

# **Dynamic documents in R**

## **reproducible research with R Markdown**

**2019-08-29**

# Rmarkdown

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



Artwork by @allison\_horst

# R Markdown



**Authoring framework: code and text in same document**

**Reproducible: re-run your analysis**

**Flexible: Output to different formats easily**



knitting

# Your turn 1

Create a new R Markdown file. Go to File > New File > R Markdown. Press OK. Save the file and press the "Knit" button above.

The screenshot shows an RStudio interface with a document titled "1-example.Rmd". The code editor contains the following R Markdown code:

```
1 ---  
2 title: "Viridis Demo"  
3 output: html_document  
4 ---  
5  
6 ```{r include = FALSE}  
7 library(viridis)  
8 ...  
9  
10 The code below demonstrates two color palettes in the  
11 [viridis](https://github.com/sjmgarnier/viridis) package. Each  
12 plot displays a contour map of the Maunga Whau volcano in  
13 Auckland, New Zealand.  
14 ## Viridis colors  
15 image(volcano, col = viridis(200))  
16 ...  
17  
18 ## Magma colors  
19  
20 ```{r}  
21 image(volcano, col = viridis(200, option = "A"))  
22 ...  
23
```

The code is annotated with three large orange curly braces on the right side:

- A brace spanning lines 1-4 is labeled "YAML Metadata".
- A brace spanning lines 10-13 is labeled "Plain text".
- A brace spanning lines 20-22 is labeled "Code chunk".

# R Markdown

Prose

Code

Metadata



# R Markdown

**Prose = Markdown**

Code

Metadata



# Basic Markdown Syntax

\*italic\*    \*\*bold\*\*

\_italic\_    \_\_bold\_\_

# Basic Markdown Syntax

```
# Header 1
```

```
## Header 2
```

```
### Header 3
```

# Basic Markdown Syntax

- \* Item 1
- \* Item 2
  - + Item 2a
  - + Item 2b
- 1. Item 1
- 2. Item 2

# Basic Markdown Syntax

`http://example.com`

`[linked phrase](http://example.com)`

# Basic Markdown Syntax



![optional caption text](figures/img.png)

# Basic Markdown Syntax

\$equation\$

\$\$ equation \$\$

# Basic Markdown Syntax

superscript<sup>2</sup>

~~strikethrough~~

## Your turn 2

Do the ten minute tutorial on markdown  
at

<https://commonmark.org/help/tutorial>.

Let us know if you need help!

## Your turn 3

Use Markdown syntax to stylize the text from the **Gapminder website** below. Experiment with bolding, italicizing, making lists, etc.

# R Markdown

Prose

**Code = R code chunks**

Metadata



# Code chunks

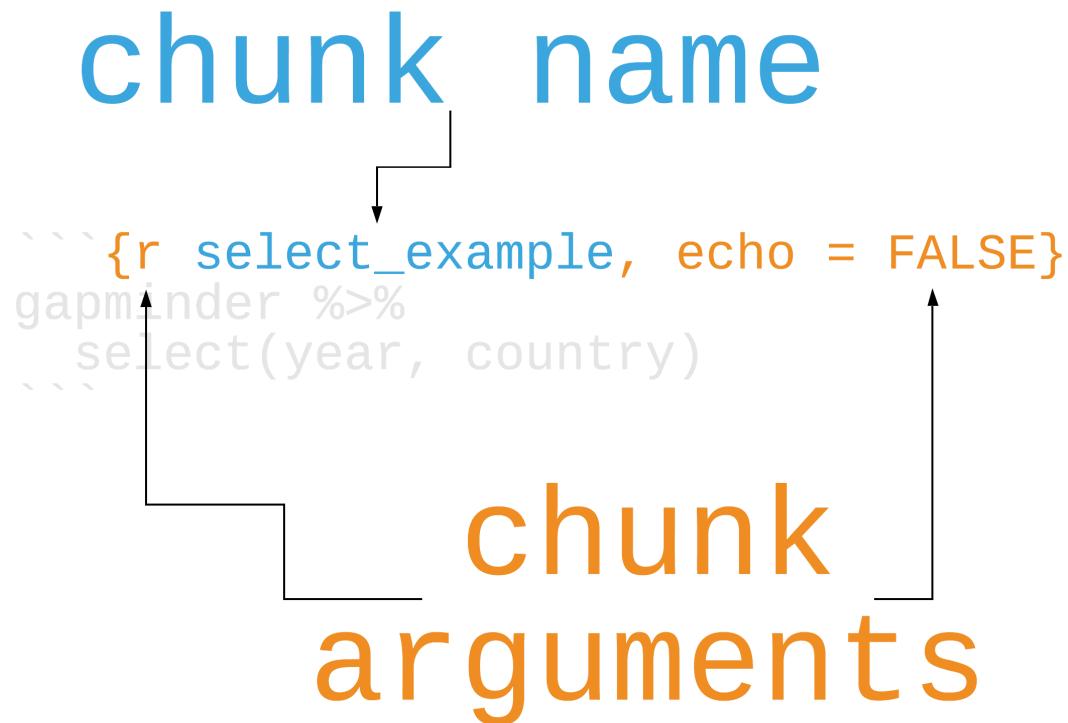
```
```{r select_example, echo = FALSE}
gapminder %>%
  select(year, country)
```
```

