

# Reproducible science workshop: Module6

Markdown

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2021/10/1 (updated: 2021-10-20)

# Credits

- Garrett Grolemund [RStudio webinar](#)



- Ulrik Lyngs [workshop material](#)



# R MARKDOWN

we're getting the BAND BACK TOGETHER.

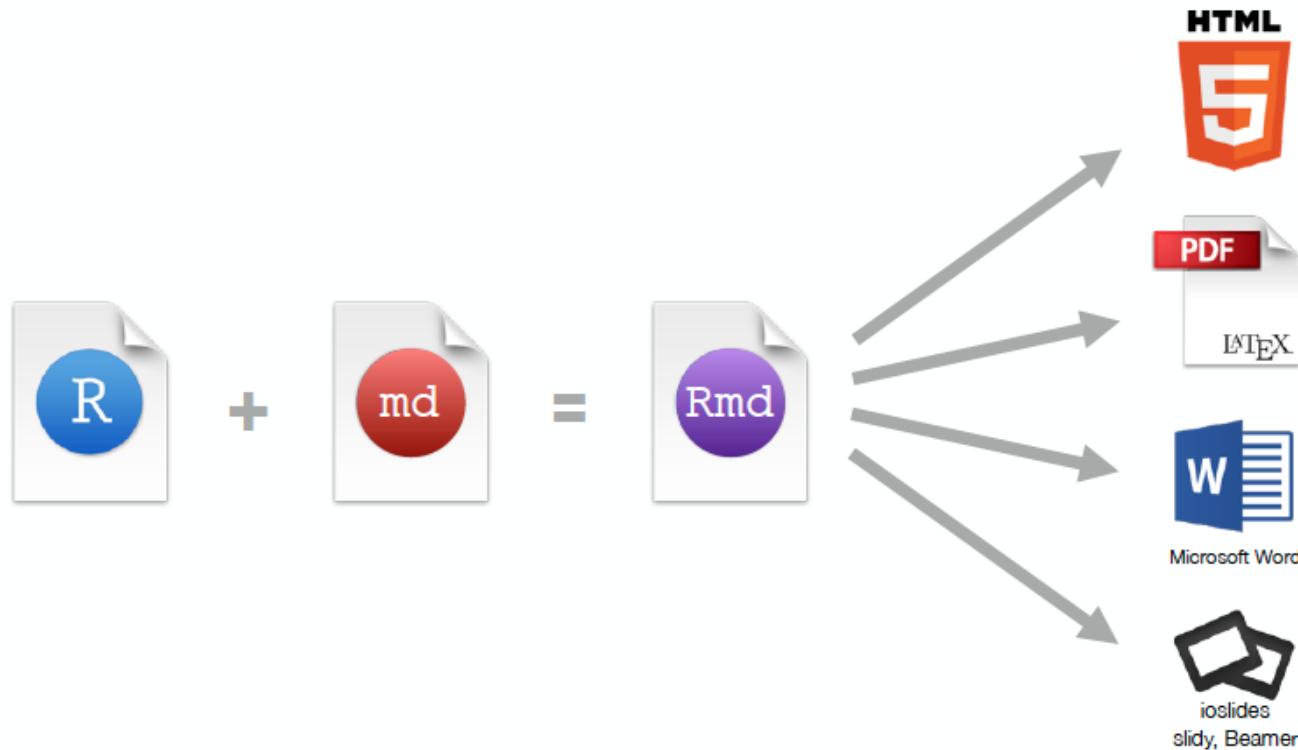


HORST '19

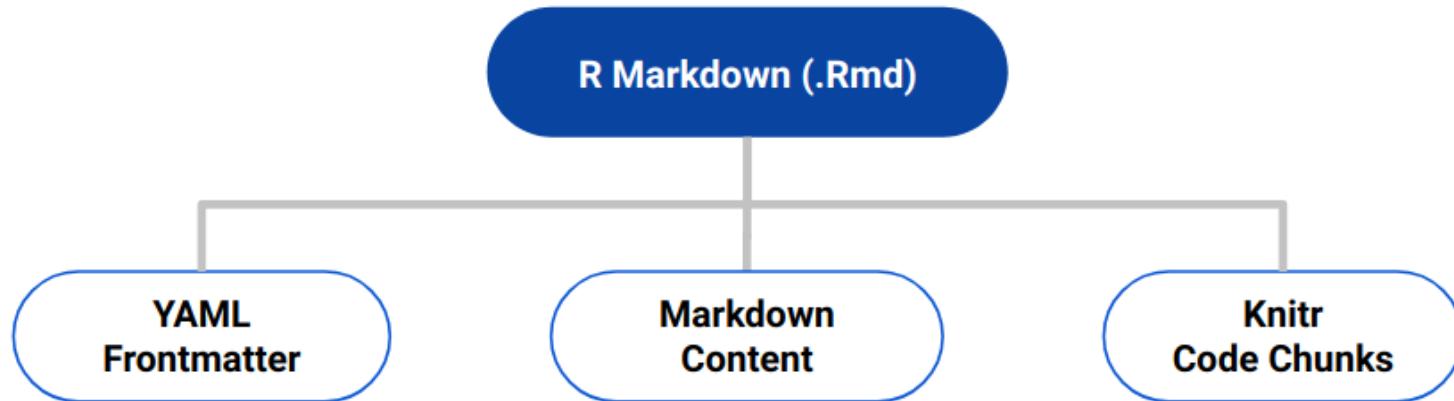
# Literate programming

- A programming paradigm introduced by Donald E. Knuth
- Treat program as literature meant to be understandable to human beings
- Makes it easy to comment code, and share your analyses/thoughts with collaborators
- Move away from writing programs in the manner and order imposed by the computer
- Focus instead on the logic and flow of human thought and understanding
- Single document to integrate data analysis (executable code) with textual documentation, linking data, code, and text

