How to use R Statistics

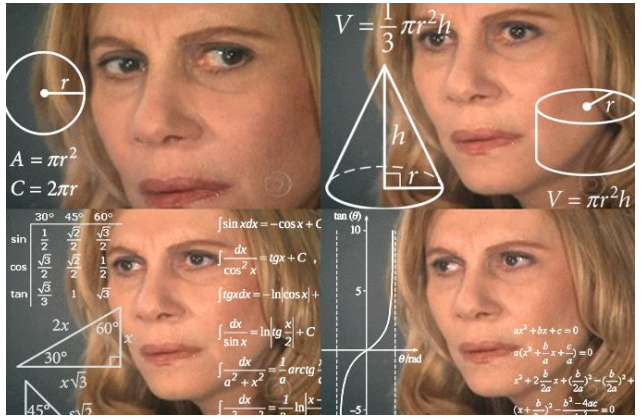
Cognition and Emotion Group

School of Psychology

Curtin University

Why R we here?

- I want to learn R…
  - but I don’t know where to start
  - but I got stuck and gave up
  - but it takes too much time to learn
  - but I can’t write scripts and coding scares me



Reasons to learn R

- It can do all the stats, for free!
- And it's not limited to stats.
  - Pre-process and organise raw data (less copy and pasting)
  - Make nice plots
- Growing popularity
  - Feel included
  - Promotes data and analysis sharing
- You also learn programming
  - Transferable skill – dealing with variables, using functions, for loops.

Purpose of the Series

- Make R accessible.
- Make it practical.
- Keep content simple and use relevant examples.
- Create opportunity to ask questions and work through problems.

Disclaimer: It’s my first time. Nnot a programming, statistics or teaching expert.

Session 1: Objectives

- Install R and R Studio
- Learn how to navigate the program
- Open an Excel data file
- Learn how to transform data between wide- to long-format
- Save data to Excel file

