4.1 Introduction to R: Hello World!

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Acknowledgements

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Outline of Topics

Getting Set up

- R
- RStudio

R basics

File types

- Scripts
- R markdown

Hello, world!

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Getting set up with R/RStudio

Steps for R

1. Go to https://cloud.r-project.org/
2. Click Download R for (your operating system).
3. For Windows, select install R for the first time. For Mac and Linux, select the download that is appropriate for your OS.
4. Download and install

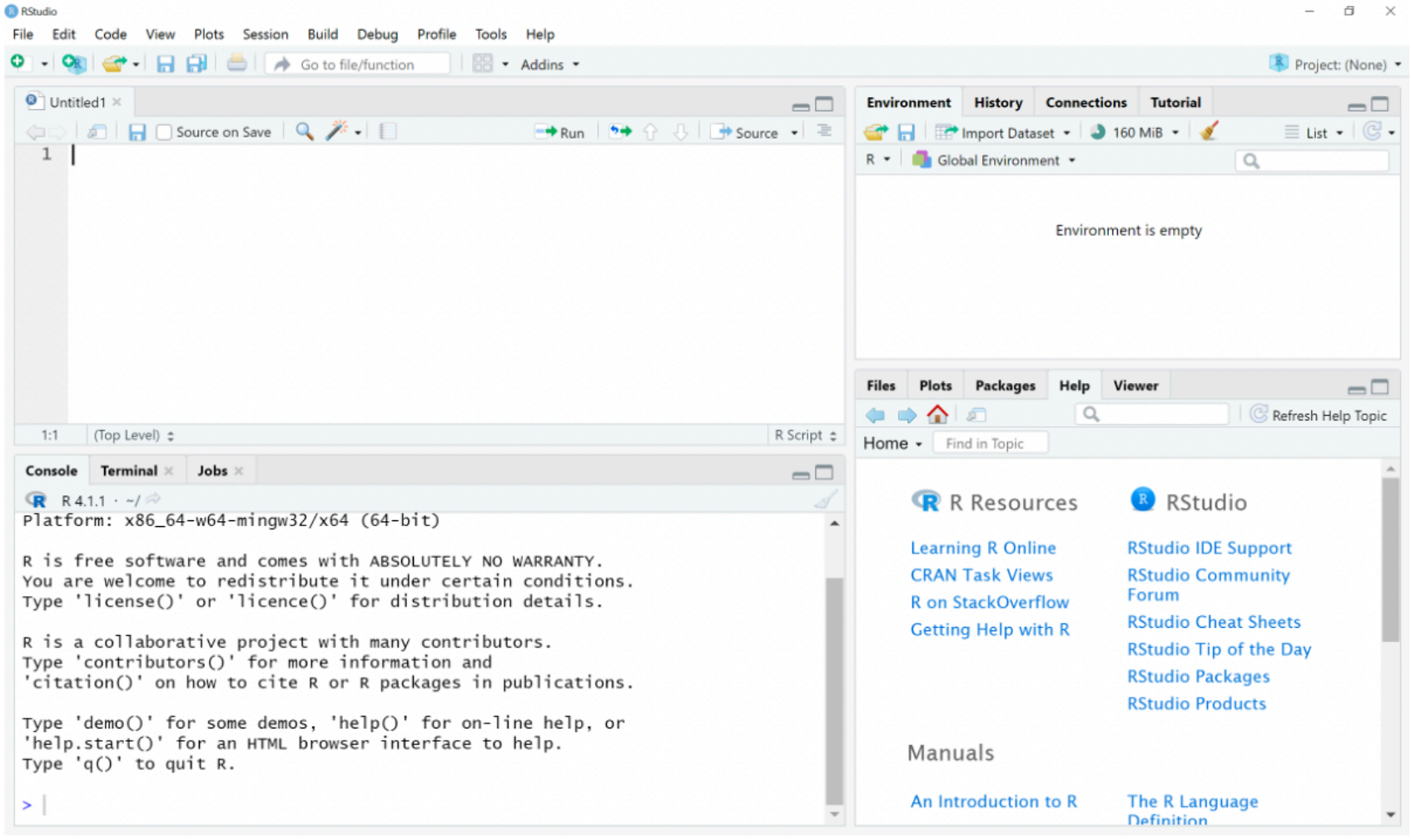
Getting set up with R/RStudio

Steps for RStudio

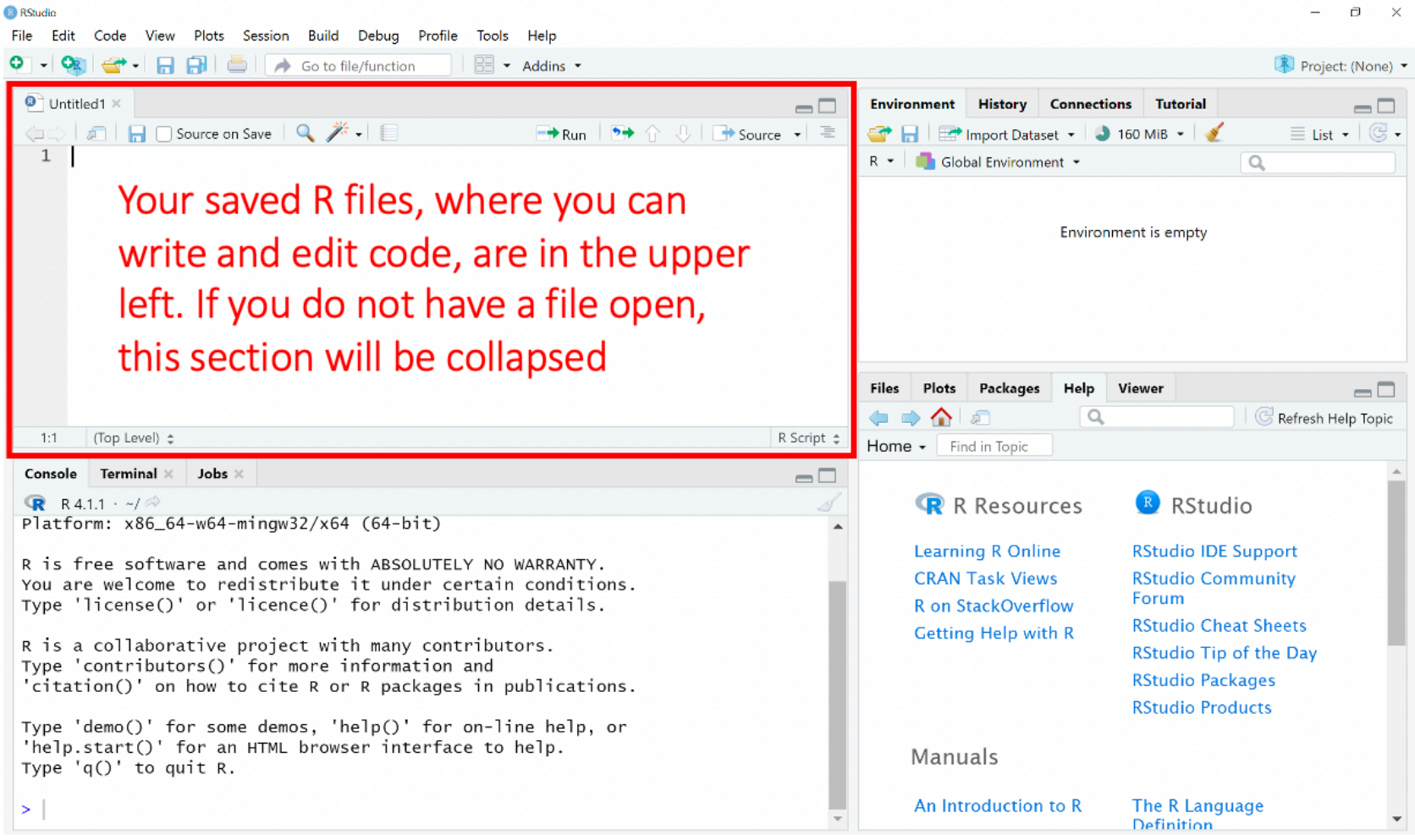
1. Go to https://posit.co/download/rstudio-desktop/
2. Under Products, look under Open Source and select *RStudio.
3. Scroll down and select RStudio Desktop and DOWNLOAD RSTUDIO DESKTOP.
4. Select the DOWNLOAD button under the Free version of RStudio Desktop.
5. If the download that is "Recommended for your system" is correct, click the download button. If not, scroll down and find the version that is correct for your OS.
6. Download and install.
7. Open and test to ensure RStudio is working.

