Introduction to R Markdown & R Notebooks

What‘s the rough idea for today?

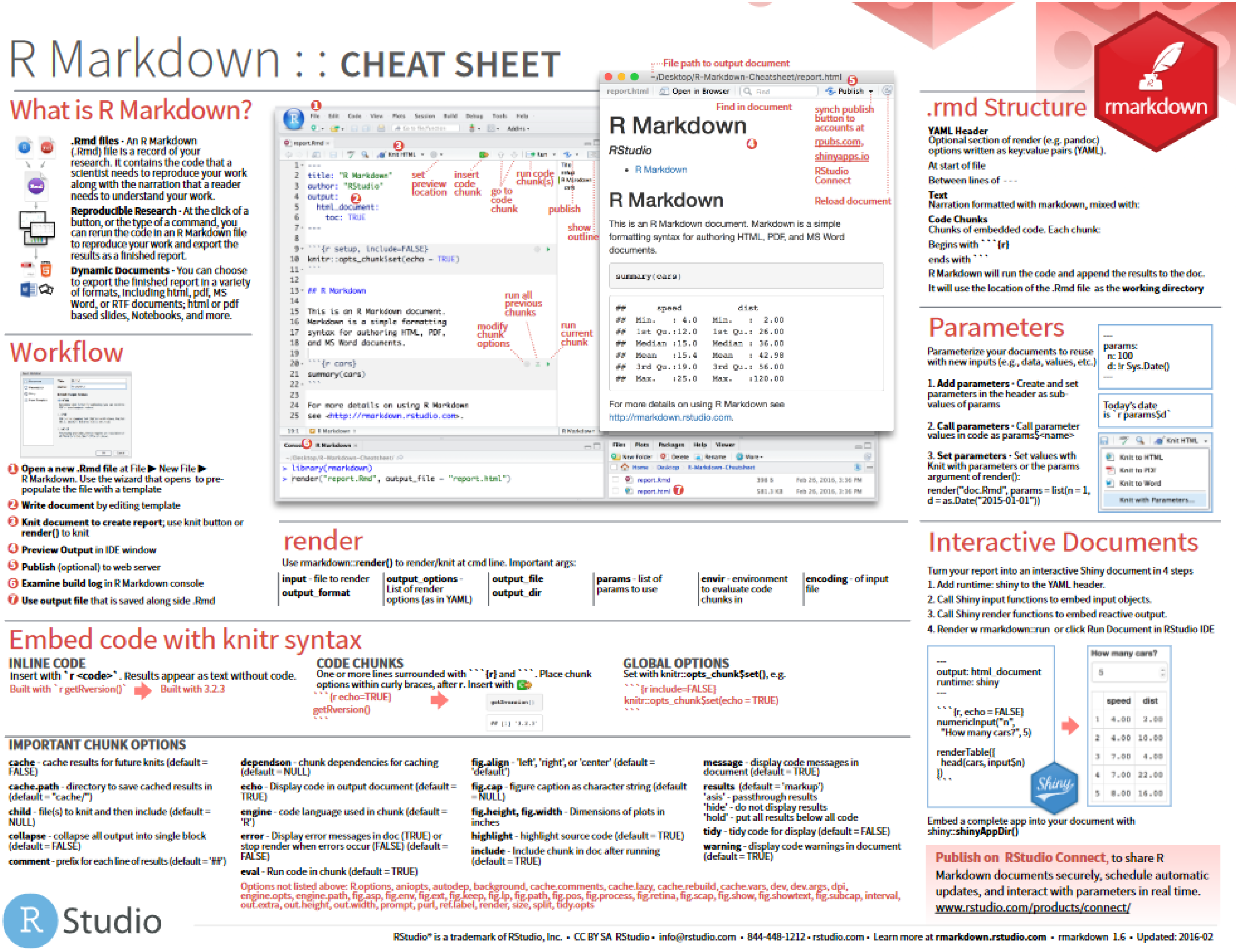
- We create an R Notebook aka R Markdown document
- We edit the header (meta-information about the document)
- We write some text and some code organized in so-called „chunks“
- We load some data and save it as a csv file
- We „knit“ the document and get the output (as preview, html, pdf or word)

What does an R Notebook do?

