Reproducible Documents with `{rmarkdown}`

Day 2

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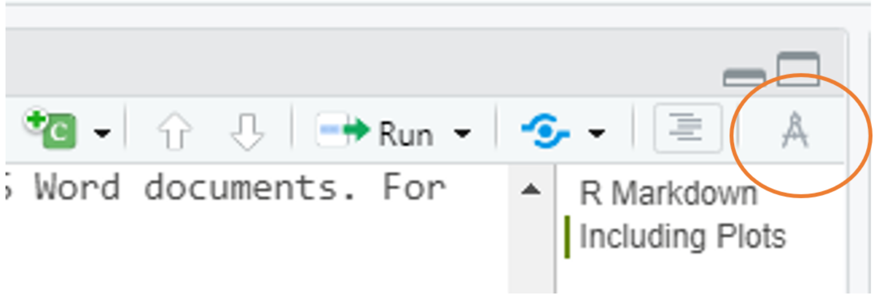
Topics today

- Citations
- A bit more output formats
    - `html_document`
    - `pdf_document`
    - `word_document`
- Make tables look nice
- Some more tips and good practice

The visual editor in RStudio

- WYSIWYG editor (*What you see is what you get*)
    - More similar to Word etc. but with less functionality
- Click on the button on the top right



```
Word documents. For
```

- Very helpful in the beginning until you remember how everything works in markdown
- Especially helpful for markdown tables and citations
- But careful: Can reformat the `.Rmd` file a bit, so sometimes if you switch back it can look different than before.

Adding citations - The classic way

Bibliographies can be included via a BibTeX data base.

- Create a `.bib` file that consists of bibliography entries

```
@Book{cookbook,
  title = {R Markdown Cookbook},
  author = {Yihui Xie and Christophe Dervieux and Emily Riederer},
  publisher = {Chapman and Hall/CRC},
  address = {Boca Raton, Florida},
  year = {2020},
  note = {ISBN 9780367563837},
  url = {https://bookdown.org/yihui/rmarkdown-cookbook},
  }
```

Adding citations - The classic way

Bibliographies can be included via a BibTeX data base.

- Create a `.bib` file that consists of bibliography entries
- Add name and location of your `.bib` file as a medatada field in YAML header

```
---
output: html_document
bibliography: references.bib
---
```

- Cite an article from the database with `@bib_item_name` for in text citations or `[@bib_item_name]` for citation in brackets
  - Here, I cite `@cookbook` because it's a good book `[@cookbook]`
  - Here, I cite Xie, Dervieux, and Riederer (2020) because it's a good book (Xie, Dervieux, and Riederer 2020)
- List of references used will be added to the end of the document
  - Just add a heading `# References` to end of the doc

Adding citations - The classic way

- Add a custom citation style file with:

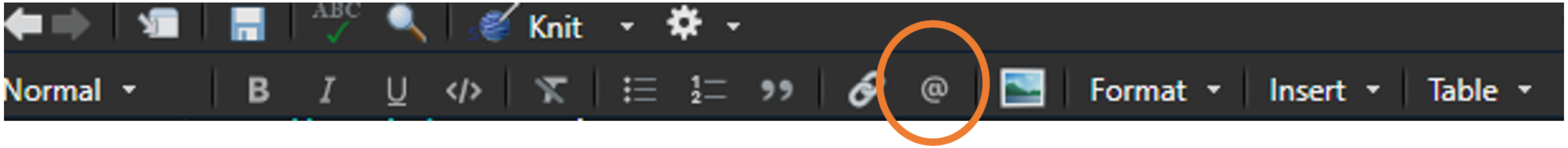
```
---
output: html_document
bibliography: references.bib
csl: myrefstyle.csl
---
```

- Most (all?) reference managers can export your citations as a `.bib` file
- Problem: RStudio does not auto-fill citations
    - You have to know the name of the citation in order to cite it

Adding citations - Visual editor

Citations can also be added using the **visual editor** in RStudio.

