

# Data Wrangling with R and the Tidyverse

Data Wrangling: Session 1

Kieran Healy

Statistical Horizons, December 2022

# Housekeeping

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**10am till 12:30pm US EST each Day**

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**10am till 12:30pm US EST each Day**

**1:30pm to 4:00pm US EST on Day 1**

**1:30pm to 3:30pm US EST Days 2 and 3**

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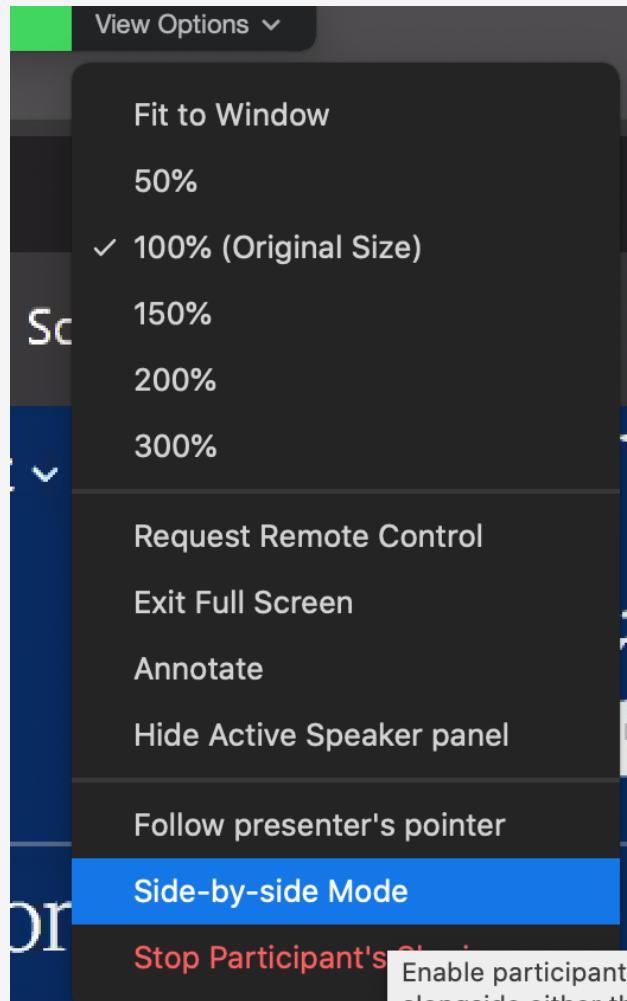
**Use the Zoom chat to ask questions, or raise a hand with**



# In between class sessions



# For a better Zoom experience



If you're watching in full-screen view and I'm sharing my screen, then from Zoom's "View options" menu *turn off* "Side-by-Side" mode.

# My Setup and Yours

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Talking, Slides, and Live-Coding in RStudio

Follow along with RStudio yourself if you can

The course packet is also an RStudio project and the place for your notes

# Goals for this first session

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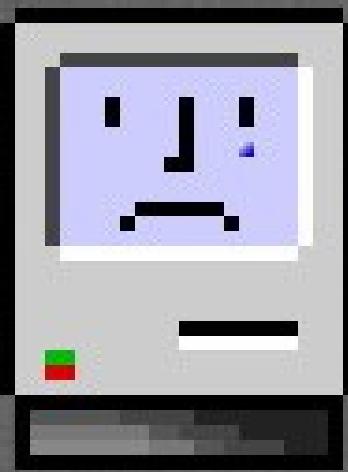
**Some big-picture motivation & perspective**

**Getting familiar with RStudio and its relationship to R**

**Getting oriented to R and how it thinks**

**DATA ANALYSIS**  
is mostly  
**DATA WRANGLING**

# Wrangling data is frustrating



# Can we make it **fun**?



# Can we make it **fun**?



No.

# Can we make it **fun**?



**No.**

⇒ Not *this* much fun, at any rate

# OK but can we eliminate frustration?



# OK but can we eliminate frustration?



Also no.

# OK but can we eliminate frustration?



Also no.

