

Getting started with R and RStudio





The engine



The dashboard

A tour of RStudio

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

Go to file/function | Addins

01_welcome-tidyverse

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

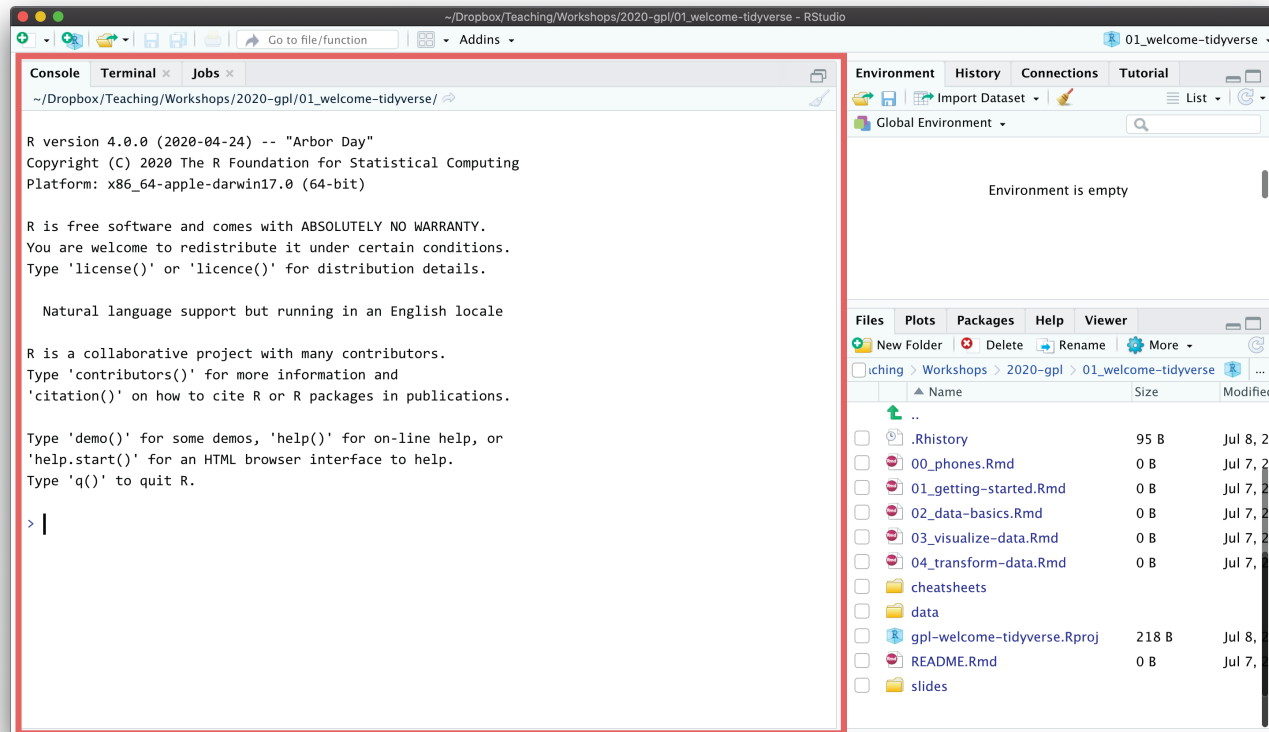
Files Plots Packages Help Viewer

New Folder Delete Rename More

iching > Workshops > 2020-gpl > 01_welcome-tidyverse

	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		

Console



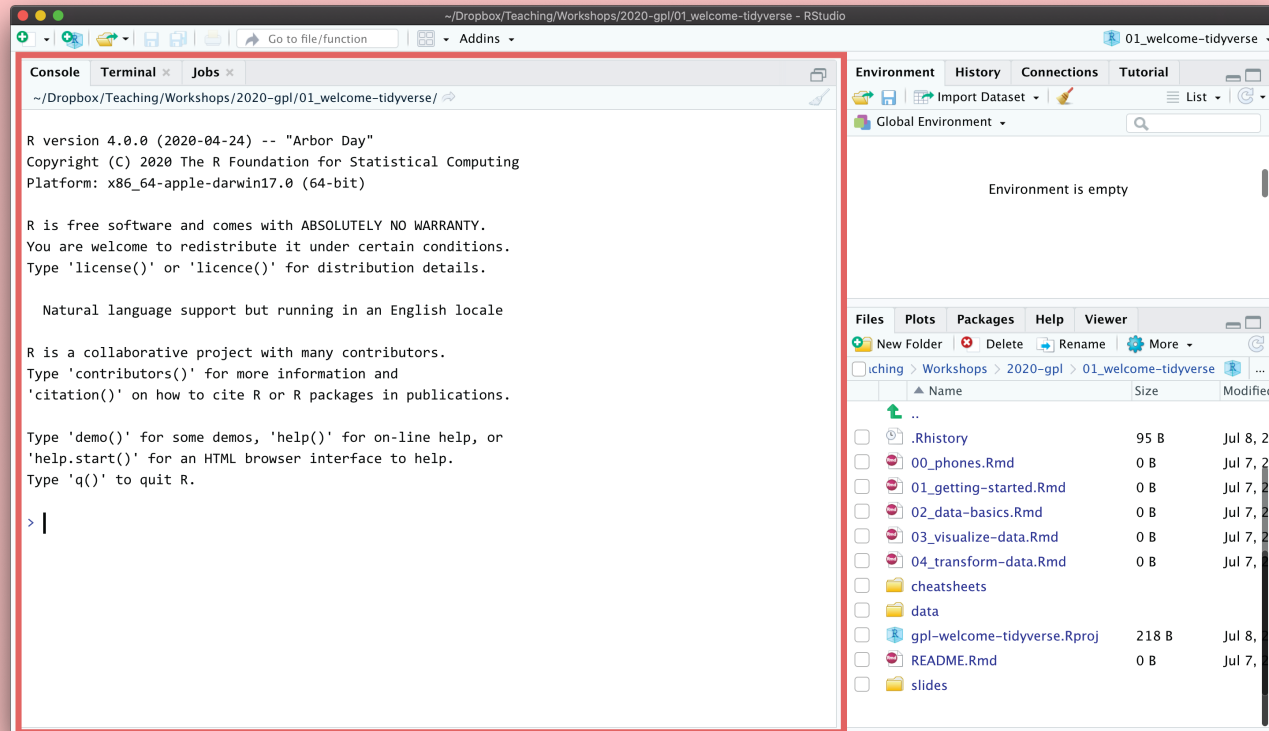
The screenshot shows the RStudio interface. The console pane on the left displays the R startup message, including the version (4.0.0), copyright information, and a list of useful commands like 'license()', 'demo()', and 'help()'. The environment pane on the right shows an empty environment. The file browser at the bottom displays a directory structure with various R script files and folders.

```
~/Dropbox/Teaching/Workshops/2020-gpl/01_welcome-tidyverse/ RStudio  
01_welcome-tidyverse  
Environment History Connections Tutorial  
Global Environment  
Environment is empty  
Files Plots Packages Help Viewer  
New Folder Delete Rename More  
iching > Workshops > 2020-gpl > 01_welcome-tidyverse  
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,  
[ ] README.Rmd 0 B Jul 7,  
[ ] slides
```

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 displays the R version information and a prompt. The file explorer on the right shows the current directory structure.

```
~/Dropbox/Teaching/Workshops/2020-gpl/01_welcome-tidyverse/ RStudio  
01_welcome-tidyverse  
Environment History Connections Tutorial  
Global Environment  
Environment is empty  
Files Plots Packages Help Viewer  
New Folder Delete Rename More  
iching > Workshops > 2020-gpl > 01_welcome-tidyverse  
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,  
[ ] README.Rmd 0 B Jul 7,  
[ ] slides
```

Console output:

```
~/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.  
> |
```

