

# Getting started with R and RStudio





**The engine**



**The dashboard**

# A tour of RStudio

~/Dropbox/Teaching/Workshops/2020-gpl/01\_welcome-tidyverse - RStudio

01\_welcome-tidyverse

Go to file/function Addins

Console Terminal x Jobs x

```
~/Dropbox/Teaching/Workshops/2020-gpl/01_welcome-tidyverse/
```

R version 4.0.0 (2020-04-24) -- "Arbor Day"  
Copyright (C) 2020 The R Foundation for Statistical Computing  
Platform: x86\_64-apple-darwin17.0 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.  
You are welcome to redistribute it under certain conditions.  
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 History Connections Tutorial

Import Dataset List

Global Environment

Environment is empty

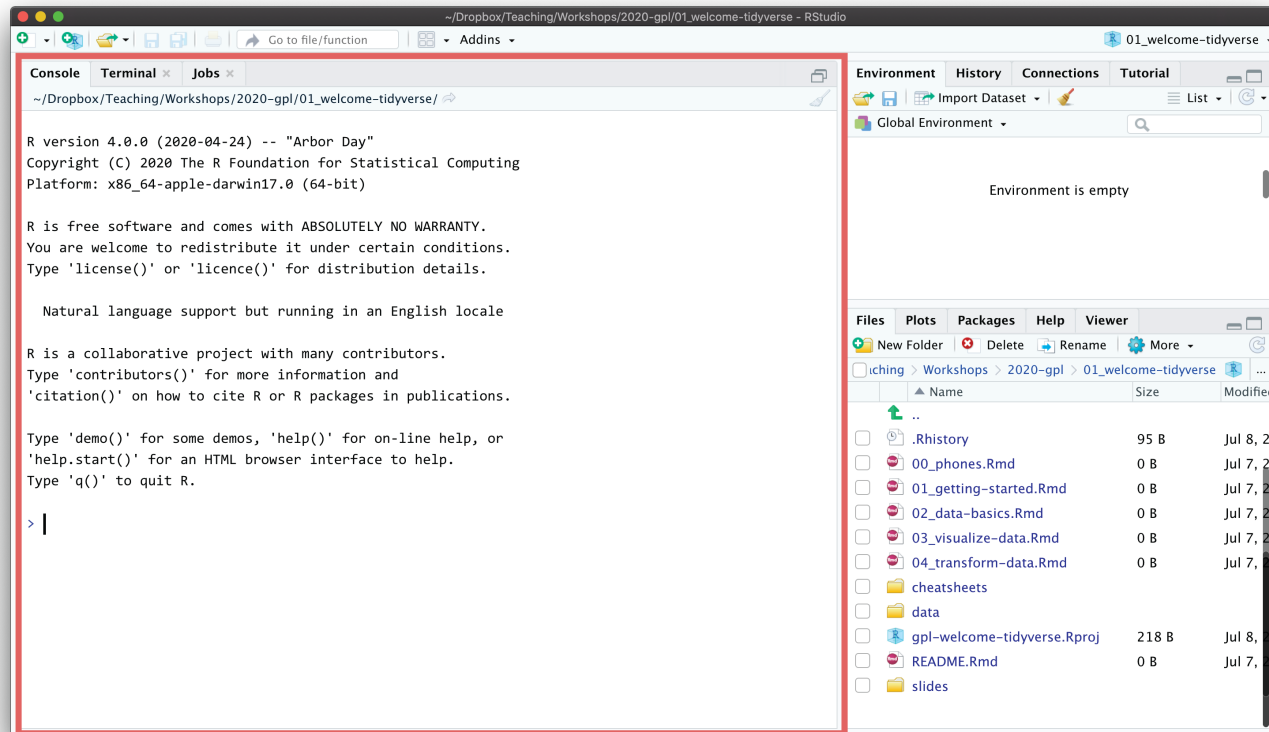
Files Plots Packages Help Viewer

New Folder Delete Rename More

Workshops > 2020-gpl > 01\_welcome-tidyverse

	Name	Size	Modified
	..		
	.Rhistory	95 B	Jul 8, 2020
	00_phones.Rmd	0 B	Jul 7, 2020
	01_getting-started.Rmd	0 B	Jul 7, 2020
	02_data-basics.Rmd	0 B	Jul 7, 2020
	03_visualize-data.Rmd	0 B	Jul 7, 2020
	04_transform-data.Rmd	0 B	Jul 7, 2020
	cheatsheets		
	data		
	gpl-welcome-tidyverse.Rproj	218 B	Jul 8, 2020
	README.Rmd	0 B	Jul 7, 2020
	slides		