- Visual editor creates and extends `.bib` file automatically
- Search and add citations from
  - The bibliography file
  - Zotero
  - DOI
  - ...
- Just click on the `@` symbol in the visual editor to add a citation



- You can also start typing `@` and the editor will suggest you a list of citations that fit

Adding citations - Visual editor

Using Zotero

- If you use Zotero on your machine, RStudio should automatically detect the installation
- If not, go to `Tools->Global Options->R Markdown -> Citations` and enter the location of your Zotero data directory and the library that you would like to use
    - In General this should be recognized automatically

Now you

Task 1: Add some citations

Find the task description here

A bit more output formats

`html_document`, `pdf_document`, `word_document`

Specify multiple ouput types

- Specify multiple output types in the YAML header
    - Here just the default settings

```
---
title: "My first document"
author: "Selina Baldauf"
date: "3/22/2022"
output:
  html_document: default
  pdf_document: default
bibliography: references.bib
---
```

- Decide which output you want before rendering
- Chose the output type with the little arrow next to the knit button
- If you knit without specifying the output type, the last rendered type is taken

Specify different ouput types

- Specify the options for different output types in the yaml header

```
---
title: "My first document"
author: "Selina Baldauf"
date: "3/22/2022"
output:
  html_document:
    toc: true
    toc_float: true
    highlight: "kate"
  pdf_document:
    toc: true
    highlight: "espresso"
bibliography: references.bib
---
```

- Keep in mind that multiple output types can become difficult if you use a lot of options and functionality specific only to one of the types
  - You will see this later e.g. when formatting tables

`html_document`

See here for more examples and options

`html_document`

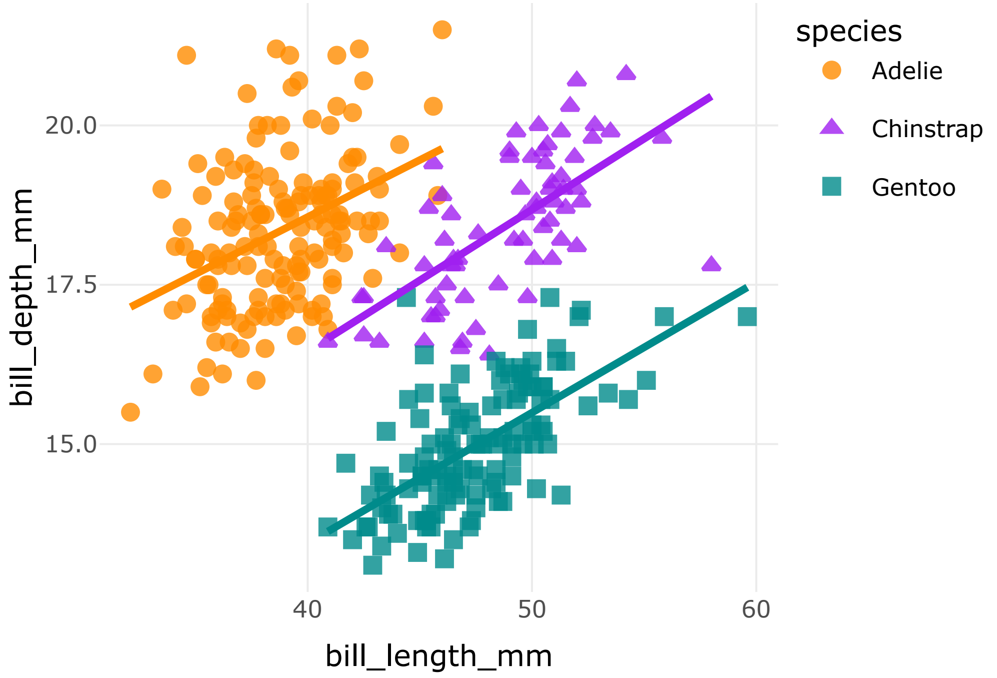
Interactive graphs e.g. with `plotly`

```r
library(ggplot2)
scatter <- ggplot(
  data = penguins,
  aes(
    x = bill_length_mm,
    y = bill_depth_mm,
    color = species,
    shape = species
  )
) +
  geom_point(size = 2, alpha = 0.8) +
  geom_smooth(method = "lm", se = FALSE) +
  scale_color_manual(values = c("darkorange", "purple", "cyan4")) +
  theme_minimal()
```

html_document

Interactive graphs e.g. with `plotly`

```r
library(plotly)
ggplotly(scatter)
```



html_document

Tabbed sections

```
## This is the main section {.tabset}

And here I add some text to the main section.

### The first tab

some content

### The second tab

some other content
```

