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/ADEIpractica"
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)
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
##
```

Inicialitzacio 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):

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

VARIABLES QUALITATIVE:

TambÃ© factoritzem aqui les categories (levels) de les variables qualitatives (discretes). Les etiquetes adicionals als factors s'afegeixen posteriorment als grafics per una questio estetica, es redueix la mida de les

etiquetes i es poden veure amb mes claredad cada una de les variables.

Job

Jobs "unknown" son considerats com a categoria.

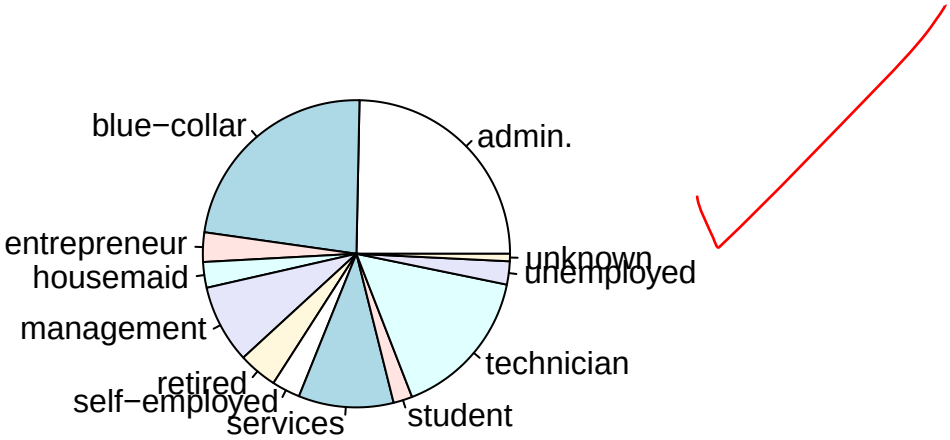
```
# Jobs "unknown" will be considered a category, not a missing value.
table(df$job, useNA="always")
```

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




```
levels(df$job)<-paste0("job-",levels(df$job))
```

Marital

Els "unknowns" seran imputats mes endavant automaticament.

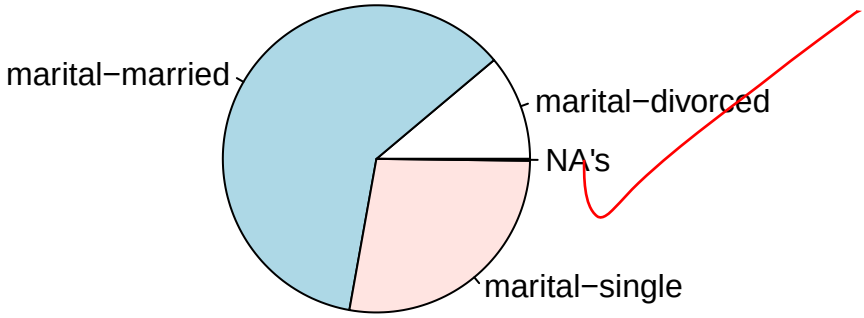
```
# Marital "unknown" will be a missing value (set to NA):
sel<-which(df$marital=="unknown");length(sel)
```

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




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

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

Education

Education "unknown" es considerada com a categoria. La categoria "illiterate" Ã©s 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
```

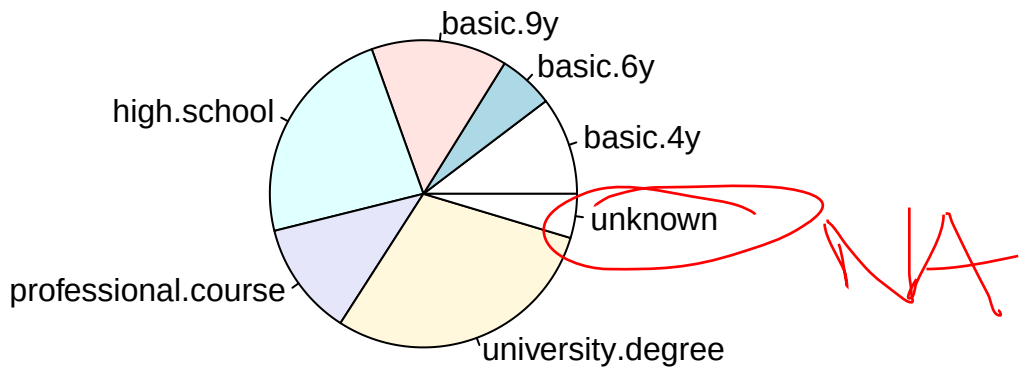
```
# Illiterates are consired as basic.4y.educated:
sel<-which(df$education=="illiterate");length(sel)
```

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

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

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

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

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




```
levels(df$education)<-paste0("education-",levels(df$education))
```

Default (has credit in default?)

Default "unknown" sera considerada com a una categoria, no com a missing value.

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

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

```
# Missings:
miss<-which(is.na(df$default));
missings$default<-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 "default-":
df$default<-factor(df$default)
summary(df$default)
```

```
##      no unknown
##    3966    1034
```

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

Housing

Housing "unknown" sera considerada com a una categoria, no com a missing value.

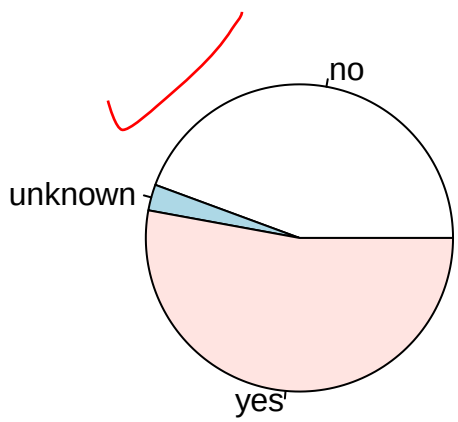
```r
table(df$housing, useNA="always")
```

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




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

Loan (has personal loan?)

Loan "unknown" sera considerat com a missing value (NA) sera imputat mes endavant automaticament.

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

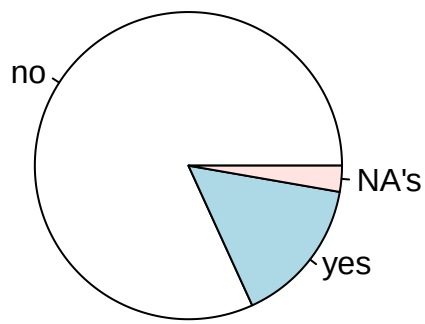
```
## [1] 137
```

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

# Missings:
```

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

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

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




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

Contact

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

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

```r
# Missings:
miss<-which(is.na(df$contact));
missings$contact<-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 "contact-":
df$contact<-factor(df$contact)
summary(df$contact)
```

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

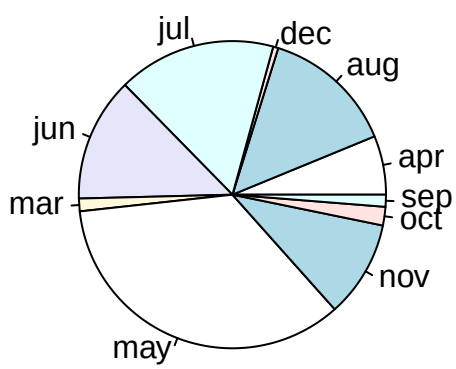
```r
levels(df$contact)<-paste0("contact-",levels(df$contact))
```

Month

```r
miss<-which(is.na(df$month));
missings$month<-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 "month-":
df$month<-factor(df$month)
pie(summary(df$month))
```




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

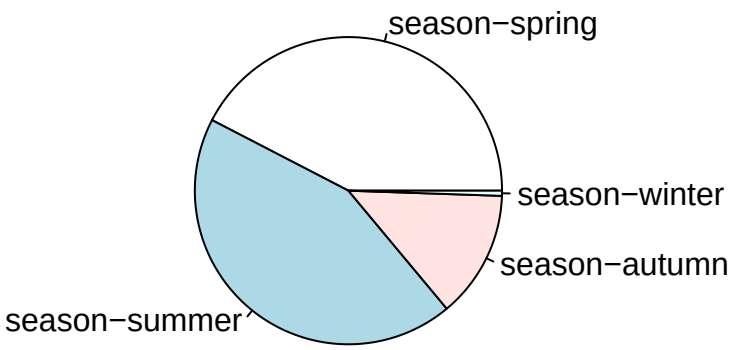
Month -> definim noves factor categories per Season.

(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
```

```r
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", "season-winter"))

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

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



Day_of_week

```r
miss<-which(is.na(df$day_of_week));
missings$day_of_week<-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 "day_of_week-":
df$day_of_week<-factor(df$day_of_week)
summary(df$day_of_week)
```

```
##  fri  mon  thu  tue  wed
##  924 1018 1039 1045  974
```

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

Poutcome (outcome of previous marketing campaign)

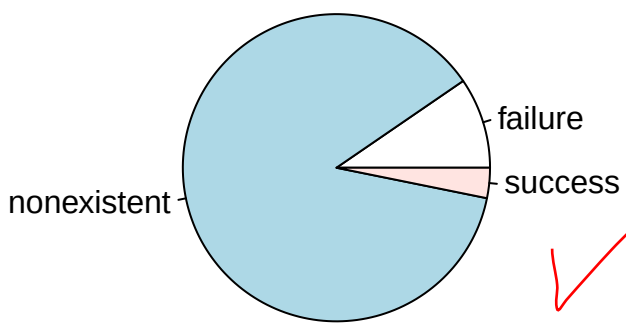
```r
# Poutcome "nonexistent" will be considered a category, not a missing value.
table(df$poutcome, useNA="always")
```

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

```r
# All missing data indicated as NA:
miss<-which(is.na(df$poutcome));
missings$poutcome<-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 "poutcome-":
df$poutcome<-factor(df$poutcome)
pie(summary(df$poutcome))
```




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

y (has the client subscribed a term deposit?)