Type `2 + 2` in the console

Press enter

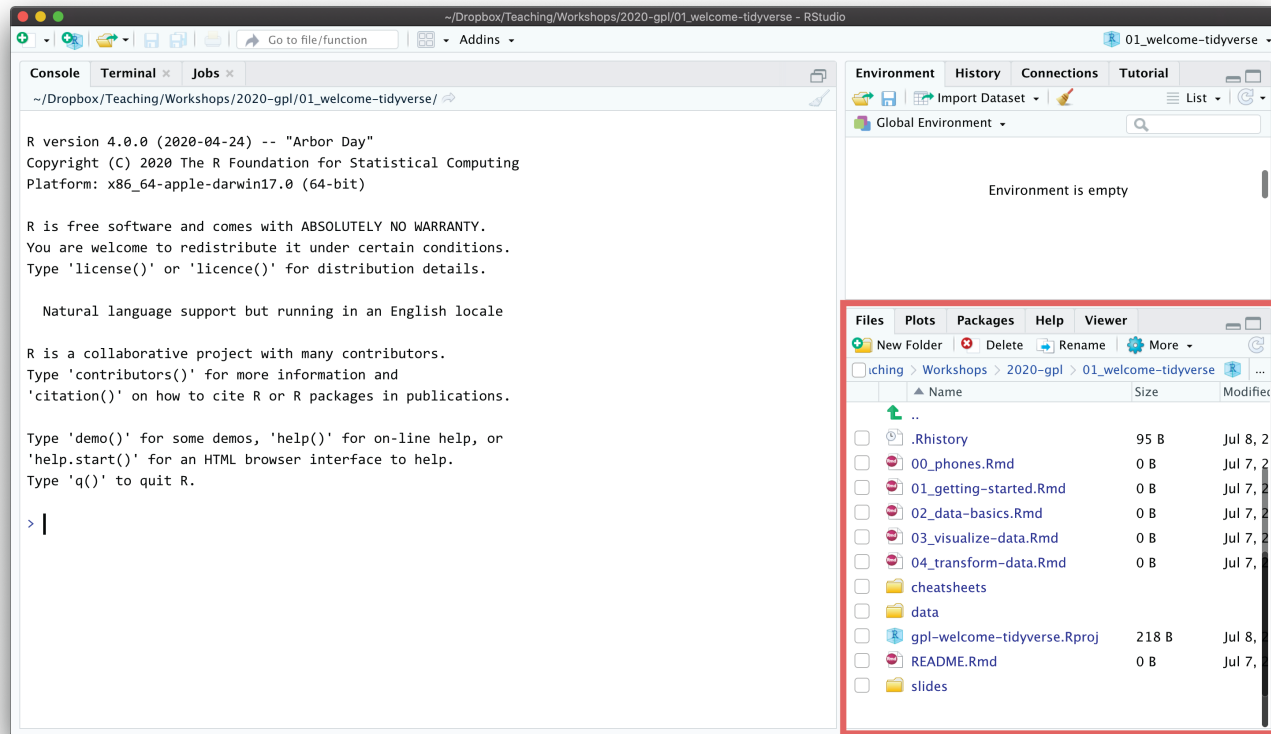
```
2 + 2
```

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

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

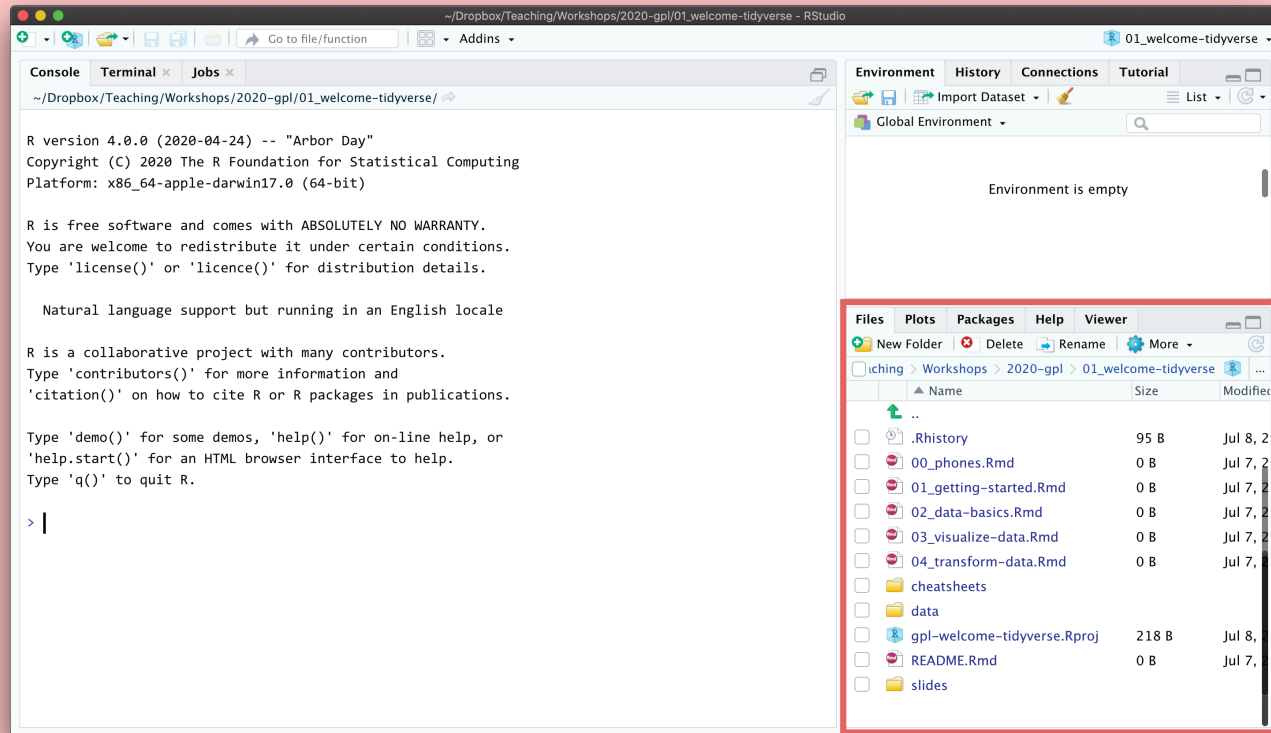
Store R code in a document instead

Files pane



All the files in your
current working
directory

Your turn



The screenshot shows the RStudio interface. The console window on the left displays the