Basic Introduction to

Simon Knüsel

Forest Dynamics, WSL

simon.knuesel@wsl.ch

Goals

- Start to code
- Learn how to use R for the analysis of your data
- Know where and how to get help if you are stuck

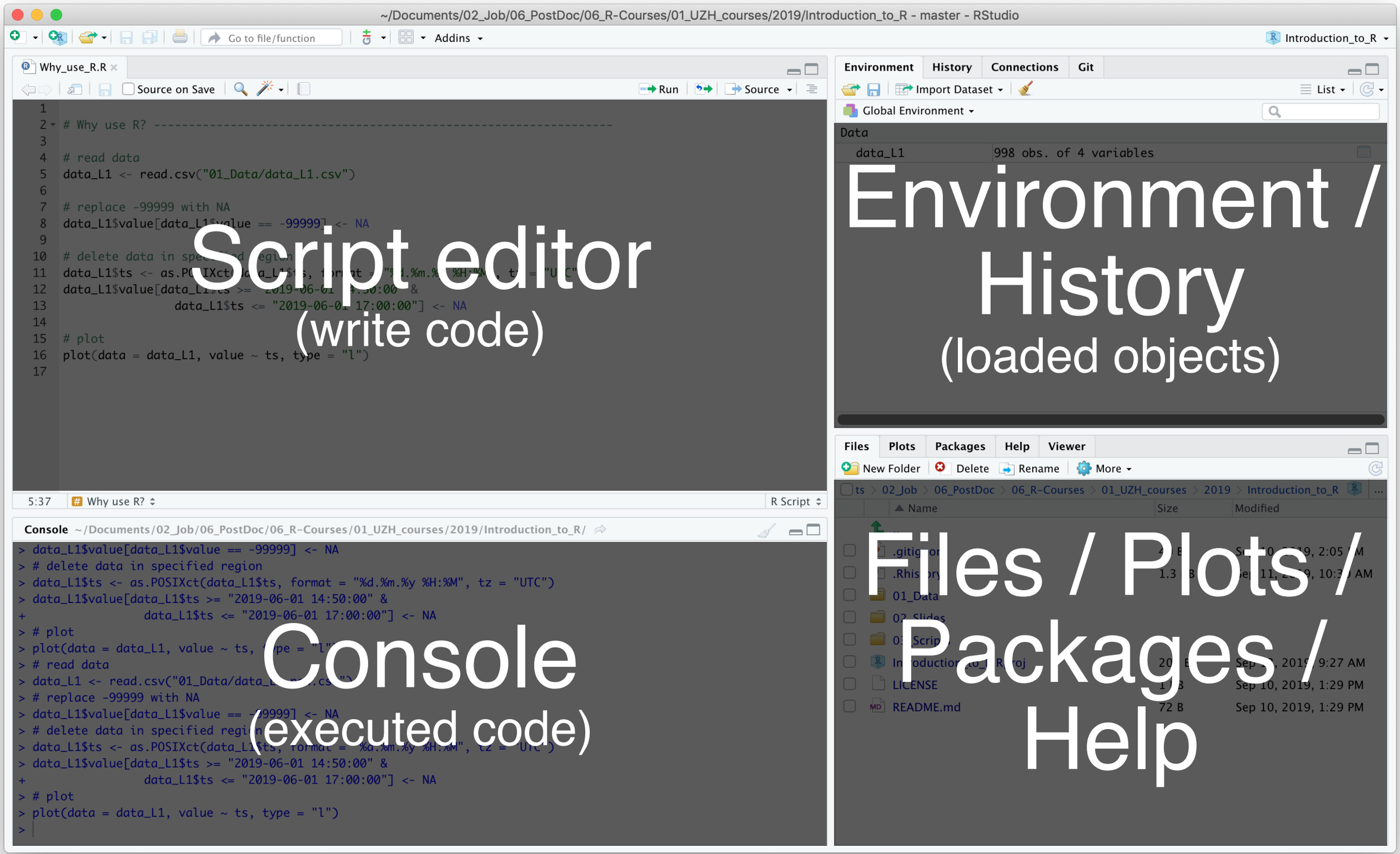
Why use R?

