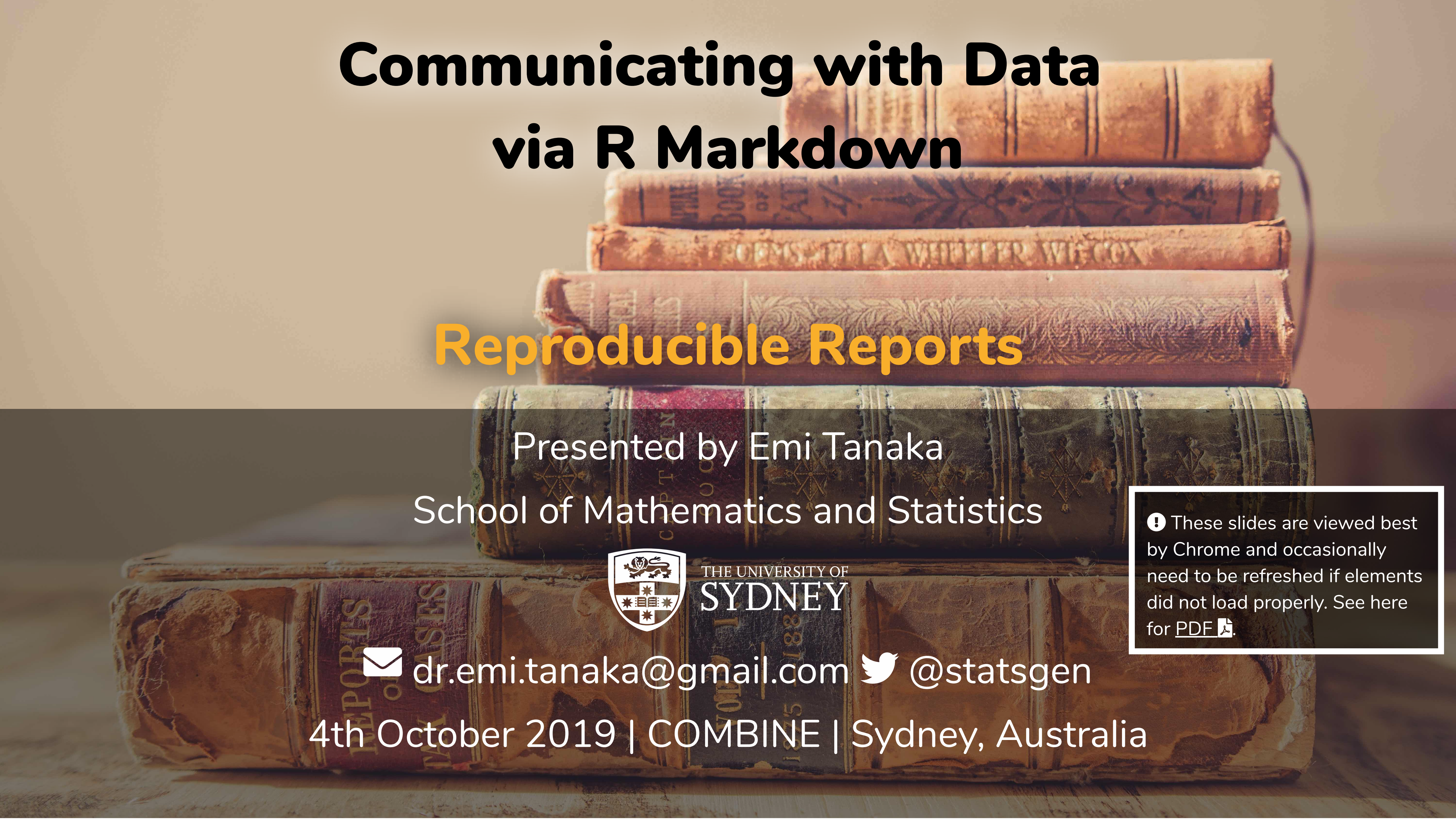

Communicating with Data via R Markdown

Reproducible Reports

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❗ These slides are viewed best by Chrome and occasionally need to be refreshed if elements did not load properly. See here for PDF.

In a nutshell 🥜

R Markdown integrates **text** + `code` in one source document with ability to knit to many output formats (via Pandoc).

Text in Markdown

```
# Header 1
## Header 2

- Unordered list 1
- Unordered list 2

1. Ordered list 1
1. Ordered list 2

_This is italic._ *This too.*
__This is bold.__ **This too.**
_**This is bold & italic.**_
```

Output

Header 1

Header 2

- Unordered list 1
- Unordered list 2

1. Ordered list 1
2. Ordered list 2

This is italic. *This too.* **This is bold.** **This too.** ***This is bold & italic.***

