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Institut de Recerca

Introduction to R and R-commander

Curs d'Estadística Bàsica per a la Recerca Biomèdica

UNITAT D'ESTADÍSTICA I BIOINFORMÀTICA

GRBIO-UEB-VHIR

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Introduction to R

- R is a **language** and **environment** for **statistical computing** and **graphics**.
- R was developed in 1993 by **R**obert Gentleman and **R**oss Ihaka as a free alternative to a commercial software with similar capabilities, known as "the S language".
- Currently maintained by the *R Development Core Team*
- Freely available from the R-Project website: http://www.r-project.org/
- Pushed by a variety of fields -apart of statistics- such as bioinformatics or ecology it has become a "de facto" standard in many fields for data exploration, manipulation, modelling and analysis.

Advantages of using R

- It is free
- Multi-platform (Linux, Mac, Windows)
- Powerful in graphics generation
- Powerful statistical tool (top statistical methods)
- Is always growing in users and functionalities
  → Frequent updates (twice a year).
- Flexible, open source, programming language
  → Useful for repetitive tasks.

Drawbacks of using R

- It is a statistical language", that is, it is based on "commands" and used best in a console.
  - Compensated by IDEs/GUIS such as Rstudio/Rcmdr
- Not so "user friendly" as SPSS or Graphpad
  - Much more powerful then the 2nd,
  - Much cheaper than the 1st
- Supporting documentation is of variable quality
- Frequent updates
- Community-based: Pieces may be different depending on who creates them.
  - Partially solved by the **tidyverse**

Using R

In short, using R consists of:

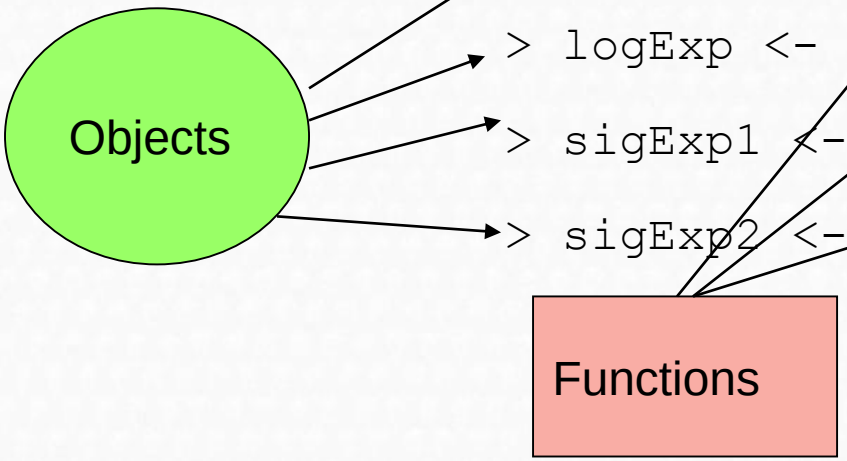
- Managing the right *objects*
- Using appropriate *functions*.

At the beginning the problema is knowing …

- Which type of objects are there,
- What can be done with them.

An example

```
> expres <- c(1.02, 3.1, 0.8, 1.4, 2)
> logExp <- log (expres)
> sigExp1 <- t.test(logExp)
> sigExp2 <- wilcox.test(logExp)
```



Using R

In short, using R consists of:

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At the beginning the problema is knowing

- Which type of objects are there
- What can be done with them.

R objects

- R objects can be:
  - Data tables ("datasets"), text, dates,
  - But also more complicated things such as
    - Plots
    - Output of statistical tests
    - Fitted models
- Objects are created
  - Reading data from a file
  - As the result of a computation
  - Assigning them a value

R functions

- R functions represent something that can be done with an object :
  - Functions opérate with objects
  - Functions can return other objects
- Functions can be
  - Incorporated in R "base"
  - Added to the system using "packages"
  - Created by the user for specific purposes