# R Markdown workflow



# Structure of a R Markdown document



<https://yongfu.name/2019-fju-rmd-talk/slides/#1>

# Demo

Open RStudio

Create a new Rmd file

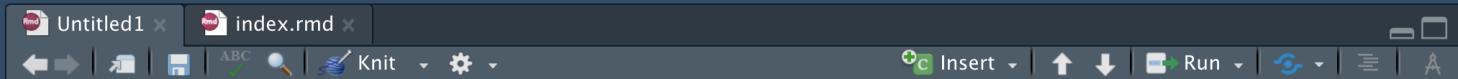
Identify 3 components (frontmatter, content, chunks)

Untitled1 x index.rmd x

ABC Knit

Insert Run

```
1 ---  
2 title: "Untitled"  
3 author: "Olivier Gimenez"  
4 date: "10/24/2020"  
5 output: html_document  
6 ---  
7  
8 ```{r setup, include=FALSE}  
9 knitr::opts_chunk$set(echo = TRUE)  
10```  
11  
12 ## R Markdown  
13  
14 This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see  
http://rmarkdown.rstudio.com.  
15  
16 When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:  
17  
18 ```{r cars}  
19 summary(cars)  
20```  
21  
22 ## Including Plots  
23  
24 You can also embed plots, for example:  
25  
26 ```{r pressure, echo=FALSE}  
27 plot(pressure)  
28```  
29  
30 Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot
```



```
1 ---  
2 title: "Untitled"  
3 author: "Olivier Gimenez"  
4 date: "10/24/2020"  
5 output: html_document  
6 ---  
7  
8 ```{r setup, include=FALSE}  
9 knitr::opts_chunk$set(echo = TRUE)  
10```  
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12 ## R Markdown  
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14 This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.  
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```

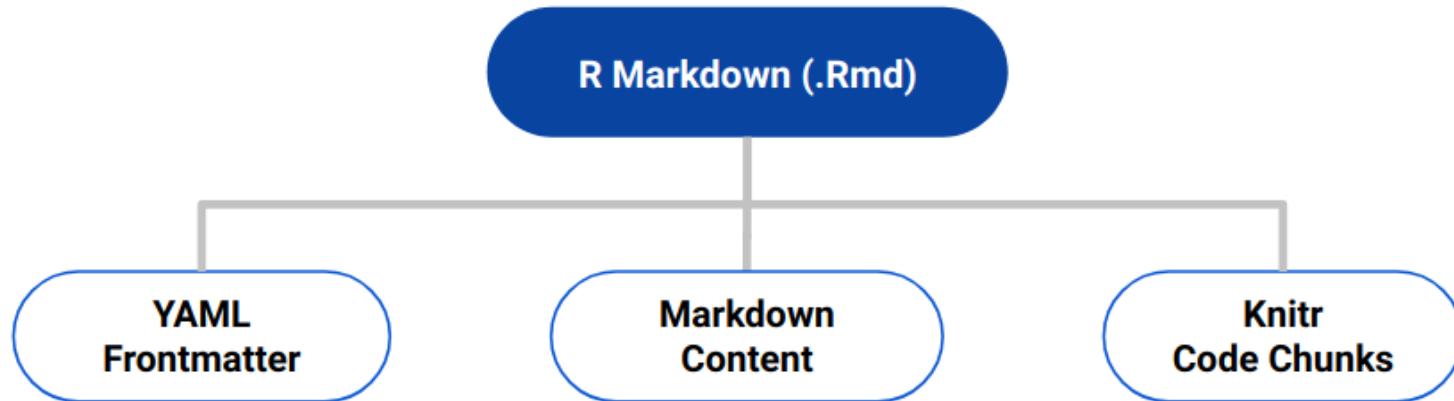
Front matter

Chunk

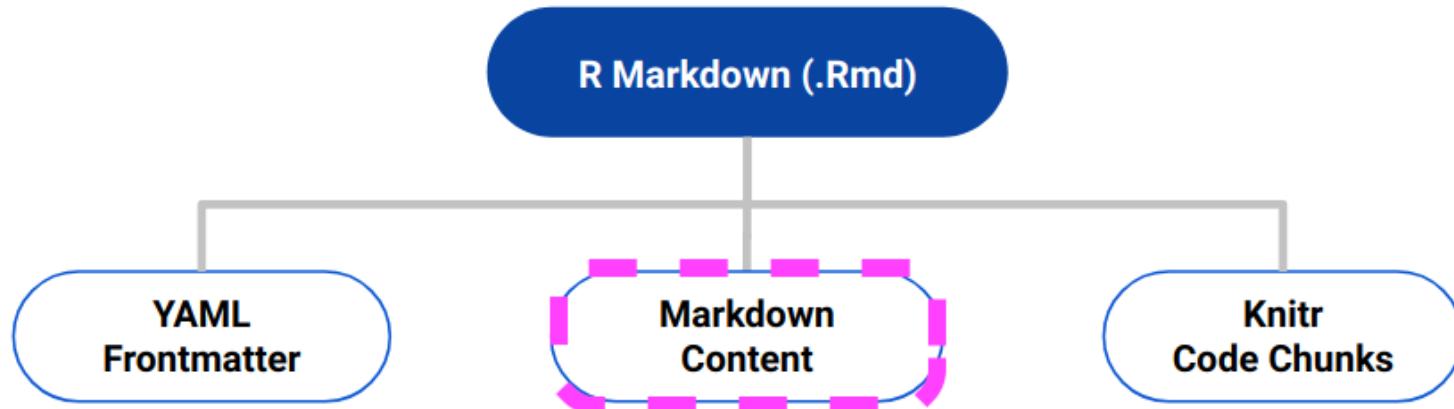
Content

Chunk

# Structure of a R Markdown document



# Structure of a R Markdown document



# Format your text with Markdown

# What is Markdown?

- A way to write stuff
- Mostly plain words, with some formating