R version information and a list of help topics. The file explorer window on the right shows a directory listing of files and folders, with the file '01_getting-started.Rmd' highlighted.

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

Console: `~/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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'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

> |
```

Environment: Environment is empty

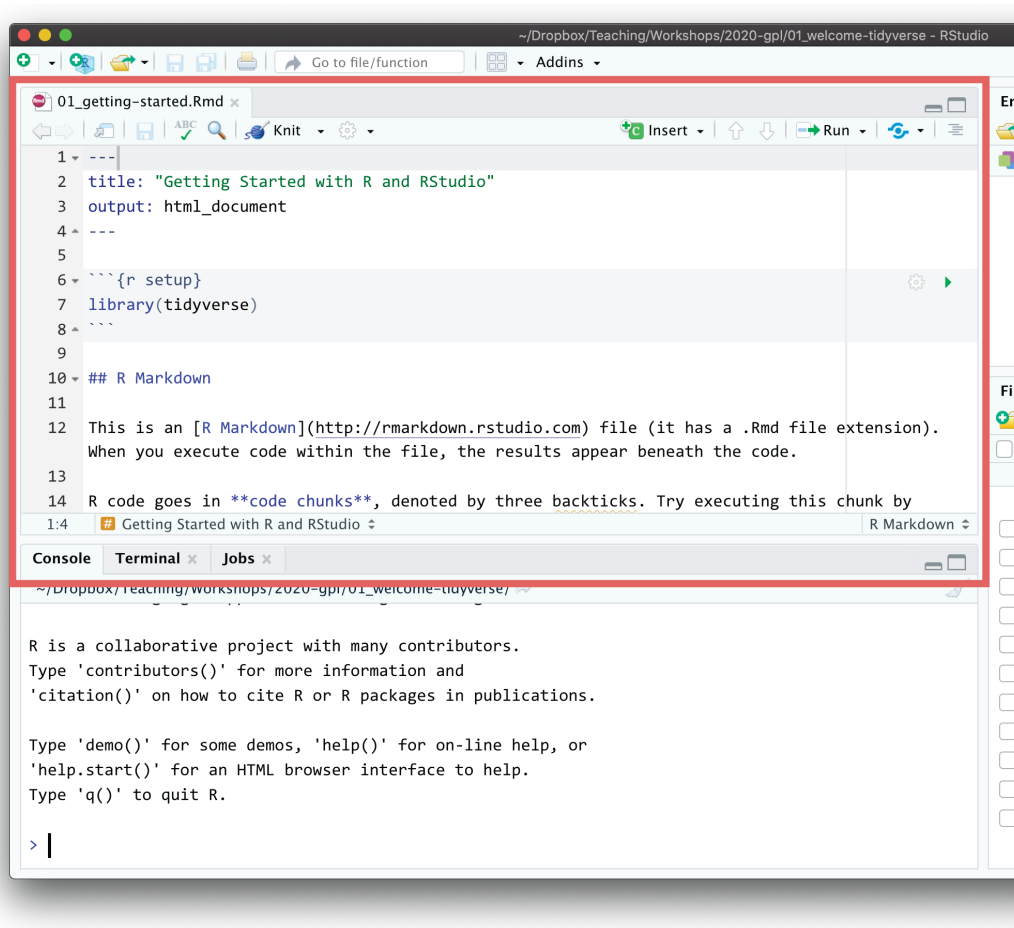
Files: `~/Dropbox/Teaching/Workshops/2020-gpl/01_welcome-tidyverse`

Name	Size	Modified
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cheatsheets		
data		
gpl-welcome-tidyverse.Rproj	218 B	Jul 8, 2
README.Rmd	0 B	Jul 7, 2
slides		

Find `01_getting-started.qmd`

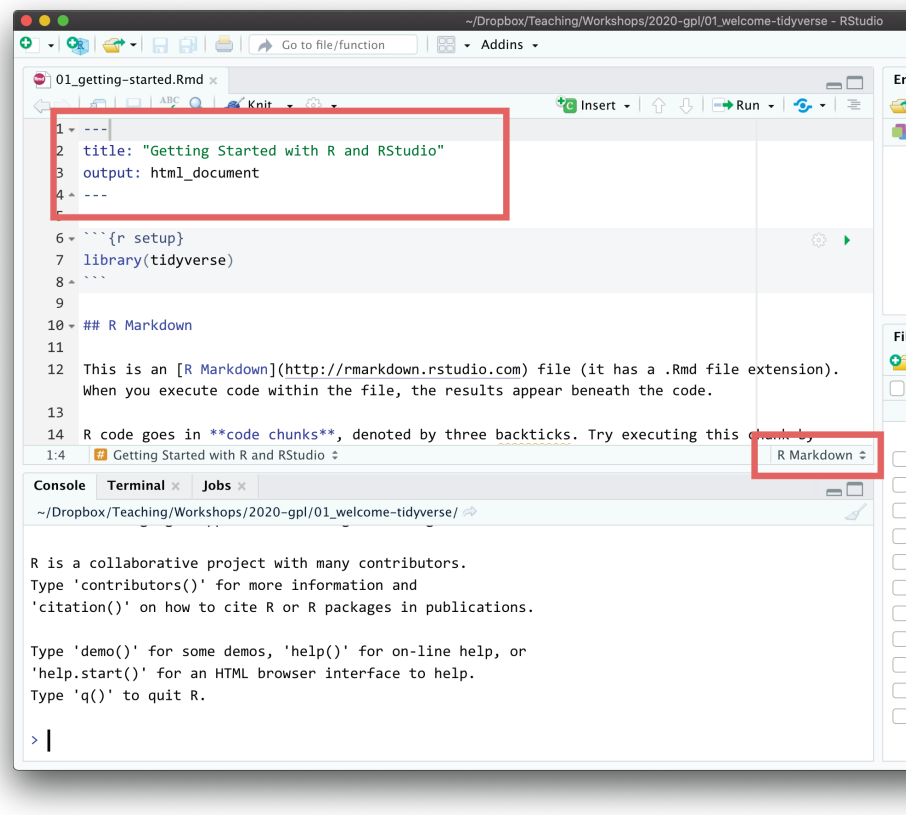
Click on its name to open the file

Source pane



Documents
open here

Quarto