Example 2

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```
# DATA
calcio <-c(11.0, 10.6, 10.5, 10.6, 10.4, 10.2, 9.5,
                                 8.2, 7.5, 6.0, 5.0)
PTH   <- c(0.5, 1.12, 1.23, 1.24, 1.31, 1.33, 2.10,
        2.15, 2.43, 3.70, 4.27)
plot(calcio,PTH, main="Hormona Paratiroidea vs [Calcio]")

regres <- lm(PTH ~ calcio) # FIT A MODEL
# RESULTS
summary(regres)
abline(regres)
par(mfrow=c(2,2))
plot(regres)
```

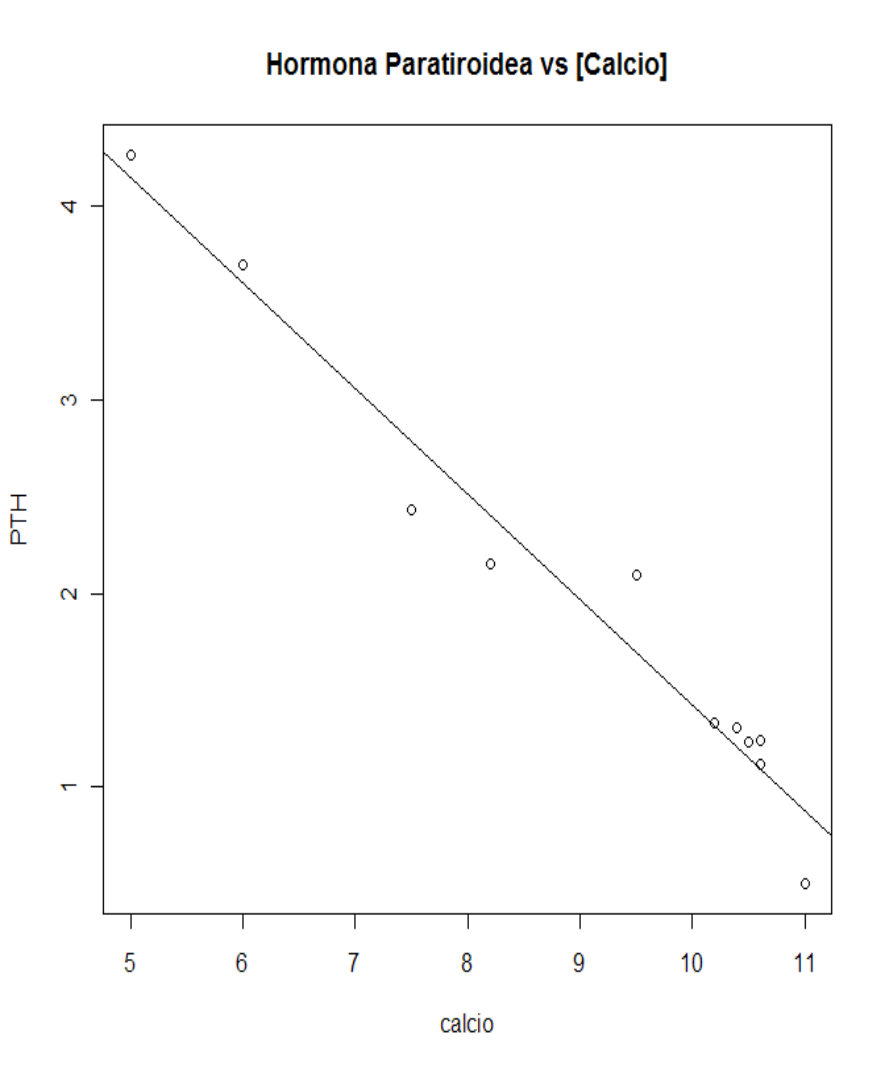
Objetos

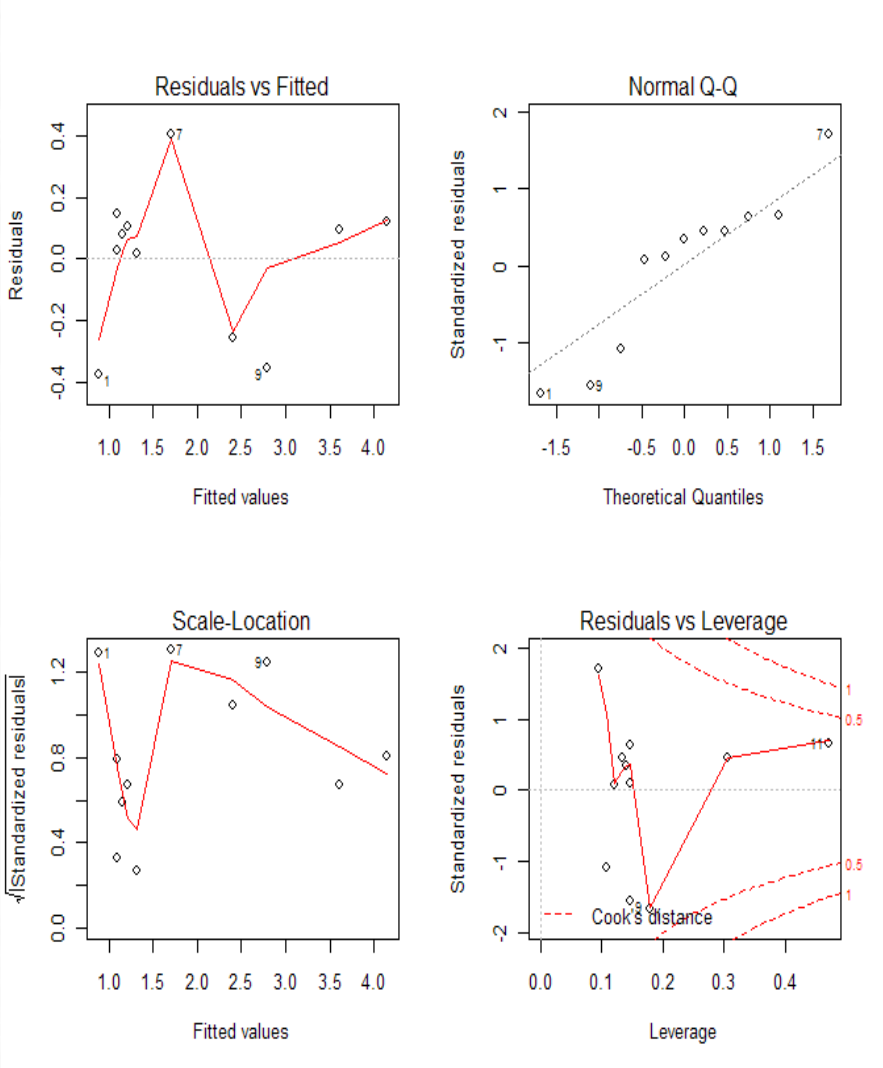
Funciones

Example 2: results