- combining code and rich text elements, such as headings, paragraphs and links, in one document
- Uses Rmarkdown, a language to write fully-formatted documents (file extension .Rmd)
- analysis and reporting in the same location, directly linking the two
- sometimes called “literate programming”
- makes reporting reproducible, as data are directly included in the document and not simply copypasted

https://argoshare.is.ed.ac.uk/healthyr_book/chap12-h1.html

Cheatsheets



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

~~~
---
title: "R Markdown"
author: "RStudio"
output:
  html_document:
    toc: TRUE
---

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

R Markdown

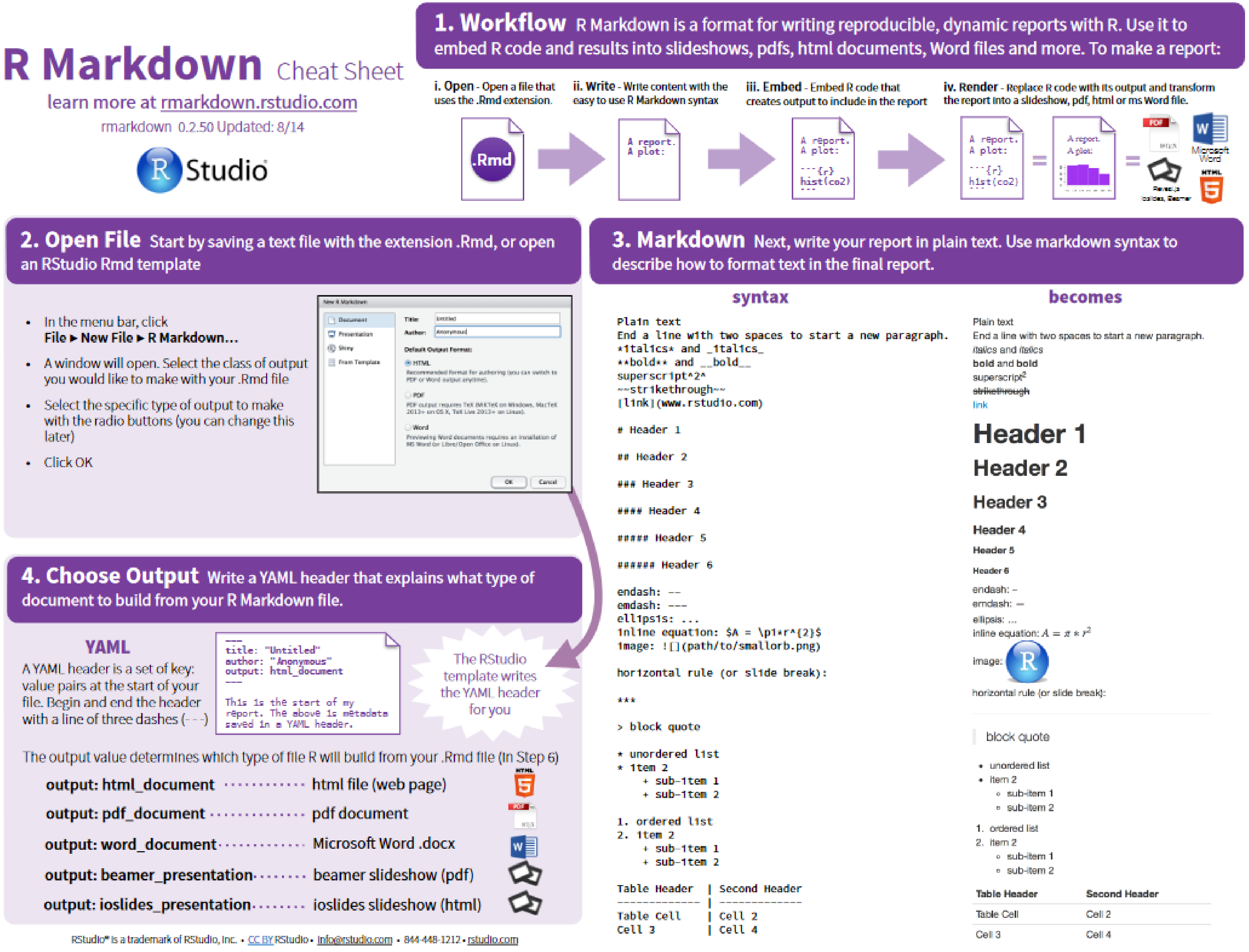
This is an R Markdown document.
Markdown is a simple formatting
syntax for authoring HTML, PDF,
and MS Word documents.

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

For more details on using R Markdown
see <http://rmarkdown.rstudio.com>.
```

```
> library(rmarkdown)
> render("report.Rmd", output_file = "report.html")
```


set preview location
insert code chunk
go to code chunk
run code chunk(s)
publish
show outline
run all previous chunks
modify chunk options
run current chunk
File path to output document
~/Desktop/R-Markdown-Cheatsheet/report.html
Open in Browser
Publish
Find in document
synch publish button to accounts at
rpubs.com,
shinyapps.io
RStudio Connect
Reload document
report.Rmd
report.html

R Markdown

RStudio

- R Markdown

R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents.

```
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
```

For more details on using R Markdown see http://rmarkdown.rstudio.com.

render

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

input - file to render
output_format

output_options - List of render options (as in YAML)

output_file
output_dir

params - list of params to use

envir - environment to evaluate code chunks in

encoding - of input file

.rmd Structure

rmarkdown

YAML Header
Optional section of render (e.g. pandoc) options written as key:value pairs (YAML).