# Console



The screenshot shows the RStudio interface. The console pane on the left displays the R startup message, including the version (4.0.0), copyright information, and instructions for using the software. The environment pane on the right shows that the environment is currently empty. The file browser at the bottom shows a directory structure with various R script files and folders.

```
~/Dropbox/Teaching/Workshops/2020-gpl/01_welcome-tidyverse/

R version 4.0.0 (2020-04-24) -- "Arbor Day"
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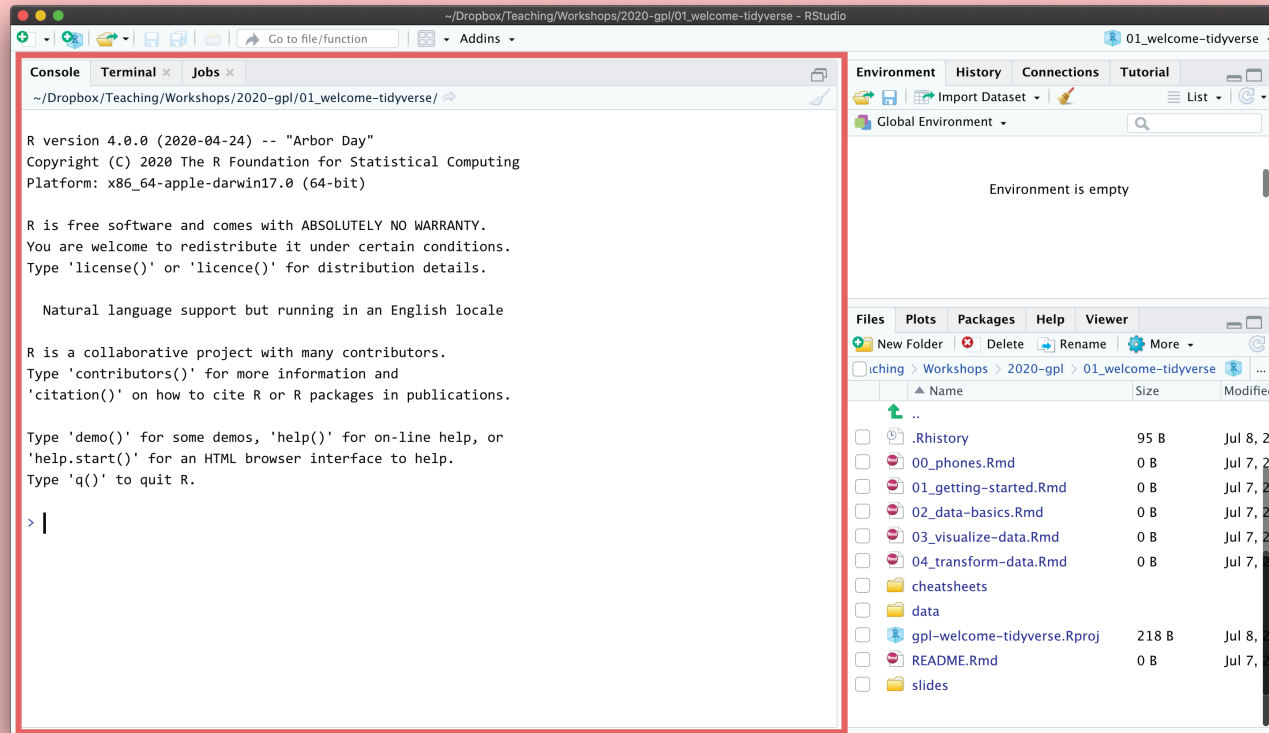
Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

> |
```

**R is awaiting your instructions**

**Type code here, press enter, and R will run it**

# Your turn



The screenshot shows the RStudio interface. The console window on the left contains the following text:

```
~/Dropbox/Teaching/Workshops/2020-gpl/01_welcome-tidyverse/

R version 4.0.0 (2020-04-24) -- "Arbor Day"
Copyright (C) 2020 The R Foundation for Statistical Computing
Platform: x86_64-apple-darwin17.0 (64-bit)

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'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.

> |
```

The file explorer on the right shows the following files and folders:

Name	Size	Modified
..		
.Rhistory	95 B	Jul 8, 2
00_phones.Rmd	0 B	Jul 7, 2
01_getting-started.Rmd	0 B	Jul 7, 2
02_data-basics.Rmd	0 B	Jul 7, 2
03_visualize-data.Rmd	0 B	Jul 7, 2
04_transform-data.Rmd	0 B	Jul 7, 2
cheatsheets		
data		
gpl-welcome-tidyverse.Rproj	218 B	Jul 8, 2
README.Rmd	0 B	Jul 7, 2
slides		

