Introduction to R Markdown

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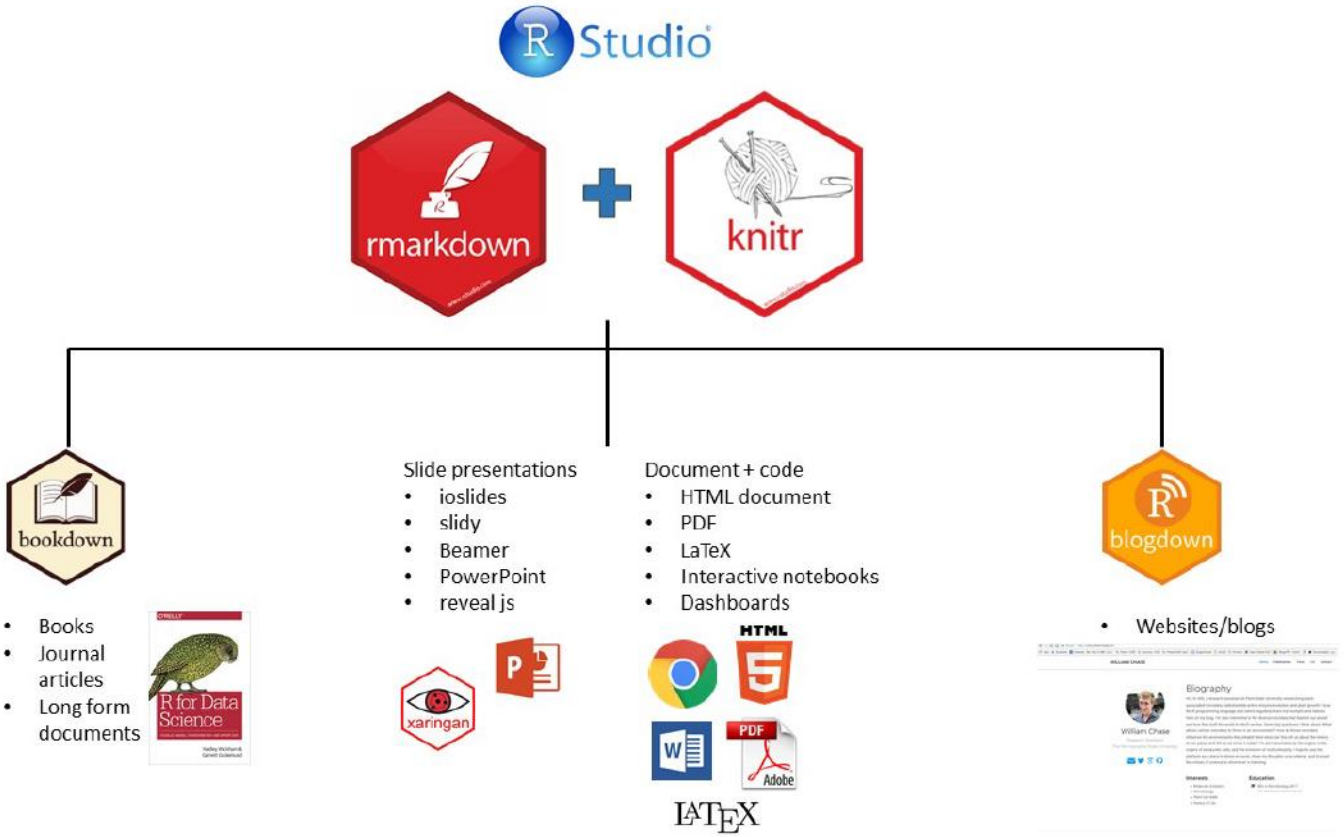
What is R Markdown?

