R Markdown

Chris Penfold

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Overview

Goals

1. To understand what R Markdown is (and isn't)
2. To be able to make your own output from R Markdown
3. To be able to apply R Markdown to your own work
    - Or know that it's not for you!

Outline

Lecture + Tutorial

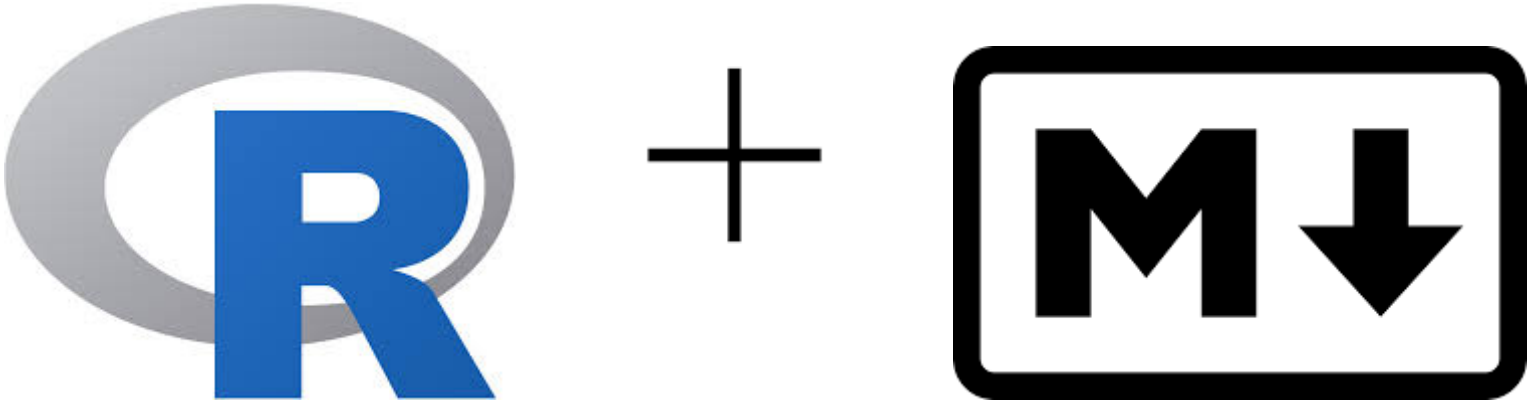
1. What is R Markdown?
2. What can you use R Markdown for?
3. How does it work?

Outline

Lecture + **Tutorial**

Make your own R Markdown document

What is R Markdown?



More specifically:

Text + R output + graphics (+ R code) into a single document

Possible uses

1. Quick report
   - R Notebooks
2. Full research paper
3. Presentation
4. PhD thesis…
5. Web page
6. eBook
7. Blog etc…

Reproducible research

Markdown

"Markdown is a lightweight markup language with plain text formatting syntax." [1]