```
# Say Hello  
To my little  
friend, markdown.
```

Markdown is

- \* easy to use
- \* simple
- \* fun?



## Say Hello

To my little friend, markdown.  
Markdown is

- *easy* to use
- **simple**
- fun?

# Websites that use Markdown

- GitHub <https://github.com/>
- StackOverflow <https://stackoverflow.com/>
- HackMD <https://hackmd.io>
- Many more

# Headers

- Use # to create headers
- Multiple #'s create lower level headers

```
# Header 1  
## Header 2  
### Header 3  
#### Header 4  
##### Header 5  
##### Header 6
```



**Header 1**  
**Header 2**  
**Header 3**  
**Header 4**  
**Header 5**  
**Header 6**

# Text

- Text is rendered as plain text

Add two spaces at  
the end of a line to  
start a new line

```
Text
_italics_
__bold__
`code`
```



Text  
*italics*  
**bold**  
`code`

# Lists

- Use asterisks to make bullet points
- Use numbers to make numbered lists
- Use 4 spaces or 1 tab for indentation

Bullets

- \* bullet 1
- \* bullet 2

Numbered list

1. item 1
2. item 2



Bullets

- bullet 1
- bullet 2

Numbered list

1. item 1
2. item 2

# Hyperlinks

- To add a hyperlink, put your text between brackets
- Then place the URL between parentheses

This is a  
[link]([www.git.com](http://www.git.com)).

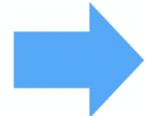


**This is a link.**

# Equations

- Write equations with Latex syntax

According to  
Einstein,  
 $E=mc^2$



According to  
Einstein,  $E = mc^2$

# Equation blocks

According to Einstein,

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



According to Einstein,

$$E = mc^2$$

# Images

- Use a link preceded by an ! to insert an image
- The link text should be
  - a URL if the image is hosted online
  - a file path if the image is saved on your computer

# Tables

| header A | header B |
|----------|----------|
| data     | data     |

Table:title

- A bit of a hassle...
- Use a [generator of Tables for Markdown](#)
- Wait for next section to learn how to generate tables from R

# R Markdown Reference Guide

<https://rstudio.com/wp-content/uploads/2015/03/rmarkdown-reference.pdf>



## R Markdown Reference Guide

Learn more about R Markdown at [rmarkdown.rstudio.com](http://rmarkdown.rstudio.com)

Learn more about Interactive Docs at [shiny.rstudio.com/articles](http://shiny.rstudio.com/articles)

### Contents:

1. **Markdown Syntax**
2. Knitr chunk options
3. Pandoc options

### Syntax

Plain text

End a line with two spaces  
to start a new paragraph.

\*italics\* and \_italics\_

\*\*bold\*\* and \_\_bold\_\_

superscript<sup>^2^</sup>

~~strikethrough~~

[link] ([www.rstudio.com](http://www.rstudio.com))

# Header 1

## Header 2

### Becomes

Plain text

End a line with two spaces to start a new paragraph.

*italics* and *italics*

**bold** and **bold**

superscript<sup>2</sup>

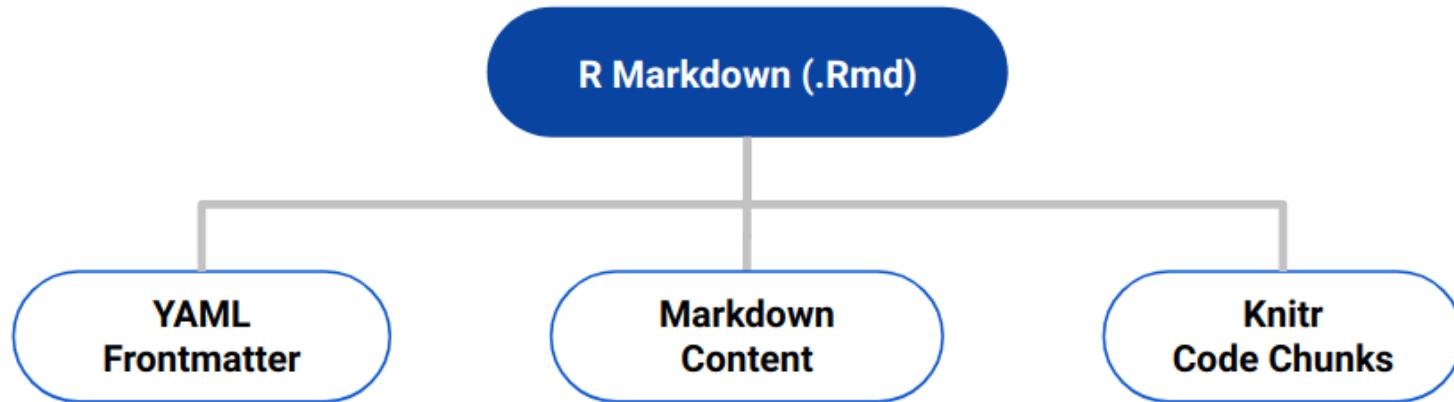
strikethrough

link

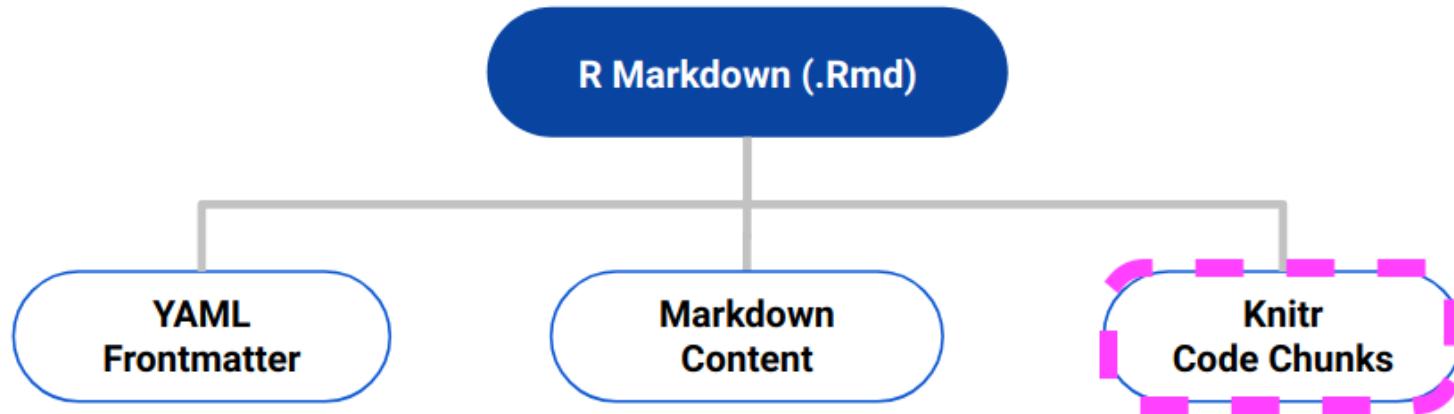
## Header 1

## Header 2

# Structure of a R Markdown document



# Structure of a R Markdown document



# *Code, figures and tables*

# Embed code

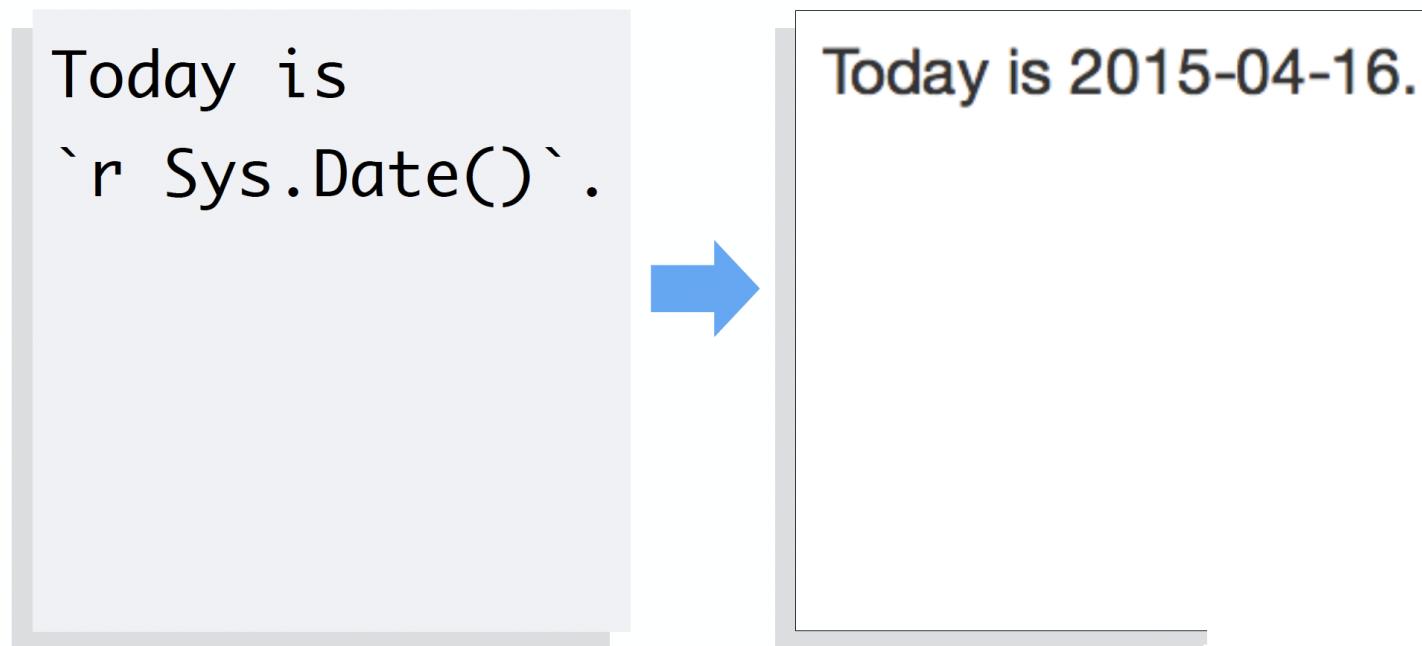
- Insert chunk of R code
- R Markdown runs code and includes results.