```
> summary(regres)

Call:

lm(formula = PTH ~ calcio)

Residuals:

     Min       1Q   Median       3Q      Max

-0.37648 -0.11926  0.08052  0.11177  0.40454

Coefficients:

            Estimate Std. Error t value Pr(>|t|)

(Intercept)  6.88232    0.35283   19.51 1.13e-08 ***

calcio      -0.54599    0.03811  -14.33 1.68e-07 ***

---

Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2496 on 9 degrees of freedom

Multiple R-squared: 0.958,      Adjusted R-squared: 0.9533

F-statistic: 205.3 on 1 and 9 DF,  p-value: 1.680e-07
```

Example 2: plots





R GUIs and IDEs

- Using R from the console can have a steep learning curve.
- Simplified with GUIs and IDEs
- Graphical User Interfaces (GUI)
  - Simplify using R in a point&click way
  - Menu-based Statistical analysis: **R-commander**
- Integrated development environments (IDE)
  - Facilitates command-based use of R: **RStudio**

RStudio

- Free IDE to facilitate Using R from the console.
  - Downloadable from https://rstudio.com
- Has become so popular that some people confounds it with R.
- It is only an interface but
  - Very user friendly
  - Specially Good for intermediate-level users

RStudio

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Source
-scripts
-text edit

Console
-commands
-output

Input data, Environment & History

Files, plots, packages, help

RStudio

File Edit Code View Project Workspace Plots Tools Help

diamondPricing.R* | formatPlot.R | diamonds