R Markdown


RStudio
rmarkdown
knitr
bookdown
Books
Journal articles
Long form documents
R for Data Science
Slide presentations
ioslides
slidy
Beamer
PowerPoint
reveal js
xaringan
Document + code
HTML document
PDF
LaTeX
Interactive notebooks
Dashboards
HTML
PDF
Adobe
LATEX
blogdown
Websites/blogs
Biography
William Chase

Examples

- Bookdown: https://rmarkdown.rstudio.com/docs/
- Bookdown: https://r4ds.had.co.nz/
- Shiny-App / dashboard (interactive): https://jjallaire.shinyapps.io/shiny-kmeans/

Own work:

- Shiny-App: https://fennapps.shinyapps.io/shinyCAMELv01/
- Website: https://fennstatistics.netlify.app/

R Markdown

- R Markdown allows you to create documents that serve as a neat record of your analysis
- enables reproducible research (appendix to a paper, upload it to an online repository, keep as a personal record, ...)
- RMarkdown file (.Rmd), when you knit the RMarkdown file, the Markdown formatting and the R code are evaluated, and an output file (HTML, PDF, etc) is produced.
- R Markdown makes use of Markdown syntax
  - R Markdown converted to standard Markdown using 'knitr' package

What is markdown?

- Markdown is a very simple ‘markup’ language (=HTML)
  - provides methods for creating documents with headers, images, links etc. from plain text files, while
  - keeping the original plain text file easy to read

- Basic Syntax:
  - https://www.markdownguide.org/basic-syntax
  - https://raw.githubusercontent.com/rstudio/cheatsheets/main/rmarkdown.pdf

Markdown syntax

MARKDOWN SYNTAX

This is an H1 header format

This is an H2 header format

This text will be in italics

This text will be in bold

Unordered list:

- First
- Second
- Third

Ordered list:

1. First item
2 Second item
3. Third item

Links:
[Google](http://www.google.com)

Advanced links:
Advanced Linking: [Google][1] and [UGent][2]
[1]: http://www.google.com [2]: http://www.ugent.be

Mardown to MS Word

```
---
title: "R markdown"
output: word_document
---
Headers:

# This is an H1

## This is an H2


Italics:

text *This text will be in italics* text

Bold:

text **This text will be in bold** text

Unordered list:

- First
- Second
- Third

Ordered list:

1. First
2. Second
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Links: [Google](http://www.google.com)

Advanced Linking: [Google][1] and [UGent][2]

[1]: http://www.google.com
[2]: http://www.ugent.be

A way to include some latex code in R Markdown
$$
y_{ij} = b_{ij} + \beta_{0} + \beta_{1}
$$
```

MARKDOWN=> MS WORD

=>

R markdown

Headers:

This is an H1

This is an H2

Italics:

text *This text will be in italics* text

Bold:

text **This text will be in bold** text

Unordered list:

- First
- Second
- Third

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Links: Google

Advanced Linking: Google and UGent

A way to include some latex code in R Markdown

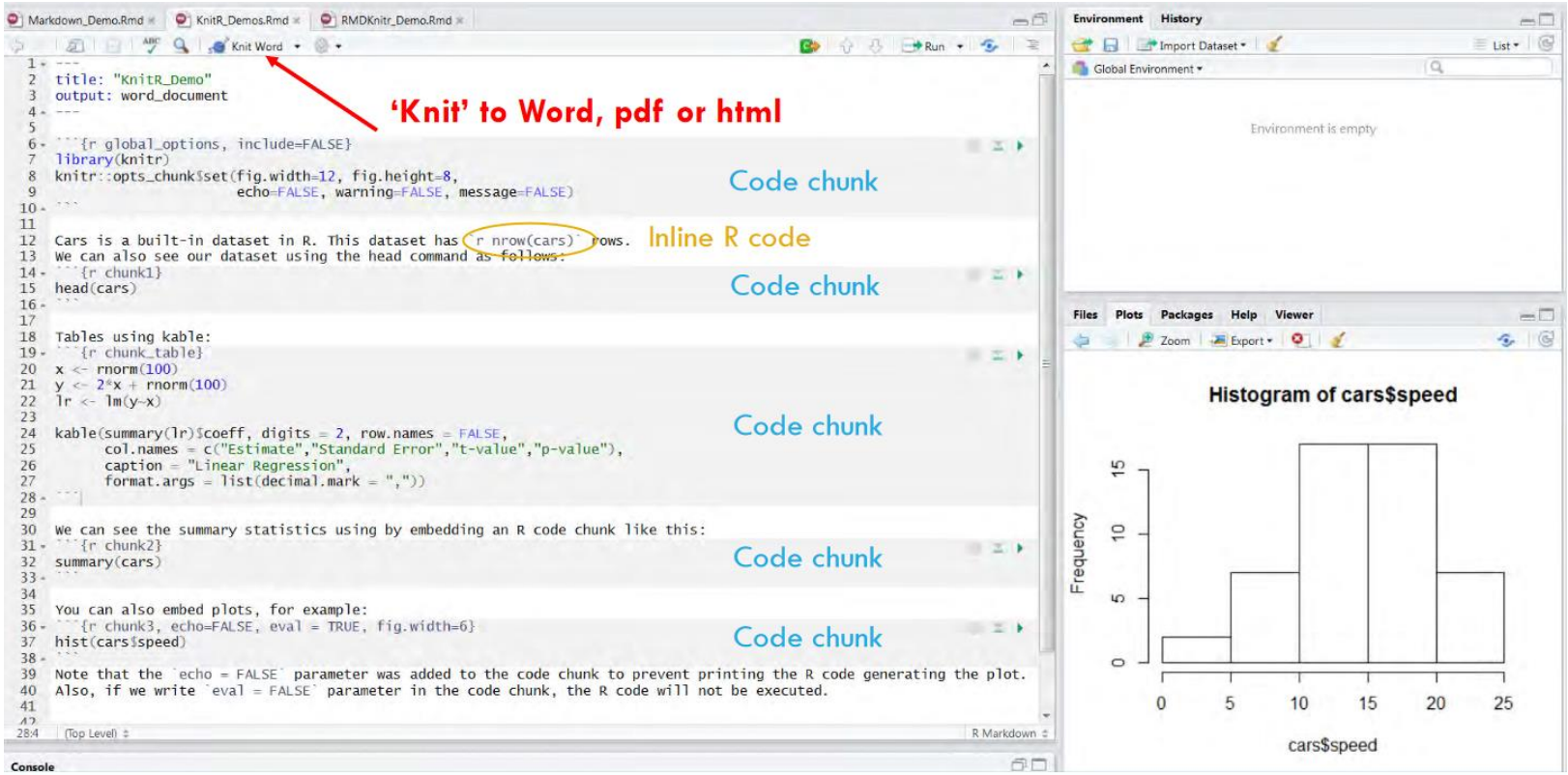
$$y_{ij} = b_{ij} + \beta_0 + \beta_1$$

What is knitr?

- R package designed for dynamic report generation in R
- Script contains a mixture of text and R code, which is when processed replaced by text and output, including figures and tables
- Uses R as programming language and a documentation language (LateX, Markdown)
- Inline R code within the text and separate code chunks

Xie, Y. (2017). *Dynamic Documents with R and knitr*. Chapman and Hall/CRC, download: https://duhi23.github.io/Analisis-de-datos/Yihue.pdf

Using rmarkdown (knitr) in R Studio



Elements: YAML Header

- at the top of any RMarkdown script is a YAML header section enclosed by ---
- by default this includes a title, author, date and the file type you want to output to
  - many other options are available for different functions and formatting

Elements: YAML Header

- using the toc option and specify the depth of headers that it applies to using the toc_depth option
- us to specify a bibliography file using the bibliography metadata field in YAML
  - See: https://bookdown.org/yihui/rmarkdown-cookbook/bibliography.html