1. Source: Wikipedia

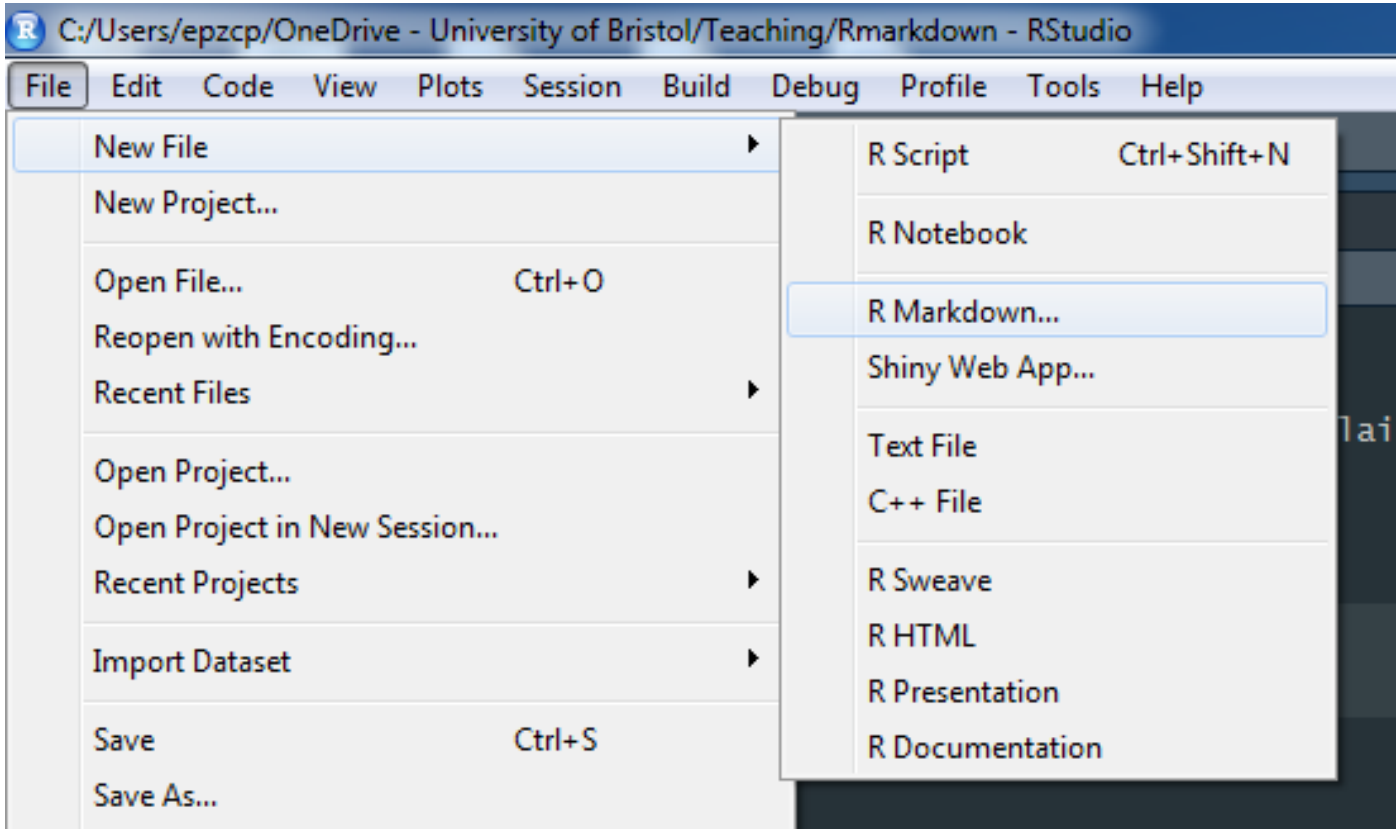
Markdown - input

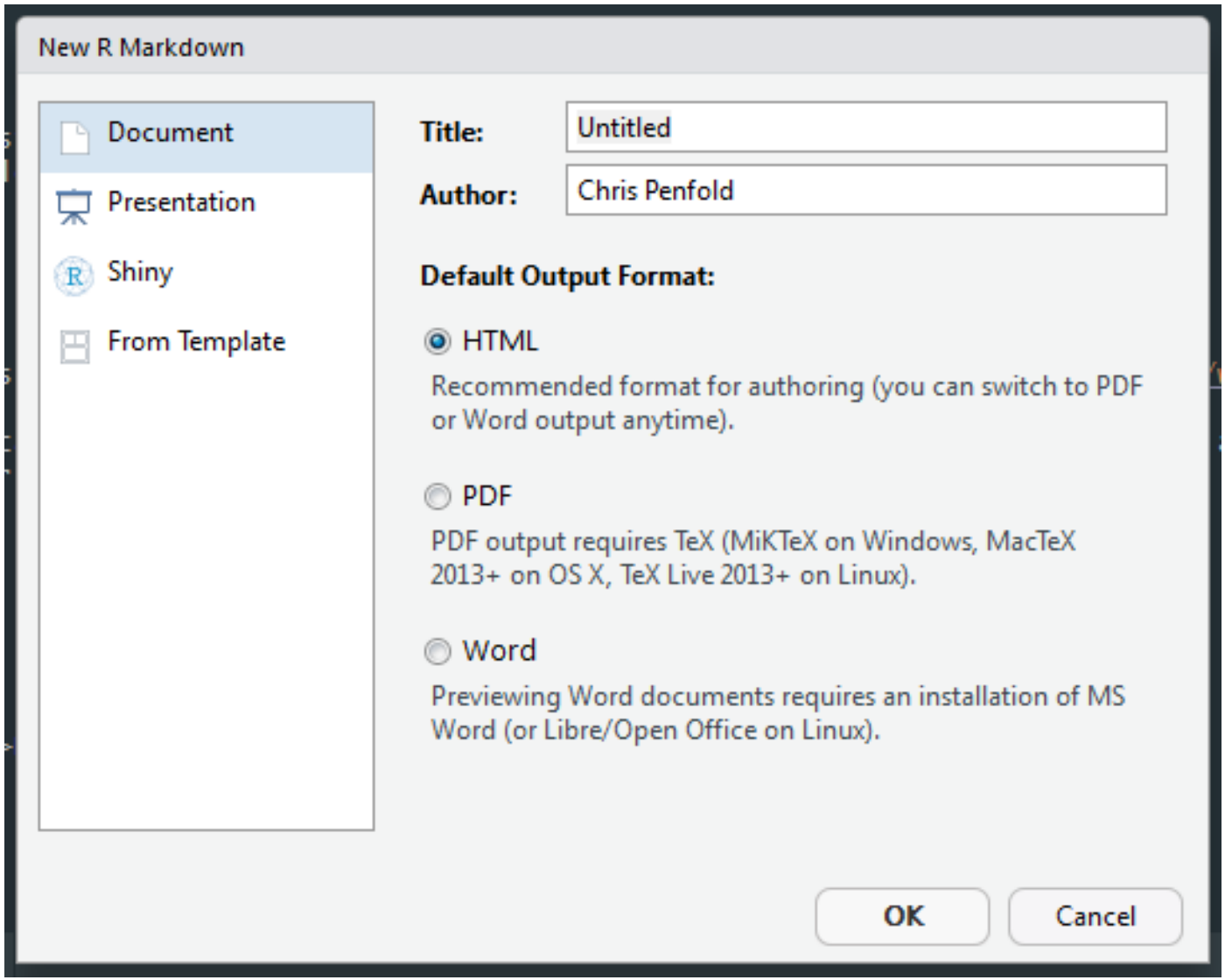
Markdown - output

Rmd to output


PDF
LaTeX
R
Slide
HTML

Making a R Markdown file




New R Markdown
Document
Presentation
Shiny
From Template
Title:
Untitled
Author:
Chris Penfold
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

R Markdown anatomy

YAML (aka *header*)

```yaml
---
title: "Untitled"
author: "Chris Penfold"
date: "7 December 2018"
output: html_document
---
```

R Markdown anatomy

Markdown text

```
12 ## R Markdown
13
14 This is an R Markdown document. Markdown is a simple formatting syntax
   for authoring HTML, PDF, and MS Word documents. For more details on
   using R Markdown see <http://rmarkdown.rstudio.com>.
15
16 When you click the **Knit** button a document will be generated that
   includes both content as well as the output of any embedded R code
   chunks within the document. You can embed an R code chunk like this:
```

R Markdown anatomy

Code 'chunks'


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


```
```{r pressure, echo=FALSE}
plot(pressure)
```
```

R Markdown anatomy

Setup code 'chunk'

```
 8 ```{r setup, include=FALSE}
 9 knitr::opts_chunk$set(echo = TRUE)
10 ```
```

- Useful for setting up advanced options
- Also used for code not related to outputs, e.g.
- data cleaning
- deriving variables to be used later
- With `include=FALSE`, the code chunk will be evaluated (unless `eval=FALSE`), but the output will be completely suppressed.