Type `2 + 2` in the console

Press enter

```
2 + 2
```

```
## [1] 4
```

**This is ephemeral though.  
If you want to run this again, you'll have to type it again.**

**Store R code in a document instead**

# Files pane

The screenshot displays the RStudio interface. The console on the left shows the R version 4.0.0 (2020-04-24) and its license information. The files pane on the right, highlighted with a red border, shows a directory listing for the current working directory: ~/Dropbox/Teaching/Workshops/2020-gpl/01\_welcome-tidyverse. The files listed include .Rhistory, 00\_phones.Rmd, 01\_getting-started.Rmd, 02\_data-basics.Rmd, 03\_visualize-data.Rmd, 04\_transform-data.Rmd, cheatsheets, data, gpl-welcome-tidyverse.Rproj, README.Rmd, and slides.

```
R version 4.0.0 (2020-04-24) -- "Arbor Day"
Copyright (C) 2020 The R Foundation for Statistical Computing
Platform: x86_64-apple-darwin17.0 (64-bit)

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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.

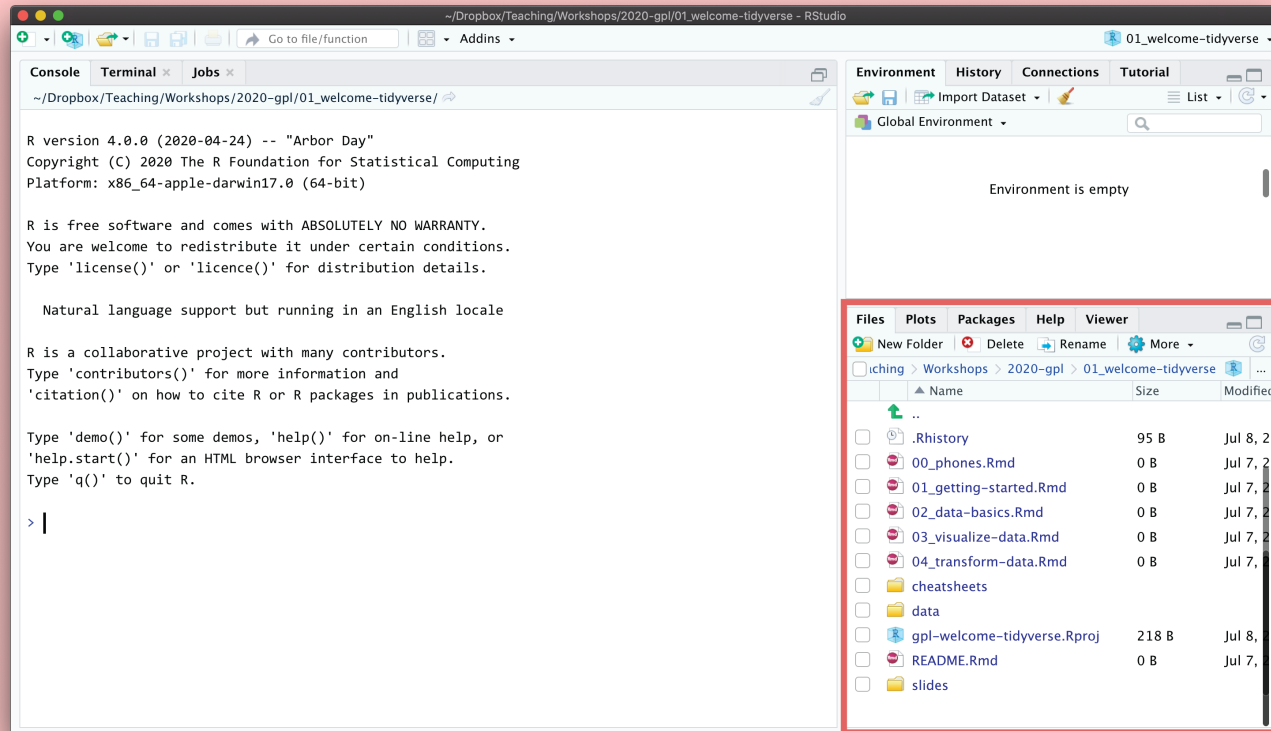
> |
```

Name	Size	Modified
..		
.Rhistory	95 B	Jul 8, 2
00_phones.Rmd	0 B	Jul 7, 2
01_getting-started.Rmd	0 B	Jul 7, 2
02_data-basics.Rmd	0 B	Jul 7, 2
03_visualize-data.Rmd	0 B	Jul 7, 2
04_transform-data.Rmd	0 B	Jul 7, 2
cheatsheets		
data		
gpl-welcome-tidyverse.Rproj	218 B	Jul 8, 2
README.Rmd	0 B	Jul 7, 2
slides		

