PRA2. Tipologia i cicle de vida de les dades

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Contents


```
if(!require('ggplot2')) install.packages('ggplot2'); library('ggplot2')
if(!require('Rmisc')) install.packages('Rmisc'); library('Rmisc')
if(!require('dplyr')) install.packages('dplyr'); library('dplyr')
if(!require('xfun')) install.packages('xfun'); library('xfun')
if(!require('gridExtra')) install.packages("gridExtra"); library(gridExtra)
```

Presentació del projecte i objectiu de l'anàlisi

Consideracions referents al dataset

- origen de les dades
- tipus de llicència

Descripció del dataset. Perquè és important i quina pregunta/problema pretén respondre?

Carreguem el conjunt de dades i fem una revisió del contingut de les diferents variables

```r
path = 'heart.csv'
dades <- read.csv(path, sep = ",")
str(dades)
```

```
## 'data.frame':    303 obs. of  14 variables:
##  $ age     : int  63 37 41 56 57 57 56 44 52 57 ...
##  $ sex     : int  1 1 0 1 0 1 0 1 1 1 ...
##  $ cp      : int  3 2 1 1 0 0 1 1 2 2 ...
##  $ trtbps  : int  145 130 130 120 120 140 140 120 172 150 ...
##  $ chol    : int  233 250 204 236 354 192 294 263 199 168 ...
##  $ fbs     : int  1 0 0 0 0 0 0 0 1 0 ...
##  $ restecg : int  0 1 0 1 1 1 0 1 1 1 ...
##  $ thalachh: int  150 187 172 178 163 148 153 173 162 174 ...
##  $ exng    : int  0 0 0 0 1 0 0 0 0 0 ...
##  $ oldpeak : num  2.3 3.5 1.4 0.8 0.6 0.4 1.3 0 0.5 1.6 ...
##  $ slp     : int  0 0 2 2 2 1 1 2 2 2 ...
##  $ caa     : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ thall   : int  1 2 2 2 2 1 2 3 3 2 ...
##  $ output  : int  1 1 1 1 1 1 1 1 1 1 ...
```

Podem observar que es tracta d'un dataset amb 303 observacions i 14 variables totes elles amb números enters excepte la variable oldpeak que conté dades decimals.

Descripció de les variables

age. Edat de la persona

sex. Sexe de la persona No indica res a l'origen del dataset, però considerant que els homes es diagnostiquen més amb atacs de cor (o en tenen més), considerem que 1 és home i 0 és dona

cp. chest pain type Value 1: typical angina Value 2: atypical angina Value 3: non-anginal pain Value 4: asymptomatic

trtbps. Pressió arterial en repòr (en mm/Hg)

chol. cholestoral in mg/dl fetched via BMI sensor

fbs. (fasting blood sugar > 120 mg/dl) (1 = true; 0 = false)

restecg. resting electrocardiographic results Value 0: normal Value 1: having ST-T wave abnormality (T wave inversions and/or ST elevation or depression of > 0.05 mV) Value 2: showing probable or definite left ventricular hypertrophy by Estes' criteria

thalachh. maximum heart rate achieved

exng. exercise induced angina (1 = yes; 0 = no)

oldpeak. Previous peak

slp. Slope 0 = unsloping 1 = flat 2 = downsloping

caa. number of major vessels (0-4)

thall. Thal rate 0 = null 1 = fixed defect 2 = normal 3 = reversable defect

output. Target variable (0= less chance of heart attack 1= more chance of heart attack) 0: < 50% diameter narrowing. less chance of heart disease 1: > 50% diameter narrowing. more chance of heart disease

Extra (incorporar) **Medical Definitions 1- Angina: chest pain due to reduced blood flow to the heart muscles. There're 3 types of angina: stable angina, unstable angina, and variant angina. To know more about angina click here: https://www.nhs.uk/conditions/angina/#:~:text=Angina%20is%20chest%20pain%20caused,of%20these%2

2- Cholesterol: a waxy substance found in the body cells and it belongs to a group of organic molecules called lipids. There are 3 types of cholesterol; high-density lipoprotein (HDL) and it's known as the "good cholesterol", low-density lipoprotein (LDL) known as the "bad cholesterol", and very-low-density lipoproteins (VLDL) and as the name implies, they're low dense particles that carry triglycerides in the blood.