Questions?

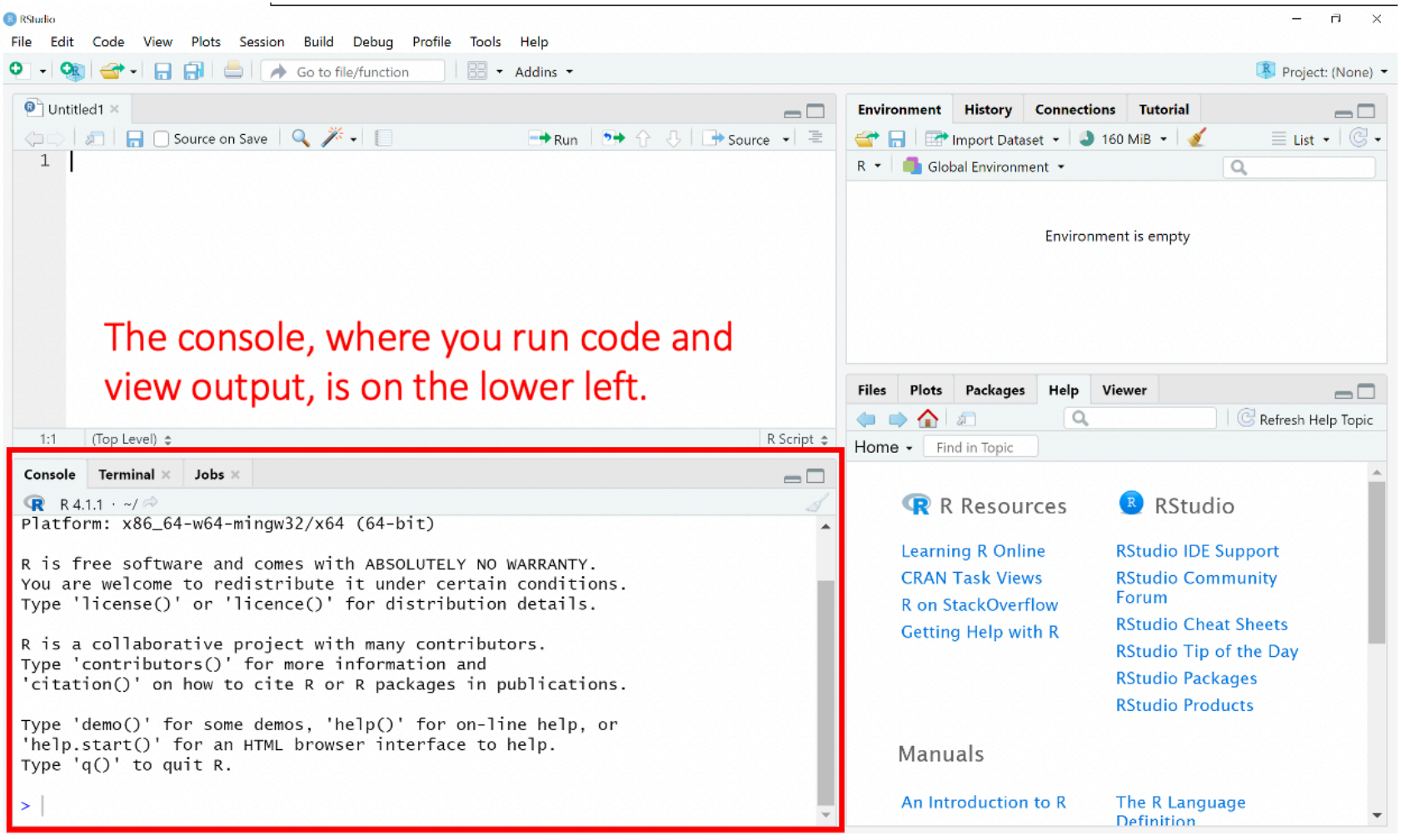
RStudio


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Untitled1
Source on Save
Run
Source
1
1:1
(Top Level)
R Script
Environment History Connections Tutorial
Import Dataset
160 MiB
List
R
Global Environment
Environment is empty
Files Plots Packages Help Viewer
Refresh Help Topic
Home
Find in Topic
Console Terminal Jobs
R 4.1.1 · ~/
Platform: x86_64-w64-mingw32/x64 (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.
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.
>
R Resources
Learning R Online
CRAN Task Views
R on StackOverflow
Getting Help with R
RStudio
RStudio IDE Support
RStudio Community Forum
RStudio Cheat Sheets
RStudio Tip of the Day
RStudio Packages
RStudio Products
Manuals
An Introduction to R
The R Language Definition