All the files in your current working directory



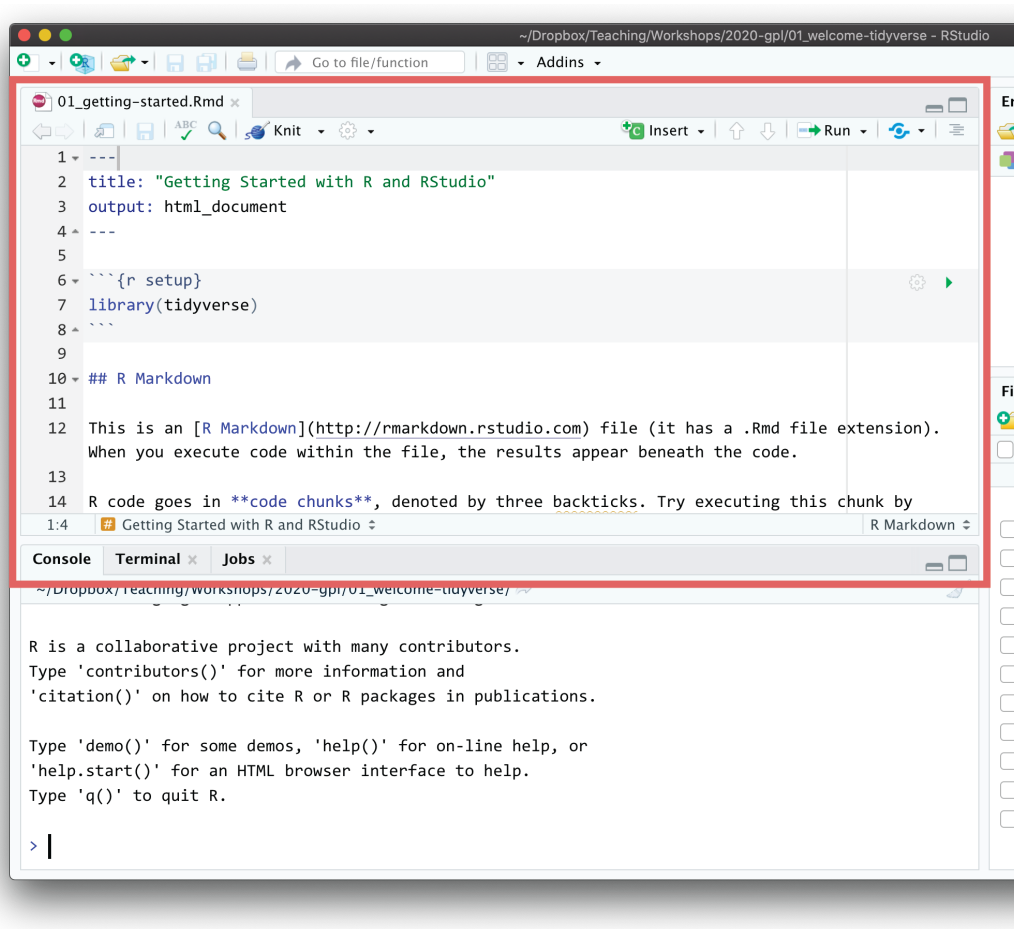
# Your turn



Find 01\_getting-started.Rmd

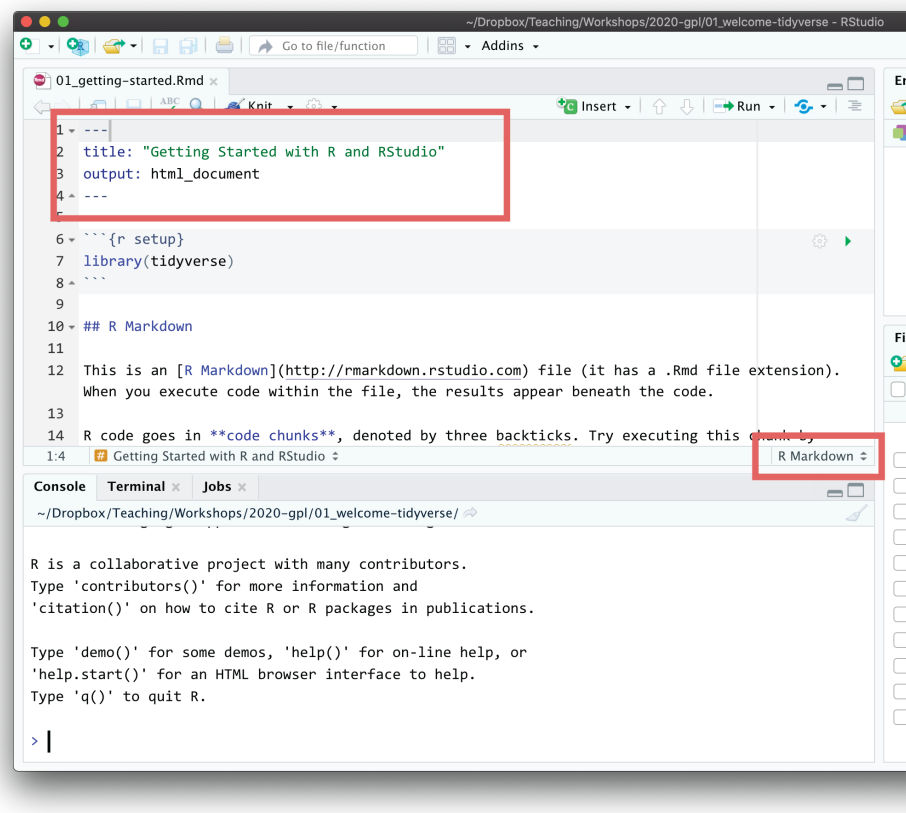
Click on its name to open the file

# Source pane



Documents  
open here

# R Markdown



The screenshot shows the RStudio interface with a file named '01\_getting-started.Rmd' open. The editor displays the following content:

```
1 ---  
2 title: "Getting Started with R and RStudio"  
3 output: html_document  
4 ---  
  
6 ```{r setup}  
7 library(tidyverse)  
8 ```  
9  
10 ## R Markdown  
11  
12 This is an [R Markdown](http://rmarkdown.rstudio.com) file (it has a .Rmd file extension).  
13 When you execute code within the file, the results appear beneath the code.  
14  
15 R code goes in code chunks, denoted by three backticks. Try executing this chunk by  
16 clicking the Run button in the top right corner.
```