`html_document`

Customize with HTML and CSS (Advanced)

- Customize elements using HTML and/or CSS (advanced)
- Define custom elements
- Add the custom CSS to the YAML header

```
output:
  html_document:
    css: "my-style.css"
```

- Add HTML tags with CSS e.g. to change font color

`<span style="color: red;">red text</span>` becomes <span style="color: red;">red text</span>

`pdf_document`

See here for more examples and options

pdf_document

See all options and default values with `?rmarkdown::pdf_document`

- `fig_caption` will automatically number figures
- `citation_package` define the citation package to use (`natbib` or `biblatex`)
- `keep_tex`: Keep the intermediate `*.tex` file?
- `template`: Path to a template file

Example

```
---
title: "My first document"
author: "Selina Baldauf"
date: "3/22/2022"
output:
  pdf_document:
    fig_caption: true
    citation_package: "natbib"
    keep_tex: true
    template: "my_template.tex"
---
```

`pdf_document`

- You can use LaTeX syntax in the text
- Define some latex options as *top-level* YAML metadata, e.g.

```
---
title: "My first document"
author: "Selina Baldauf"
date: "3/22/2022"
output:
  pdf_document:
    fig_caption: true
fontsize: 11pt
geometry: "margin=1in"
documentclass: "article"
urlcolor: "blue"
---
```

`word_document`

See here for more examples and options

`word_document`

See all options and default values with `?rmarkdown::word_document`

- Not so many features directly available in R Markdown
- Use an office template for customization

```
---
title: "My first document"
author: "Selina Baldauf"
date: "3/22/2022"
output:
  word_document:
    reference_docx: "my-styles.docx"
---
```

Read or watch how to create a custom office template

- Package `{officedown}` might be useful
  - It offers templates for advanced Word documents and Powerpoint presentations
  - `File` -> `New File` -> `R Markdown...` -> `From Template`

Now you

Task 1: Create some documents

Find the task description here

Nice looking tables in R Markdown

Nice looking tables with R Markdown

- The default for printing tables looks the same as printing it in the console:

```
iris_sum
```

```
## # A tibble: 3 x 5
##   Species    Sepal.Length Sepal.Width Petal.Length Petal.Width
##   <fct>             <dbl>       <dbl>        <dbl>       <dbl>
## 1 setosa             5.01        3.43         1.46       0.246
## 2 versicolor         5.94        2.77         4.26       1.33
## 3 virginica          6.59        2.97         5.55       2.03
```

- This is not really nice for documents

`knitr::kable()`

Simple to use table generator from the `knitr` package.

```
knitr::kable(iris_sum) # or iris_sum %>% knitr::kable()
```

Species	Sepal.Length	Sepal.Width	Petal.Length	Petal.Width
setosa	5.006	3.428	1.462	0.246
versicolor	5.936	2.770	4.260	1.326
virginica	6.588	2.974	5.552	2.026

- Chose `kable` as default table printing in YAML header:

```
df_print: "kable"
```

`knitr::kable()`

Add arguments for additional formatting:

```r
kable(x,
  format,
  digits = getOption("digits"),
  row.names = NA,
  col.names = NA,
  align, caption = NULL,
  label = NULL,
  format.args = list(),
  escape = TRUE, ...
)
```

- See here for many examples many different use cases

knitr::kable()

Example:

```
knitr::kable(
  iris_sum,
  digits = 1,
  col.names = c("Species", "Sepal Length", "Sepal Width", "Petal Length", "Petal Width"),
  caption = "Summary of the Iris data",
  align = "l"
)
```

Summary of the Iris data

Species	Sepal Length	Sepal Width	Petal Length	Petal Width
setosa	5.0	3.4	1.5	0.2
versicolor	5.9	2.8	4.3	1.3
virginica	6.6	3.0	5.6	2.0

The `{kableExtra}` package

- Most of the features work for both HTML and PDF tables
- Find the full documentation here
  - If you use tables a lot, I recommend looking through the documentation to see all possibilities
- You can use the pipe operator (`%>%`) to pipe `kable()` output to styling functions
- The basic styling function is `kable_styling()`

```r
library(knitr)
library(kableExtra)
kable(iris_sum) %>% kable_styling(font_size = 14)
```