Go to RStudio > Help > Markdown Quick Reference

Shortcut for inserting code chunk

In RStudio .Rmd 🗋 press

- Mac: ⌘ + ⌥ + i

- PC: Ctrl + Alt + i

to insert a chunk of R code

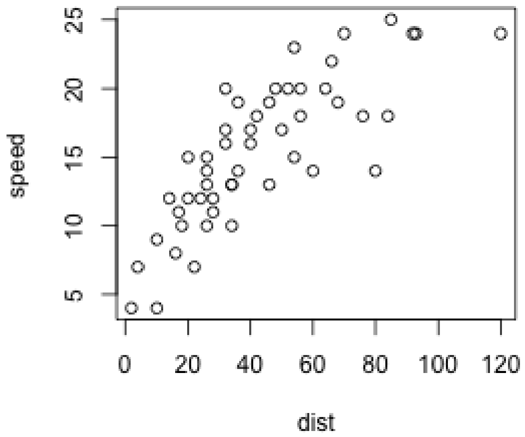
~~~~
```{r}

```
~~~~

Chunk options: `echo` & `eval`

~~~
```{r, echo = FALSE}
plot(speed ~ dist, cars)
```
~~~

↓



~~~
```{r, eval = FALSE}
plot(speed ~ dist, cars)
```
~~~

↓

```
plot(speed ~ dist, cars)
```

There are many more chunk options.

Can you name 5 other ones?

Hint: https://yihui.name/knitr/options/

(We'll explore some later.)

Valid chunk options

- Chunk options must be written in **one line**, i.e. no line break.
- All option values must be **valid R expressions**. Exception is the chunk name. E.g.
  - `fig.path = figures/` is not valid but `fig.path = "figures/"` is valid
  - `eval = true` is not valid but `eval = runif(1) > 0.5` is valid

Chunk names (or labels)

The chunk below is called `plot1`.

~~~
```{r plot1}
ggplot(cars, aes(dist, speed)) + geom_point()
```
~~~

All chunks have a label regardless of whether it is explicitly supplied or not.

⚠ Do not include spaces, "_" or punctuation marks in your chunk name!

Inline R Commands

```
Today's date is `r Sys.Date()`.
```

Today's date is 2019-10-03.

```
The value of $\pi$ is `r pi`.
```

The value of π is 3.1415927.

- Note: the inline command needs to be R commands.
- Inline command does *not* `echo` and always `eval`uates.

Go through

- `challenge-02.Rmd`
- `challenge-03.Rmd`
- `challenge-04.Rmd`
- `challenge-05.Rmd`
- `challenge-06.Rmd`

25:00

R Markdown is not just for R

~~~
```{python, echo = FALSE}
a = [1, 2, 3]
a[0]
```
~~~

↓

```
## 1
```

~~~
```{bash, echo = FALSE}
date +%B
```
~~~

↓

```
## October
```

Can you name some other engines?

Hint:

https://yihui.name/knitr/demo/engines/

YAML - YAML Ain't Markup Language

Basic format

```
---
key: value
---
```

Example

```
---
title: "Communicating with Data via R Markdown"
subtitle: "Reproducible Reports"
author: "Emi Tanaka"
date: "`r Sys.Date()`"
output: html_document
---
```

There must be a space after "`:`"!

Metadata

All YAML data are stored in `rmarkdown::metadata` as list.

```
rmarkdown::metadata$title
```

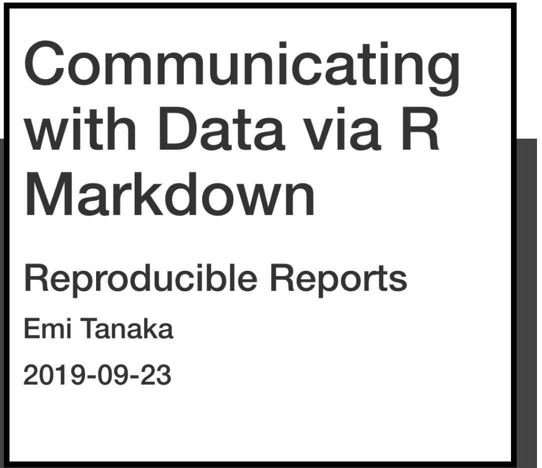
```
## [1] "Communicating with Data via R markdown"
```

```
rmarkdown::metadata$author
```

```
## [1] "Emi Tanaka"
```

Default (minimal) html output

output



Communicating with Data via R Markdown

Reproducible Reports

Emi Tanaka

2019-09-23

```
<!DOCTYPE html>
<html xmlns="http://www.w3.org/1999/xhtml">

<head>
<meta name="author" content="Emi Tanaka" />
<meta name="date" content="2019-10-04" />
<title>Communicating with Data via R Markdown</title>
</head>

<body>
<h1 class="title toc-ignore">Communicating with Data via R Markdown</h1>
<h3 class="subtitle">Reproducible Reports</h3>
<h4 class="author">Emi Tanaka</h4>
<h4 class="date">2019-10-04</h4>
</body>
</html>
```

html meta data

Default html template add special YAML key values to file automatically

YAML structure

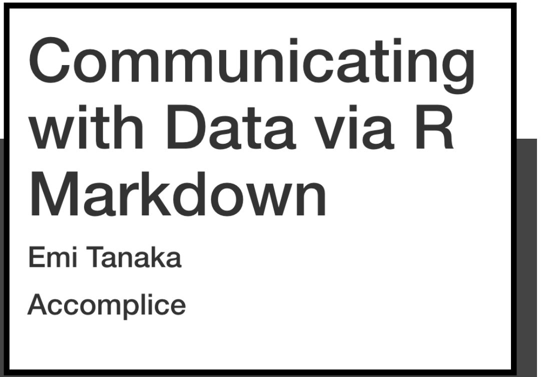
- White spaces indicate structure in YAML - don't use tabs though!
- Same as R, you can comment lines by starting with #.
- YAML is case sensitive.
- A `key` can hold multiple values.

```
key:
  - value 1
  - value 2
```

```
key: [value 1, value 2]
```

