R foundations Handout

Paula Andrea Martinez

2018-02-19

Getting started

Start out by installing R and then RStudio[1]

[1] See installation instructions installation.md

Remember

- R is **case sensitive**
- **No spaces** in names
- Be ready to learn a **new language**

Hands-on Training

- This is a hands-on training :)
- It is interactive, which means your interaction and awareness will improve your learning
- Questions are always welcome
- Let's start with short introductions

Starting with programming

Learn things that last longer - pick your battles - Learn the fundamentals[2]

[2] "Learning to code is a never ending journey with a set of challenges and delights unique to each person"

This workshop aim

On the workshop, we aim to go from gaining new knowledge to comprehension of the foundations of R.[3]

[3] Key levels of learning

What is R and Rstudio

R is a powerful programming language for data analysis, statistics, visualisation and more. RStudio is the program that interacts between you and the R language. R and RStudio are two freely available software with a huge community of users and developers.[4]

[4] resources

What are we going to learn?

At the end of this session you will be able to:

- Create a project for data analysis

- Execute basic operations in R
- Find an R style guide
- Practice using the help from R in RStudio
- Describe differences between R data types and R data structures
- Read tabular data into R
- Select subsets of your data
- Describe how to diagnose programming problems and to look up answers from the web or forums
- Recall how to install packages

Rstudio interaction

Our analysis should be located in a findable and accessible location. Getting used to a reusable project structure is good practice for our project data management.

Please create a folder called **RProjects** under the **Documents** folder

Exercise 1 - New Rstudio Project (4 min)

[5]

[5] FYI: Projects make managing multiple directories straightforward

- RStudio menu (top left corner): click **File** menu button,
- Then **New Project**
- Click **New Directory**
- Click **New Project**
- In Directory name type the name of your project, e.g. **Rfoundation** (Browse and select a folder where to locate your project, e.i. the **RProjects** folder)
- Lastly, click the **Create Project** button

Panes or panels

There are four main panels on RStudio. We will soon work on these panels, but first be shortly introduced.

1. The upper-left panel is the editor where we interact with code and scripts.
2. The panel in the upper-right, where it says *Environment is empty* will show you the variables that you are currently working with.
3. The lower-left panel is called the console, which runs the R code. It only saves the code temporarily so it is mostly used as testing ground.
4. The panel in the bottom-right will display files, plots, packages, help and more.

Exercise 2 - Folder structure (3 min)

Create two folders in your project

- scripts
- data

In RStudio, you can use the fourth panel, click **Files** then **New Folder**.

When in doubt of naming conventions check[6].

[6] a style guide

Exercise 3 - New R script (2 min)

- RStudio menu (top left corner): click **File**, then **New File**, then **R script**. Did you see the shortcut? You can also create a new script with *Ctrl+Shift+N*, for mac users replace *Ctrl* for *command*. There is another button close by, maybe you already found it
- Save your script. You can click on the save icon or *Ctrl+S*. Select the **scripts** folder and type a name like **learning.R**. [7]
- Now, check with your neighbour if they have finished too, maybe they need more time, or maybe you can help out

[7] [The **.R** extension is important for R to recognise your script]

Exercise 4 - Add comments to your new R script file (3 min)

Comments start with a hash # and follows with a single space

```
# Description:
# Author:
# Date:
```

To add a section

```
# Starting with calculations --------------------------
```

From now on, I will recommend you to add a new section for each exercise, and comments on every line.

R syntax

Tip: To have a readable code, use spaces around all symbols and after commas.

To get the hang of R, we start using it as a calculator. Type 2 + 2 directly into the console panel and press enter. You should see this:

```
2 + 2
```

```
## [1] 4
```

Exercise 5 - Try any other calculation (2 min)

- In your new script try a new calculation, and add comments
- To run code from a script you need to click *Ctrl+Enter* or click the button **Run** (green right direction arrow)

R variables or objects

R can calculate, but we would also like to save these results. We can store one or multiple values in *variables* to access them later.

- Syntax: **variableName <- value**
- Notice the symbol **<-** its called **assignment operator**
- Values can be fixed, calculated or a result of a transformation

When in doubt of naming conventions and style check[8]. Let's create a few variables together

[8] a style guide

```
# Creating a few variables --------------------------

# text should be inside double quotes
today <- "Monday"
# numbers can be small, long or with decimals
howManyPeople <- 21
# Sometimes we need to save yes or no answers,
# write TRUE or FALSE in upper case
myAnswer <- TRUE
```

Exercise 6 - Naming and syntax (4 min)

Now, stop for a sec and have a look at the style guide[9] again and discuss with your neighbour. If you are keen and there is time, feel free to change the values of the variables we just created.

[9] style guide

Functions

Figure 1: A simple function

How to get help

To use functions we first need to learn how they work.

There are three ways to find help using RStudio[10]

1. ?functionName
2. help(functionName)
3. Press **F1** or **command F1** on the functionName

From now on, I will encourage you to use the help for any new function you encounter.

[10] The help panel will show you the Documentation with examples at the end

Exercise 7 - Using the help on RStudio to find your variables (1 min)

- What does `ls` stand for?
- test `ls()` on your script
- How many variables do you have in your environment?

