

A Gentle Introduction to R

EXTRAS

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Section 1



Check your Operating System

On **Linux**, R is often available in your *package management system*, and can be installed directly from there.

On **macOS**, R can be installed directly with one of:

- Homebrew (formula `r`)
- MacPorts

Otherwise, you can download and install R from CRAN (next→)

- 1 Go to www.r-project.org in your web browser
- 2 Click on 'CRAN' in the menu on left (under "**Download**")
 - ▶ CRAN = Comprehensive R Archive Network
- 3 Choose a "mirror" (server) that is close to where you are, or at an institution that you trust.
If you're not sure, you can use one of:
 - ▶ cloud.r-project.org
 - ▶ cran.r-project.org
- 4 Click on the link for your computer Operating System: Linux, macOS, or Windows (in the top section labelled "**Download and Install R**")
- 5 The next steps depend on your computer's Operating System
 - ▶ follow the instructions on the subsequent web pages

Section 2

About 

- It's **fast & lean**
 - ▶ Load only the components you need at the time
- It works on **multiple platforms**
- It has sophisticated **graphics** capabilities
 - ▶ Produce publication-quality graphs in the same software as your analysis. No need for post-processing in Illustrator or Photoshop.
- It's **flexible, powerful, and innovative**
 - ▶ Advanced methods are often available in R before other statistical software.
- It can be used interactively, or to run pre-written *scripts*
 - ▶ Scripts provide automatic record of how an analysis was performed, that can be re-produced even years later.

is Free/Libre Open Source Software (FLOSS)

- Free as in 'beer': you do not have to pay \$ for it.
- Free as in 'speech': You have the *freedom* to ...
 - ▶ use it for any purpose
 - ▶ study how it works and adapt it to your needs
 - ▶ redistribute copies to your friends & neighbours
 - ▶ improve it and release improvements publicly
- The source code is *open* ("open source"¹²)
 - ▶ the source code is publicly available
 - ▶ the license allows for anyone to copy, modify, or distribute the code.
 - ▶ open collaboration is encouraged
 - ▶ anyone can propose changes and improvements, but a *Core Team* controls what changes are integrated into the versions released & distributed by the R Project

¹https://en.wikipedia.org/wiki/Open_source

²<https://opensource.org/definition-annotated/>

Section 3

Using 

R is a programming language

- R is command-driven
 - ▶ Not “point and click”
 - ▶ No menus, pop-up windows, or wizards
- R will not tell you what to do, or guide you through the steps of an analysis or method. R provides no structure.
- R will do all the calculations for you, and it will do *exactly what you tell it* (not necessarily *what you want*).
- This means R has the flexibility and power to do *exactly what you want, exactly how you want it done*.
- **The hard part is figuring out *how to do what you want***

Learning R

Learning any programming language is a journey. source: R-ladies Sydney, Real Python

It always feels like there's more to learn.

R is designed so that users can start by using it *interactively* (as in this workshop), and then gradually use it for more programming as their needs and skills grow.

Section 4

Names

Symbolic Variables

- You can store values (*objects*) in symbolic variables (*names*) using an *assignment operator*

->	assign the <i>value</i> on the left to the <i>name</i> on the right
<-	assign the <i>value</i> on the right to the <i>name</i> on the left
=	assign the <i>value</i> on the right to the <i>name</i> on the left

- '<-' is preferred, because it is unambiguous (to people *and* to R)
- '=' is not allowed in certain situations (e.g., when surrounded by other expressions)
 - '=' is also used to set *argument values* in *function calls*, which is a different meaning and its most common use.
- You can also use the *assign function* (advanced):

```
assign('x', 3)      # assign the value 3 to the variable 'x'
```

Variable / Object Names

- In R, all variables are *objects*
 - ▶ In R, **everything** is an *object*
- Object names can include:
(depending on the language or *locale*)

letters	a-z A-Z
numbers	0-9
periods	.
underscores	_

- Names *should begin with a letter*

```
A <- 10
B = 10 * 10
log(A) -> A_log
B.seq <- 1:B
assign('x', 3)
```

Object Names: Details

Names can start with a **letter** or a **period** (*more on this later*)

```
myvar <- T  
.myvar <- T
```

but anything else triggers an **error**

```
Omyvar <- F  
_myvar <- F  
my var <- F
```

For more information about object names in R, see:

- Section 1.8 of 'An Introduction to R'
- Section 2.1.3 of 'The R Language Definition'

Object Names: Hidden

- Names starting with a period (.) are special and normally hidden from users.

```
ls()  
ls(all.names = TRUE)
```

- Names starting with a period are used by packages or the system for special objects that users should not interact with directly.
- Such objects may not behave as expected with common commands, such as `ls()` (above).
- Therefore, most users should avoid doing this unless they know what they are doing and have a good reason to do so.

Object Names: Advanced

- 'Valid' names following the rules above can be referred to easily in code.
- Names with any character are actually possible, but must be quoted with backticks (` `)
 - ▶ **This is not recommended practice**, but occasionally useful when you need to refer to an element of an object, such as list items or data frame columns, that have non-standard names.

```
`(my) [strange] {variable} 'name' "!@# $" ` <- T  
print(`(my) [strange] {variable} 'name' "!@# $" `)
```

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

Section 5

Special Operators

Matrix math

- R can do *matrix math* — which is used in many statistical procedures
 - ▶ But the *syntax* is different from the usual math operators
- Using a regular multiplication symbol (*) results in *element*-wise multiplication
 - ▶ each *element* (item) in matrix1 is multiplied by the corresponding *element* in matrix2, etc.

```
c(1, 2, 3) * c(3, 2, 1)
```

- *Matrix multiplication* is specified by this operator: `%%`

```
c(1, 2, 3) %% c(3, 2, 1)
```