At start of file

Between lines of - - -

Text
Narration formatted with markdown, mixed with:

Code Chunks
Chunks of embedded code. Each chunk:

Begins with ```{r}

ends with ```

R Markdown will run the code and append the results to the doc.

It will use the location of the .Rmd file as the **working directory**

Parameters

Parameterize your documents to reuse with new inputs (e.g., data, values, etc.)

1. **Add parameters** - Create and set parameters in the header as sub-values of params
2. **Call parameters** - Call parameter values in code as params$<name>
3. **Set parameters** - Set values wth Knit with parameters or the params argument of render():

render("doc.Rmd", params = list(n = 1, d = as.Date("2015-01-01"))

```
---
params:
  n: 100
  d: !r Sys.Date()
---
```

Today's date is `r params$d`

Knit HTML
Knit to HTML
Knit to PDF
Knit to Word
Knit with Parameters...

Interactive Documents

Turn your report into an interactive Shiny document in 4 steps

1. Add runtime: shiny to the YAML header.
2. Call Shiny input functions to embed input objects.
3. Call Shiny render functions to embed reactive output.
4. Render w rmarkdown::run or click Run Document in RStudio IDE

```
---
output: html_document
runtime: shiny
---

```{r, echo = FALSE}
numericInput("n",
  "How many cars?", 5)

renderTable({
  head(cars, input$n)
})
```
```

How many cars?

5

	speed	dist
1	4.00	2.00
2	4.00	10.00
3	7.00	4.00
4	7.00	22.00
5	8.00	16.00

Embed a complete app into your document with shiny::**shinyAppDir()**

Publish on RStudio Connect, to share R Markdown documents securely, schedule automatic updates, and interact with parameters in real time.
www.rstudio.com/products/connect/

Embed code with knitr syntax

INLINE CODE

Insert with `r <code>`. Results appear as text without code.

Built with `r getRversion()` ➡ Built with 3.2.3

CODE CHUNKS

One or more lines surrounded with ```{r} and ```. Place chunk options within curly braces, after r. Insert with

```
```{r echo=TRUE}
getRversion()
```
```

➡

```
getRversion()
```

```
## [1] '3.2.3'
```

GLOBAL OPTIONS

Set with knitr::**opts_chunk$set()**, e.g.

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

IMPORTANT CHUNK OPTIONS

cache - cache results for future knits (default = FALSE)

cache.path - directory to save cached results in (default = "cache/")

child - file(s) to knit and then include (default = NULL)

collapse - collapse all output into single block (default = FALSE)

comment - prefix for each line of results (default = '##')

dependson - chunk dependencies for caching (default = NULL)

echo - Display code in output document (default = TRUE)

engine - code language used in chunk (default = 'R')

error - Display error messages in doc (TRUE) or stop render when errors occur (FALSE) (default = FALSE)

eval - Run code in chunk (default = TRUE)

fig.align - 'left', 'right', or 'center' (default = 'default')

fig.cap - figure caption as character string (default = NULL)

fig.height, fig.width - Dimensions of plots in inches

highlight - highlight source code (default = TRUE)

include - Include chunk in doc after running (default = TRUE)

message - display code messages in document (default = TRUE)

results (default = 'markup')
'asis' - passthrough results
'hide' - do not display results
'hold' - put all results below all code

tidy - tidy code for display (default = FALSE)

warning - display code warnings in document (default = TRUE)

Options not listed above: R.options, aniopts, autodep, background, cache.comments, cache.lazy, cache.rebuild, cache.vars, dev, dev.args, dpi, engine.opts, engine.path, fig.asp, fig.env, fig.ext, fig.keep, fig.lp, fig.path, fig.pos, fig.process, fig.retina, fig.scap, fig.show, fig.showtext, fig.subcap, interval, out.extra, out.height, out.width, prompt, purl, ref.label, render, size, split, tidy.opts