- Reproducibility
- Keep original data untouched
- It is open source…
  with a large community
- Advanced statistics
- State-of-the-art graphics
- Powerful data manipulation
- Supports large datasets
- Fast computation
- Easier automation
- Anyone can contribute
- …

R vs. RStudio

- R is a programming language that runs in the program 
- RStudio adds a more structured user interface to R and uses the R language (*RStudio is an Integrated Development Environment (IDE) in which one can use the R language*)
- **RStudio can not run independently of R!**

RStudio



Script editor
(write code)

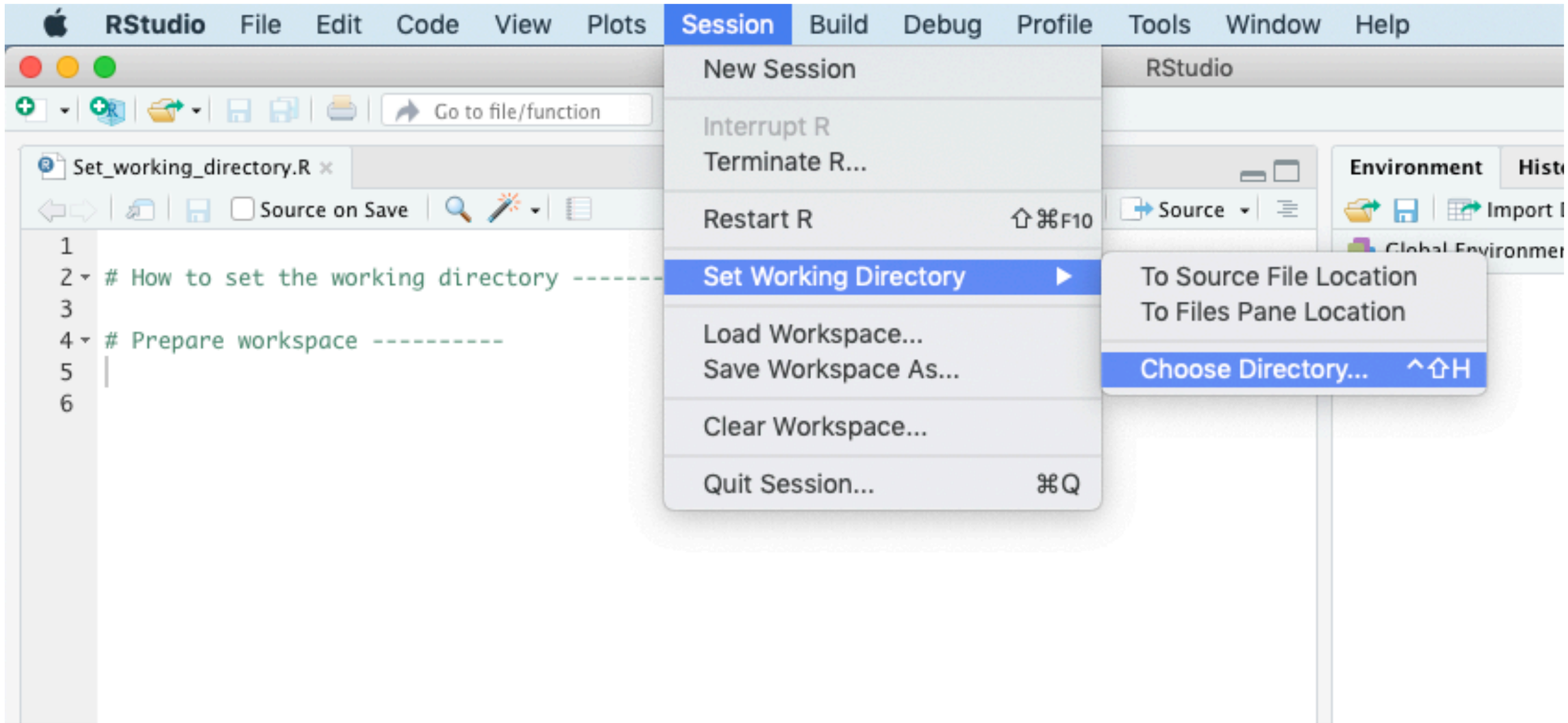
Environment / History
(loaded objects)