Below the editor, the console shows the output of the R code:

```
> |  
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.  
  
> |
```

Two red boxes highlight the YAML header and the 'R Markdown' label in the console.

Document format that  
combines text and code

Acts like a notebook  
for your analysis

# R Markdown



The screenshot shows an R Markdown document titled "01\_getting-started.Rmd" in RStudio. The document content is as follows:

```
10 ## R Markdown
11
12 This is an [R Markdown](http://rmarkdown.rstudio.com) file (it has a .Rmd file extension).
13 When you execute code within the file, the results appear beneath the code.
14 R code goes in code chunks, denoted by three backticks. Try executing this chunk by
15 clicking the Run button (a small green triangle) within the chunk or by placing your cursor
16 inside it and pressing Ctrl+Shift+Enter (or Cmd+Shift+Enter on Mac).
17
18 ```{r}
19 ggplot(data = mpg) +
20   geom_point(mapping = aes(x = cty, y = hwy), alpha = 0.2)
21 ```
```

The text from lines 12 to 14 is highlighted with a red box. Below the code, a scatter plot is displayed, showing the relationship between city miles per gallon (cty) on the x-axis and highway miles per gallon (hwy) on the y-axis. The plot shows a positive correlation between the two variables, with data points semi-transparent (alpha = 0.2).

Text

# R Markdown



The screenshot shows the RStudio interface with a file named '01\_getting-started.Rmd'. The code editor contains the following text:

```
10 - ## R Markdown
11
12 This is an [R Markdown](http://rmarkdown.rstudio.com) file (it has a .Rmd file extension).
    When you execute code within the file, the results appear beneath the code.
13
14 R code goes in code chunks, denoted by three backticks. Try executing this chunk by
    clicking the Run button (a small green triangle) within the chunk or by placing your cursor
    inside it and pressing Ctrl+Shift+Enter (or Cmd+Shift+Enter on Mac).
15
16 ```{r}
17 ggplot(data = mpg) +
18   geom_point(mapping = aes(x = cty, y = hwy), alpha = 0.2)
19 ```
```

The code chunk is highlighted with a red border. Below the code, a scatter plot is displayed with 'hwy' on the y-axis and 'cty' on the x-axis. The plot shows a positive correlation between city miles per gallon and highway miles per gallon. The y-axis has labels at 30 and 40. The plot area is overlaid with a light gray grid.

Text

Code

# R Markdown



The screenshot shows an R Markdown document titled "01\_getting-started.Rmd" in RStudio. The document contains the following text and code:

```
10 - ## R Markdown
11
12 This is an [R Markdown](http://rmarkdown.rstudio.com) file (it has a .Rmd file extension).
    When you execute code within the file, the results appear beneath the code.
13
14 R code goes in code chunks, denoted by three backticks. Try executing this chunk by
    clicking the Run button (a small green triangle) within the chunk or by placing your cursor
    inside it and pressing Ctrl+Shift+Enter (or Cmd+Shift+Enter on Mac).
15
16 ```{r}
17 ggplot(data = mpg) +
18   geom_point(mapping = aes(x = cty, y = hwy), alpha = 0.2)
19 ```
```

The output of the code is a scatter plot showing the relationship between city miles per gallon (cty) on the x-axis and highway miles per gallon (hwy) on the y-axis. The plot is semi-transparent (alpha = 0.2) and shows a positive correlation between the two variables. The plot is highlighted with a red border.

Text

Code

Output

# Your turn

Read the instructions

Run the code chunk by clicking the play button



The screenshot shows the RStudio interface with a file named '01\_getting-started.Rmd'. The editor contains the following text:

```
10 - ## R Markdown
11
12 This is an [R Markdown](http://rmarkdown.rstudio.com) file (it has a .Rmd file extension).
    When you execute code within the file, the results appear beneath the code.
13
14 R code goes in code chunks, denoted by three backticks. Try executing this chunk by
    clicking the Run button (a small green triangle) within the chunk or by placing your cursor
    inside it and pressing Ctrl+Shift+Enter (or Cmd+Shift+Enter on Mac).
15
16 ```{r}
17 ggplot(data = mpg) +
18   geom_point(mapping = aes(x = cty, y = hwy), alpha = 0.2)
19 ```
```

The code chunk is highlighted with a red box. Below the code, a scatter plot is displayed with 'hwy' on the y-axis and 'cty' on the x-axis. The plot shows a positive correlation between city miles per gallon and highway miles per gallon for various car models.

