

Intro to R

RStudio

Help! Office hours

Office hours will always be held at the *same Zoom link*.

Working with R – RStudio

RStudio is an Integrated Development Environment (IDE) for R

- Helps you write code - makes suggestions
- Helps you view the output of your code
- Helps you find errors
- Is NOT a dropdown statistical tool (such as Stata)
 - See [Rcmdr](#) or [Radiant](#)



[[source](#)]

RStudio used to be the name of a company that is now called [Posit](#).

RStudio

Easier working with R

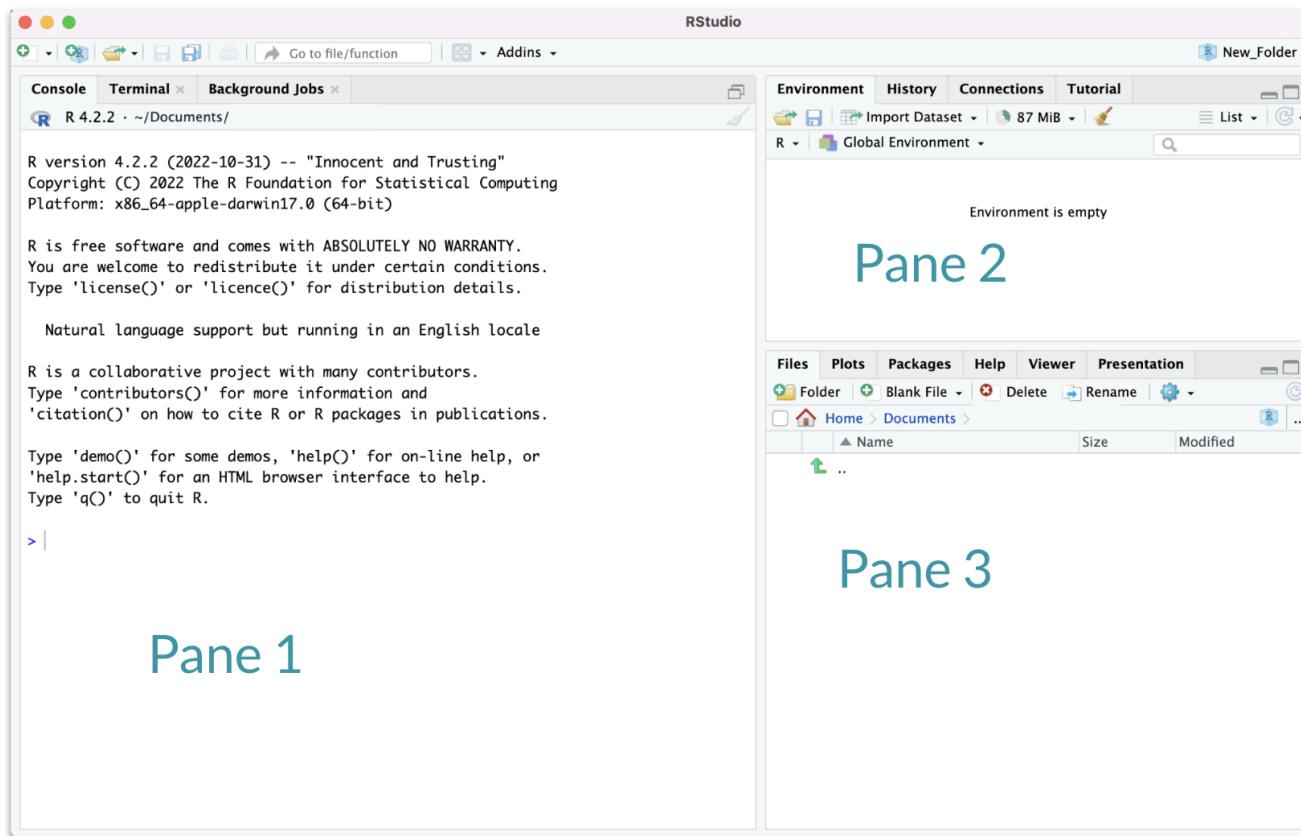
- Syntax highlighting, code completion, and smart indentation
- Easily manage multiple working directories and projects

More information

- Workspace browser and data viewer
- Plot history, zooming, and flexible image and file export
- Integrated R help and documentation

RStudio

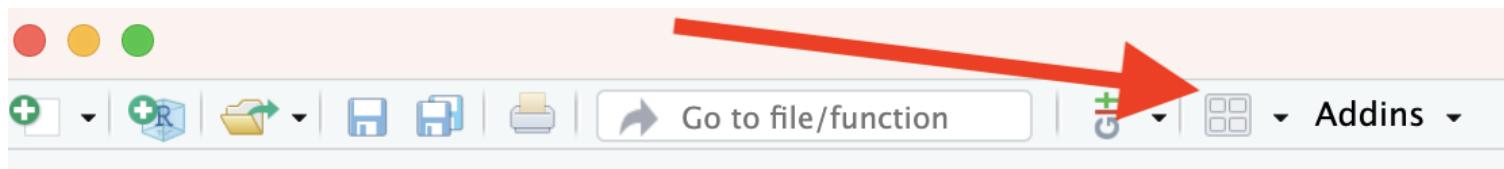
First it is important to be familiar with the layout. When you first open RStudio, you will see 3 panes.



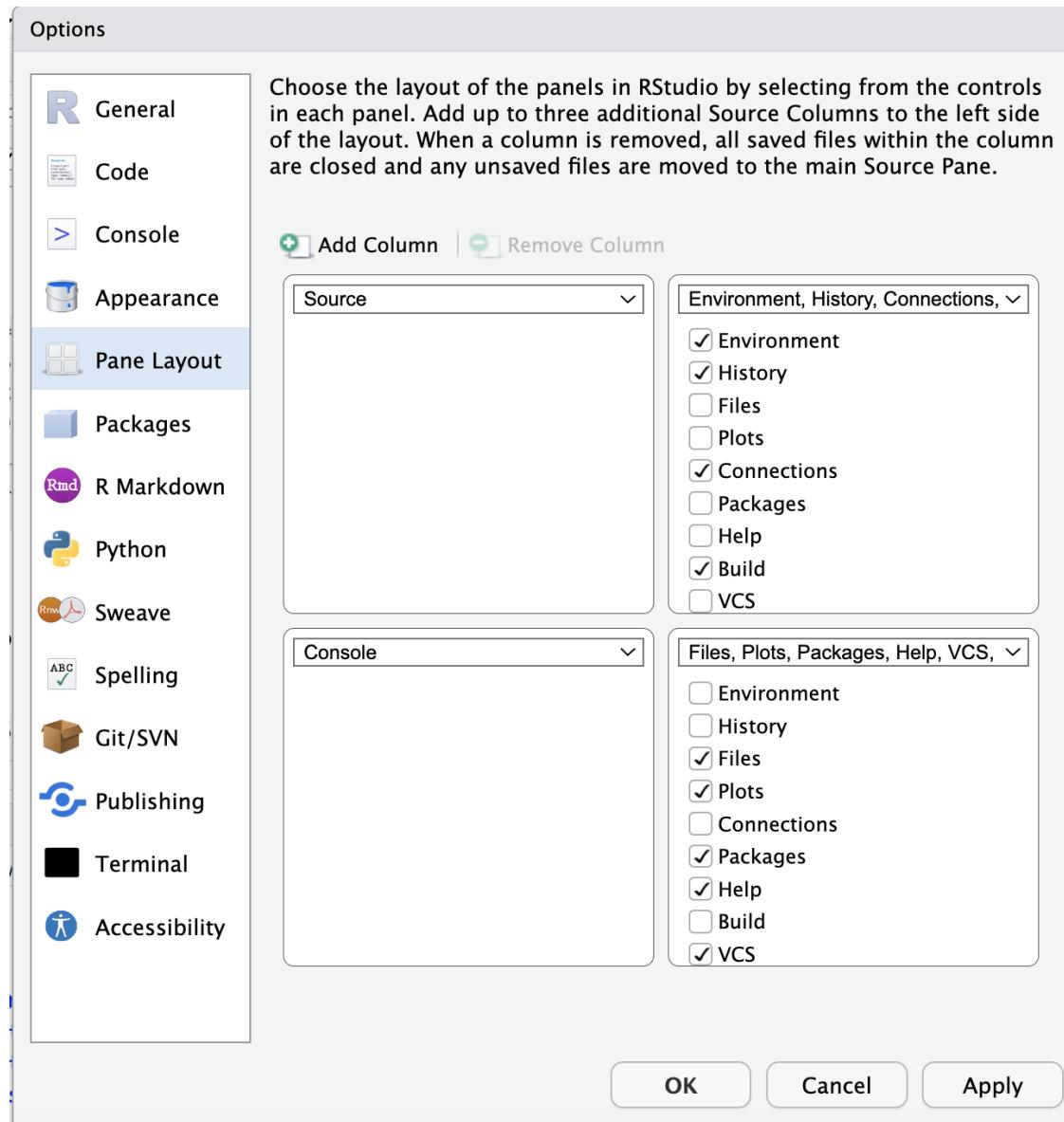
RStudio Layout

If RStudio doesn't look the way you want (or like our RStudio), then:

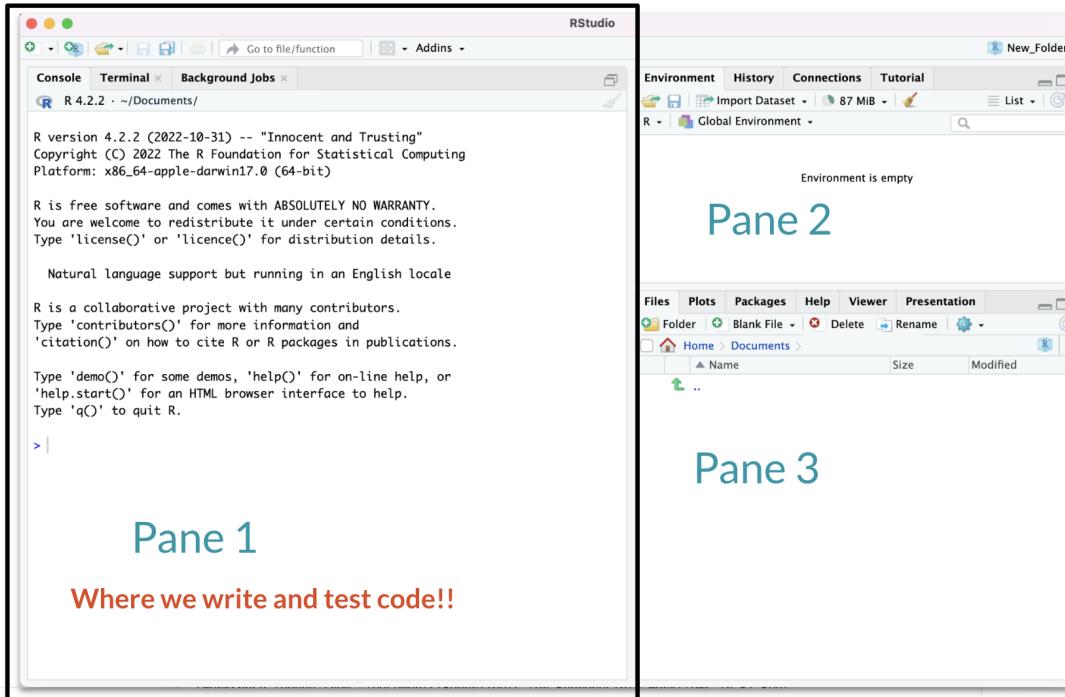
Click on the pane button, which looks like a waffle with 4 indentations. Scroll down to "Pane Layout".



Default Layout

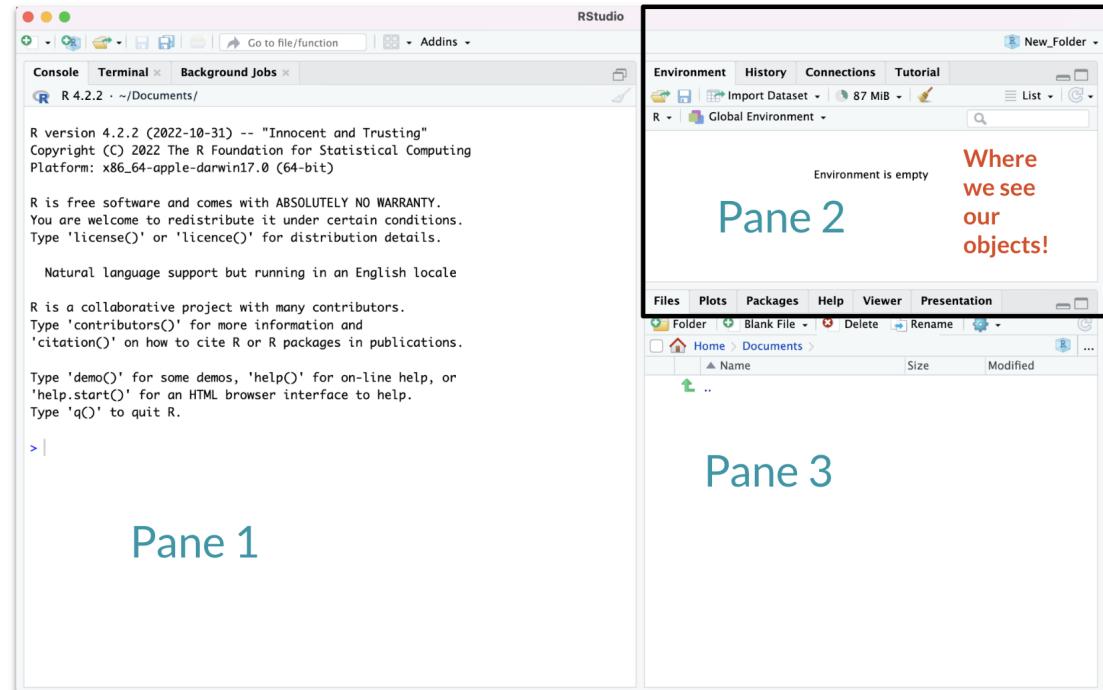


Pane 1 (Left side) for writing code

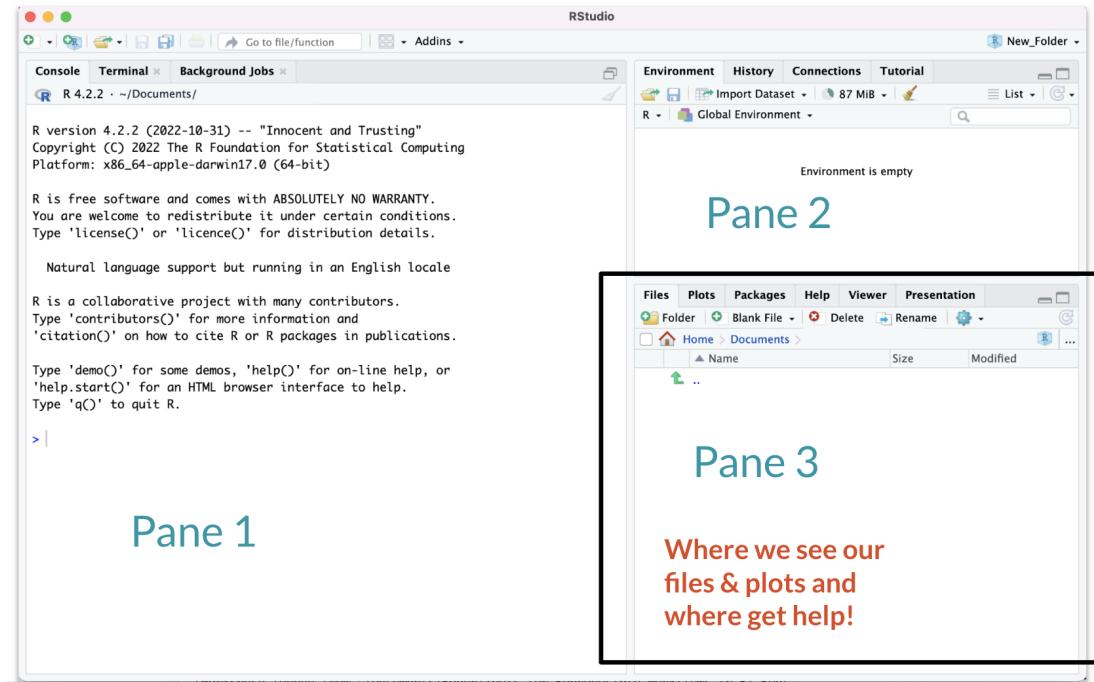


Pane 2 - where objects will be

We will start seeing this tomorrow!