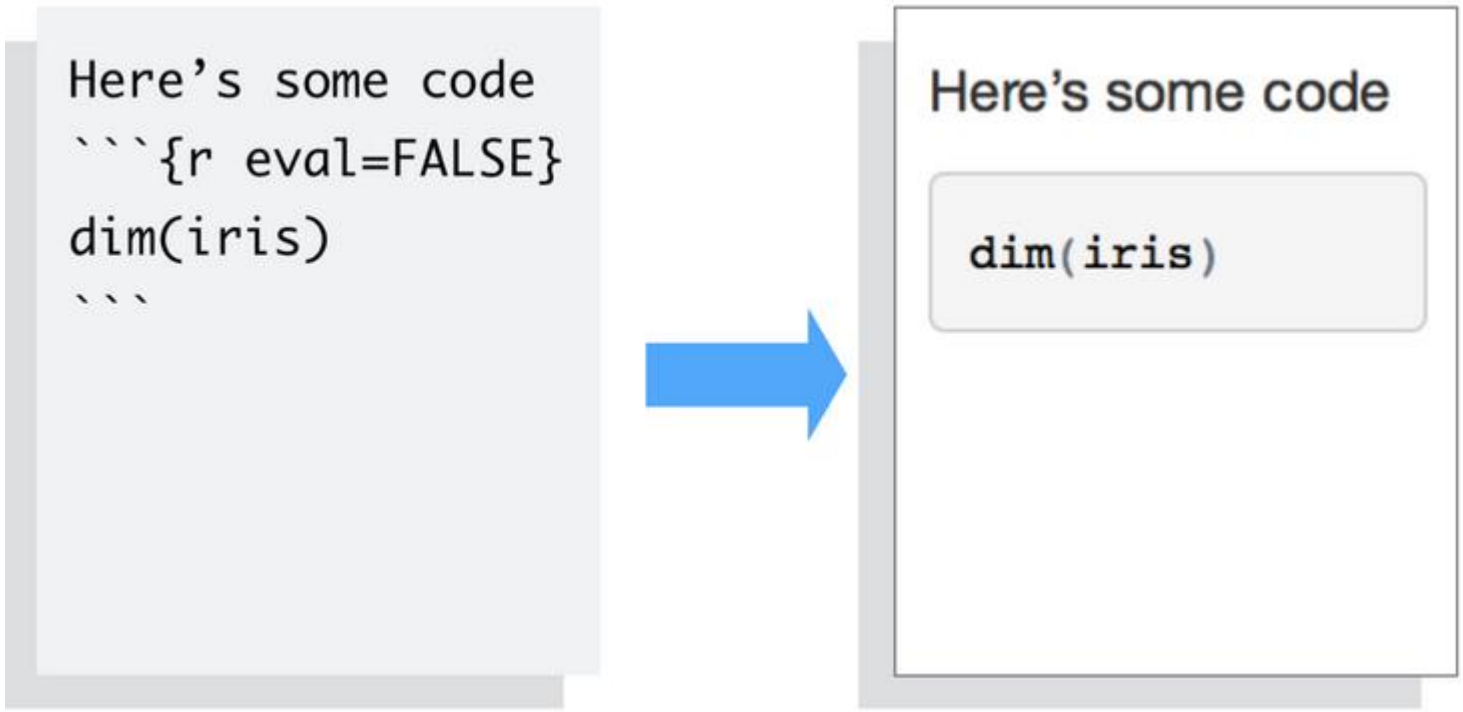
```yaml
---
title: "my title"
author: "Julius Fenn"
date: "2021-0X-XX"
output:
  html_document:
    toc: yes
    toc_depth: 3
    number_sections: yes
  pdf_document:
    toc: yes
    toc_depth: '3'
  word_document:
    toc: yes
    toc_depth: '3'
bibliography: LibraryAll.bib
biblio-style: apalike
link-citations: yes
---
```

Elements: Code chunk

- To embed a chunk of R code into your report, surround the code with two lines that each contain three backticks. After the first set of backticks, include {r}, which alerts knitr that you have included a chunk of R code