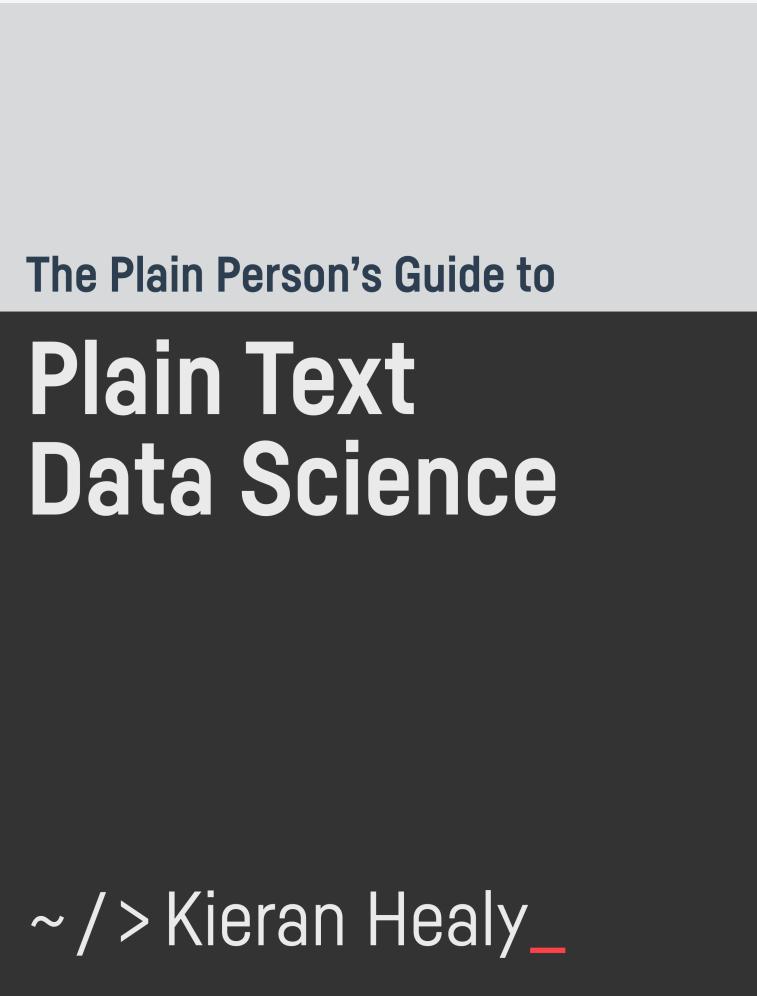
Sorry.

**HOWEVER, WE CAN  
MAKE IT *WORK***

**HOWEVER, WE CAN  
MAKE IT *WORK***

Also, it's weirdly satisfying once you get into it.

# We take a broadly *Plain Text* approach



# We take a broadly *Plain Text* approach

The Plain Person's Guide to

## Plain Text Data Science

~ /> Kieran Healy \_

Using R and the Tidyverse can be understood within this broader context.

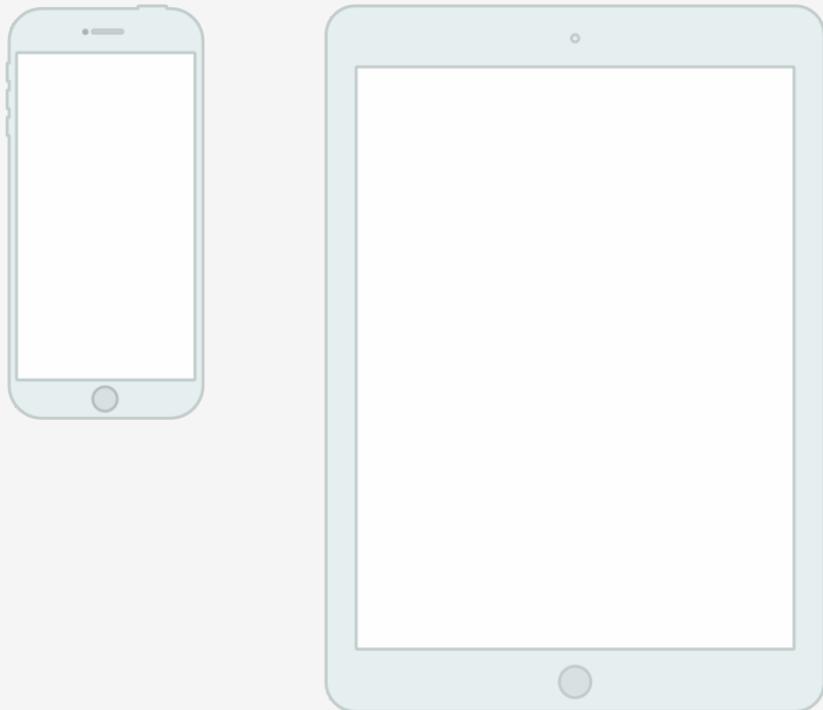
The same principles would apply to, e.g., using Python or similar tools.