RStudio

RStudio® is a trademark of RStudio, Inc. • CC BY SA RStudio • info@rstudio.com • 844-448-1212 • rstudio.com • Learn more at **rmarkdown.rstudio.com** • rmarkdown 1.6 • Updated: 2016-02

https://raw.githubusercontent.com/rstudio/cheatsheets/master/rmarkdown-2.0.pdf
```

# Cheatsheets



**R Markdown** Cheat Sheet

learn more at rmarkdown.rstudio.com

rmarkdown 0.2.50 Updated: 8/14

RStudio

**1. Workflow** R Markdown is a format for writing reproducible, dynamic reports with R. Use it to embed R code and results into slideshows, pdfs, html documents, Word files and more. To make a report:

**i. Open** - Open a file that uses the .Rmd extension.

**ii. Write** - Write content with the easy to use R Markdown syntax

**iii. Embed** - Embed R code that creates output to include in the report

**iv. Render** - Replace R code with its output and transform the report into a slideshow, pdf, html or ms Word file.

.Rmd
A report.
A plot:
```{r}
hist(co2)
```
=
Microsoft Word
Reveal.js
ioslides, Beamer
HTML

2. Open File Start by saving a text file with the extension .Rmd, or open an RStudio Rmd template

- In the menu bar, click **File ▸ New File ▸ R Markdown…**
- A window will open. Select the class of output you would like to make with your .Rmd file
- Select the specific type of output to make with the radio buttons (you can change this later)
- Click OK

New R Markdown

Document
Presentation
Shiny
From Template

Title: Untitled
Author: Anonymous

Default Output Format:

● HTML
Recommended format for authoring (you can switch to PDF or Word output anytime).

○ PDF
PDF output requires TeX (MiKTeX on Windows, MacTeX 2013+ on OS X, TeX Live 2013+ on Linux).

○ Word
Previewing Word documents requires an installation of MS Word (or Libre/Open Office on Linux).

OK Cancel

3. Markdown Next, write your report in plain text. Use markdown syntax to describe how to format text in the final report.

syntax

```
Plain text
End a line with two spaces to start a new paragraph.
*italics* and _italics_
**bold** and __bold__
superscript^2^
~~strikethrough~~
[link](www.rstudio.com)

# Header 1

## Header 2

### Header 3

#### Header 4

##### Header 5

###### Header 6

endash: --
emdash: ---
ellipsis: ...
inline equation: $A = \pi*r^{2}$
image: ![](path/to/smallorb.png)

horizontal rule (or slide break):

***

> block quote

* unordered list
* item 2
    + sub-item 1
    + sub-item 2

1. ordered list
2. item 2
    + sub-item 1
    + sub-item 2

Table Header  | Second Header
------------- | -------------
Table Cell    | Cell 2
Cell 3        | Cell 4
```

becomes

Plain text
End a line with two spaces to start a new paragraph.
italics and *italics*
bold and **bold**
superscript^2
~~strikethrough~~
link

Header 1

Header 2

Header 3

Header 4

Header 5

Header 6

endash: –
emdash: —
ellipsis: …
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  - sub-item 1
  - sub-item 2

1. ordered list
2. item 2
   - sub-item 1
   - sub-item 2

Table Header	Second Header
Table Cell	Cell 2
Cell 3	Cell 4

4. Choose Output Write a YAML header that explains what type of document to build from your R Markdown file.

YAML

A YAML header is a set of key: value pairs at the start of your file. Begin and end the header with a line of three dashes (- - -)