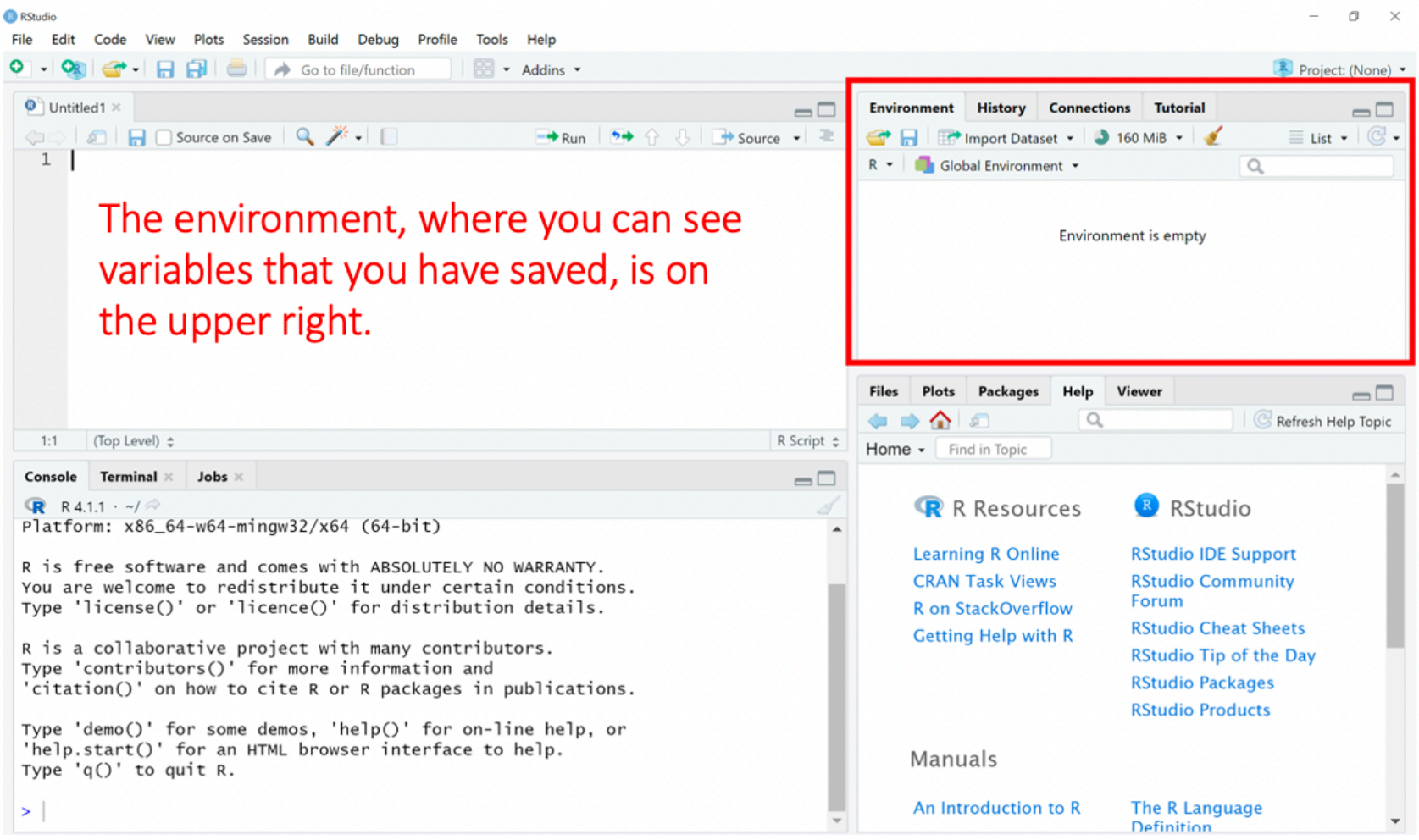
Components of RStudio



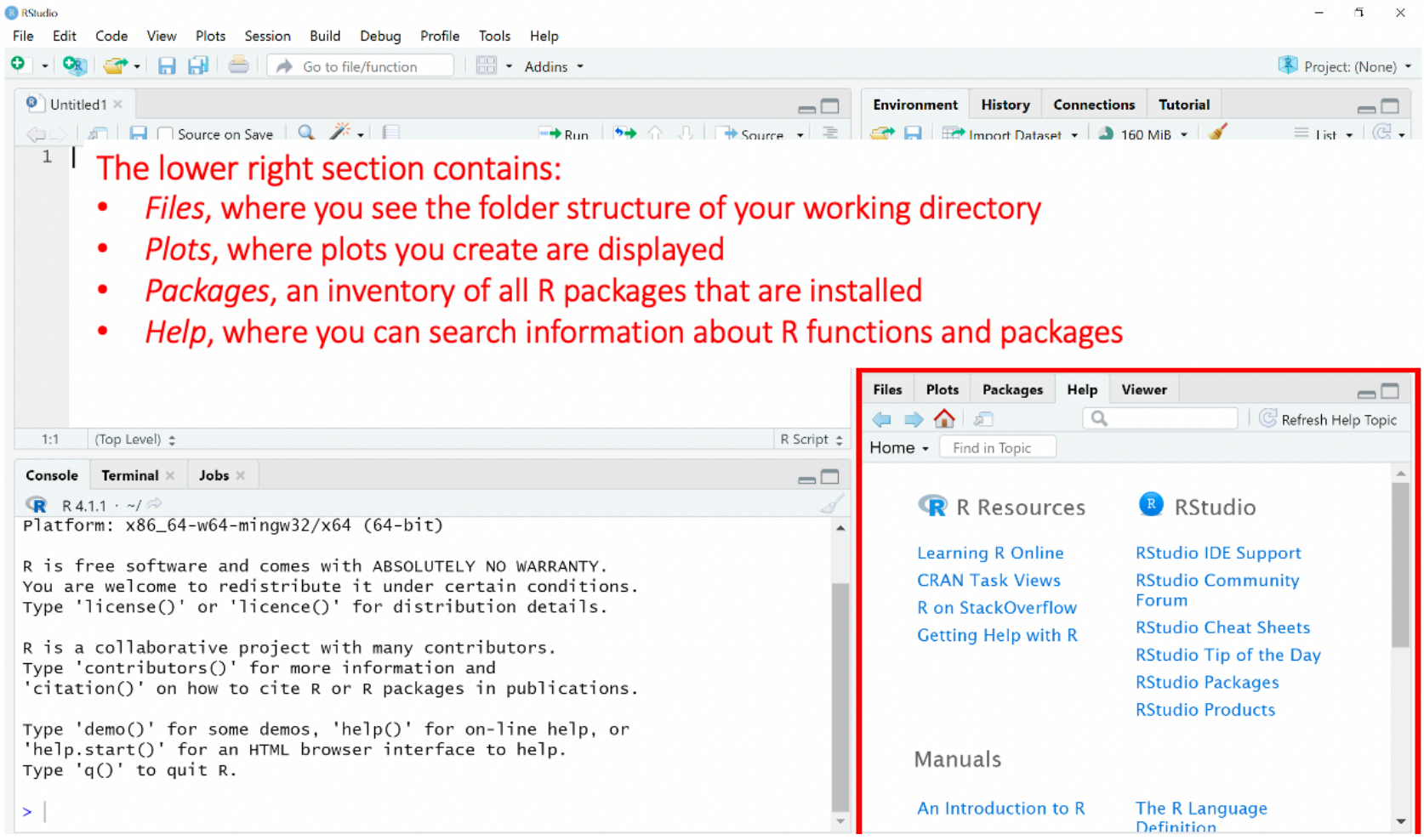
Components of RStudio



Components of RStudio



Components of RStudio



Interacting with R

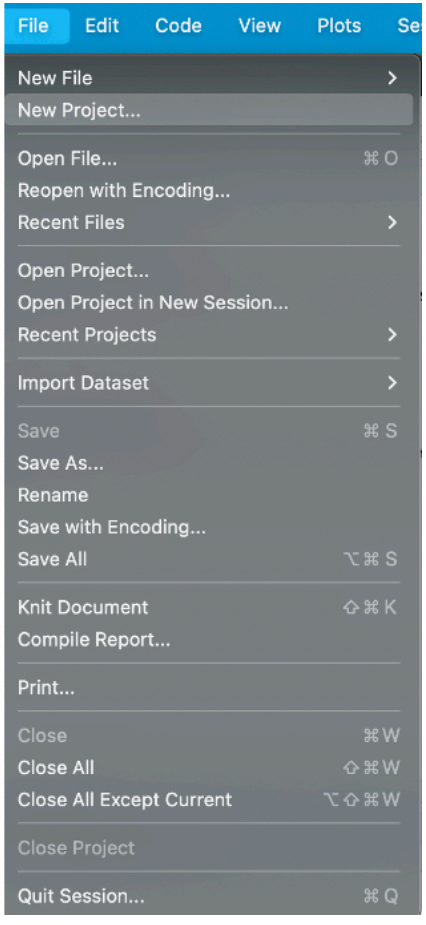
Console

- Type commands directly into the console and press ‘Enter’ to execute
- Clear console with ‘Ctrl’ + ‘L’
- If R is still waiting for you to enter more text, the console will show a +prompt.

Script

- Put cursor at the end of the line to execute OR highlight the section.
- Press ‘Ctrl’ + ‘Enter’ on Windows, Mac OR ‘Cmd’ + ‘Return’ on Mac.

R Project



Good to keep data, analyses and text in a single folder

RStudio interface for this is Projects.

- File → New project; choose New Directory → New projecct
  Enter a name for this folder ("directory") and choose a convenient location for it. This will be your working directory (save as "DSI IntroR" on Desktop)
- Click on "Create" project, create a new file where we will type our scripts
- Go to file → New File → R script. Click the save icon on your toolbar and save your script as "script.R"

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Hello, world!

Location

Current location of the file, if saved:

```
getwd()
```

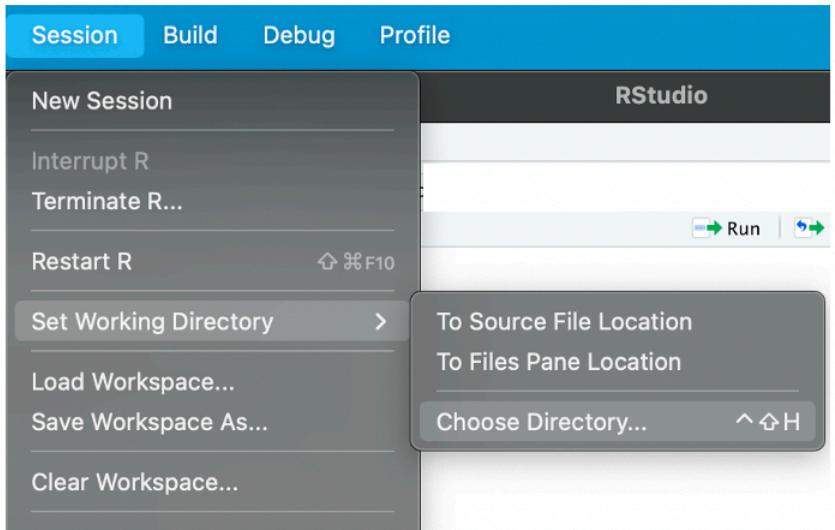
```
[1] "/cloud/project"
```

Set working directory by typing path:

```
#setwd("/Users/<Name>/Desktop")
```

Or (*recommended method*):

Session → Set Working Directory → Choose Directory...