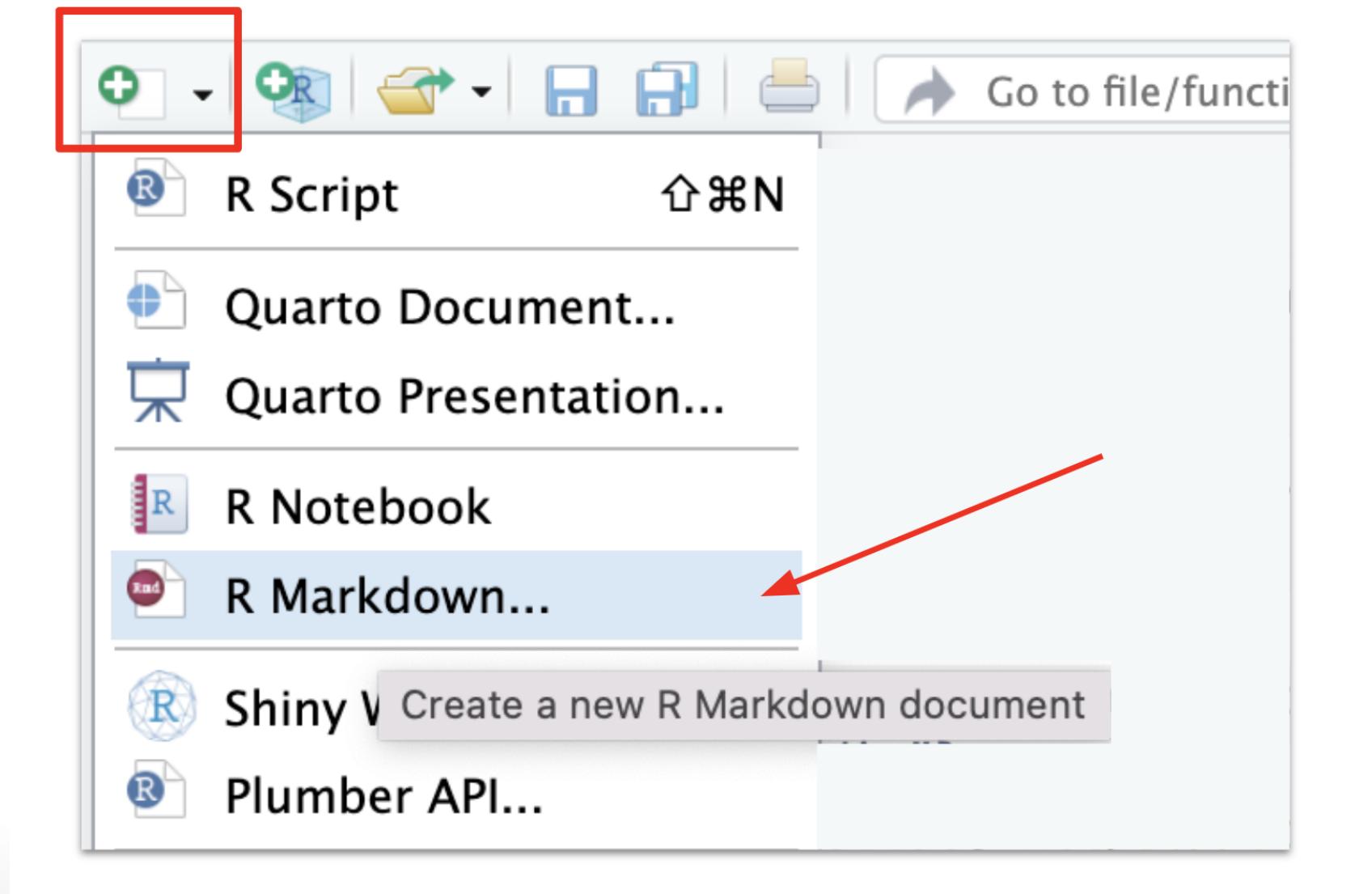


Pane 3 - where we get help and see plots



Hidden Pane

To save a copy of your code. You must open a file first - this will open a 4th pane. These files include Scripts or what are called R Markdown files.



Hidden Pane

You will see a popup that you can just say “OK” to for now.

New R Markdown

Document Presentation Shiny From Template

Title:

Author:

Date:

Use current date when rendering document

Default Output Format:

HTML
Recommended format for authoring (you can switch to PDF or Word output anytime).

PDF
PDF output requires TeX (MiKTeX on Windows, MacTeX 2013+ on OS X, TeX Live 2013+ on Linux).

Word
Previewing Word documents requires an installation of MS Word (or Libre/Open Office on Linux).

Hidden Pane

Nice! now we have a place to save code! This is where we will mostly be working.

The screenshot shows the RStudio interface with three main panes:

- New Pane!**: The leftmost pane, which is the Source pane, contains R Markdown code. It includes a title, author, date, and a chunk setup. A note at the bottom indicates it's an R Markdown document. The code is as follows:

```
1 ---  
2 title: "Untitled"  
3 author: ""  
4 date: ""  
5 output: html_document  
6 ---  
7  
8 ```{r setup, include=FALSE}  
9 knitr::opts_chunk$set(echo = TRUE)  
10 ```  
11  
12 ## R Markdown  
13  
14 This is an R Markdown document. 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>.
```

- Pane 2**: The top-right pane, which is the Environment pane, displays the message "Environment is empty".
- Pane 3**: The bottom-right pane, which is the Files pane, shows the file structure: Home > Documents > Roger > New_Folder. It lists a single file named "Untitled.Rmd".

The bottom-left pane is the Console, which displays the standard R startup message and license information.

Labels in the screenshot:

- New Pane!
- Pane 2
- Pane 3
- Pane 1 squished down

Working with R in R Studio - 2 major panes:

1. The **Source/Editor**: "Analysis" Script + Interactive Exploration

- Static copy of what you did (reproducibility)
- Top by default

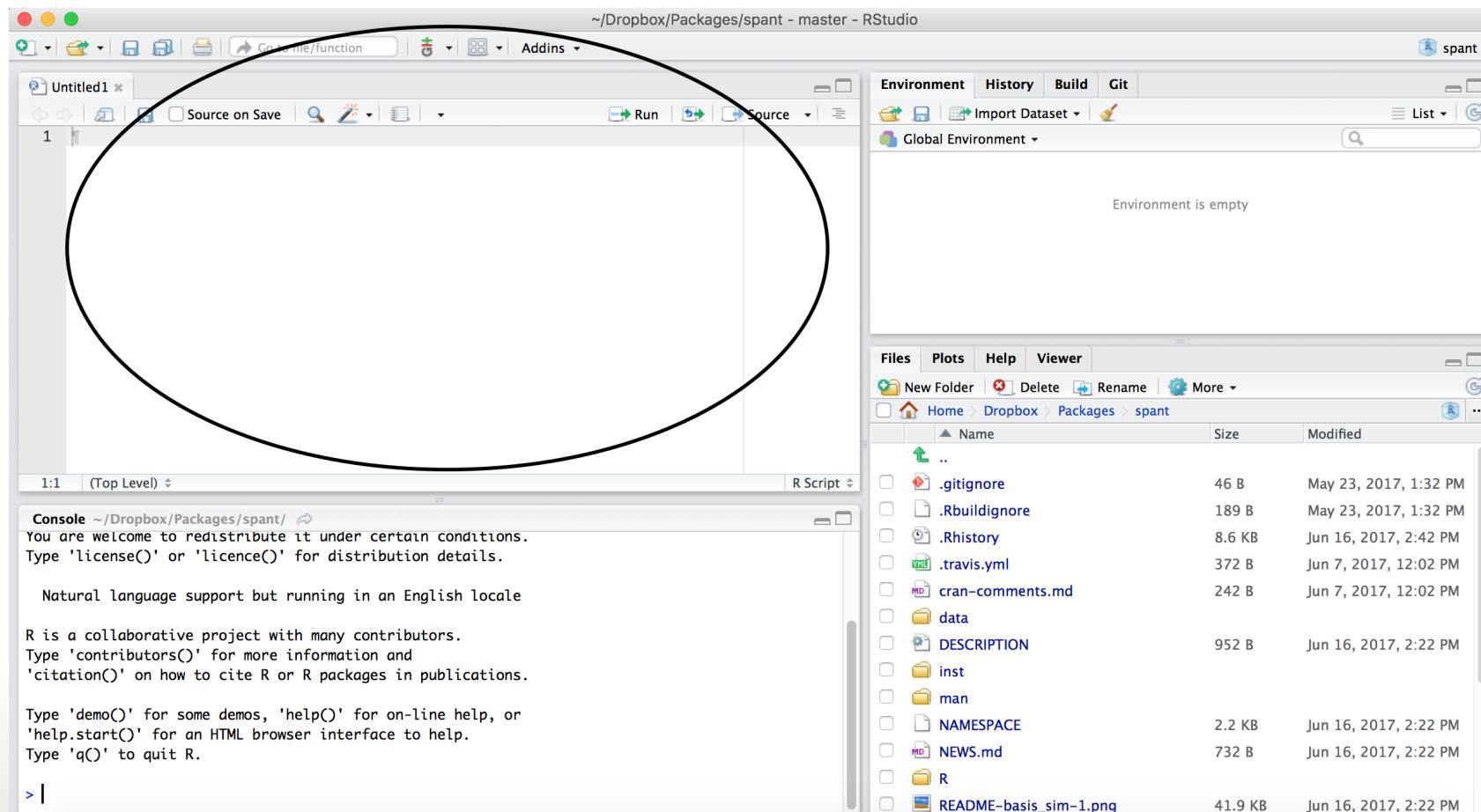
2. The **R Console**: "interprets" whatever you type

- Calculator
- Try things out interactively, then add to your editor
- Bottom by default

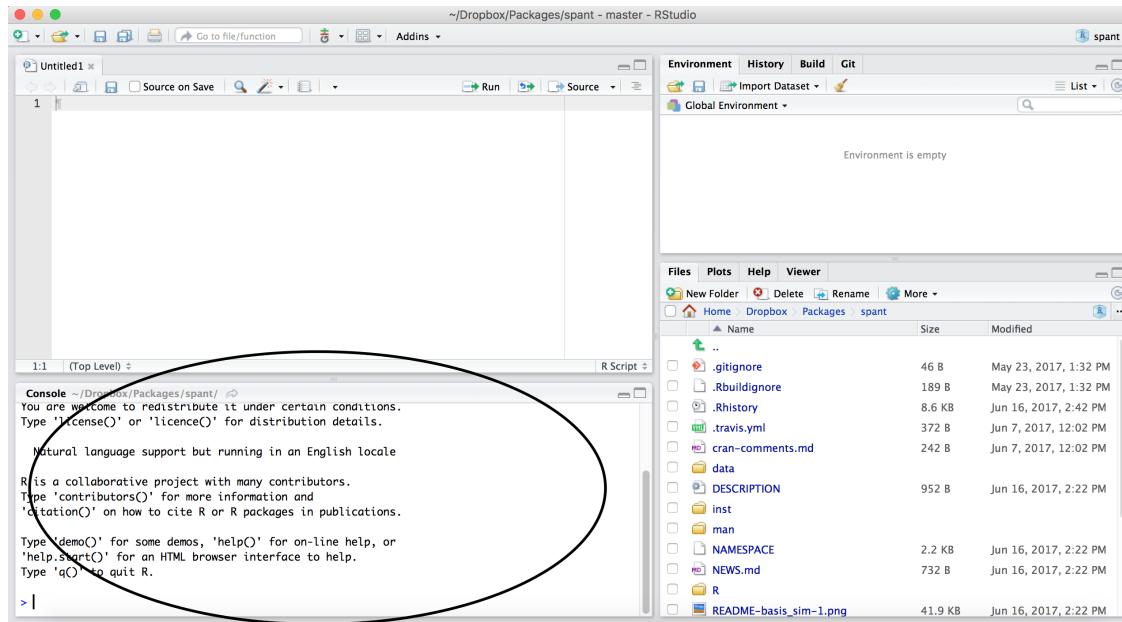
Source / Editor

- Where files open to
- Have R code and comments in them
- Can highlight and press (CMD+Enter (Mac) or Ctrl+Enter (Windows)) to run the code