```
library(ggplot2)
source("plots/formatPlot.R")

view(diamonds)
summary(diamonds)

summary(diamonds$price)
aveSize <- round(mean(diamonds$carat), 4)
clarity <- levels(diamonds$clarity)

p <- qplot(carat, price,
           data=diamonds, color=clarity,
           xlab="Carat", ylab="Price",
           main="Diamond Pricing")
```

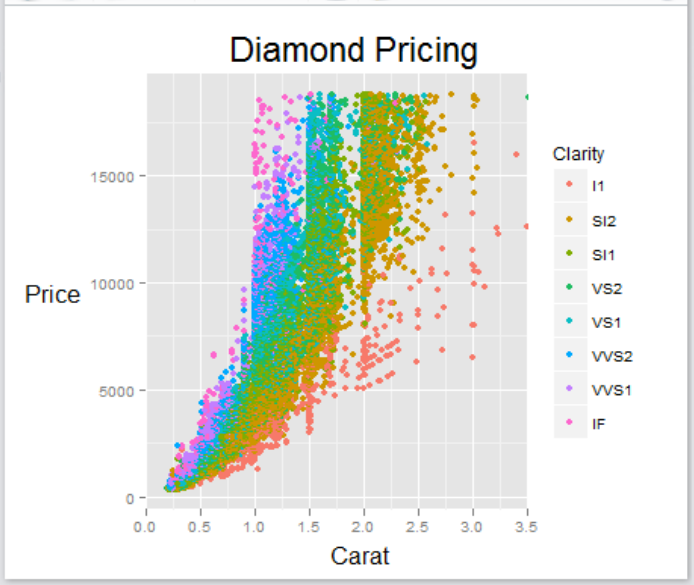
Workspace | History

Data	
diamonds	53940 obs. of 10 variables
Values	
aveSize	0.7979
clarity	character[8]
p	ggplot[8]
Functions	
format.plot(plot, size)	

Console