Coding style

Limit yourself to 80 characters per line.

Use comments. Don't describe what the code does, but explain why you wrote it that way.

Use only $\leftarrow$ for assignment, not $=$

Never reassign reserved words/built in functions (i.e., mean)

Optional: You may read more

- https://google.github.io/styleguide/Rguide.html
- http://steipe.biochemistry.utoronto.ca/abc/index.php/RPR-Coding_style

Features of R

In R, the indexing begins from 1.

```
set_of_numbers <- c(1:10)
set_of_numbers
```

```
 [1]  1  2  3  4  5  6  7  8  9 10
```

```
set_of_numbers[1] #index 1
```

```
[1] 1
```

R is case sensitive ("X" is not the same as "x").

```
x <- 1
X
```

```
Error in eval(expr, envir, enclos): object 'X' not found
```

Mathematical operations in R

For now we will work in the console.

To run code, hit enter.

If it runs successfully, you will see a $>$ on the line with the cursor.

If it instead shows a $+$, the command was incomplete. You can finish the command and hit enter, or hit ESCAPE to start again.

```
(27 +0.4 - 2 * 7 / 11) ^ 3
```

```
[1] 17835.37
```

Basic Math Operators	Operation
x + y	Addition
x - y	Subtraction
x * y	Multiplication
x / y	Division
x ^ y	Exponent
x %% y	Modulus

Creating objects in R

<- is the assignment operator.

To assign the value 27 to the object named num_participants, you type:

```
num_participants  <- 27
```

Rules for object names:

1. Must start with a letter
2. Can only contain letters, numbers, underscores, and periods
3. Typical style conventions; camelCase, snake_case

Running the name of the object will display the object.

```
num_participants  <- 27
num_participants
```

```
[1] 27
```

Built-in R Functions

R has a rich set of functions that can be used to perform almost every task for the user

Built-in functions perform many operations. They take the form:

function_name(argument1 = value1, argument2 = value2, ...)

```
sqrt(16)
```

```
[1] 4
```

```
seq(1,14)
```

```
 [1]  1  2  3  4  5  6  7  8  9 10 11 12 13 14
```

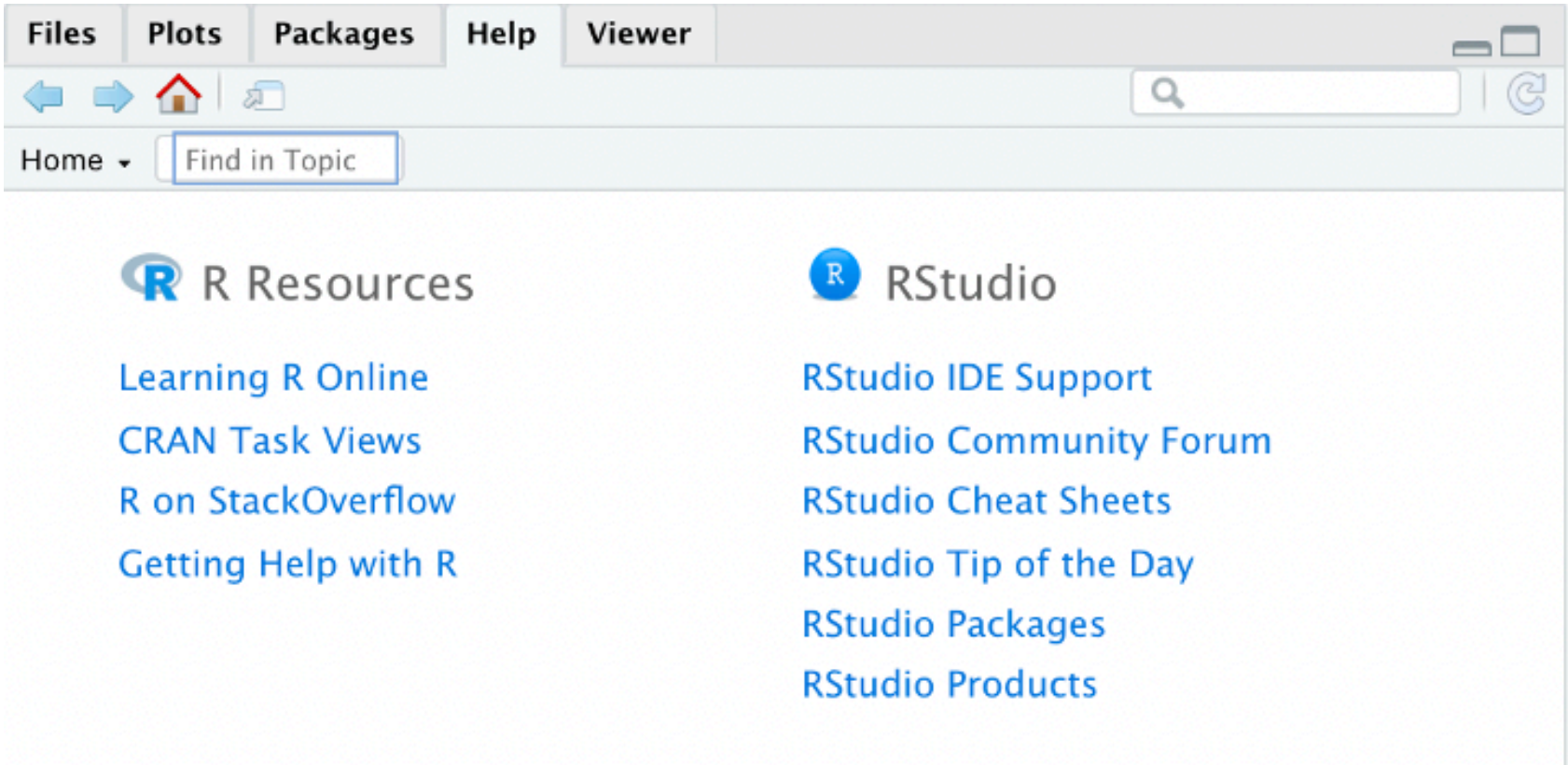
Help in R

Online documentation for functions and variables in R exists.

Obtained by typing help(function_name) or ? function_name at the Rprompt, where function_name refers to the name of function.

```
help(sqrt)
```

```
?sqrt
```



R packages

Packages are collections of R functions, data, and compiled code.

Libraries are directories in R where the packages are stored.

Built-in functions are part of R standard or base packages and do not need to be downloaded.

```
library(help = "base")
```

```
library(help = "stats")
```

Some functions are not built-in. To get these, need to download packages

R packages extend R's functionality.