## Code chunks

fences (3  
backticks)

```
r select_example, echo = FALSE}  
gapminder %>%  
  select(year, country)
```

# Code chunks



# Chunk options

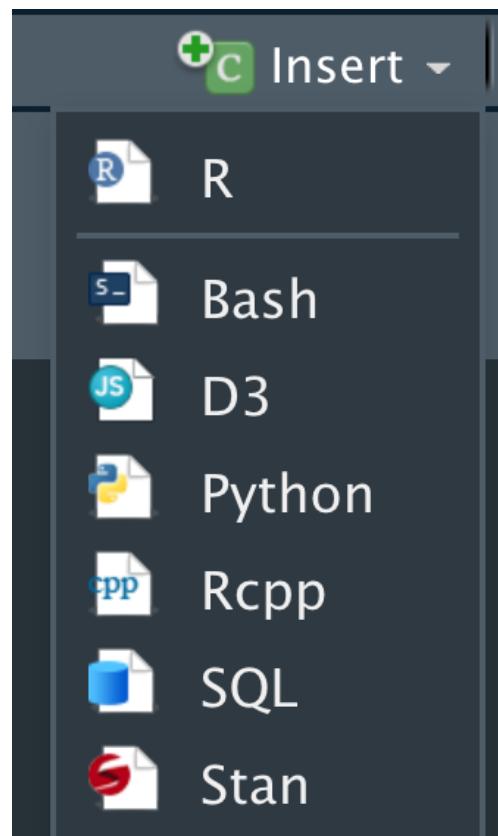
| Option                            | Effect                                       |
|-----------------------------------|--|
| <code>include = FALSE</code>      | run the code but don't print it or results   |
| <code>eval = FALSE</code>         | don't evaluate the code                      |
| <code>echo = FALSE</code>         | run the code and output but don't print code |
| <code>message = FALSE</code>      | don't print messages (e.g. from a function)  |
| <code>warning = FALSE</code>      | don't print warnings                         |
| <code>fig.cap = "Figure 1"</code> | caption output plot with "Figure 1"          |

See the [knitr web page](#)