YAML with multiple key values

output



Communicating with Data via R Markdown

Emi Tanaka

Accomplice

```
---
title: "Communicating with Data via R Markdown"
author:
  - "Emi Tanaka"
  - "Accomplice"
output: html_document
---
```

```
<body>
<h1 class="title toc-ignore">Communicating with Data via R Markdown</h1>
<h4 class="author">Emi Tanaka</h4>
<h4 class="author">Accomplice</h4>
</body>
```

key can contain keys

```
---
output:
  html_document:
    toc: true
    toc_float: true
---
```

What does this do?

(Note: white space is important)

Values spanning multiple lines

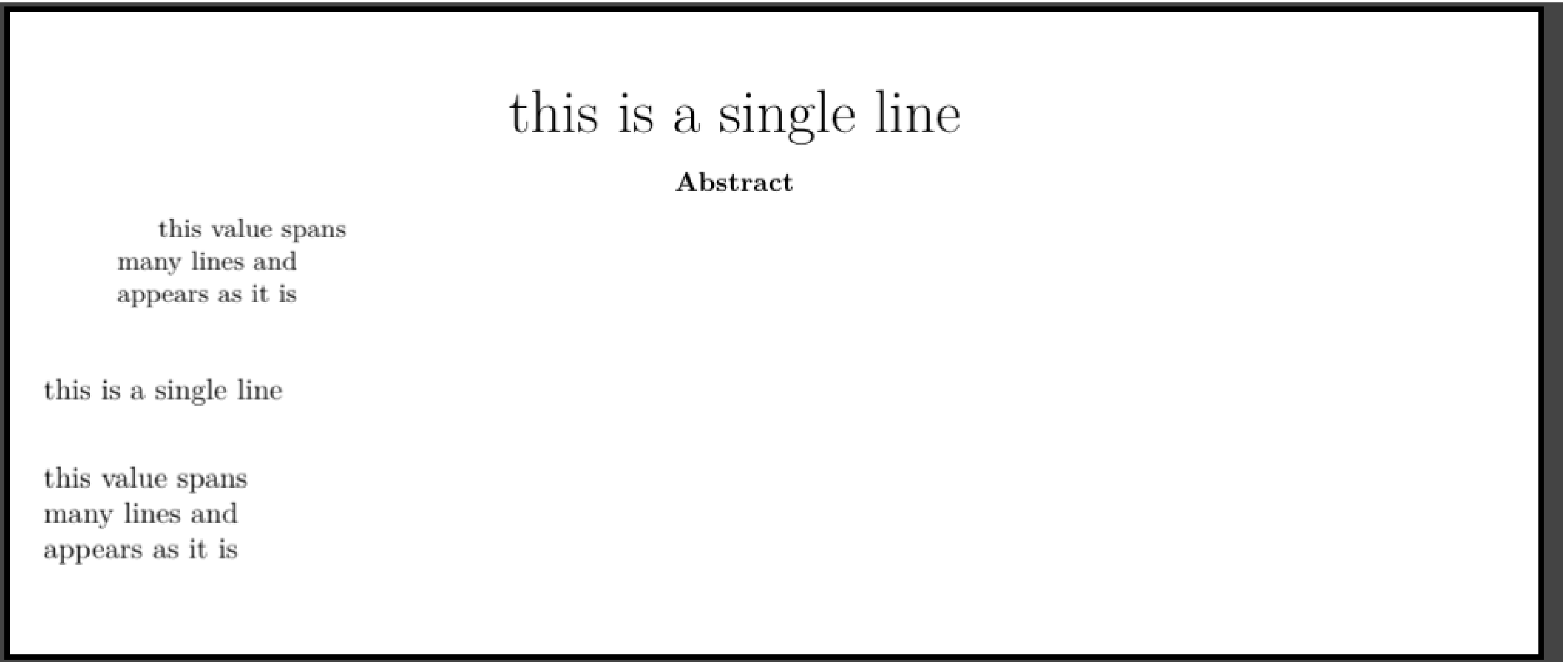
```
---
title: >
  this is a\
  single line\

abstract: |
  this value spans\
  many lines and\
  appears as it is\

output: pdf_document
---

`r rmarkdown::metadata$title`
`r rmarkdown::metadata$abstract`
```