Console
(executed code)

Files / Plots / Packages / Help

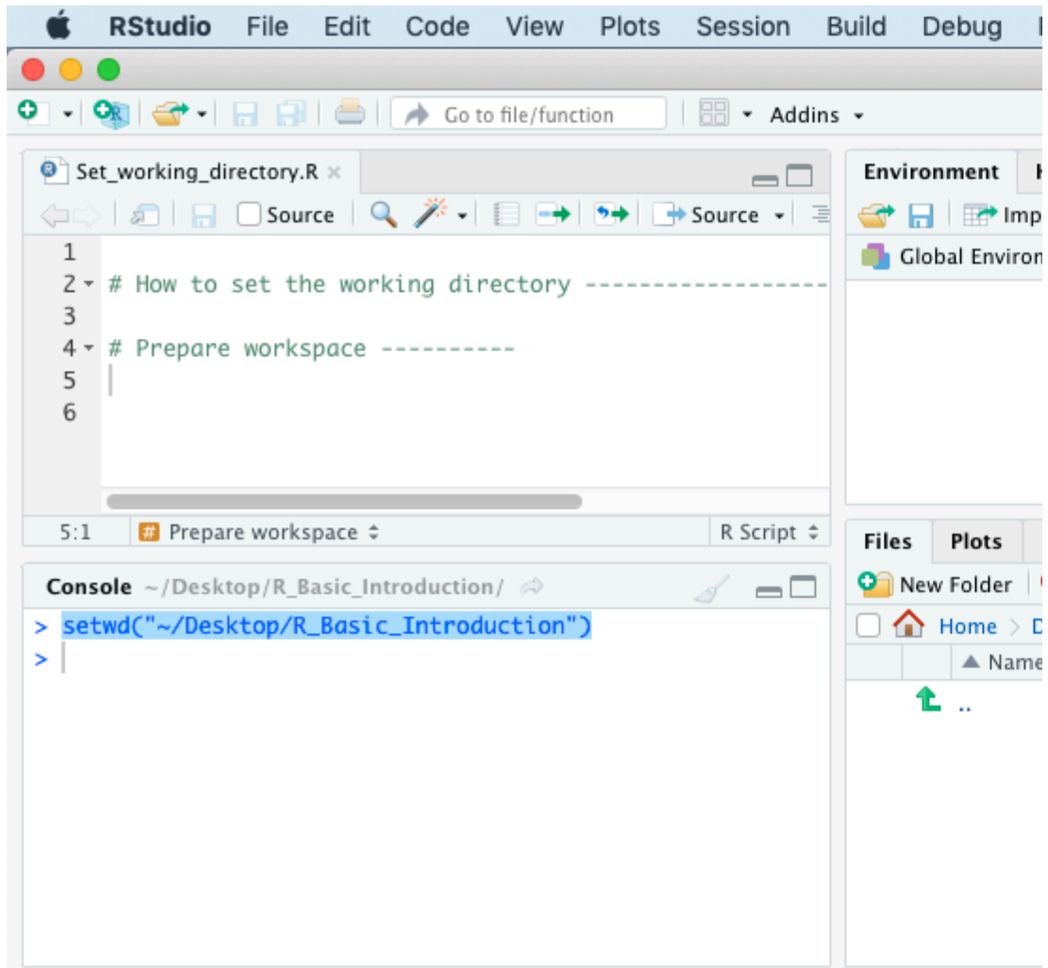
Set working directory

1) Choose the working directory from file
   Session > Set Working Directory > Choose Directory…