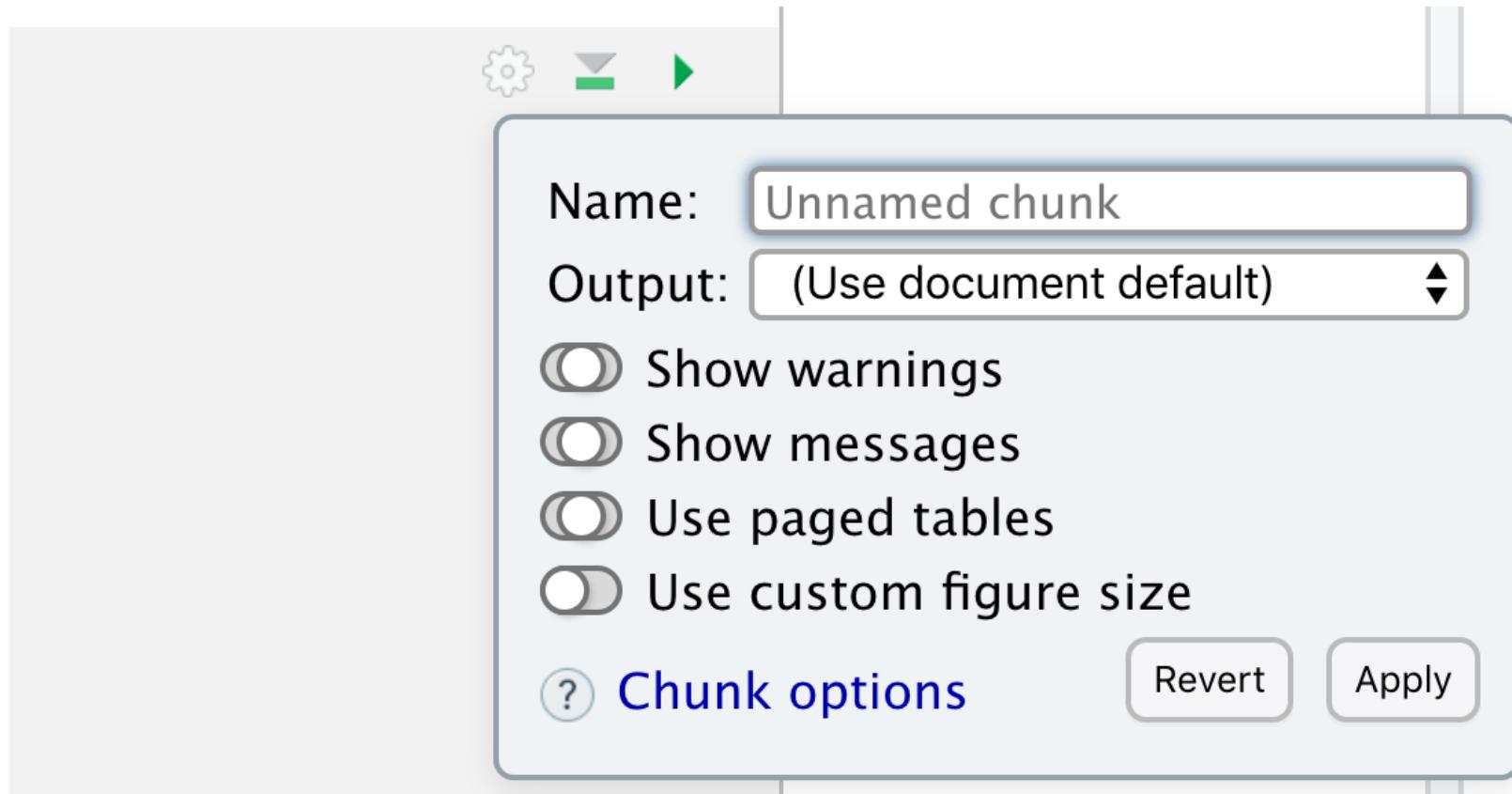
# Engines

52! Including **Python, Julia, C++, SQL, SAS, and Stata**

# Insert code chunks with cmd/ctrl + alt/option + I



# Edit code chunk options



# Your turn 4 (open exercises.Rmd)

Create a code chunk. You can type it in manually, use the keyboard short-cut (Cmd/Ctrl + Option/Alt + I), or use the "Insert" button above. Put the following code in it:

```
gapminder %>%
  slice(1:5) %>%
  knitr::kable()
```

**Knit the document**

# Your turn 5

**Add echo = FALSE to the code chunk above and re-knit**

**Remove echo = FALSE from the code chunk and move it to knitr::opts\_chunk\$set() in the setup code chunk. Re-knit. What's different about this?**

**Make sure to remove knitr::opts\_chunk\$set(echo = FALSE)**

# Inline Code

  Lorem ipsum dolor sit  
  amet, consetetur  
  sadipscing  
`r max(gapminder\$year)`  
  elitr, sed diam nonumy  
  eirmod tempor invidunt

# Inline Code

Lore  
backticks  
`r max(gapminder\$year)`  
any R code

The diagram illustrates the use of backticks in R. A large orange bracket labeled "backticks" spans the entire line of code. Inside the backticks, the character "r" is highlighted in orange, and the word "max" is highlighted in blue. A bracket above the "r" is labeled "+ r". Below the code, the text "any R code" is written in blue. Arrows point from the labels "backticks" and "+ r" to their respective parts in the code.

## Your turn 6

**Remove eval = FALSE so that R Markdown evaluates the code.**

**Use summarize() and n\_distinct() to get the the number of unique years in gapminder and save the results as n\_years.**

**Use inline code to describe the data set in the text below the code chunk and re-knit.**

# R Markdown

Prose

Code

**Metadata = YAML**



# YAML Metadata

```
---
```

```
author: Malcolm Barrett
title: Quarterly Report
output:
  html_document: default
  pdf_document:
    toc: true
---
```

```
title: "Annual report"  
author: Malcolm Barrett  
date: "`r Sys.Date()`"  
output:  
  pdf_document:  
    toc: true
```