# Two revolutions in computing

# Where the action is

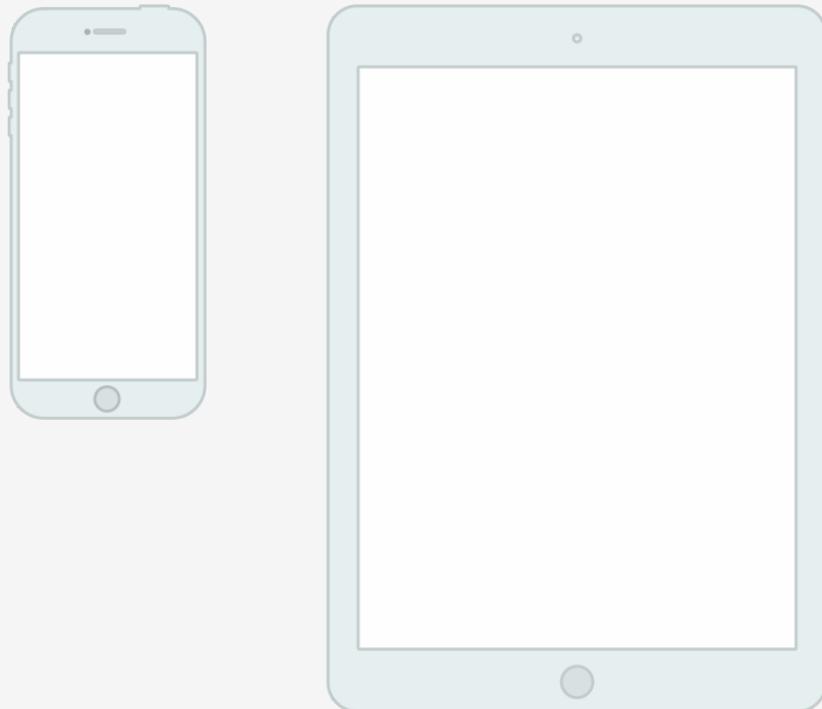


# Where the action is



Touch-based user interface

# Where the action is



Touch-based user interface

Foregrounds a single application

# Where the action is



Touch-based user interface

Foregrounds a single application

Dislikes multi-tasking\*

# Where the action is



Touch-based user interface

Foregrounds a single application

Dislikes multi-tasking\*

Hides the file system

# \*Multitasking

I mean, “Making different specialized applications and resources work together in the service of a single but multi-dimensional project”, not “Checking Twitter while also listening to a talk and waiting for an update from the school nurse.”

# Where statistical computing lives



# Where statistical computing lives



Windows and pointers.



# Where statistical computing lives



Windows and pointers.

Multi-tasking, multiple windows.



# Where statistical computing lives



Windows and pointers.

Multi-tasking, multiple windows.

Exposes and leverages the file system.



# Where statistical computing lives



Windows and pointers.

Multi-tasking, multiple windows.

Exposes and leverages the file system.

Many specialized tools in concert.



# Where statistical computing lives



Windows and pointers.

Multi-tasking, multiple windows.

Exposes and leverages the file system.

Many specialized tools in concert.

Underneath, it's the 1970s, UNIX, and the command-line.