In a .R file (we call a script), code is saved on your disk



R Console



- Where code is executed (where things happen)
- You can type here for things interactively to test code
- Code is **not saved** on your disk

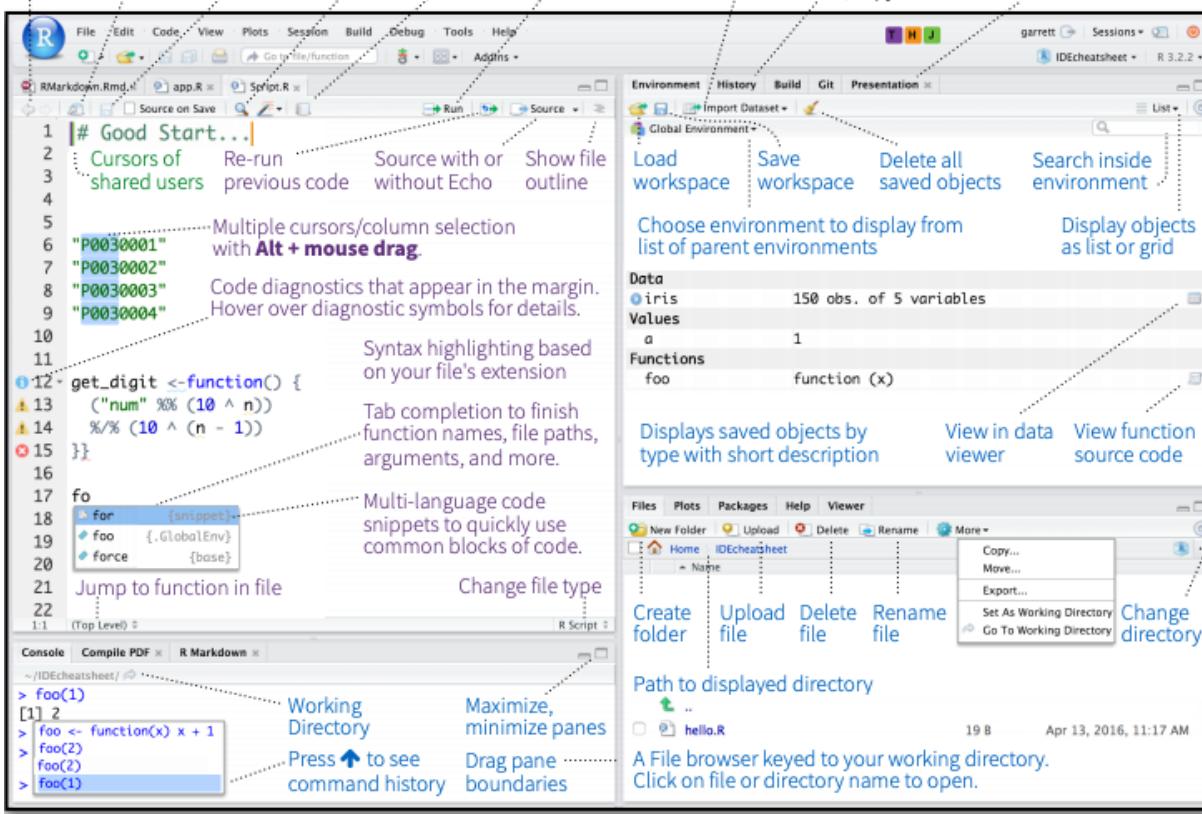
RStudio

Super useful “cheat sheet”:

<https://github.com/rstudio/cheatsheets/raw/master/rstudio-ide.pdf>

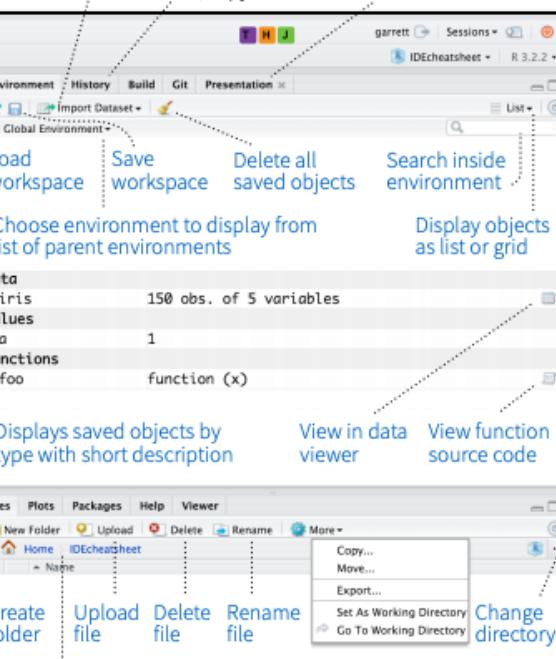
Write Code

Navigate tabs
Open in new window
Save
Find and replace
Compile as notebook
Run selected code



R Support

Import data with wizard
History of past commands to run/copy
Display .RPres slideshows
File > New File > R Presentation



R Markdown files look different from scripts

It will look like this with text in it, unlike a script.

The screenshot shows the RStudio interface with a red box highlighting the code editor area. The code editor contains an R Markdown document named 'Untitled1'. The code includes YAML front matter, R code chunks, and explanatory text. The R console at the bottom shows standard R startup messages and locale information.

```
1 ---  
2 title: "first_markdown"  
3 output: html_document  
4 ---  
5  
6 ```{r setup, include=FALSE}  
7 knitr::opts_chunk$set(echo = TRUE)  
8 ````  
9  
10 ## R Markdown  
11  
12 This is an R Markdown document. 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>.  
13  
14 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. You can embed an R code chunk like this:  
15  
16 ```{r cars}  
2:23 # first_markdown
```

Console output:

```
~/Documents/GitHub/Teaching/intro_to_r/  
You are welcome to read source code and certain connections.  
Type 'license()' or 'licence()' for distribution details.  
  
Natural language support but running in an English locale  
  
R is a collaborative project with many contributors.  
Type 'contributors()' for more information and  
'citation()' on how to cite R or R packages in publications.  
  
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.
```

Environment pane:

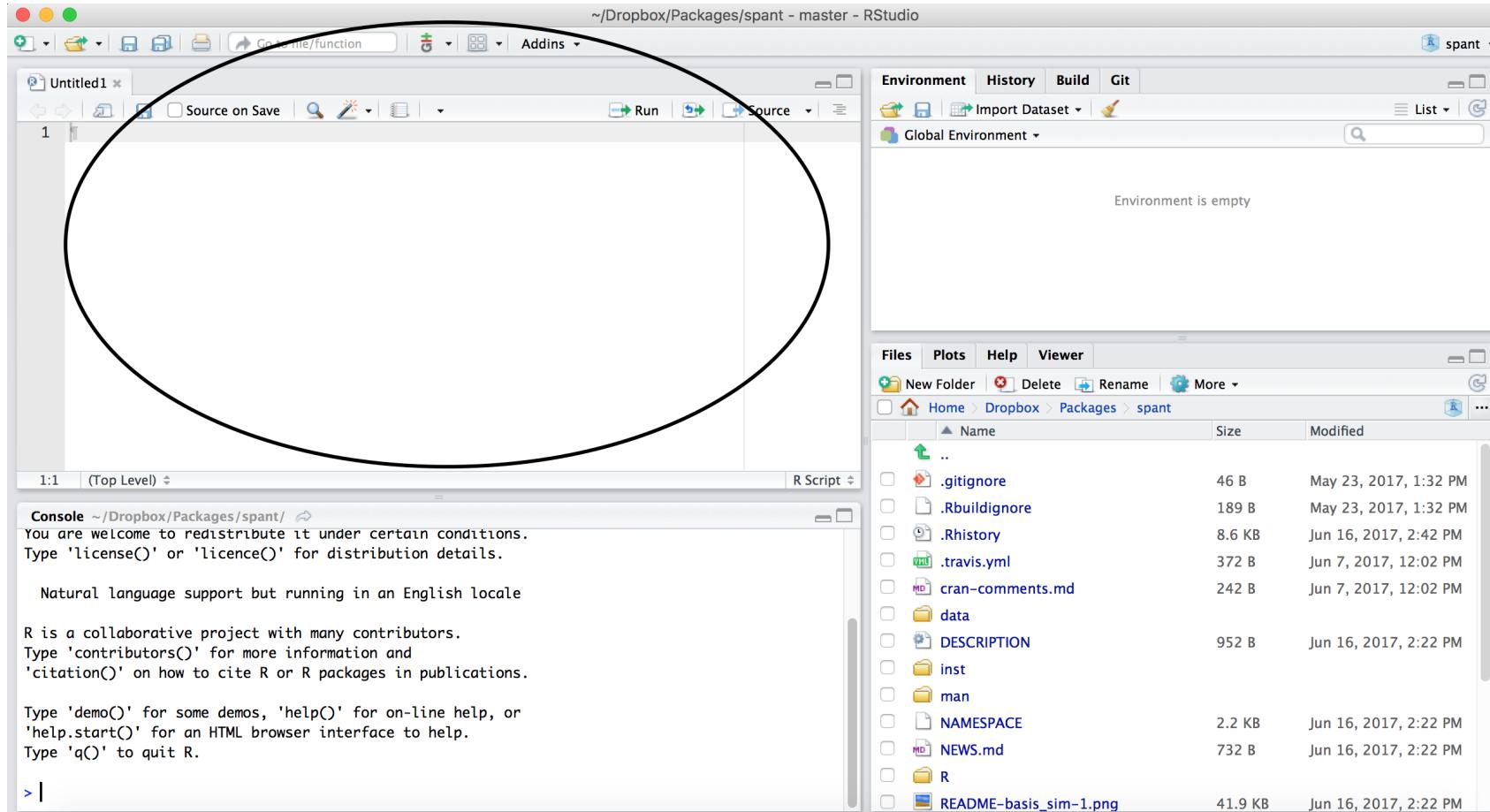
Global Environment

Environment is empty

Files pane:

| Name | Size | Modified |
|---------------------------------|---------|------------------|
| .gitignore | 245 B | May 18, 2021, 1 |
| .Rbuildignore | 16 B | May 18, 2021, 1 |
| .Rhistory | 43 B | Jun 10, 2021, 1 |
| .travis.yml | 666 B | Jun 9, 2021, 12 |
| all_functions.xlsx | 13.4 KB | Jun 8, 2021, 3:1 |
| all_the_functions.csv | 57.3 KB | Jun 8, 2021, 3:1 |
| all_the_packages.txt | 211 B | May 18, 2021, 1 |
| Arrays_Split | | |
| Basic_R | | |
| Best_Model_Coefficients.csv | 587 B | May 18, 2021, 1 |
| Best_Model_Coefficients.xlsx | 3.8 KB | May 18, 2021, 1 |
| bibliography.bib | 599 B | May 18, 2021, 1 |
| black_and_white_theme.pdf | 45.1 KB | May 18, 2021, 1 |
| bloomberg logo small horizontal | 25.4 KB | May 18, 2021, 1 |

Recall that a script was just empty

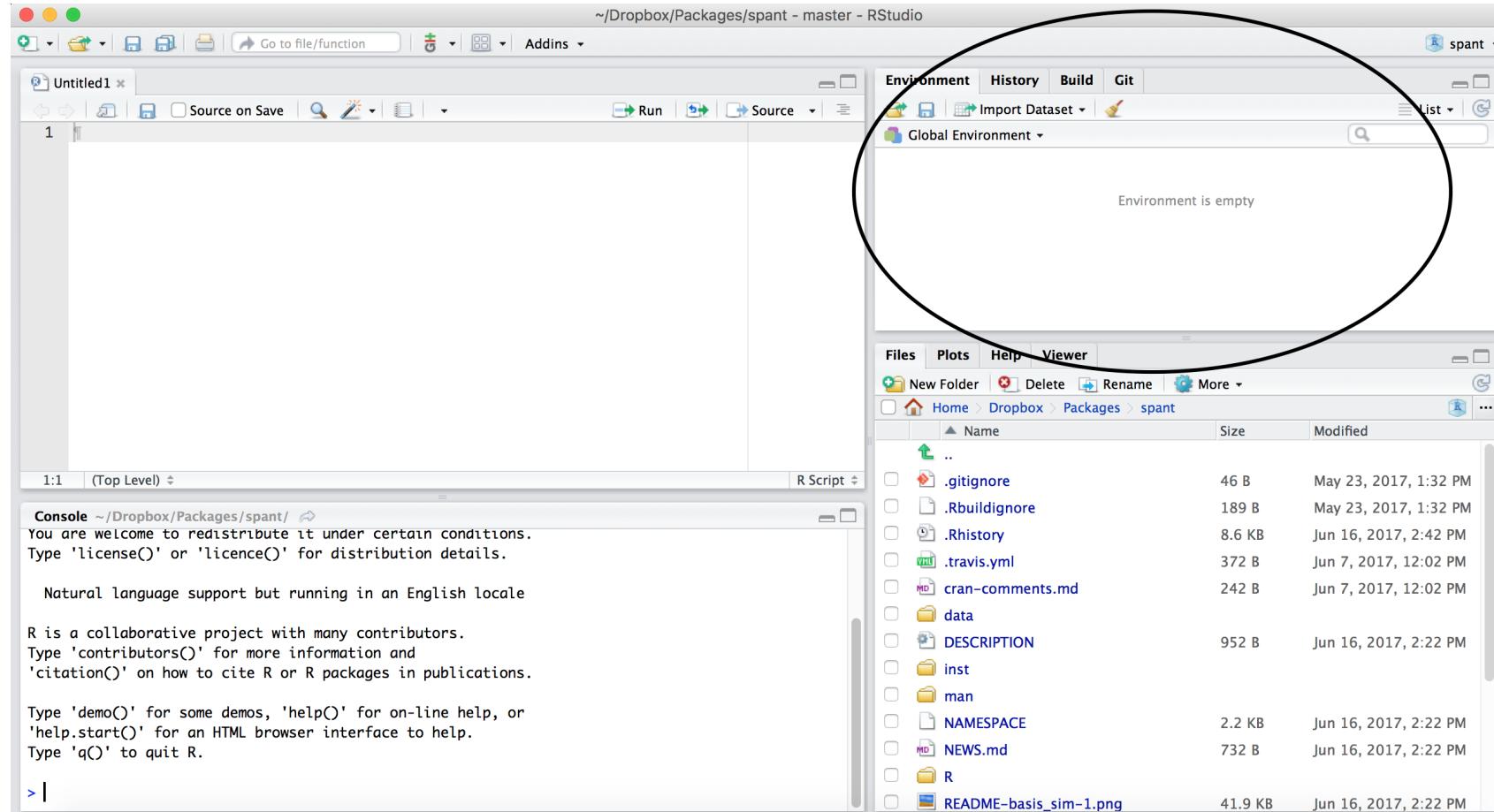


Scripts and R Markdown

Although people will use scripts often, and they are good for more programmatic purposes, we generally don't recommend them for Public Health Researchers.

For data analyses, R Markdown files are generally superior because they allow you to check your code and write more info about your code.

Workspace/Environment



Workspace/Environment

- Tells you what **objects** are in R
- What exists in memory/what is loaded?/what did I read in?

History

- Shows previous commands. Good to look at for debugging, but **don't rely** on it.
Instead use RMarkdown!
- Also type the “up” key in the Console to scroll through previous commands

Other Panes

- **Files** - shows the files on your computer or the directory you are working in
- **Viewer** - can view data or R objects
- **Help** - shows help of R commands
- **Plots** - pictures and figures
- **Packages** - list of R packages that are loaded in memory

Let's take a look at R Studio
ourselves!

Lab: Starting with R and RMarkdown

RStudio Lab

To do this lab we need to:

- Download the file at the link above by clicking on it or go to the [website](#) schedule page
- Find the downloaded file on your computer
- Open the file in RStudio (double clicking the file name typically works)

These videos can help if you aren't sure where your downloads are:

If you have a PC: <https://youtu.be/we6vwB7DsNU>

If you have a Mac: <https://www.youtube.com/watch?v=Ao9e0cDzMrE>

You can find these on the resource page of the class website.

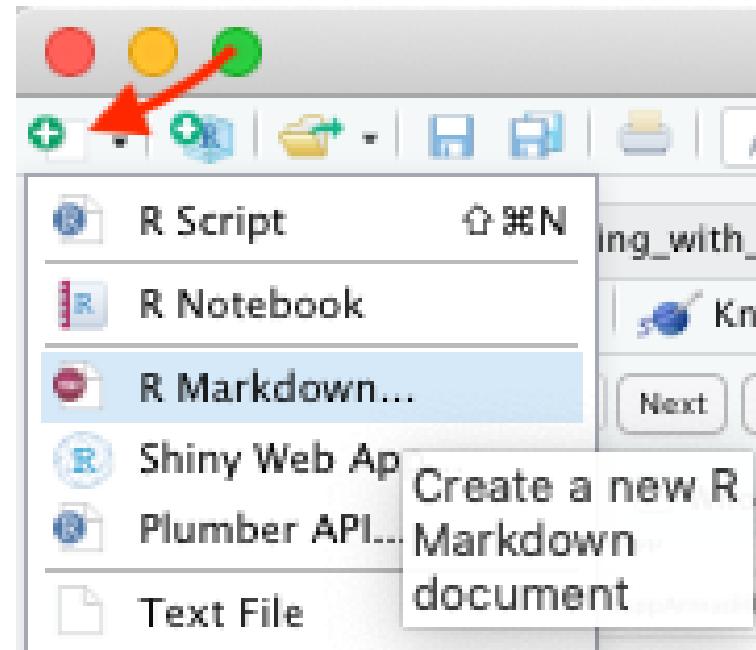
R Markdown file

R Markdown files (.Rmd) help generate reports that include your code and output. Think of them as fancier scripts.