R Markdown anatomy

Rendering the document

Then we 'knit' (render) the document

- Either by pressing the 'Knit' button in RStudio:

OR

- Press 'ctrl' + 'shift' + 'k'

R Markdown anatomy

et voila: rendered output

Slide with Bullets

If I type:

```
- Bullet 1
- Bullet 2
- Bullet 3
```

I get:

- Bullet 1
- Bullet 2
- Bullet 3

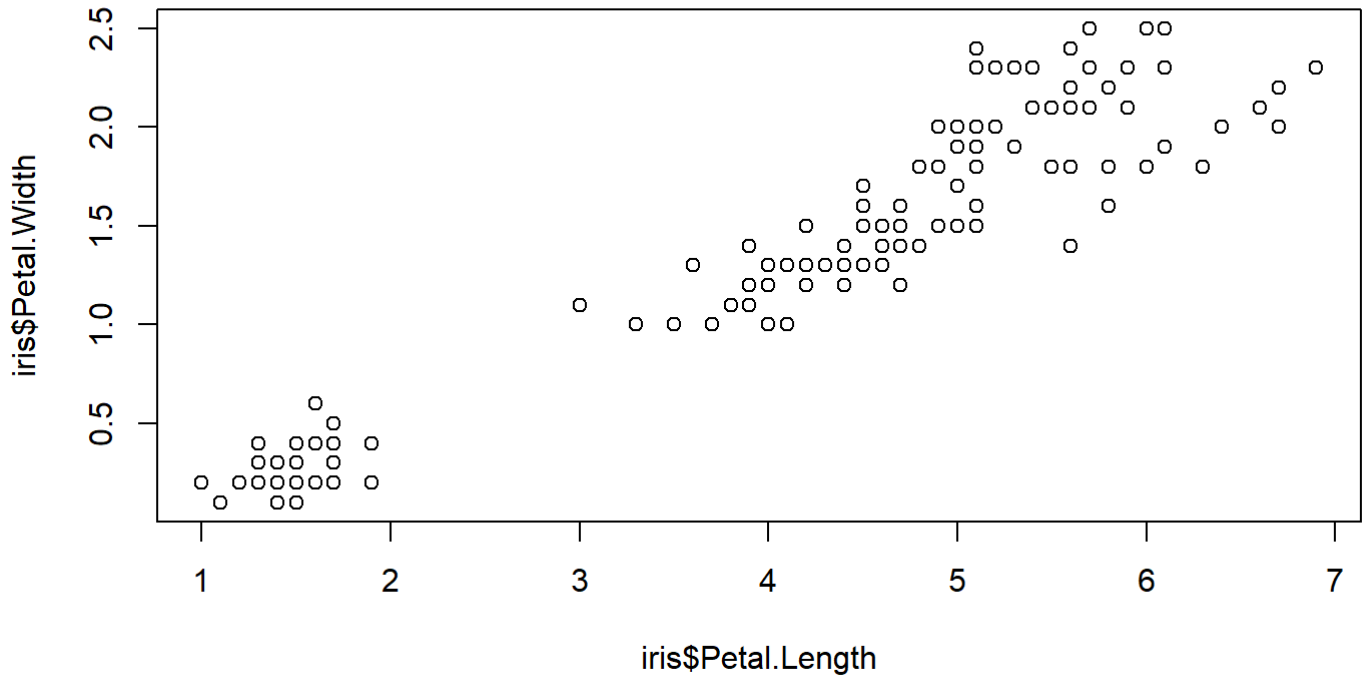
Slide with R Output

```
summary(iris)
```

```
##   Sepal.Length    Sepal.Width     Petal.Length    Petal.Width
##  Min.   :4.300   Min.   :2.000   Min.   :1.000   Min.   :0.100
##  1st Qu.:5.100   1st Qu.:2.800   1st Qu.:1.600   1st Qu.:0.300
##  Median :5.800   Median :3.000   Median :4.350   Median :1.300
##  Mean   :5.843   Mean   :3.057   Mean   :3.758   Mean   :1.199
##  3rd Qu.:6.400   3rd Qu.:3.300   3rd Qu.:5.100   3rd Qu.:1.800
##  Max.   :7.900   Max.   :4.400   Max.   :6.900   Max.   :2.500
##        Species
##  setosa    :50
##  versicolor:50
##  virginica :50
##
##
##
```