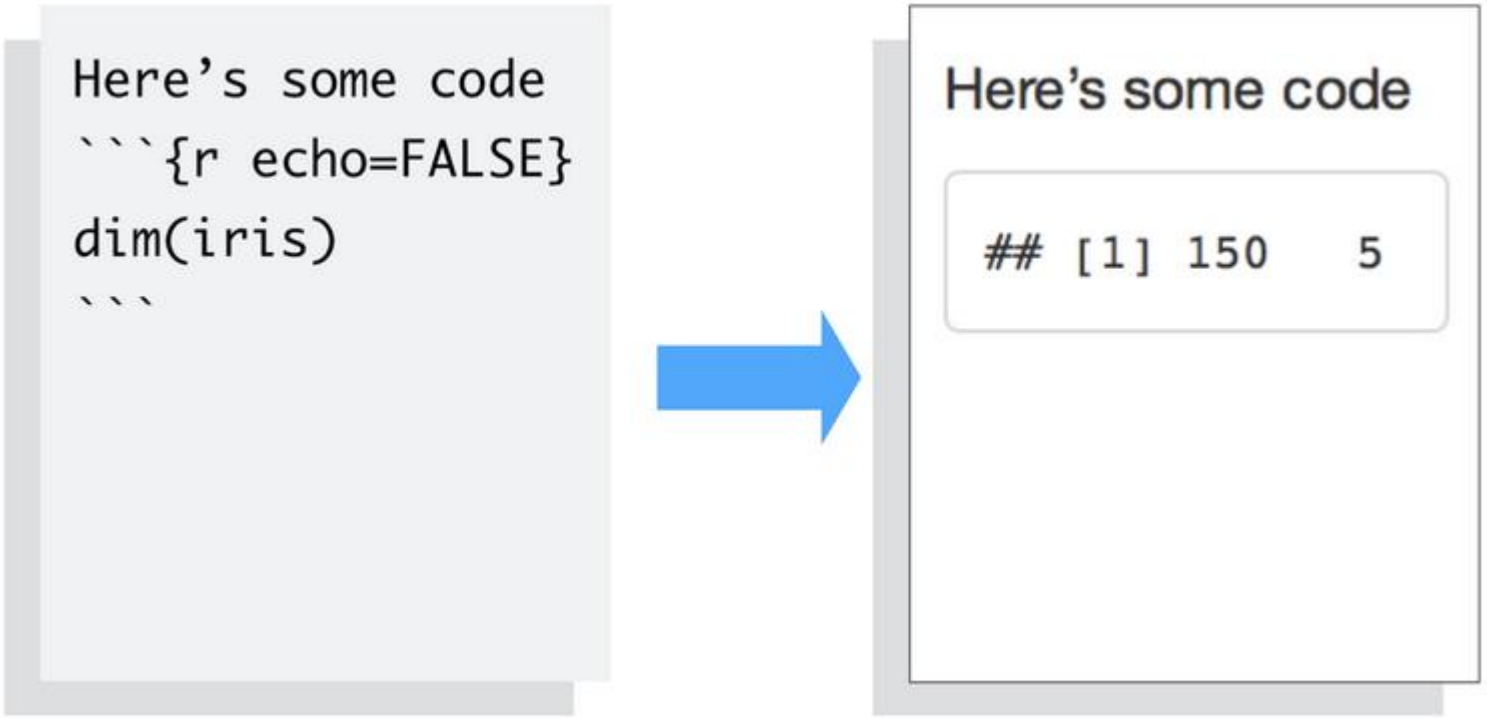
Elements: Code chunk options

- to omit the results from your final report (and not run the code) add the argument eval = FALSE inside the brackets and after r



Elements: Code chunk options

- to omit the code from the final report (while including the results) add the argument echo = FALSE