1. Helps you describe your code
2. Allows you to check the output
3. Can create many different file types

Create an R Markdown file

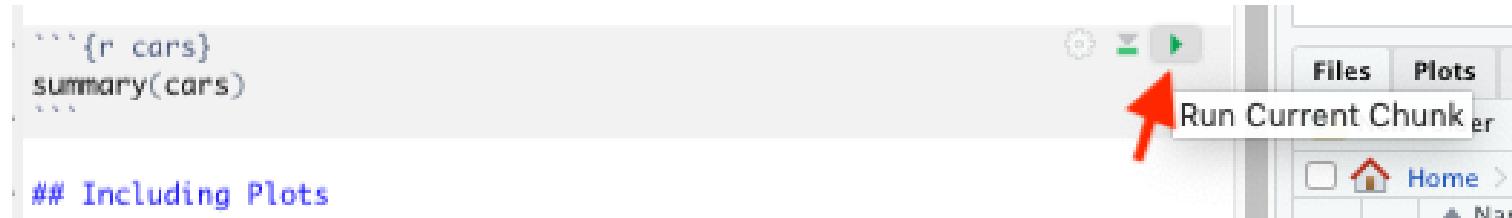
Go to File → New File → R Markdown or click the green add file button.



Code chunks

Within R Markdown files are code “chunks”.

This is where you can type R code and run it!

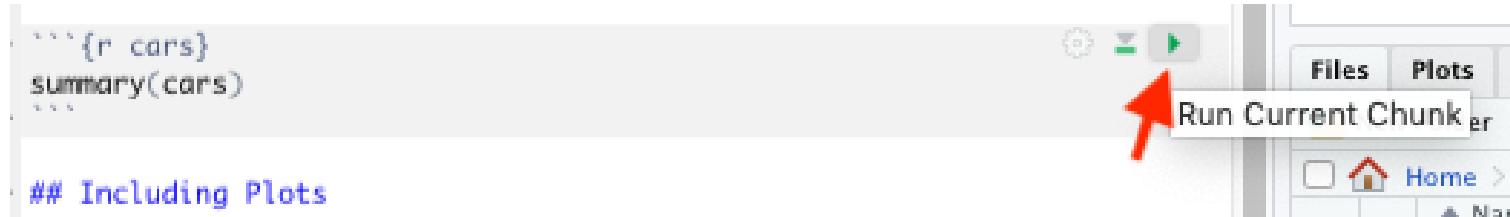


The image shows a screenshot of the RStudio IDE. On the left, there is a code editor window containing R code. The code includes a code chunk with three dots at the top, followed by `summary(cars)`, another three dots, and then a comment `## Including Plots`. On the right, the RStudio toolbar is visible, featuring various icons for file operations like Open, Save, and Print, as well as tabs for 'Files' and 'Plots'. A prominent red arrow points upwards from the bottom of the image towards the 'Run Current Chunk' button, which is highlighted with a green border and a small green play icon. The status bar at the bottom of the RStudio window shows the text 'Run Current Chunk'.

```
```{r cars}
summary(cars)
```
## Including Plots
```

Run code in a chunk

Clicking the run (play) button runs the code in the chunk.



Ctrl + Enter on Windows or Command + Enter on Mac in your script evaluates that line of code

Running a chunk executes the code

- generally see a preview of the output of the code just below the chunk
- see the code in the console

The screenshot shows the RStudio interface. At the top, there are two tabs: "Untitled2" and "RStudio.Rmd". Below the tabs is a toolbar with icons for back, forward, knit, run, and other functions. The main area is divided into two panes: "Source" (top) and "Visual" (bottom). In the Source pane, the R Markdown code is visible:

```
14 This is an R Markdown document. 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. You can embed an R code chunk like this:  
17  
18 ```{r cars}  
19 summary(cars)  
20 ```
```

In the Visual pane, the output of the `summary(cars)` chunk is displayed as a table:

| | speed | dist |
|---------|-------|----------------|
| Min. | : 4.0 | Min. : 2.00 |
| 1st Qu. | :12.0 | 1st Qu.: 26.00 |
| Median | :15.0 | Median : 36.00 |
| Mean | :15.4 | Mean : 42.98 |
| 3rd Qu. | :19.0 | 3rd Qu.: 56.00 |
| Max. | :25.0 | Max. :120.00 |

At the bottom of the RStudio window, the "Console" tab is active, showing the R session history:

```
>  
>  
>  
> summary(cars)  
    speed          dist  
Min. : 4.0   Min. : 2.00  
1st Qu.:12.0  1st Qu.: 26.00  
Median :15.0  Median : 36.00  
Mean   :15.4  Mean   : 42.98  
3rd Qu.:19.0  3rd Qu.: 56.00
```

If you get annoyed by code previews in Markdown files:

In RStudio Click the Edit tab → scroll down to Preferences... → R Markdown

Uncheck the following:

The screenshot shows the 'Options' dialog in RStudio. On the left, a sidebar lists various sections: General, Code, Console, Appearance, Pane Layout, Packages, R Markdown (which is selected and highlighted in blue), Python, Sweave, and Spelling. The main area has tabs at the top: Basic (selected), Advanced, Visual, and Citations. Under the 'R Markdown' section, there are several configuration options:

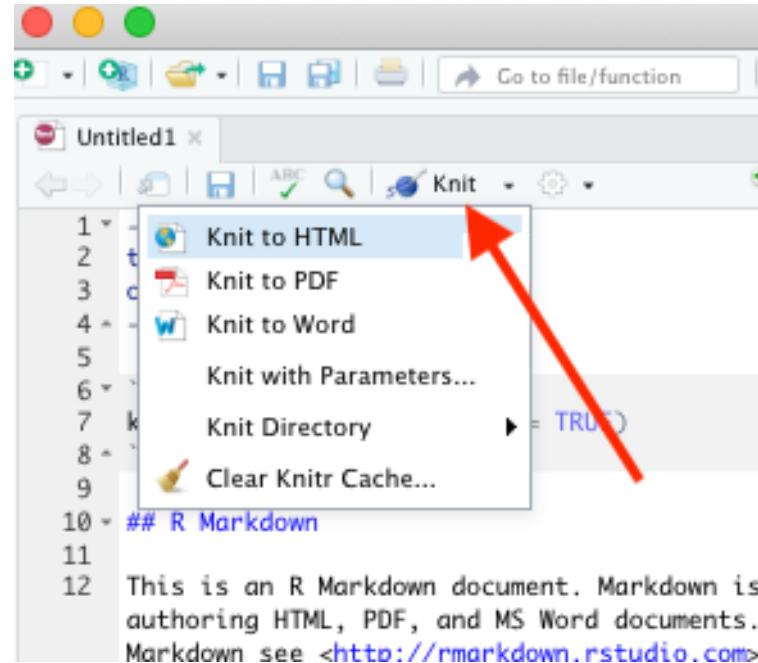
- Show document outline by default
- Soft-wrap R Markdown files
- Show in document outline:
- Show output preview in:
- Show output inline for all R Markdown documents (this option is highlighted with a red border)
- Show equation and image previews:
- Evaluate chunks in directory:

Below this, under 'R Notebooks', are two more options:

- Execute setup chunk automatically in notebooks
- Hide console automatically when executing notebook chunks

Knit file to html

Running all chunks - this will create a report from the R Markdown document!



Nice report!

This generates a nice report that you can share with others who can open in any browser.

The screenshot shows a window titled 'Untitled.html' with the URL ' ~/Documents/Roger/New_Folder/Untitled.html'. The window includes standard OS X window controls (red, yellow, green) and a toolbar with 'Untitled.html', 'Open in Browser', 'Find', and a 'Publish' button. The main content area contains:

Untitled

Your Name
2023-03-29

R Markdown

This is an R Markdown document. 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>.

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. You can embed an R code chunk like this:

```
summary(cars)
```

```
##      speed      dist
## Min.   : 4.0   Min.   : 2.00
## 1st Qu.:12.0   1st Qu.: 26.00
## Median :15.0   Median : 36.00
## Mean   :15.4   Mean   : 42.98
## 3rd Qu.:19.0   3rd Qu.: 56.00
## Max.   :25.0   Max.   :120.00
```

Including Plots

You can also embed plots, for example:

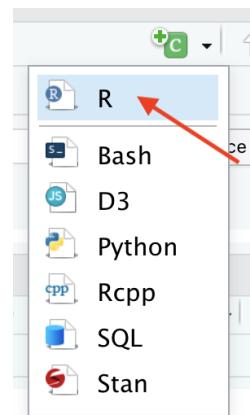
Create Chunks

To create a new R code chunk:

- Use the insert code chunk button at the top of RStudio.