3- ECG: short for electrocardiogram, it's a routine test usually done to check the heart's electrical activity.

4- ST depression: a type of ST-segment abnormality. the ST segment is the flat, isoelectric part of the ECG and it represents the interval between ventricular depolarization and repolarization. For more details check this link: https://litfl.com/st-segment-ecg-library/.

5- Thalassemia: it's a genetic blood disorder that is characterized by a lower rate of hemoglobin than normal.

Integració i selecció de les dades d'interès a analitzar.

Pot ser el resultat d'addicionar diferents datasets o una subselecció útil de les dades originals, en base a l'objectiu que es vulgui aconseguir.

```
summary(dades)
```

```
##       age             sex               cp            trtbps
##  Min.   :29.00   Min.   :0.0000   Min.   :0.000   Min.   : 94.0
##  1st Qu.:47.50   1st Qu.:0.0000   1st Qu.:0.000   1st Qu.:120.0
##  Median :55.00   Median :1.0000   Median :1.000   Median :130.0
##  Mean   :54.37   Mean   :0.6832   Mean   :0.967   Mean   :131.6
##  3rd Qu.:61.00   3rd Qu.:1.0000   3rd Qu.:2.000   3rd Qu.:140.0
##  Max.   :77.00   Max.   :1.0000   Max.   :3.000   Max.   :200.0
##       chol            fbs            restecg          thalachh
##  Min.   :126.0   Min.   :0.0000   Min.   :0.0000   Min.   : 71.0
##  1st Qu.:211.0   1st Qu.:0.0000   1st Qu.:0.0000   1st Qu.:133.5
##  Median :240.0   Median :0.0000   Median :1.0000   Median :153.0
##  Mean   :246.3   Mean   :0.1485   Mean   :0.5281   Mean   :149.6
##  3rd Qu.:274.5   3rd Qu.:0.0000   3rd Qu.:1.0000   3rd Qu.:166.0
##  Max.   :564.0   Max.   :1.0000   Max.   :2.0000   Max.   :202.0
##       exng           oldpeak          slp              caa
##  Min.   :0.0000   Min.   :0.00   Min.   :0.000   Min.   :0.0000
##  1st Qu.:0.0000   1st Qu.:0.00   1st Qu.:1.000   1st Qu.:0.0000
##  Median :0.0000   Median :0.80   Median :1.000   Median :0.0000
##  Mean   :0.3267   Mean   :1.04   Mean   :1.399   Mean   :0.7294
##  3rd Qu.:1.0000   3rd Qu.:1.60   3rd Qu.:2.000   3rd Qu.:1.0000
##  Max.   :1.0000   Max.   :6.20   Max.   :2.000   Max.   :4.0000
##      thall           output
##  Min.   :0.000   Min.   :0.0000
##  1st Qu.:2.000   1st Qu.:0.0000
##  Median :2.000   Median :1.0000
##  Mean   :2.314   Mean   :0.5446
##  3rd Qu.:3.000   3rd Qu.:1.0000
##  Max.   :3.000   Max.   :1.0000
```

Comprovem que hi ha 302 registres diferents, per la qual cosa, donat el nivell d'especificitat de les dades, podem valorar que hi ha un registre repetit.

```r
dim(unique(dades))
```

```
## [1] 302  14
```

Eliminem el registre repetit i conservarem la resta donat que tenim un número de registres perfectement gestionable

```r
dades <- unique(dades)
```