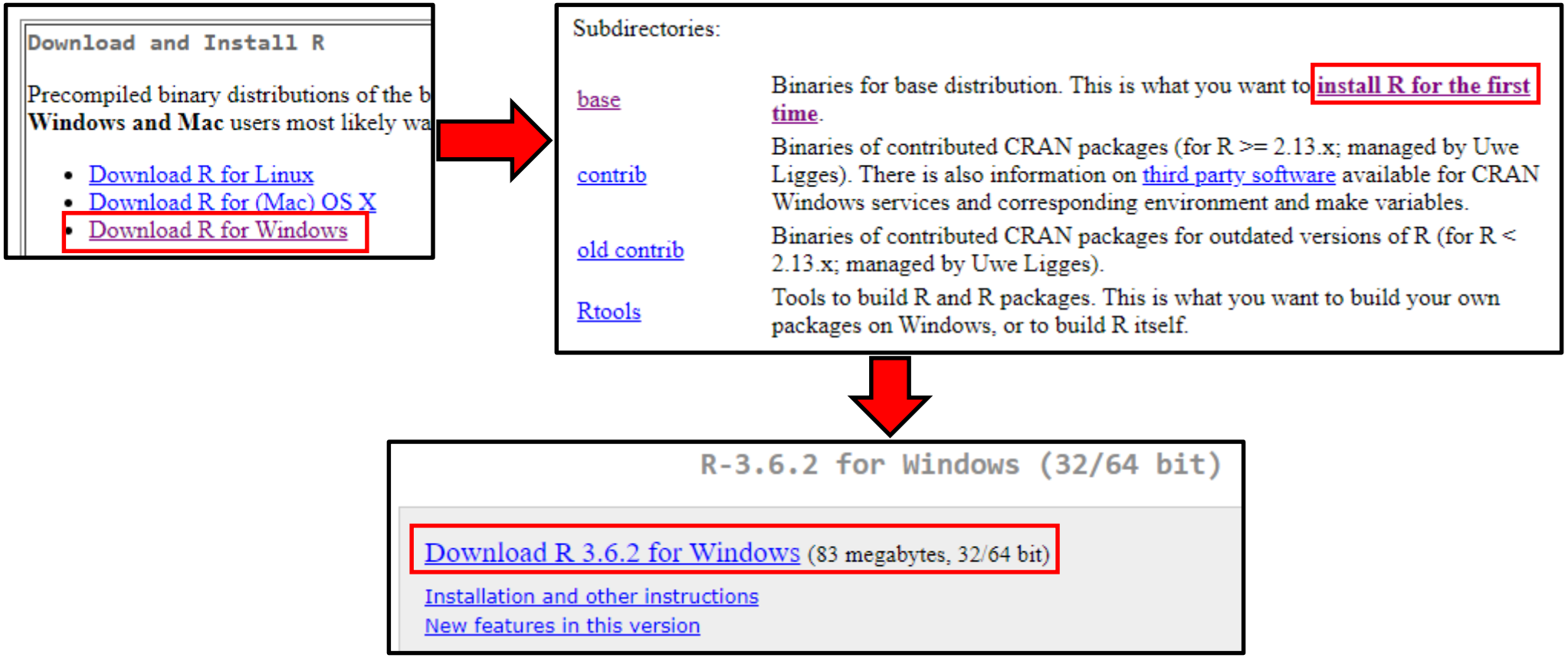
Download Tutorial Materials from GitHub

- https://github.com/angnguyen/ce_group
- Clone or download > download .zip

- Contains sample data, sample code, power-point slides.
  - Open slides to go at your own pace.
  - Use for future reference

Install R (Windows)

Go here: https://cran.curtin.edu.au/

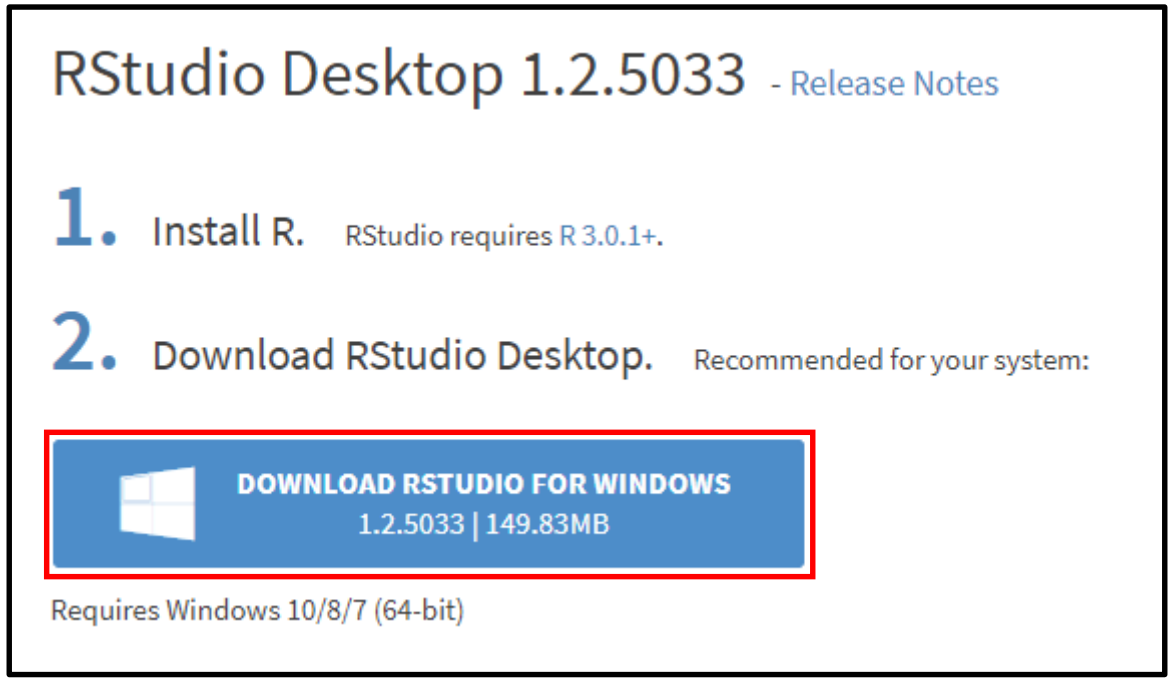


Install R (Mac OS)