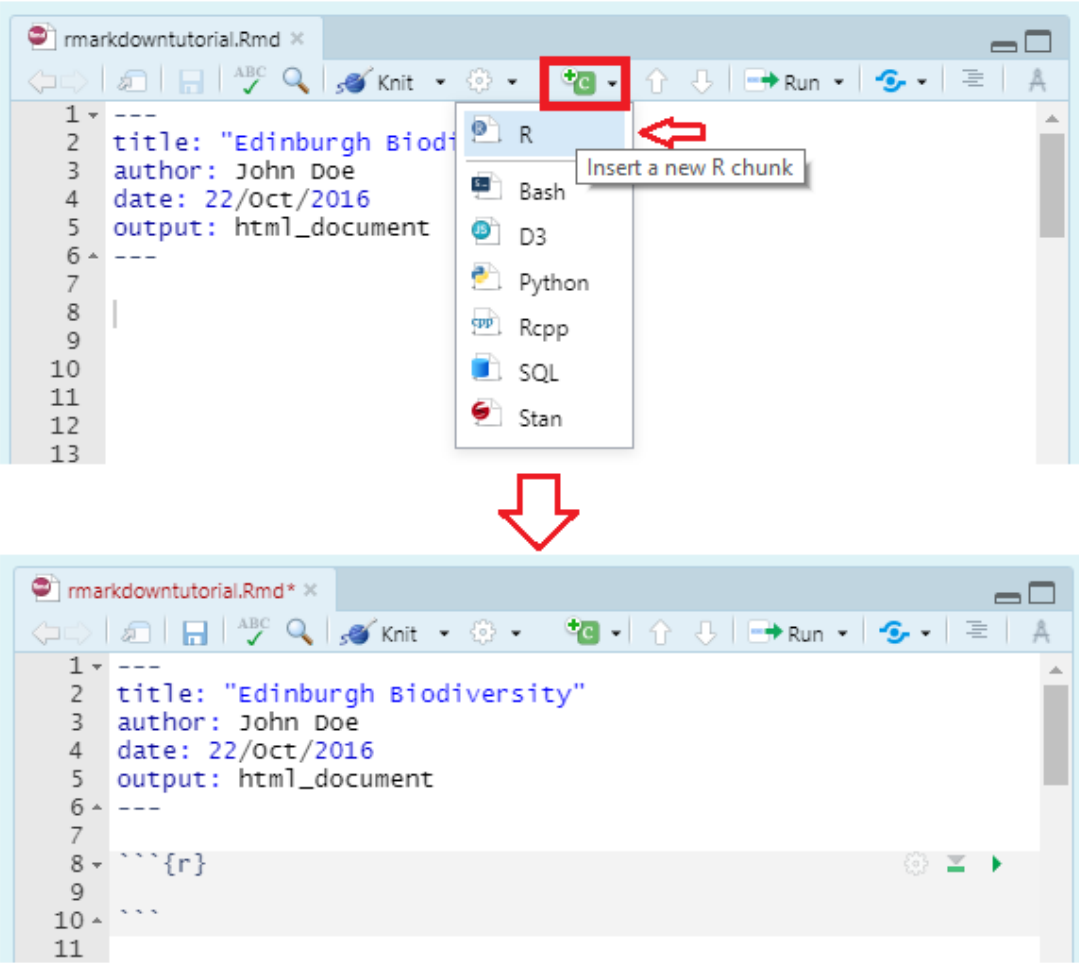


More Code Chunk Instructions

Rule	Example (default)	Function
eval	eval=TRUE	Is the code run and the results included in the output?
include	include=TRUE	Are the code and the results included in the output?
echo	echo=TRUE	Is the code displayed alongside the results?
warning	warning=TRUE	Are warning messages displayed?
error	error=FALSE	Are error messages displayed?
message	message=TRUE	Are messages displayed?
tidy	tidy=FALSE	Is the code reformatted to make it look “tidy”?
results	results="markup"	**How are results treated?** "hide" = no results "asis" = results without formatting "hold" = results only compiled at end of chunk (use if many commands act on one object)
cache	cache=FALSE	Are the results cached for future renders?
comment	comment="##"	What character are comments prefaced with?
fig.width, fig.height	fig.width=7	What width/height (in inches) are the plots?
fig.align	fig.align="left"	"left" "right" "center"

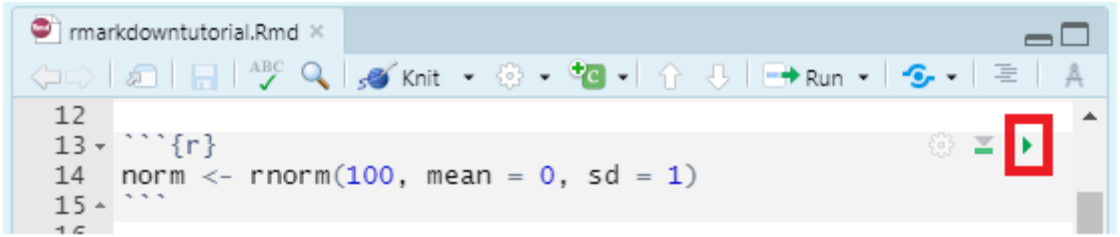
all possible options see: https://yihui.org/knitr/options/