```
       x                y                z
 Min.   : 0.000   Min.   : 0.000   Min.   : 0.000
 1st Qu.: 4.710   1st Qu.: 4.720   1st Qu.: 2.910
 Median : 5.700   Median : 5.710   Median : 3.530
 Mean   : 5.731   Mean   : 5.735   Mean   : 3.539
 3rd Qu.: 6.540   3rd Qu.: 6.540   3rd Qu.: 4.040
 Max.   :10.740   Max.   :58.900   Max.   :31.800
> summary(diamonds$price)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
    326     950    2401    3933    5324   18820
> aveSize <- round(mean(diamonds$carat), 4)
> clarity <- levels(diamonds$clarity)
> p <- qplot(carat, price,
+            data=diamonds, color=clarity,
+            xlab="Carat", ylab="Price",
+            main="Diamond Pricing")
>
> format.plot(p, size=24)
>
```

Files | Plots | Packages | Help



R commander

- Free GUI to facilitate doing statistical analyses with R.
- Originally developed for statistics courses where there was no time to learn to use R through the console.
- Has become very popular and has been adopted by many teaching institutions.

RCommander

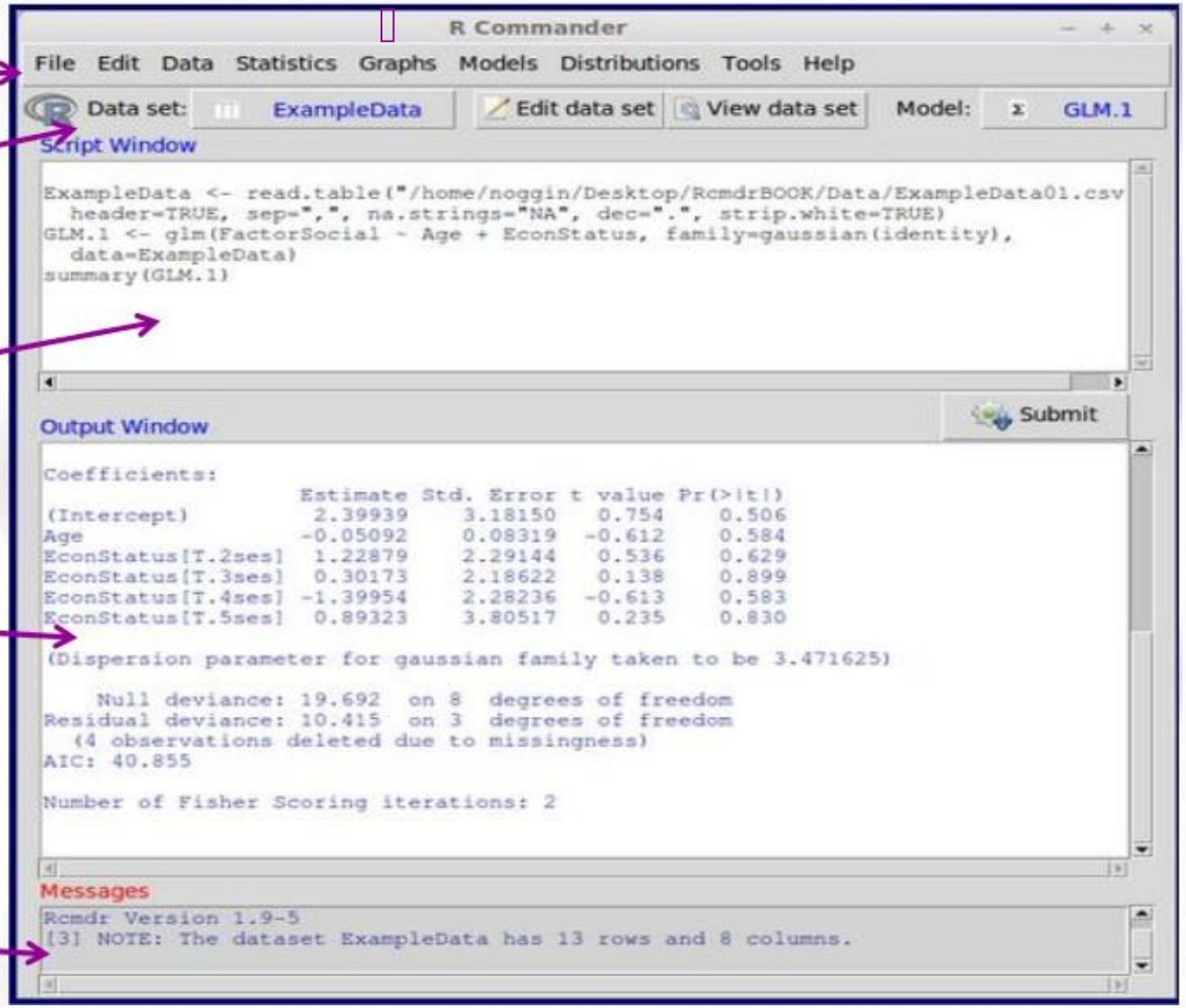
Menu bar

Tool bar

Command window

Text output window

Messages window



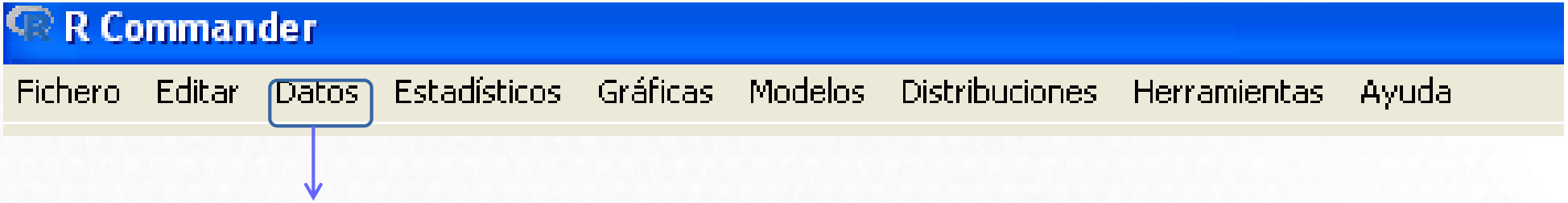
RCommander

Menu bar

- **File**: contains options to load and save files, define settings and exit.
- **Edit**: options for editing output and log/script window contents.