- Download and run **R-3.6.2.pkg** (or most recent version)
- Install with default settings

Install R Studio (Windows)

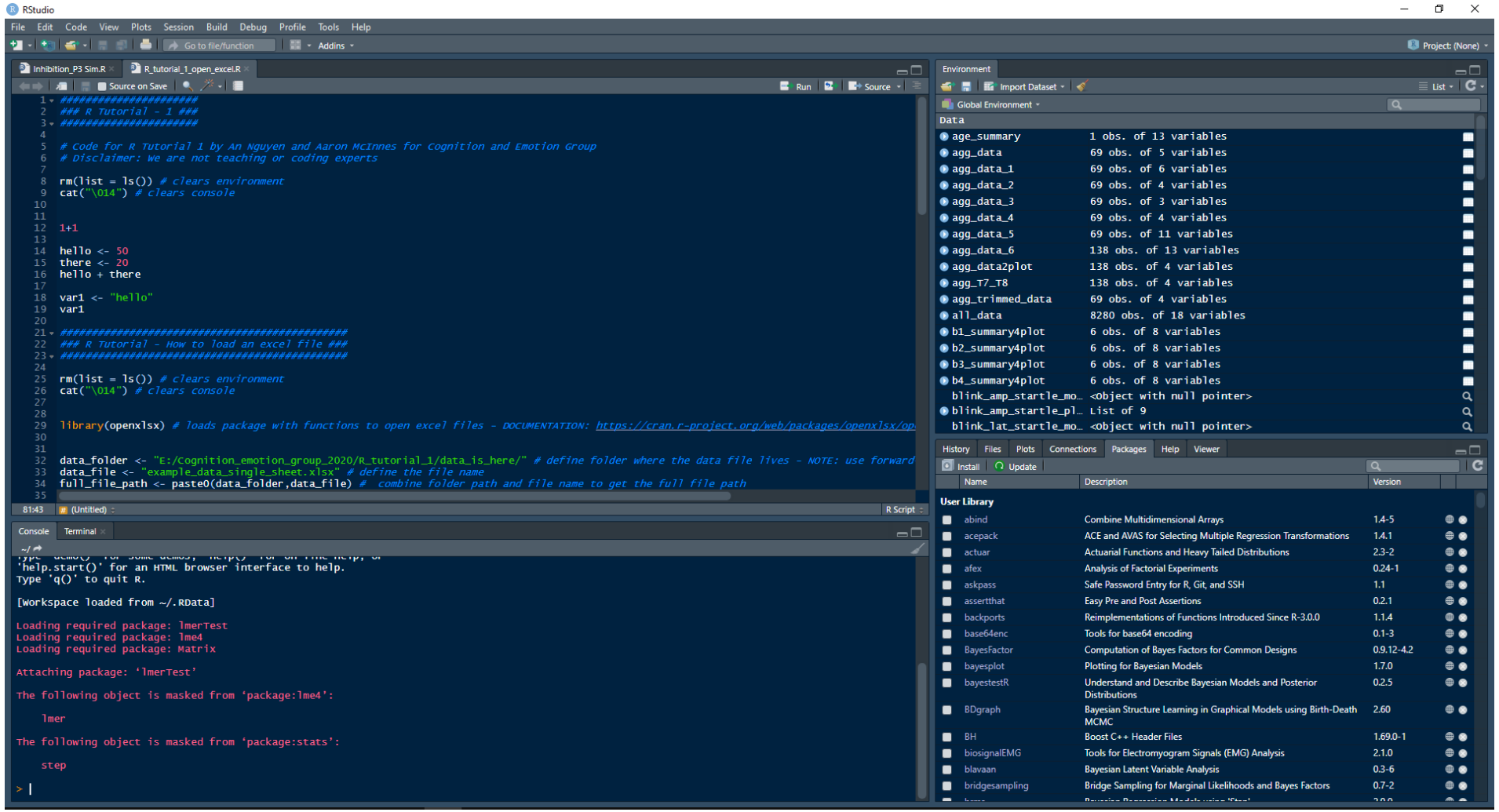
Go here: https://rstudio.com/products/rstudio/download/#download