```
---
title: "Untitled"
author: "Anonymous"
output: html_document
---

This is the start of my
report. The above is metadata
saved in a YAML header.
```

The RStudio template writes the YAML header for you

The output value determines which type of file R will build from your .Rmd file (in Step 6)

output: html_document ············ html file (web page)
output: pdf_document ·············· pdf document
output: word_document ············ Microsoft Word .docx
output: beamer_presentation ······· beamer slideshow (pdf)
output: ioslides_presentation ······· ioslides slideshow (html)

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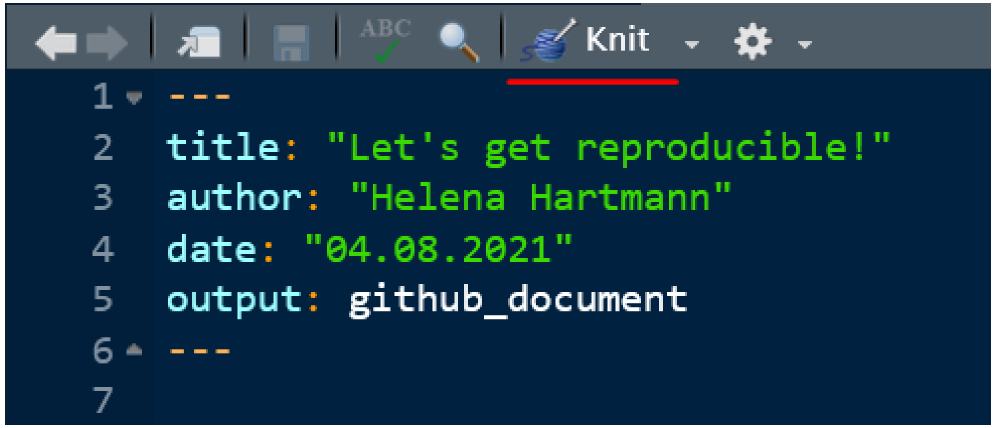
www.rstudio.com/wp-content/uploads/2015/02/rmarkdown-cheatsheet.pdf

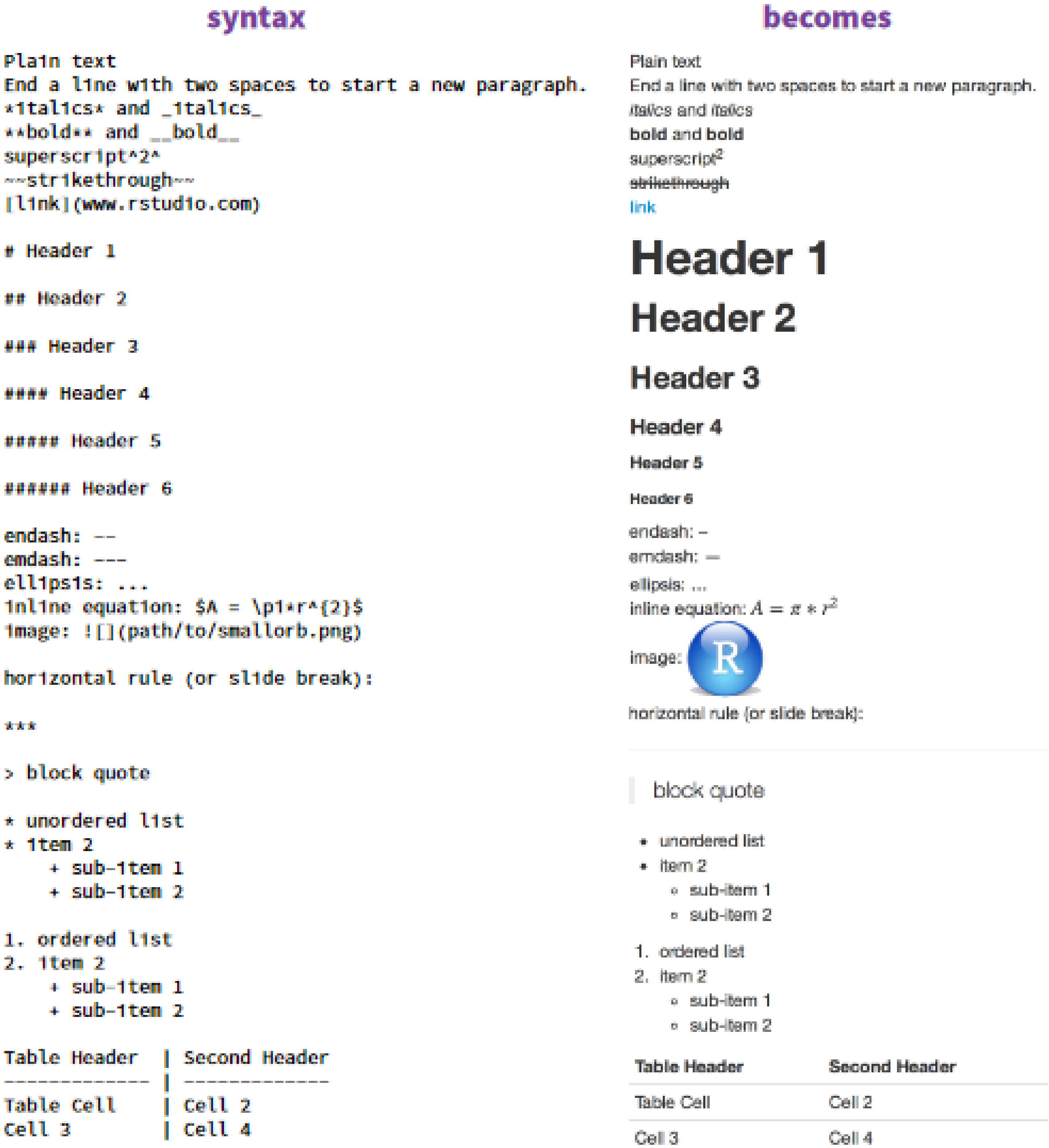
Writing text

- When you wrote some text, you can „knit“ the document to get the output