O POTSER NO. VARLORAR SI APORTA ALGUNA COSA

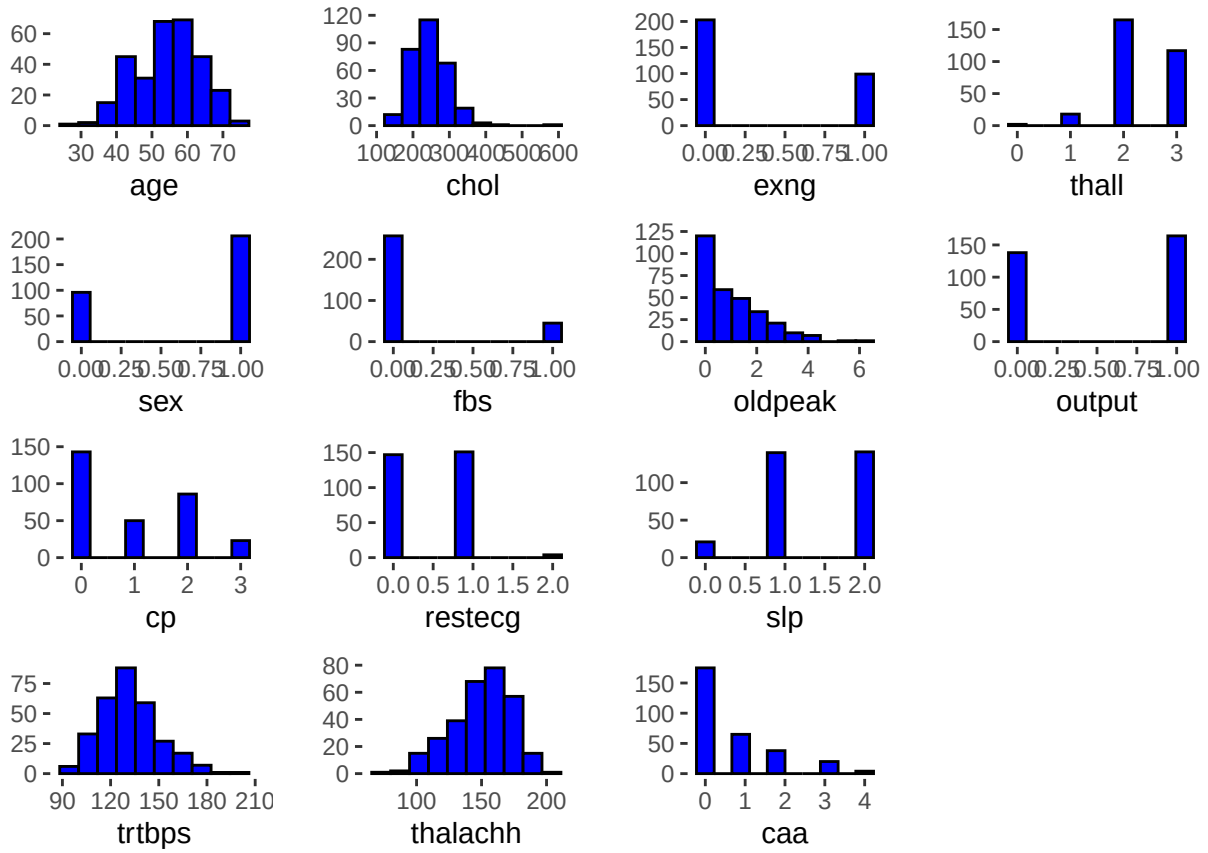
Per tal valorar quins valors ens interessa utilitzar per fer l'anàlisi, començarem fer una revisió de la distribució de cada una de les variables

```r
histogrames_num <- list()
variables_num <- names(dades)
dades_num <- dades %>% select(all_of(variables_num))

for(i in 1:ncol(dades_num)){
  var <- names(dades_num)[i]
  grafic <- ggplot(dades_num, aes_string(x = var)) +
    geom_histogram(bins = 10, fill = "blue", color = "black") +
    labs(y = "") +
    theme(panel.grid = element_blank(), panel.background = element_blank())
  histogrames_num[[i]] <- grafic
}
```

```
## Warning: `aes_string()` was deprecated in ggplot2 3.0.0.
## i Please use tidy evaluation ideoms with `aes()`
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

```r
multiplot(plotlist = histogrames_num, cols = 4)
```



Aplicarem una anàlisi de components principals per tal valorar si podem treballar amb menys variables

```
dades_acp <- prcomp(dades, center = TRUE, scale = TRUE)
summary(dades_acp)
```

```
## Importance of components:
##                           PC1    PC2    PC3     PC4     PC5     PC6     PC7
## Standard deviation     1.8192 1.2557 1.1068 1.10095 1.01153 0.98461 0.93027
## Proportion of Variance 0.2364 0.1126 0.0875 0.08658 0.07308 0.06925 0.06181
## Cumulative Proportion  0.2364 0.3490 0.4365 0.52310 0.59619 0.66543 0.72725
##                           PC8     PC9    PC10    PC11    PC12    PC13    PC14
## Standard deviation     0.88297 0.84761 0.78999 0.72720 0.65579 0.61065 0.60382
## Proportion of Variance 0.05569 0.05132 0.04458 0.03777 0.03072 0.02664 0.02604
## Cumulative Proportion  0.78294 0.83425 0.87883 0.91660 0.94732 0.97396 1.00000
```

Observem que, tot i que hi ha dues compronents principals que expliquen juntes un 34,9% per la variància, aquesta està molt repartida i necessitem 13 dels 14 components per explicar el 95% de la variància.

A priori treballarem amb les 14 observacions originals.

Normalització de les dades

Tenim cuatre variables numèriques que ens pot interessar normalitzar per tal que siguin comparables en el nostre estudi. Primer de tot, comprovarem si la distribució de les variables trtbps, chol, thalachh i oldpeak és o no normal aplicant el test de Shapiro

