Introduction to R, Rstudio & Project Management

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swc-bb.github.io/2017-05-17-r-workshop

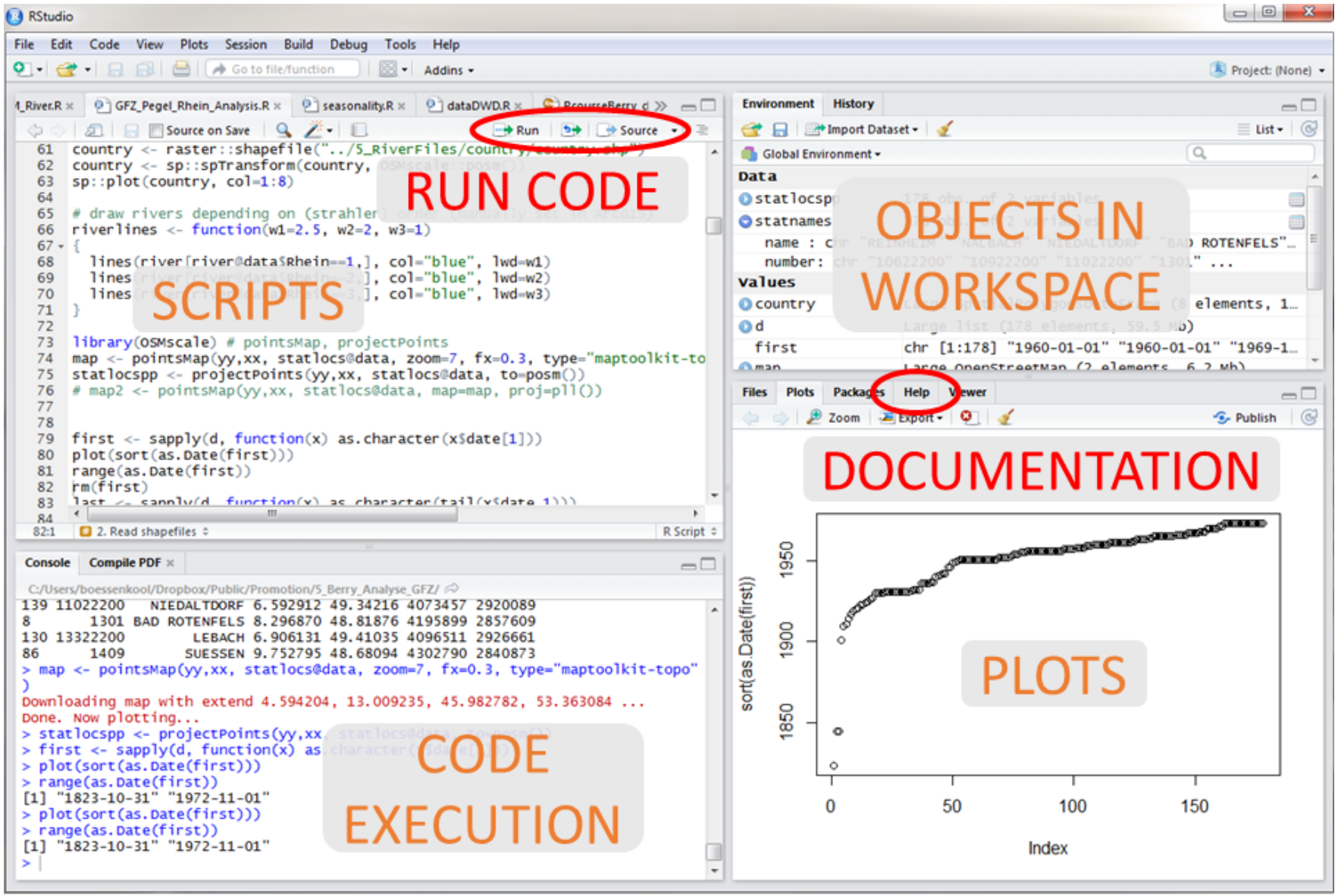
Presentation template generated with `berryFunctions::createPres`

Survey

knowledge survey to determine focus for this session

bit.ly/knowR

RStudio


RUN CODE
SCRIPTS
OBJECTS IN WORKSPACE
DOCUMENTATION
PLOTS
CODE EXECUTION
sort(as.Date(first))
Index

RStudio configuration

keyboard shortcuts (`ALT+SHIFT+K`)

Recommended settings for reproducible research under
Tools - Global Options - General
ON: Restore previously open source documents at startup
OFF: Restore .Rdata into workspace at startup
Save workspace to .RData on exit: **NEVER**

Instead use `save(object, file="object.Rdata")` *after long computations. You can load them later with* `load("object.Rdata")`.