```r
miss<-which(is.na(df$y));
missings$y<-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 "y-":
df$y<-factor(df$y)
summary(df$y)
```

```
##   no  yes
## 4435  565
```

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

VARIABLES QUANTITATIVES:

Funcio de gran utilitat per a la deteccio d'outliers:

```r
calcQ <- function(x){
  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

```r
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
```

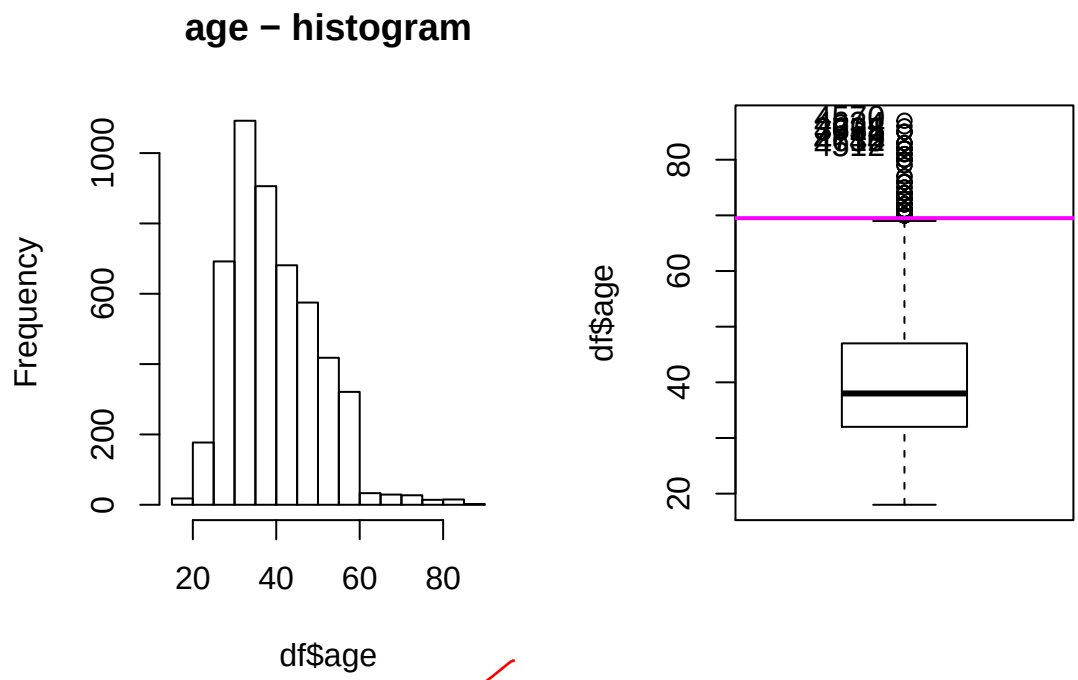
```r
# Errors are under aged people:
err<-which(df$age < 18)
errors$age<-length(err); length(err)
```

```
## [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)
```




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

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

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

Duration

Els outliers en la variable duracio 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 segons (26 minuts).

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

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

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

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

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

par(mfrow=c(1,2))
```

```r
hist(df$duration, breaks=20, main="duration - histogram")
Boxplot(df$duration)
```

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

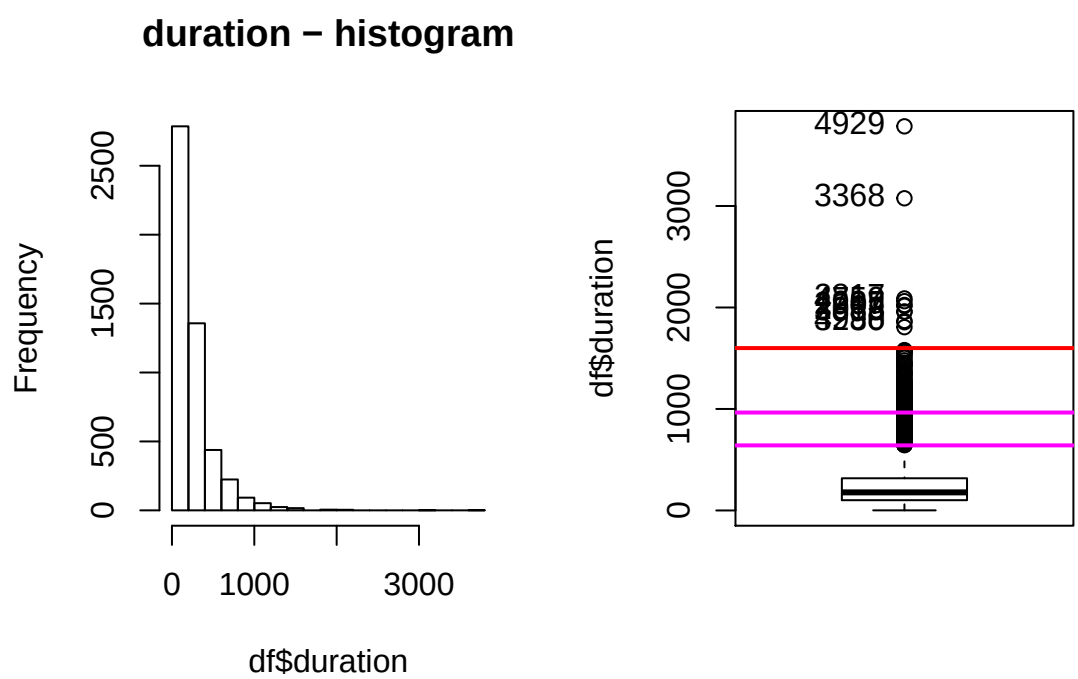
```r
# Outliers:
out.var <- calcQ(df$duration)
abline(h=out.var[["mouts"]], col="magenta", lwd=2); out.var[["mouts"]]
```

```
## 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$duration)
# Boxplot(df$duration)
```

Duration -> creem una columna de duracio 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$campaign)
# No tenim cap missing NA!
miss<-which(is.na(df$campaign));
missings$campaign<-length(miss); length(miss)
```

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

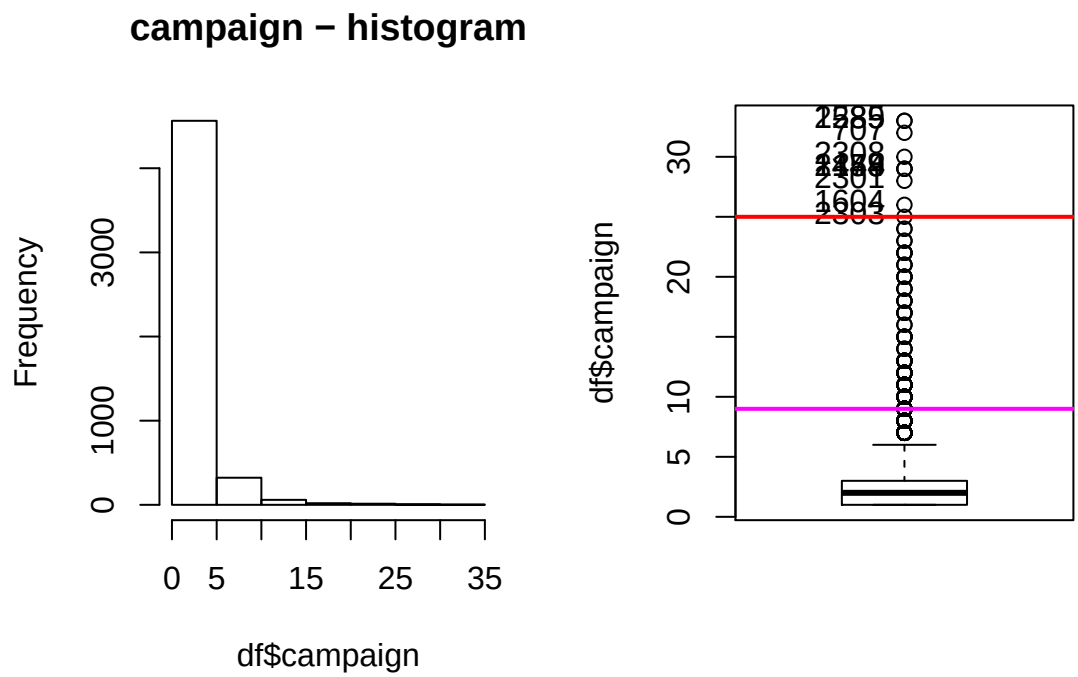
```r
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

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)
```