```r
shapiro_trtbps <- shapiro.test(dades$trtbps)
print(shapiro_trtbps)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  dades$trtbps
## W = 0.96573, p-value = 1.419e-06
```

```r
shapiro_chol <- shapiro.test(dades$chol)
print(shapiro_chol)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  dades$chol
## W = 0.94658, p-value = 5.196e-09
```

```r
shapiro_thalachh <- shapiro.test(dades$thalachh)
print(shapiro_thalachh)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  dades$thalachh
## W = 0.97679, p-value = 8.268e-05
```

```r
shapiro_oldpeak <- shapiro.test(dades$oldpeak)
print(shapiro_oldpeak)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  dades$oldpeak
## W = 0.84522, p-value < 2.2e-16
```

En els quatre casos, observant el valor de p podem dir que es rebutja la hipòtesi nul · la i, per tant, no distribueixen com una normal.

En base a aquesta no normalitat,

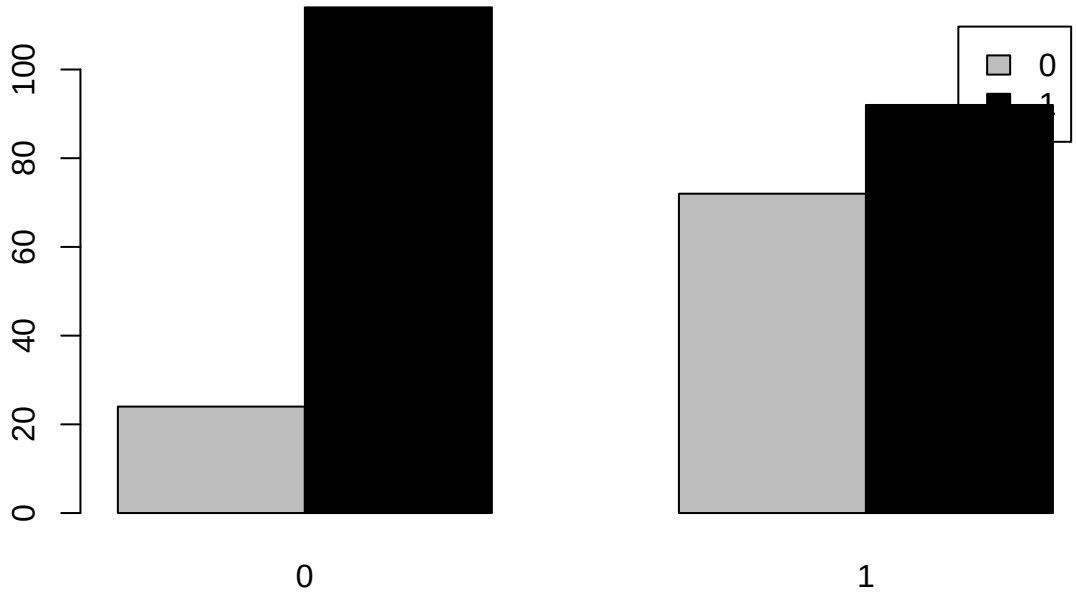
```r
print(table(dades$sex, dades$output))
```

```
##
##       0   1
##   0  24  72
##   1 114  92
```

```
print(prop.table(table(dades$sex, dades$output), 2))
```

```
##
##           0         1
##   0 0.1739130 0.4390244
##   1 0.8260870 0.5609756
```

```
barplot(table(dades$sex, dades$output), beside = TRUE, col = c("grey", "black"), legend = rownames(table
```