output



this is a single line

Abstract

this value spans
many lines and
appears as it is

this is a single line

this value spans
many lines and
appears as it is

Go through

`challenge-07.Rmd`

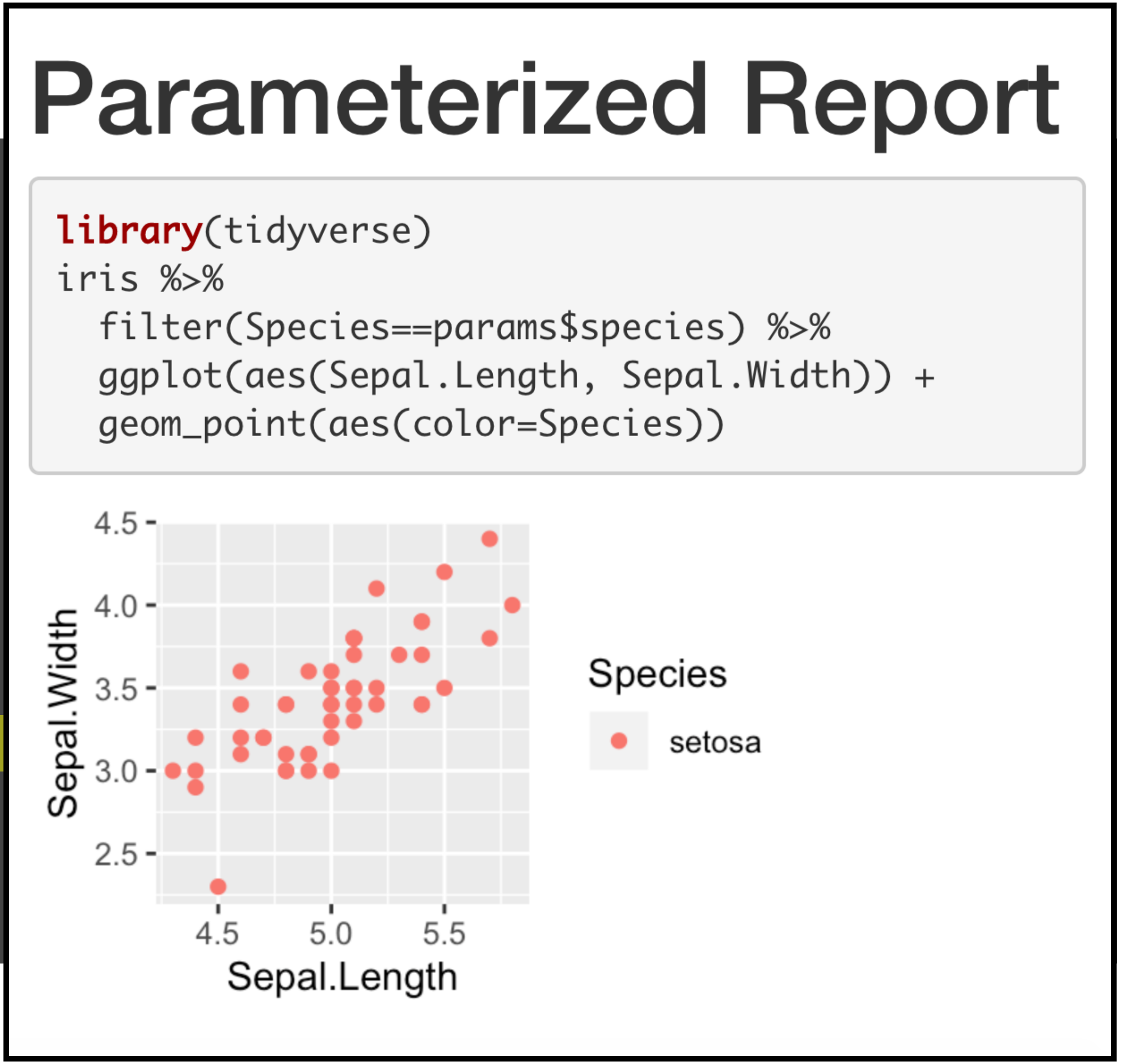
10:00

Parametrized Report

~~~
---
title: "Parameterized Report"
params:
  species: setosa
output: html_document
---

```{r, message = FALSE, fig.dim = c(3,2)}
library(tidyverse)
iris %>%
   filter(Species==params$species) %>%
   ggplot(aes(Sepal.Length, Sepal.Width)) +
   geom_point(aes(color=Species))
```
~~~

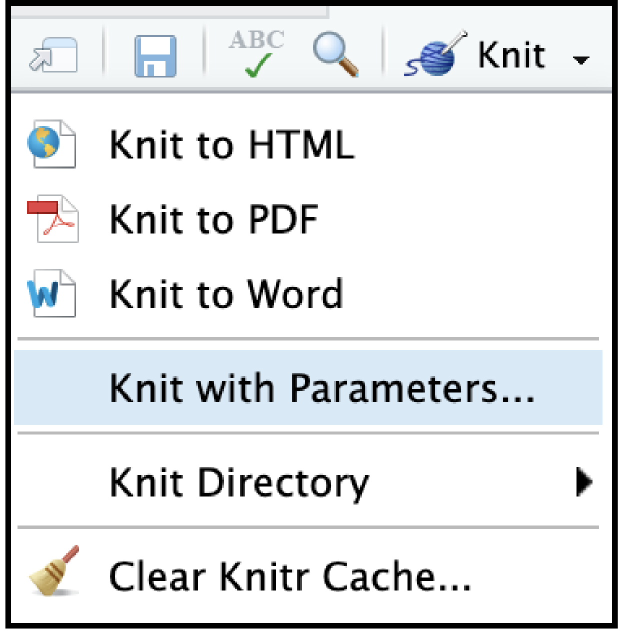
output



Parameterized Report

```
library(tidyverse)
iris %>%
  filter(Species==params$species) %>%
  ggplot(aes(Sepal.Length, Sepal.Width)) +
  geom_point(aes(color=Species))
```