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

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

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

# Final summary of campaign variable:
# par(mfrow=c(1,1))
# summary(df$campaign)
# Boxplot(df$campaign)
```

Pdays

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

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

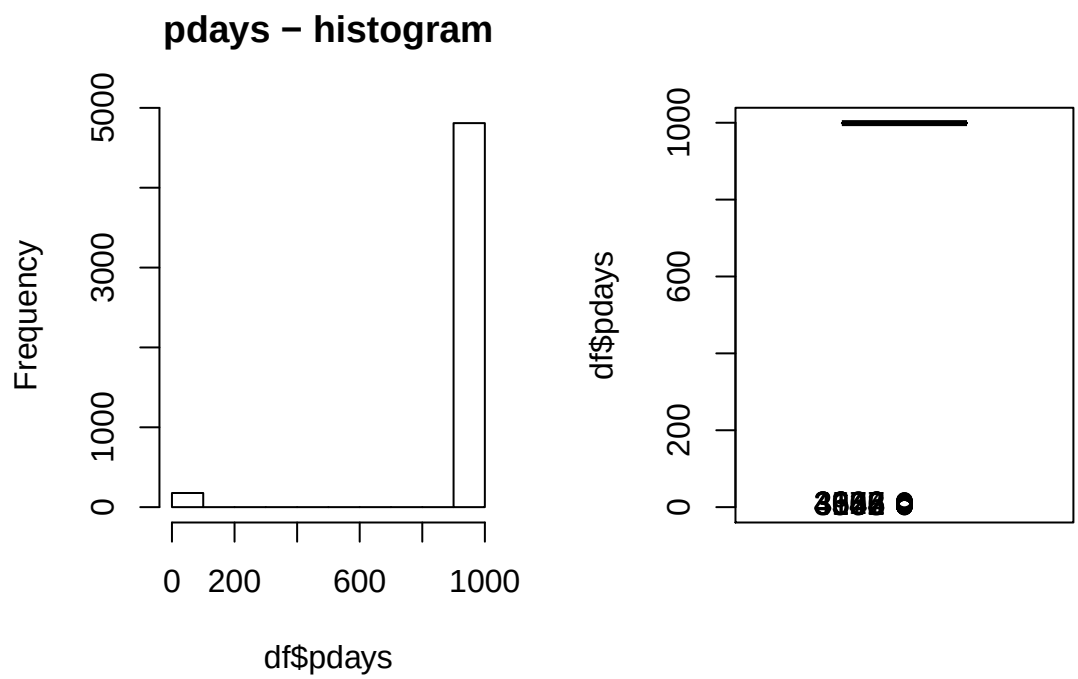
```
df[miss, "num_missings"]<- df[miss, "num_missings"]+1

# Values that are 999 mean never contacted before:
never<-which(df$pdays==999)

# They correspond to this percentage of rows:
length(never)/5000*100
```

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

```r
# No outliers!

# Final summary of pdays variable:
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)
```

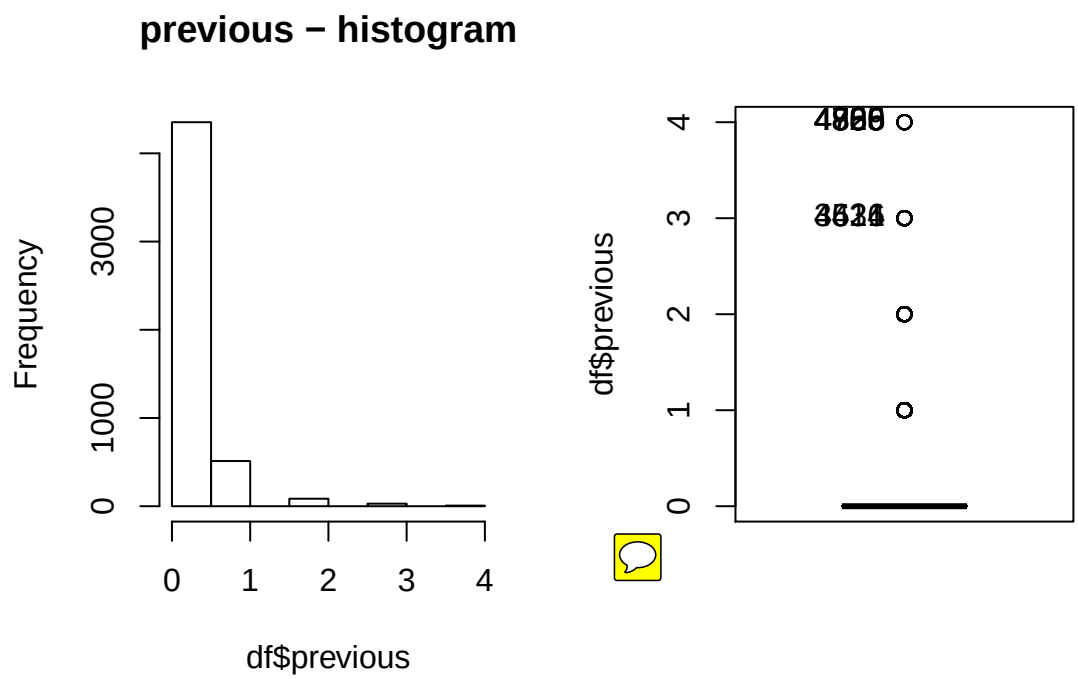
```
## [1] 0
```

```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)
```



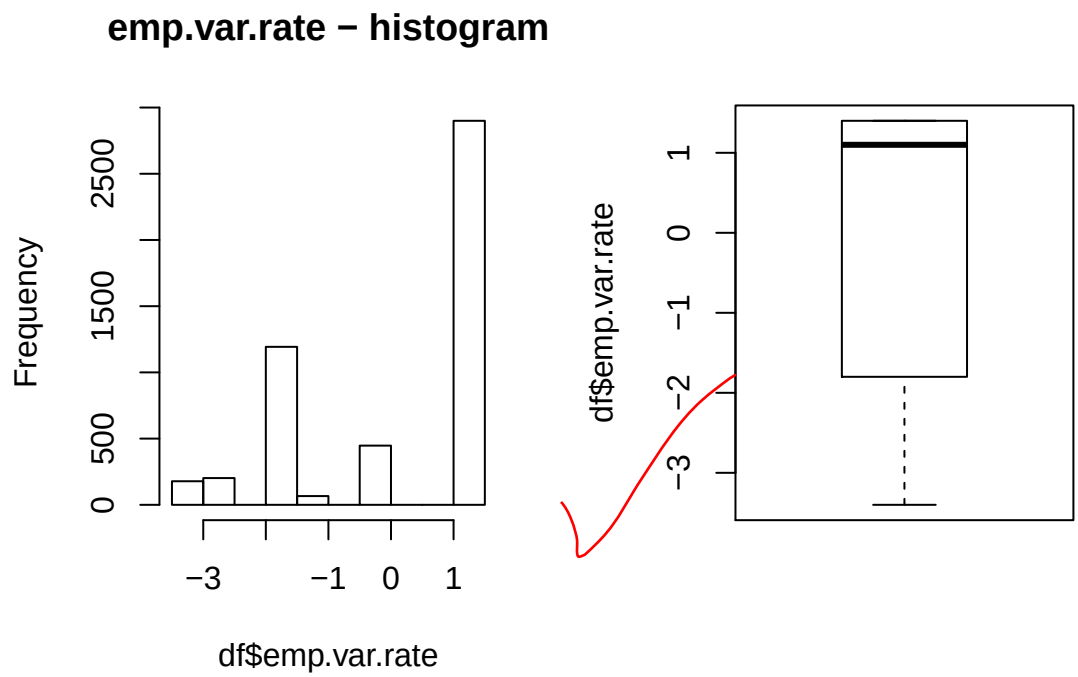

```
##  [1] 4769 4786 4805 4826 4850 4888 4925 3431 4516 4624
```

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)
```