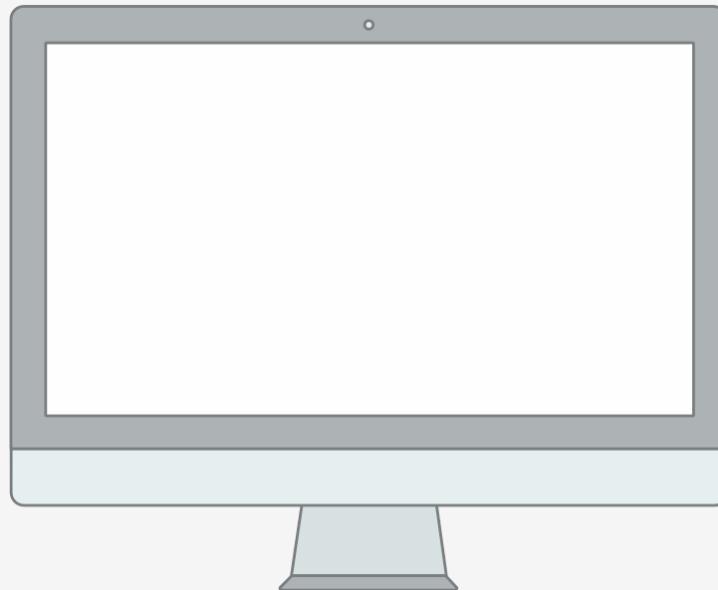
# Plain-Text Tools for Data Analysis



# Plain-Text Tools for Data Analysis



Better than they've ever been!



# Plain-Text Tools for Data Analysis



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Free! Open! Powerful!



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Friendly community! Many resources!



# Plain-Text Tools for Data Analysis



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But grounded in a UI paradigm that is  
increasingly far away from the everyday use of  
computing devices

# Plain-Text Tools for Data Analysis



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increasingly far away from the everyday use of  
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So why do we use these tools?



The research process is  
*intrinsically messy*

# The research process is *intrinsically messy*

A rough distinction: "Office" vs "Engineering"  
approaches

# Questions

What is "real" in your project?

What is the final output?

How is it produced?

How are changes managed?

# Different Answers

## In the Office model

Formatted documents are real.

Intermediate outputs are cut and pasted  
into documents.

Changes are tracked inside files.

Final output is often in the same format  
you've been working in, e.g. a Word file, or  
perhaps a PDF.

# Different Answers

## In the Office model

Formatted documents are real.

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## In the Engineering model

Plain-text files are real.

Intermediate outputs are produced via code, often inside documents.

Changes are tracked outside files.

Final outputs are assembled programmatically and converted to a desired output format.

# Different strengths and weaknesses

Everyone knows Word, Excel, or Google Docs.

"Track changes" is powerful and easy.

Hm, why can't I remember how I made this figure?.

Where did this table of results come from?.

Paper\_Submitted\_Final\_edits\_FINAL\_kh-1.docx

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Plain text is universally portable.

Push button, recreate analysis.

Why can't I make R do this simple thing?

This version control stuff is a pain.

Object of type 'closure' is not subsettable

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## Each approach generates solutions to its own problems

# **INTO THE KITCHEN**



# RStudio is an IDE for R



# A kitchen is an IDE for Meals



# R & RStudio

The screenshot shows the RStudio interface with the following components:

- Code Editor:** Displays the file `covdata.Rmd` containing R Markdown code. The code includes a header, a note about the covdata package, and a setup block for tidyverse.
- Environment Pane:** Shows the global environment with a single entry: `set function (name, value)`.
- Console:** Displays R startup messages, including the R logo, a note about contributors, help information, and the loading of the `testthat` package.
- File Browser:** Shows the directory structure of the `covdata` project, listing files like `.github`, `.gitignore`, `.Rbuildignore`, `.Rhistory`, `_pkgdown.yml`, `_sinewconfig.yml`, `covdata.Rproj`, `data`, `data-raw`, `DESCRIPTION`, `inst`, `LICENSE`, `LICENSE.md`, `man`, and `NAMESPACE`.