Species	Sepal.Length	Sepal.Width	Petal.Length	Petal.Width
setosa	5.006	3.428	1.462	0.246
versicolor	5.936	2.770	4.260	1.326
virginica	6.588	2.974	5.552	2.026

The `{kableExtra}` package

`kable_styling()`

- Some simple styling options

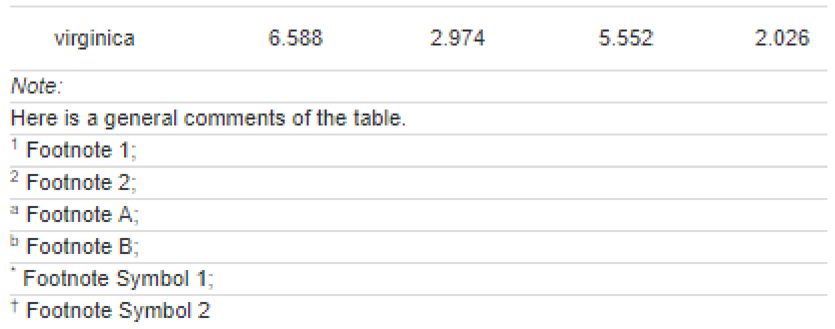
```
iris_sum %>% kable() %>%
  kable_styling(
  full_width = FALSE, # display table on full page width?
  position = "left",  # if not full width -> where
  font_size = 15
)
```

Species	Sepal.Length	Sepal.Width	Petal.Length	Petal.Width
setosa	5.006	3.428	1.462	0.246
versicolor	5.936	2.770	4.260	1.326
virginica	6.588	2.974	5.552	2.026

The {kableExtra} package

Adding footnotes

```r
iris_sum %>%
  kable() %>%
  footnote(general = "Here is a general comments of the table. ",
           number = c("Footnote 1; ", "Footnote 2; "),
           alphabet = c("Footnote A; ", "Footnote B; "),
           symbol = c("Footnote Symbol 1; ", "Footnote Symbol 2")
           )
```



virginica	6.588	2.974	5.552	2.026

Note:
Here is a general comments of the table.
[1] Footnote 1;
[2] Footnote 2;
[a] Footnote A;
[b] Footnote B;
[*] Footnote Symbol 1;
[†] Footnote Symbol 2

The {kableExtra} package

Packing rows and columns

```
iris_sum %>%
  kable() %>%
  add_header_above(c("","Sepals" = 2, "Petals" = 2)) %>%
  pack_rows("Group 1", 1, 1) %>%
  pack_rows("Group 2", 2,3)
```

	Sepals		Petals	
Species	Sepal.Length	Sepal.Width	Petal.Length	Petal.Width
Group 1				
setosa	5.006	3.428	1.462	0.246
Group 2				
versicolor	5.936	2.770	4.260	1.326
virginica	6.588	2.974	5.552	2.026

The `{kableExtra}` package

Some predefined html themes

- `kableExtra` offers some themes for HTML tables
  - `kable_paper`, `kable_classic`, `kable_classic_2`, `kable_minimal`, `kable_material` and `kable_material_dark`
  - Use them alternative to `kable_styling()`

```
kable(iris_sum) %>% kable_classic(c("striped", "hover"))
```

Species	Sepal.Length	Sepal.Width	Petal.Length	Petal.Width
setosa	5.006	3.428	1.462	0.246
versicolor	5.936	2.770	4.260	1.326
virginica	6.588	2.974	5.552	2.026

The `{kableExtra}` package

PDF/LaTeX options

```r
iris_sum %>% kable(booktabs = TRUE) %>%
  kable_styling(latex_options = c("striped", "hold_position"))
```

- `booktabs = TRUE` will use the `booktabs` package to create nicer horizontal lines and removes vertical lines
- `hold_position` places the table where it is created in the docuemnt (no floating)
- `striped` creates striped tables

The {kableExtra} package

- In general, style your table in a way that fits your primary output format
- If you have multiple output formats, you can chose a table style that looks good in all output formats

Example

```r
iris_sum %>% kable(booktabs = TRUE, caption = "Iris table") %>%
  kable_styling(latex_options = c("striped", "hold_position"),
                full_width = FALSE,
                position = "left",
                font_size = 10
                )
```

Iris table

Species	Sepal.Length	Sepal.Width	Petal.Length	Petal.Width
setosa	5.006	3.428	1.462	0.246
versicolor	5.936	2.770	4.260	1.326
virginica	6.588	2.974	5.552	2.026