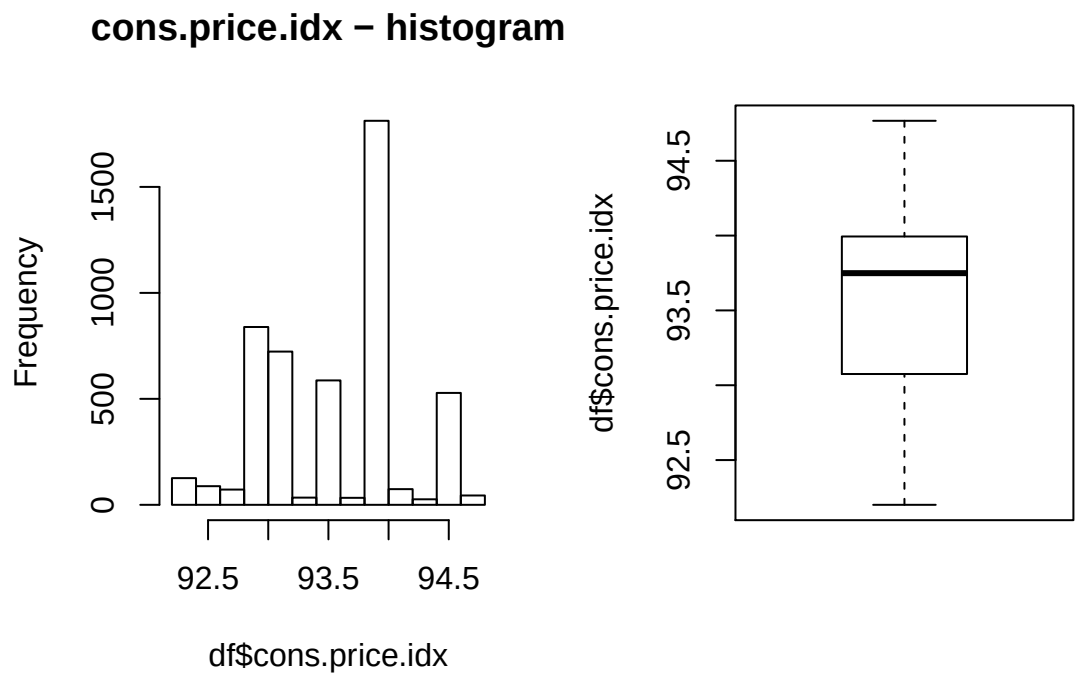


cons.price.idx

```
# 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)
```

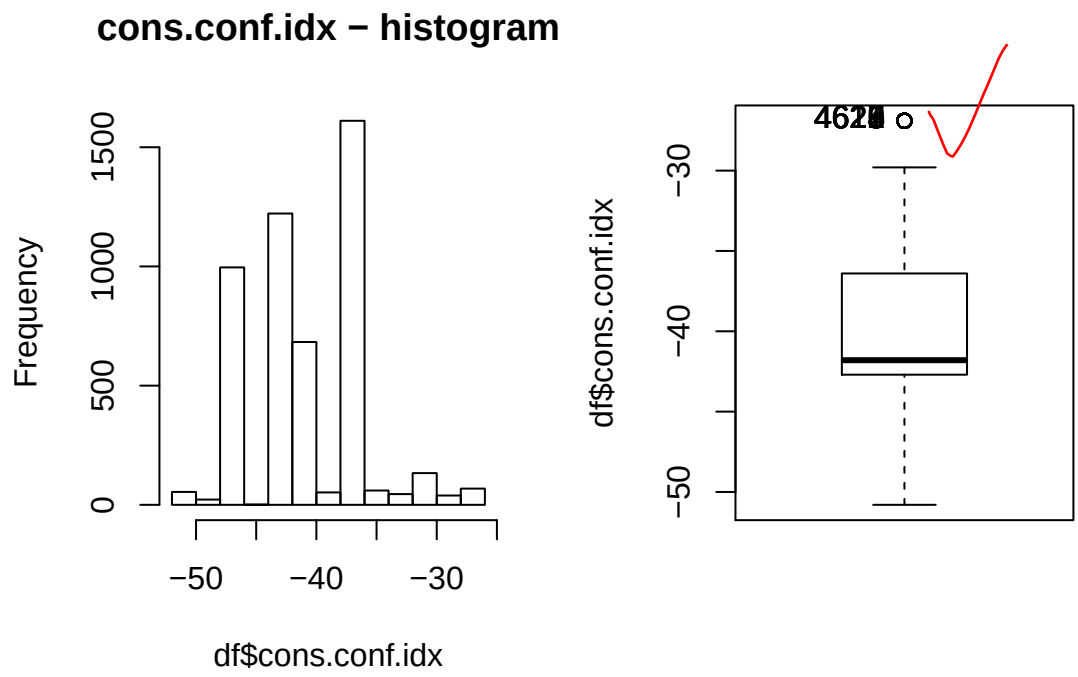


cons.conf.idx

```
# 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)
```



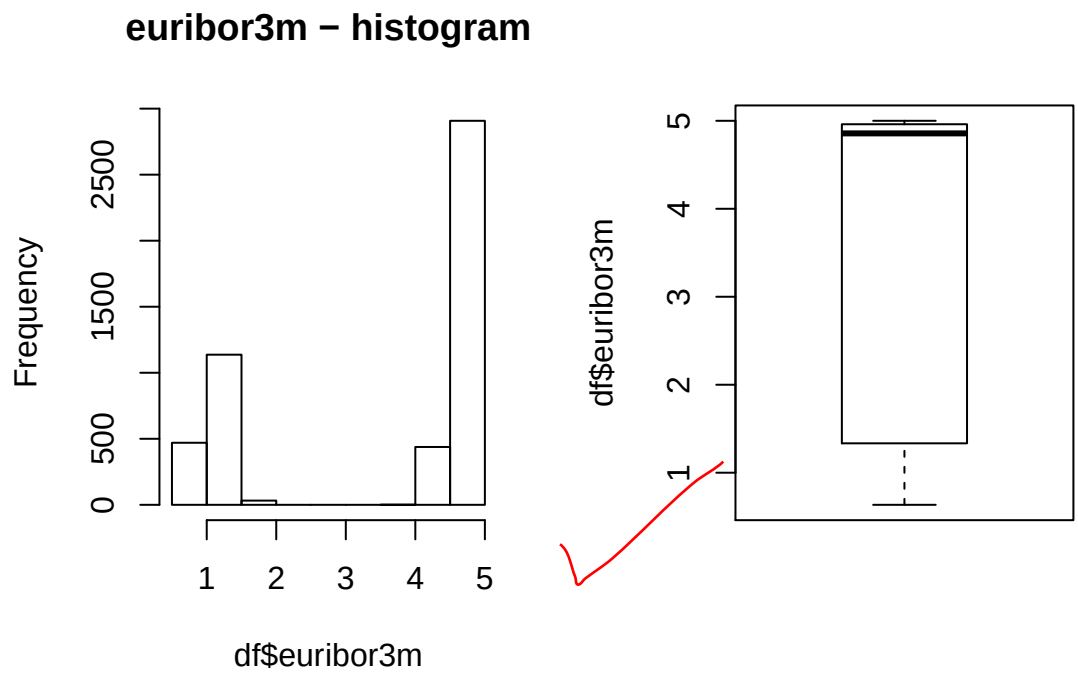

```
##  [1] 4617 4618 4619 4620 4621 4622 4623 4624 4625 4626
```

euribor3m

```r
# 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
```

```r
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)
```

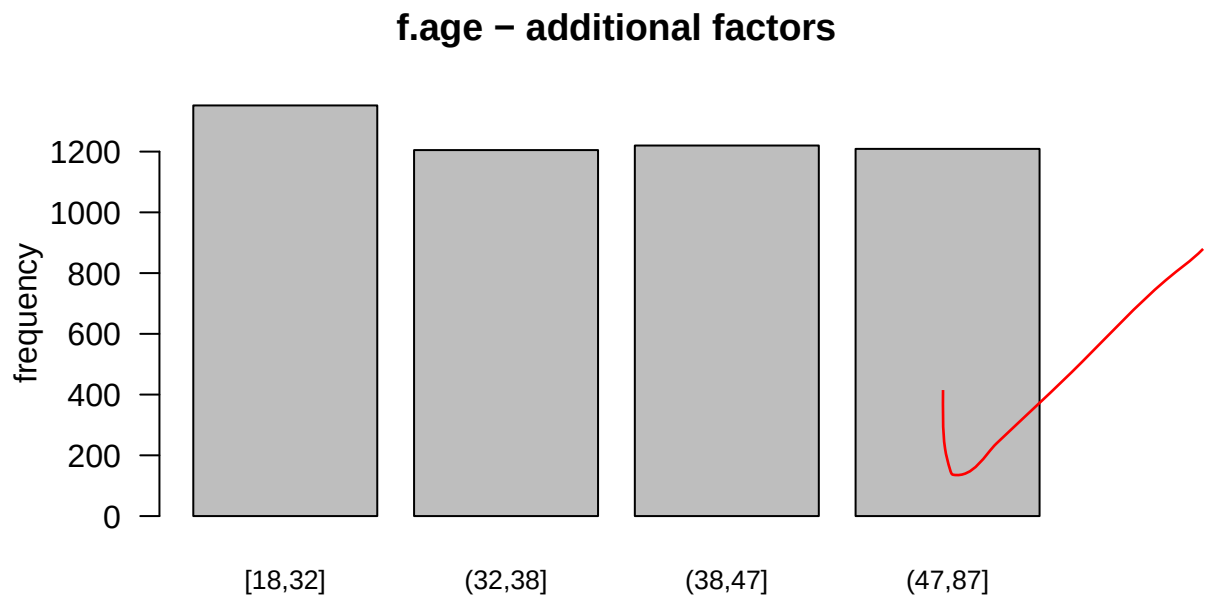
```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    4964    5099    5191    5166    5228    5228
```

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

DISCRETITZACIO DE VARIABLES NUMERIQUES:

Les variables numeriques originals que corresponen a conceptes quantitatius reals es mantenen com a numeriques, pero tambe s'han de crear factors addicionals com a discretitzacio de cada variable numerica. Les etiquetes adicionals als factors s'afegeixen posterior als grafics per una questio estetica, es redueix la mida de les etiquetes i es poden veure amb mes claredad cada una de les variables.

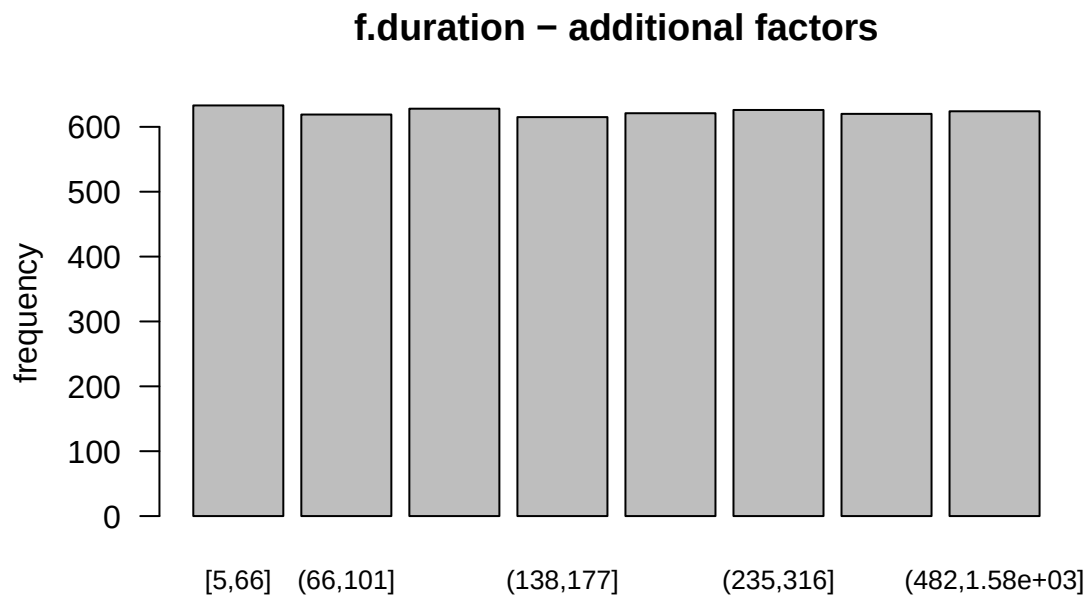
```
par(mfrow=c(1,1))

# 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) )

# Es mostra una distribucio d'edats equitativa amb aquesta factoritzacio:
barplot(table(df$f.age), main="f.age - additional factors", ylab="frequency", las=1, cex.names=0.8)
```




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

```
## [18,32] (32,38] (38,47] (47,87]
##    1352    1205    1220    1209
```