- **Data**: options to read and modify data.
- **Statistics**: submenu containing options for basic statistical analysis
- **Graphs**: contains options for creating simple statistical graphs
- **Models**: options for obtaining numerical summaries, testing hypotheses and regression models.
- **Distributions**: options to calculate probabilities, obtain quantiles, and get plots of already known statistical distributions.
- **Help**: contains menus with info about how to work with R commander.

RCommander

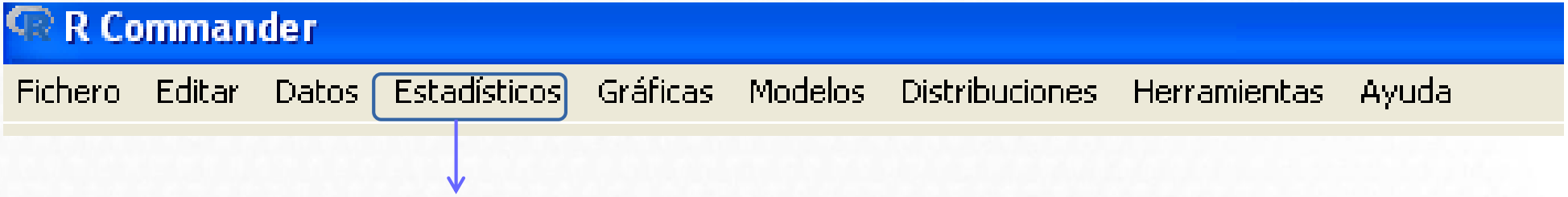
Menu bar



- Create / Load data
- Editing and inspection of data files.
- Data transformation / Creation of new variables.
- Selection of subsets of data or subgroups of variables.
- Conversion of numerical variables into factors.

RCommander

Menu bar



- Summaries
- Contingency tables
- Mediums
- Proportions
- Variants
- Non-parametric tests
- Dimensional analysis (A. Multivariant)
- Model adjustment (Regression)

RCommander

Tool bar

- The program always works with a main set of data (active dataset).
- With the active "dataset" we can:
  - edit or visualize it
  - Do analysis
  - Build and use models
- At any moment we can change the active dataset.

RCommander

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Command window

R Script | R Markdown