```
---
title: "Let's get reproducible!"
author: "Helena Hartmann"
date: "04.08.2021"
output: github_document
---

```



syntax

```
Plain text
End a line with two spaces to start a new paragraph.
*italics* and _italics_
**bold** and __bold__
superscript^2^
~~strikethrough~~
[link](www.rstudio.com)

# Header 1

## Header 2

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###### Header 6

endash: --
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* unordered list
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1. ordered list
2. item 2
    + sub-item 1
    + sub-item 2

Table Header  | Second Header
------------- | -------------
Table Cell    | Cell 2
Cell 3        | Cell 4
```

becomes

Plain text
End a line with two spaces to start a new paragraph.
italics and *italics*
bold and **bold**
superscript^2
~~strikethrough~~
link

Header 1

Header 2

Header 3

Header 4

Header 5

Header 6

endash: –
emdash: —
ellipsis: …
inline equation: $A = \pi * r^2$
image: R

horizontal rule (or slide break):

> block quote

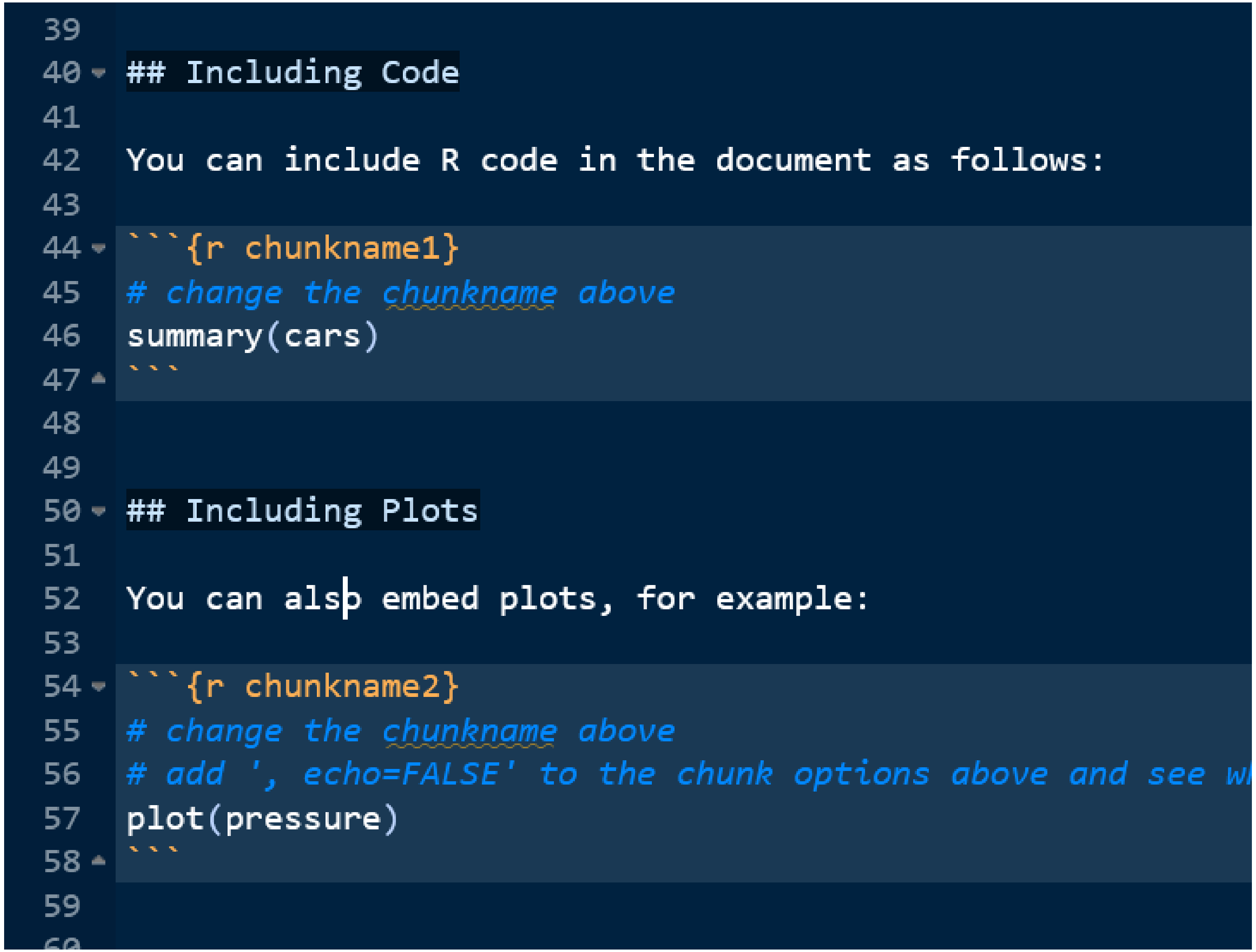
- unordered list
- item 2
    - sub-item 1
    - sub-item 2

1. ordered list
2. item 2
    - sub-item 1
    - sub-item 2

Table Header	Second Header
Table Cell	Cell 2
Cell 3	Cell 4

Chunks

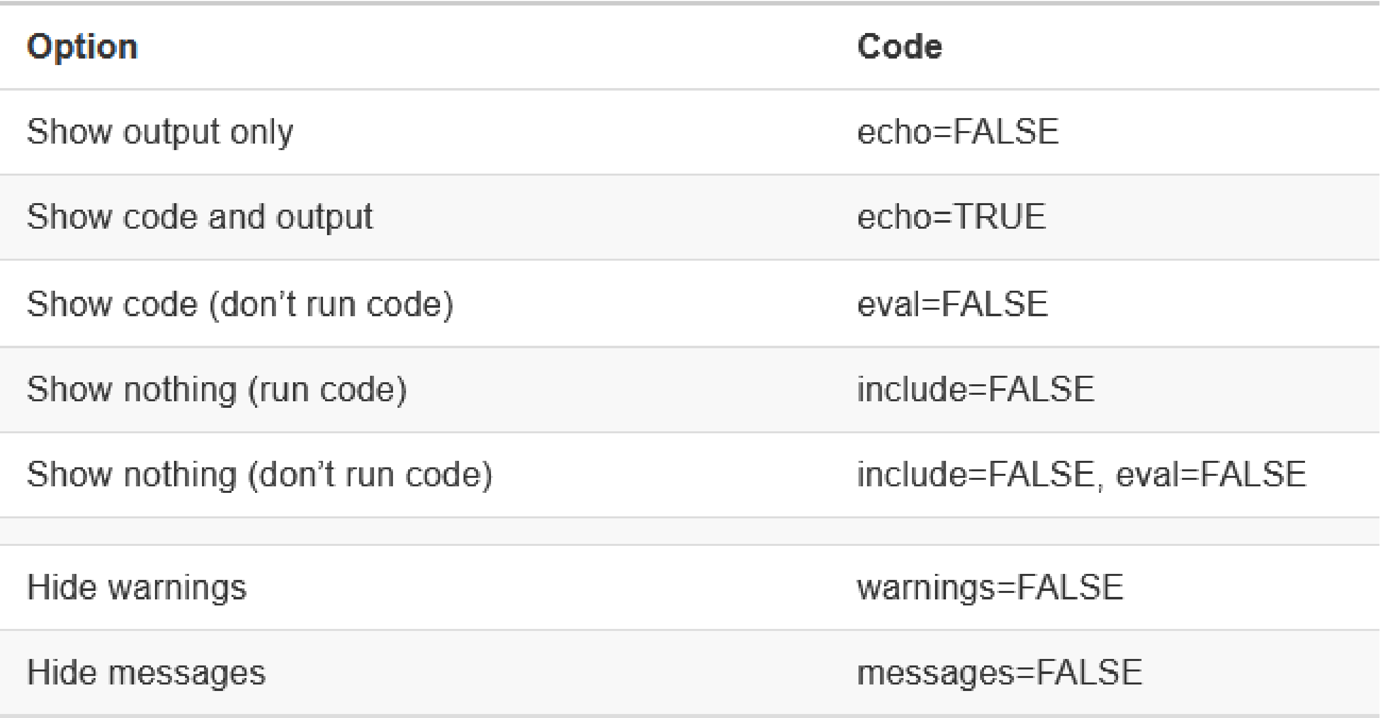
- Structuring and organizing code for anaysis, tables and plots
- Name each chunk so it makes sense
- Chunk options