- Select R (default) as the language:



Create Chunks

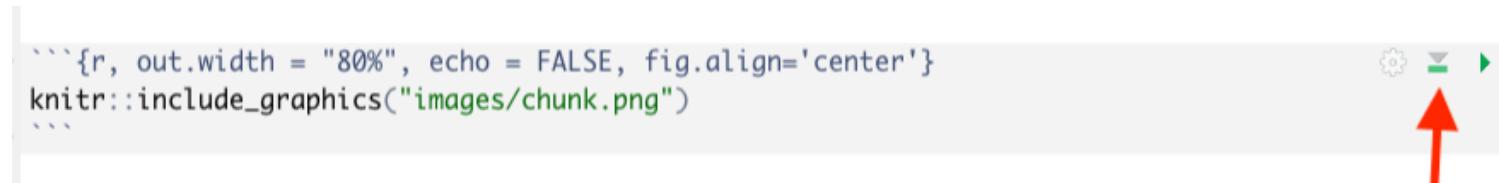
If you like keyboard shortcuts:

- Windows & Linux use Ctrl+Alt+I
- Mac use Command+Option+I

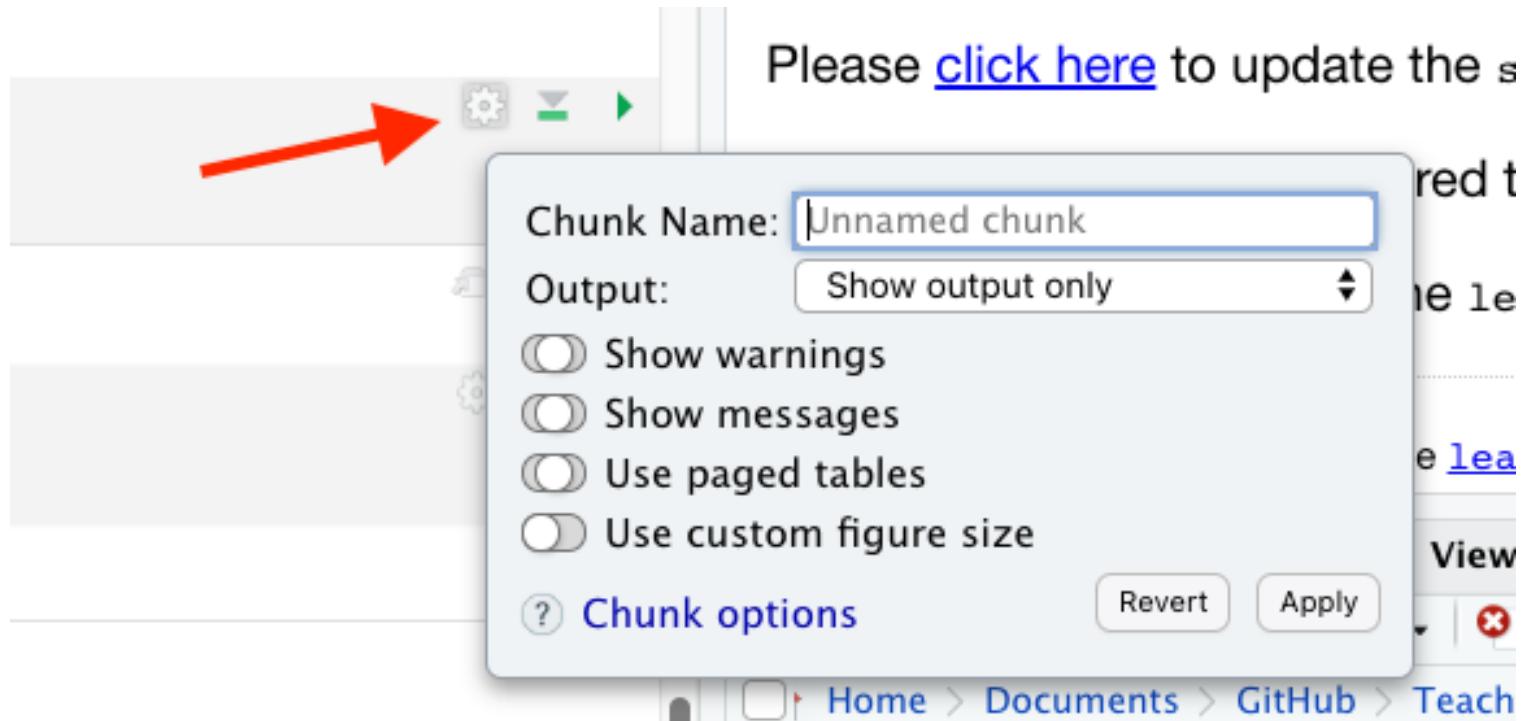
I is for insert.

Run previous chunks button

You can run all chunks above a specific chunk using this button:

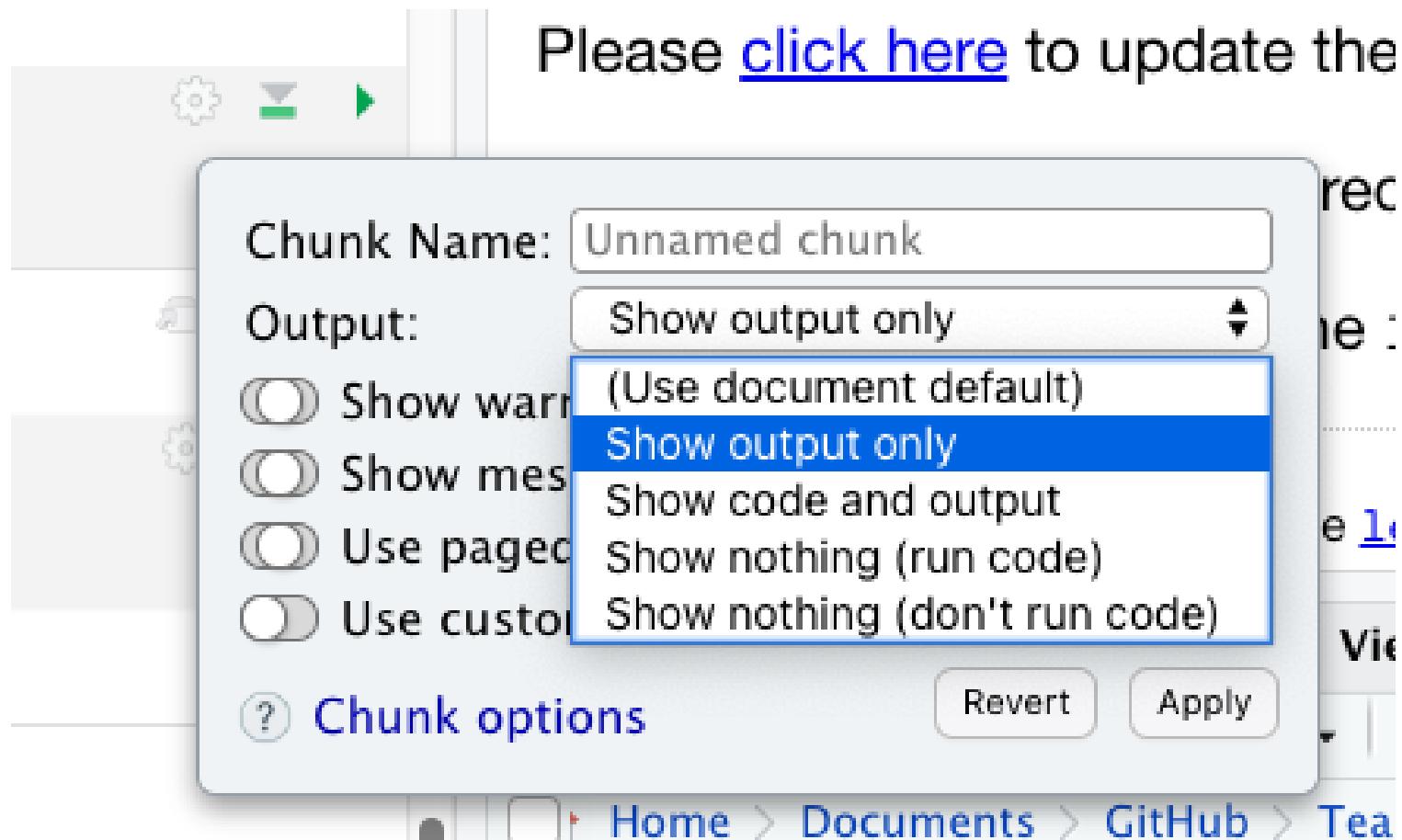


Chunk settings



Chunk settings

You can specify if a chunk will be seen in the report or not.



Errors

R studio can help you find issues in your code. Note that sometimes the error occurs earlier than RStudio thinks.



A screenshot of the RStudio interface showing a code editor with the following content:

```
305 print(x, ...)  
306 - {r}  
✖ 307 print(x))  
308 ...  
3 unexpected token ')'  
3 unexpected end of document
```

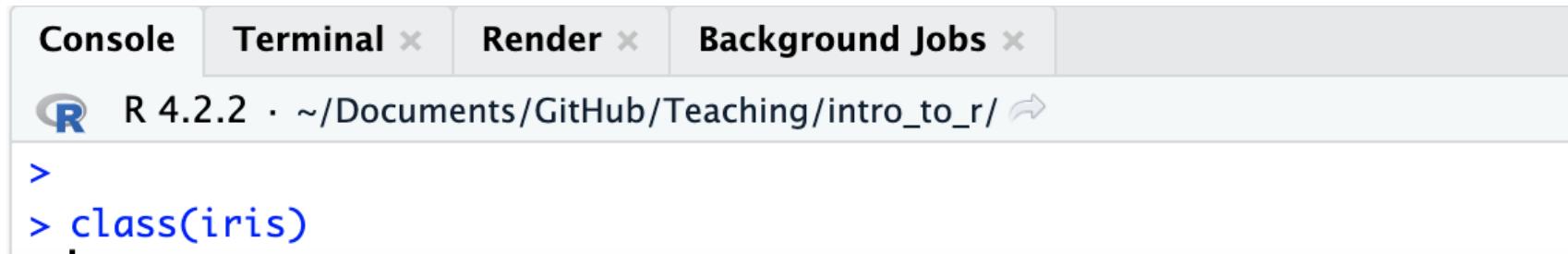
The line "print(x))" is highlighted with a red error indicator, and a tooltip box is open over it displaying the error message: "unexpected token ')'". The RStudio toolbar is visible at the top right, showing icons for settings, file, and run.

