



R Markdown and Interactive Dashboards

Introduction

Carl Howe, Director of Education, RStudio
Kelly O'Brient, Solutions Engineer, RStudio



RStudio's Mission:



Equip everyone, regardless of means,
to participate in a global economy that
rewards data literacy



RStudio Education's mission:



Train the next million R users

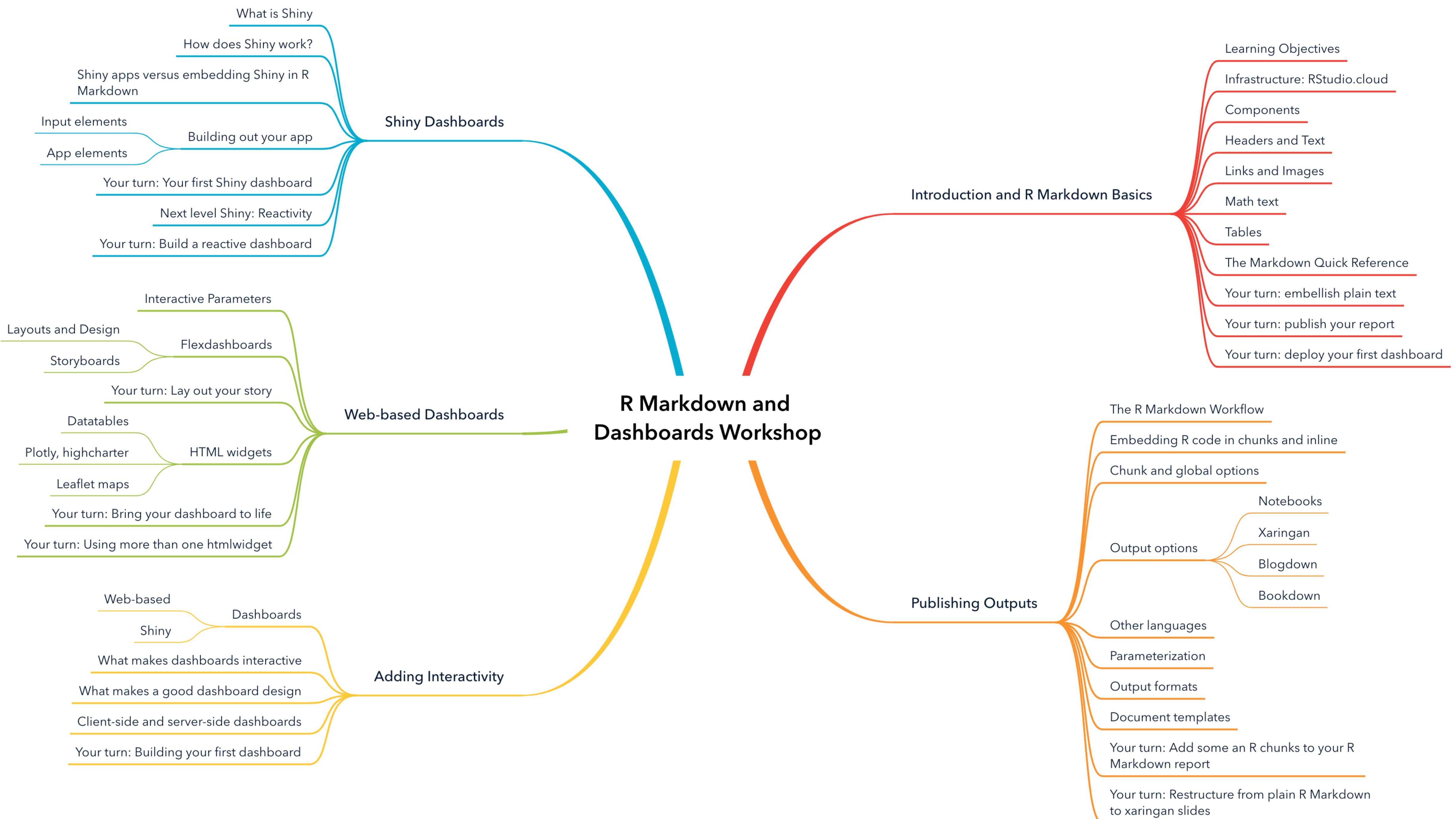
#NextMillionRUsers

WHAT YOU'LL LEARN TODAY

Today you'll learn how to

- Use the RStudio IDE and RStudio.cloud
- Knit an R Markdown document
- Create reports in R Markdown
- Turn static reports into dynamic content
- Apply web browser and Shiny interactivity
- Publish your insights to a larger web audience

R Markdown and Dashboards Workshop



Introduction and R Markdown Basics

Learning Objectives

Infrastructure: RStudio.cloud

Components

Headers and Text

Links and Images

Math text

Tables

The Markdown Quick Reference

Your turn: embellish plain text

Your turn: publish your report

Your turn: deploy your first dashboard

Publishing Outputs

The R Markdown Workflow

Embedding R code in chunks and inline

Chunk and global options

Output options

Notebooks

Xaringan

Blogdown

Bookdown

Other languages

Parameterization

Output formats

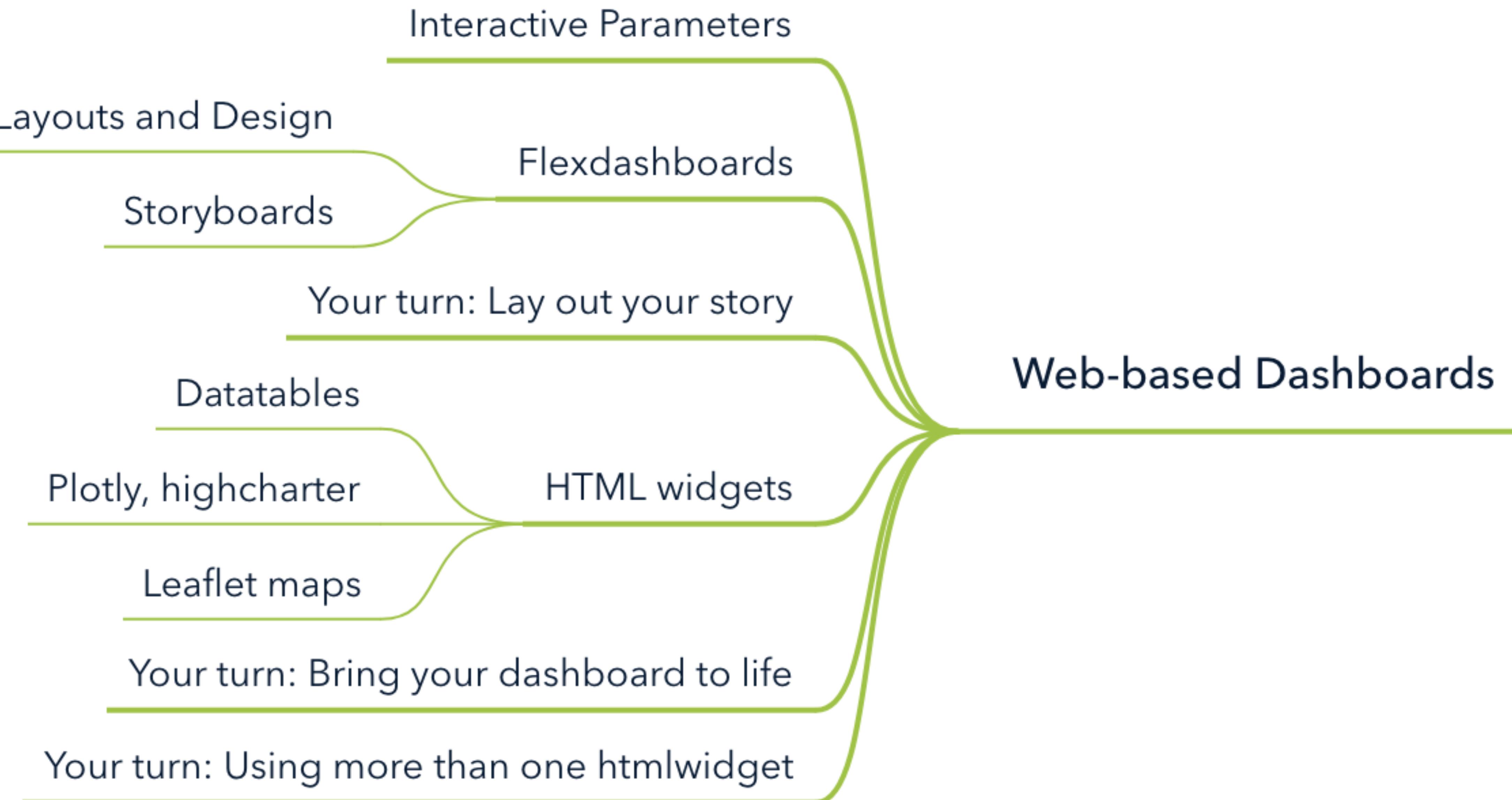
Document templates

Your turn: Add some an R chunks to your R
Markdown report

Your turn: Restructure from plain R Markdown
to xaringan slides

Adding Interactivity

- Web-based Dashboards
- Shiny
- What makes dashboards interactive
- What makes a good dashboard design
- Client-side and server-side dashboards
- Your turn: Building your first dashboard



Shiny Dashboards

What is Shiny

How does Shiny work?

Shiny apps versus embedding Shiny in R
Markdown

Input elements

Building out your app

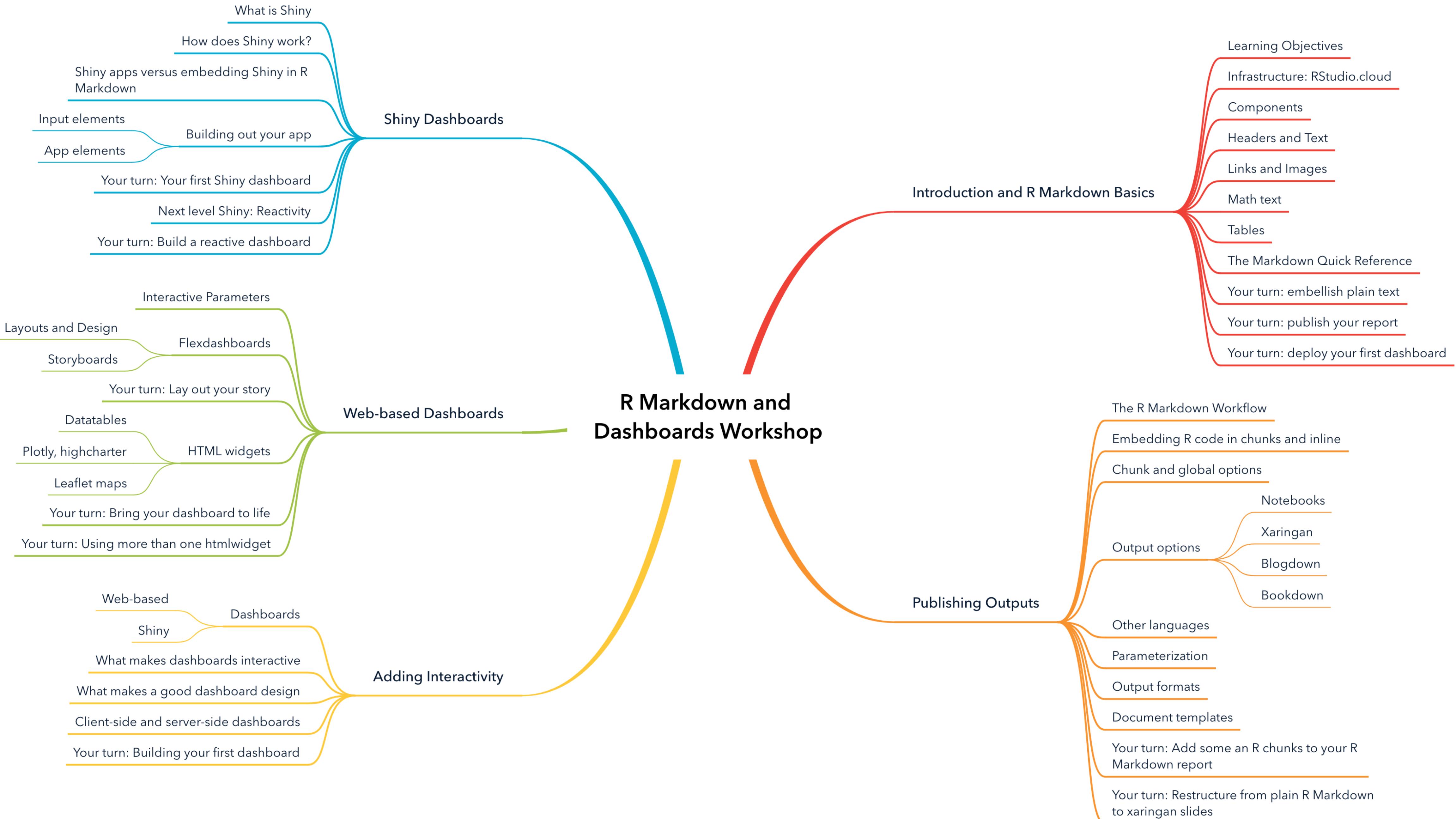
App elements

Your turn: Your first Shiny dashboard

Next level Shiny: Reactivity

Your turn: Build a reactive dashboard

R Markdown and Dashboards Workshop

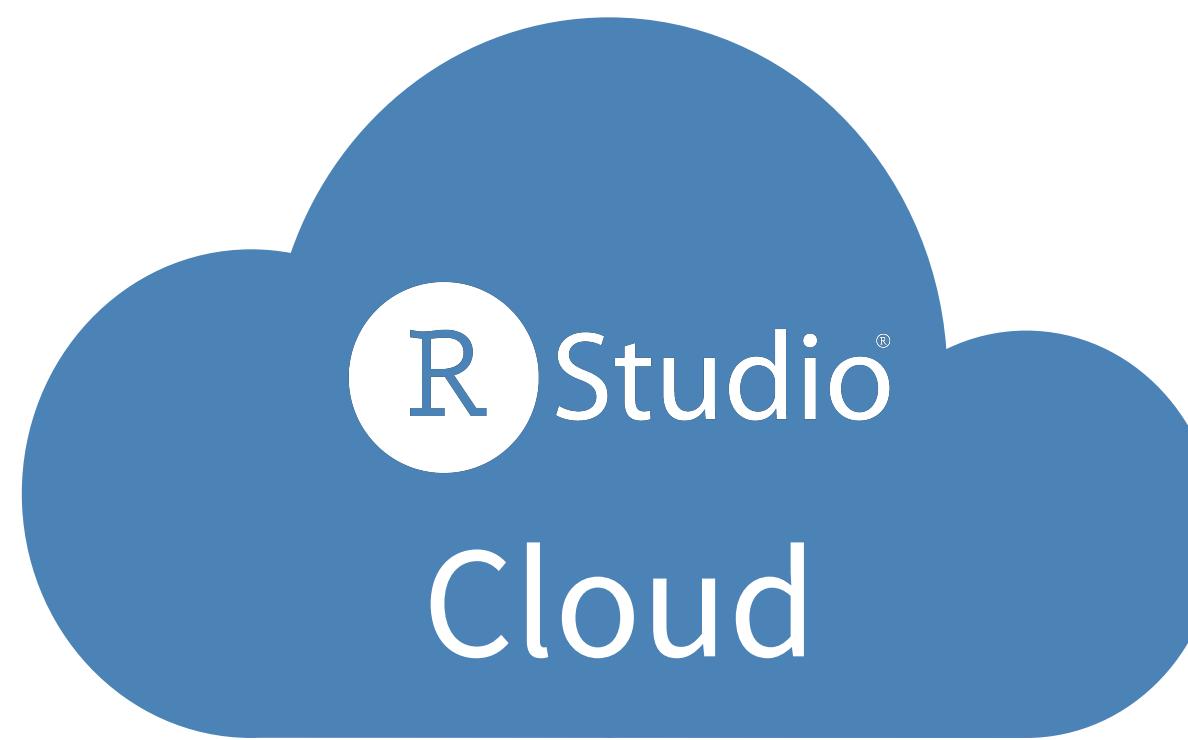


GETTING SET UP



WORKSHOP MATERIALS

OPTION 1



log in and sit tight

OPTION 2



Clone or download
bit.ly/2m2azap

A screenshot of a GitHub repository page for 'rstudio/rmarkdown'. The page includes navigation buttons for 'Create new file', 'Upload files', 'Find File', and a green 'Clone or download' button. A dropdown menu is open under 'Clone or download' with options 'Clone with HTTPS' and 'Use SSH'. Below this, there's a text input field with the URL 'https://github.com/rstudio/rmarkdown-' followed by a clipboard icon. At the bottom right of the page, there are 'Open in Desktop' and 'Download ZIP' buttons.