```
```{r}  
# some code
```

```
```
```

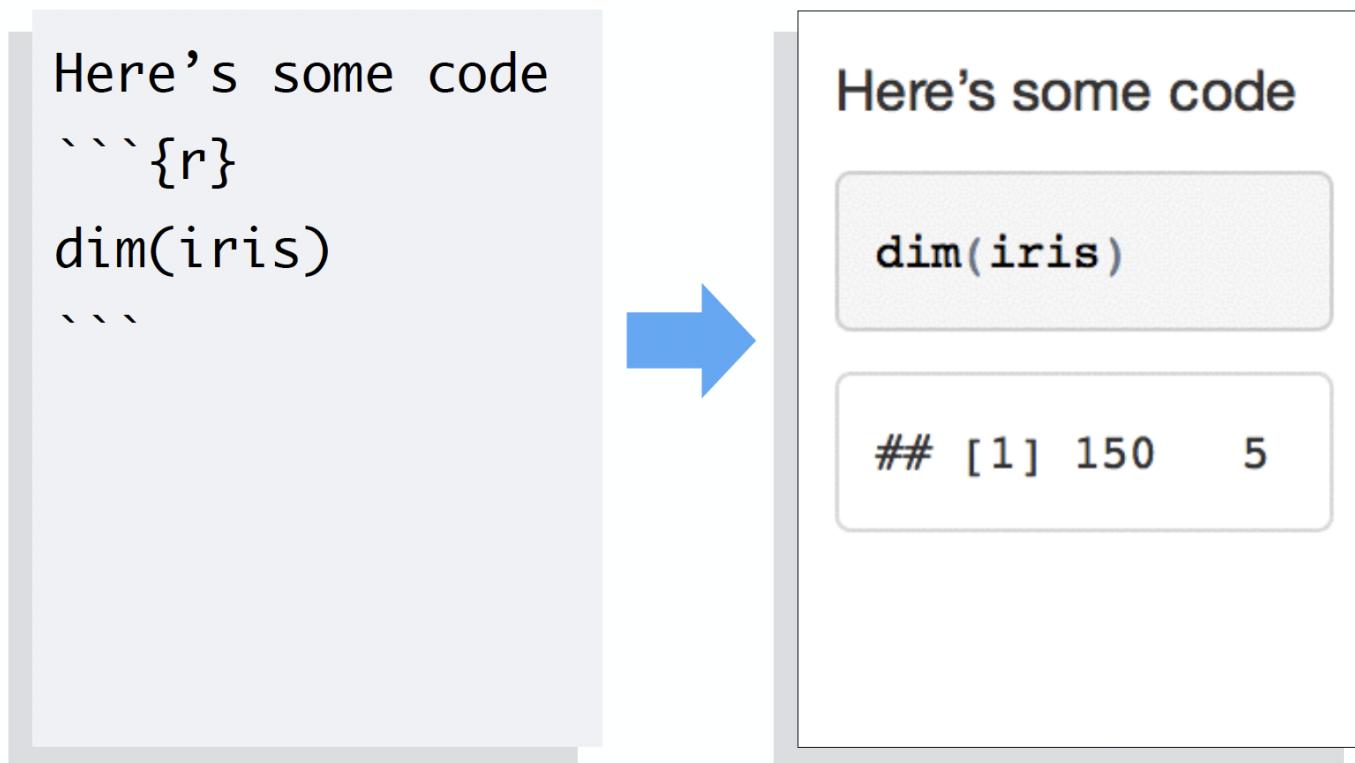
# Inline code

- Place code in a sentence with
- R Markdown replaces code with results



# Chunk options

- By default, R markdown includes both code and results



# echo

- Add options between brackets after r.
- echo = FALSE hides code.