Elements: Code chunk insert



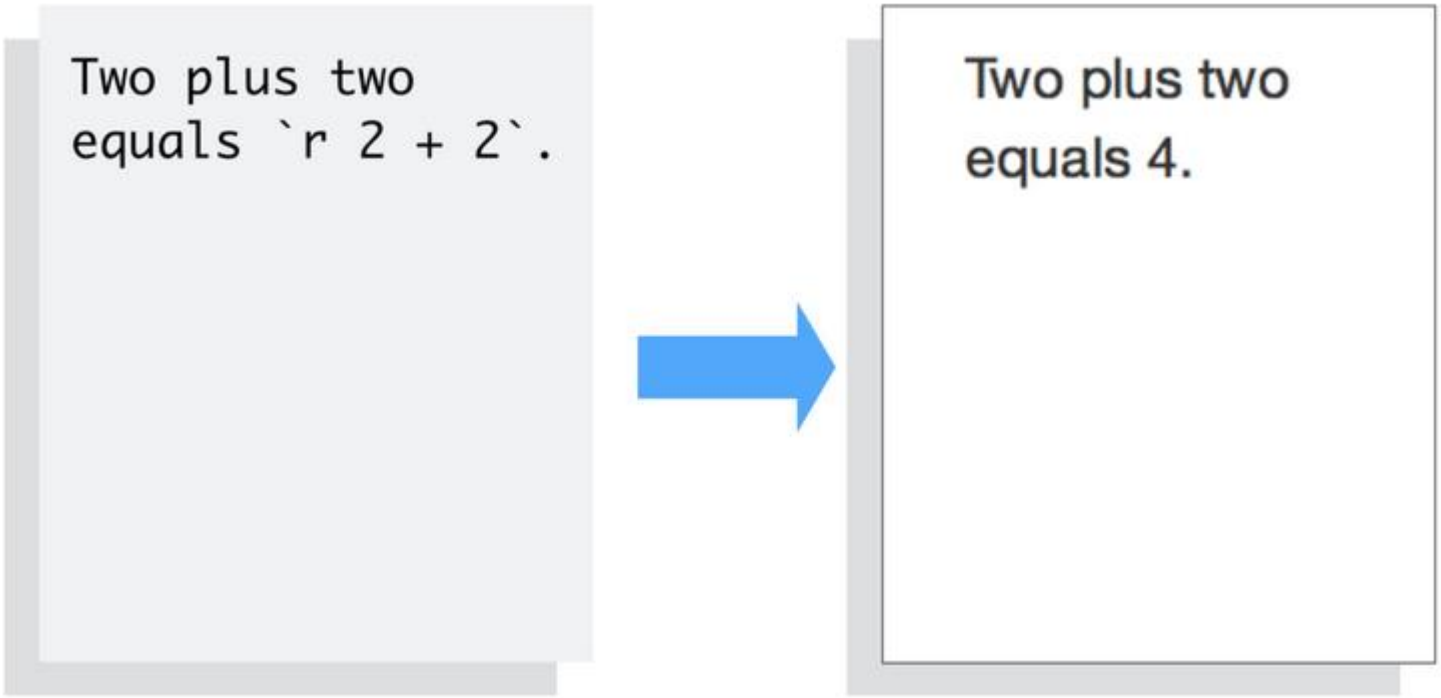
Elements: Code chunk run

- you can run an individual chunk of code at any time by clicking on the small green arrow and the output of the code will appear just beneath the code chunk



Elements: Inline code

- knitr will replace the inline code with its result in your final document (inline code is always replaced by its result). The result will appear as if it were part of the original text



Inserting figures, tables

- by default, RMarkdown will place graphs by maximizing their height, while keeping them within the margins of the page and maintaining aspect ratio

````
```{r, fig.width = 4, fig.height = 3}
A <- c("a", "a", "b", "b")
B <- c(5, 10, 15, 20)
dataframe <- data.frame(A, B)
print(dataframe)
boxplot(B~A,data=dataframe)
```
````

- the most aesthetically pleasing and simple table formatting function is kable() in the knitr package (and stargazer package)

````
```{r}
library(knitr)
kable(dataframe, digits = 2)
```
````