- Some LaTeX options will just be ignored in HTML output

The `{flextable}` package

- Works with PDF, HTML and Word output
    - I recommend it for Word output
- Alternative to `kable` and `kableExtra`
- Set options for all tables in beginning (e.g. in setup chunk)

```r
library(flextable)
set_flextable_defaults(
  font.size = 10,
  theme_fun = theme_booktabs,
  padding = 6,
  digits = 1
)
```

- See all options with `?flextable::set_flextable_defaults`

The {flextable} package

- An example table that looks decent in all 3 outputs

```r
iris_sum %>%
  flextable() %>%
  set_header_labels(
    Sepal.Length = "Sepal Length",
    Sepal.Width = "Sepal Width",
    Petal.Length = "Petal Length",
    Petal.Width = "Petal Width"
  ) %>%
  autofit()
```

Species	Sepal Length	Sepal Width	Petal Length	Petal Width
setosa	5.006	3.428	1.462	0.246
versicolor	5.936	2.770	4.260	1.326
virginica	6.588	2.974	5.552	2.026

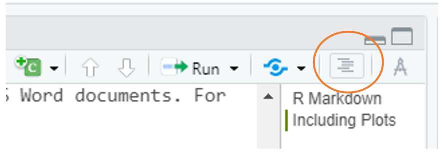
- See here for all the functions that you can add to the flextable
  - Use `?function_name` to see how to use the function

Some general tips and good practice

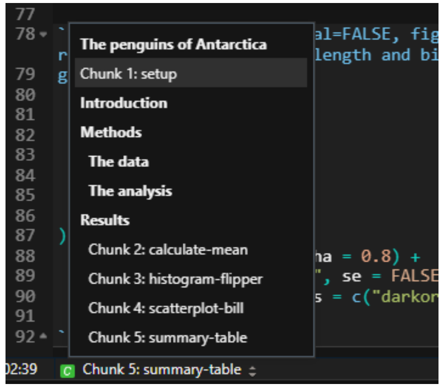
Tip 1: Keep your document clean

`.Rmd` documents can quickly become large and messy. To keep them clean, you can

- Use headers to mark sections in your document
  - Navigate the file using the document outline



- Use names for your code chunks
  - Navigate code chunks with the code and document outline (bottom left of script)



Tip 2: Source large data preparation scripts

- Related to Tip 1
- If it's not necessary for the document, do data preparation in a separate R Script
- Place that R Script in the project where the `.Rmd` is located
- Then source the script in a code chunk:

~~~
```{r prepare-data, warning=TRUE, message=TRUE}
source("path/to/script.R")
```
~~~

- This runs all the R code in `script.R` and loads the results into the `.Rmd` document

Tip 3: Split larger documents into multiple `.Rmd` files

- Related to Tip 1
- Write separate `.Rmd` files e.g. for Introduction, Methods and Results
- Have on main `.Rmd` file that
  - Combines the sections into one
  - Controls YAML options of the output
- You can load an `.Rmd` file into another one using the `child` chunk option

~~~
```{r load-child, child="path/to/child.Rmd"}
```
~~~

Tip 3: Split larger documents into multiple `.Rmd` files

- 3 separate files `Introduction.Rmd`, `Methods.Rmd`, `Results.Rmd`

- The separate files control everything that happens on the lower levels of the documents, e.g.

~~~
## First results

```{r result-plot, fig.width=3}
plot(1:10, 1:10)
```
~~~

- `Main.Rmd` (see right) controls
  - YAML options
  - Global setup options
  - Includes the sections via the `child` option

~~~
---
title: "My paper"
author: "Selina Baldauf"
output:
  pdf_document:
    toc: true
---

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

# Introduction

```{r intro, child="Introduction.Rmd"}
```

# Methods

```{r methods, child="Methods.Rmd"}
```

# Results

```{r results, child="Results.Rmd"}
```
~~~

Tip 4: Read through some online resources

- Read or scroll through some R Markdown books or tutorials to
  - See what is possible with R Markdown
  - Find thing that are relevant for your own documents
- I recommend to start with the two books:
  - R Markdown Cookbook
  - R Markdown - The Definitve Guide
- You can also find some resources on the workshop website