Knit with Parameters

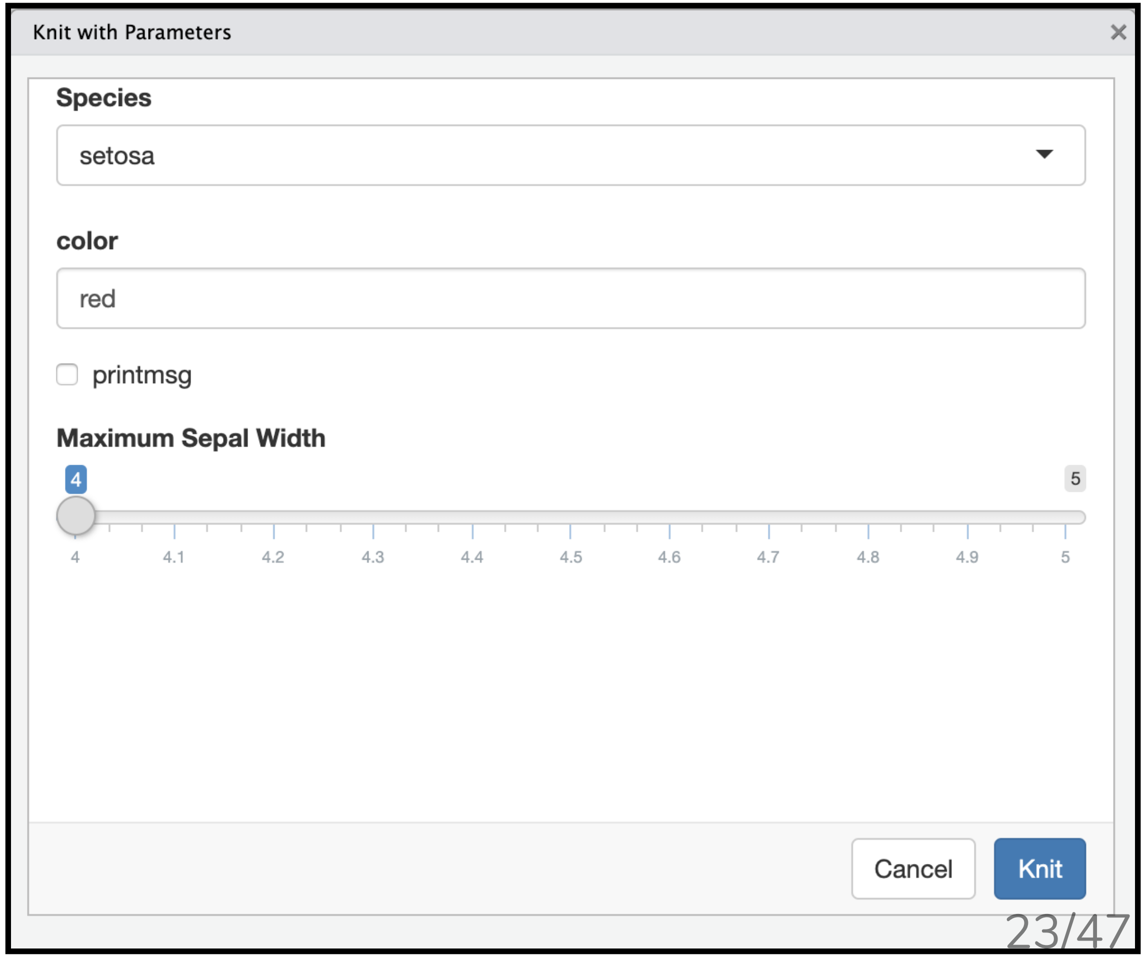


```
---
title: "Parameterized Report"
params:
  species:
    label: "Species"
    value: setosa
    input: select
    choices: [setosa, versicolor, virginica]
  color: red
  max:
    label: "Maximum Sepal Width"
    value: 4
    input: slider
    min: 4
    max: 5
    step: 0.1
output: html_document
---
```

~~~
```{r, message = params$printmsg, fig.dim = c(
library(tidyverse)
iris %>%
  filter(Species==params$species) %>%
  filter(Sepal.Width < params$max) %>%
  ggplot(aes(Sepal.Length, Sepal.Width)) +
  geom_point(aes(color=Species),
             color = params$color)
```
~~~

Shiny Report Generator

```
---
title: "Parameterized Report"
params:
  species:
    label: "Species"
    value: setosa
    input: select
    choices: [setosa, versicolor, virginica]
  color: red
  max:
    label: "Maximum Sepal Width"
    value: 5
    input: slider
    min: 4
    max: 5
    step: 0.05
output: html_document
---
```



Knit with Parameters

Species

setosa

color

red

□ printmsg

Maximum Sepal Width

4

R Markdown via Command Line

`demo-render.Rmd`

~~~
---
title: "Parameterized Report"
params:
  species: setosa
output: html_document
---

```{r, message = FALSE, fig.dim = c(3,2)}
library(tidyverse)
iris %>%
   filter(Species==params$species) %>%
   ggplot(aes(Sepal.Length, Sepal.Width)) +
   geom_point(aes(color=Species))
```
~~~