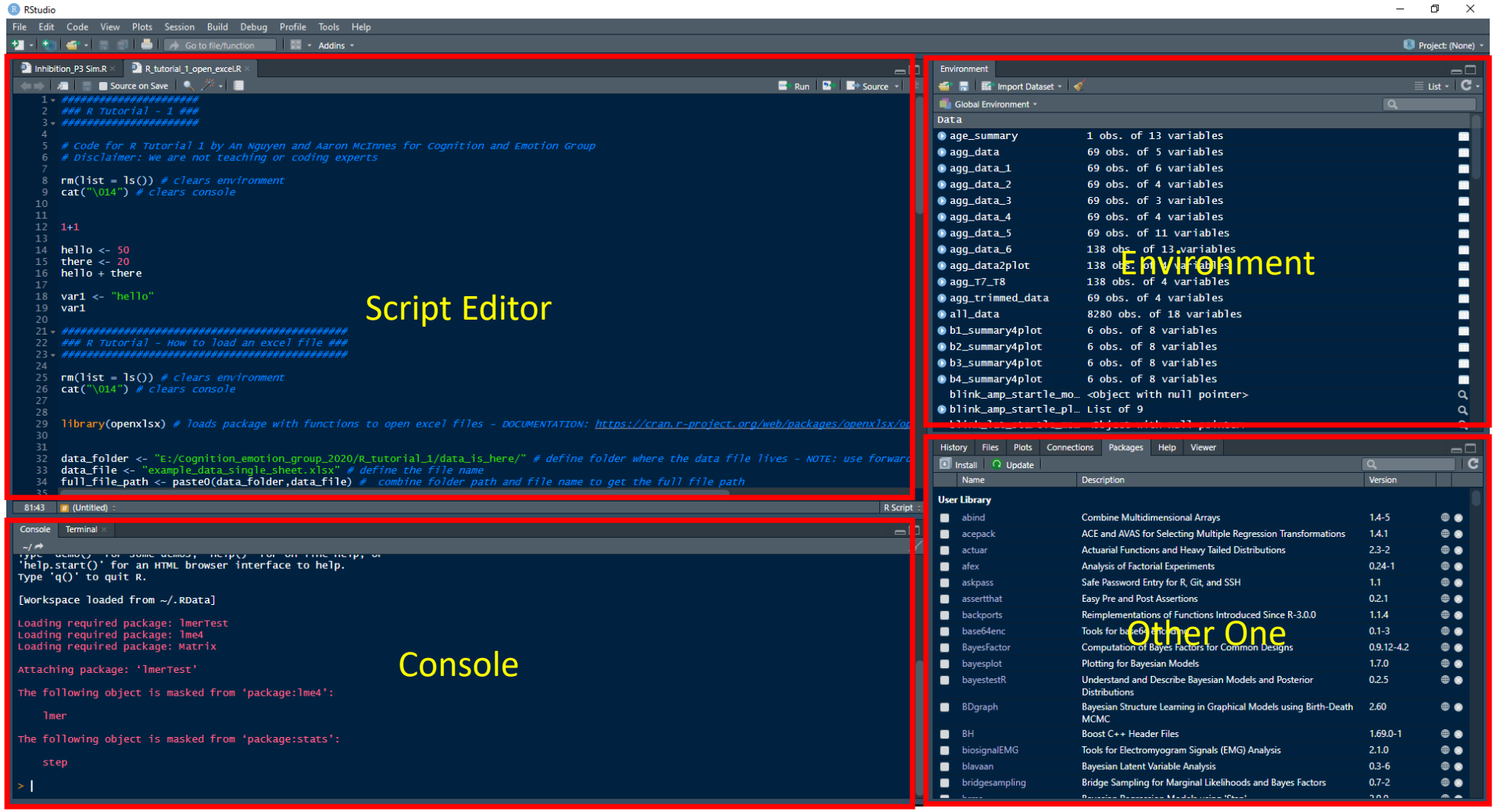
Install R Studio (Mac OS)