Clone or download ▾

Clone with HTTPS ⓘ

[Use SSH](#)

Use Git or checkout with SVN using the web URL.

<https://github.com/mine-cetinkaya-runde>



[Open in Desktop](#)

[Download ZIP](#)

IF YOU RUN LOCALLY, YOU NEED TO INSTALL PACKAGES

The list is in the top level directory as `00-libraries-required.Rmd`. They are also listed here.

- `library(geonames)`
- `library(dplyr)`
- `library(magrittr)`
- `library(rmarkdown)`
- `library(flexdashboard)`
- `library(leaflet)`
- `library(babynames)`
- `library(tufte)`
- `library(rticles)`
- `library(shiny)`
- `library(DT)`

ASKING FOR HELP



I'm stuck



I'm not stuck, but I need help
on my computer



I need help
understanding something
(which likely means others
do too)
rstd.io/RMAID

SCHEDULE

Time	Content
10:00-10:45	Introduction and your first dashboard
10:45-11:00	Break
11:00-12:30	R Markdown Basics and Publishing
12:30-13:30	Lunch
13:30-15:00	Adding Interactivity and Web-based Dashboards
15:00-15:15	Break
15:15-16:30	Shiny and Putting It All Together
16:30-17:00	Q&A, Recap, and Wrap-up

The rstudio.cloud space for this course is
rstd.io/RMAID

The github repository for all the materials is at
bit.ly/2m2azap

THINGS YOU SHOULD KNOW

- There are no stupid questions
- Because we have limited time, please write down questions as they occur to you, and then ask them when the instructor pauses for questions
- Don't be afraid to experiment and try things out; you won't blow up anything important if you make a mistake.

RSTUDIO TECHNOLOGIES WE'LL USE

- RStudio Integrated Development Environment (the RStudio IDE)
- RStudio.cloud interactive service
- The R Markdown document language
- The Tidyverse series of R packages
- HTML Widgets
- Shiny interactivity



WHY R MARKDOWN AND INTERACTIVE DASHBOARDS?

Your Turn

Form groups of 2-4 people. Introduce yourself to your group members. Tell them:

1. Who you are
2. What you do with data
3. How long you have been using R
4. What do they want to do with R Markdown and Interactive Dashboards?





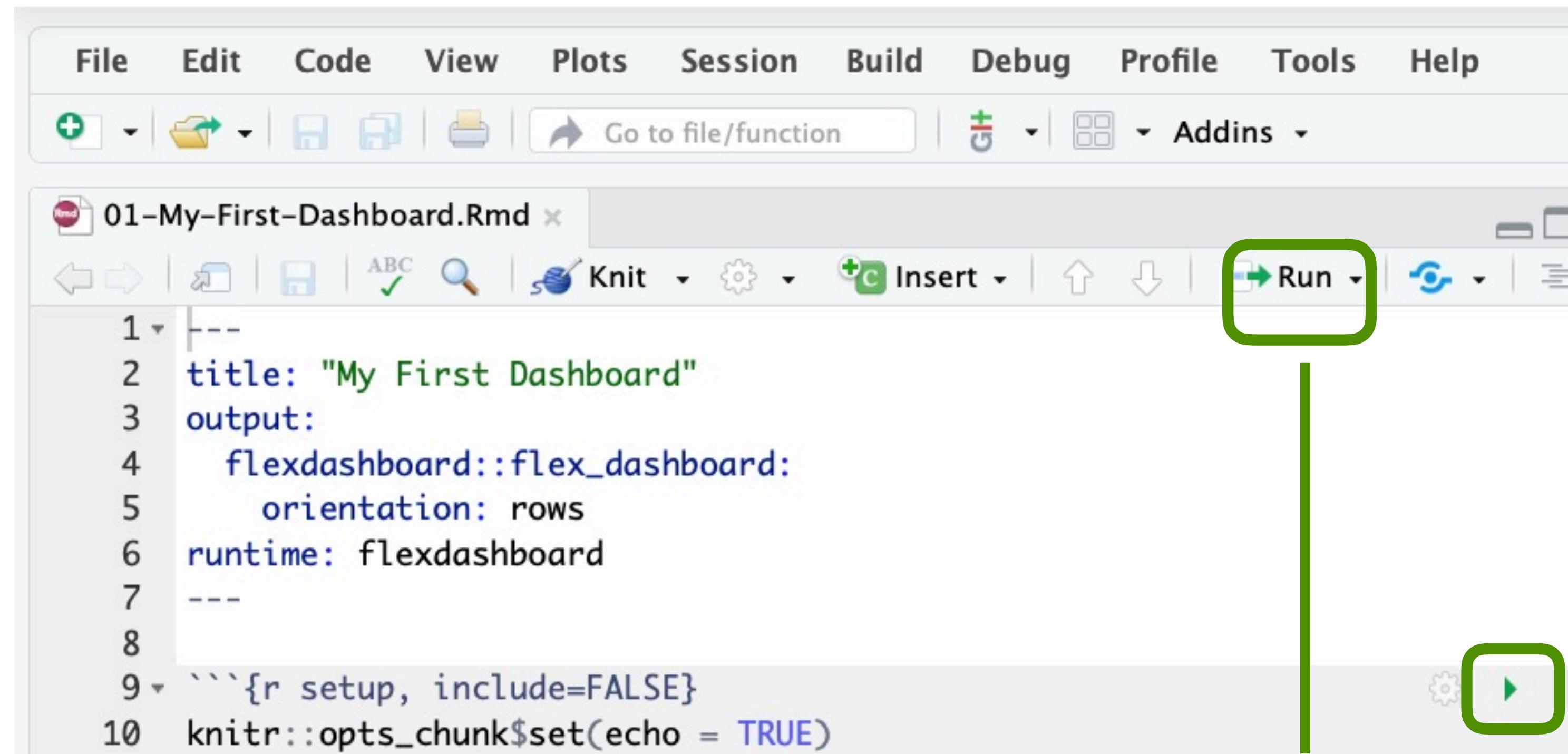
RSTUDIO.CLOUD

AND

YOUR FIRST DASHBOARD

IMPORTANT BUTTONS

R Markdown And Interactive Dashboards / 01-Introduction



Run

Allows you to run a code chunk or your whole document

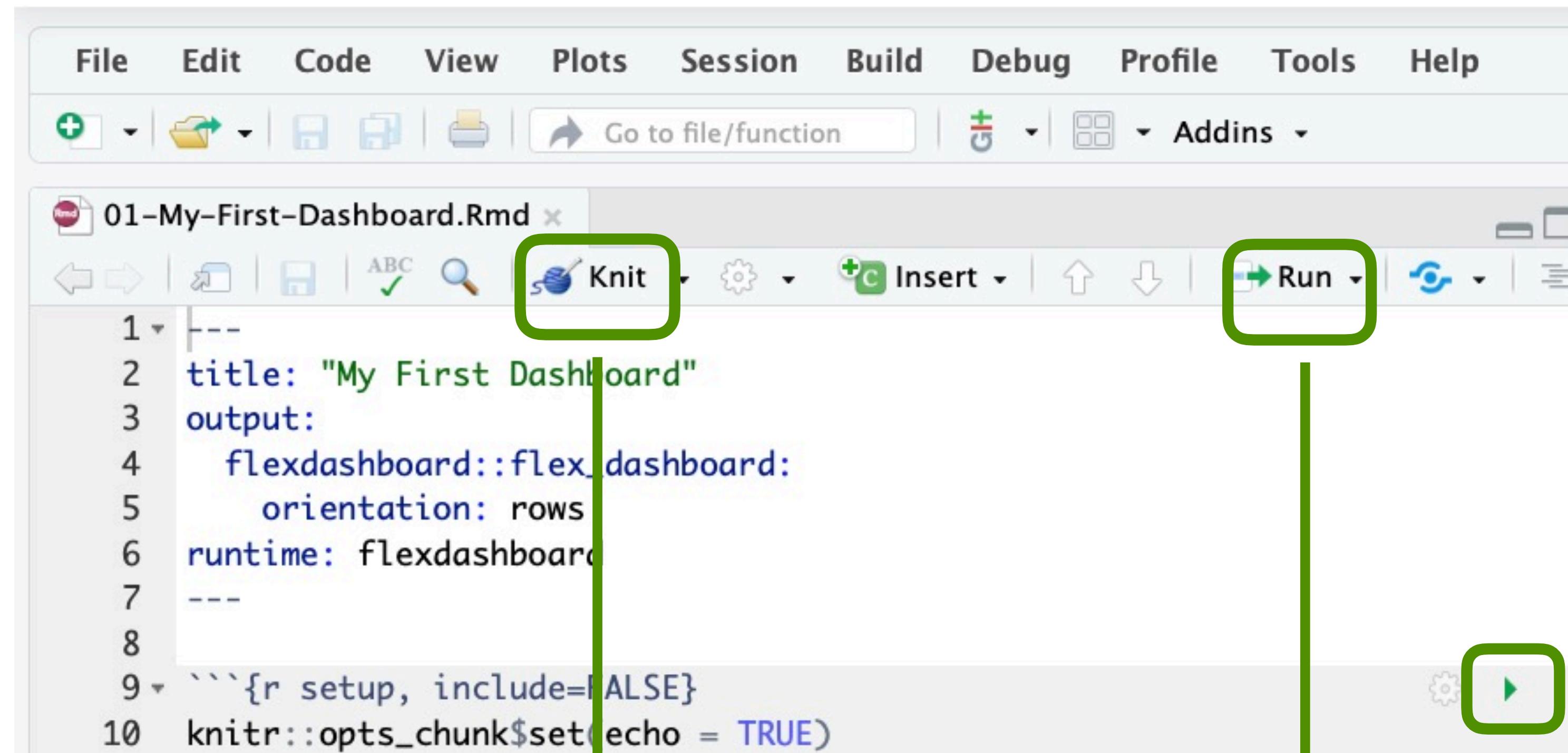


Run Chunk

Allows you to run a single code chunk

IMPORTANT BUTTONS

R Markdown And Interactive Dashboards / 01-Introduction



Knit

Knits all your text and code
into a finished document

Run

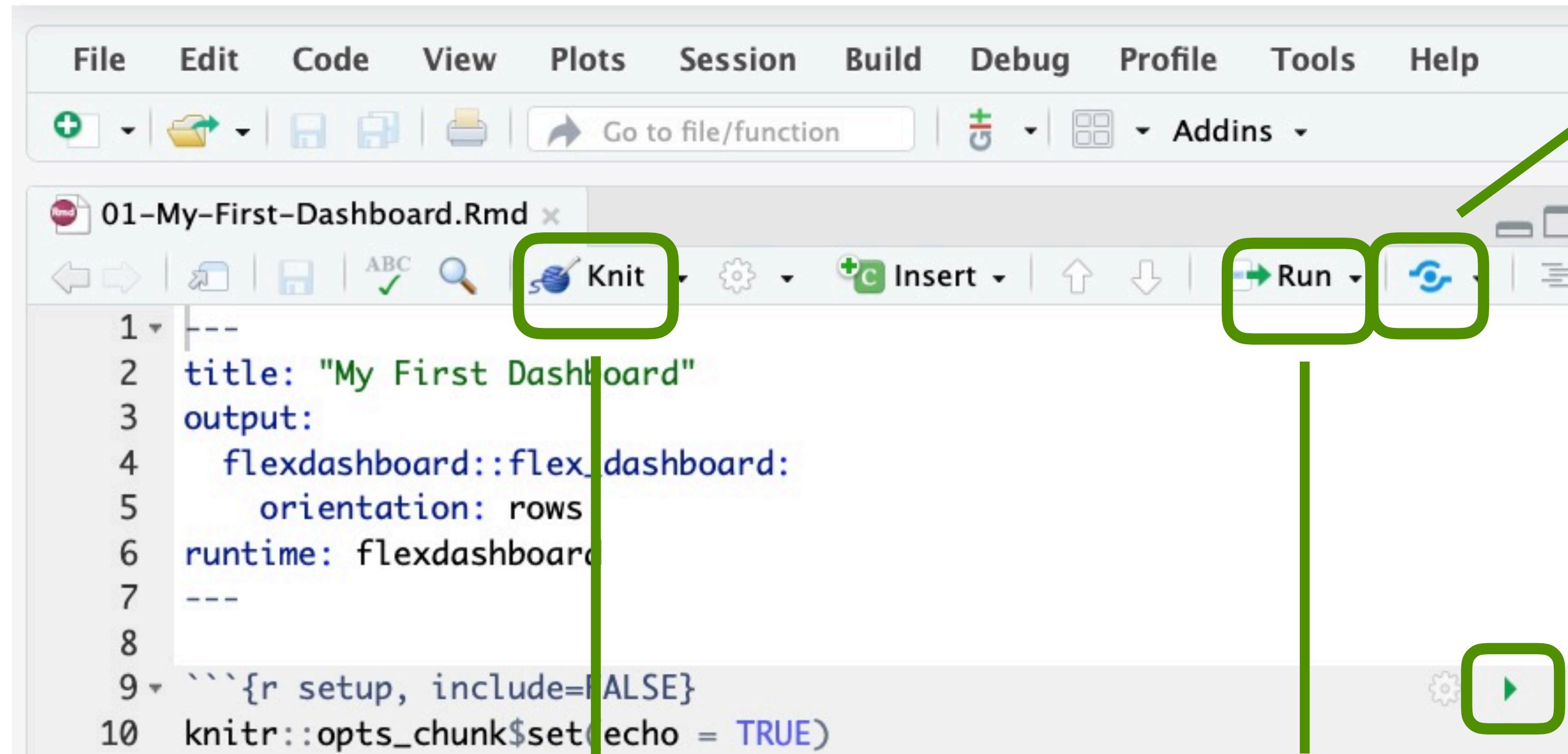
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R Markdown And Interactive Dashboards / 01-Introduction