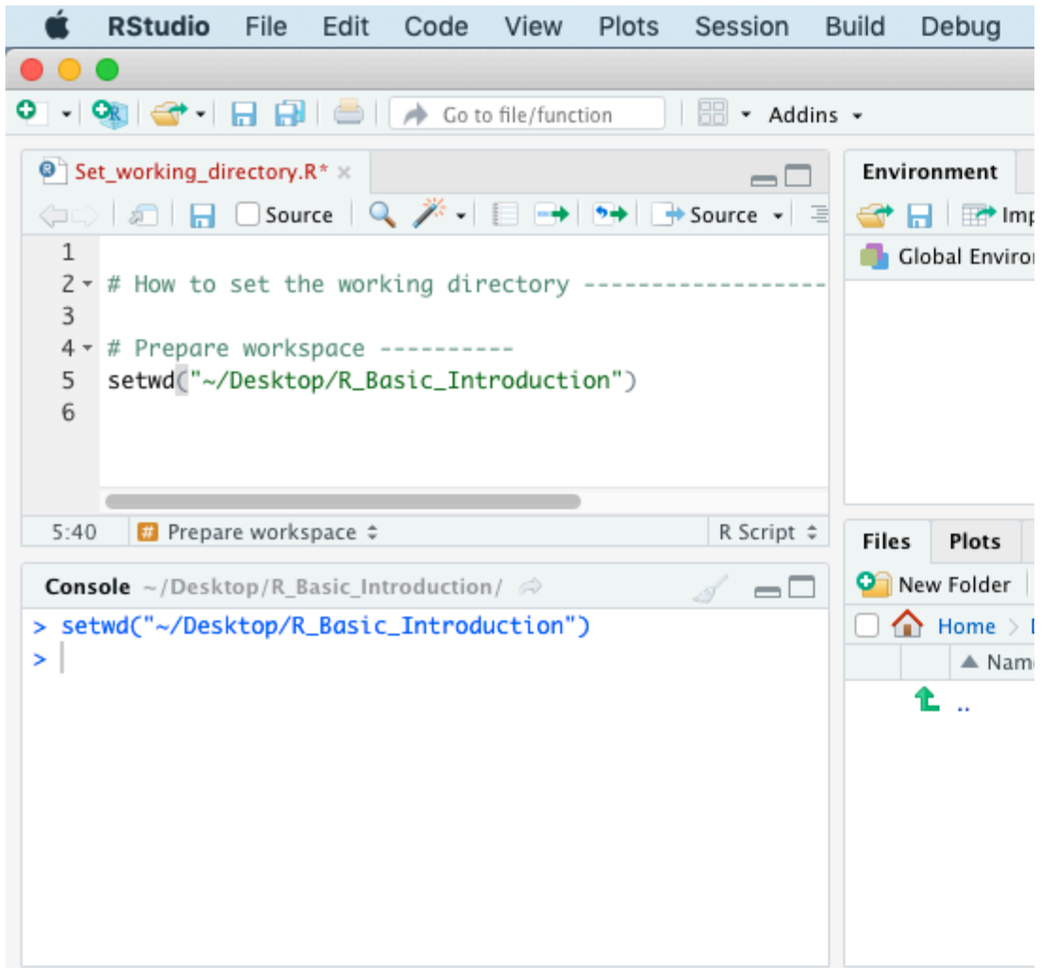


Set working directory

2) Copy the code output in the console



3) Paste it into the R-script



Functions

```
function_name(first argument, second argument, …)
```

Example:

```
vec <- c(3, 6, 7, 4.2, NA, 6, 8)
```

```
mean(x = vec, na.rm = TRUE)
```

Help on functions:

```
?mean (?function_name)
```

Data structures

Vector

Elements separated by a comma

```
vec <- c(3, 6, 7, 4.2, 6, 8)
```

Data frame

Table with rows and columns

Species	Length (cm)	Height (cm)	Weight (kg)
Lynx lynx	112	65	22.5
Canis lupus	145	78	34

Indexing of vectors

```
vec <- c(3, 6, 7, 4.2, 6, 8)

# select the first element of the vector
> vec[1]
```

```
3
```

Indexing of vectors

```
vec <- c(3, 6, 7, 4.2, 6, 8)

# select the first element of the vector
> vec[1]
3

# select elements 1 to 3
vec[1:3]
3 6 7
```