# Your turn

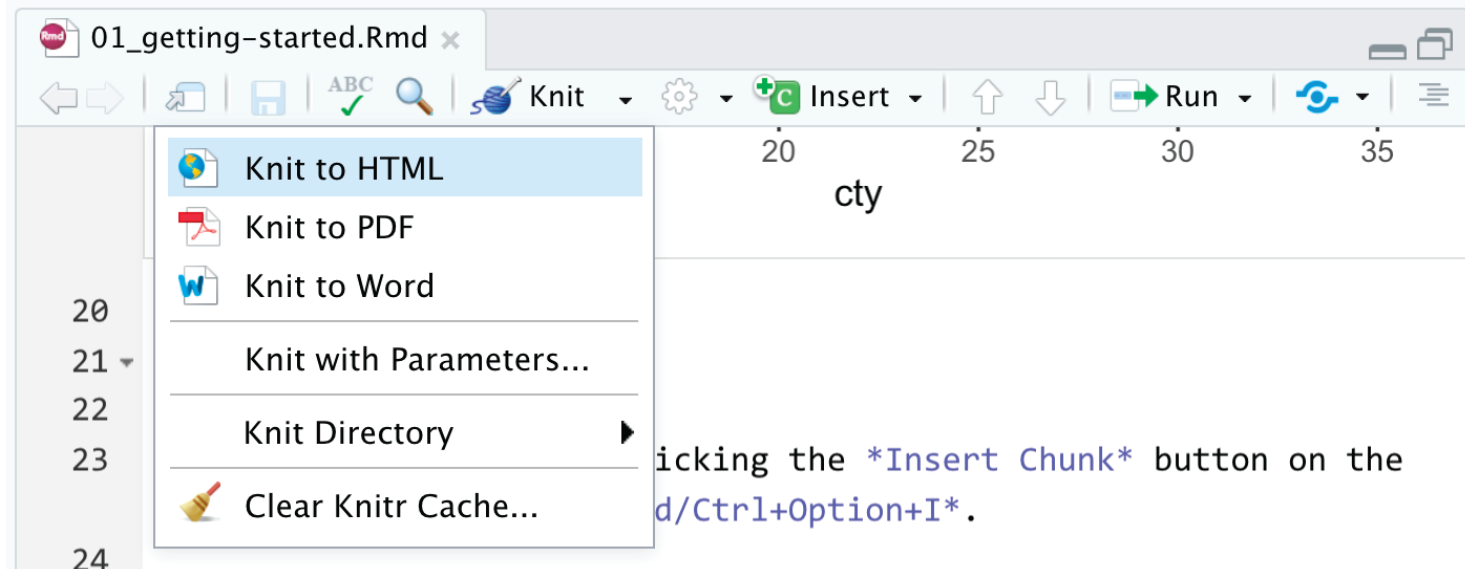
Add a new chunk

Put  $2 + 2$  in the chunk and run it



# Knitting

"Knit" an R Markdown document into a standalone sharable file



# R Markdown

The best way to combine R code and narrative

We'll use it throughout the class:

I'll provide starter code

You'll complete "Your turns"

In the end, you'll have an annotated record for yourself

# Your turn

**Spot the difference:**

```
filter(mtcars, cyl == 4)
```

```
four_cyls <- filter(mtcars, cyl == 4)
```

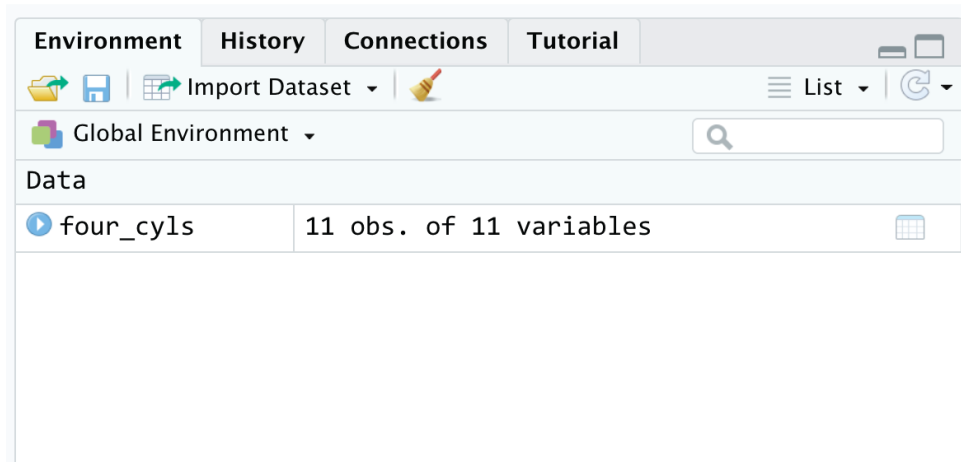
**Find these chunks in the notebook and run them.  
What's different about what happens?**