- Run the **.dmg** file
- Drag the RStudio icon to your “Applications” folder

Open R Studio



Navigating the Interface



Navigating the Interface

- **Script Editor** *(only appears if you have a script open)*
  - Write and save R scripts
- **Console**
  - Type in and run commands
  - Output shows up here
- **Environment**
  - Existing variables and data show up here
- **Other One**
  - Plots show up here and Install packages

Customise the look of R Studio

- Tools > Global Options > Appearance
- Go nuts – I like Cobalt

Using the Console

- Use it like a calculator – output is *not* saved

```
> 1+1
[1] 2
```

```
> (50+100+60+200)*4
[1] 1640
```

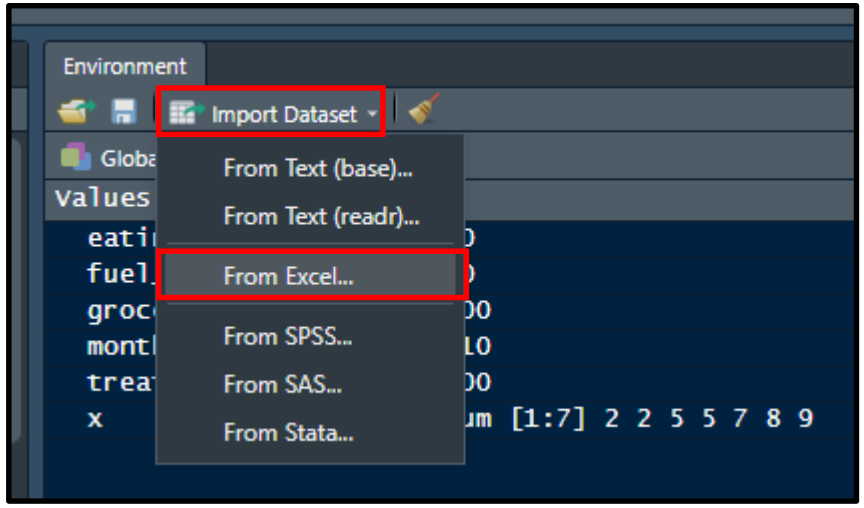
```
> mean( c(2,2,5,5,7,8,9) )
[1] 5.428571
```

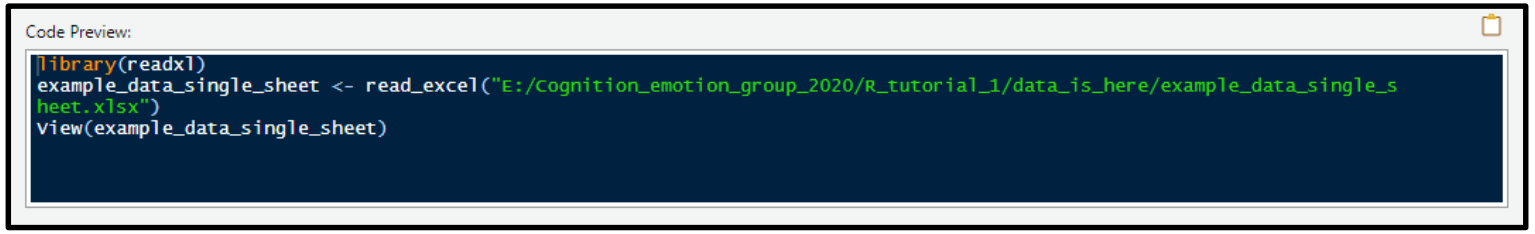
  - *c()* stands for *concatenate* – use it to group things
- Output can be saved into **Variables**

```
> monthly_spend <- (50+100+60+200)*4
>
```

  - Saved in the environment (*goes away when you close R*)
  - Makes code understandable
  - Makes it easier to adjust values in code
    - Not just for numbers but also words
    - **"Alt + minus"** to get the arrow

