BST02: Using R for Statistics in Medical Research

Part A: Introduction

Eleni-Rosalina Andrinopoulou

Department of Biostatistics, Erasmus Medical Center

e.andrinopoulou@erasmusmc.nl

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What is this Course About

Statistics have flourished in the recent years mainly due to the possibility of doing complex analysis using computers

- Many statistical software exist to do simple and specialized analysis

The **programming language R** is popular for data scientists

- Analysts must not only learn how to use the software but also the ideas behind it
- Learning statistical modelling and algorithm is more important than learning a programming language.

The most valuable tool of a modern quantitative researcher is his/her personal computer

What is this Course About (cont'd)

- **Part A**: General Introduction
  - how does the programming language **R** work
- **Part B**: Basic use of **R**
  - getting started with a data set, data visualizations
- **Part C**: Programming
  - using and writing functions, popular functions which you will later need for the more advanced courses such as **Repeated Measurements (CE08)**, **Bayesian Statistics (CE09)**, **Missing Values in Clinical Research (EP16)**, etc.
- **Part D**: Statistics with **R**
  - basic statistical tests, regression analysis
- **Part E**: tools
  - some interesting tools for reporting data analyses in a reproducible manner

Agenda

- **Part A**:
  - What does **R** look like ?
  - What is R ?
  - A brief history of R
  - Why learn R ?
  - Where do I get R ?
  - How does R work ?
  - How to get help in R ?
  - Disadvantages of R

Agenda (cont'd)

- **Part B**:
  - Using R
  - In practice examples
  - Basics in R
  - Common R objects
  - Importing data and saving your work
  - Data transformation
  - Data exploration
  - Data visualization
  - Indexing

Agenda (cont'd)

- **Part C**:
  - Merging data sets
  - Functions
  - Loops
  - The apply family
  - Combine everything we learned

Agenda (cont'd)

- **Part D**:
  - Statistical tests
  - Regression models
  - Dummies, interaction and nonlinear effects
  - Survival models
  - Visualization of results

Agenda (cont'd)

- **Part E**
  - Markdown
  - Creating reports

Schedule

- February 24: 10h00 - 13h00, 14h00 - 17h00
- February 25: 10h00 - 13h00, 14h00 - 17h00
- February 26: 10h00 - 13h00, 14h00 - 17h00
- February 27: 10h00 - 13h00, 14h00 - 17h00

Exams

- Date: February 28: 14h15 - 17h00
- Format: Assignment
- Open-book

Structure & Material

- Lectures: slides interchanged with live **R** sessions
- Practicals in-between the lectures
  - you will be asked to perform small and big tasks
  - solutions of the practicals available beforehand
- Material
  - slides
  - **R** code with the output
  - **more than what we are going to cover!**

Structure & Material (cont'd)

- You are welcome to try along

- You are welcome to interrupt and ask questions

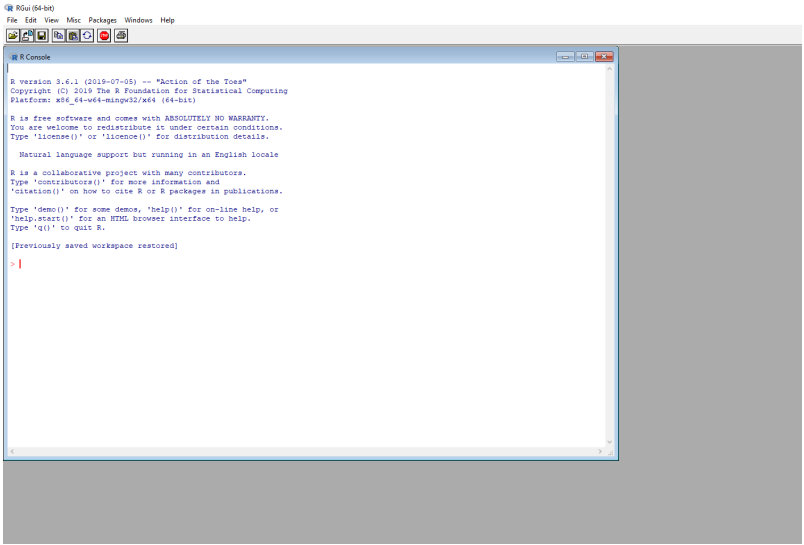
References

- More books that use R (or S) can be found at:

http://www.r-project.org/doc/bib/R-books.html, or
http://www.r-project.org/doc/bib/R-jabref.html

- R ships with a number of helpful manuals (illustrated later)
- Other manuals and helpful material are available on-line via CRAN:
  http://cran.r-project.org/other-docs.html

What does R look like ?



What is R

- **R** is a software environment for statistical computing and graphics
  - extensive catalog of statistical and graphical methods
- **R** is mainly used in academia. However, many large companies also use **R** programming language, including healthcare industries but also Uber, Google, Airbnb, Facebook and so on
- Unlike SPSS, **R** is purely command driven

A brief history of R

- **1993**: University of Auckland, New Zealand by Ross Ihaka and Robert Gentleman
- **1997**: R core Team was formed (20 members)
- **2000**: R 1.0.0 released
- **2004**: First international user conference in Vienna
- **2013**: 5026 packages available
- **2017**: 10875 packages available
- **Now**: `nrow(available.packages())`

Why learn R ?

- **R** is a free software environment for statistical computing and graphics
- It compiles and runs on LINUX, Windows and MacOS
- Open source language
- Users are allowed to modify and redistribute the code
- Advanced statistical language
- Supports extensions
- Related to other languages
- **Flexible and fun!**

Where do I get R ?

- http://cran.r-project.org
- choose your platform, e.g., Windows, Linux
- e.g., for Windows: Windows $\rightarrow$ base $\rightarrow$ Download R 3.6.2 for Windows
- Install . . .

How does R work ?

- Packaged built for specific tasks
- Download R packages from the CRAN web site → within R
  - Packages
  - Install package(s) . . .
  - make you choice(s)
  - load the package using library() (note: install does not mean load)

How to get help in R

- Within R
  - help.search("topic") or ??"topic" (depends on the installed packages)
  - RSiteSearch("topic") (requires internet connection)
  - help() or ? invoke the on-line help file for the specified function
  - checking the FAQ
- Online
  - R-help (https://stat.ethz.ch/mailman/listinfo/r-help – mailing list)
  - R-seek (http://www.rseek.org – Google-like searched engine)
  - CRAN Task Views (http://cran.r-project.org/web/views/ – categorization of packages)
  - Crantastic (http://crantastic.org/ – categorization of packages + reviews)
  - R4stats (http://www.r4stats.com/ – examples of basic R programs)
  - R related Blogs (http://www.r-bloggers.com/ – many useful illustrations of R and R packages)
  - Open community for developers (https://stackoverflow.com/ – ask/answer a question)

Disadvantages of R

- Appears intimidating to the first-time user
- Output is not so nice looking (but there are some alternatives)
- Exporting output is more difficult
- Cannot easily handle very big data sets (depends on the installed RAM)
- A lot of things are available but it is sometimes hard to find your way
- The quality of the available packages is greatly varying
- Has been criticized for using only one CPU at a time (but the parallel packages helps you perform tasks in different cores)

Summary

- **R** is a great tool to explore and investigate the data
- Several statistical methods can be performed with **R**
- It is important to understand the methods before applying them in **R**

How to use

R uses packages that perform specific tasks

- Install package only once
- Load package every time you open **R**