```
Dataset <- read.table("E:/BioStatFLOSS/dades/osteoporosis.csv", header=TRUE,
   sep="\t", na.strings="NA", dec=",", strip.white=TRUE)
library(abind, pos=14)
library(e1071, pos=15)
summary(Dataset)
```

- The menu actions are converted into instructions in the Command window.

RCommander

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Text output window

Salida

Ejecutar

```
> Dataset <- read.table("E:/BioStatFLOSS/dades/osteoporosis.csv", header=TRUE,
+    sep="\t", na.strings="NA", dec=",", strip.white=TRUE)

> library(abind, pos=14)

> library(e1071, pos=15)

> summary(Dataset)
    registro          area              f_nac          edad          grupedad        peso            talla           imc             bua
 Min.   :   3.0   Min.   :10.00   11509689600:  3   Min.   :45.00   45 - 49:378   Min.   : 44.00   Min.   :138.0   Min.   :17.21   Min.   : 11.0
 1st Qu.: 280.8   1st Qu.:10.00   11718518400:  3   1st Qu.:48.00   50 - 54:233   1st Qu.: 60.50   1st Qu.:153.0   1st Qu.:24.80   1st Qu.: 62.0
 Median : 531.5   Median :11.00   11010297600:  2   Median :52.00   55 - 59:176   Median : 68.00   Median :157.0   Median :27.51   Median : 72.0
 Mean   : 529.9   Mean   :11.58   11090822400:  2   Mean   :53.42   60 - 64:129   Mean   : 69.12   Mean   :156.9   Mean   :28.11   Mean   : 73.3
 3rd Qu.: 781.2   3rd Qu.:13.00   11098166400:  2   3rd Qu.:58.00   65 - 69: 84   3rd Qu.: 75.00   3rd Qu.:161.0   3rd Qu.:30.82   3rd Qu.: 84.0
 Max.   :1033.0   Max.   :13.00   11181283200:  2   Max.   :69.00                 Max.   :123.50   Max.   :180.0   Max.   :48.39   Max.   :136.0
                                  (Other)    :986
        clasific      menarqui        edad_men      menop                          tipo_men                        nivel_ed
 NORMAL      :469   Min.   : 8.00   Min.   :24.00   NO:303   AMBAS                    : 79   PRIMARIOS              :467
 OSTEOPENIA  :467   1st Qu.:12.00   1st Qu.:46.00   SI:697   HISTERECTOMIA            : 63   PRIMARIOS SIN FINALIZAR:212
 OSTEOPOROSIS: 64   Median :13.00   Median :51.00            NATURAL                  :544   SECUNDARIOS            :150
                    Mean   :12.71   Mean   :63.04            NO MENOPAUSIA/NO CONSTA:303   SIN ESTUDIOS           :122
                    3rd Qu.:14.00   3rd Qu.:99.00            OVARIECTOMIA             : 11   SUPERIORES             : 49
                    Max.   :17.00   Max.   :99.00
```

Message window

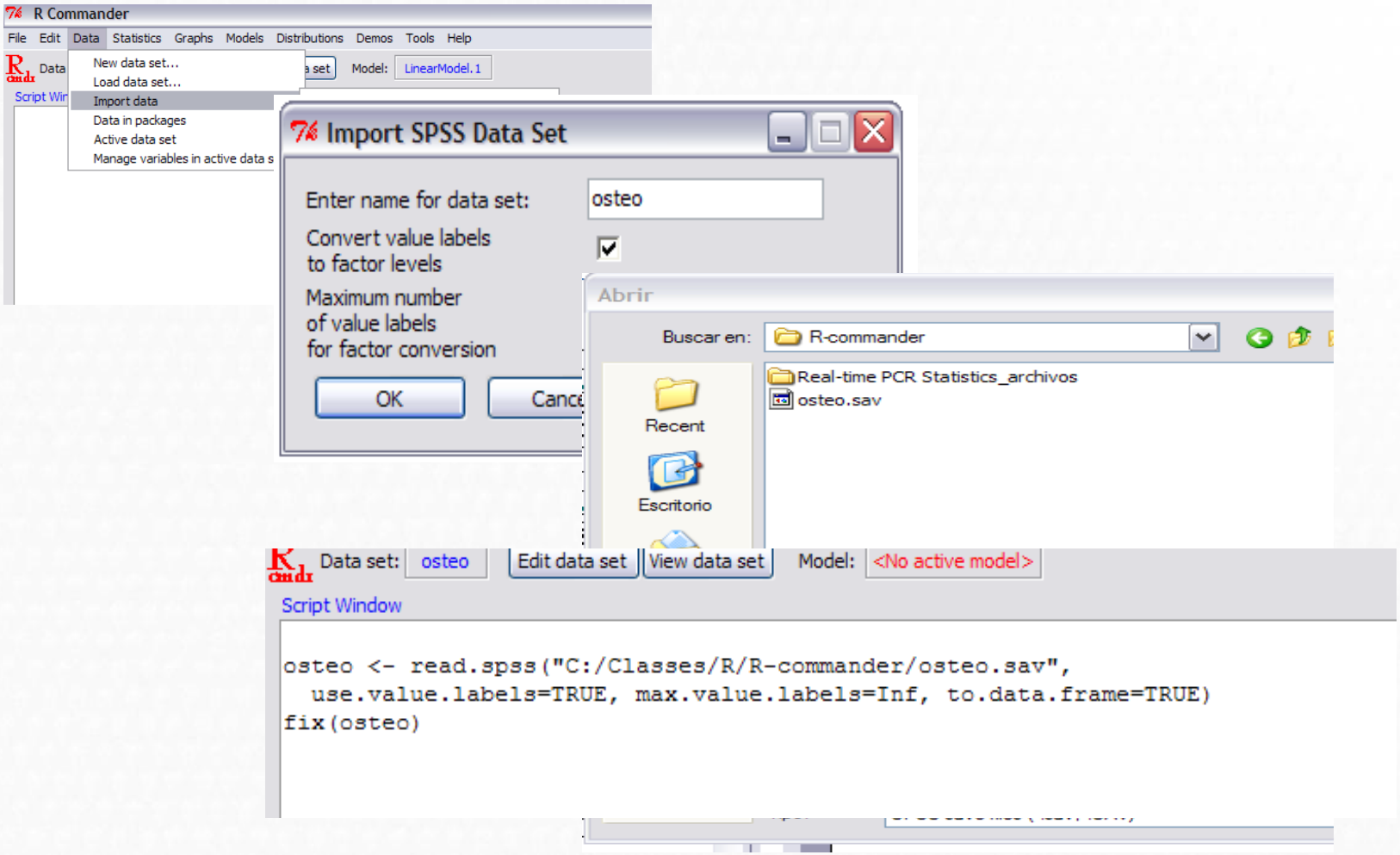
Mensajes