# R & RStudio

```
# COVID      covidcases.Rmd

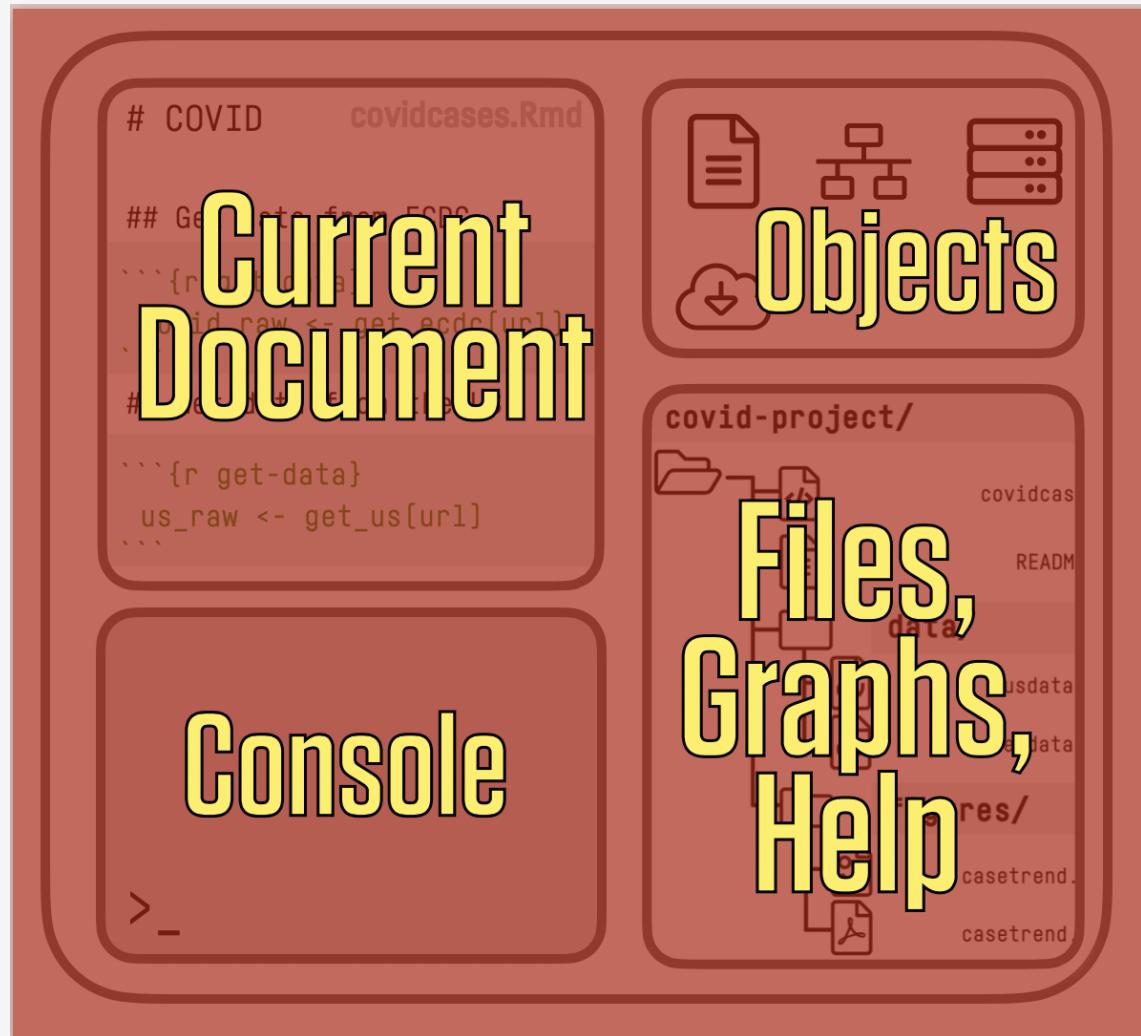
## Get data from ECDC
```{r get-data}
covid_raw <- get_ecdc[url]
```

## Get data from the US
```{r get-data}
us_raw <- get_us[url]
```

```

The diagram shows a project directory structure named "covid-project/". The root folder contains a file named "covidcas" and a file named "READM". Inside the "data/" folder, there are two subfolders: "usdata" and "eudata", each containing CSV files. Inside the "figures/" folder, there are two subfolders: "casetrend." and "casetrend.", each containing PDF files.