```
1 ---
2 title: "Getting Started with R and RStudio"
3 output: html_document
4 ---
5
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 clicking
16 the Run icon. For more information on chunks, see http://rmarkdown.rstudio.com/running-an-r-markdown-document.html.
```

Console

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

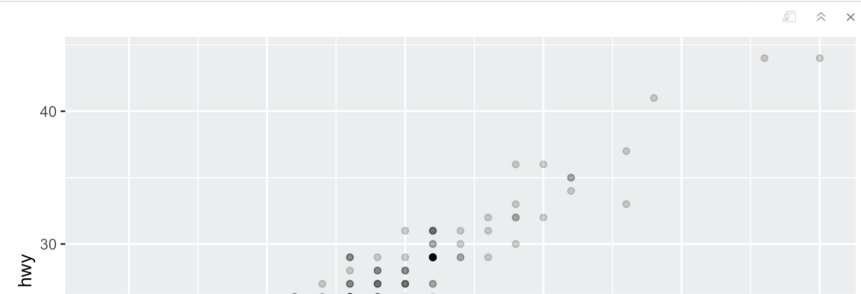
> |
```

Document format that combines text and code

Acts like a notebook for your analysis

Quarto

```
01_getting-started.Rmd x
Insert Run
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 ```
```



Text

Quarto



The screenshot shows the Quarto editor interface. The top toolbar includes buttons for Insert, Run, and other functions. The main editor area contains R Markdown text and a code chunk. The code chunk is highlighted with a red border and contains the following R code:

```
16 ```{r}
17 ggplot(data = mpg) +
18   geom_point(mapping = aes(x = cty, y = hwy), alpha = 0.2)
19 ```
```

Below the code chunk, a scatter plot is displayed. The y-axis is labeled 'hwy' and has tick marks at 30 and 40. The x-axis is labeled 'cty'. The plot shows a positive correlation between city miles per gallon (cty) and highway miles per gallon (hwy). The points are semi-transparent, allowing overlapping points to appear darker.

