Introduction to Epidemiology Data Analysis with R

Introductions

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Course details

- Course Blackboard: learn.mssm.edu
- Tuesdays 6:15 pm – 8:45 pm
- 12 sessions
- Hybrid format
  - In Person: Annenberg 11-40
  - Zoom: https://mssm.zoom.us/j/85798543780

Course schedule (1)

Week 1	01/3/2023	Get up and running with R and RStudio	• The basic data analysis cycle • Download and install R • Download and install RStudio • Install a set of R packages called the Tidyverse • Understand the environment interface • Where and how to get help • Building scripts • R studio project
Week 2	01/10/2023	Introduction to coding with R (I)	• Create and name a vector • Create and name matrices • Create and name factors
Week 3	01/17/2023	Introduction to coding with R (II)	• Create, name, and subset lists • Create and name a data frame

Week 4	01/24/2023	Data transformation (I)	• dplyr basics
			• Tibbles
			  • Filter rows
			  • Arrange rows
			  • Select columns
			  • Add new variables

Week 5	01/31/2023	Data transformation (II)	• Combining multiple operations with the pipe • Missing values • Counts • Summary functions • Grouping and ungrouping

Week 6	02/07/2023	Data Wrangling using the Tidyverse (I)	• Tidy data
			  • Pivoting
			  • Separating and uniting
			  • Missing values
			• Mutating joins
			• Filtering joins
			• Factors: modifying order and levels

Course schedule (2)

Week 7	02/14/2023	Basic Statistical analyses	• t.test • GLM
Week 8	02/21/2023	Data Visualization (I)	• Understand what geometries and mappings are • The layered grammar of graphics • Create visualizations using the x, y, color, size, alpha, and shape properties. • Facets • Geometric objects
Week 9	02/28/2023	Data Visualization (II)	• Statistical transformations • Position adjustments • Coordinate systems • Themes
Week 10	03/07/2023	Exploratory Data Analysis	• Introduction • Variation and covariation • Patterns • Build simple linear regression models
Week 11	03/14/2023	Modeling basics for Epidemiology research studies	• Formulas • Model families • Adjust for confounders • Model interactions
Week 12	03/21/2023	Final Project Presentations and Course Wrap-up	• Present and discuss the final student epidemiology project using R

Grading

- Pass/Fail Grading System
- To pass, you need to:
  - Attend 80% of classes
  - Submit 80% of the assignments
  - Present a final project