```
[1] NOTA: Versión de R Commander 2.3-1: Thu Jan 26 08:42:06 2017
[2] NOTA: El conjunto de datos Dataset tiene 1000 filas y 15 columnas.
```

How does Rcmdr work

- Similarly to other GUIS:
  - point-and-click
- Without forgetting that it is an interface with R
  - Actions selected in menus
  - Become R commands (in command window)
  - That are automatically executed
- Some "new concepts".
  - Active dataset
  - Active model

Data input (*the first step!*)



Data management (*prior to analysis*)

- Actions defined through Rcmdr menú system are applied to a privileged dataset: the "active dataset".
- The active dataset can be
  - Edited or visualized
  - Transformed row-wise (cases)
    - Add cases, Subset
  - Transformed columna-wise (variables)
    - Add new variables, recode variables
- Any dataset can become "active dataset"

Data Analysis

- R commander provides a series of standard statistical analyses that can be applied to the active dataset
  - Selecting options from menus
  - Configuring operations through forms
- If a given analysis cannot be done in "basic" in R commander it may be available in extensions known as "Rcmdr-plugins"
  - Survival analysis
  - Multivariate statistics, …
  - MORE THAN 30 PLUGINS

Analysis reports

- R commander results go either
  - To the output window
  - To the graphics window
- Once the analyses are completed
  - We may need to copy and paste results to a Word document to create a report.
  - We may need to reproduce the analysis step-by-step
    - To check results
    - To extend or change the prior análisis.
- R commander creates an Rmarkdown document
  - That, when run, generates an HTML or Word document
  - Containing the code from the analysis

Additional souRces

R manuals

* Intro for beginners http://cran.r-project.org/doc/contrib/rdebuts_es.pdf

* SimpleR http://cran.r-project.org/doc/contrib/Verzani-SimpleR.pdf

* Quick-R http://www.statmethods.net/

* Basic statistics with R and R-commander http://knuth.uca.es/ebrcmdr/

* Statistical methods with R and R-commander

http://cran.r-project.org/doc/contrib/Saez-Castillo-RRCmdrv21.pdf

* Try R http://tryr.codeschool.com/levels/1/challenges/1

R books

* Introductory Statistics with R

* R for SPSS and SAS users