Text

Code

Quarto

```
01_getting-started.Rmd x
Insert Run
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 ```
```



Text

Code

Output

Your turn

Read the instructions

Run the code chunk by clicking the play button



The screenshot shows an R Markdown document titled "01_getting-started.Rmd" in RStudio. The document 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).
```

The code chunk is enclosed in three backticks and contains the following R code:

```
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. To the right of the code, there is a small green triangle icon, which is the "Run" button. Below the code chunk, a scatter plot is displayed, showing the relationship between highway mileage (hwy) on the y-axis and city mileage (cty) on the x-axis. The plot shows a positive correlation between the two variables.

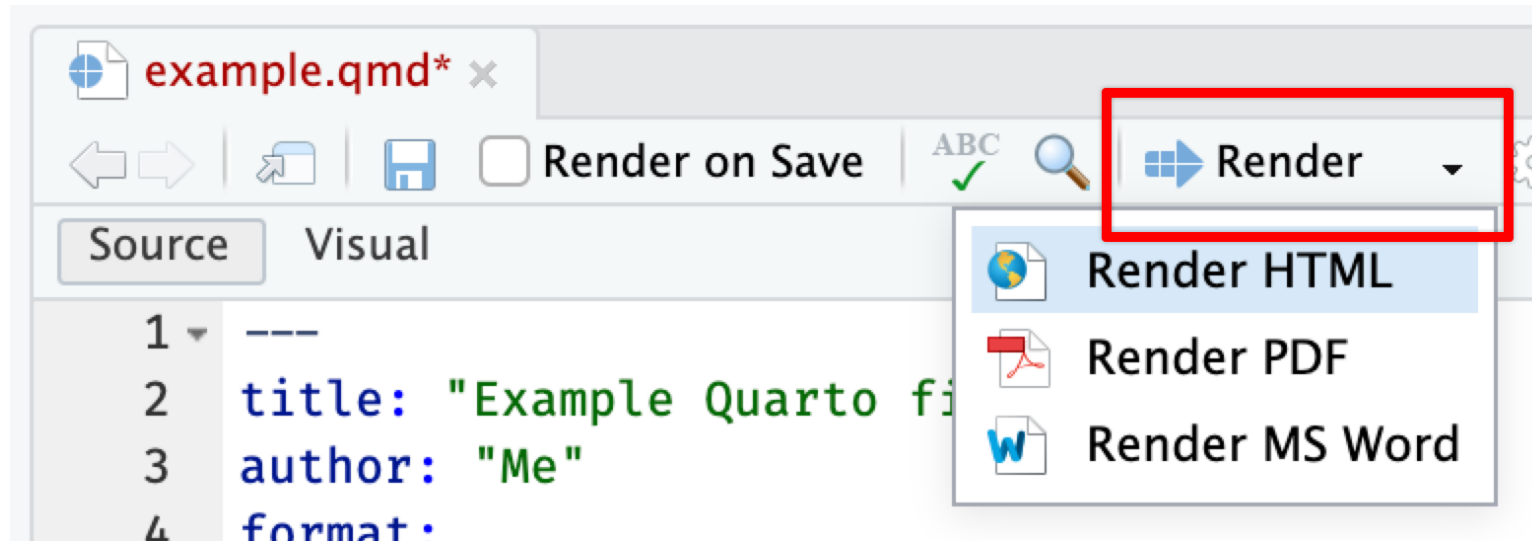
Your turn

Add a new chunk

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

Render

Render a Quarto document into a standalone shareable file



Quarto

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)
```

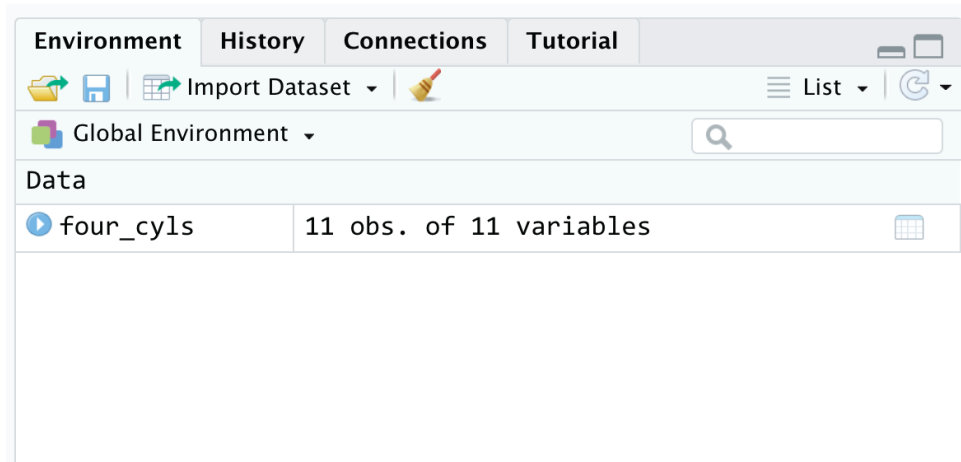
**Find these chunks in the notebook and run them.
What's different about what happens?**

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

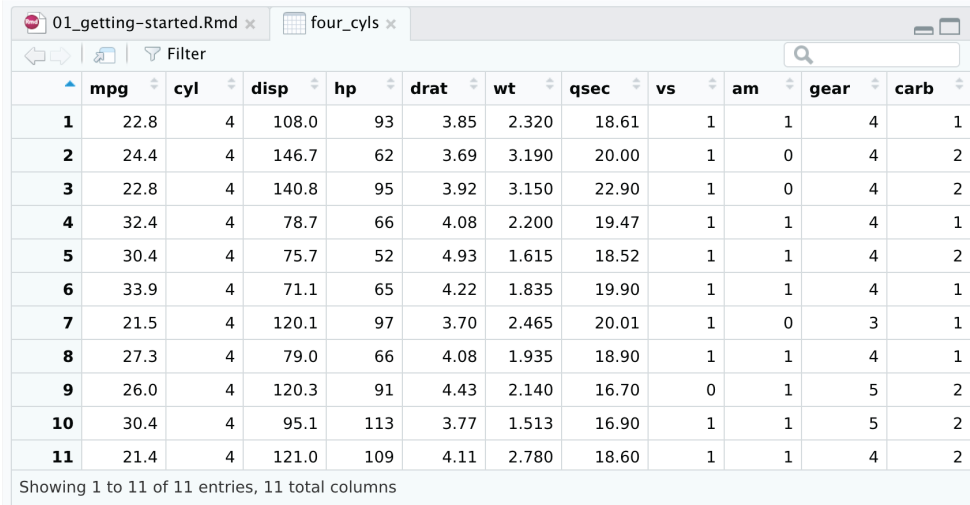
Your turn

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 the RStudio Viewer interface. At the top, there are two tabs: '01_getting-started.Rmd' and 'four_cyls'. Below the tabs is a search bar and a 'Filter' button. The main area 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. At the bottom of 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

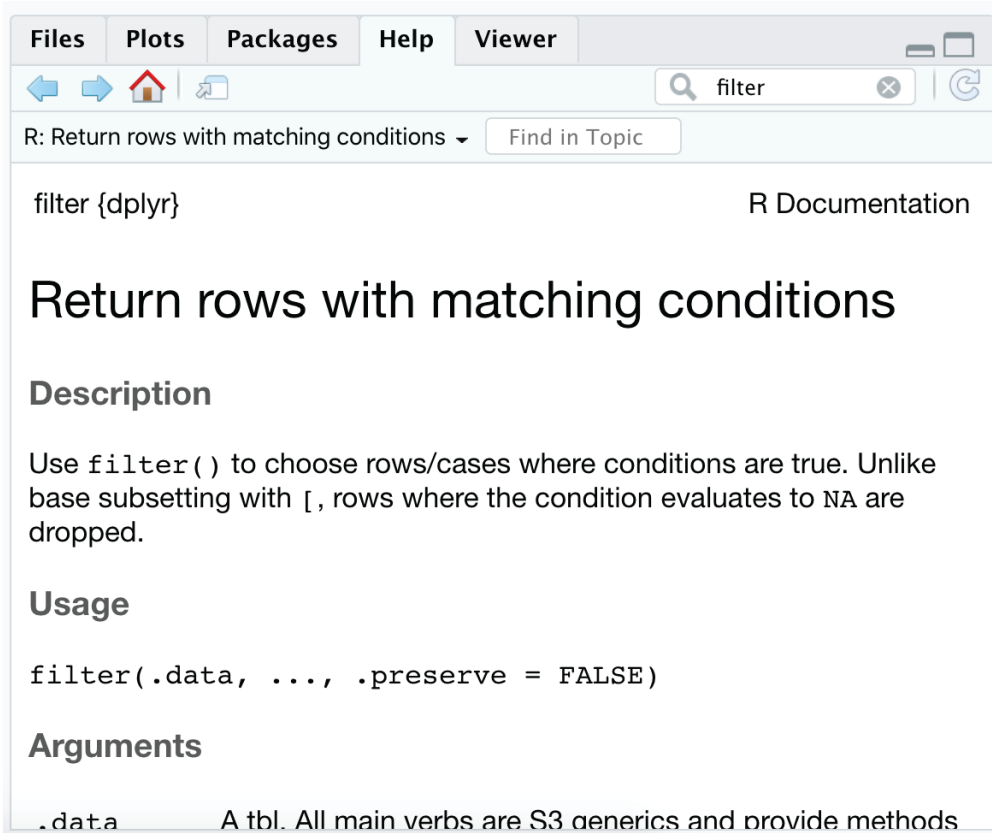
Help