# R & RStudio



# RStudio

The screenshot shows the RStudio interface. The main area is divided into several panes:

- Code Editor (highlighted by a red box):** Displays the R Markdown file `01_introduction.Rmd`. The content includes metadata (title, author, date) and a section titled "## Data Visualization Notes". A large red box highlights this section.
- Preview Pane:** Shows the rendered content of the R Markdown file, featuring a large red title: "Paper, Report, Analysis, Notes, etc, in RMarkdown".
- Environment Pane:** Shows the global environment, which is currently empty.
- File Explorer:** Shows the project structure under `stathorizons_0820`, including files like `01_introduction.Rmd`, `02_get_started.Rmd`, and `03_make_a_plot.Rmd`.
- Console:** Displays R code and its output, including the loading of the `testthat` package and the creation of a `test_file`.

# R & RStudio

The screenshot shows the RStudio IDE interface. The top menu bar includes RStudio, File, Edit, Code, View, Plots, Session, Build, Debug, Profile, Tools, Window, and Help. The title bar indicates the project is "stathorizons\_0820 - master - RStudio".

The left pane displays the code editor for "01\_introduction.Rmd". The content of the file is:

```
1 ---  
2 title: "Data Visualization"  
3 author: "Kieran Healy"  
4 date: "10-January-2020"  
5 output: html_document  
6 ---  
7  
8 ## Data Visualization Notes  
9  
10 This is a starter RMarkdown project template to accompany courses taught with Data Visualization. You can use it to take notes, write your code, and produce a good-looking, reproducible document that records the work you have done. At the very top of the file is a section of metadata, or information about what the file is and what it does. The metadata is delimited by three dashes at the start and another three at the end. You should change the title, author, and date to the values that suit you. Keep the 'output' line as it is for now, however. Each line in the metadata has a structure. First the *key* ("title", "author", etc), then a colon, and then the *value* associated with the key.  
11  
12 ## This Document is an RMarkdown File  
13  
14 Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.  
15  
16 When you click the Knit button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. A code chunk is
```

The right pane shows the Environment tab, which displays "Environment is empty". Below it is the Global Environment tab.

The bottom right pane is the File Browser, showing the directory structure of the project:

| Name                          | Size    | Modified               |
|-------------------------------|---------|------------------------|
| ..                            |         |                        |
| .gitignore                    | 40 B    | Jul 21, 2020, 11:16 AM |
| 01_introduction.Rmd           | 4 KB    | Jul 21, 2020, 11:16 AM |
| 02_get_started.Rmd            | 3.3 KB  | Jul 21, 2020, 11:16 AM |
| 03_make_a_plot.Rmd            | 5.8 KB  | Jul 21, 2020, 11:16 AM |
| 04_show_the_right_numbers.Rmd | 4.8 KB  | Jul 21, 2020, 11:16 AM |
| 05_tables_and_labels.Rmd      | 9.9 KB  | Jul 21, 2020, 11:16 AM |
| 06_models.Rmd                 | 15 KB   | Jul 21, 2020, 11:16 AM |
| 07_maps.Rmd                   | 12.5 KB | Jul 21, 2020, 11:16 AM |
| 08_refine_plots.Rmd           | 21.7 KB | Jul 21, 2020, 11:16 AM |
| 09_supplementary_material.Rmd | 16.9 KB | Jul 21, 2020, 11:16 AM |
| assets                        |         |                        |
| data                          |         |                        |
| figures                       |         |                        |
| keynote                       |         |                        |
| LICENSE.md                    | 18.1 KB | Jul 21, 2020, 11:16 AM |
| materials                     |         |                        |
| README.md                     | 5.7 KB  | Jul 21, 2020, 11:16 AM |
| slides                        |         |                        |
| stathorizons_0820.Rproj       | 205 B   | Jul 22, 2020, 9:50 AM  |

The bottom left pane is the Console, which contains the following text:

```
~/Documents/courses/stathorizons_0820/ ↵  
Type 'demo()' for some demos, 'help()' for on-line help, or  
'help.start()' for an HTML browser interface to help.  
Type 'q()' to quit R.  
  
knitr hook "anchor" is now available  
Loading required package: testthat  
  
Attaching package: 'testthat'  
  
The following object is masked from 'package:devtools':  
  
    test_file  
  
> |
```

A large red box highlights the Console area, and overlaid text reads:

Console: Type or send code here, see results

# R & RStudio

The screenshot shows the RStudio interface with a project titled "stathorizons\_0820".

