

# BST02: Using R for Statistics in Medical Research

## Part A: Introduction

Eleni-Rosalina Andrinopoulou

Department of Biostatistics, Erasmus Medical Center

✉ [e.andrinopoulou@erasmusmc.nl](mailto:e.andrinopoulou@erasmusmc.nl)

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# What is this Course About

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**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

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- ▶ **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

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## ► **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

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## ► **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

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

# Agenda

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

# Agenda

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



# Schedule

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- ▶ 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

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

# Structure & Material

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- ▶ 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

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- ▶ You are welcome to try along
- ▶ You are welcome to interrupt and ask questions

## References

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- ▶ 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

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- ▶ **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

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- ▶ **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 ?

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- ▶ **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 ?

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- ▶ <http://cran.r-project.org>
- ▶ choose your platform, e.g., Windows, Linux
- ▶ e.g., for Windows: Windows → base → Download R 3.6.2 for Windows
- ▶ Install . . .

## How does R work ?

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- ▶ Packages 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

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- ▶ 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

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- ▶ 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

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- ▶ **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**