R packages

Popular repositories for Packages:

The Comprehensive R Archive Network (CRAN)

- https://cran.r-project.org/web/packages/

Bioconductor

- https://www.bioconductor.org/packages/release/bioc/

GitHub

- https://github.com/search?q=r+packages&type=registrypackages

Note: Depending on the source of the package download, instructions may differ. Typically:

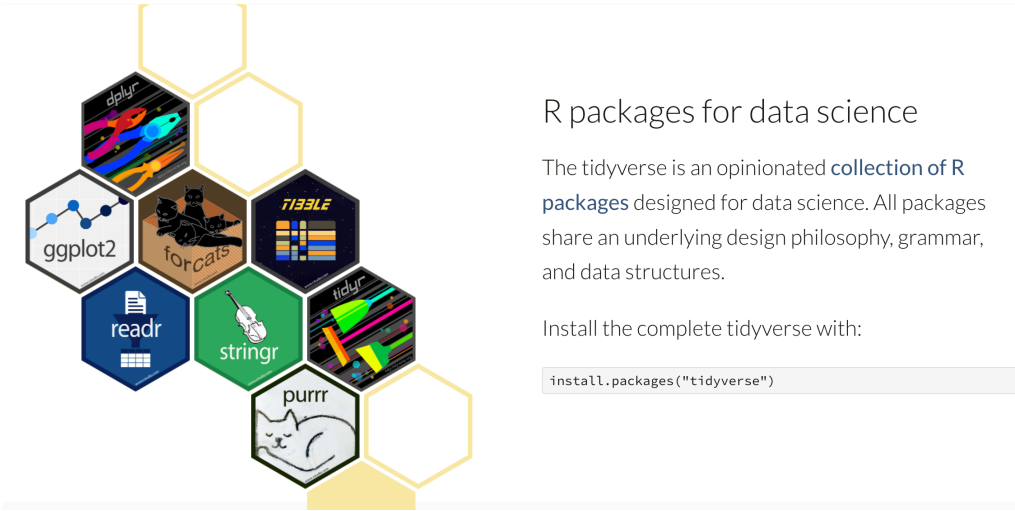
```
install.packages("tidyverse") #download a package
library(tidyverse) #load it into your RStudio session
```

Tidyverse Package

Tidyverse is a package from CRAN.

(https://cran.rproject.org/web/packages/tidyverse/index.html)

To get more details on tidyverse package..




```
ls("package:tidyverse") # list all functions in package
```

```
[1] "tidyverse_conflicts" "tidyverse_deps"      "tidyverse_
[4] "tidyverse_packages"  "tidyverse_sitrep"    "tidyverse_
```

```
?tidyverse # get information on package
```

In class exercise

Basic R Operations

1. Create an object named my_sequence that is a sequence from 1 to 7.
2. Use an R function to take the square roots of all the numbers in the sequence. Save this new sequence as an object named sqrt_sequence.
3. Multiply sqrt_sequence by 5.

Basic R Operations

```r
my_sequence <- c(1:7)
my_sequence
```

```
[1] 1 2 3 4 5 6 7
```

```r
sqrt_sequence <- sqrt(my_sequence)

sqrt_sequence
```

```
[1] 1.000000 1.414214 1.732051 2.000000 2.236068 2.449490 2
```

```r
sqrt_sequence * 5
```

```
[1]  5.000000  7.071068  8.660254 10.000000 11.180340 12.24
```

Package installation & loading

1. Install and load the faraway library

Package installation & loading

```
install.packages("faraway")
library(faraway)
```

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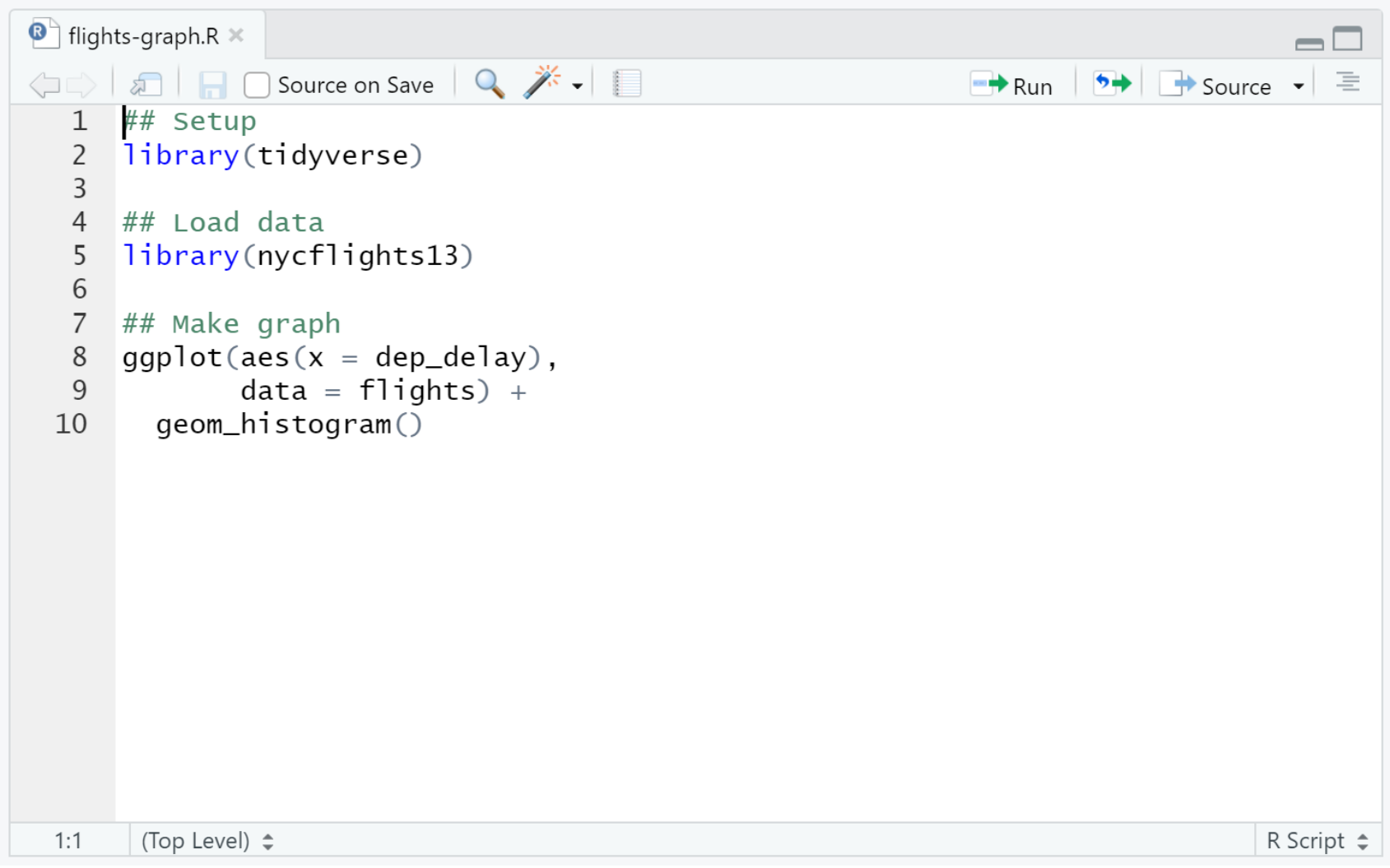
- **R markdown**

Hello, world!

R Scripts

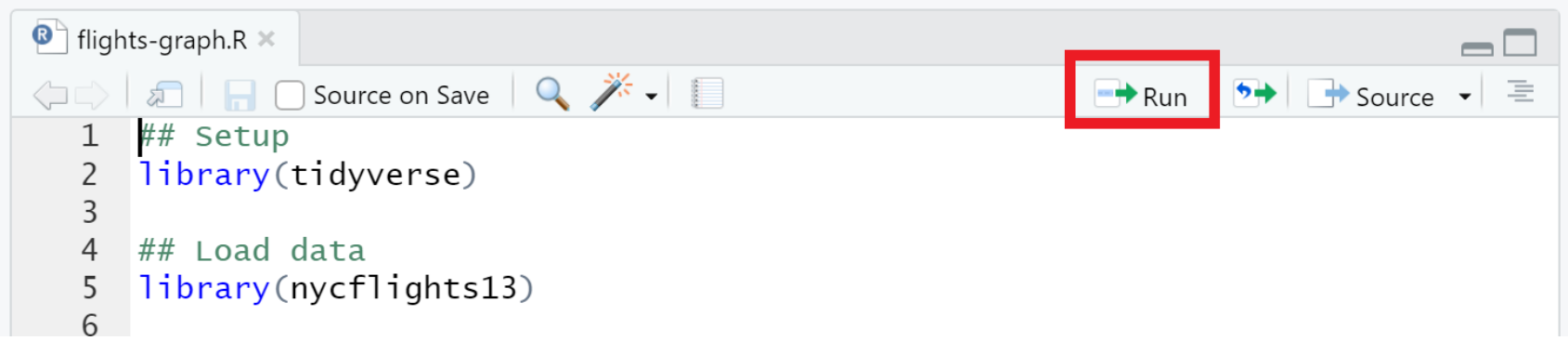
Files where you can save and edit your code