- Left Panel:** The code editor displays the file "01\_introduction.Rmd". The content includes R Markdown metadata (title, author, date) and a note about the project template.
- Middle Panel:** The Environment pane shows an empty global environment.
- Bottom Panel:** The Console pane shows R startup messages and package loading.
- Right Panel:** The Files pane displays the project directory structure:

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| slides                        |         |                        |
| stathorizons_0820.Rproj       |         | Jul 22, 2020, 8:50 AM  |

**Project files, Plots, Help**

# R & RStudio

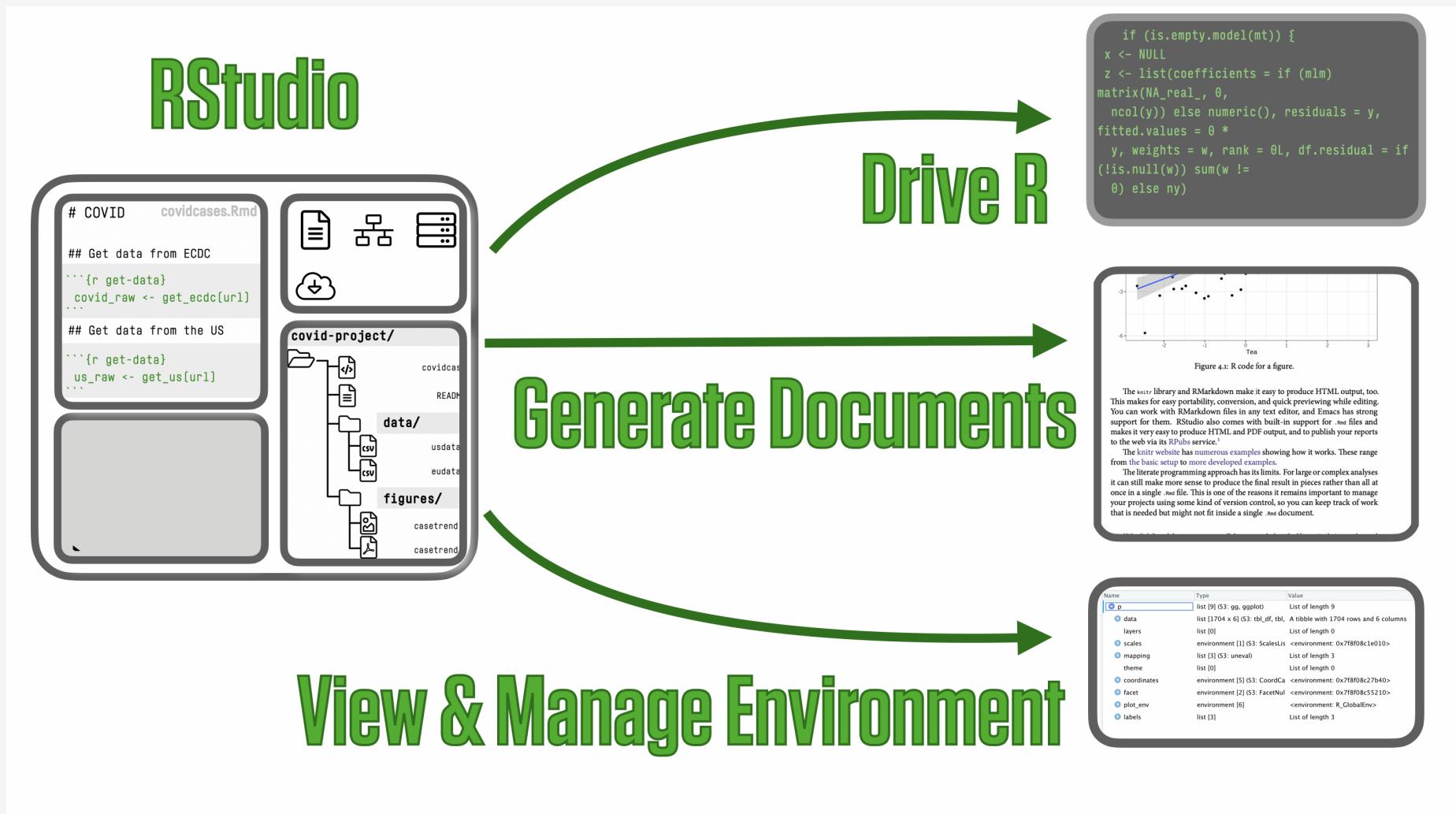
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Environment is empty