```
Here's some code  
```{r echo=FALSE}  
dim(iris)  
```
```



Here's some code

```
## [1] 150    5
```

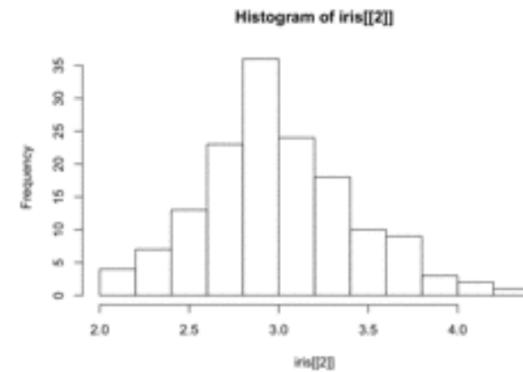
# echo

- Add options between brackets after r.
- echo = FALSE hides code.

```
Here's a plot  
```{r echo=FALSE}  
hist(iris[[2]])  
```
```



Here's a plot

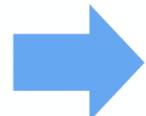


# eval

- eval = FALSE prevents code from being run
- No results is displayed, only code

Here's some code

```
```{r eval=FALSE}  
dim(iris)  
```
```



Here's some code

```
dim(iris)
```

# fig.height, fig.width

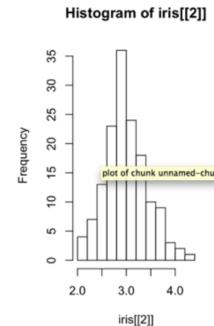
- Specify dimension of plots (in inches) with `fig.width` and `fig.height`
- Separate multiple arguments with commas.

Here's a plot

```
```{r echo=FALSE, fig.width=3, fig.height=5}
hist(iris[[2]])
```
```



Here's a plot



# message

- `message = FALSE` prevents messages from appearing in output

```
Here's some code  
```{r message=FALSE}  
library(forecast)  
```
```



```
Here's some code  
library(forecast)
```

# Default chunk options

- Repeating chunk options can be painful
- If you have `echo = FALSE` in every single chunk, how to set the default chunk option to `echo = FALSE` ?
- Use `knitr:::opts_chunk$set(echo = FALSE)`
- You may overwrite the default for each chunk
- For chunk options, check out <https://yihui.name/knitr/options/>

# Cache time-consuming code chunks

- When you time-consuming calculations (simulations, Bayes stuff), and/or a looooong document
- Use `cache = TRUE` in all chunks or the chunk that takes long to compile
- Skip execution if executed before and nothing has changed since then
- If you do modifications to the cached chunk(s), previous cache will be automatically invalidated, and new cache is built

# Including tables