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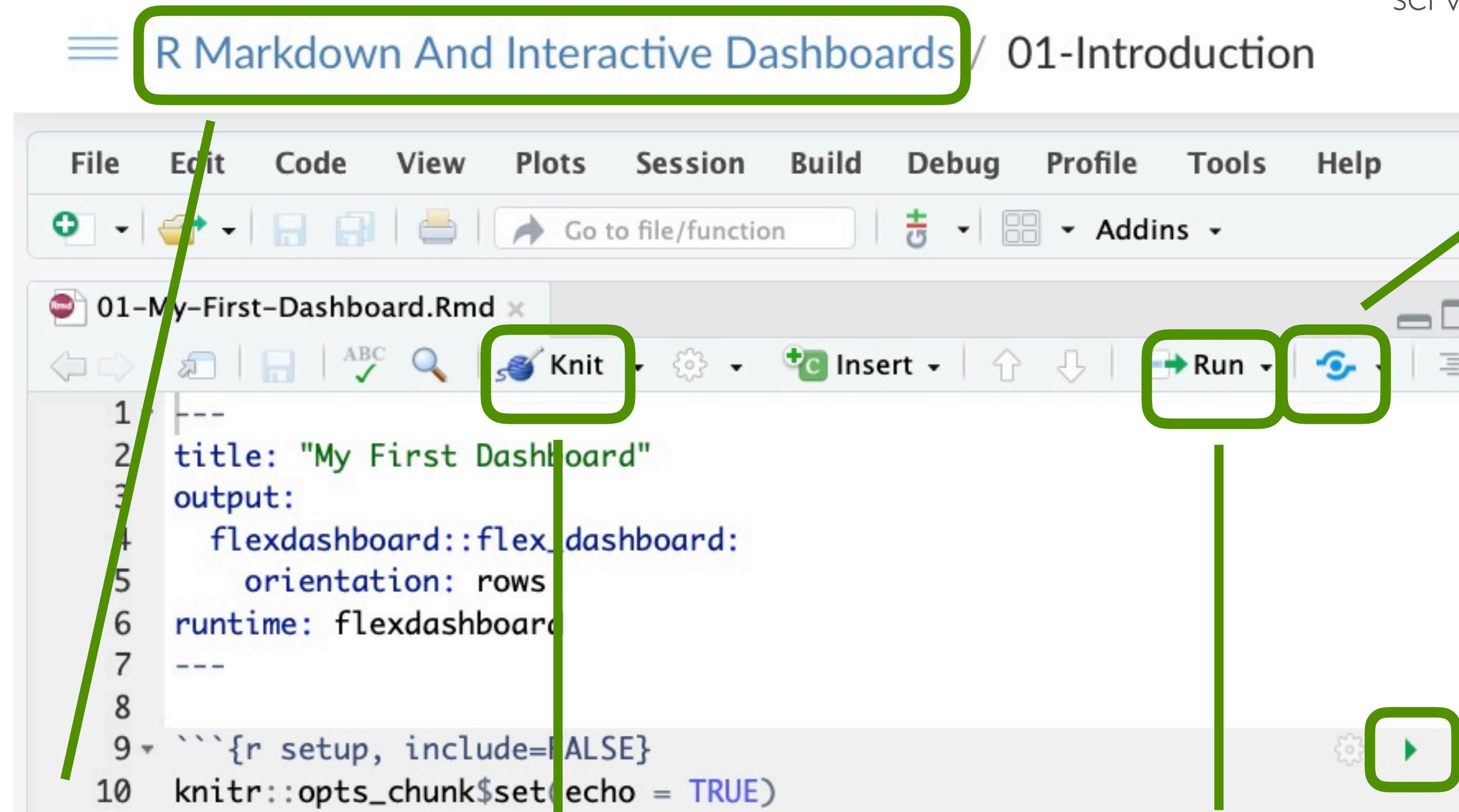
Publish

Publish your document to presentation
services such as RStudio Connect or
shinyapps.io

Run Chunk

Allows you to run a single code chunk

IMPORTANT BUTTONS



Return to Project List

Leaves this project
and returns
you to the list of projects
in this space

Knit

Knits all your text and code
into a finished document

Run

Allows you to run a code
chunk or your whole
document

Run Chunk
Allows you to run a single code chunk

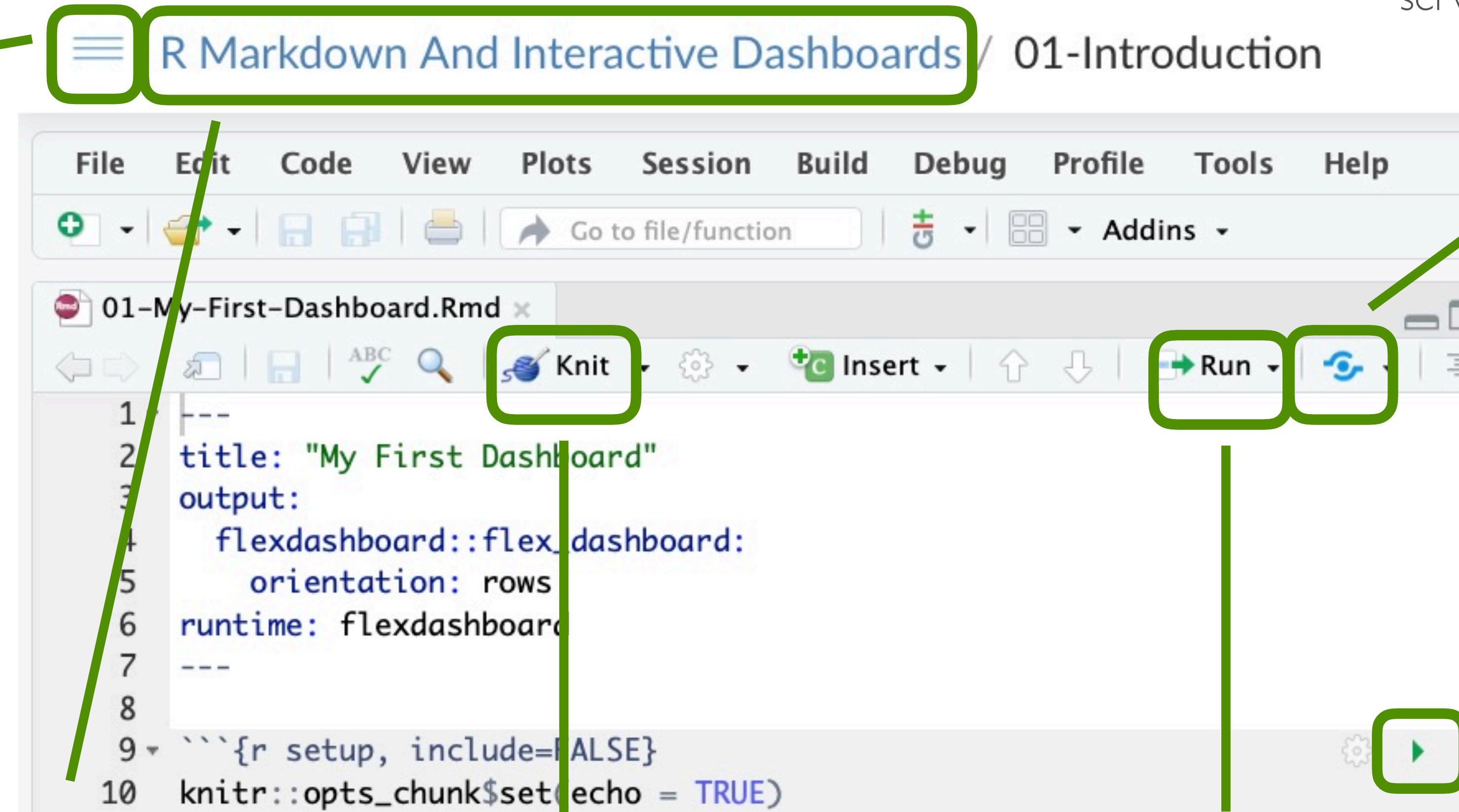
Publish

Publish your document to presentation
services such as RStudio Connect or
shinyapps.io

IMPORTANT BUTTONS

Top Menu

Go somewhere
else in RStudio.cloud



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Leaves this project
and returns
you to the list of projects
in this space

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into a finished document

Run

Allows you to run a code
chunk or your whole
document

Publish

Publish your document to presentation
services such as RStudio Connect or
shinyapps.io

Run Chunk

Allows you to run a single code chunk

R Studio Cloud

In 90 Minutes Projects Members Info

Spaces

- Your Workspace
- MVD
- R In 90 Minutes**
- R Markdown Tutorial Pages
- RStudio Portfolio Training Exercises
- Shiny Essentials - JSM 2018
- New Space

Learn

- Guide
- What's New
- Primers**
- DataCamp Courses
- Cheat Sheets**
- Feedback and Questions

Info

- Terms and Conditions
- System Status

All Projects

01A Minimal Recipe

Carl Howe
Created Mar 7, 2019 2:54 PM

1-Simple-Google-Spreadsheet

Carl Howe
Created Mar 1, 2019 11:20 AM

2-Simple-Counting

Carl Howe
Created Mar 5, 2019 4:42 PM

Untitled Project

Carl Howe
Created Mar 7, 2019 2:49 PM

Don't Panic!

RStudio.cloud also has Primers for helping you learn more of the details of the language once this class is done.

RStudio.cloud also has Cheat Sheets for the IDE functions and for all the packages we are using!

ACCOUNT SETUP FOR GEONAMES.ORG

- This process allows us to use real-time weather and earthquake data
- Please set up an account for yourself at <https://www.geonames.org/login>
- Only a user name, email account, and password are required; no other information is gathered



EXERCISE 1

Knit Your First Document

1. Click on **01-My-First-Dashboard.Rmd** in the files pane to open that file
2. Change the **geonames_account** parameter to the account name you created a few moments ago.
2. Click **Knit** above the source pane
3. Admire the result.

WARNING: you may need to disable your browser pop-up blocker to see the result

3m 00s

The screenshot shows the RStudio Cloud interface. The top navigation bar includes Environment, History, Connections, and Git tabs. Below the navigation is a search bar with 'json' entered. The main workspace shows a code editor for '01-My-First-Dashboard.Rmd' with the following content:

```
1 ---  
2 title: "My First Dashboard"  
3 output:  
4   flexdashboard::flex_dashboard:  
5     orientation: rows  
6 runtime: flexdashboard  
7 params:  
8   geonames_account: "rstudio_dashboard"  
9 my_city: "Boston"  
10 my_airport: "KBOS"  
11 ---  
12  
13 `r setup, include=FALSE}  
14 knitr::opts_chunk$set(echo = TRUE)  
21:49 [C] Chunk 1: setup
```

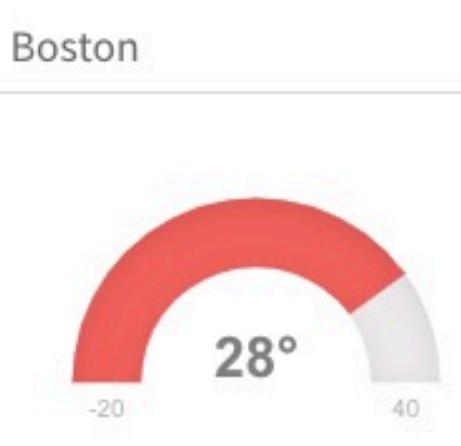
The 'geonames_account' line is highlighted with a green box. Below the code editor is a 'Console' pane showing the command: `.../01-Introduction/01-My-First-Dashboard.Rmd`. The 'Jobs' tab is also visible. To the right is a 'Files' pane listing various R Markdown files and their status. The file '01-My-First-Dashboard.Rmd' is selected and highlighted with a green box. Other files listed include '01-Introduction.Rproj', '01-My-First-Dashboard.html', '01-RMAID-Introduction.key', and several '03-' and '07-' prefixed files.

YOU SHOULD SEE SOMETHING LIKE THIS

01-My-First-Dashboard.html | Open in Browser | Find | Publish

My First Dashboard

Temperatures

Boston	London	Mumbai	Tierra Del Fuego	Sydney
 28°	 17°	 29°	 3°	 10°

-20 40

Description

This dashboard shows you weather and recent earthquakes around the world in real-time.

The temperatures above are simple *gauge* HTML widgets. The map is generated by the *leaflet* mapping widget.

Map



A world map showing weather stations and recent earthquakes. The map includes a legend in the top right corner with two checked checkboxes: "Weather Stations" and "Earthquakes". The map displays various colored dots representing these locations across the globe.