R Scripts

Running the code

Run the entire script by pressing Run



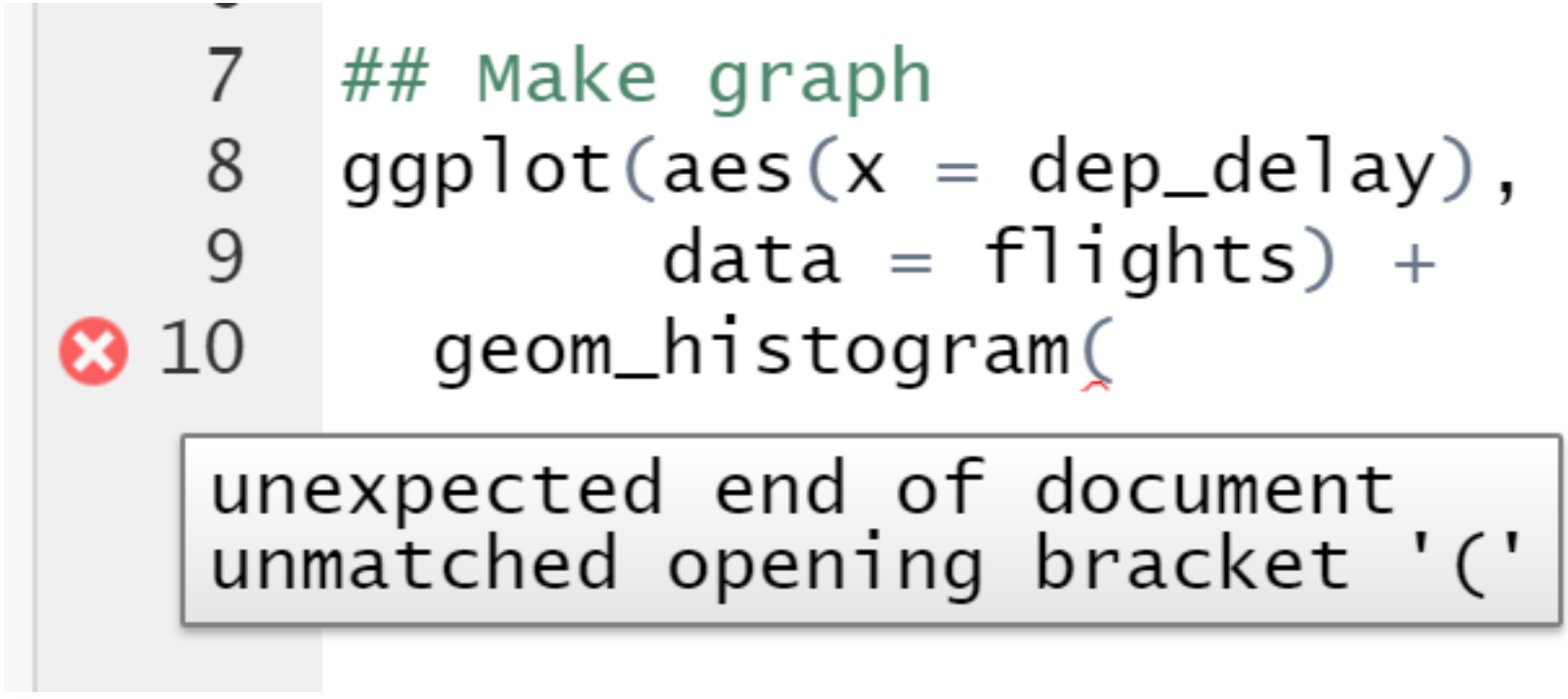
Run the command where your cursor is located by pressing Cmd/Ctrl + Enter

Run a section of commands by highlighting them and pressing Cmd/Ctrl +Enter

R Scripts

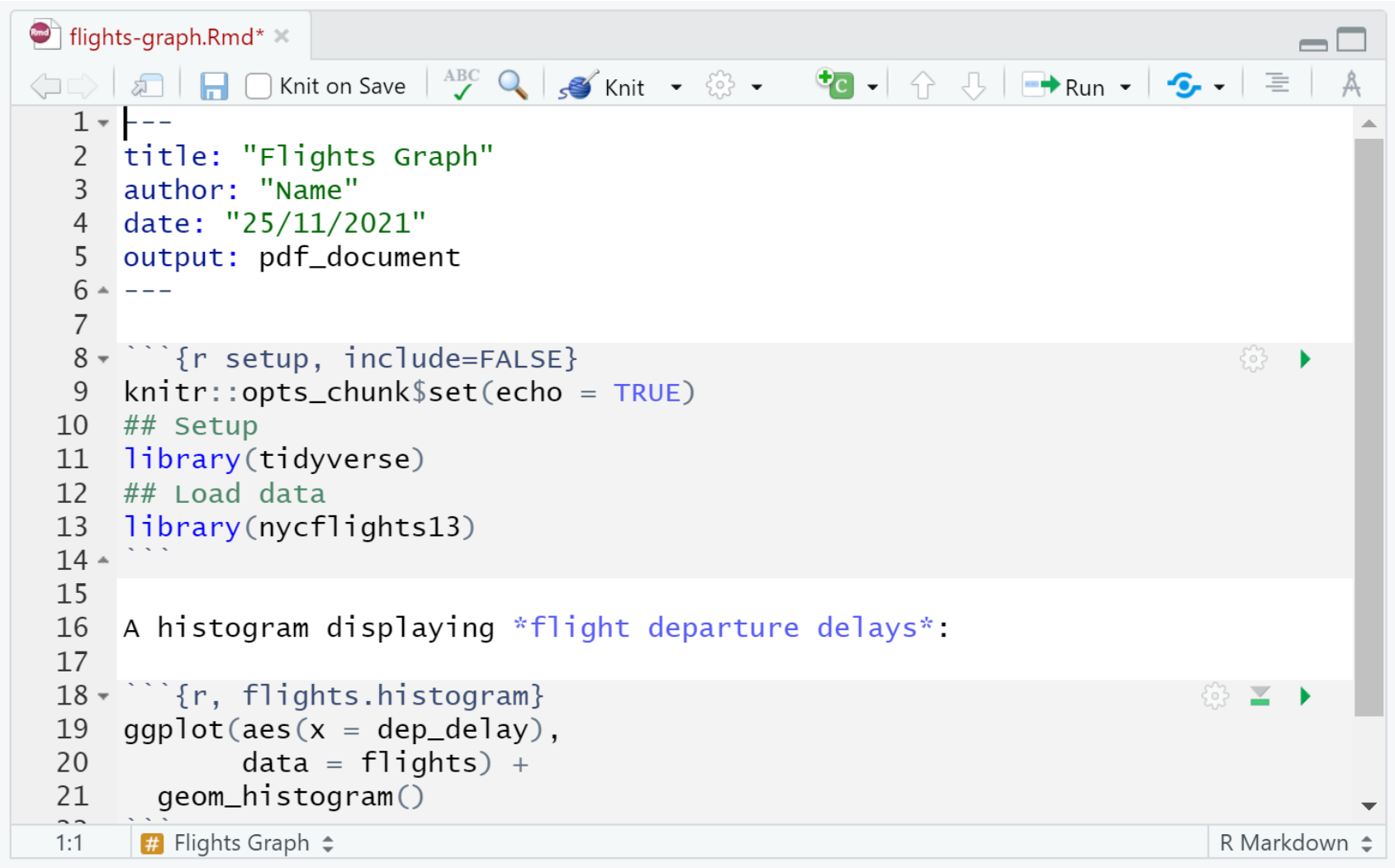
Diagnostics

When working in a script, RStudio will mark syntax errors. If you hover over the red x, you can see what the problem is.