```
print(prop.table(table(dades$chol, dades$output)))
```

```
##
##                0           1
##   126 0.000000000 0.003311258
##   131 0.003311258 0.000000000
##   141 0.000000000 0.003311258
##   149 0.003311258 0.003311258
##   157 0.000000000 0.003311258
##   160 0.000000000 0.003311258
##   164 0.003311258 0.000000000
##   166 0.003311258 0.000000000
##   167 0.003311258 0.000000000
##   168 0.000000000 0.003311258
##   169 0.003311258 0.000000000
```

```
##   172 0.003311258 0.000000000
##   174 0.003311258 0.000000000
##   175 0.000000000 0.006622517
##   176 0.003311258 0.000000000
##   177 0.006622517 0.006622517
##   178 0.000000000 0.003311258
##   180 0.000000000 0.003311258
##   182 0.000000000 0.003311258
##   183 0.000000000 0.003311258
##   184 0.003311258 0.000000000
##   185 0.003311258 0.000000000
##   186 0.000000000 0.003311258
##   187 0.003311258 0.000000000
##   188 0.006622517 0.000000000
##   192 0.000000000 0.006622517
##   193 0.003311258 0.003311258
##   195 0.000000000 0.003311258
##   196 0.000000000 0.006622517
##   197 0.006622517 0.013245033
##   198 0.003311258 0.003311258
##   199 0.000000000 0.009933775
##   200 0.003311258 0.000000000
##   201 0.000000000 0.009933775
##   203 0.006622517 0.003311258
##   204 0.006622517 0.013245033
##   205 0.003311258 0.003311258
##   206 0.006622517 0.000000000
##   207 0.003311258 0.003311258
##   208 0.000000000 0.006622517
##   209 0.000000000 0.006622517
##   210 0.000000000 0.003311258
##   211 0.000000000 0.013245033
##   212 0.013245033 0.003311258
##   213 0.000000000 0.006622517
##   214 0.000000000 0.006622517
##   215 0.000000000 0.003311258
##   216 0.003311258 0.003311258
##   217 0.003311258 0.000000000
##   218 0.006622517 0.000000000
##   219 0.003311258 0.006622517
##   220 0.000000000 0.009933775
##   221 0.000000000 0.006622517
##   222 0.000000000 0.006622517
##   223 0.003311258 0.006622517
##   224 0.003311258 0.000000000
##   225 0.006622517 0.000000000
##   226 0.000000000 0.013245033
##   227 0.000000000 0.006622517
##   228 0.003311258 0.003311258
##   229 0.009933775 0.000000000
##   230 0.009933775 0.000000000
##   231 0.006622517 0.003311258
##   232 0.003311258 0.003311258
##   233 0.003311258 0.009933775
```

```
##   234 0.006622517 0.013245033
##   235 0.000000000 0.006622517
##   236 0.003311258 0.006622517
##   237 0.003311258 0.000000000
##   239 0.006622517 0.006622517
##   240 0.000000000 0.013245033
##   241 0.003311258 0.000000000
##   242 0.000000000 0.003311258
##   243 0.006622517 0.006622517
##   244 0.003311258 0.006622517
##   245 0.000000000 0.009933775
##   246 0.006622517 0.003311258
##   247 0.003311258 0.003311258
##   248 0.003311258 0.003311258
##   249 0.009933775 0.000000000
##   250 0.000000000 0.009933775
##   252 0.000000000 0.003311258
##   253 0.003311258 0.003311258
##   254 0.013245033 0.003311258
##   255 0.003311258 0.003311258
##   256 0.006622517 0.003311258
##   257 0.000000000 0.003311258
##   258 0.006622517 0.003311258
##   259 0.003311258 0.000000000
##   260 0.003311258 0.003311258
##   261 0.003311258 0.003311258
##   262 0.000000000 0.003311258
##   263 0.003311258 0.006622517
##   264 0.003311258 0.003311258
##   265 0.000000000 0.006622517
##   266 0.003311258 0.003311258
##   267 0.003311258 0.003311258
##   268 0.003311258 0.003311258
##   269 0.006622517 0.009933775
##   270 0.003311258 0.003311258
##   271 0.000000000 0.006622517
##   273 0.003311258 0.003311258
##   274 0.009933775 0.000000000
##   275 0.003311258 0.003311258
##   276 0.003311258 0.000000000
##   277 0.000000000 0.006622517
##   278 0.000000000 0.003311258
##   281 0.003311258 0.000000000
##   282 0.013245033 0.000000000
##   283 0.006622517 0.003311258
##   284 0.003311258 0.000000000
##   286 0.006622517 0.000000000
##   288 0.006622517 0.003311258
##   289 0.006622517 0.000000000
##   290 0.003311258 0.000000000
##   293 0.003311258 0.000000000
##   294 0.003311258 0.003311258
##   295 0.000000000 0.006622517
##   298 0.003311258 0.003311258
```