Indexing of data frames

```
df <- airquality
View(df)

# select first row
df[1, ]

# select thrid column
df[, 3]


df[row, column]
```

	Ozone	Solar.R	Wind	Temp	Month	Day
1	41	190	7.4	67	5	1
2	36	118	8.0	72	5	2
3	12	149	12.6	74	5	3
4	18	313	11.5	62	5	4
5	*NA*	*NA*	14.3	56	5	5
6	28	*NA*	14.9	66	5	6
7	23	299	8.6	65	5	7
8	19	99	13.8	59	5	8
9	8	19	20.1	61	5	9
10	*NA*	194	8.6	69	5	10
11	7	*NA*	6.9	74	5	11
12	16	256	9.7	69	5	12
13	11	290	9.2	66	5	13
14	14	274	10.9	68	5	14
15	18	65	13.2	58	5	15
16	14	334	11.5	64	5	16
17	34	307	12.0	66	5	17
18	6	78	18.4	57	5	18

Indexing of data frames

```
# select custom range
df[c(3:5, 7), 3:4]
```

	Ozone	Solar.R	Wind	Temp	Month	Day
1	41	190	7.4	67	5	1
2	36	118	8.0	72	5	2
3	12	149	12.6	74	5	3
4	18	313	11.5	62	5	4
5	*NA*	*NA*	14.3	56	5	5
6	28	*NA*	14.9	66	5	6
7	23	299	8.6	65	5	7
8	19	99	13.8	59	5	8
9	8	19	20.1	61	5	9
10	*NA*	194	8.6	69	5	10
11	7	*NA*	6.9	74	5	11
12	16	256	9.7	69	5	12
13	11	290	9.2	66	5	13
14	14	274	10.9	68	5	14
15	18	65	13.2	58	5	15
16	14	334	11.5	64	5	16
17	34	307	12.0	66	5	17
18	6	78	18.4	57	5	18

Shortcuts

	Mac	Windows / Linux
Run line	Cmd + Enter	Ctrl + Enter
# (Comment line)	Alt + 3	#
%>% (Pipe sign, used in dplyr package)	Cmd + Shift + M	Ctrl + Shift + M
Show keyboard shortcuts	Alt + Shift + K	Option + Shift + K

Update 

If you see a variation of the following warning message after you load a package:

```
library(dplyr)
Warning message: package 'dplyr' was built under
R version 3.5.1
```