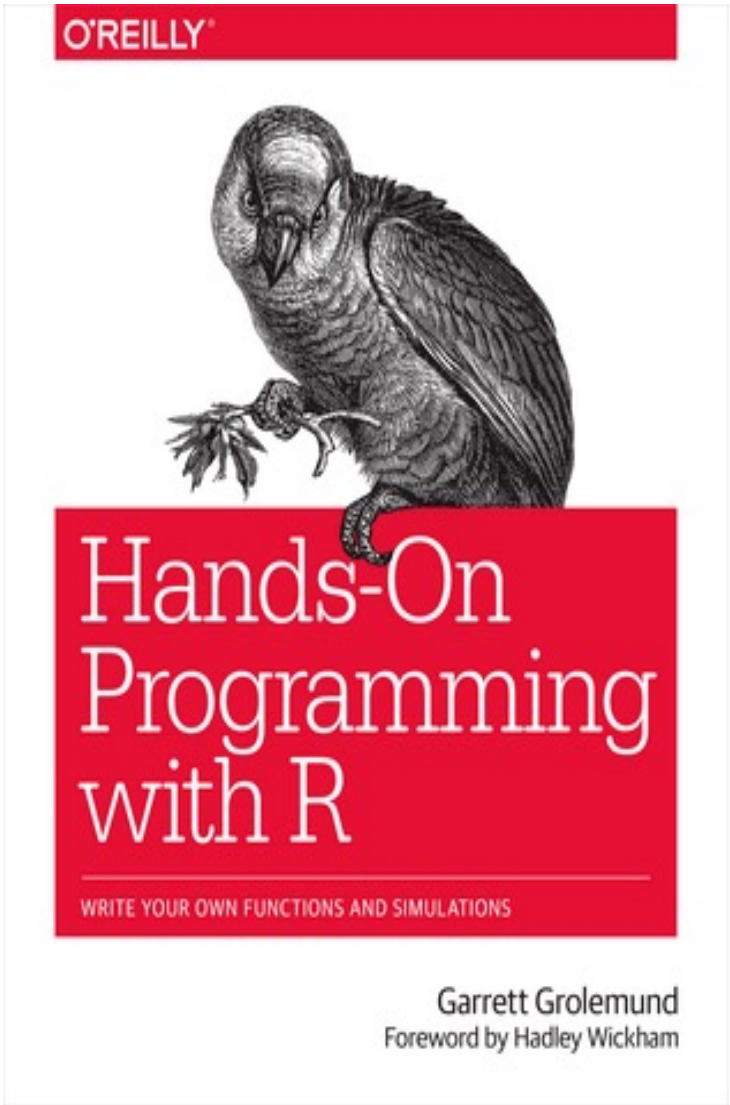
Questions

Week 1

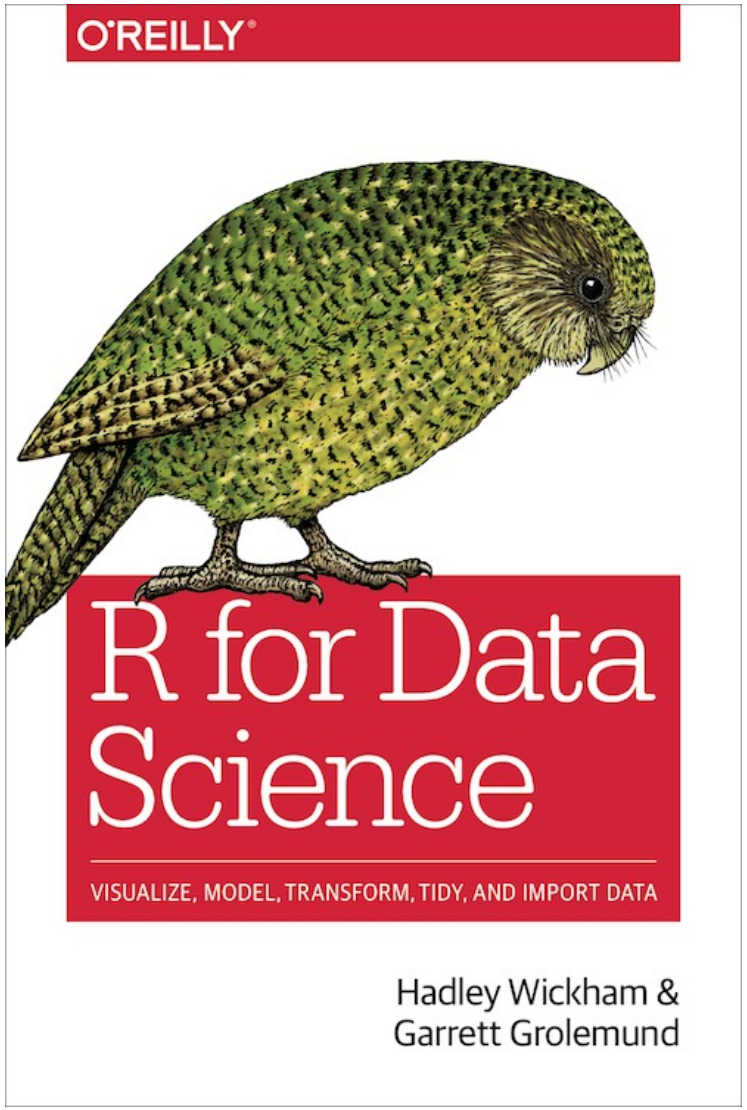
Get up and running with R and RStudio

Getting started with R

- What is R?
  - R is an open-source language widely used as a statistical software and data analysis tool to:
    - Manage and clean data
    - Carry out statistical analyses
    - Produce high-quality figures for research communications
- Why R?
  - Free & open source
  - Great community
  - 9000+ free packages
- What is RStudio?
  - An integrated development environment (IDE) for R