R Markdown

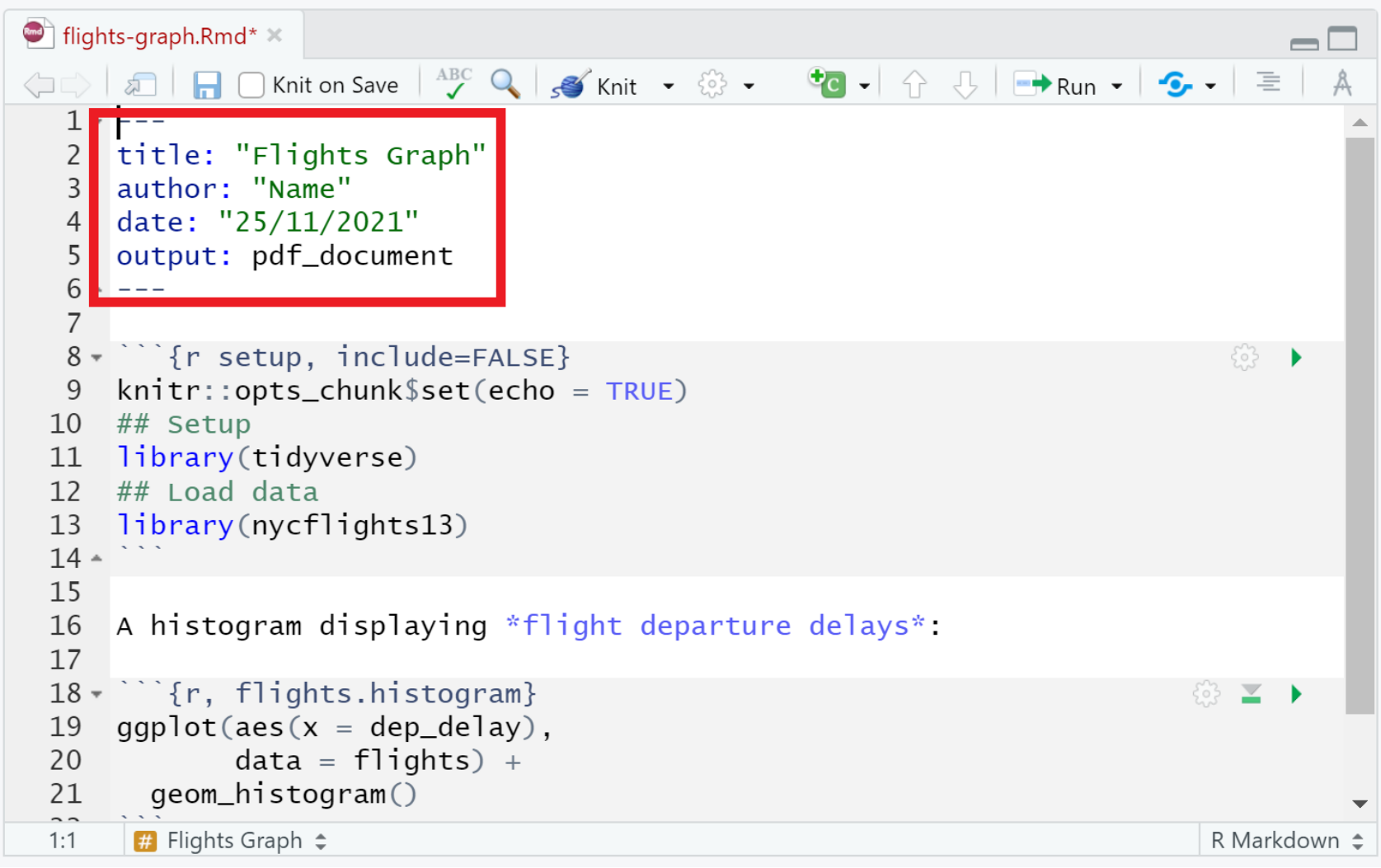
R Markdown files combine code chunks with the results of those chunks and text and support formats like PDF, HTML, word files and slideshows.



R Markdown

YAML header

contains the document information and settings are specified

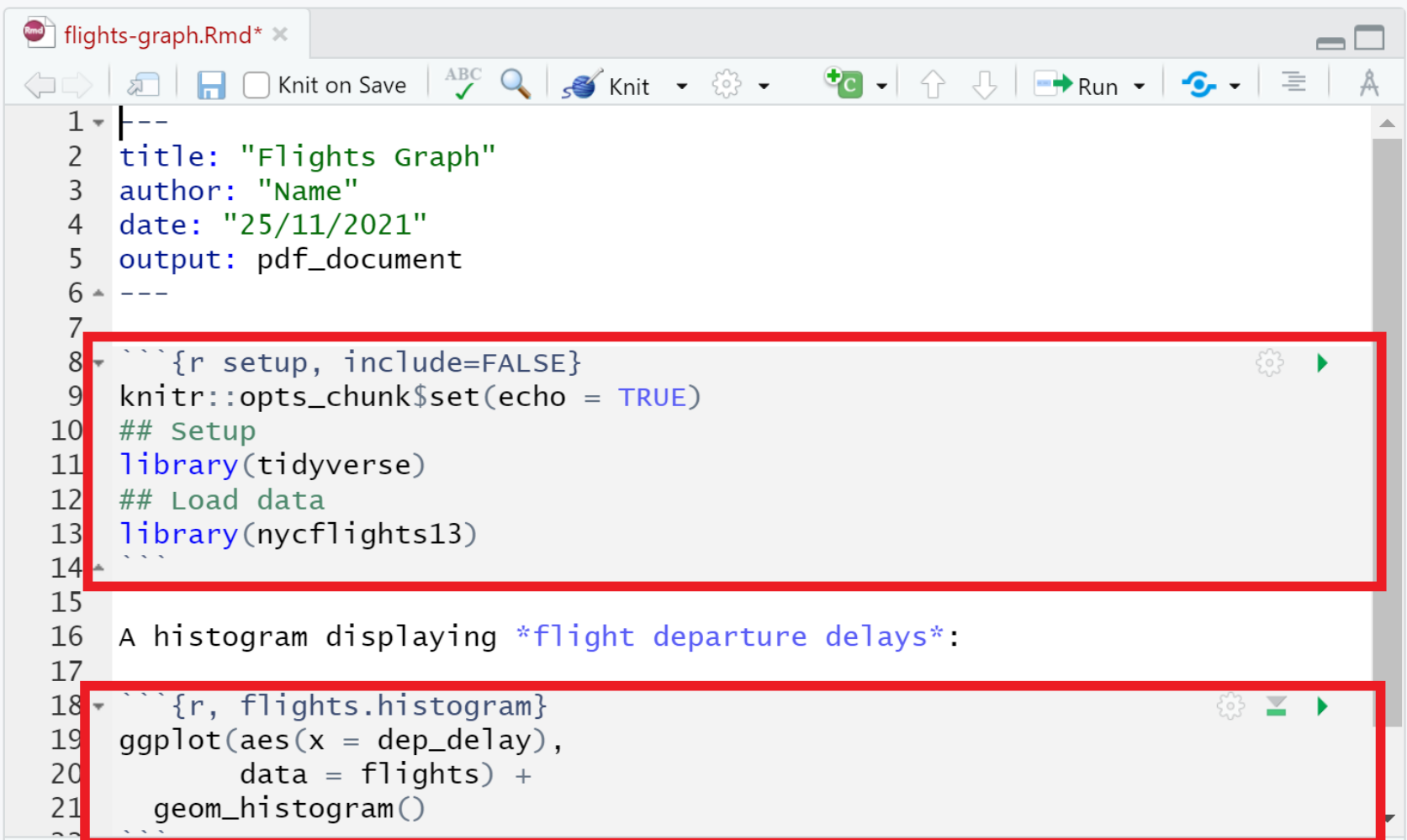


R Markdown

Chunks

Text goes in between the code chunks. This text can be formatted with basic markdown syntax.