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 with the following content:

Files Plots Packages Help Viewer

filter

R: Return rows with matching conditions Find in Topic

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  
## returning 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, Jupyter files and more in Source Pane
- Check spelling
- Render output
- Choose output format
- Choose selected code chunk location
- Insert code chunk
- Jump to previous/next chunk
- Run selected chunk
- Publish to server
- Show file outline
- Access markdown guide at **Help > Markdown Quick Reference**
- Jump to Set knitr chunk options
- Run this chunk and all previous code chunks
- Run this chunk and all previous code chunks

Write Code

- Save and replace
- Find and replace
- Compile and notebook
- Run selected code
- Open in new window
- Customize previous code
- Source with or without Echo
- Multiple custom column selection with **Alt + mouse drag**
- Code diagnostics that appear in the margin
- Hover over diagnostic symbols for details
- Syntax highlighting based on your file's extension
- Tab completion to finish function names, file paths, arguments, and more
- Multi-language code snippets to quickly use common blocks of code
- Jump to function in file
- Change file type

R Support

- Import data with wizard
- History of past commands to **run/typo**
- Display R/Reps slideshows
- File > New File > R Presentation**
- Load workspace
- Delete all saved objects
- Search inside environment
- Choose environment to display from list of parent environments
- Display objects as list or grid
- Deletes 100 obj. of 5 variables
- View in data viewer
- View function source code
- Displays saved objects by type with short description
- Click on file or directory name to open