```
##   299 0.006622517 0.000000000
##   300 0.003311258 0.000000000
##   302 0.000000000 0.006622517
##   303 0.000000000 0.009933775
##   304 0.003311258 0.003311258
##   305 0.003311258 0.000000000
##   306 0.000000000 0.003311258
##   307 0.003311258 0.000000000
##   308 0.000000000 0.006622517
##   309 0.006622517 0.003311258
##   311 0.003311258 0.000000000
##   313 0.000000000 0.003311258
##   315 0.003311258 0.003311258
##   318 0.003311258 0.003311258
##   319 0.003311258 0.000000000
##   321 0.000000000 0.003311258
##   322 0.003311258 0.000000000
##   325 0.000000000 0.006622517
##   326 0.003311258 0.000000000
##   327 0.003311258 0.000000000
##   330 0.006622517 0.000000000
##   335 0.006622517 0.000000000
##   340 0.000000000 0.003311258
##   341 0.003311258 0.000000000
##   342 0.000000000 0.003311258
##   353 0.003311258 0.000000000
##   354 0.000000000 0.003311258
##   360 0.000000000 0.003311258
##   394 0.000000000 0.003311258
##   407 0.003311258 0.000000000
##   409 0.003311258 0.000000000
##   417 0.000000000 0.003311258
##   564 0.000000000 0.003311258
```

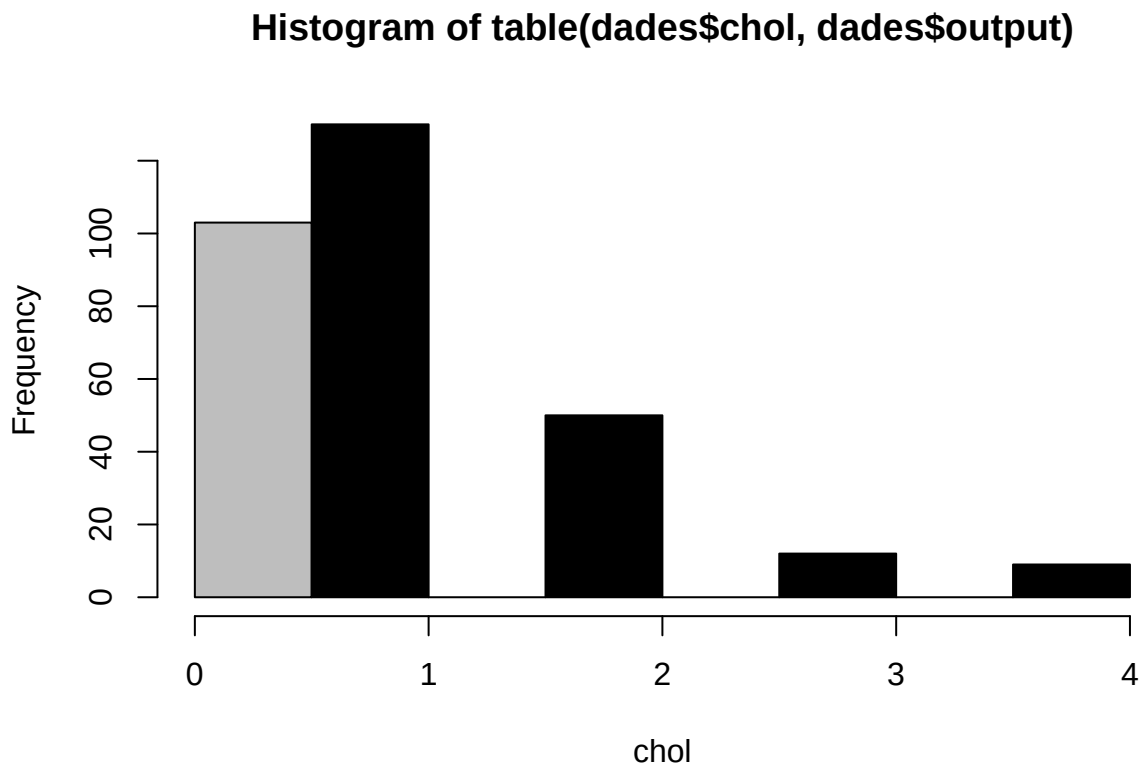
```
hist(table(dades$chol, dades$output), col = c("grey", "black"), legend = rownames(table(dades$chol, dad
```

