed=f.nr.employed-(5.19e+03,5.23e+03] -12.778626
## f.pdays=f.pdays-never                             -16.245323
##
##
## Link between the cluster variable and the quantitative variables
## ================================================================
##                        Eta2       P-value
## duration       0.164777620 3.759496e-197
## minutes        0.164777620 3.759496e-197
## nr.employed    0.121012601 8.238443e-142
## pdays          0.090100788 2.433135e-104
## euribor3m      0.090010720 3.115343e-104
## emp.var.rate   0.085417483  8.992557e-99
## previous       0.042523921  5.101307e-49
## cons.price.idx 0.018386453  6.794885e-22
## cons.conf.idx  0.004669195  1.369222e-06
## campaign       0.004489049  2.189052e-06
## <NA>                    NA            NA
##
## Description of each cluster by quantitative variables
## =====================================================
## $`y-no`
##                    v.test Mean in category  Overall mean sd in category
## nr.employed     24.561104      5175.3298261 5166.47621340     64.3842715
## pdays           21.193217       983.3030029  963.73706378    123.8692868
## euribor3m       21.182621         3.7992890    3.61448034      1.6425449
## emp.var.rate    20.635071         0.2287424    0.06446049      1.4946001
## cons.price.idx   9.573739        93.6004884   93.57245006      0.5619158
## campaign         4.730529         2.5940750    2.53512998      2.5654605
## cons.conf.idx   -4.824514       -40.5398961  -40.42591256      4.4454152
## previous       -14.559593         0.1255362    0.15984757      0.4004406
```

```
## duration       -28.660364      217.4563107  250.62194144    191.6321071
## minutes        -28.660364        3.6242718    4.17703236      3.1938685
##                  Overall sd       p.value
## nr.employed     71.7679377 3.291367e-133
## pdays          183.8068310  1.102990e-99
## euribor3m        1.7370025  1.381286e-99
## emp.var.rate     1.5850448  1.329502e-94
## cons.price.idx   0.5830800  1.031083e-21
## campaign         2.4808187  2.239350e-06
## cons.conf.idx    4.7037753  1.403451e-06
## previous         0.4691873  5.075919e-48
## duration       230.3904064 1.190744e-180
## minutes          3.8398401 1.190744e-180
##
## $`y-yes`
##                    v.test Mean in category  Overall mean sd in category
## minutes         28.660364         8.572322    4.17703236      5.3967235
## duration        28.660364       514.339318  250.62194144    323.8034093
## previous        14.559593         0.432675    0.15984757      0.7821222
## cons.conf.idx    4.824514       -39.519569  -40.42591256      6.3242738
## campaign        -4.730529         2.066427    2.53512998      1.5845655
## cons.price.idx  -9.573739        93.349503   93.57245006      0.6904449
## emp.var.rate   -20.635071        -1.241831    0.06446049      1.6751620
## euribor3m      -21.182621         2.144969    3.61448034      1.7676126
## pdays          -21.193217       808.157989  963.73706378    391.3731388
## nr.employed    -24.561104      5096.076481 5166.47621340     86.9764988
##                  Overall sd       p.value
## minutes          3.8398401 1.190744e-180
## duration       230.3904064 1.190744e-180
## previous         0.4691873  5.075919e-48
## cons.conf.idx    4.7037753  1.403451e-06
## campaign         2.4808187  2.239350e-06
## cons.price.idx   0.5830800  1.031083e-21
## emp.var.rate     1.5850448  1.329502e-94
## euribor3m        1.7370025  1.381286e-99
## pdays          183.8068310  1.102990e-99
## nr.employed     71.7679377 3.291367e-133
```

```
# $`y-yes`
#                                         Cla/Mod    Mod/Cla Global      p.value     v.test
# f.duration=f.duration-(483,1.58e+03]  40.8064516 44.7787611  12.40 2.180784e-97  20.942837
# poutcome=poutcome-success             62.2641509 17.5221239   3.18 5.331532e-56  15.766007
# f.pdays=f.pdays-[0,6]                 62.2222222 14.8672566   2.70 2.653287e-47  14.446089
# contact=contact-cellular              14.5686901 80.7079646  62.60 6.688527e-23   9.852462

# df: degrees of freedom, #categories - 1

# Dins el cluster que s'ha acceptat el producte financer, la "durada(483 a 1580]" és el 44,778% dels va

# Es donen per ordre d'importància (p-value), per cal interpretar les diferències a ull i veure quines p
```