You can knit this file via R command by using `render` function:

```
library(rmarkdown)
render("demo-render.Rmd")
```

You can overwrite the YAML values by supplying arguments to `render`:

```
library(rmarkdown)
render("demo-render.Rmd",
       output_format = "pdf_document",
       params = list(species = "virginica"))
```

Go through

`challenge-08.Rmd` and `challenge-09.Rmd`

10:00

Themes: `html_document`

You can change the look of the html document by specifying themes:

- `default`
- `cerulean`
- `journal`
- `flatly`
- `darkly`
- `readable`
- `spacelab`
- `united`
- `cosmo`
- `lumen`
- `paper`
- `sandstone`
- `simplex`
- `yeti`
- `NULL`

```
output:
  html_document:
    theme: cerulean
```

These bootswatch themes attach the whole bootstrap library which makes your html file size larger.

prettydoc

prettydoc 📦 is a community contributed theme that is light-weight:

- cayman
- tactile
- architect
- leonids
- hpstr

```
output:
  prettydoc::html_pretty:
    theme: cayman
```

See more about it below:

https://prettydoc.statr.me/

rmdformats

rmdformats 📦 contains four built-in html formats:

- readthedown
- html_clean
- html_docco
- material

You can use these formats by simply specifying the output in YAML as below:

```
output: rmdformats::readthedown
```

See more about it below:

https://github.com/juba/rmdformats

`rticles` - LaTeX Journal Article Templates

- `acm`
- `acs`
- `aea`
- `agu`
- `amq`
- `ams`
- `asa`
- `biometrics`
- `copernicus`
- `elsevier`
- `frontiers`
- `ieee`
- `jss`
- `mdpi`
- `mnras`
- `peerj`
- `plos`
- `pnas`
- `rjournal`
- `rsos`
- `rss`
- `sage`
- `sim`
- `springer`
- `tf`

Go to RStudio > File > New File > R Markdown ... > From Template

External Files in Templating

- When using `rticles`, each journal usually require external files (e.g. `cls` or image files).
- These external components are stored within the package.
- If you are drafting an Rmd template with external components then you need to extract these to your folder first.

GUI

- `RStudio > File > New File > R Markdown ... > From Template`

Command line

```
rmarkdown::draft("file.Rmd",
  template = "biometrics_article",
  package = "rticles")
```

More customisation needed?

Default templates for many output are found at

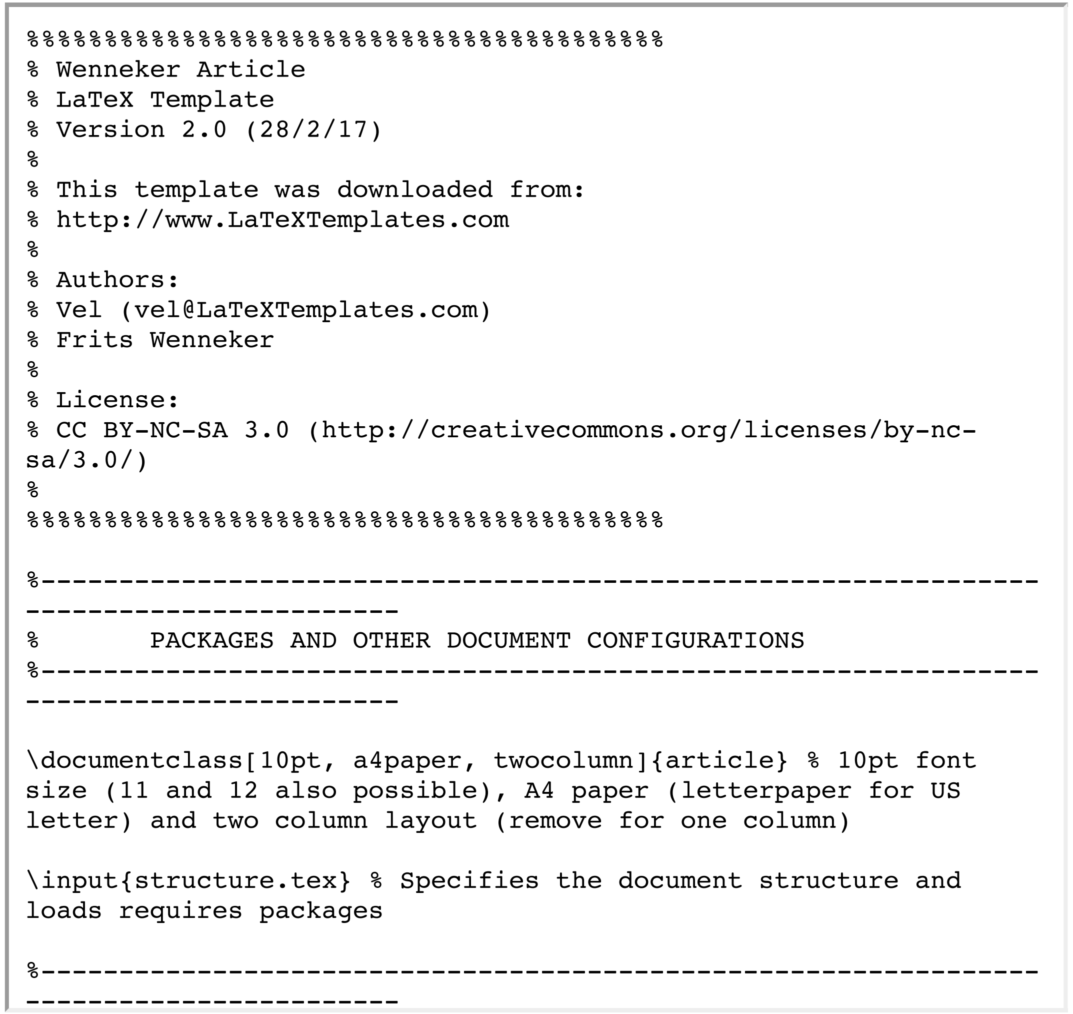
https://github.com/jgm/pandoc-templates

We'll go through the latex template.