A diagram illustrating a key-value pair in a YAML configuration. The word "key" is written in orange and "value" in blue. An arrow points from the top of "key" to the first line of code, and another arrow points from the end of "value" to the closing double quote of the value string.

```
title: "Annual report"  
author: Malcolm Barrett  
date: "r Sys.Date()"
```

output:

pdf\_document:

toc: true

```
title: "Annual report"
```

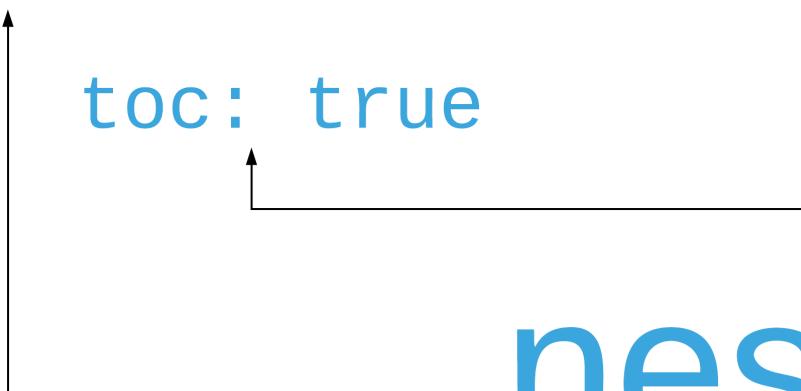
```
author: Malcolm Barrett
```

```
date: "``r Sys.Date()``"
```

```
output: ← top level
```

```
pdf_document:
```

```
  toc: true
```



```
nested
```

title: "Annual report"

author: Malcolm Barron

date: "r Sys.Date()"

output:

pdf\_document:

toc: true

output  
function

output

arguments



```
title: "Annual report"
```

```
author: Malcolm Barrett
```

```
date: "`r Sys.Date()`"
```

```
output:
```

```
pdf_document:
```

```
  toc: true
```

**pdf\_document(toc = TRUE)**

# Output formats

| Function                               | Outputs             |
|--|---------------------|
| <code>html_document()</code>           | HTML                |
| <code>pdf_document()</code>            | PDF                 |
| <code>word_document()</code>           | Word .docx          |
| <code>odt_document()</code>            | .odt                |
| <code>rtf_document()</code>            | .rtf                |
| <code>md_document()</code>             | Markdown            |
| <code>slidy_presentation()</code>      | Slidy Slides (HTML) |
| <code>beamer_presentation()</code>     | Beamer Slides (PDF) |
| <code>ioslides_presentation()</code>   | ioslides (HTML)     |
| <code>powerpoint_presentation()</code> | Powerpoint Slides   |

# Your turn 7

**Set figure chunk options such as dpi, fig.width, and fig.height. Run knitr::opts\_chunk\$get() in the console to see the defaults.**

**Change the YAML header above from output: html\_document to another output type like pdf\_document or word\_document.**

**Add your name to the YAML header using author: Your Name.**

ymlthis

check out the ymlthis package for tools  
and documentation for working with  
**YAML**

<https://r-lib.github.io/ymlthis/>

# Parameters

```
---  
params:  
  param1: x  
  param2: y  
  data: df  
---
```

```
params$param1  
params$param2  
params$data
```

## Your turn 8

**Change the params option in the YAML header to use a different continent. Re-knit**

```
gapminder %>%
  filter(continent == params$continent) %>%
  ggplot(aes(x = year, y = lifeExp, group = country, color = country
  geom_line(lwd = 1, show.legend = FALSE) +
  scale_color_manual(values = country_colors) +
  theme_minimal(14) +
  theme(strip.text = element_text(size = rel(1.1))) +
  ggtitle(paste("Continent:", params$continent))
```

# Bibliographies and citations

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**Bibliography files: .bib, End Note, others**

# Bibliographies and citations

Bibliography files: .bib, End Note, others

Citation styles: .csl

# Bibliographies and citations

Bibliography files: .bib, End Note, others

Citation styles: .csl

[@citation-label]

# Including bibliography files in YAML

```
---
```

```
bibliography: file.bib
```

```
csl: file.csl
```

```
--
```

## Your turn 9

**Cite the Causal Inference book in text below in the format [@citation-label]. The label for the citation is hernan\_causal\_2019**

**Add the American Journal of Epidemiology CSL to the YAML using csl: aje.csl**

Check out the `citr` package for  
easy citation insertion and `.bib`  
management

# Make cool stuff in R Markdown!

`bookdown`

`blogdown`

`these slides!`

# Resources

**R Markdown:** A comprehensive but friendly introduction to R Markdown and friends. Free online.

**R for Data Science:** A comprehensive but friendly introduction to the tidyverse. Free online.

**R Markdown for Scientists:** R Markdown for Scientists workshop material.