You can write in code chunks the same way you would write in a script



R Markdown

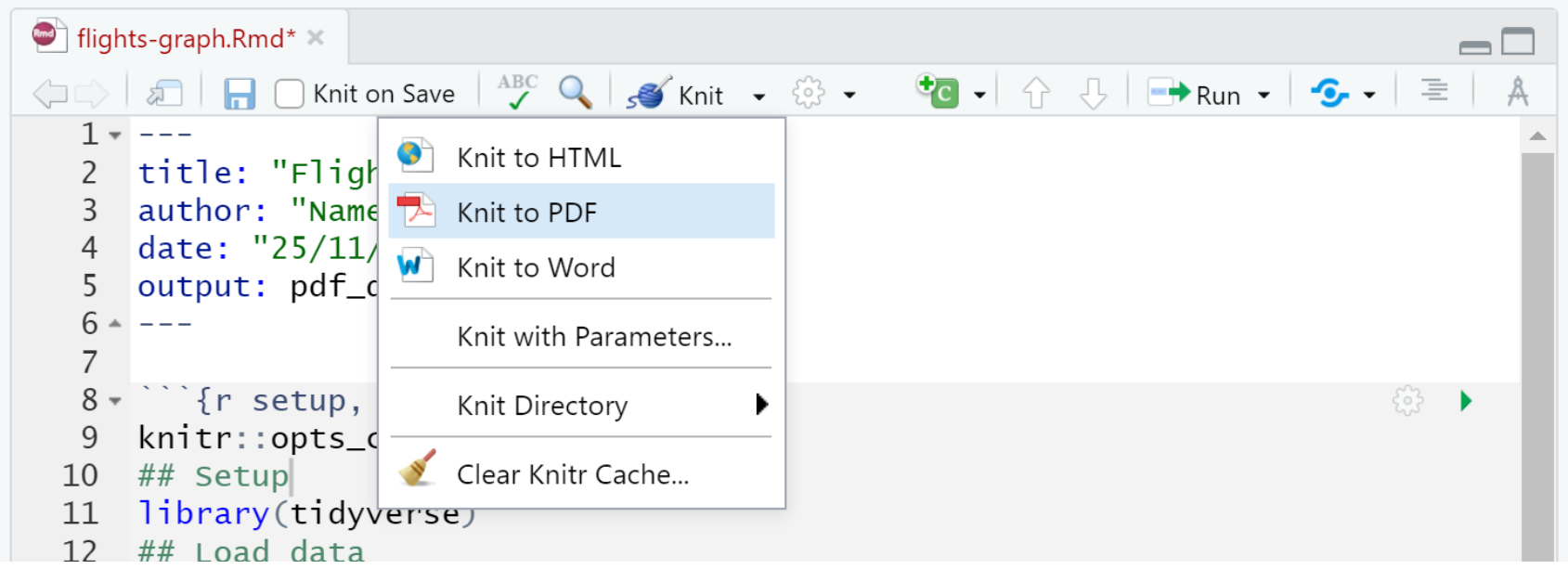
Running the code

Like with a script, you can use the Run button Cmd/Ctrl + Enter.
Each chunk also has an arrow you can press to run the code in that chunk.
The output will display below the code chunk rather than in the console or the Plots section.

R Markdown

Knitting to .Rmd file

To present your work, you can knit your R Markdown file to a more common file type, including PDFs, Word documents, and html files.

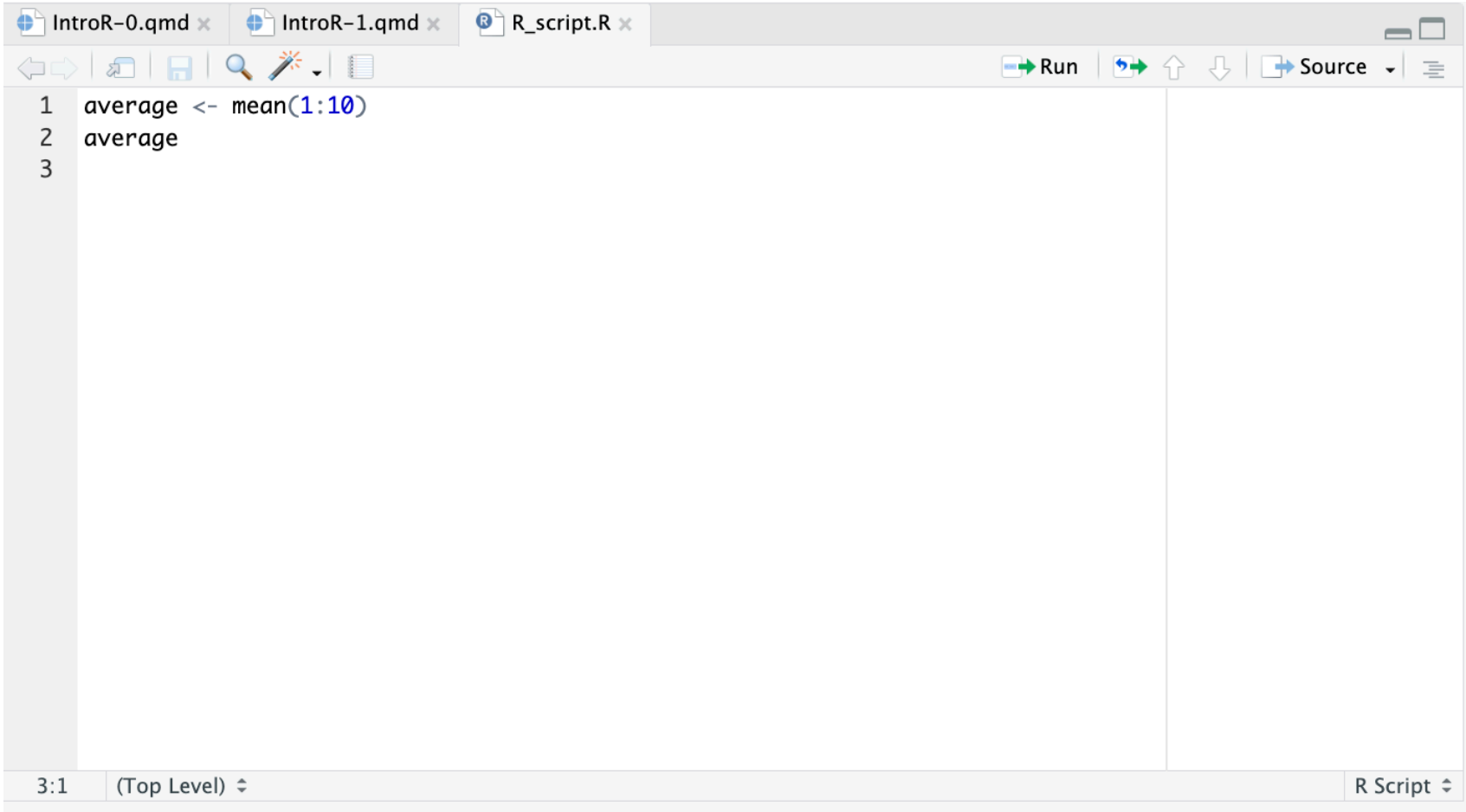


In class exercise

R Script

1. Create a new R script.
2. Write code to calculate the average of numbers 1 to 10.
3. Run the script.
4. Save the script.

R Script


IntroR-0.qmd
IntroR-1.qmd
R_script.R
Run
Source
1 average <- mean(1:10)
2 average
3
3:1
(Top Level)
R Script

R Markdown

1. Create a new R Markdown file.
2. Load the tidyverse and faraway libraries.
3. Load the dataset "broccoli" by calling the function data()
4. Print out the broccoli dataset in the R Markdown file.
5. Save the file.
6. Knit the R Markdown file to PDF.

R Markdown

```
---
title: "R_markdown"
output: html_document
date: "2023-05-19"
---
```

```{r}
#install.packages("tidyverse")
#install.packages("faraway")
library(tidyverse)
library(faraway)
```

```{r}
data("broccoli")
broccoli
```

Description: df [36 × 4]

	wt <dbl>	grower <fctr>	box <fctr>	cluster <fctr>
1	352	1	1	1
2	369	1	1	2
3	383	1	1	3
4	339	2	1	1
5	367	2	1	2
6	328	2	1	3
7	376	3	1	1
8	359	3	1	2
9	388	3	1	3
10	365	1	2	1

1–10 of 36 rows

Previous 1 2 3 4 Next

Chunk 2

R Markdown

Questions?

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Hello, world! *(Live coding)*