I found this nice latex template online.

You can see it at `main.pdf`.

It was compiled from `main.tex`.



```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Wenneker Article
% LaTeX Template
% Version 2.0 (28/2/17)
%
% This template was downloaded from:
% http://www.LaTeXTemplates.com
%
% Authors:
% Vel (vel@LaTeXTemplates.com)
% Frits Wenneker
%
% License:
% CC BY-NC-SA 3.0 (http://creativecommons.org/licenses/by-nc-
sa/3.0/)
%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%----------------------------------------------------------------
------------------------
%       PACKAGES AND OTHER DOCUMENT CONFIGURATIONS
%----------------------------------------------------------------
------------------------

\documentclass[10pt, a4paper, twocolumn]{article} % 10pt font
size (11 and 12 also possible), A4 paper (letterpaper for US
letter) and two column layout (remove for one column)

\input{structure.tex} % Specifies the document structure and
loads requires packages

%----------------------------------------------------------------
------------------------
```

Find `main.tex` and `main.pdf` in demo folder.

How do I use this template so that I can write contents from an Rmd file instead?

Templating

We will use

```
---
output:
  pdf_document:
    template: main.tex
---

But nothing written in the body shows up in the output!
```

You need to add `$body$` in the latex template file where you want the body of the md file to appear.

Templating: few more tweaks

- R Markdown needs a few more special tweaks before `\begin{document}` in latex template:

```
\IfFileExists{bookmark.sty}{\usepackage{bookmark}}{\usepackage{hyperref}}
$if(highlighting-macros)$
$highlighting-macros$
$endif$
```

- These are *minimum* tweaks needed for a LaTeX template.
- You can find common tweaks (including for beamer) at https://github.com/jgm/pandoc-templates
- You can define your own tweaks but it is better practice to use the ones defined in pandoc template rather than trying to reinvent the wheel.

How pandoc template works: `key`

`Rmd`

```
---
title: "COMBINE 2019"
author: "Emi Tanaka"
output:
  pdf_document:
    template: "template.tex"
---
```

YAML meta data can be used by surrounding `key` with $.

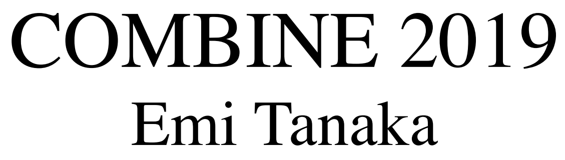
`template.tex`

```
\documentclass{article}
\title{$title$}
\author{$author$}
\date{}

\begin{document}

\maketitle

\end{document}
```



COMBINE 2019

Emi Tanaka

How pandoc template works: if statements

Rmd

```
---
title: "COMBINE 2019"
author: "Emi Tanaka"
output:
  pdf_document:
    template: "template.tex"
---
```

Simple "if null statements".

template.tex

```
\documentclass[
$if(fontsize)$
$fontsize$,
$endif$
]{article}
\title{$title$}
\author{$author$}
\date{}

\begin{document}

\maketitle

\end{document}
```

How pandoc template works: accessing list

`Rmd`

```
---
title: "COMBINE 2019"
author:
 - name: "Rachel Wang"
   email: "rachel.wang@sydney.edu.au"
 - name: "Connor Smith"
   email: "connor.smith@sydney.edu.au"
output:
  pdf_document:
    template: "template.tex"
---
```

Here it will become

```
\author{Rachel Wang \and Connor Smith}
```

`template.tex`

```
\documentclass{article}
\title{$title$}
\author{
$for(author)$
$author.name$$sep$ \and
$endfor$
}
\date{}

\begin{document}

\maketitle

\end{document}
```