Importing Excel data manually



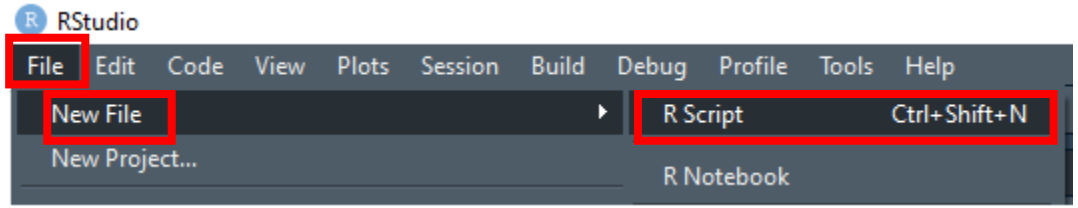


- It's loading the ***readxl*** package from library
  - What is a package? Add-on with additional functions
  - Ok and what is a function? Mini-program that does a specific task
- Using ***read_excel()*** function to open the file
- Saves data to variable called ***'example_data_single_sheet'***

But we want to do that using scripts!

- First we need to create a new script.

- Create New R-Script
  - File > New File > R Script

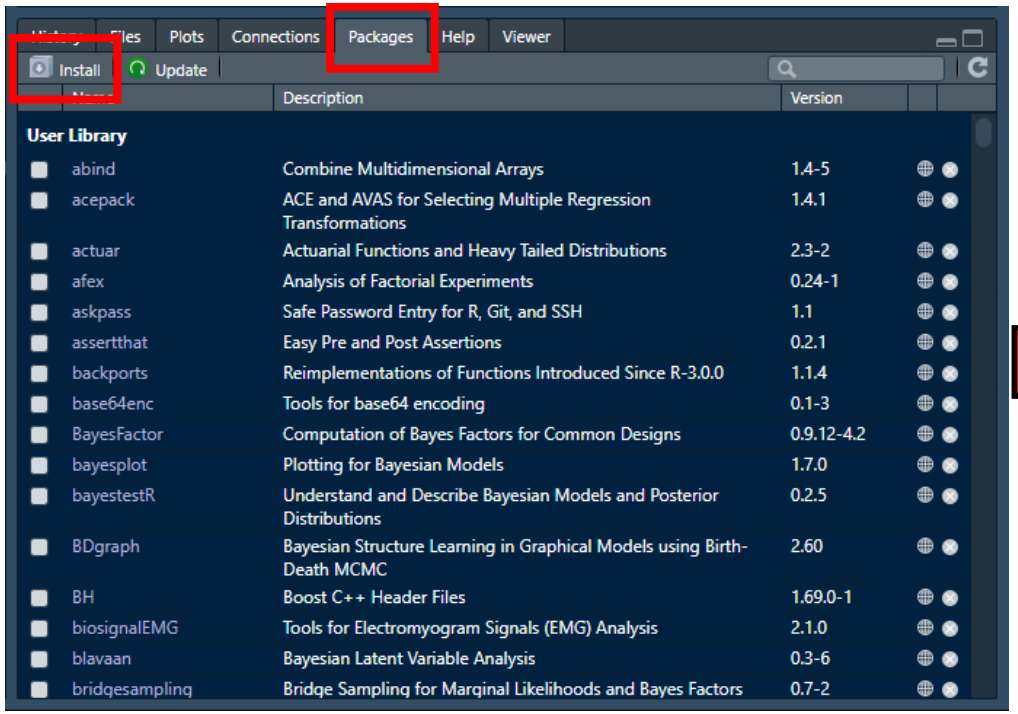


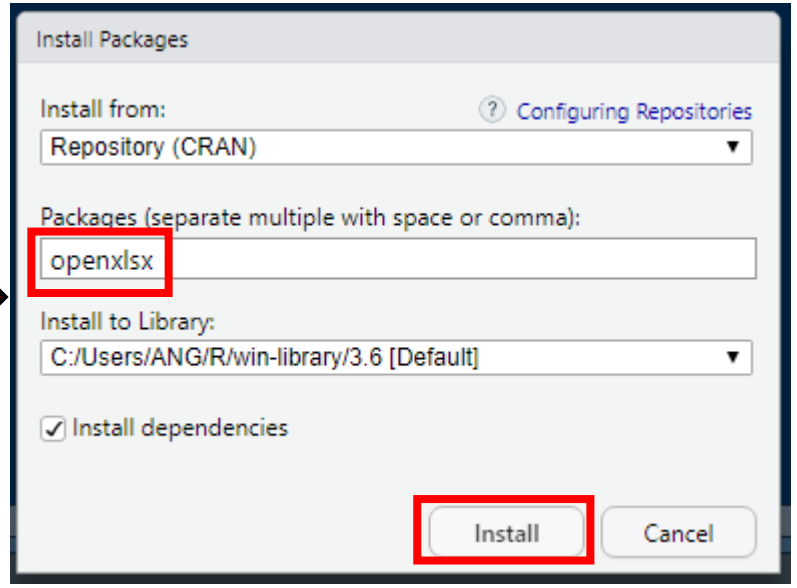
- Say what script is about
  - # this is my first script