```
# cars is a built-in-to-R data set of cars
# and their stopping distances
cars %>%
  head(5) %>%
  knitr::kable(format = "html", caption = "A kable table")
```

| A kable<br>table |      |
|------------------|------|
| speed            | dist |
| 4                | 2    |
| 4                | 10   |
| 7                | 4    |
| 7                | 22   |
| 8                | 16   |

- The `kable` package is often used with the `kableExtra` package
- A number of other packages are available for making pretty tables, see [rmarkdown.rstudio.com](http://rmarkdown.rstudio.com)

# R Markdown Reference Guide

<https://rstudio.com/wp-content/uploads/2015/03/rmarkdown-reference.pdf>



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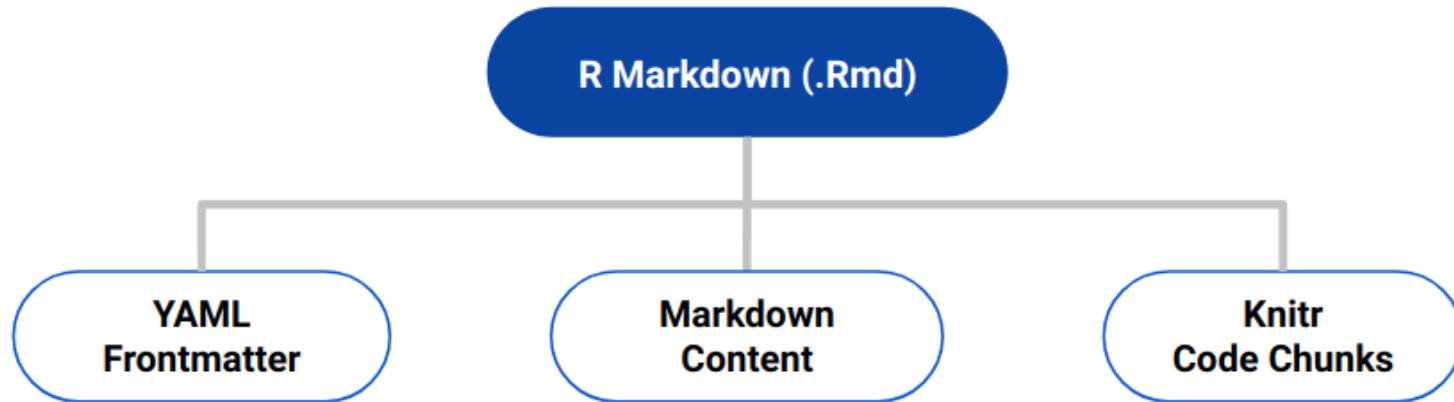
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### Contents:

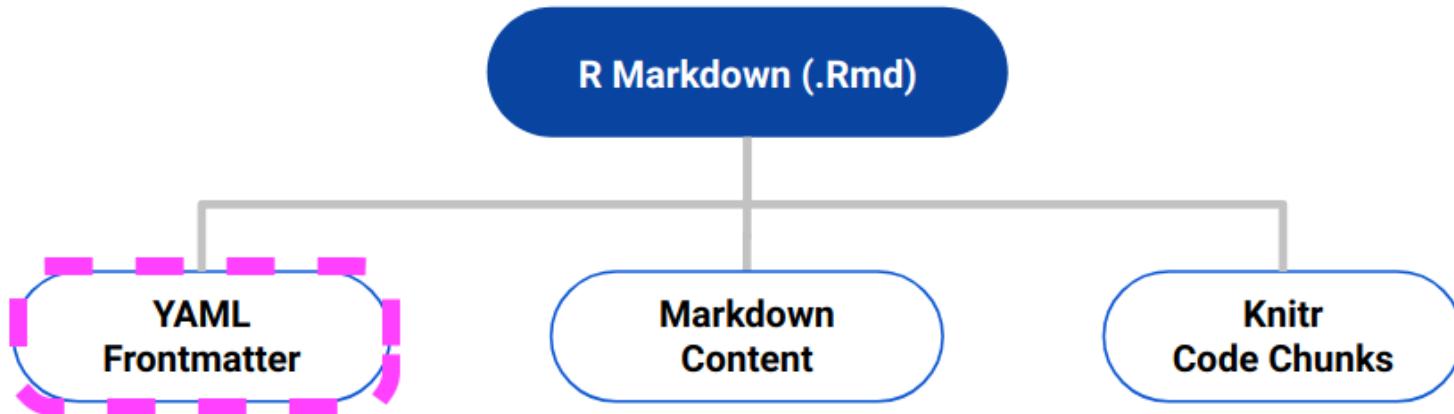
1. Markdown Syntax
- 2. Knitr chunk options**
3. Pandoc options

| Syntax  | Becomes   |
|---|---|
| <p>Make a code chunk with three back ticks followed by an r in braces. End the chunk with three back ticks:</p> <pre>```{r} paste("Hello", "World!") ```</pre>                        | <p>Make a code chunk with three back ticks followed by an r in braces. End the chunk with three back ticks:</p> <pre>paste("Hello", "World!")</pre><br><pre>## [1] "Hello World!"</pre> |
| <p>Place code inline with a single back ticks. The first back tick must be followed by an R, like this `r paste("Hello", "World!")`.</p>  | <p>Place code inline with a single back ticks. The first back tick must be followed by an R, like this Hello World!.</p>  |
| <p>Add chunk options within braces. For example, `echo=FALSE` will prevent source code from being displayed:</p> <pre>```{r eval=TRUE, echo=FALSE} paste("Hello", "World!") ```</pre> | <p>Add chunk options within braces. For example, <code>echo=FALSE</code> will prevent source code from being displayed:</p> <pre>## [1] "Hello World!"</pre>                            |

# Structure of a R Markdown document



# Structure of a R Markdown document

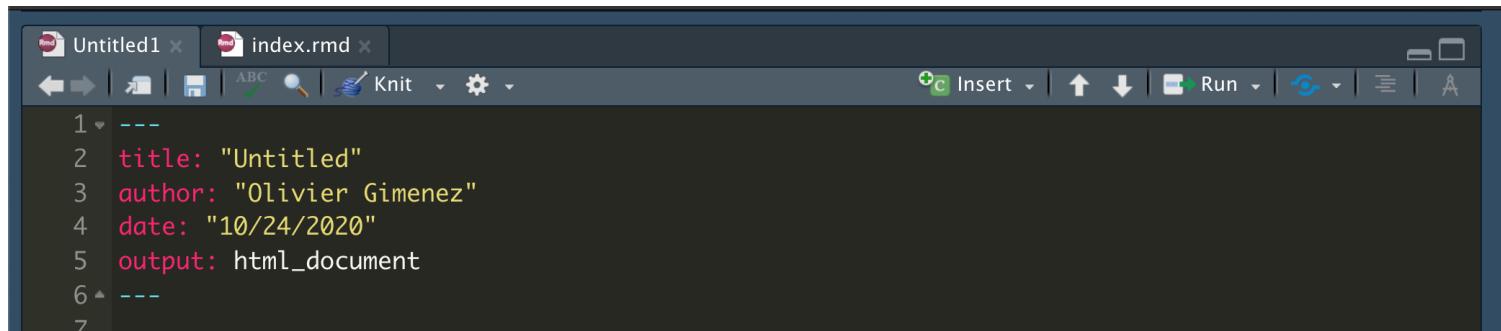


# YAML Yet Another Markup Language

# YAML in brief

- Contains the metadata of the document
- Starts and ends by three dashes
- Comes first in the document

# Simplest example



The screenshot shows the RStudio interface with the title bar "Untitled1" and "index.rmd". The toolbar includes icons for back, forward, search, and knit. The main editor area contains the following R Markdown code:

```
1 ---  
2 title: "Untitled"  
3 author: "Olivier Gimenez"  
4 date: "10/24/2020"  
5 output: html_document  
6 ---  
7
```

# Output formats

## Untitled

Olivier Gimenez

10/25/2020

### R Markdown

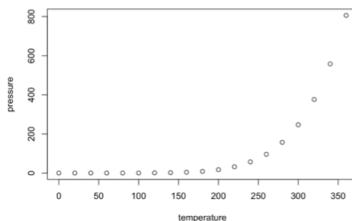
This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

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



html

## Untitled

Olivier Gimenez

10/25/2020

### R Markdown

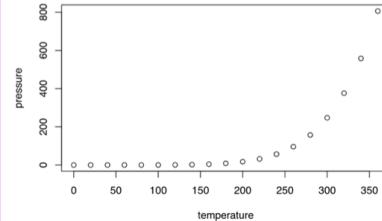
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## #> Mean   :15.4   Mean  : 42.98
## #> 3rd Qu.:19.0 3rd Qu.: 56.00
## #> Max.  :25.0  Max.  :120.00
```

### Including Plots



pdf

## Untitled

Olivier Gimenez

10/25/2020

### R Markdown

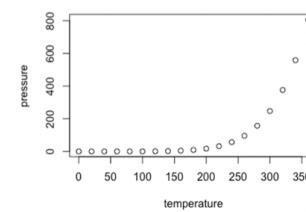
This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

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## #> Mean   :15.4   Mean  : 42.98
## #> 3rd Qu.:19.0 3rd Qu.: 56.00
## #> Max.  :25.0  Max.  :120.00
```

### Including Plots



docx

# Knit



# Output formats

# Appearance and style

- In HTML output, you can use `theme` or a custom `.css` style sheet
- `theme` options ([bootswatch.com](http://bootswatch.com)) : “cerulean”, “journal”, “flatly”, “darkly”, “readable”, “spacelab”, “united”, “cosmo”, “lumen”, “paper”, “sandstone”, “simplex”, “yeti”
- You may also use LaTeX templates with R Markdown, and write [reproducible scientific paper](#)
- You can also [use Word templates in R Markdown](#) (see also [this short video](#))

# Managing bibliography

1. Put references in a plain text file with the extension **.bib**, in **BibTex** format (Example of using **Zotero**)

```
@article{Shea2014,
  author = {Shea, Nicholas and Boldt, Annika},
  journal = {Trends in Cognitive Sciences},
  pages = {186--193},
  title = {{Supra-personal cognitive control
```

2. Reference this file in your YAML header