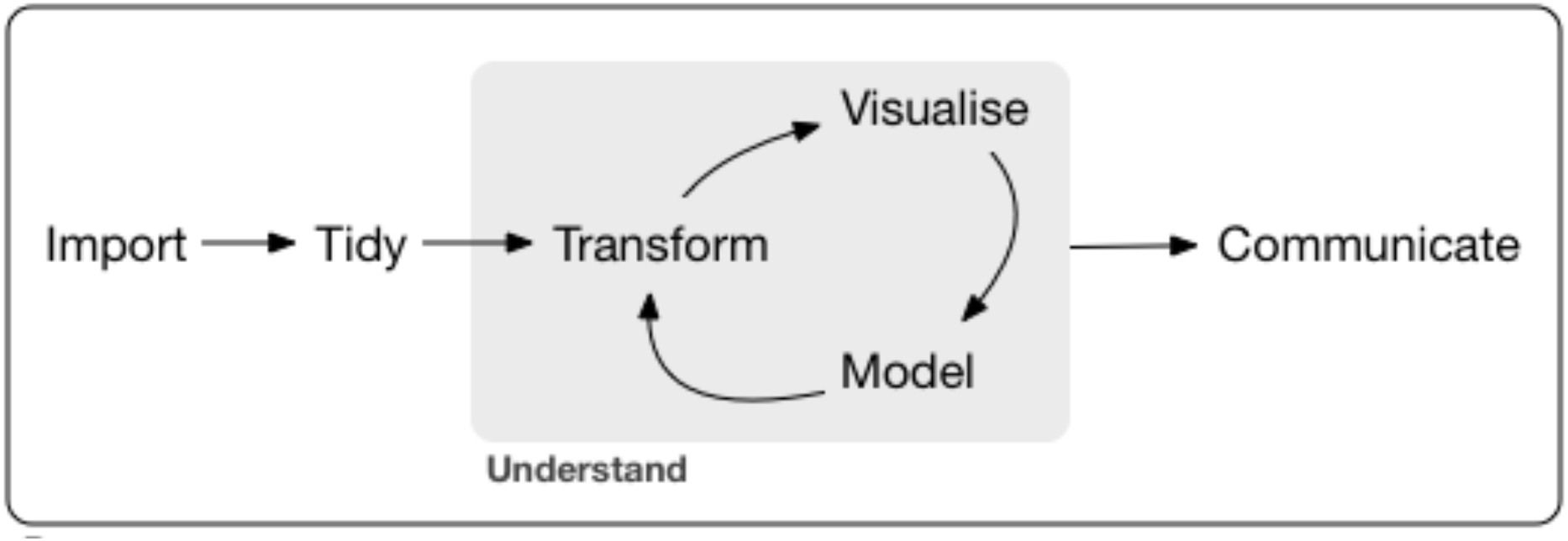


https://rstudio-education.github.io/hopr/



https://r4ds.had.co.nz/

A typical data science project :



Downloading and installing R

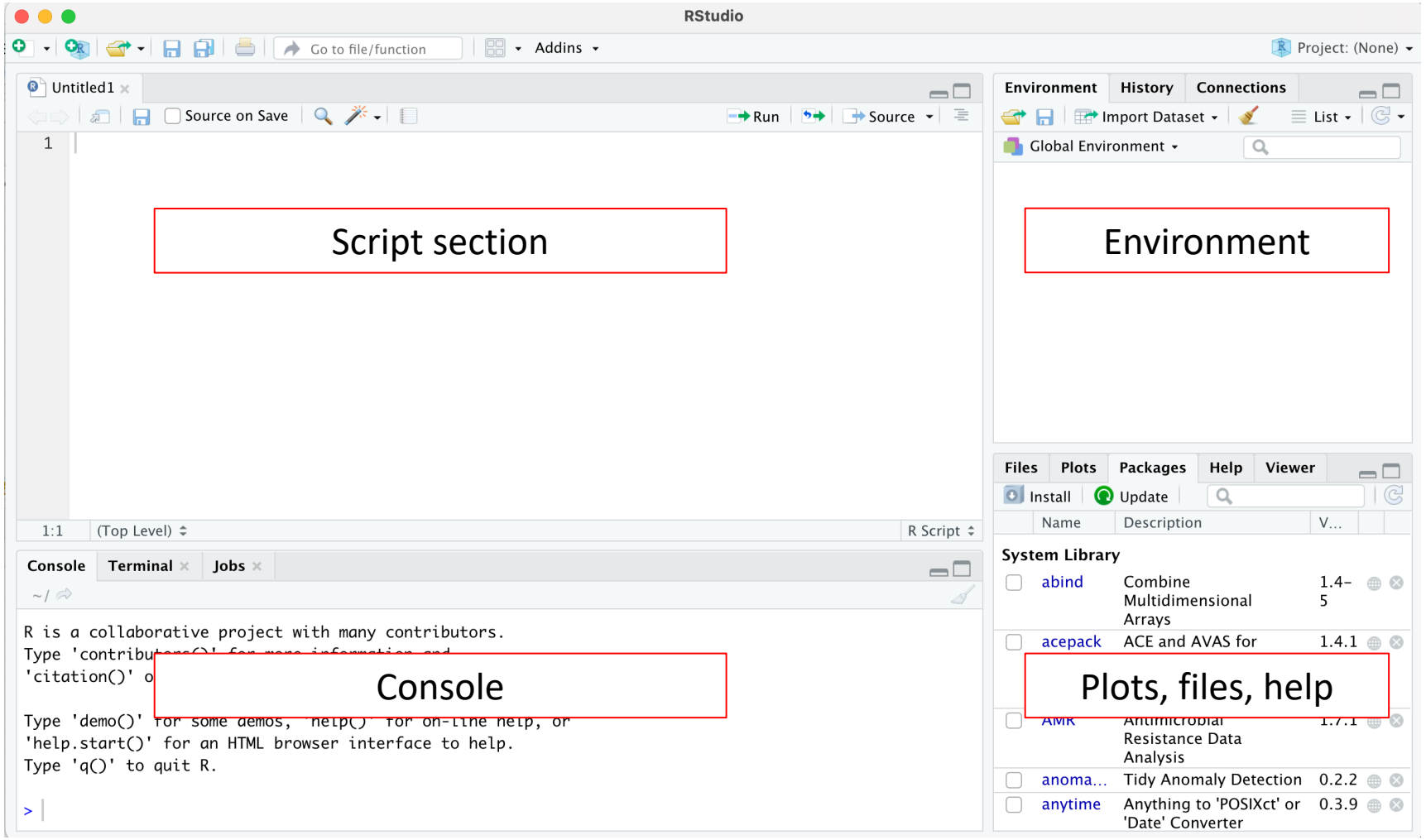
- Download and install R: http://lib.stat.cmu.edu/R/CRAN/
  - Windows
    - Download R for Windows
    - Base
    - Download R 4.2.2 for Windows
    - Run this program and step through the installation wizard that appears.
    - The wizard will install R into your program files folders and place a shortcut in your Start menu.
  - Mac
    - Download R for MacOS
    - R-4.2.2.pkg
    - An installer will download to guide you through the installation process