- Save the script somewhere
  - File > Save As

Install ‘openxlsx’ package

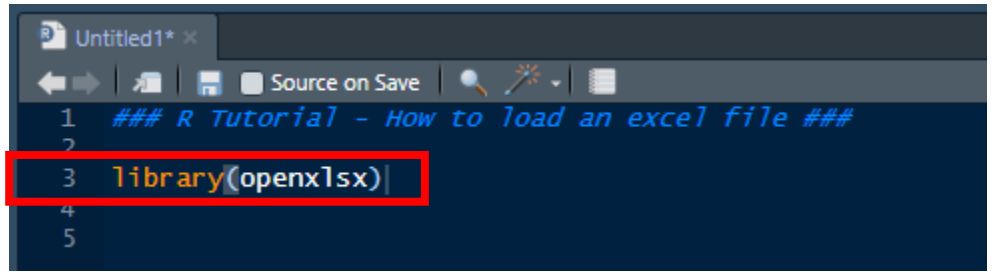
- Bottom-left > ‘Packages’ tab > ‘Install’ > type ‘openxlsx’ > ‘Install’





Load package into R

- Type ‘library(openxlsx)’ into script
- Comment the code – e.g. # for opening excel
- Place cursor on that line and press **Ctrl + Enter** to run that line



Tell R where to look

Variable name – can give any name, but try to keep sort and informative

- **data_folder** <- "E:/Cognition_emotion_group_2020/R_tutorial_1/data_is_here/"

Folder directory – with forward slash (opposite to windows explorer)
Put your own directory – don't copy this one.

- **data_file** <- "example_data_single_sheet.xlsx"

- **full_path** <- paste0(**data_folder** , **data_file**)
  - paste0() function – literally just stitches two words together, put comma between objects

- Keep variable names short and informative
- No spaces, use underscore instead

read.xlsx() function

- data2use <- read.xlsx(full_path)
  - Or use your own variable name
- data2use should appear in environments section

Let’s have look at the data

- Double-click variable in environment
  - Or type View(<insert variable name>)

- This is a **data-frame** – basically a table, contains many variables

- This data is based on the Go/No-go task
  - Respond quickly to Go stimulus but not No-go stimulus
  - RT recorded on each trial. Only Failed Nogo trials have RTs. Successful Nogo trials don’t have RTs – hence NA.
  - Data from 5 participants, with 5 trials each

R likes data in long format

- What is long format?
  - Each variable is a separate column (participant, trial, condition, RT)
    - Each variable should only be specifying one thing.
  - Each observation is a separate row (each trial)
  - ***Long format is ideal for big datasets with many variables of different scales/type***

Participant	Trial	Condition	RT
P001	1	Congruent	230
P001	2	Neutral	235
P001	3	Incongruent	290
P002	1	Congruent	220
P002	2	Neutral	230
P002	3	Incongruent	300

Examples of not-long data

This variable is specifying 2 things – no good.