+ -

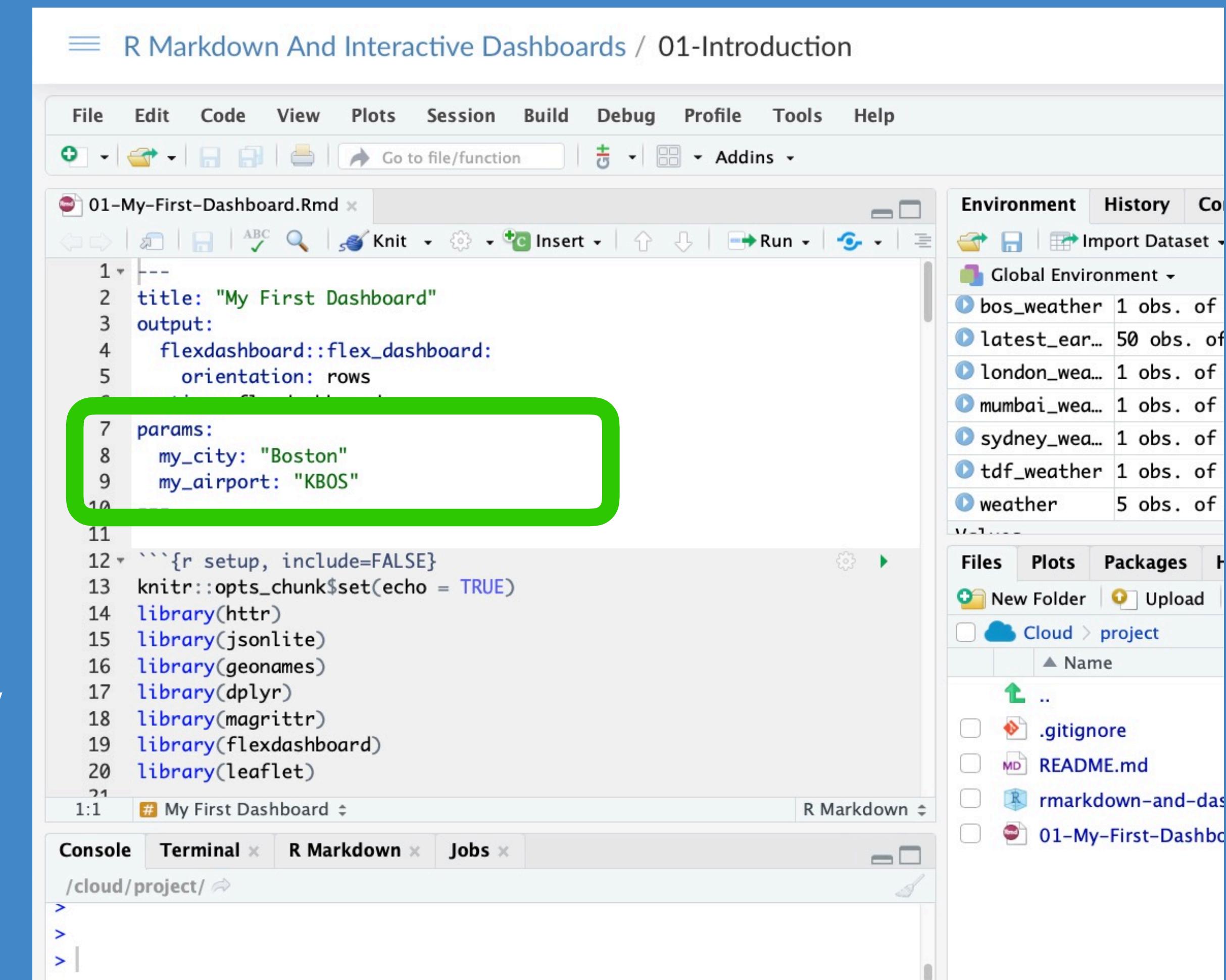
Leaflet | © OpenStreetMap contributors, CC-BY-SA

EXERCISE 2

Edit Your Dashboard To Use A Different City

1. Find the lines following the word **params:**
2. Change the value **Boston** to the name of another city.
3. Change the value **KBOS** to the ICAO airport code for an airport in that city (you can look up the ICAO code for any major airport using Google)
4. Knit your dashboard again and see the new city temperature gauge and map location.

5m 00s



```

1 ---  

2 title: "My First Dashboard"  

3 output:  

4   flexdashboard::flex_dashboard:  

5     orientation: rows  

6     vertical_layout: fill  

7 params:  

8   my_city: "Boston"  

9   my_airport: "KBOS"  

10  

11  

12 ```{r setup, include=FALSE}  

13 knitr::opts_chunk$set(echo = TRUE)  

14 library(httr)  

15 library(jsonlite)  

16 library(geonames)  

17 library(dplyr)  

18 library(magrittr)  

19 library(flexdashboard)  

20 library(leaflet)  

21  

# My First Dashboard

```

The 'params:' section is highlighted with a green box.

Console Terminal × R Markdown × Jobs ×

/cloud/project/

>
>
> |



Congratulations! You have created your first dashboard!

Time Check: 20 minutes

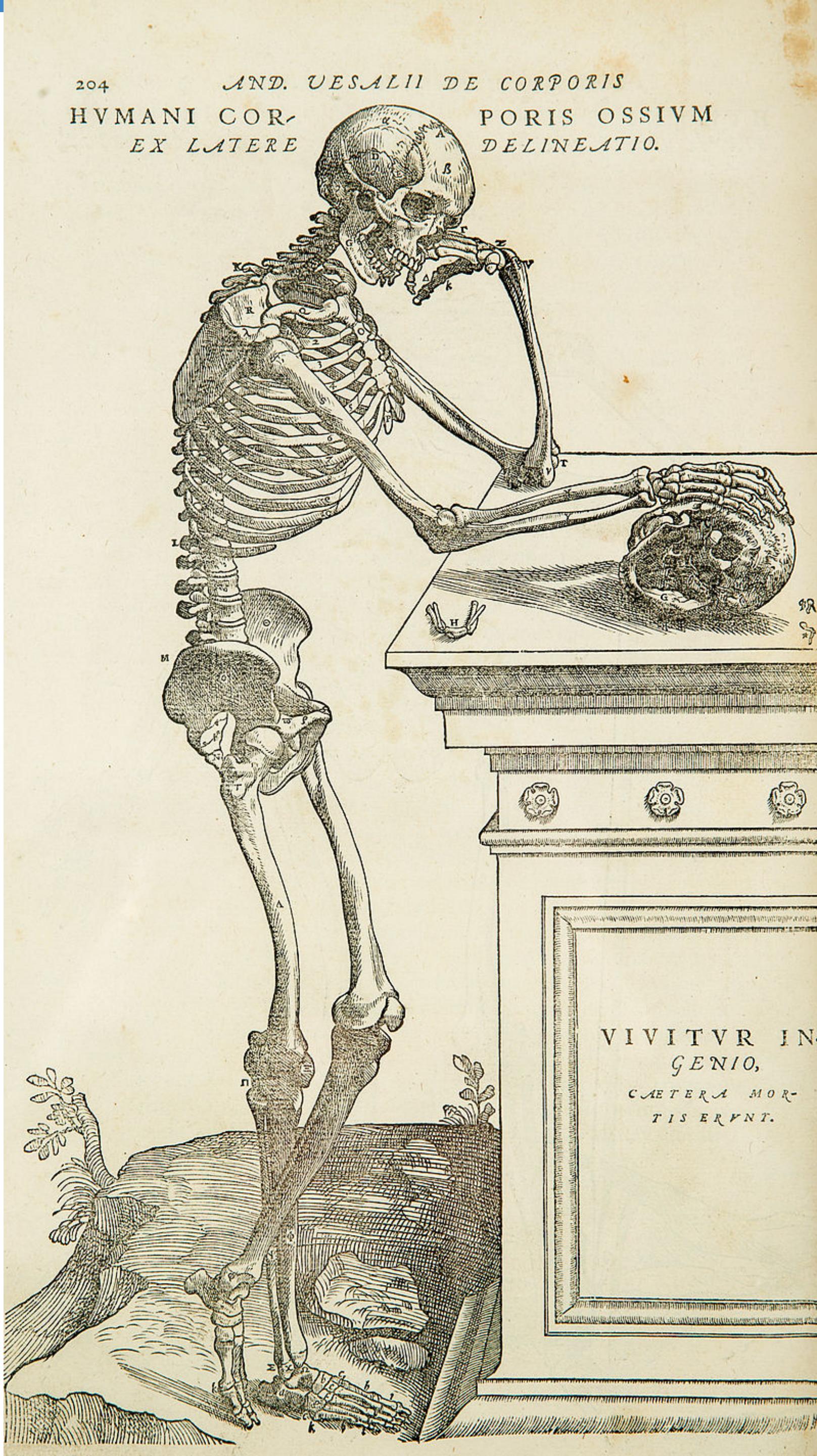


WHAT YOU'VE LEARNED

You've already learned how to

- Launch a project in rstudio.cloud
- Edit a file
- Knit a file into a result





THE ANATOMY OF AN R MARKDOWN DOCUMENT

You'll learn

- What R Markdown is
- How to create your own R Markdown document
- The components of an R Markdown document
- How to customize the content R Markdown documents

R Markdown is a language for creating *computational* *documents**

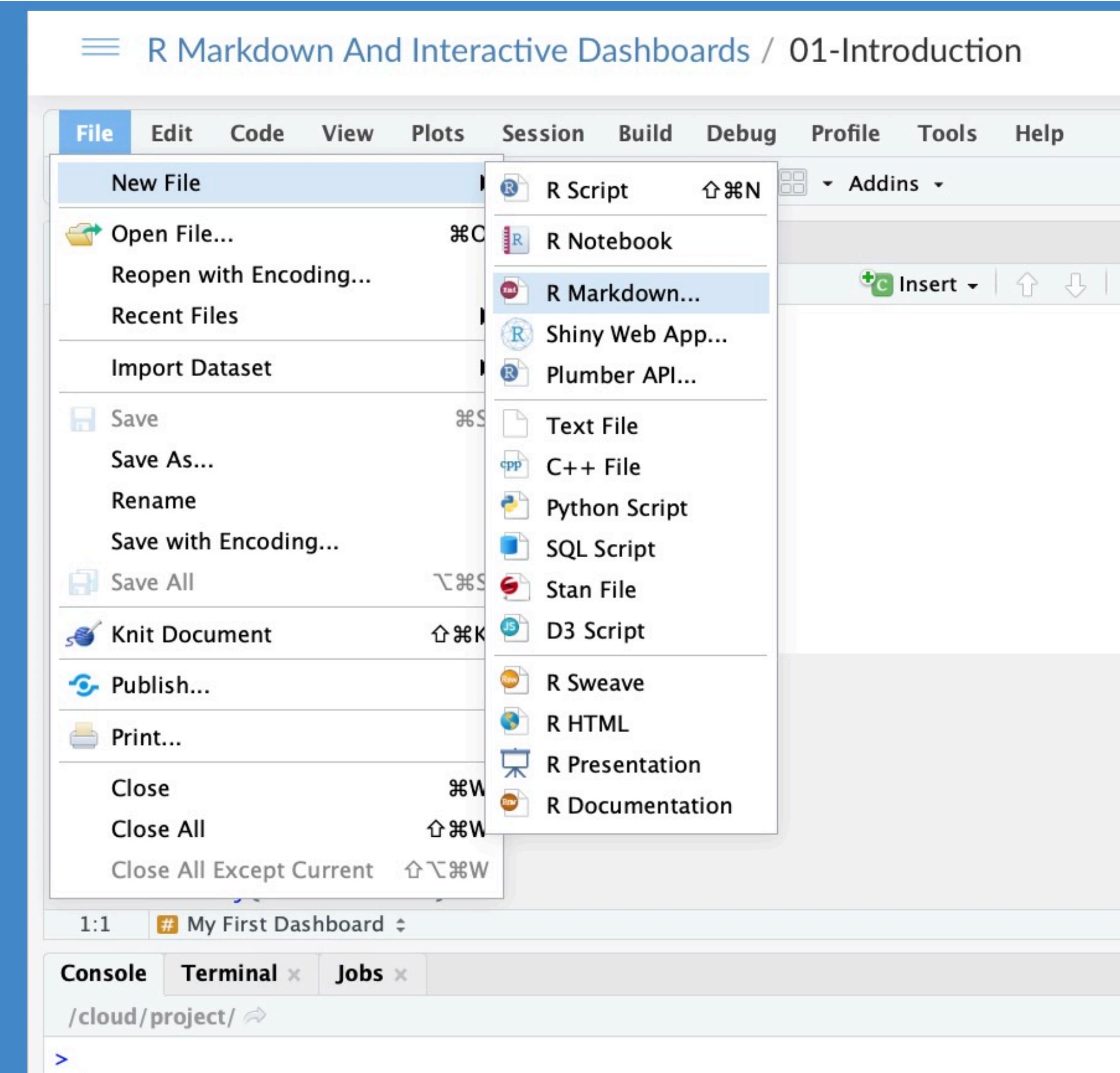
Donald Knuth's name for computational documents was *Literate Programming*, which he defined in a book of the same name. I prefer computation documents because it is more intuitively descriptive.

EXERCISE 3

Create Your Own R Markdown Document

1. Choose *New File* from the *File* Menu
2. Pick *Document*, select *HTML* as your output type, and title it *My First R Markdown Document*
3. Select *Knit* to render your document

5m 00s



THIS IS OK; CLICK TRY AGAIN

R Markdown And Interactive Dashboards / 01-Introduction

The screenshot shows the RStudio interface with a 'Popup Blocked' dialog box in the foreground. The dialog message states: "We attempted to open an external browser window, but the action was prevented by your popup blocker. You can attempt to open the window again by pressing the 'Try Again' button below." It also includes a note: "NOTE: To prevent seeing this message in the future, you should configure your browser to allow popup windows for carl-howe.rstudio.cloud." Below the message are 'Try Again' and 'Cancel' buttons. The background shows an R Markdown document titled '01-My-First-Dashboard.Rmd' and a console window at the bottom.

File Edit Code View Plots Session Build Debug Profile Tools Help

01-My-First-Dashboard.Rmd x My-First-R-Markdown-Documen... x

1 ---
2 title: "My First R Markdown Document"
3 author: "Carl Howe, RStudio"
4 date: "8/26/2019"
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 format
15 Word documents. For more details on using R Markdown see
16 When you click the **Knit** button a document will be generated
17 the output of any embedded R code chunks within the document
18 ```{r cars}
19 summary(cars)
20
21
22 ## Including Plots
23
24 You can also embed plots, for example:
25
26 ```{r pressure, echo=FALSE}
27 plot(pressure)

1:1 # My First R Markdown Document

Environment History Connection

Insert Run Addins

Popup Blocked

We attempted to open an external browser window, but the action was prevented by your popup blocker. You can attempt to open the window again by pressing the "Try Again" button below.

NOTE: To prevent seeing this message in the future, you should configure your browser to allow popup windows for carl-howe.rstudio.cloud.

Try Again Cancel

Console Terminal R Markdown Jobs

/cloud/project/ ↗

> library(knitr)
> knitr::include_graphics("https://radar.weather.gov/ridge/Conus/full.php")
> xx <- knitr::include_graphics("https://radar.weather.gov/ridge/Conus/full.php")
>

Global Environment

New Folder Upload Delete

Cloud > project

Name

..