- It is time to update R

Update 

- You need to download and re-install R from: https://www.r-project.org/

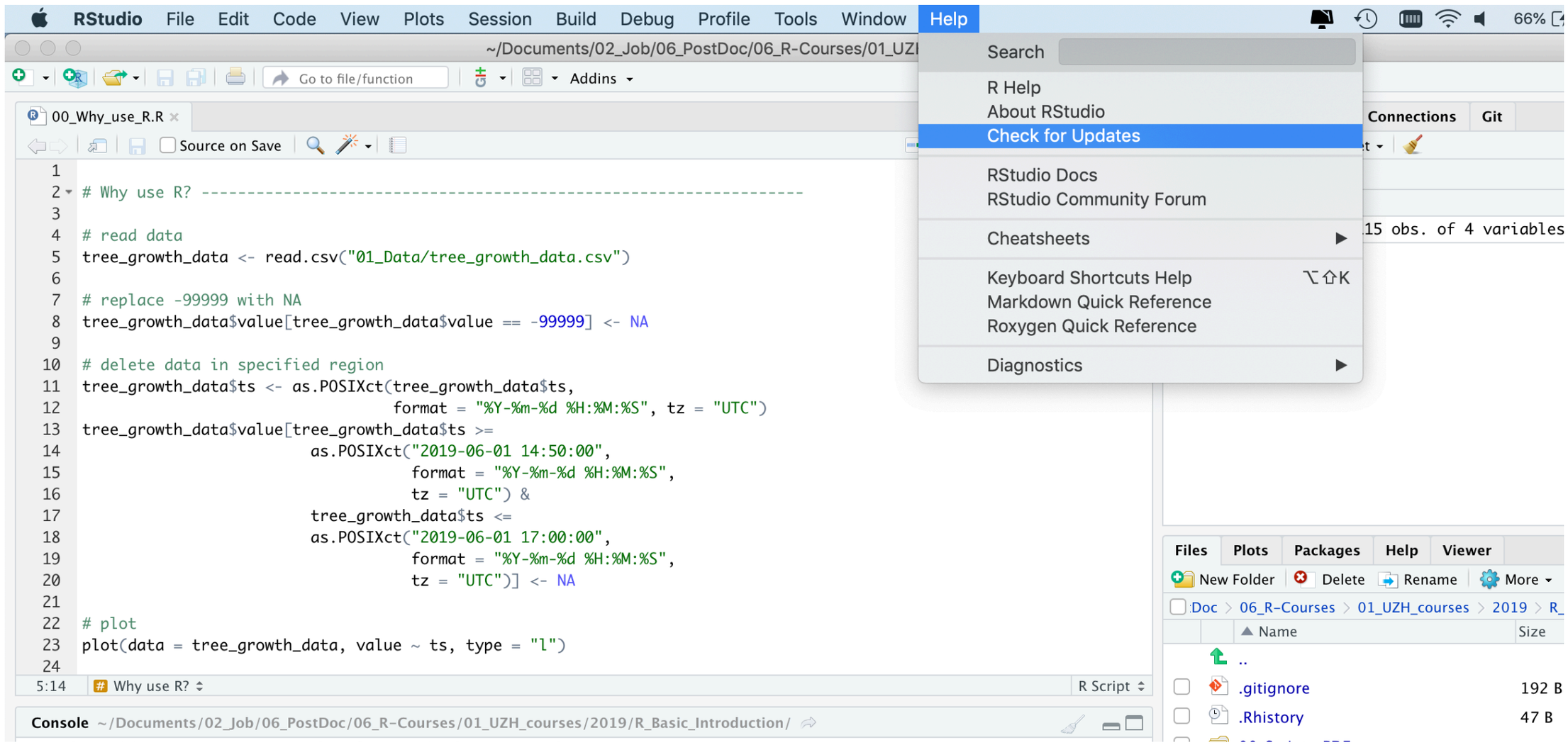
- After the installation RStudio will automatically recognise the new R version.

- You have to re-install the packages after the installation of a new version of R.

  (*Attention*: Few *old packages* might not run on the new R version. However, you can have multiple versions of R on your computer or downgrade to a previous version)

Update RStudio

Check from time to time whether there is a new version of RStudio available (Help > Check for Updates)



Capabilities of R

- Nice graphs
  https://www.r-graph-gallery.com/violin_and_boxplot_ggplot2.html

- Maps with R
  https://www.r-graph-gallery.com/choropleth-map.html

- Interactive web applications (R Shiny)
  https://shiny.rstudio.com/gallery/movie-explorer.html

- R and databases
  https://db.rstudio.com/getting-started/connect-to-database

Where to get help

- Websites
    - RStudio Cheat Sheets
      https://www.rstudio.com/resources/cheatsheets/
    - Google
      e.g. „r how to merge two data frames“
    - https://stackoverflow.com/
    - https://www.r-bloggers.com/
- Online book
    - R for Data Science
      https://r4ds.had.co.nz/

…more help

- Other R courses
    - R: tidyverse for data science (UZH) https://app.connect.uzh.ch/apps/id/kurse.nsf/veranstaltungen.xsp
    - Specialised R-Workshops (2 days, 1ECTS for PhD students, Plant Science Center) https://www.plantsciences.uzh.ch/en/teaching/phdplantscience/coursecatalogue.html
    - Zurich R Courses https://www.zhrcourses.uzh.ch/en.html
    - Specialised R-Workshops (1 day intensive course, small groups) https://ethz.ch/services/de/it-services/katalog/support-weiterbildung/it-training/kurse.html

Sources

For the development of this course I was mainly inspired by the course material of Jan Wunders *R* course

Introdution to R (Wunder, 2016)