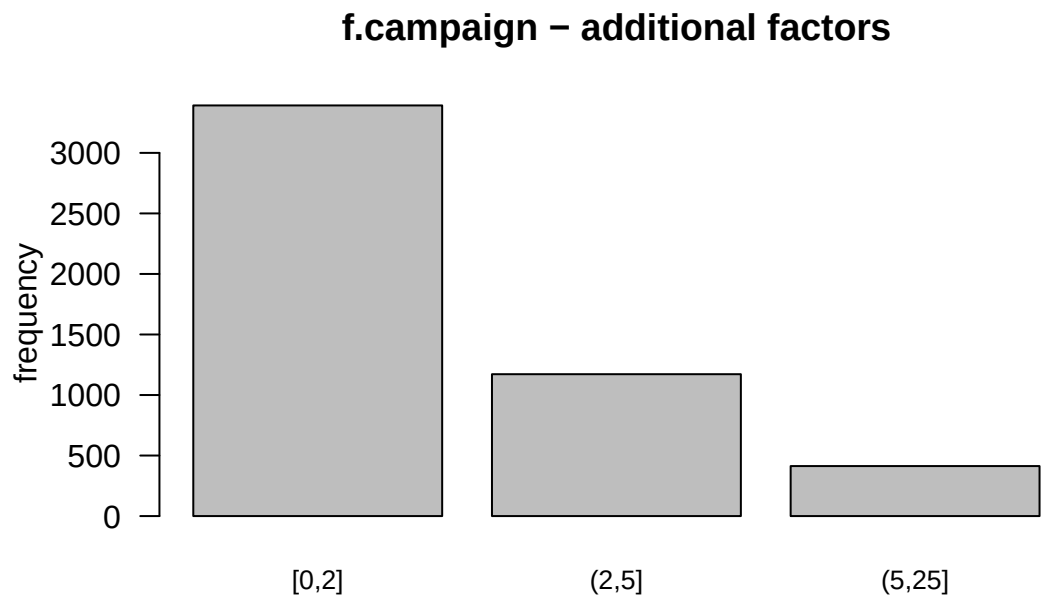
```r
levels(df$f.age)<-paste0("f.age-", levels(df$f.age) )


# 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) )

# Es mostra una distribucio de duracions de la trucada equitativa amb aquesta factoritzacio:
barplot(table(df$f.duration), main="f.duration - additional factors", ylab="frequency", las=1, cex.name
```




```r
levels(df$f.duration)<-paste0("f.duration-", levels(df$f.duration) )
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
```

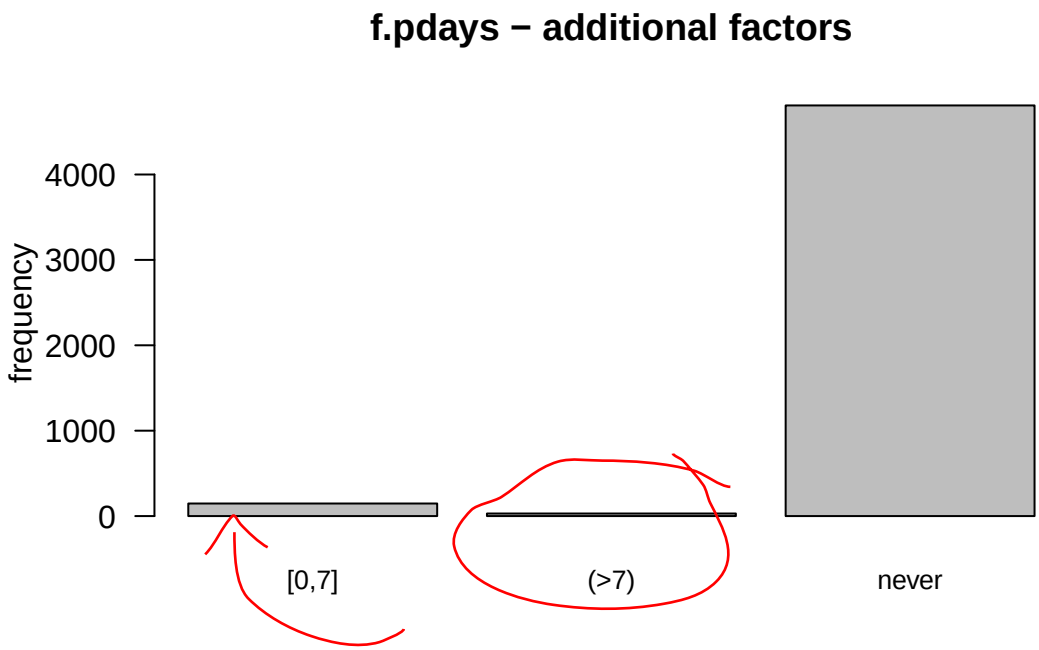
```r
# CAMPAIGN
qulist<-quantile(df$campaign, seq(0,1,0.5), na.rm=TRUE)

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

# Resultat de la factoritzacio de cops que s'ha contactat al client en la campanya actual:
barplot(table(df$f.campaign), main="f.campaign - additional factors", ylab="frequency", las=1, cex.name
```




```r
levels(df$f.campaign)<-paste0("f.campaign-", levels(df$f.campaign) )
summary(df$f.campaign)
```

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

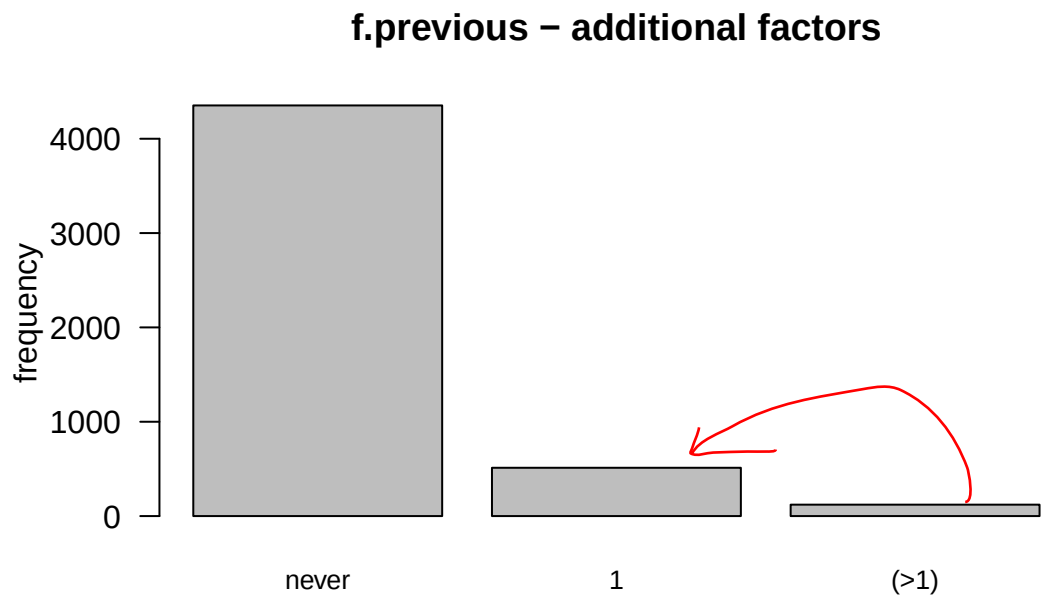
```r
# PDAYS
df$f.pdays<-factor( cut(df$pdays, breaks=c(0, 7, 998, 999), include.lowest=T) )


# Resultat de la factoritzacio dels dies que fa
# que s'ha contactat al client en una altra campanya:
levels(df$f.pdays)<-c("[0,7]", "(>7)", "never")
barplot(table(df$f.pdays), main="f.pdays - additional factors", ylab="frequency", las=1, cex.names=0.8)
```




```
levels(df$f.pdays)<-paste0("f.pdays-", levels(df$f.pdays) )
summary(df$f.pdays)
```

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

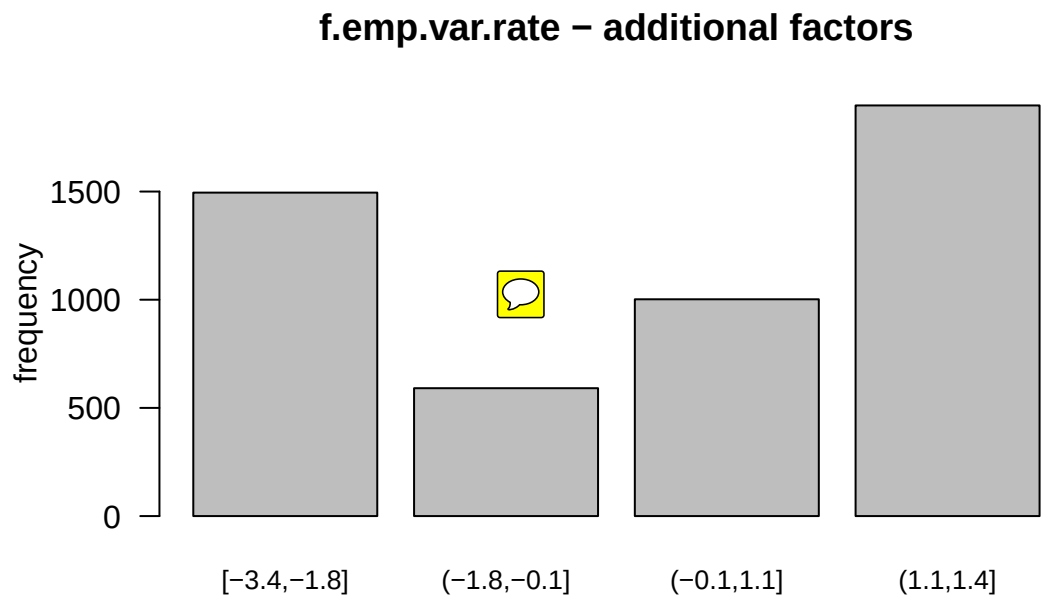
```
# PREVIOUS
df$f.previous<-factor( cut(df$previous, breaks=c(-Inf, 0, 1, +Inf), include.lowest=T) )

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

# Resultat de la factoritzacio de number of contacts performed
# before this campaign and for this client:
barplot(table(df$f.previous), main="f.previous - additional factors", ylab="frequency", las=1, cex.names
```




```
levels(df$f.previous)<-paste0("f.previous-", levels(df$f.previous) )
summary(df$f.previous)
```

