BST02: Using R for Statistics in Medical Research

Part A: Introduction

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24 - 28 February 2020

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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)**, 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
  - Visualization of data
  - 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

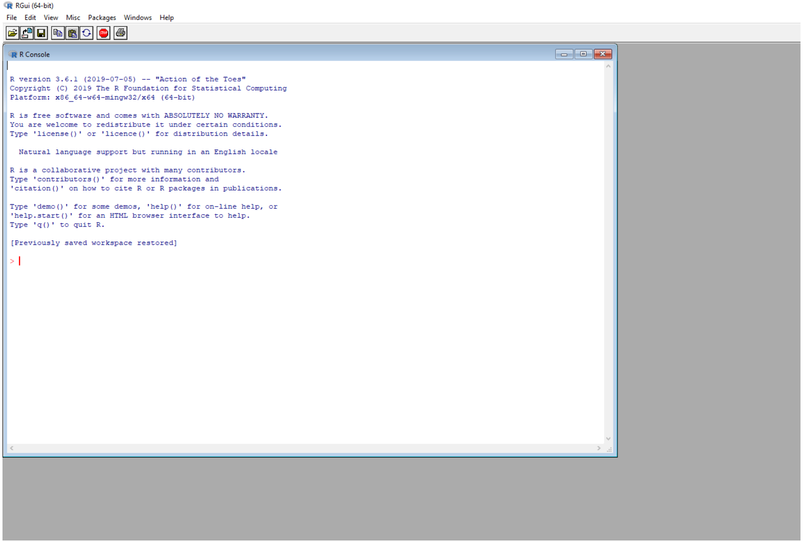
References

- 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 ?



```
R version 3.6.1 (2019-07-05) -- "Action of the Toes"
Copyright (C) 2019 The R Foundation for Statistical Computing
Platform: x86_64-w64-mingw32/x64 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

  Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

[Previously saved workspace restored]

>
```

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 → base → 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**