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.
- Name of current project
- RStudio opens plots in a dedicated Plots pane
- Navigation: Open in recent plots window, Export plot, Delete all plots
- GUI Package manager lists every installed package
- Install Packages: Update, Create reproducible package
- Click to load package with **library()** link or detach package with **detach()**
- RStudio opens documentation in a dedicated Help pane
- Home page of RStudio: Search within help file, Search for help file
- Viewer Pane displays HTML content, such as Shiny apps, R Markdown reports, and interactive visualizations
- Stop Shiny app: Publish to shinyapps.io, Refresh app
- Viewer Pane displays HTML content, such as Shiny apps, R Markdown reports, and interactive visualizations
- View(<data>)** opens spreadsheet like view of data set

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
- Click next to line number to add/remove breakpoint.
- Highlighted line shows where execution has paused
- Run commands in environment where execution has paused
- Examine variables in executing environment
- Select function in traceback to debug
- Step through code one line at a time
- Resume execution at a time
- Quit debug mode

Version Control

- Turn on **Tools > Project Options > Git/SVN**
- Stage files: Show file, Commit staged files, Push/Pull, View History
- Added, Deleted, Modified, Untracked
- Open shell to current branch

Package Writing

- File > New Project > New Directory > R Package**
- Turn project into package
- Enable longer documentation with **Tools > Project Options > Build Tools**
- Rougeyan guide to **Help > Rougeyan Quick Reference**

R Studio

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Next up

Data basics