~~~
## Including Code

You can include R code in the document as follows:

```{r chunkname1}
# change the chunkname above
summary(cars)
```


## Including Plots

You can also embed plots, for example:

```{r chunkname2}
# change the chunkname above
# add ', echo=FALSE' to the chunk options above and see w
plot(pressure)
```

~~~

Chunk options using knitr

- Name your chunks so that they make sense!
- Setup-chunk sets default options for all chunks, but this can be overwritten by settings in single chunks
- *echo = FALSE* prevents printing the R code that generated e.g. a plot
- *include = FALSE* hides that complete code chunk in the output



Option	Code
Show output only	echo=FALSE
Show code and output	echo=TRUE
Show code (don't run code)	eval=FALSE
Show nothing (run code)	include=FALSE
Show nothing (don't run code)	include=FALSE, eval=FALSE
Hide warnings	warnings=FALSE
Hide messages	messages=FALSE

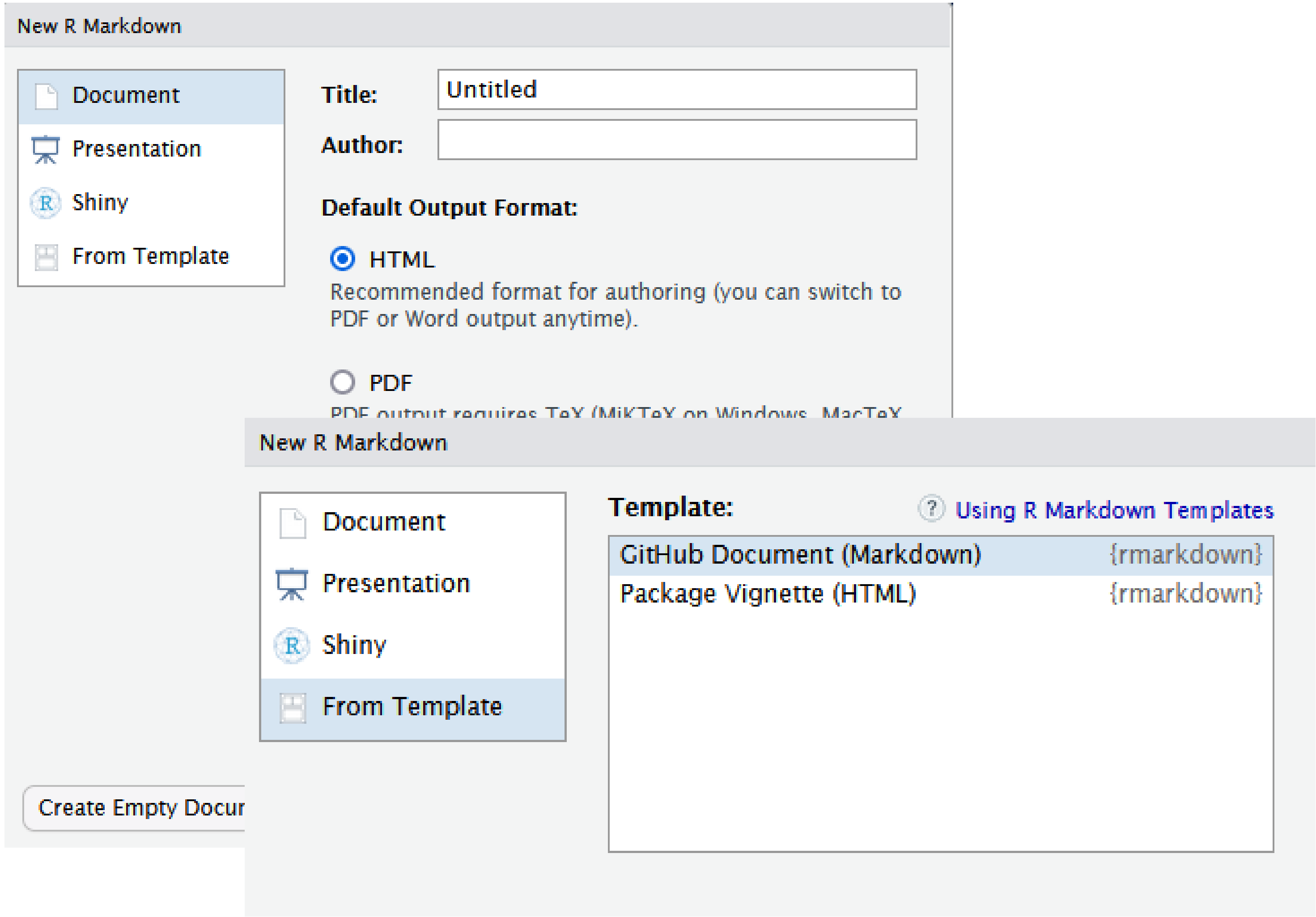
Now let‘s do some exercises!

First step: Get the Rmarkdown file I created for this purpose or create a new document!

Next up:

We go through the exercises together and change/add some things!

We‘ll upload/push that file to GitHub!



Title: Untitled

Author:

Default Output Format:

● HTML
Recommended format for authoring (you can switch to PDF or Word output anytime).

○ PDF
PDF output requires TeX (MiKTeX on Windows, MacTeX

Template:

GitHub Document (Markdown) {rmarkdown}
Package Vignette (HTML) {rmarkdown}