```
## Warning in plot.window(xlim, ylim, "", ...): "legend" is not a graphical
## parameter
```

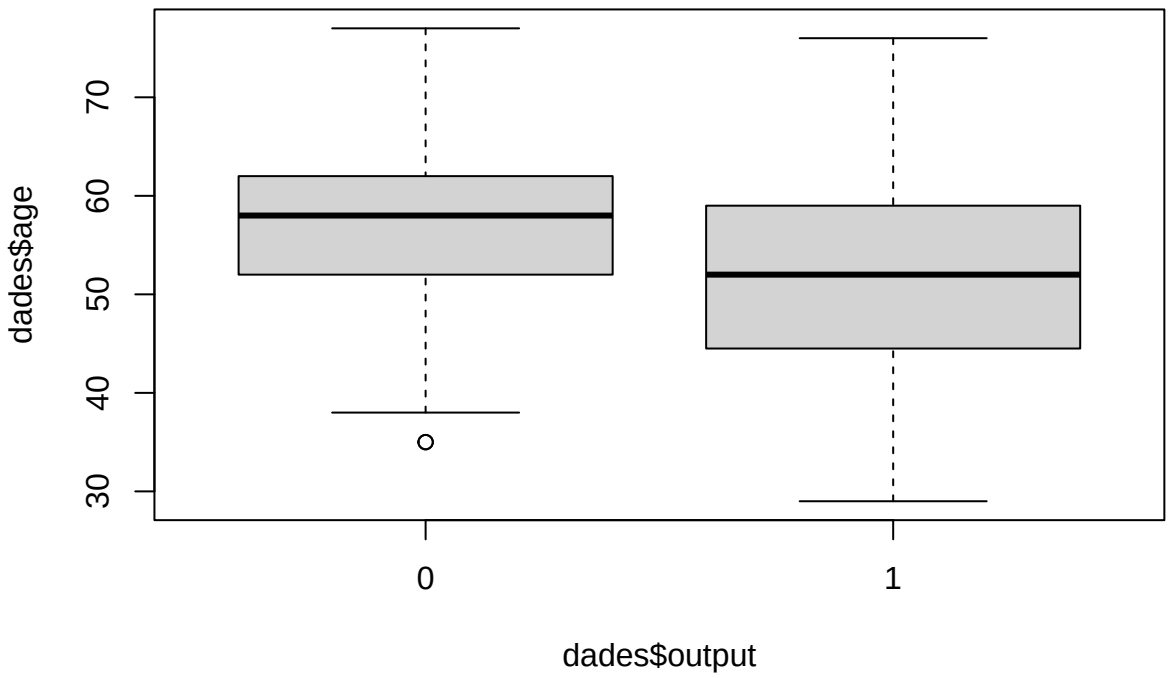
```
## Warning in title(main = main, sub = sub, xlab = xlab, ylab = ylab, ...):
## "legend" is not a graphical parameter
```

```
## Warning in axis(1, ...): "legend" is not a graphical parameter
```

```
## Warning in axis(2, ...): "legend" is not a graphical parameter
```




```
boxplot(dades$age~dades$output)
```



Neteja de les dades. Les dades contenen zeros o elements buits?

Gestiona cadascun d'aquests casos.

Identifica i gestiona els valors extrems.

Anàlisi de les dades

Selecció dels grups de dades que es volen analitzar/comparar (p. e., si es volen comparar grups de dades, quins són aquests grups i quins tipus d'anàlisi s'aplicaran?).

Comprovació de la normalitat i homogeneïtat de la variància.

Aplicació de proves estadístiques per comparar els grups de dades. En funció de les dades i de l'objectiu de l'estudi, aplicar proves de contrast d'hipòtesis, correlacions, regressions, etc. Aplicar almenys tres mètodes d'anàlisi diferents.

Conclusions

A partir dels resultats obtinguts, quines són les conclusions?

Els resultats permeten respondre al problema?