.gitignore

01-My-First-Dashboard.Rmd

03-Links-and-images.Rmd

My-First-R-Markdown-Docu

README.md

rmarkdown-and-dashboards

My-First-R-Markdown-Docu

rstid.io/RMAID

YOU SHOULD SEE SOMETHING LIKE THIS

My First R Markdown Document

Carl Howe, RStudio

8/26/2019

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>.

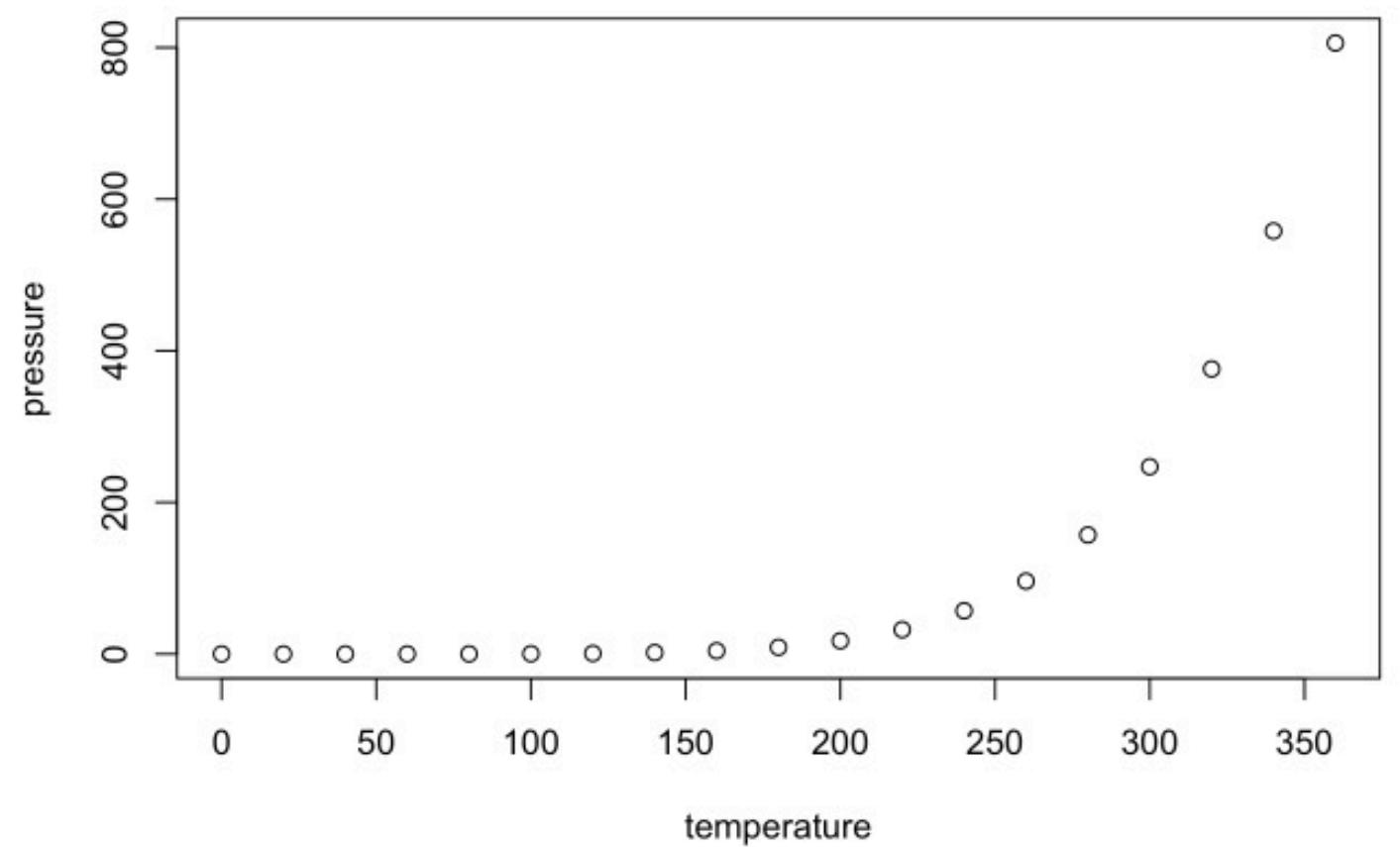
When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
summary(cars)
```

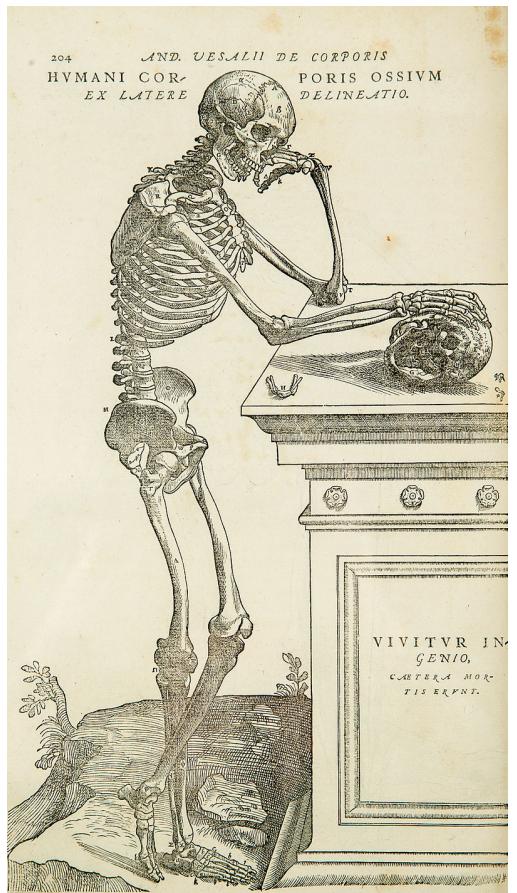
```
##      speed      dist
## Min.   : 4.0   Min.   :  2.00
## 1st Qu.:12.0   1st Qu.: 26.00
## Median :15.0   Median : 36.00
## Mean    :15.4   Mean   : 42.98
## 3rd Qu.:19.0   3rd Qu.: 56.00
## Max.    :25.0   Max.   :120.00
```

Including Plots

You can also embed plots, for example:



Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.



```
---
```

```
title: "My First R Markdown Document"
author: "Carl Howe, RStudio"
date: "8/26/2019"
output: html_document
```

```
---
```

```
```{r setup, include=FALSE}
knitr::opts_chunk$set(echo = TRUE)
```
```

```
## 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:

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

```
## Including Plots
```

You can also embed plots, for example:

```
```{r pressure, echo=FALSE}
plot(pressure)
```
```

YAML* Header Data About Your Document (Metadata)

*YAML: Yet Another Markup Language

Everything between --- and --- is read as key value pairs

Metadata for an R Markdown
document is written at the
top of the document in YAML

Things To Know About YAML

- **output** selects what type of file your R Markdown will generate
- If you indent YAML lines, they must be indented 2 spaces and those lines will become sub-parameters (we'll get to this later)
- If you omit or modify one or both --- lines, you may get strange output and very unhelpful errors

R Markdown flags structural
elements of our text for
special treatment



Text Headers

```
---
```

```
title: "My First R Markdown Document"
author: "Carl Howe, RStudio"
date: "8/26/2019"
output: html_document
```

```
---
```

```
```{r setup, include=FALSE}
knitr:::opts_chunk$set(echo = TRUE)
```
```

R Markdown

This is an R Markdown document. Markdown is a simple text-to-markup language that you can use to write Word documents. For more details on using R Markdown, see the [R Markdown documentation](#).

When you click the **Knit** button a document will be generated from the output of any embedded R code chunks within the document.

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

Including Plots

You can also embed plots, for example:

```
```{r pressure, echo=FALSE}
plot(pressure)
```
```

The # signs indicate that this is a heading line

= Level 1 heading

= Level 2 heading

= Level 3 heading

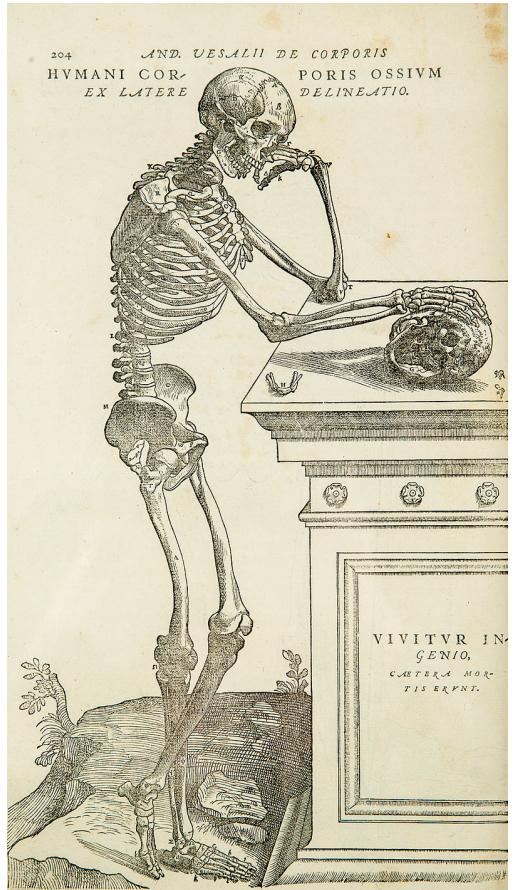
When we get to dashboards, you'll find that these headings are interpreted differently according to what kind of dashboard layout you are using:

= New dashboard page

= New column or row on this dashboard page

= New tab on this column or row

This will make more sense when we discuss layouts.



```
---
```

```
title: "My First R Markdown Document"
author: "Carl Howe, RStudio"
date: "8/26/2019"
output: html_document
```

```
--
```

```
```{r setup, include=FALSE}
knitr::opts_chunk$set(echo = TRUE)
```
```

R Markdown

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Including Plots

You can also embed plots, for example:

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```

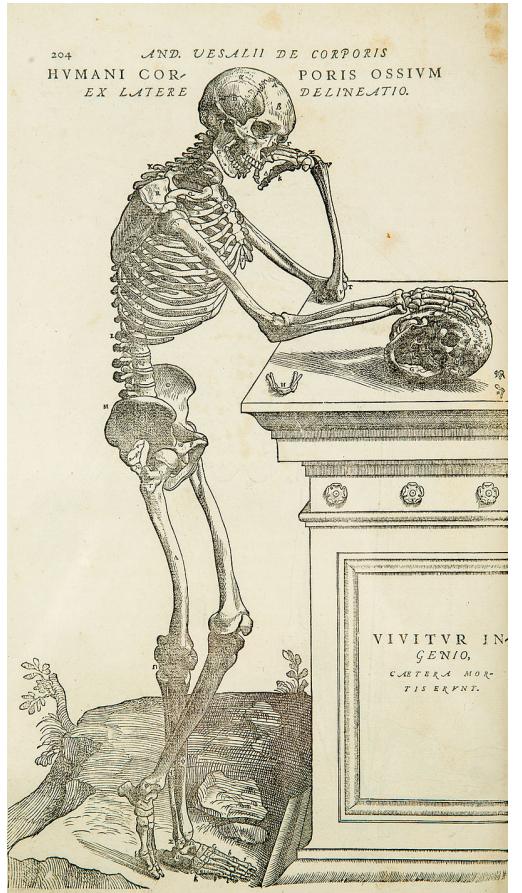
Ordinary Text

Any text you type will flow into the resulting report unchanged, although lines may be wrapped.
Use ***text*** for italics, or ****text**** for bold.

Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.

Code chunks delimited by
``` glyphs allow us to add  
computation to our  
document.





```

```

```
title: "My First R Markdown Document"
author: "Carl Howe, RStudio"
date: "8/26/2019"
output: html_document
```

```

```

```
```{r setup, include=FALSE}
knitr::opts_chunk$set(echo = TRUE)
```
```

## ## R Markdown

This is an R Markdown document. Markdown is a simple way to write documents in a format that is easy to read and easy to produce in other formats like Word documents. For more details on using R M

When you click the **Knit** button a document will be generated that includes both the text and the output of any embedded R code chunks with

## Code Chunks

R Code should start with ````{r chunk_name}```` and end with `````. Any output generated by the code will be inserted into your knit document.

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

## ## Including Plots

You can also embed plots, for example:

```
```{r pressure, echo=FALSE}
plot(pressure)
```
```

Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.

# RECAP

```

title: "My First R Markdown Document"
author: "Carl Howe, RStudio"
date: "8/26/2019"
output: html_document

```

```
```{r setup, include=FALSE}  
knitr::opts_chunk$set(echo = TRUE)  
```
```

## ## 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>>.

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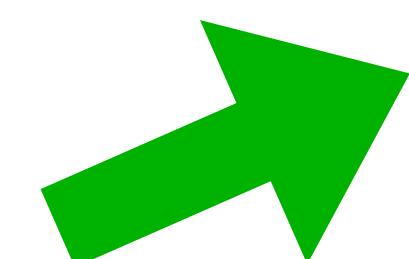
```
```{r cars}  
summary(cars)  
```
```

## ## Including Plots

You can also embed plots, for example:

```
```{r pressure, echo=FALSE}  
plot(pressure)  
```
```

Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.



## My First R Markdown Document

Carl Howe, RStudio

8/26/2019

### R Markdown

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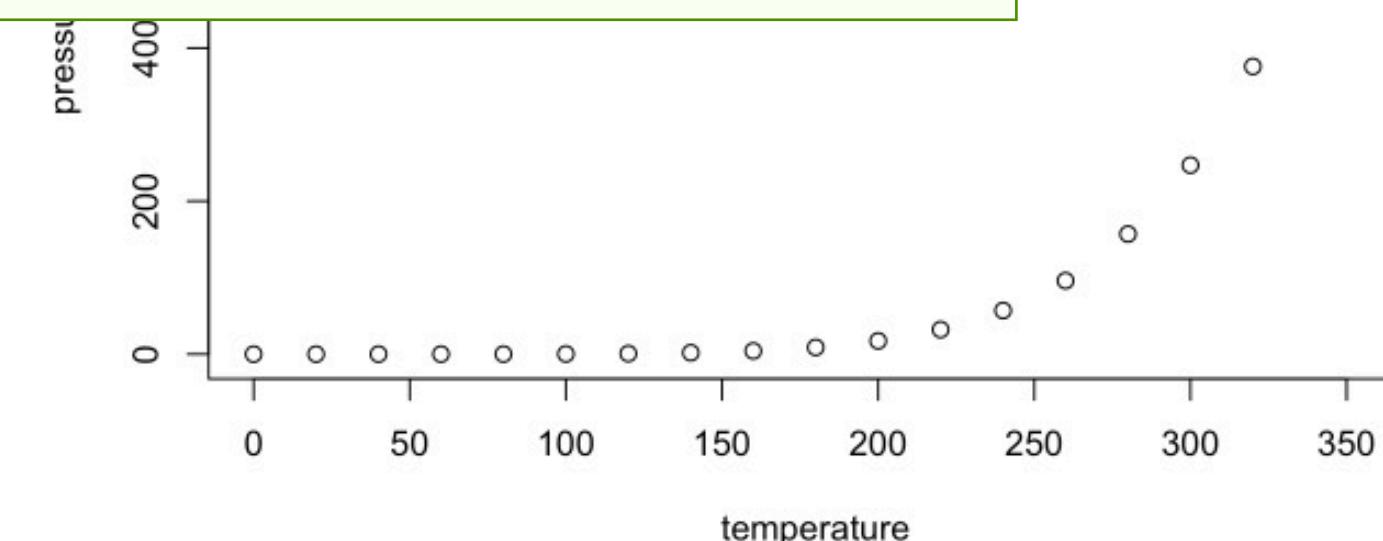
When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
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
```

## Text Gets Reformatted

- Headers get formatted
- Ordinary text flows through



Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.