Downloading and installing RStudio

- Download and install RStudio: https://www.rstudio.com/products/rstudio/
- Download Rstudio Desktop
  - Windows
    - Download RSTUDIO-2022.12.0-353.EXE
    - Install through the installation wizard
  - Mac
    - Download RSTUDIO-2022.12.0-353.DMG
    - An installer will download to guide you through the installation process

RStudio Desktop

1. Open Rstudio
2. Start a new script



Your turn!

In the console pane, solve:

- 5 + 2 =
- 6 X 3 =
- 7^2 =
- $\sqrt{9}$ =

Using variables

- Type in the console a <- 5
- Check your environment
- Type in the console a*2

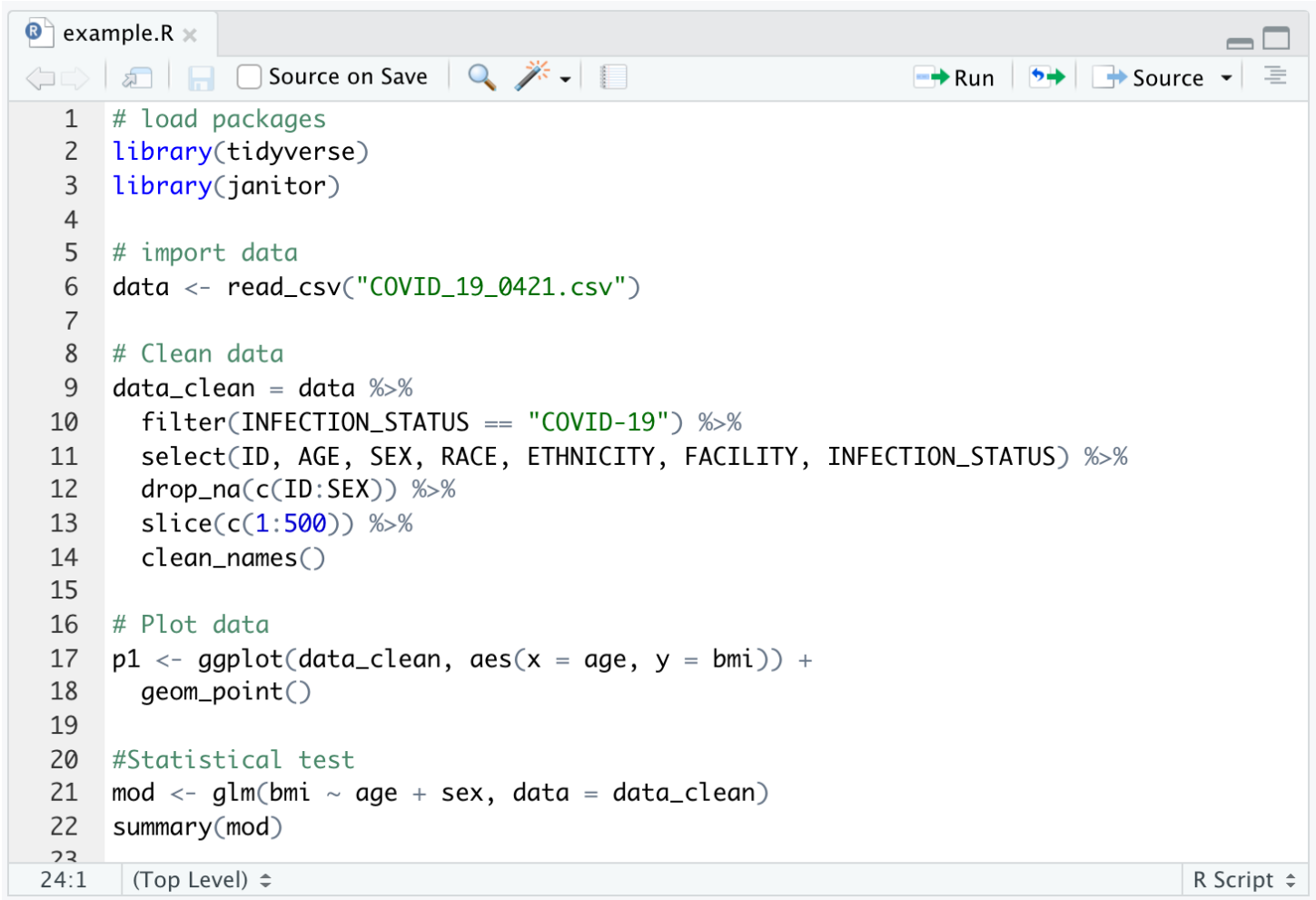
- Type in the console b <- seq(from = 0, to = 50)
- b^2