Useful R Studio Shortcuts

- **Ctrl + Enter** on Windows or **Command + Enter** on Mac in your script evaluates that line of code
 - It's like copying and pasting the code into the console for it to run.
- **Ctrl+1** on Windows or **Command + 1** on Mac takes you to the script page
- **Ctrl+2** on Windows or **Command + 2** on Mac takes you to the console
- http://www.rstudio.com/ide/docs/using/keyboard_shortcuts

Recap of where code goes

- you can test code in the console



The screenshot shows the RStudio interface with the 'Console' tab selected. The top bar displays 'Console', 'Terminal x', 'Render x', and 'Background Jobs x'. Below the bar, the R logo and session information 'R 4.2.2 · ~/Documents/GitHub/Teaching/intro_to_r/' are visible. The console window contains the following text:
>
> `class(iris)`
[1] "data frame"

- you can save code in a chunk in the editor (Markdown file)

```
## R Markdown
```

Code does not go here and instead goes within the grey chunks like this:

```
```{r}
summary(cars)
```
```



Getting help from the preview

When you type in a function name, a pop up will preview documentation to help you. It also helps you remember the name of the function if you don't remember all of it!

The screenshot shows two examples of RStudio's documentation preview feature.

Top Example: The user has typed `> class`. A tooltip appears over the first result in the completion dropdown, which is `class(x)`. The tooltip contains the following text:

```
R possesses a simple generic function mechanism which can be used for an object-oriented style of programming. Method dispatch takes place based on the class of the first argument to the generic function.
```

Bottom Example: The user has typed `> read_`. A tooltip appears over the first result in the completion dropdown, which is `read_csv`. The tooltip contains the following text:

```
read_csv(file, col_names = TRUE, col_types = NULL, col_select = NULL, id = NULL, locale = default_locale(), na = c("", "NA"), quoted_na = TRUE, quote = "\"", comment = "", trim_ws = TRUE, skip = 0, n_max = Inf, guess_max = min(1000, n_max), name_repair = "unique", num_threads = readr_threads(), progress = show_progress(), show_col_types = should_show_types(),
```

Both toolbars show tabs for "Main" and "Other".

Get help with the help pane



The screenshot shows the R help pane interface. At the top, there is a navigation bar with tabs: Files, Plots, Packages, Help (which is selected), Git, Viewer, and Presentation. Below the navigation bar are several icons: a left arrow, a right arrow, a house icon, and a refresh/circular arrow icon. To the right of these icons is a search bar containing the text "class". Further to the right are icons for closing the window and minimizing/maximizing it. Below the navigation bar, the title "R: Object Classes" is displayed next to a dropdown arrow, and there is a "Find in Topic" button. The main content area shows the title "class {base}" on the left and "R Documentation" on the right.

class {base} R Documentation

Object Classes

Description

R possesses a simple generic function mechanism which can be used for an object-oriented style of programming. Method dispatch takes place based on the class of the first argument to the generic function.

Usage

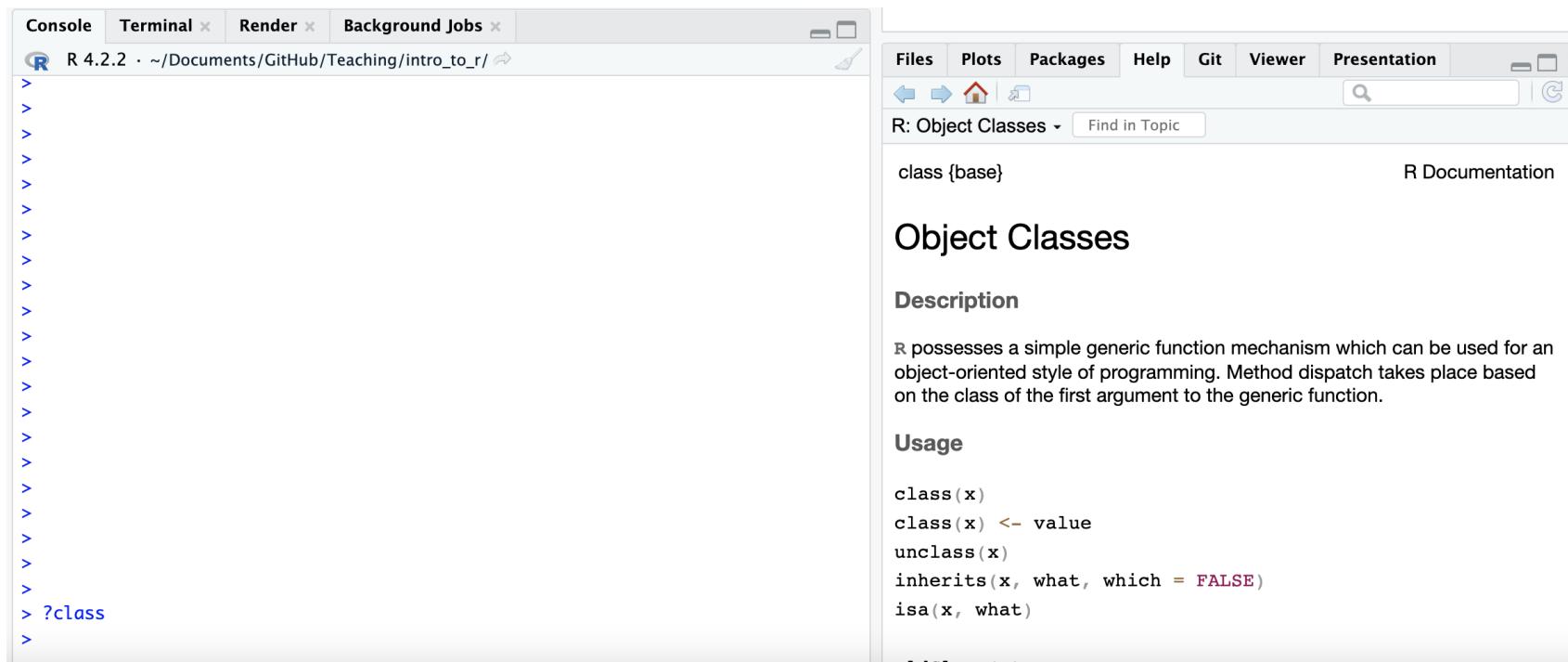
```
class(x)
class(x) <- value
unclass(x)
inherits(x, what, which = FALSE)
isa(x, what)
oldClass(x)
```

Getting Help with ?

If you know the name of a package or function:

Type `?package_name` or `?function_name` in the console to get information about packages and functions.

For example: ?readr or ?read_csv.



Double Question Mark

If you haven't loaded a package yet into R than you may get a response that there is no documentation.

Typing in `??package_name` can show you packages that you haven't loaded yet.

The screenshot shows the RStudio interface. On the left, the Console tab is active, displaying R code and its output. The user has run several commands related to the tidyverse package, including `?class`, `?tidyverse`, and `??tidyverse`. The output for `??tidyverse` shows that there is no documentation for 'tidyverse' in specified packages and libraries, but suggests trying `??tidyverse`. The user then loads the tidyverse package using `library(tidyverse)`. The output shows the packages attached and conflicts resolved. On the right, the Help tab is active, displaying the documentation for the tidyverse package. The title is 'tidyverse: Easily Install and Load the 'Tidyverse''. It includes sections for 'Description', 'Author(s)', and 'Maintainer'. A 'tidyverse' logo is visible on the right side of the help window.

Console Terminal × Render × Background Jobs ×

R 4.2.2 · ~/Documents/GitHub/Teaching/intro_to_r/ ↵

```
>
>
>
>
>
>
> ?class
> ?tidyverse
No documentation for 'tidyverse' in specified packages and libraries:
you could try '??tidyverse'
> ??tidyverse
> library(tidyverse)
— Attaching packages ——————— tidyverse 1.3.2 —
✓ ggplot2 3.4.0   ✓ dplyr  1.0.10
✓ tibble  3.1.8   ✓ stringr 1.5.0
✓ tidyr   1.2.0   ✓forcats 0.5.1
✓ purrr   1.0.0
— Conflicts ——————— tidyverse_conflicts() —
✖ dplyr::filter() masks stats::filter()
✖ dplyr::lag()    masks stats::lag()
> ?tidyverse
> |
```

Files Plots Packages Help Git Viewer Presentation

R: tidyverse: Easily Install and Load the 'Tidyverse' Find in Topic

tidyverse-package {tidyverse} R Documentation

tidyverse: Easily Install and Load the 'Tidyverse'

Description

The 'tidyverse' is a set of packages that work in harmony because they share common data representations and 'API' design. This package is designed to make it easy to install and load multiple 'tidyverse' packages in a single step. Learn more about the 'tidyverse' at <https://www.tidyverse.org>.

Author(s)

Maintainer: Hadley Wickham hadley@rstudio.com

Other contributors:



Summary

- RStudio makes working in R easier
- the Editor (top) is for static code like scripts or R Markdown documents
- The console is for testing code (bottom) - best to save your code though!
- R markdown documents are really helpful for lots of reasons!
- R code goes within what is called a chunk (the gray box with a green play button)
- Code chunks can be modified so that they show differently in reports

[Class Website](#)

[Lab](#)



Image by [Gerd Altmann](#) from [Pixabay](#)