Participant	AUDIT_Q1	AUDIT_Q2	AUDIT_Q3	BISBAS_Q1	BISBAS_Q2	BISBAS_Q3
P001	4	2	2	1	1	2
P002	1	2	2	3	3	1
P003	3	4	4	2	2	2

These scores are from ***separate*** items and questionnaires but are on the ***same*** row… **NOT LONG.**

Participant	RT_Congruent	RT_Incongruent	RT_Neutral
P001	230	300	300
P002	250	290	200
P003	200	340	230

These RTs are from ***separate*** conditions (i.e. separate observations) but are on ***same*** row… **NOT LONG.**

This is what you want…

Participant	AUDIT_Q1	AUDIT_Q2	AUDIT_Q3	BISBAS_Q1	BISBAS_Q2	BISBAS_Q3
P001	4	2	2	1	1	2
P002	1	2	2	3	3	1
P003	3	4	4	2	2	2

Participant	Questionnaire	Item	Score
P001	AUDIT	1	4
P001	AUDIT	2	2
P001	AUDIT	3	2
P001	BISBAS	1	1
P001	BISBAS	2	1
P001	BISBAS	3	2

This is what you want…

Participant	RT_Congruent	RT_Neutral	RT_Incongruent
P001	230	300	300
P002	250	200	290
P003	200	230	340

Participant	Condition	RT
P001	Congruent	230
P001	Neutral	300
P001	Incongruent	300
P002	Congruent	250
P002	Neutral	200
P002	Incongruent	290

Ok, show me how to do that.

- We need ***tidyr*** package
- We will use the ***gather()*** function – Wide to Long
- Then we will use ***spread()*** function – Long to Wide

- Links:
  - R-documentation (*explains how to use functions*):
    - https://www.rdocumentation.org/packages/tidyr/versions/0.8.3/topics/gather
  - Another guide to use gather() and spread() :
    - http://www.cookbook-r.com/Manipulating_data/Converting_data_between_wide_and_long_format/

Tidyr and gather()

- Install tidyr
- Load tidyr from library using library()
- Load **‘gather_example_data.xlsx’** into a variable using read.xlsx()
- View data
  - not long-format, RTs for different conditions on same row
  - Want separate columns for RT and condition

Inhibition_P3 Sim.R | R_tutorial_1_open_excel.R | data2use

Filter

	subject_id	gender	age	RT_control	RT_condition_1	RT_condition_2
1	P001	M	18	200	300	190
2	P002	M	19	230	350	200
3	P003	F	17	240	320	210
4	P004	F	20	220	310	180
5	P005	M	19	235	290	210

Tidyr and gather()

2. Creating new column for condition names

1. Variable to transform

- data2use_v2 <- gather(data = data2use, key = “condition”, value = “RT”, c(“RT_control”, “RT_condition_1”, “RT_condition_2”))

3. Creating new column for condition names

- Name the ‘key’ after the variable names
- Name ‘value’ after the stuff in the actual cells

- View (data2use_v2)

spread()

- Working from the last dataset

- data2use_v3 <- spread(data = data2use_v2, key = "condition", value = "RT")

Save variable into Excel

- write.xlsx(data2use_v3 , full_path)

Exercise: Lets open our own data

- Use read.xlsx() function to open your own file
- Use gather() to convert to long format (if not already long)
- If data is long, use spread() to convert to wide-format

- If different sheets, single file
  - There is code
- If different excel files
  - There is code
- If something else
  - ask

That’s it for today

- Next Cognition and Emotion Group Meeting (6 March)
  - Discussing pre-registration
- Next R Session (13 March)
  - Plotting in R using ggplot2

Cheat sheet - Hotkeys

- **Ctrl + Enter** – Runs single line of code
- **Alt + minus** – **<-** - for defining variables
- **Ctrl + 3** - **#** - ignores stuff after this
- **Ctrl + Shift + C** – disable/enable line of code
- **Ctrl + Shift + Enter** – Runs whole script

Cheat sheet - Functions

paste0() or paste(), cbind() and rbind()

- Lets you stick things together

Substring()

- Extract part of a word – good for getting subject id from filenames

Unique()

- Gets unique values from variable – good for checking participants or factors in large datasets

Length() and dim()

- Shows you size of variable – good for troubleshooting – check if right number of trials/participants or whatever are there

Subset()

- Extract a smaller part of bigger dataset – good for follow-up analyses (e.g. only want to analyse a certain condition of the data).

Aggregate()

- Can use to calculate mean values per participant and condition.