# Assignment

**<- assigns the output from the righthand side to a variable with the name on the lefthand side**

```
four_cyls <- filter(mtcars, cyl == 4)
```

# Environment pane



List of all the variables you've created

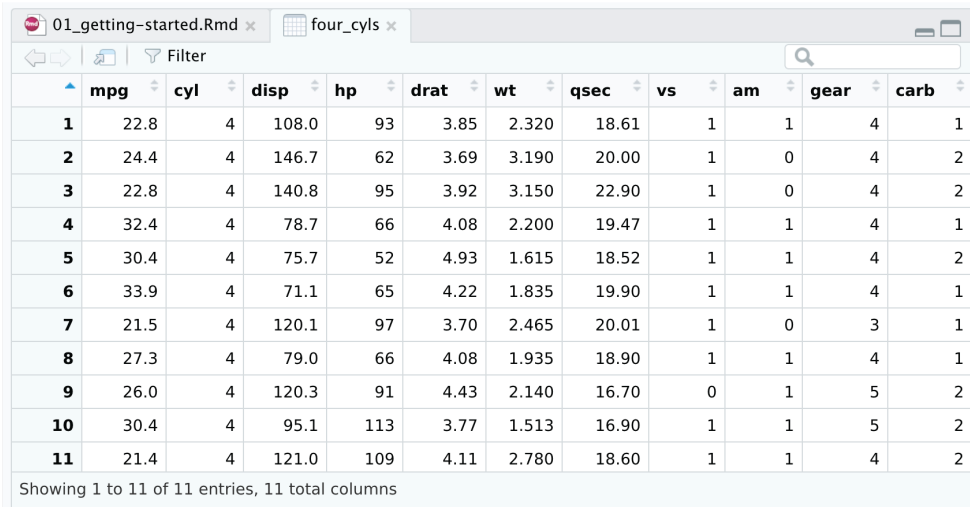
# Your turn

Find `four_cyls` in the environment pane.  
Click on the name `four_cyls`

What happens?

# Viewer

Clicking on an object in the environment panel opens it an interactive viewer tab



The screenshot shows an RStudio Viewer window with a tab titled 'four\_cyls'. The window displays a data table with 11 rows and 11 columns. The columns are labeled: mpg, cyl, disp, hp, drat, wt, qsec, vs, am, gear, and carb. The rows are numbered 1 through 11. Below the table, it says 'Showing 1 to 11 of 11 entries, 11 total columns'.

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
1	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
2	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
3	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
4	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
5	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
6	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
7	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
8	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
9	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2
10	30.4	4	95.1	113	3.77	1.513	16.90	1	1	5	2
11	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2