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

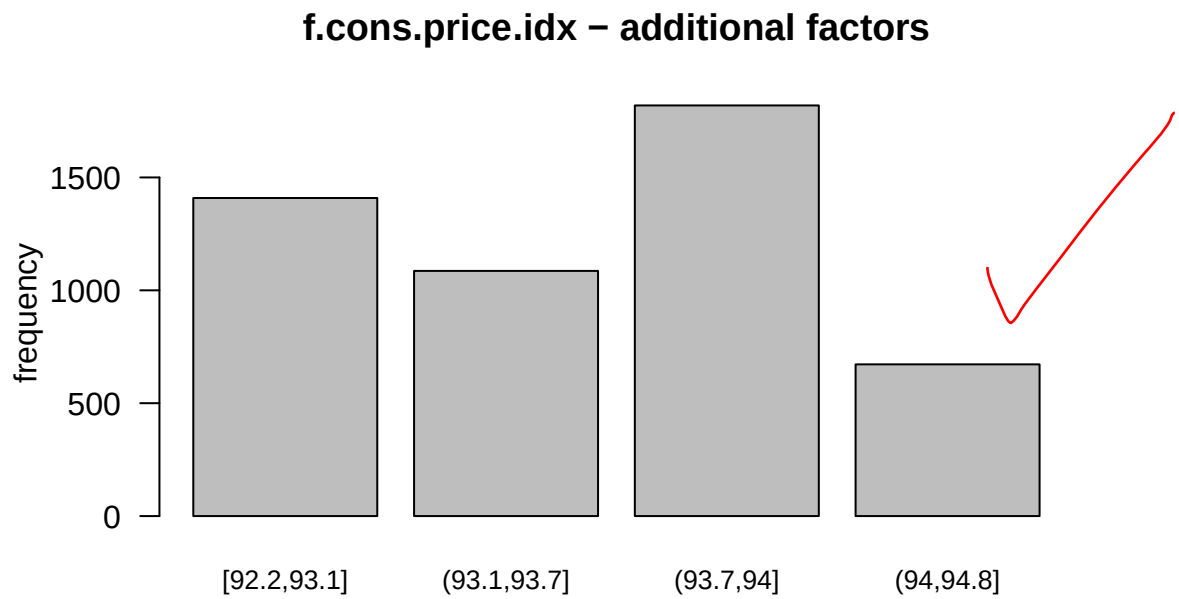
```
# EMP.VAR.RATE
qulist<-quantile(df$emp.var.rate, seq(0,1,0.125), na.rm=TRUE)

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

barplot(table(df$f.emp.var.rate), main="f.emp.var.rate - additional factors", ylab="frequency", las=1, c
```




```
levels(df$f.emp.var.rate)<-paste0("f.emp.var.rate-", levels(df$f.emp.var.rate) )
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
```

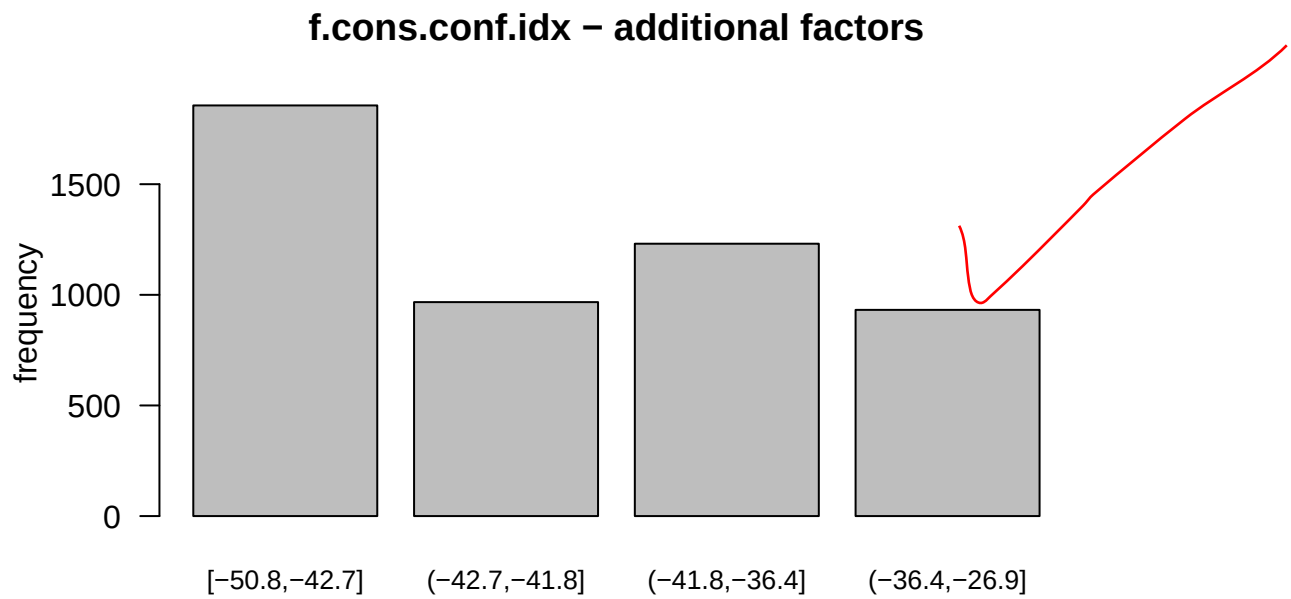
```
# CONS.PRICE.IDX
qulist<-quantile(df$cons.price.idx, seq(0,1,0.25), na.rm=TRUE)

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

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




```
levels(df$f.cons.price.idx)<-paste0("f.cons.price.idx-", levels(df$f.cons.price.idx) )
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
```

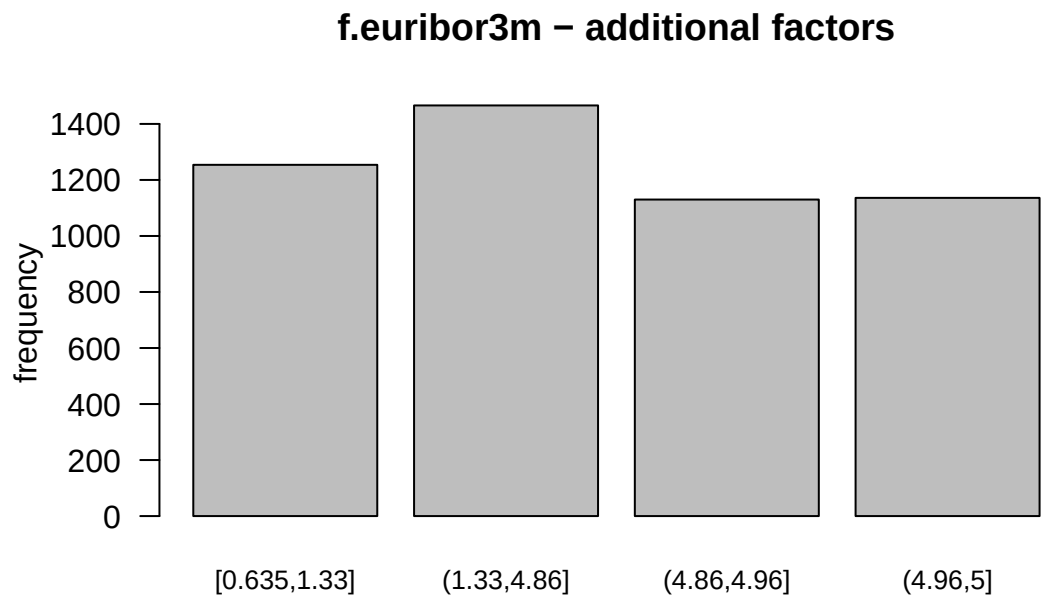
```
# CONS.CONF.IDX
qulist<-quantile(df$cons.conf.idx, seq(0,1,0.25), na.rm=TRUE)

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

barplot(table(df$f.cons.conf.idx), main="f.cons.conf.idx - additional factors", ylab="frequency", las=1
```




```
levels(df$f.cons.conf.idx)<-paste0("f.cons.conf.idx-", levels(df$f.cons.conf.idx) )
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
```

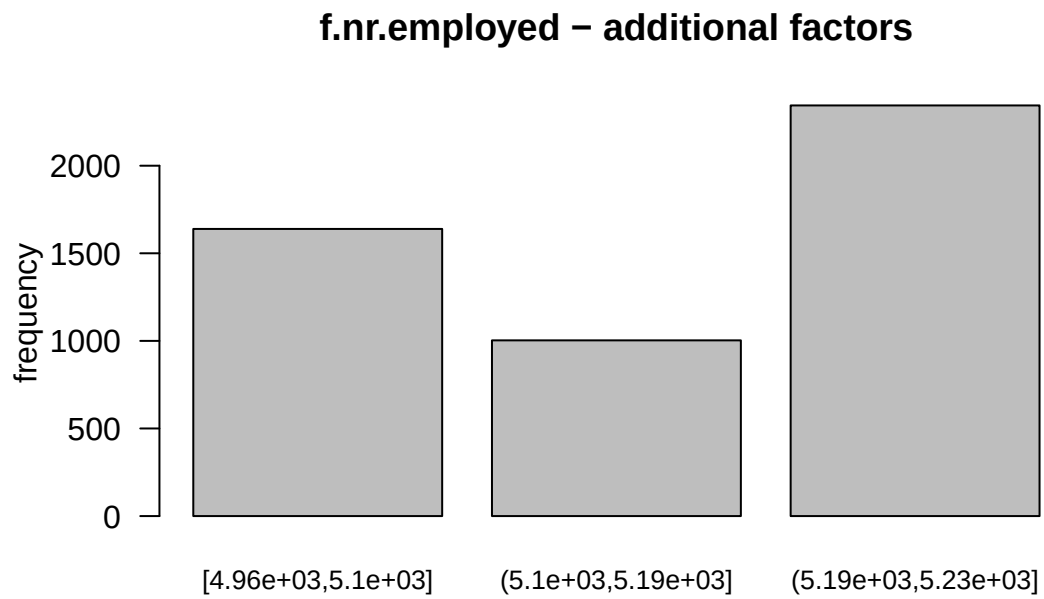
```
# EURIBOR3M
qulist<-quantile(df$euribor3m, seq(0,1,0.25), na.rm=TRUE)