Tools - Global Options - Code - Display
ON: Show margin (Margin column:80) *People hate horizontal scrolling!*

Tools - Global Options - Code - Saving
Line ending conversion: **Windows (CR/LF)**

Assignments

- objects: assignment with $<-$

```
nstudents <- 15
nstudents
nstudents > 12
```

- Rstudio Keyboard shortcut: `ALT` + `-`
- What's a good object name? $\rightarrow$ short, but explanatory, lowerCamelStandard.or.dot_or_underscore are good naming conventions
- comments: `# everything after a hashtag is not executed.`

Exercise

- Open Rstudio, start new script. Write comments about what you do, save the file in a useful place.
- Calculate `21+21` , `7*6` and $\frac{0,3}{4} * \sqrt{313600}$
- Is `0.5 - 0.2` equal to `0.3`? Is `0.4 - 0.1` equal to `0.3`?
- With the `c` command, create a vector with body sizes of people around you. You can also use the values 1.75, 1.76, 1.83, 1.84, 1.77, 1.76, 1.77, 1.66, 1.86, 1.76
- What does `3:6` create? What does `YourObject[3:6]` do?
- What does `YourObject[-4]` do?
- BONUS (for fast people): Analyze the descriptive statistics: `mean(YourObject)`, `median`, `min`, `max`, `range`, `quantile`
- BONUS 2: Generate 150 random numbers from a normal distribution with $\mu = 170cm$ and $\sigma = 8cm$. Perform a Kolmogorov-Smirnov test for normality of that sample.

Reading files

- Copy the file `treesize.txt` (from bit.ly/swc_tree)
- Tell R where to look for it with: `setwd("C:/path/to/input")`
  `# change back- to forwardslashes`
- Read the file into R with the command `read.table`.
- If R tells you "no such file" exists, check the output of `dir()`.
- Use the documentation to find out the correct settings of the arguments: `help(read.table)`, `?read.table`, or press F1.
- `str(YourObject)` must yield the column data types: `num, num, factor`.
- You need to set the argument `header`.

```
treesize <- read.table(file="treesize.txt", header=TRUE)
```

Objects

- Check the objects in your workspace with `ls()`.
- Remove objects with `rm(YourObject, AnotherOne)`
- Remove all objects with `rm(list=ls() )`
- Or just the Rstudio button
- To make sure your script is reproducible (you may rename objects, for example, and miss one occurrence):
  restart R (`CTRL` + `SHIFT` + `F10`) every once in a while (Make sure Rstudio settings are reproducible as shown on slide 4).

Overview: data types

In order of coercion (if mixed, TRUE is converted to 1, 3.14 to "3.14" etc)

Description	example	`typeof`	`class`
empty set	NULL	NULL	NULL
not available	NA	logical	logical
logical	c(T, F, FALSE, TRUE)	logical	logical
category	factor("left")	integer	**factor**
integer number	4:6	integer	integer
decimal	8.7	double	**numeric**
complex	5+3i	complex	complex
character string	"homer rocks"	character	character
time	Sys.time()	double	**POSIXct**
date	as.Date("2017-05-02")	double	**Date**
function	ncol	closure	**function**

adv-r.had.co.nz/Data-structures. `as.character(3.14)` converts a data type; `is.integer(4:6)` checks. `str` shows an abbreviation of `class`. `mode` (for users) is like `typeof` (R internal), but combines integer and double to numeric (& closure, special and builtin to function). When mixing date/time with others, the order of appearance determines the output class.

Overview: Object types

Object	example	`typeof`	`class`
vector	*see data types*	...	...
matrix	matrix(9:15, ncol=2)	...	matrix
array	array(letters[1:24], dim=c(2,6,4))	...	array
data.frame	data.frame(C1=4:5, C2=c("a","b"))	list	data.frame
list	list(el1=7:15, el2="big")	list	list
function	function(x) 12+0.5*x	closure	function
...	lm(b ~ a)	list	lm

A `matrix` consists of only one data type. If you accidentally change one element to a character, all are converted and calculations are not possible any more (See coercion order in previous slide).
`data.frame`s can have multiple data types, but a column in itself also has only one type.
`list`s can combine anything, even other lists.
`is.atomic(Object)` returns TRUE (vector, matrix, array) or FALSE
`as.matrix(Object)` converts the class of an object by force.

R Packages

- Many people write code for specific tasks and publish it on CRAN, the Comprehensive R Archive Network
- Packages for a range of topics: cran.r-project.org/web/views
- All >10'500 available packages: cran.r-project.org/web/packages
- `install.packages("ggplot2")` to download and install.
  (only needs to be executed once, works on user level, no admin rights required)
  You can do this in Rstudio
- `library("ggplot2")` to load it
  (needed in every new R session) Put this in the script for reproducibility
- Better to use the `package::function` syntax
- Regularly run `update.packages()` or use the Rstudio button
- Rarely needed: `remove.packages("packagename")`

Linear Regression

- Install and load the package `berryFunctions`
- How can we pass the treesize data to `?linReg` with a formula?
- Describe the resulting graph (height vs age).
- Look into the source code of `linReg`. What is actually the backbone for the calculation of the function?
- Feed the data into `lm`, assign the output to an object (useful name!).
- Briefly explain the `summary` of the linear model.

More things

- Connect Rstudio to github
- Plotting

Objects: data.frames

- For tables with different data types (numbers, characters, categories, integers), R has the object type data.frame: `data.frame(count=c(2,6,5), type=c("a","k","k"))`
- `read.table` also returns a data.frame
- If we have the object `df`, we can subset with `df[rows,columns]`
- `df[1,2:4]; df[2, ]; df[ ,"name"]; df$name`
- Logical values: `vect[c(TRUE,TRUE,FALSE,FALSE,TRUE,FALSE)]`

From the dataset `treesize` from the previous exercise, obtain:

- The first 5 values in column 2
- The maximum "Height" (the maximum of the values in that column)
- For each entry: is the measurement equal to (==) A?
- BONUS 1: The height entries for trees older than 23.5 years
- BONUS 2: All rows, excluding rows 3, 7,8,9,...,20