R data types

We had created these three variables with specific R data types

- numeric
- logical
- character

Exercise 8 - Check the R data type of your variables using `class` (2 min)

- Articulate a description of each R data type

Data structures

- vector
- matrix
- data.frame

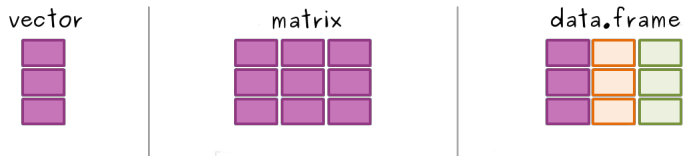


Figure 2: Structure graph

Example of a numeric vector

We use the function `c()` to combine values and create vectors

```
track <- c(10, 2, 5.3, 6, -25, 14) # numeric vector
track
```

```
## [1]  10.0   2.0   5.3   6.0 -25.0  14.0
```

Exercise 9 - Create a vector (3 min)

You can create either a vector of characters or a vector of logicals

- If you create a vector of characters use quotes `""` for each value
- If you create a vector of logicals use `TRUE` and `FALSE` as values

These is how the results should look

```
## [1] "one"   "two"   "three"
```

```
## [1]  TRUE  TRUE FALSE
```

Exercise 10 - Discuss with your neighbour (2 min)

- Did an error come up? Could you fix it?
- Did you use the help?
- Did you google up for hints?

Exercise 11 - Other structures (4 min)

Use the help to find out more about

- `factor`
- `list`
- Can you find an example of your own data where you can use one of these structures?

Import files

Let's introduce some data to R.

First, make sure you have a data folder!

Remember R is **case sensitive**

```
download.file(url = "http://tiny.cc/csvexample",
              destfile = "data/example.csv")
```

```
mydata <- read.csv(file = "data/example.csv")
```

Exercise 12 - Importing data into R (4 min)

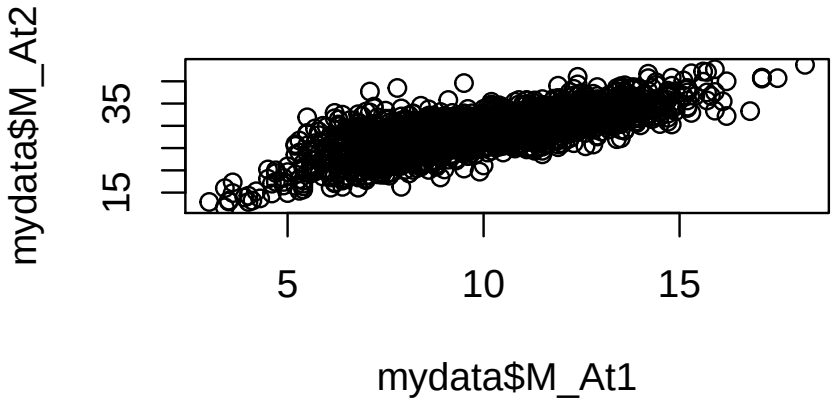
- Use the code above to import data into R.[11]
- It is recommended that you always use the help to find out more about the new functions before using them.[12]
- checkout the function `str` with your new variable

[11] You can either read the example.csv file or copy another csv file to your data folder
[12] You can also read other kinds of files using `read.table` or use functions from packages like **readr**

Exercise 13 - Let's discuss

- what have you learned from the new functions?
- what kind of data did you read into R?
- is `str` useful?

```
# let's now create a plot
plot(x = mydata$M_At1, y = mydata$M_At2)
```



Install packages

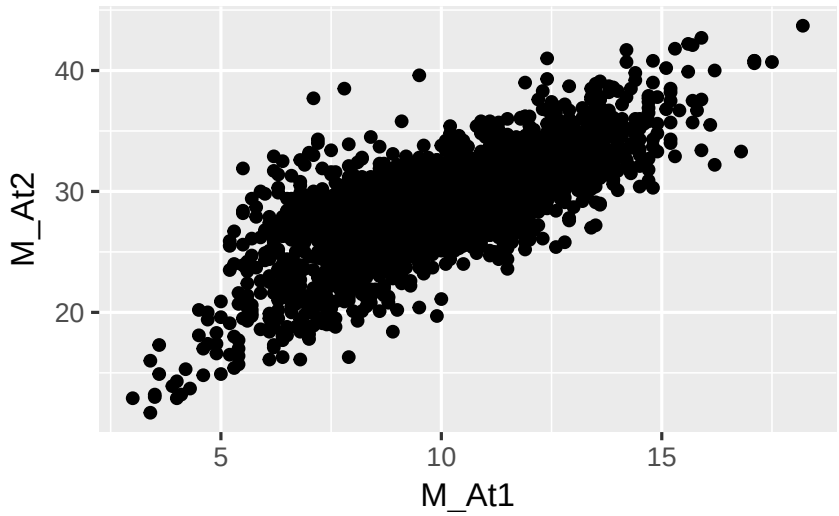
Most R packages can be installed like this: `install.packages("packageName")`
After installing, you need to load it using `library(packageName)`.
You will need to load a package for each new R session.
Then, go to the fourth panel and select the packages tab, after loading a package it should be checked.
You can also check `sessionInfo()`

Exercise 14 - Install the ggplot2 package for graphics (3 min)

- Use what you have learned to install the ggplot2 package. After that, if you are keen you can install the tidyverse package.

```
library(ggplot2)

ggplot(data = mydata,
       mapping = aes(x = M_At1, y = M_At2)) +
  geom_point()
```



Exercise 15 - how to find help on the web (7 min)

- Your task is now to create a new ggplot with colours. It can be any kind of ggplot and you can use any colour
- You need to google is out, you can work in pairs

This is the start of your own R self-learning path

Now look at your script, look how good you are doing, and you can keep going.

Resources

There are plenty of R resources, these are only a few.

Feedback

To finish up please send your anonymous feedback through this link before leaving `http://tiny.cc/elixir_feedback`

Close project

File close project (save your data if you want), then you can close RStudio.

Open source

This handout was written in Rmarkdown and uses the open-source style Tufte. It has been published in Github pages and also as a PDF handout.

I acknowledge this publication is resulting from support of Elixir-Belgium for my role as data science and bioinformatics trainer.

Last update: 2018-02-14