Go through

`challenge-10.Rmd`

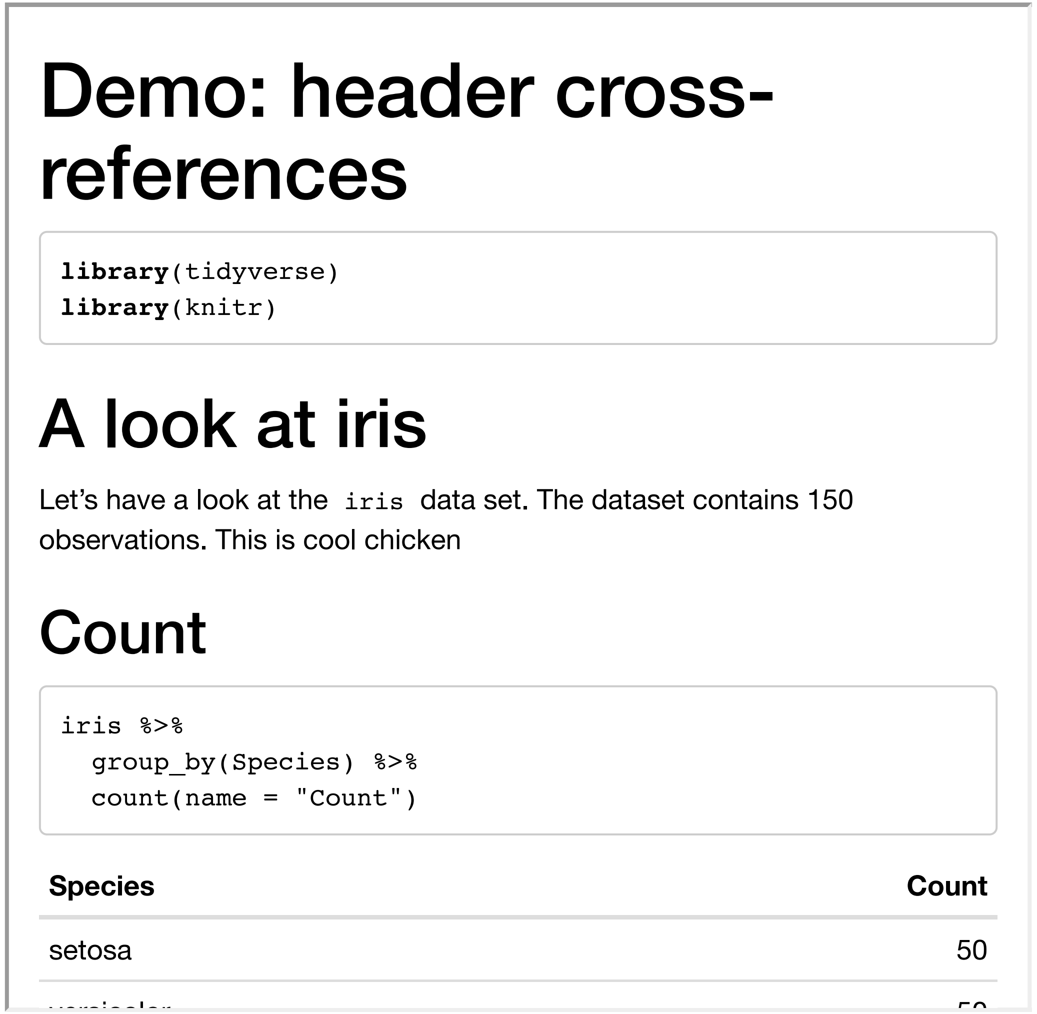
05:00

Cross Reference

- When you make a header via Rmd

  ```
  # Some Header
  ```

  an id is created automatically.
- The id is created by replacing space with – and making it all lower case.
- Now you can link to this header by `[some text](#some-header)`.
- Cross references work for both pdf and html outputs.



Demo: header cross-references

```
library(tidyverse)
library(knitr)
```

A look at iris

Let’s have a look at the `iris` data set. The dataset contains 150 observations. This is cool chicken

Count

```
iris %>%
  group_by(Species) %>%
  count(name = "Count")
```

Species	Count
setosa	50
versicolor	50

Direct Reference for `html`

- For `html` output, you can also give a link directly to the relevant section.
- E.g. open `demo-header.html` in the `demo` folder in a web browser.
- Append say `#chicken-data` to the url. It should look like

  `demo-header.html#chicken-data`

- It should have taken you to straight to the corresponding header.

User-defined id

- You can define your own id by appending `{#your-id}`.

```
# Some header {#header1}
```

- Now you can link to this header with the id `header1`.
- Note there should be no space in the id name!

Bibliography

- BibTeX citation style format is used to store references in `.bib` files.
- Remember that you can get most BibTeX citation for R packages `citation` function. (Scroll below to see the BibTeX citation).

```
citation("xaringan")
```

```
##
## To cite package 'xaringan' in publications use:
##
##   Yihui Xie (2019). xaringan: Presentation Ninja. R package
##   version 0.9. https://CRAN.R-project.org/package=xaringan
##
## A BibTeX entry for LaTeX users is
##
##   @Manual{,
##     title = {xaringan: Presentation Ninja},
```

Citations

- You can include BibTeX by specifying the `bib` file at YAML as:

```
bibliography: bibliography.bib
```

[@bibtex-key] → (Author et al. 2019)

or

@bibtex-key → Author et al. 2019

- See `demo-citation.Rmd` in the demo folder.

R Markdown is such an *indispensible tool* for making documents, especially if you have plan to *include statistical output.*

How do you use (or plan to use) R Markdown?

People that made R Markdown possible

The development of R Markdown is largely thanks to

- Yihui Xie
  Software Engineer at RStudio
  for `knitr`

- John MacFarlane
  Professor of Philosophy at UC Berkeley
  for `pandoc`

- and many contributors behind the development of these tools.

POEMS ELLA WHEELER WILCOX
POETICAL WORKS
CAPTAIN COOK
REPORTS OF TAX CASES
VOL. I.
1875 — 1883