# RECAP: R MARKDOWN GENERATES THIS OUTPUT

```

title: "My First R Markdown Document"
author: "Carl Howe, RStudio"
date: "8/26/2019"
output: html_document

```

```
```{r setup, include=FALSE}  
knitr::opts_chunk$set(echo = TRUE)  
```
```

## ## 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:

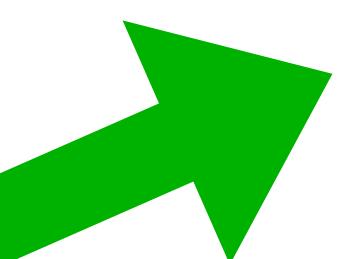
```
```{r cars}  
summary(cars)  
```
```

## ## Including Plots

You can also embed plots, for example:

```
```{r pressure, echo=FALSE}  
plot(pressure)  
```
```

Note that the `echo = FALSE` parameter was added to the code that generated the plot.



## My First R Markdown Document

Carl Howe, RStudio

8/26/2019

## 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>.

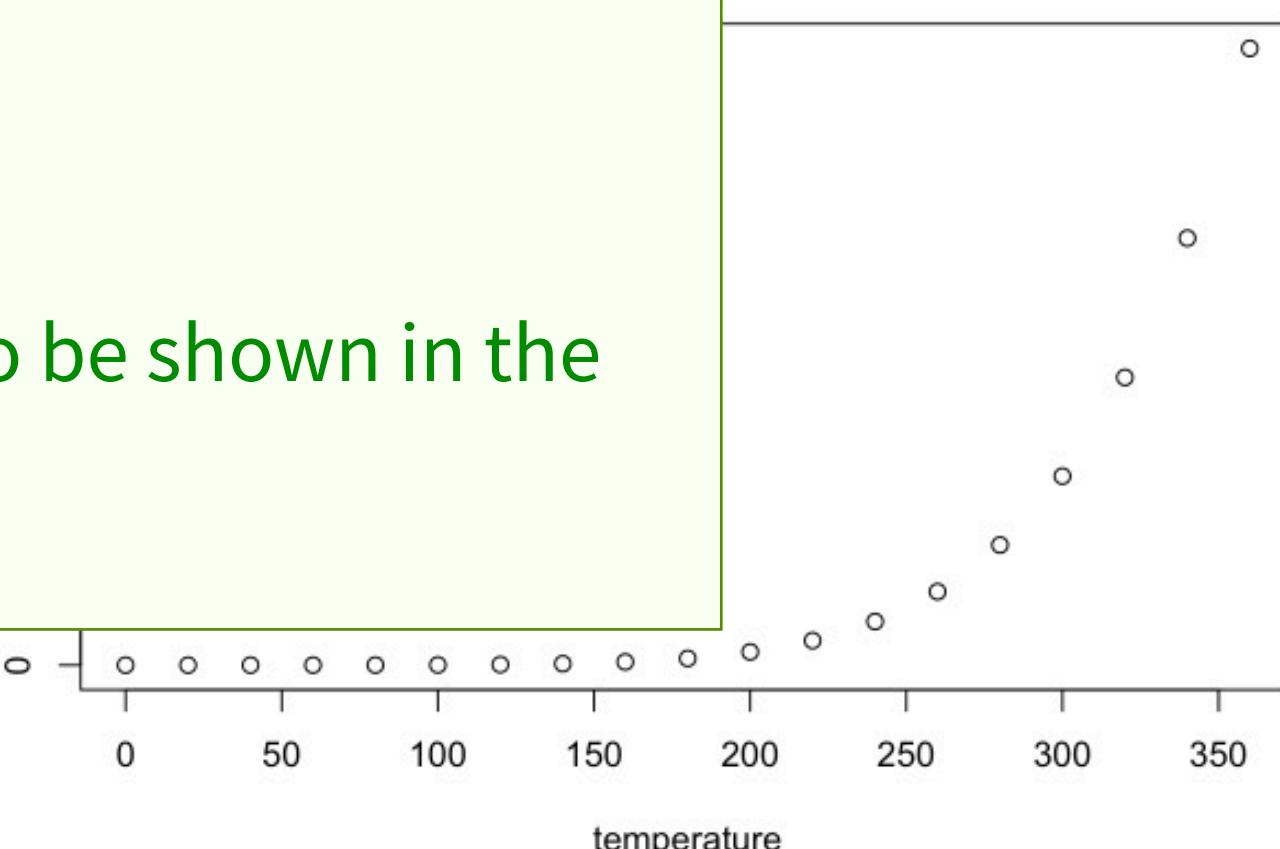
When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
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:



## Code Chunks Get Run

- Output gets put into the document.
- If the echo option is true, the code run will also be shown in the document

Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.

# RECAP: R MARKDOWN GENERATES THIS OUTPUT

```

```

```
title: "My First R Markdown Document"
author: "Carl Howe, RStudio"
date: "8/26/2019"
output: html_document
```

```

```

```
```{r setup, include=FALSE}
knitr::opts_chunk$set(echo = TRUE)
```

```

## ## 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:

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

```

## ## Including Plots

You can also embed plots, for example:

```
```{r pressure, echo=FALSE}
plot(pressure)
```

```

Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.

## Output Includes Plots and Graphs

- Static plots show up in the output document
- Code chunk isn't shown because we included a chunk option turning off the echo option

## My First R Markdown Document

Carl Howe, RStudio

8/26/2019

## R Markdown

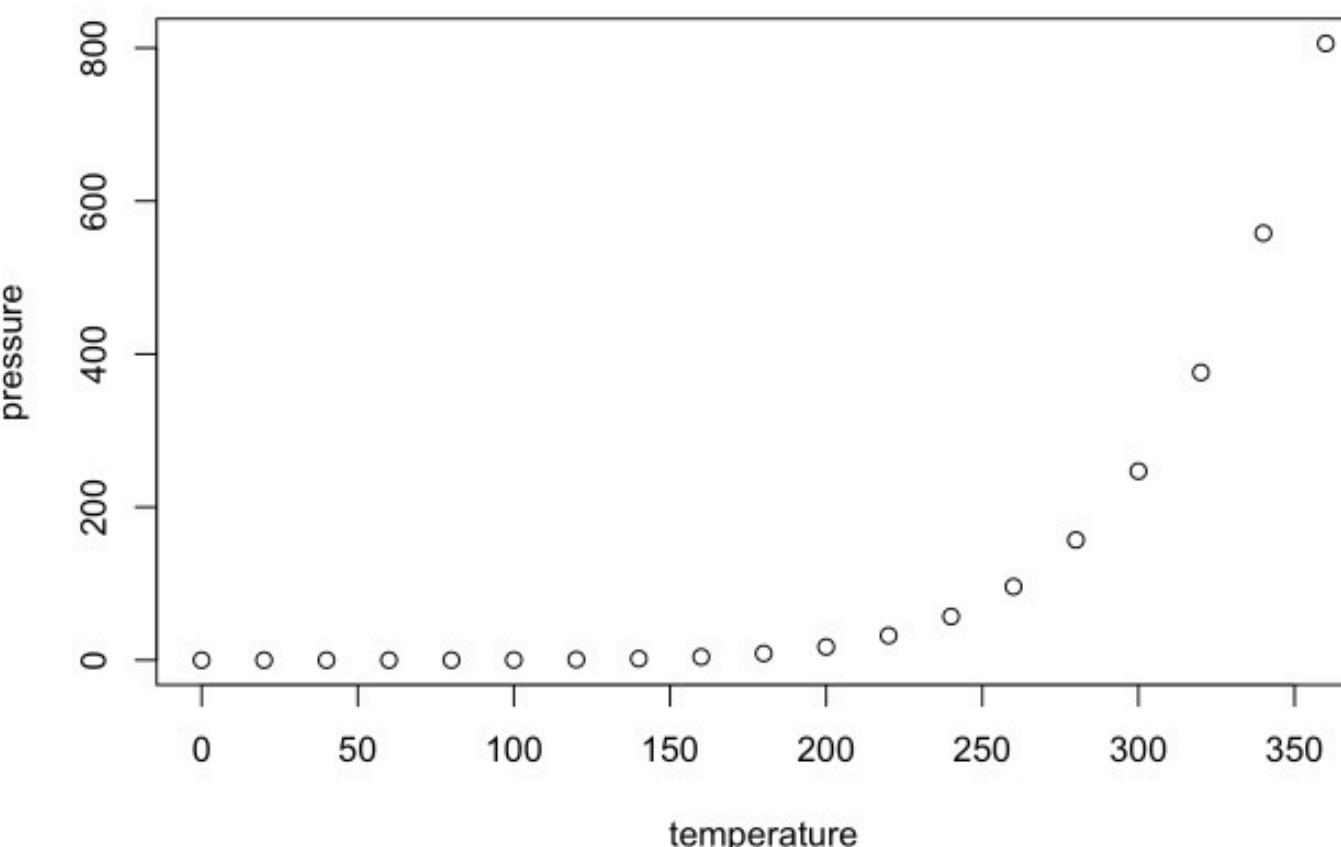
This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

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:

```
dist
Min. : 2.00
1st Qu.: 26.00
Median : 36.00
Mean : 42.98
3rd Qu.: 56.00
Max. :120.00
```

## Plots

for example:



Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.

## Modify Your R Markdown Document

1. Add the text `library(ggplot2)` to the setup code chunk
2. Add a new section with a header, text, and a code chunk at the bottom.
3. In the code section, add code to create a ggplot graphic of the pressure data set. The following is code you can copy if you don't know ggplot:

```
ggplot(pressure, aes(temperature, pressure)) + geom_point()
```

4. Test your ggplot code chunk using the green arrow.
5. When you're happy with your ggplot, knit the final document.
6. Save your file as the file name `my-first-rmarkdown.Rmd`

# Your Turn

In your group, discuss the following questions:

1. Why are chunks scattered through the R Markdown document? Why not put all the code in one chunk?
2. Did you notice anything special about the **setup** R chunk when you ran just your **ggplot** chunk?



# DISCUSSION TAKEAWAYS

- Allowing text and code in the same document allows us to create what Donald Knuth called *literate programming*, a type of holistic programmable document
- The setup chunk is special. When you run any code chunk in your document, the setup chunk is guaranteed to have been run previously. It's a great place to put global parameter settings and library statements.



# References and Resources

Time Check: 40 minutes

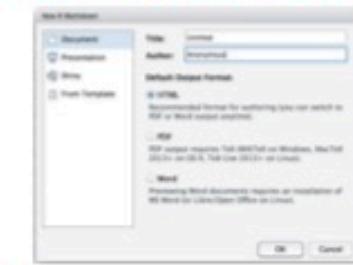
# You've Knit The Doc, Now GET THE CHEAT SHEET!

## R Markdown :: CHEAT SHEET

### What is R Markdown?

- .Rmd files** • An R Markdown (.Rmd) file is a record of your research. It contains the code that a scientist needs to reproduce your work along with the narration that a reader needs to understand your work.
- Reproducible Research** • At the click of a button, or the type of a command, you can rerun the code in an R Markdown file to reproduce your work and export the results as a finished report.
- Dynamic Documents** • You can choose to export the finished report in a variety of formats, including html, pdf, MS Word, or RTF documents; html or pdf based slides, Notebooks, and more.

### Workflow



- ① Open a new .Rmd file at File ▶ New File ▶ R Markdown. Use the wizard that opens to pre-populate the file with a template
- ② Write document by editing template
- ③ Knit document to create report; use knit button or render() to knit
- ④ Preview Output in IDE window
- ⑤ Publish (optional) to web server
- ⑥ Examine build log in R Markdown console
- ⑦ Use output file that is saved along side .Rmd

The screenshot illustrates the R Markdown workflow within RStudio. It shows the RStudio interface with an Rmd file open in the editor. The browser window displays the rendered HTML output, which includes the R code and its results. The file browser shows the generated HTML file alongside the original Rmd file.

### render

Use rmarkdown::render() to render/knit at cmd line. Important args:

|                               |                                                             |                    |                                       |                                                       |                                 |
|-------------------------------|-------------------------------------------------------------|--------------------|---------------------------------------|-------------------------------------------------------|---------------------------------|
| <b>input</b> - file to render | <b>output_options</b> - List of render options (as in YAML) | <b>output_file</b> | <b>params</b> - list of params to use | <b>envir</b> - environment to evaluate code chunks in | <b>encoding</b> - of input file |
| <b>output_format</b>          |                                                             | <b>output_dir</b>  |                                       |                                                       |                                 |

cheatsheets/rmarkdown-2.0.pdf

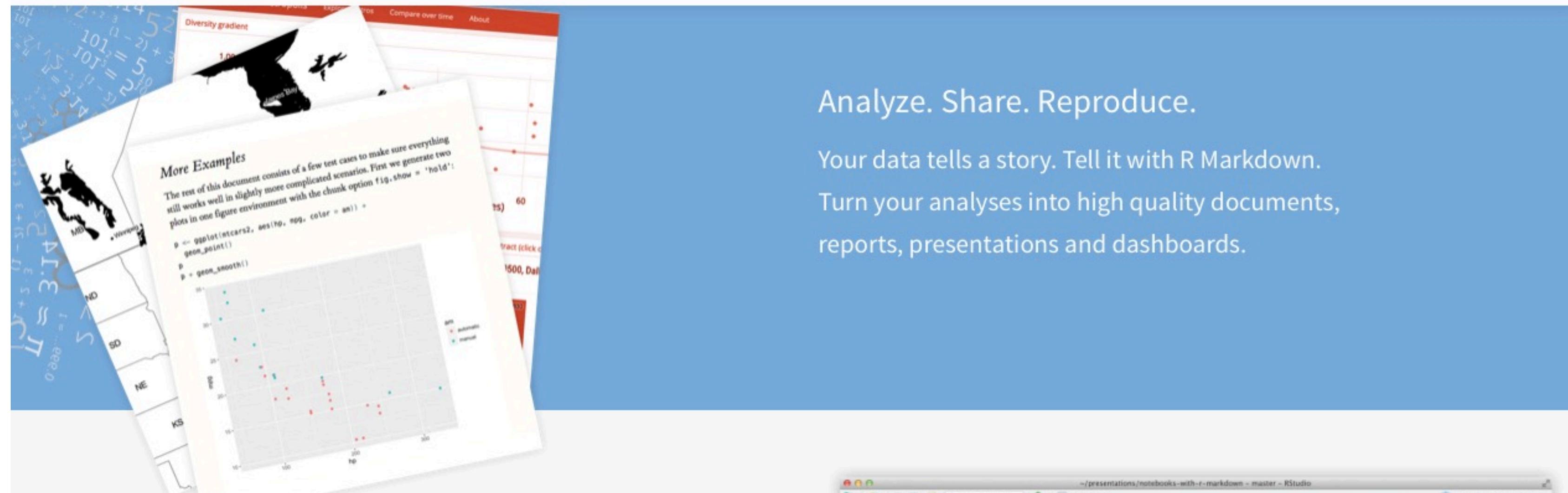
<https://github.com/rstudio/cheatsheets/raw/master/rmarkdown-2.0.pdf>

rstd.io/RMAID

# R Markdown

from R Studio

Get Started    Gallery    Formats    Articles    Book    References



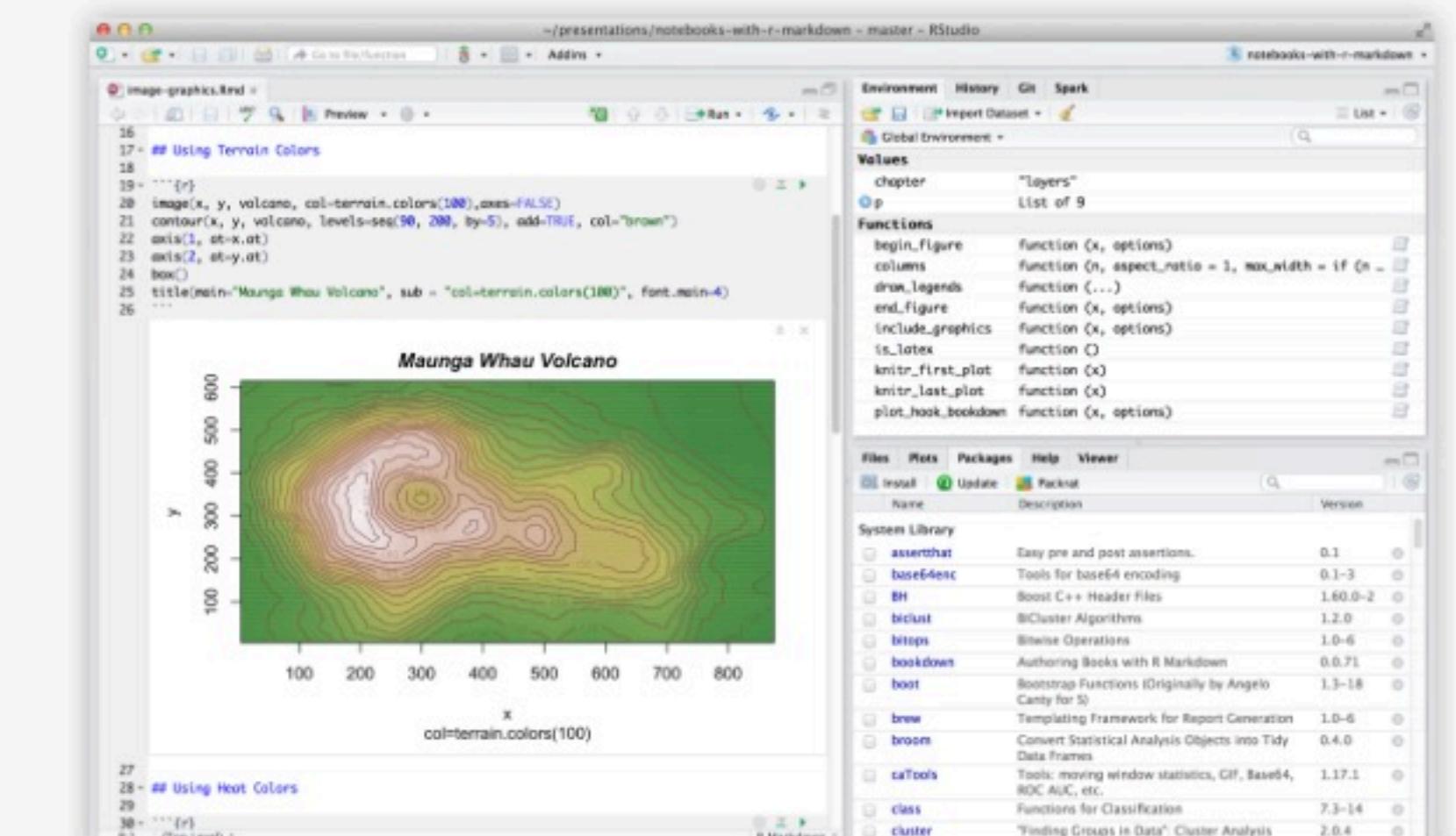
R Markdown documents are fully reproducible.

Use a productive [notebook interface](#) to weave together narrative text and code to produce elegantly formatted output. Use [multiple languages](#) including R, Python, and SQL.

Analyze. Share. Reproduce.

Your data tells a story. Tell it with R Markdown.

Turn your analyses into high quality documents, reports, presentations and dashboards.



<https://rmarkdown.rstudio.com>

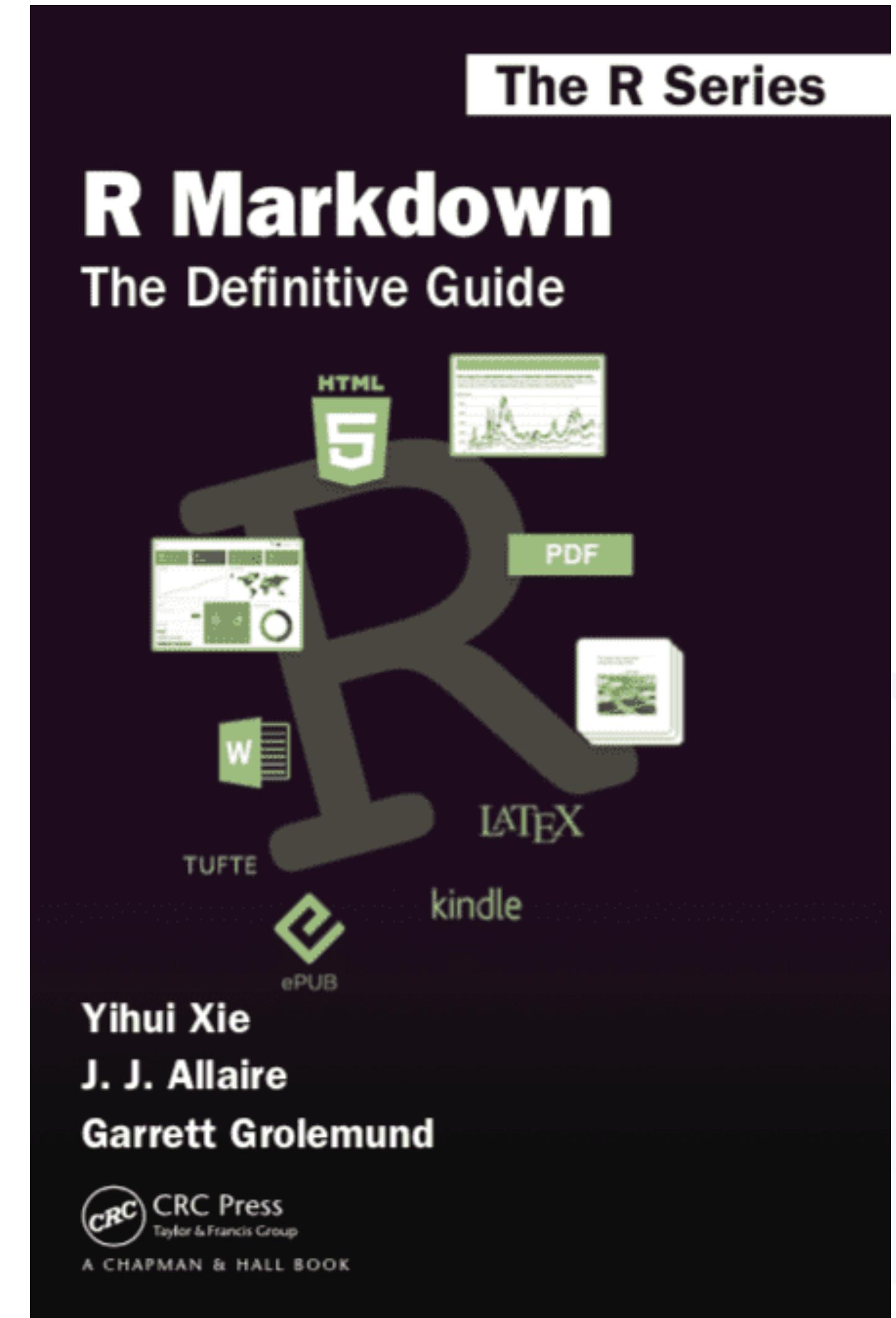
[rstd.io/RMAID](http://rstd.io/RMAID)

# R MARKDOWN: THE DEFINITIVE GUIDE

Free!

<https://bookdown.org/yihui/rmarkdown/>

Also available from CRC Press, Amazon, Apple Books



[rstd.io/RMAID](http://rstd.io/RMAID)



# MORE FORMATTING TYPES

# TEXT AND HEADERS

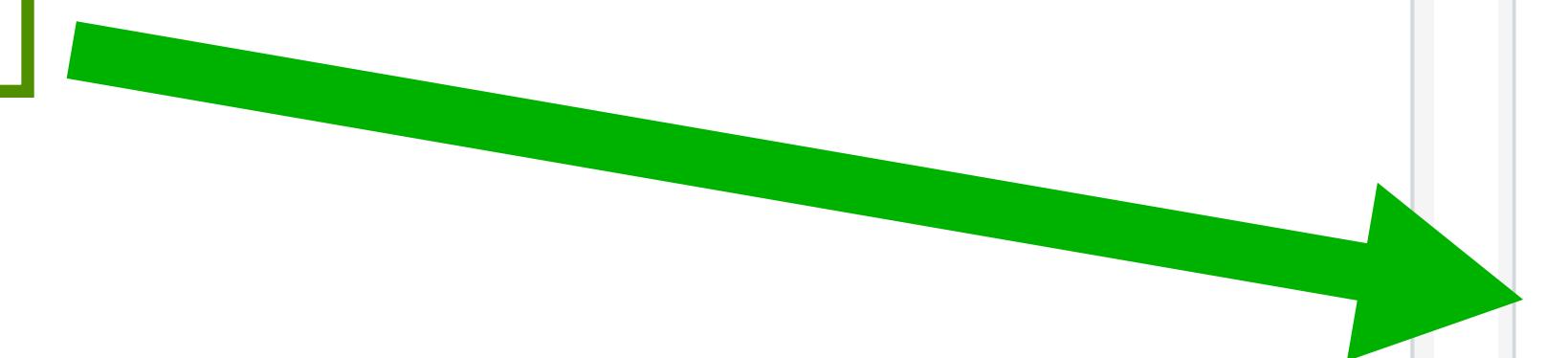
- Text can be plain text or decorated as **\*italic\*** or **\*\*bold\*\***
- Headers use #s

# Header 1

## Header 2

### Header 3

# NUMBERED SECTIONS



The image shows the RStudio interface with two panels. The left panel displays the R Markdown code for a document named "my-first-rmd.Rmd". The code includes YAML metadata and various sectioning commands. A green box highlights the line `number_sections: true`. The right panel shows the generated HTML output. The output title is **My First R Markdown doc**, followed by author information (*Mine Cetinkaya-Rundel*) and the date (1/23/2018). Below this, the document structure is shown with numbered sections: **1 Section 1**, **1.1 Section 1.1**, **1.2 Section 1.2**, **1.2.1 Section 1.2.1**, and **1.2.2 Section 1.2.2**.