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

barplot(table(df$f.euribor3m), main="f.euribor3m - additional factors", ylab="frequency", las=1, cex.nam
```




```
levels(df$f.euribor3m)<-paste0("f.euribor3m-", levels(df$f.euribor3m) )
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
```

```
# 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) )

barplot(table(df$f.nr.employed), main="f.nr.employed - additional factors", ylab="frequency", las=1, ce
```




```r
levels(df$f.nr.employed)<-paste0("f.nr.employed-", levels(df$f.nr.employed) )
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 continues 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 continues
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"
```

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

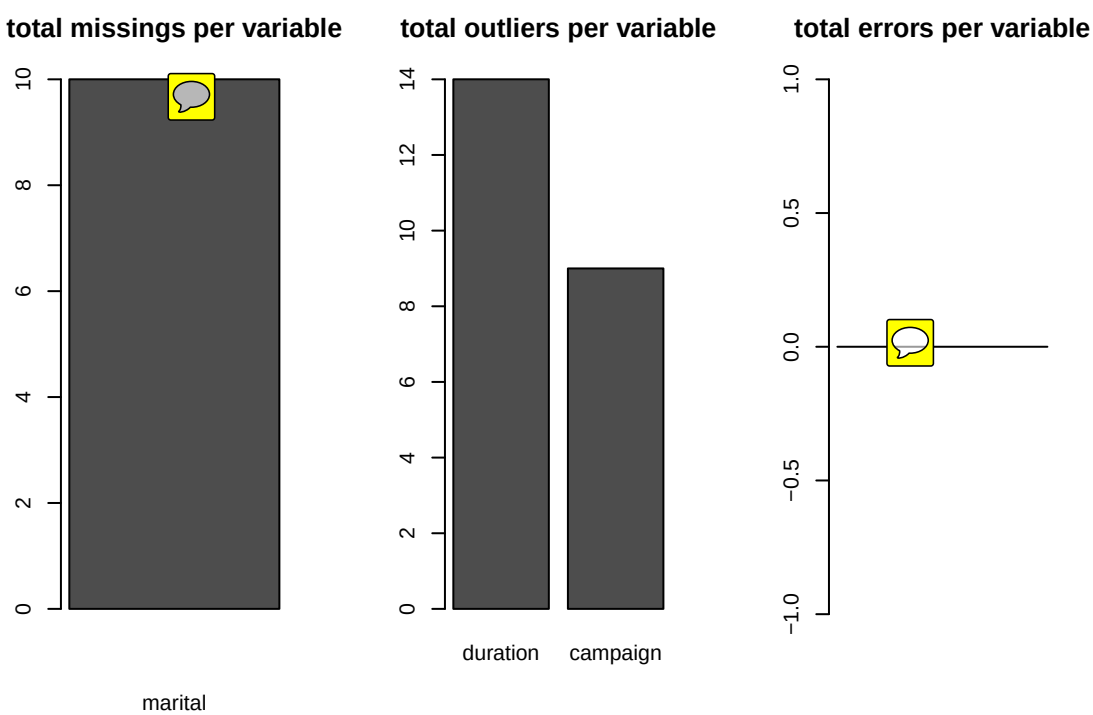
```
##  [1] "job"              "marital"          "education"
##  [4] "default"          "housing"          "loan"
##  [7] "contact"          "month"            "day_of_week"
## [10] "poutcome"         "y"                "f.season"
## [13] "f.age"            "f.duration"       "f.campaign"
## [16] "f.pdays"          "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:

Nomes es mostren aquelles variables que tenen un valor diferent a 0 en el camp que expresa la grafica en concret.

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



Per individu:

Cap individu en te mes d'un. Es mostra en format taula el numero d'individus que tenen 0 i/o 1 (o mes) missings, errors i outliers. Per ultim, es mostren alguns dels individus que han tingut algun outlier i que

aquest ha estat imputat.

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

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

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

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

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

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

```r
head(df[which(df$num_outliers>0), ], 2) #individus amb algun outlier
```

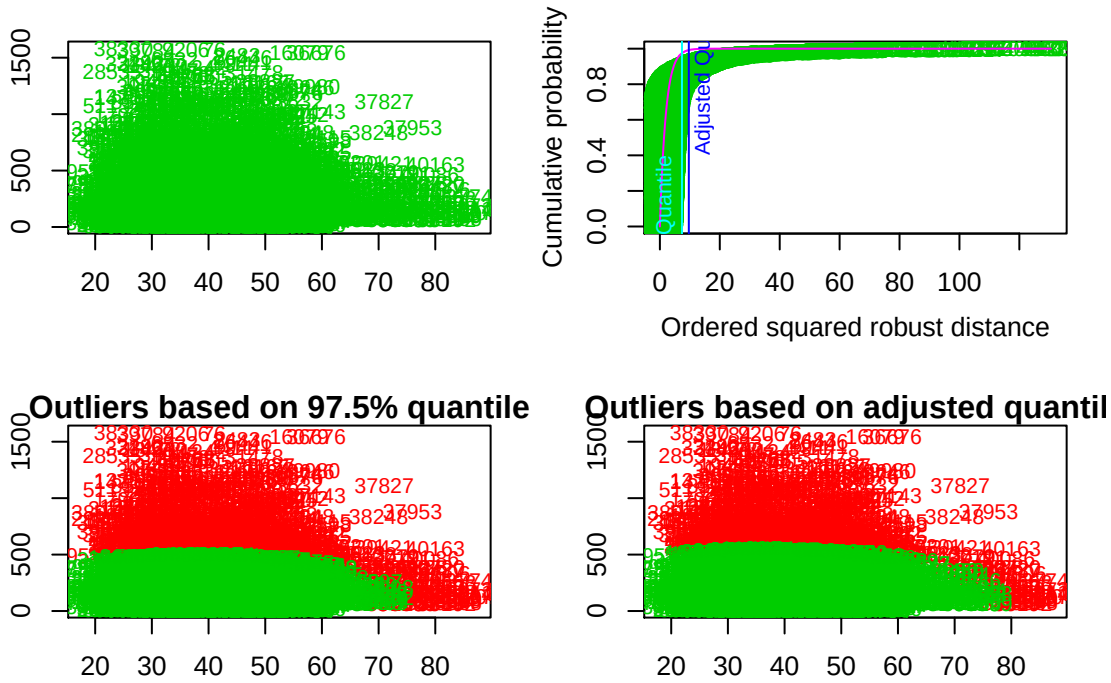
```
##      age             job         marital                   education
## 5565  39      job-admin. marital-married education-university.degree
## 9014  30 job-blue-collar marital-married          education-basic.9y
##         default     housing    loan           contact     month
## 5565 default-no housing-yes loan-no contact-telephone month-may
## 9014 default-no  housing-no loan-no contact-telephone month-jun
##          day_of_week duration campaign pdays previous             poutcome
## 5565 day_of_week-mon       14       NA   999        0 poutcome-nonexistent
## 9014 day_of_week-thu       53       NA   999        0 poutcome-nonexistent
##      emp.var.rate cons.price.idx cons.conf.idx euribor3m nr.employed    y
## 5565          1.1         93.994         -36.4     4.857      5191.0 y-no
## 9014          1.4         94.465         -41.8     4.866      5228.1 y-no
##      num_missings num_outliers num_errors      f.season   minutes
## 5565            0            1          0 season-spring 0.2333333
## 9014            0            1          0 season-summer 0.8833333
##              f.age        f.duration f.campaign       f.pdays
## 5565 f.age-(38,47] f.duration-[5,66]       <NA> f.pdays-never
## 9014 f.age-[18,32] f.duration-[5,66]       <NA> f.pdays-never
##            f.previous            f.emp.var.rate           f.cons.price.idx
## 5565 f.previous-never f.emp.var.rate-(-0.1,1.1] f.cons.price.idx-(93.7,94]
## 9014 f.previous-never  f.emp.var.rate-(1.1,1.4] f.cons.price.idx-(94,94.8]
##                    f.cons.conf.idx             f.euribor3m
## 5565 f.cons.conf.idx-(-41.8,-36.4] f.euribor3m-(1.33,4.86]
## 9014 f.cons.conf.idx-(-42.7,-41.8] f.euribor3m-(4.86,4.96]
##                          f.nr.employed
## 5565  f.nr.employed-(5.1e+03,5.19e+03]
## 9014 f.nr.employed-(5.19e+03,5.23e+03]
```

Outliers Multivariants:

No hem aconseguit trobar una configuracio del aq.plot que ens doni una bona grafica per a veure les distancies de Mahalanobis i detectar outliers multivariants.