```
---
title: "Citation test"
bibliography: example.bib
output: html_document
---
```

# Citations

3. In your text, citations go inside brackets and separated by semicolons

This...

Blah blah [@Shea2014;  
@Lottridge2012].

turns into this...

Blah blah (Shea et al. 2014; Lottridge et al. 2012).

# Citations

3. In your text, citations go inside brackets and separated by semicolons

This...

Blah blah [@Shea2014;  
@Lottridge2012].

@Shea2014 says blah.

Blah blah [see @Shea2014, pp. 33-35;  
also @Wu2016, ch. 1].

turns into this...

Blah blah (Shea et al. 2014; Lottridge et al. 2012).

Shea et al. (2014) says blah.

Blah blah (see Shea et al. 2014, 33–35; also Wu 2016, ch. 1).

# Citations

3. In your text, citations go inside brackets and separated by semicolons

This...

Blah blah [@Shea2014;  
@Lottridge2012].

@Shea2014 says blah.

Blah blah [see @Shea2014, pp. 33-35;  
also @Wu2016, ch. 1].

turns into this...

Blah blah (Shea et al. 2014; Lottridge  
et al. 2012).

Shea et al. (2014) says blah.

Blah blah (see Shea et al. 2014, 33–  
35; also Wu 2016, ch. 1).

- Add e.g `csl: my-style.csl` in the YAML header to change to other formats
- Browse through and download styles at [zotero.org/styles](https://zotero.org/styles)

# Citations

For an easy way to insert citations, try the `citr` RStudio add-in.

# R Markdown Reference Guide

<https://rstudio.com/wp-content/uploads/2015/03/rmarkdown-reference.pdf>



## R Markdown Reference Guide

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### Contents:

1. Markdown Syntax
2. Knitr chunk options
- 3. Pandoc options**

| Templates             | Basic YAML                 | Template options      | Latex options               | Interactive Docs      |
|-----------------------|----------------------------|-----------------------|-----------------------------|-----------------------|
| html_document         | ---                        | ---                   | ---                         | ---                   |
| pdf_document          | title: "A Web Doc"         | title: "Chapters"     | title: "My PDF"             | title: "Slides"       |
| word_document         | author: "John Doe"         | output:               | output: pdf_document        | output:               |
| md_document           | date: "May 1, 2015"        | <b>html_document:</b> | <b>fontsize: 11pt</b>       | slidy_presentation:   |
| ioslides_presentation | <b>output: md_document</b> | <b>toc: true</b>      | <b>geometry: margin=1in</b> | incremental: true     |
| slidy_presentation    | ---                        | <b>toc_depth: 2</b>   | ---                         | <b>runtime: shiny</b> |
| beamer_presentation   | ---                        | ---                   | ---                         | ---                   |

# Rmarkdown

TEXT. CODE. OUTPUT.  
(GET IT TOGETHER, PEOPLE.)



What else can we reproduce with R Markdown?

# Let's have a tour

R Markdown from R Studio

Get St:

## Gallery

Check out the range of outputs and formats you can create using R Markdown.

## Documents

With R Markdown, you write a single .Rmd file and then use it to render finished output in a variety of formats

### Great NYT Interactive -- Now Reusable with rCharts



### A Pandoc Markdown Article Starter and Template\*

Steven Y. Miller | [Connecticut](#)

This document generates an article in R Markdown, aspire for its benefits, and presents a simple manuscript template intended for academic audiences. I include basic syntax in R Markdown and a minimal working example of how the `asymptotic` package can be utilized within R with the `knitr` package.

[Knitr](#) [pandoc](#), [asymptotic](#), [knitr](#)

#### Introduction

Academic writing, especially in political science, is at a crossroads. The American Journal of Political Theory (AJPT) demands a rigorously “show your work” methodology while academic publishers tend to accept manuscripts for publication in the journal most likely to receive the most citations during their tenure. The *Journal of Politics* (JOP) then represents the most likely outlet for the manuscript. Pending successful publication, the manuscript moves toward publication. The JOP’s copyright of the text of this manuscript, and it is likely the most aggressive requiring political science journals, but other journals in our field have lagged. The *Journal of Democracy* (*JDEM*) is another exemplary (JDEM) instance. Thus, as a fair researcher, requires updating one’s typesetting to generated published articles to be more directives toward the standard or its alternatives.

There are workflow implications to the LaTeX contribution as well. Workflow writers, for the foreseeable future, will struggle with the extent of the tools used to implement LaTeX in an article environment with Donald E. Goss in Science, the general scientific journal of interest in the United States. A Julian to reproduce LaTeCer's results with different sample environments.

A Micr

#### R Markdown

This is an R Markdown document.  
HTML, PDF, and MS Word documents  
[Download](#)

What you click the R Markdown  
will use the source of any methods  
and R code block like this.

[asymptotic](#)  
by Steven Y. Miller  
AP Mic - AP Mic - 1200  
AP Mic - AP Mic - 1200

#### Including Plots

[Via `knitr` and `grid`](#), for exa

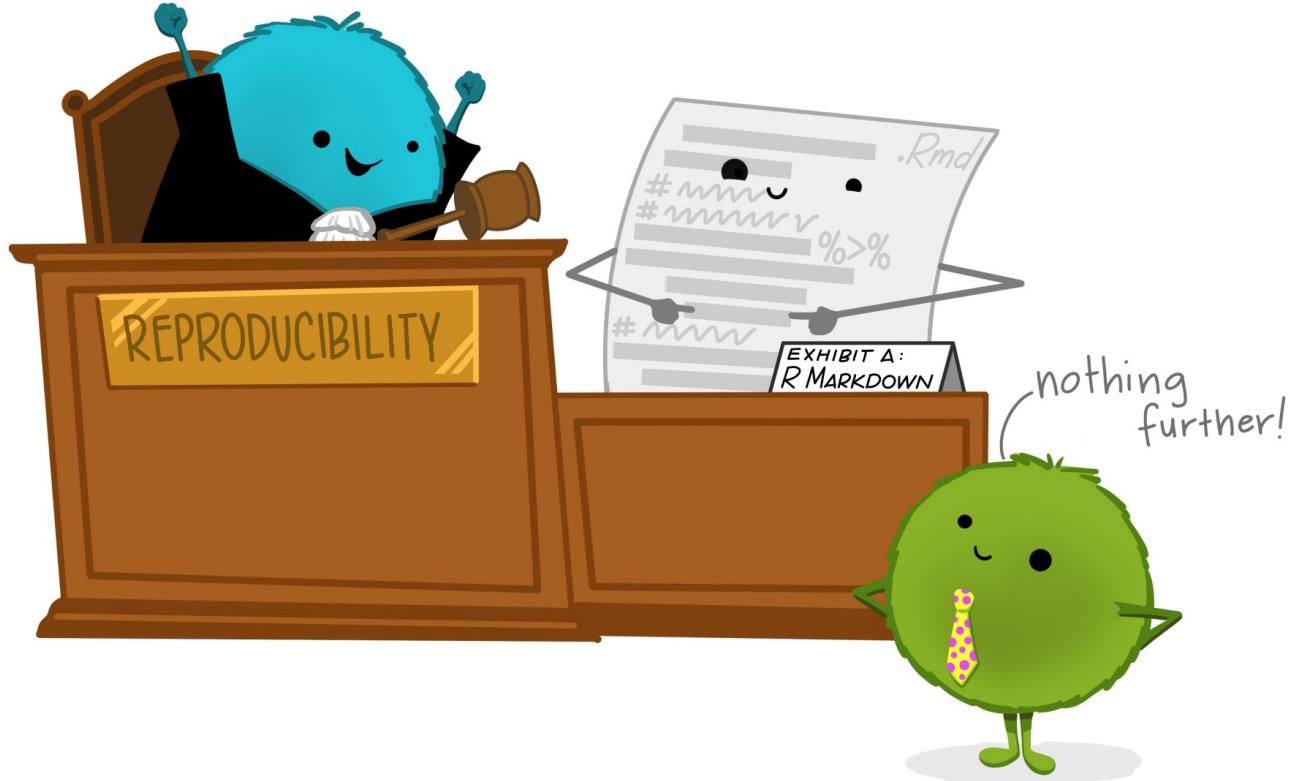
R Markdown gallery <https://rmarkdown.rstudio.com/gallery.html>

# Websites

- Use package `blogdown` <https://bookdown.org/yihui/blogdown/>
- Customize with Hugo <https://themes.gohugo.io/>
- Deploy via GitHub pages or Netlify
- See a video tutorial [here](#)

# Reproducibility and collective work

- How to work with Word using `redoc`: generate a Word document, revise the Word document, and convert the revised Word document back to R Markdown
- How to collaborate on Rmd documents with [Google Drive](#).



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