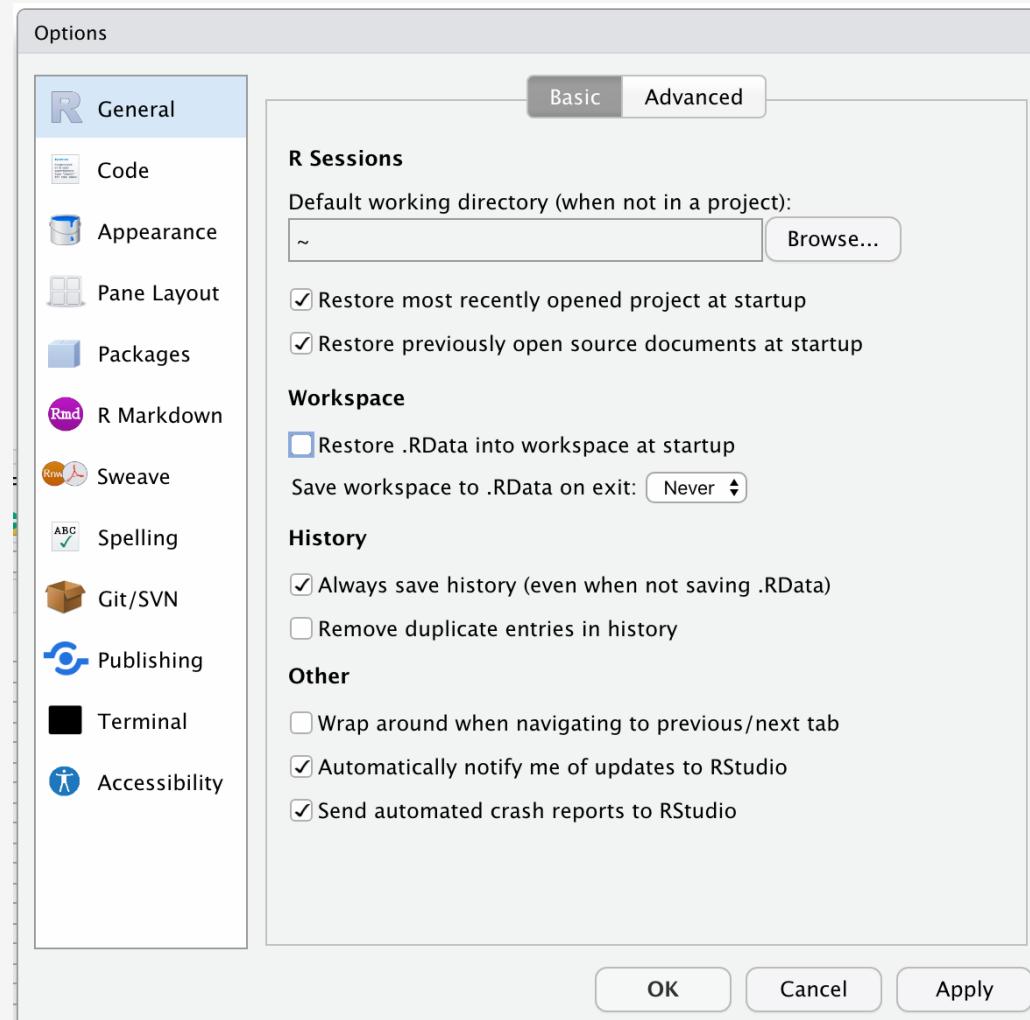
Inspect objects you create

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# R & RStudio



# Your code is what's real in your project



# Consider not showing output inline