```
my-first-rmd.Rmd x ABC Knit Insert Run Viewer Publish
```

```
1 ---
2 title: "My First R Markdown doc"
3 author: "Mine Cetinkaya-Rundel"
4 date: "1/23/2018"
5 output:
6 html_document:
7 number_sections: true
8 ---
9
10 # Section 1|
11
12 ## Section 1.1
13
14 ## Section 1.2
15
16 ### Section 1.2.1
17
18 ### Section 1.2.2
```

10:12 # Section 1 ▾ R Markdown

# My First R Markdown doc

*Mine Cetinkaya-Rundel*

1/23/2018

## 1 Section 1

### 1.1 Section 1.1

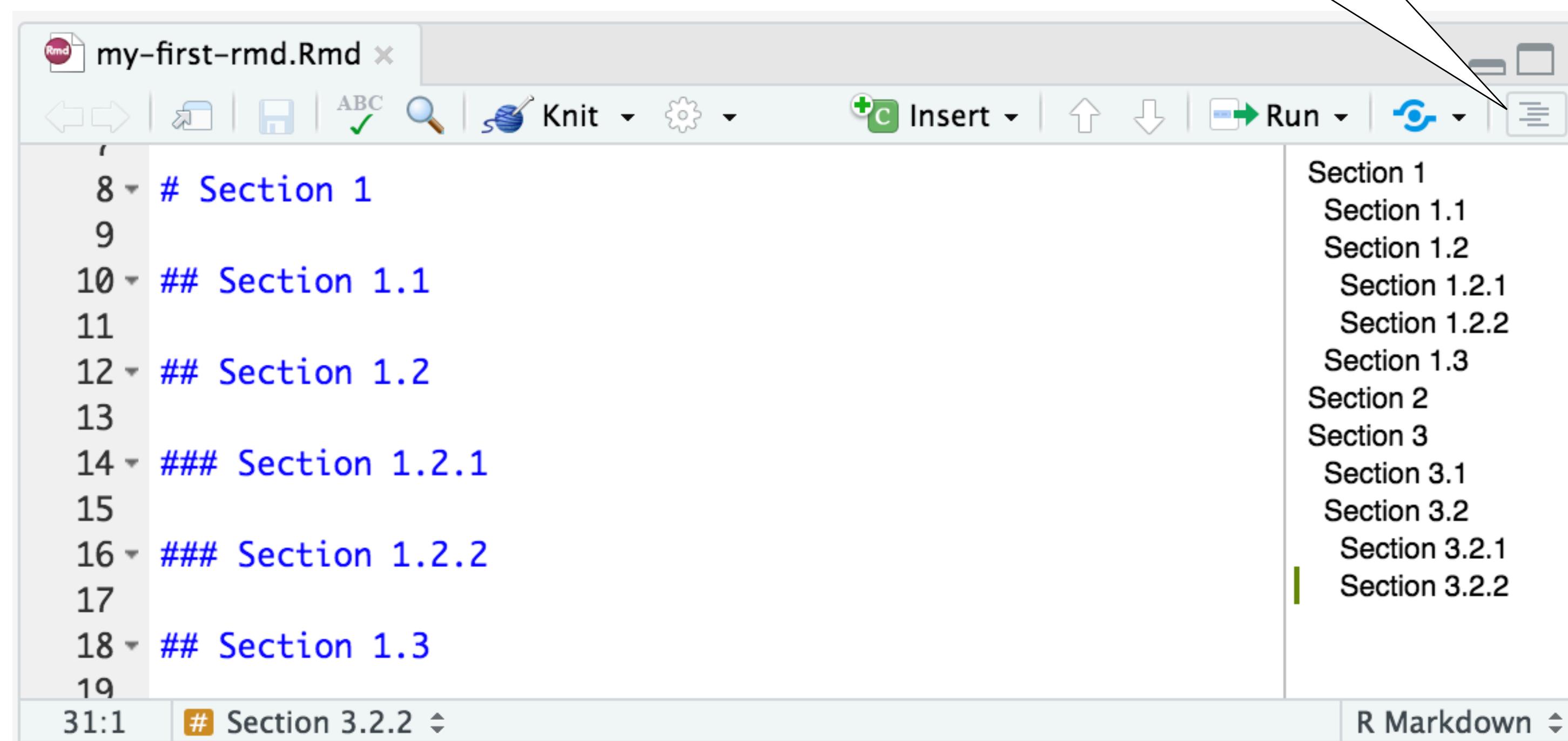
### 1.2 Section 1.2

#### 1.2.1 Section 1.2.1

#### 1.2.2 Section 1.2.2

# Tips

Show / hide  
document  
outline

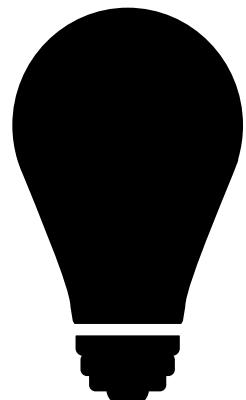


The screenshot shows the RStudio interface with a document titled "my-first-rmd.Rmd". The code editor pane contains the following R Markdown code:

```
8 # Section 1
9
10 ## Section 1.1
11
12 ## Section 1.2
13
14 ### Section 1.2.1
15
16 ### Section 1.2.2
17
18 ## Section 1.3
19
```

The right pane displays the document outline, which includes:

- Section 1
  - Section 1.1
  - Section 1.2
    - Section 1.2.1
    - Section 1.2.2
  - Section 1.3
- Section 2
- Section 3
  - Section 3.1
  - Section 3.2
    - Section 3.2.1
    - Section 3.2.2



# LISTS

- Lists can be ordered
  1. Item 1
  2. Item 2
    - + Item 2a
    - + Item 2b
- And lists can be unordered
  - \* Item 1
  - \* Item 2
    - + Item 2a
    - + Item 2b

*Hint: you don't have to keep track of the numbers in an ordered list. You can just put 1. at the front of each item, and R Markdown will supply the proper item numbers.*



# LINKS

- Links can be plain http address or they can add a link to a phrase:
  - <http://rmarkdown.rstudio.com/>
  - [R Markdown website] (<http://rmarkdown.rstudio.com/>)

# IMAGES

- Including an image is very similar to hyperlinking

- Images can be on the web:

```
![RStudio logo](https://www.rstudio.com/wp-content/uploads/2014/04/rmarkdown.png)
```

- Or they can be locally stored:

```
![RStudio logo](img/rmarkdown.png)
```

# TIPS

- To improve the accessibility of your document, always add alt text to your images.
- To print the alt text underneath the image as a caption, use `fig_caption: true` in the YAML, and make sure there is a line break before the figure call.



```
Rmd my-first-rmd.Rmd x
← → | ↕ | ↓ | ABC ✓ | Knit | Insert | Run | ⌂ | ⌂ | ⌂ |
1 ---
2 title: "My First R Markdown doc"
3 author: "Mine Cetinkaya-Rundel"
4 date: "1/23/2018"
5 output:
6 html_document:
7 number_sections: true
8 fig_caption: true
9 ---
10
```

# REFERENCE STYLE LINKS AND IMAGES

- Links
  - A [linked phrase][id]
  - At the bottom of the document: [id]: <http://example.com/> "Title"
- Images
  - ! [alt text][id]
  - At the bottom of the document: [id]: "Title"
- Useful if you'll be linking to the same target/image multiple times throughout the document

# MATH TEXT

- If you already know some LaTeX, you're good to go
- Equations can be inline:

```
$\bar{x} \sim N(\mu, \frac{\sigma}{\sqrt{n}})$
```

- Equations can be inline:  $\bar{x} \sim N\left(\mu, \frac{\sigma}{\sqrt{n}}\right)$
- And equations can be centered in a new line:

```
$$ \bar{x} \sim N(\mu, \frac{\sigma}{\sqrt{n}}) $$
```

- And equations can be centered in a new line:

$$\bar{x} \sim N\left(\mu, \frac{\sigma}{\sqrt{n}}\right)$$

# MATH TEXT (CONTINUED)

- If your LaTeX is rusty or non-existent, you can try out equations in the RStudio IDE using an equations code chunk, and RStudio will show you how it will render.
- The equation code chunk starts and ends with \$\$

```
38 $$
39 \bar{x} \sim N(\mu, \frac{\sigma}{\sqrt{n}})
40 $$
```

$$\bar{x} \sim N\left(\mu, \frac{\sigma}{\sqrt{n}}\right)$$

## EXERCISE 5

Add An Equation to Your R Markdown Document

1. Still using `my-first-rmarkdown.Rmd`, add the following text after your last chunk:

```
$$
E = mc^{\{2\}}
$$
```

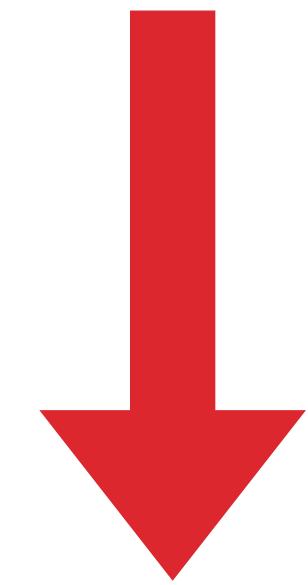
3m 00s

You should see Einstein's equation appear below the code chunk. Don't forget the curly braces around the 2. If you have time, try some other simple equations.

# TABLES

- Two components let you define tables:
  - A header row that starts and ends with a vertical bar
  - A separator row starting and ending with a vertical bar containing hyphens and optionally colons
- Hyphens separate the header row from content cells, and vertical bars separate the columns

| Column A | Column B | Column C |
|----------|----------|----------|
| Value 1A | Value 1B | Value 1C |
| Value 2A | Value 2B | Value 2C |



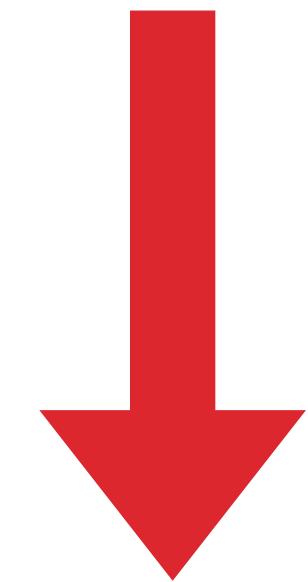
| Column A | Column B | Column C |
|----------|----------|----------|
| Value 1A | Value 1B | Value 1C |
| Value 2A | Value 2B | Value 2C |

# TABLE ALIGNMENT

| Left-Aligned | Right Aligned | Centered |
|--------------|---------------|----------|
| Value 1A     | Value 1B      | Value 1C |
| Left         | Right         | Centered |

Colons in the row that separates the header from the values let you left-align, right-align, and center your columns

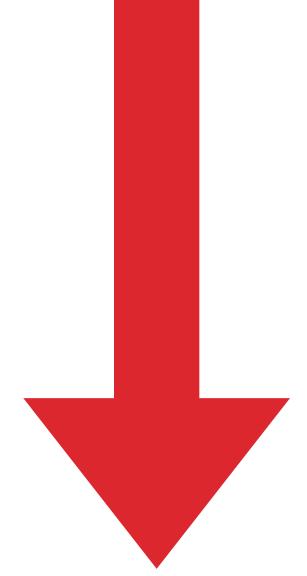
| Left-Aligned | Right Aligned | Centered |
|--------------|---------------|----------|
| Value 1A     | Value 1B      | Value 1C |
| Left         | Right         | Centered |



# TABLE INPUT FORMATTING DOESN'T MATTER

| Left-Aligned | Right Aligned | Centered |
|--------------|---------------|----------|
| :- :- :-     |               |          |
| Value 1A     | Value 1B      | Value 1C |
| Left         | Right         | Centered |

Note that you don't have to format your input so that things line up -- the vertical bars and hyphens are all you need



| Left-Aligned | Right Aligned | Centered |
|--------------|---------------|----------|
| Value 1A     | Value 1B      | Value 1C |
| Left         | Right         | Centered |

# TABLE FONT DIRECTIVES (HTML ONLY)

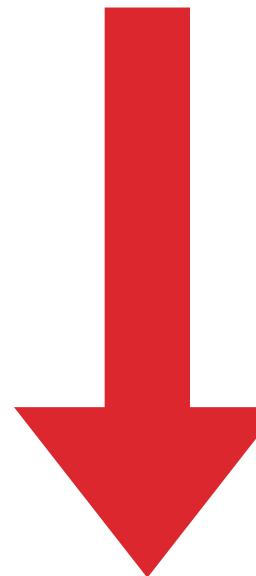
You can modify some font attributes using html directives of the form:

```
<font color="red"
size="10pt"
face="times">text

```

Only do this for small local changes. for document wide changes, you would want to use a custom CSS file.

|                                                                                                             |               |          |
|-------------------------------------------------------------------------------------------------------------|---------------|----------|
| Left-Aligned                                                                                                | Right Aligned | Centered |
| :- :- :-                                                                                                    |               |          |
| Left Right Centered                                                                                         |               |          |
| <font color="red">Red</font> <font size="10pt">Big</font> <font face="times" color="blue">Times Blue</font> |               |          |



| Left-Aligned | Right Aligned | Centered   |
|--------------|---------------|------------|
| Left         | Right         | Centered   |
| Red          | Big           | Times Blue |

# MARKDOWN QUICK REFERENCE

In RStudio: Help ➔ Markdown Quick Reference

## Markdown Quick Reference

R Markdown is an easy-to-write plain text format for creating dynamic documents and reports.  
See [Using R Markdown](#) to learn more.

### Emphasis

```
italic **bold**
italic __bold__
```

### Headers

```
Header 1
Header 2
Header 3
```

### Lists

#### Unordered List

```
* Item 1
* Item 2
 + Item 2a
 + Item 2b
```

## EXERCISE 6

## Add A Table to Your R Markdown Document

1. Still using `my-first-markdown.Rmd`, add a table to the bottom of your document that recreates the table to the right.

Don't forget **Help ➔ Markdown Quick Reference**

| Roses | Violets | Markdown | R Markdown |
|-------|---------|----------|------------|
| are   | are     | is       | is         |
| Red   | Blue    | sweet    | too        |

5m 00s

# TIPS

- Keep your text to max ~80 characters across, especially if you use a version control system (like git)
- Starting a list? Leave an empty line before the first item on your list
- Need to test out bits of markdown code without knitting the entire document? Start another document with bits and pieces of code to test them out

# EXERCISE 7

Turn Plain Text Into A Report

1. Open 07-Open-Share-Repro.Rmd
2. Add R Markdown notation to make it render as shown at right
3. You can view a file showing you are trying to produce as 07-Open-Share-Repro-solution.html

Don't forget **Help ➔ Markdown Quick Reference**

10m 00s

## Analyze. Share. Reproduce. and do it all with R Markdown

Your data tells a ~~joke~~ story. Tell it with R Markdown. Turn your analyses into **high quality** documents, reports, presentations and dashboards – and don't forget to drink some H<sub>2</sub>O while you do that.<sup>1</sup>

R Markdown documents are fully reproducible. Use a productive [notebook interface](#)<sup>2</sup> to weave together narrative text and code to produce *elegantly formatted* output. Use multiple languages including

- R
- Python

and

- SQL

Do you need still need convincing to use R Markdown? See what a friend once said:

I used to use Sweave, and get terrible headaches. Now I use R Markdown, and life is much more pleasant.

- 
1. Or coffee, whatever floats your boat. ↵
  2. This link should point to [http://rmarkdown.rstudio.com/r\\_notebooks.html](http://rmarkdown.rstudio.com/r_notebooks.html). ↵

# WHAT HAVE WE FORGOTTEN? CODE CHUNKS

- Up until this point, we've focused our efforts on R Markdown text.
- But the essence of a computational document is code.
- We put our code in *code chunks*
- Code chunks look like this:

```
```{r chunk_name parameter1=value, param2=value}
print("My R code goes here")
```
```

R Markdown code chunks  
support many languages.



# CODE CHUNKS SUPPORT MANY LANGUAGES

- R and Python are the most common in R Markdown documents
- However, R Markdown also supports
  - SQL
  - Bash
  - Rcpp
  - Stan
  - JavaScript
  - CSS



## EXERCISE 8

Observe R Markdown's Multi-Language Support

1. Open **08-code-chunks.Rmd** by clicking on it in the File menu
2. Read and either run or knit the code
3. Where does the value `py$python_string` come from?

3<sub>m</sub> 00<sub>s</sub>

# SUMMARY

- R Markdown is a language for creating computational documents.
- Metadata for an R Markdown document is written at the top of the document in \_\_\_\_\_
- R Markdown documents can include a variety of formatting elements
  - Headers
  - Plain text
  - Code chunks in several languages
  - Links
  - Tables
  - Images
  - More





# Break

[rstd.io/RMAID](https://rstd.io/RMAID)