# Functions

```
four_cyls <- filter(mtcars, cyl == 4)
```

**Functions do things**

**Functions take arguments, output results**

**If you want to keep the output, assign it to a variable**



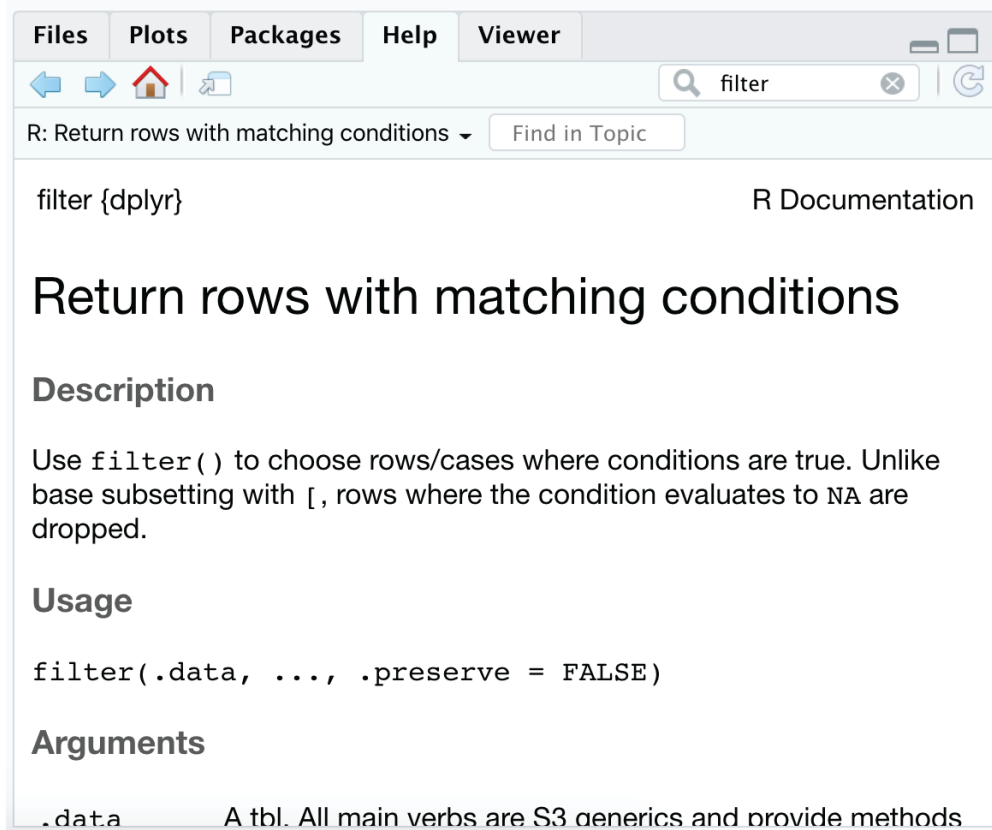
# Help

To look up the help page for an R function,  
type this in the console:

```
?function_name
```

**(Or google it!)**

# Help pane



The screenshot shows the R help pane for the `filter` function. The window title is "R: Return rows with matching conditions" and the search bar contains "filter". The content includes the following sections:

- filter {dplyr}** R Documentation
- Return rows with matching conditions**
- Description**

Use `filter()` to choose rows/cases where conditions are true. Unlike base subsetting with `[]`, rows where the condition evaluates to `NA` are dropped.
- Usage**

```
filter(.data, ..., .preserve = FALSE)
```
- Arguments**

`.data` A `tbl`. All main verbs are S3 generics and provide methods

These help pages provide details about the arguments you can supply a function

Often full of examples at the bottom

# Your turn

Look at the help page for `seq`

Add a chunk that uses `seq()` to create a list of numbers from 5 to 100, spaced by 5 (so 5, 10, 15, 20, ...)

02:00

```
seq(from = 5, to = 100, by = 5)
```

```
## [1] 5 10 15 20 25 30 35 40 45 50 55 60 65 70  
## [20] 100
```

# Common syntax problem #1

Missing closing parentheses or quotes

```
mean(mtcars
```

```
"Oops this is wrong
```

# Common syntax problem #2

Surrounding something in quotes when it should be (or vice versa)

```
mean("mtcars")
```

```
## Warning in mean.default("mtcars"): argument is not numeric or
```

```
## NA
```

```
## [1] NA
```

# Your turn

**There are three chunks under "Syntax gone wrong"**

**Run each, read the error message, and try to fix the syntax**

# Cheatsheets

Go to Help > Cheatsheets to find quick reference guides to different packages

## RStudio IDE : : CHEAT SHEET

**Documents and Apps**

- Open Shiny, R Markdown, knitr, Sweave, LaTeX, All Files and more in Source Pane
- Check spelling
- Render output
- Choose output format
- Choose output location
- Insert chunk

**Write Code**

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

**R Support**

- Import data with wizard
- History of past commands to `runHistory`
- Display R/Perl slideshows
- File > New File > R Presentation**

**Pro Features**

- Share Project with Collaborators
- Active shared collaborators
- Start new R Session in current project
- Close R Session in project
- Select R Version

**PROJECT SYSTEM**

- File > New Project**
- RStudio saves the call history, workspace, and working directory associated with a project. It reloads each when you re-open a project.
- RStudio opens plots in a dedicated Plots pane

**Debug Mode**

- Open with **debug()**, **browser()**, or a breakpoint. RStudio will open the debugger mode when it encounters a breakpoint while executing code.
- Launch debugger mode from origin of error
- Open traceback to examine the functions that R called before the error occurred

**Version Control** with Git or SVN

- Turn on **Tools > Project Options > Git/SVN**
- Stage files
- Show file comment
- Commit staged files to remote
- Push/Pull
- View History

**Package Writing**

- File > New Project > New Directory > R Package**
- Turn project into package.
- Enable roxygen documentation with **Tools > Project Options > Build Tools**
- Roxygen guide at **Help > Roxygen Quick Reference**

**Other features shown:**

- Jump to Jump to Run Publish Show file
- Custom of Run Run previous code Source with or Show file without Echo outline
- Multiple custom column selection with **Alt + mouse drag**
- Code diagnostics that appear in the margin
- Syntax highlighting based on your file extension
- Tab completion to finish function names, file paths, arguments, and more.
- Multi-language code snippets to quickly use common blocks of code
- RStudio recognizes that files named **app.R**, **server.R**, **ui.R**, and **global.R** belong to a shiny app
- Run app Choose Publish to Manage app location to shinyapps.io account
- Run app Choose Publish to Manage app location to shinyapps.io account
- Maximize, minimize panes
- Path to displayed directory
- A File browser keyed to your working directory. Click on file or directory name to open.
- Click to load package with **library()** Unlick to detach package with **detach()**
- RStudio opens documentation in a dedicated Help pane
- Home page of help file Search within help file Search for help file
- Viewer Pane displays HTML content, such as Shiny apps, RMarkdown reports, and interactive visualizations
- Stop Shiny Publish to shinyapps.io Refresh app
- View<data>** opens spreadsheet like view of data set





# Next up

**Data basics**