R CODE + TEXT => REPORT

```
---
title: "KnitR_Demo"
output: word_document
---

```{r global_options, include=FALSE}
library(knitr)
knitr::opts_chunk$set(fig.width=12, fig.height=8,
                      echo=FALSE, warning=FALSE, message=FALSE)
```

Cars is a built-in dataset in R. This dataset has `r nrow(cars)` rows.
We can also see our dataset using the head command as follows:
```{r chunk1}
head(cars)
```

Tables using kable:
```{r chunk_table}
x <- rnorm(100)
y <- 2*x + rnorm(100)
lr <- lm(y~x)

kable(summary(lr)$coeff, digits = 2, row.names = FALSE,
      col.names = c("Estimate","Standard Error","t-value","p-value"),
      caption = "Linear Regression",
      format.args = list(decimal.mark = ","))
```

We can see the summary statistics using by embedding an R code chunk like this:
```{r chunk2}
summary(cars)
```

You can also embed plots, for example:
```{r chunk3, echo=FALSE, eval = TRUE, fig.width=6}
hist(cars$speed)
```

Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing the R code generating the plot.
Also, if we write `eval = FALSE` parameter in the code chunk, the R code will not be executed.
```

Use ‘kable’ for tables

Plot

=>

KnitR_Demo

Cars is a built-in dataset in R. This dataset has 50 rows. We can also see our dataset using the head command as follows:

```
##   speed dist
## 1     4    2
## 2     4   10
## 3     7    4
## 4     7   22
## 5     8   16
## 6     9   10
```

Tables using kable:

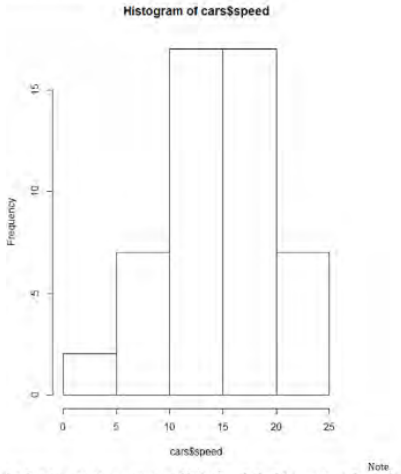
Linear Regression

Estimate	Standard Error	t-value	p-value
-0.07	0.1	-0.71	0.48
1.88	0.1	18.62	0.00

We can see the summary statistics using by embedding an R code chunk like this:

```
##      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
```

You can also embed plots, for example:

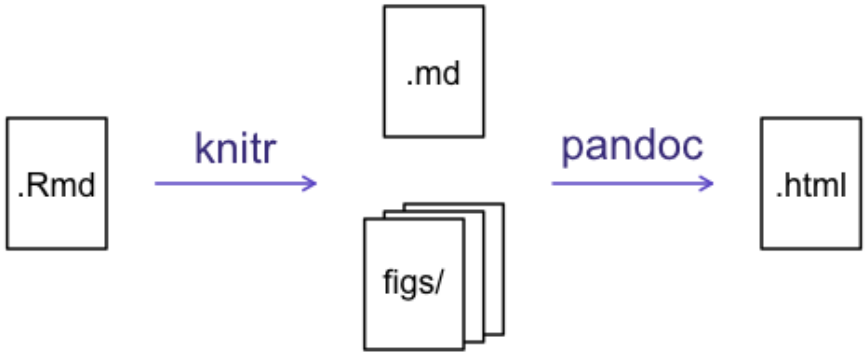


Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing the R code generating the plot. Also, if we write `eval = FALSE` parameter in the code chunk, the R code will not be executed.

For more complex tables consider ‘pander’ or ‘stargazer’

Relationship between R Markdown, Knitr and Pandoc

- Pandoc is a document converter. It can convert from a number of different markup formats to many other formats, such as .doc, .pdf etc.
- R Markdown is based on markdown: a lightweight markup language with plain text formatting syntax designed so that it can be converted to HTML and many other formats
  - ! no clearly defined Markdown standard
- rmarkdown is a library which proceses and converts .Rmd files into a number of different formats



In detail see: https://stackoverflow.com/questions/40563479/relationship-between-r-markdown-knitr-pandoc-and-bookdown