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

```r
vars_con_sub<-vars_con[c(1:2)]
x<-df[,vars_con_sub]
# aq.plot(x, delta=qchisq(0.975, df=ncol(x)) )
index <- data.frame(aq.plot(x, delta=qchisq(0.975, df=ncol(x)), quan=0.5, alpha=0.05))
```




```r
table(index$outliers)
```

```
##
## FALSE  TRUE
##  4429   557
```

IMPUTATION:

Factors:

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

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

# 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 imputaciÃ³:
df$loan<-res.impf$completeObs[,"marital"]
df$loan<-res.impf$completeObs[,"loan"]
#summary(df[,vars_dis])
```

Numeric Variables:

La variable numerica campaign te certs individus que han estat considerats outliers previament. Aqui els imputem mitjaÃ§ant la imputacio automatica imputePCA().

```r
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
```

```r
# Amb dades imputades:

# Acceptem la imputaciÃ³:
df$campaign<-res.imp$completeObs[,"campaign"]
#summary(df[,vars_con])
```

PROFILING:

CONTINOUS DESCRIPTION - Numeric Target (Duration):

La funcio d'R "condes" ens descriu la variable continua "duration" a partir d'altres variables quantitatives o de les variables categoriques. Aixo ho fa mitjançant els tres outputs diferenciats mes avall; etiquetats com a "*quanti*", "quali" i "$category".

El primer dels quals ($quanti) ens mostra la correlacio de la variable estudiada "duration" amb altres variables numeriques, mostrant nomes les correlacions que tenen un p-value per sota del llindar o nivell de significacio del 5% (en aquest cas). Com mes petit es el p-valor, menys evidencia hi ha de que la hipotesi nul.la sigui certa i mes segurs estem del rebuig de la hipotesi nul.la. Aquesta hipotesi nul.la H0 afirma que la correlacio o resultat obtingut es fruit d'una aleatorietat de les dades i no pot ser atribuible a una causa especifica. Per tant, a partir d'ara, direm que quan el p-valor esta per sota del nivell de significacio establert, els resultats son significatius.

Comentar que ens apareix el valor NA pero no tenim cap valor en la nostra mostra (ho vam estar mirant a classe), tot i aixi no afecta al resultat obtingut, simplement l'obviem. De la mateixa manera obviem la correlaciÃ³ d'1 entre la duracio de la trucada en segons i en minuts, ja que es una correlacio perfecta deguda a una conversio d'unitats. Dit aixo, observem lleugeres correlacions negatives significatives (ordenades de mes correlacio positiva a no correlacio i despres a mes correlacio negativa) entre la duracio de la trucada i la

variable pdays, euribor3m, nr.employed i campaign. Es pot veure com la duracio de la trucada augmenta com menys cops s'ha contactat al client en aquesta campanya (campaign), el quals es logic perque un client molt contactat estara cansat ja de rebre trucades. Tambe es pot veure com la duracio de la trucada augmenta com menys dies fa que s'ha contactat a un client en relacio a una campanya anterior (pdays), el que pot estar relacionat amb l'interes del client per les diferents campanyes actuals que se li han exposat. Finalment tenim dos indicados socioeconomics que tenen una lleugera correlacio negativa amb la duracio de la trucada.

El segon output ($quali) ens mostra els factors (variables categoriques) que estan mes relacionades amb la variable target "duration". Ens mostra els resultats significatius ordenats per factors de mes a menys relacionats la duracio. Obviant la discretitzacio de la duracio (f.duration) que obviament esta molt relacionada, observem com la la decisio final (y) del client a contractar un servei esta forca relacionada amb la duracio d'una trucada. Molt menys relacionades (pero llegurament) ho estan les variables "f.campaign", "month", aixi com altres indicadors socioeconomics.

El tercer output ($category) ens indica una estimacio de les unitats que la durada de la trucada esta per sobre (+) o per sota (-) de la mitja global quan el registre pertany a la categoria en questio; ordenades per p-valor. Deixant de banda les categories de f.duration que son fruit de la discretitzacio, pot veure com quan el producte es contractat (y-yes), la duracio de la trucada esta 148 segons per sobre, com era d'esperar en una contractacio per telefon. Altres resultats obtinguts interessants son que la duracio de la trucada esta 72 segons per sobre quan s'ha contactat amb el client en aquesta campanya 1 o 2 cops (f-campaign-[0,2]) i que tambe augmenta en 38 segons quan el resultat de la campanya anterior va ser positiu pel mateix client (poutcome-success). Tambe podem destacar el mes d'abril (month-apr), en el qual les duracions de les trucades estan 28 segons per sobre de la mitja, o la primavera (season-spring) amb 18 segons per sobre de la mitja. D'altra banda podem veure com en el mes d'agost (month-aug) la duracio de les trucades esta 28 segons per sota la mitja, en el novembre (month-nov) 20 segons per sota, i que els clients que mai han estat contactats abans (f.pdays-never) estan 28 segons menys al telefon que la mitja.

El oneway.test d'R ens compara si dues o mes mostres de variables amb distribucio normal tenen o no la mateixa mitjana (no cal assumir igualtat de variancies pels grups implicats que es comparen). En aquest cas ens permet concluore que la mitjana de la durada de la trucada en els casos que s'ha contractat el servei es significativament diferent a la dels casos en els quals no s'ha contractat el servei. L'estadadistic de contrast segueix una distribucio F de Fisher i pren el valor 447.7, que es molt significatiu (p-value < 1e-16).

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

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

```r
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
# mitjana de la duraciÃ³ per categoria de la duraciÃ³
# tapply(df$duration, df$f.duration, mean)

# duraciÃ³ global
summary(df$duration)
```

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

```
##     5.0   101.0   177.0   250.6   316.0  1580.0
```

```r
# mitjana de la duraciÃ³ per categoria de la y
tapply(df$duration, df$y, mean)
```

```
##     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):

La funcio d'R "catdes" ens descriu la variable categorica "y" a partir d'altres variables categoriques o de les variables quantitatives. Aixo ho fa mitjancant outputs diferenciats mes avall. Notem que el nostre llindar de signifiacio en aquest cas es del 0.025 per tal de limitar una mica la gran quantitat de resultats mostrats.

L'apartat "Link between the cluster variable and the categorical variables (chi-square test)" ens mostra les variables categoriques que han caracteritzat al factor "y" ordenades de mes a menys caracteritzacio del factor (de menys a mes p-value). La columna "df" mostra els Degrees of Freedom, que corresponen amb el nombre de categories del factor menys 1. Les variables categoriques que han influenciat mes en la decisio final (y) son la f.duration (pero es una dada que s'obte a posteriori de la trucada, no ens serveix per a generar un perfil de client), f.pdays (nombre de dies des de l'ultim contacte), poutcome (si la ultima campanya va ser acceptada per aquest client o no), el mes (month), previous (si havia estat contactat o no abans d'aquesta campanya), diferents indicadors socioeconomics, contact (via de contacte), el job (feina), etc.

L'apartat "Description of each cluster by the categories" ens mostra per a cada categoria de la "y" (y-yes, y-no), una descripcio de les variables categoriques per tal de poder estudiar-ne el seu enllac. La primera columna Cla/Mod esn mostra el tant per cent de la categoria de la fila indicada que pertany a la resposta (y) corresponent. D'altra banda, per a una resposta (y-yes, y-no) fixada, la segona columna Mod/Cla ens mostra el tant per cent de valors de la fila corresponent que pertanyen a la resposta fixada. Aquesta columna pot esser comparada amb la columna Global i d'aquesta manera trobar sobrerepresentacions en algunes categories, ja que la tercera columna ens indica el tant per cent de valors que representa la categoria sense tenir en compte la resposta (y) fixada. Per acabar, v.test ens indica si la categoria de la fila es troba sobrerepresentada (v.test>0) o infrarepresentada (v.test<0) dins una resposta (y) fixada. Al cluster "y-no", podem veure com el fet de no haver contactat mai al client abans o fer-ho a través del telèfon fixe, estan sobrerepresentats en la resposta (y) negativa, pel que no són bones caracteritzacions d'individu a l'hora d'acceptar el producte. Al cluster "y-yes", podem veure una lleguera sobrerepresentacio dels individus que van ser contactats fa fa menys de 7 dies en altres campanyes i d'aquells que una campanya anterior va resultar exitosa, el que es pot interpretar com que en aquests casos el client es més propens a donar un si com a resposta. Així com el fet de realitzar la trucada al telèfon mòbil o altres categories, que estan sobrerepresentades i poden ser observades en la llista donada per R. Tambe hi ha certs valors socioeconomics que estan mes o menys representats en la resposta positiva que en la negativa del client, i viceversa.

L'apartat "Link between the cluster variable and the quantitative variables" ens mostra les variables quantitatives que han caracteritzat al factor "y" ordenades de mes a menys caracteritzacio del factor (de menys a mes correlacio). Les variables quantitatives que han influenciat mes en la decisio final (y) son la duration i minutes (pero son dades que s'obtenen a posteriori de la trucada, no ens serveixen per a generar un perfil de client), pdays (nombre de dies des de l'ultim contacte), previous (si havia estat contactat o no abans d'aquesta campanya), diferents indicadors socioeconomics, etc.

L'apartat "Description of each cluster by quantitative variables". D'aquesta part de l'analisi no en podem

extreure informacio dels individus que conformen el cluster "y-no", donat que els valors que es presenten de les categories dins el cluster i de manera general no presenten una diversificacio notable. Per altra banda del cluster "y-yes" si que en poden extreure informacio, podem veure que la mitjana de la duracio de les trucades dels individus del cluster duplica la mitjana global (donat que la duració és un consequencia del desenvolupament de la trucada). Altres factors con l'euribor o la taxa de variacio de la ocupacio tambe tenen un impacte en la decisio final.

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

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

```
catdes(df, num.var=pos_y, proba = 0.025)
```

```
##
## 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
## 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
## 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
## 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-(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-(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-(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
```