RStudio settings which you can adjust

- **Restore workspace:** By default, R saves your workspace, which is no longer considered best practice. To change:
  - Tools > Global Options >
    - **Uncheck** “Restore .RData into Workspace on startup”
    - Set “Save .RData on exit” to **Never**
- **Appearance:** By default, RStudio comes with a white background and black text. To change:
  - Tools > Global Options > Appearance > Editor theme
- **Auto-complete:** By default, the “auto-complete” option is enabled. To change:
  - Tools > Global Options > Code” and uncheck “Insert matching parens/quotes

Writing a script

- A script is a sequence of commands stored in an .R file
- R execute scripts sequentially line-by-line
- Comments start with #



Tips for writing a script

- Keyboard Shortcuts to run your script
  - Windows: Control + Enter
  - Mac: Command + Enter
- Don’t spend time memorizing functions that can easily be looked up and copied (you will be mostly copy-pasting and adapting existing R code)
- Don’t worry about making mistakes - you can’t do anything wrong!

Packages

- A Package is a collection of functions that are not included in the standard R installation (base-R)
- Install the tidyverse package using **install.packages()**
- Load the tidyverse package using **library()**

Getting help

- Error messages:
  - Google the error message.
  - copy-paste solutions into your R script and then modify it.
- RStudio's built in Help - type ? and the command (for example ?read_csv).
- Help drop-down menu at the top of the RStudio window

Your turn!

- Choose any number
- Add 2 to it
- Multiply the result by 3
- Subtract 6 from the answer
- Divide what you get by 3

What did you get?

What if you would choose a different number and run the same steps?

Can you think of a way to write a script for this process?

RStudio Projects

- Keep data and scripts in the same folder
- Keep files from each project separated
- Set the working directory
- Scripts and output files will be automatically saved in your Rstudio project folder

Let’s create an R project

- 2 Methods
  - New Directory
  - Existing Directory

Your turn!

1. Create an R project called “Week_1”
2. Open the project
3. Open a script
4. Write a script in which you:
    1. Assign the number **81** to a variable called **a**
    2. Create a new variable **b** that equals the square root of **a**
    3. Save the script under the name “my_first_script.R”
5. Close the R project
6. Reopen the R project and run your script

Import data into R

- Download “Sinai_covid.csv” from Blackoard and save it in your R project folder.
- In your Script Pane type:

```
library(tidyverse)

Sinai_covid <- read_csv("Sinai_covid.csv")

View(Sinai_covid)
```

Writing to a file

readr also comes with functions for writing data back to disk: write_csv()

Assignment 1

1. Download R script "Assignment1.R"
2. Save the script in the R project folder we created (“Week_1”)
3. Open R project “Week_1”
4. Open the script "Assignment1.R"
5. Complete all the questions
6. Save the script under a new name "Assignment1_FirstName_LastName.R”
   - For example, for me, it would be: "Assignment1_Elza_Rechtman.R"
7. Upload your assignment by next Monday, March 9 at 5 pm.