Slide with Plot

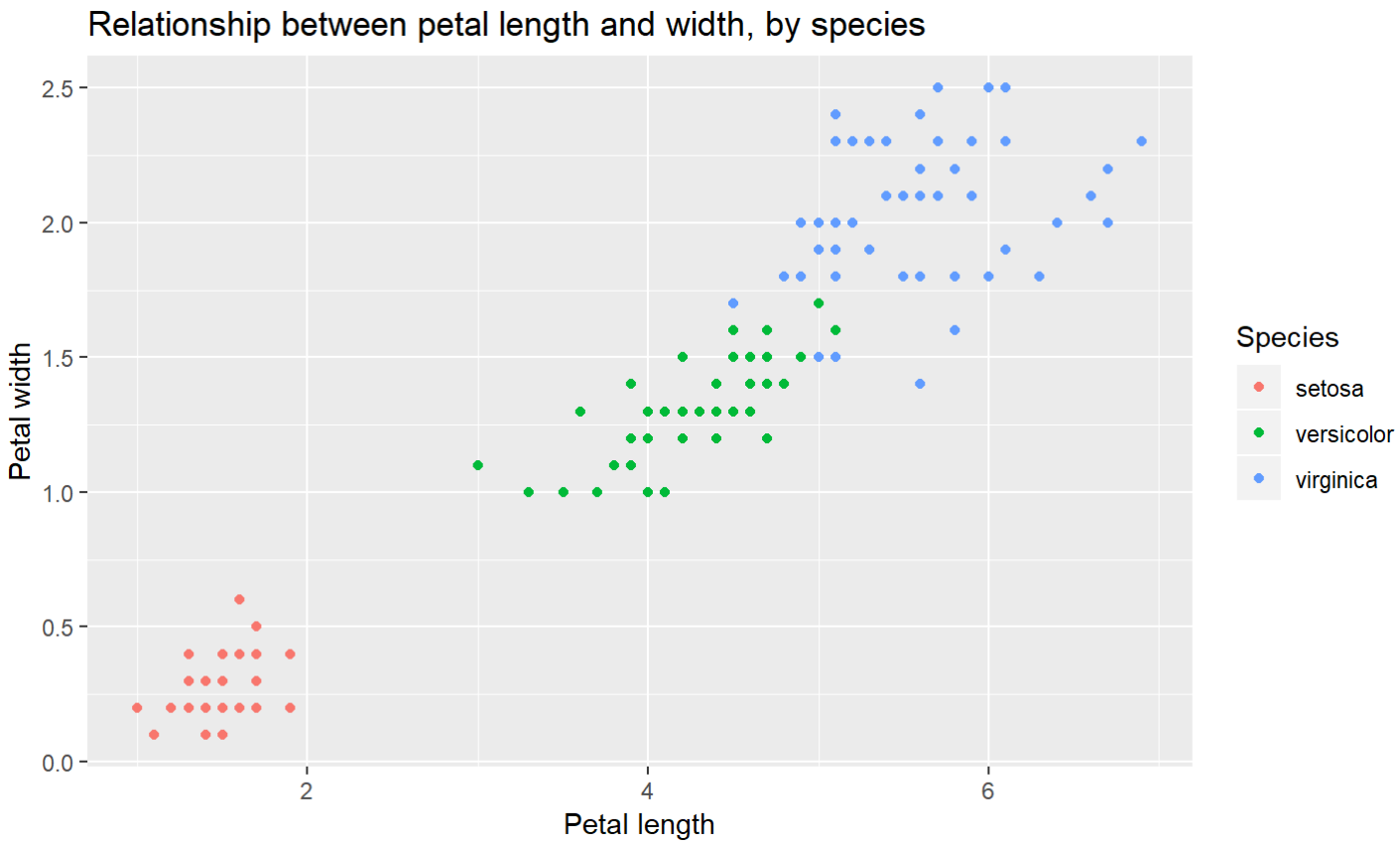
```
plot(iris$Petal.Length, iris$Petal.Width)
```



Slide with ggplot2

```
library(ggplot2)
ggplot(data = iris) +
  geom_point(aes(x = Petal.Length,
                 y = Petal.Width,
                 colour = Species)) +
  labs(title =
         "Relationship between petal length and width, by species",
       x = "Petal length",
       y = "Petal width")
```

Slide with ggplot2



Slide with table

```
summary(iris)
```

```
##   Sepal.Length    Sepal.Width     Petal.Length    Petal.Width
##  Min.   :4.300   Min.   :2.000   Min.   :1.000   Min.   :0.100
##  1st Qu.:5.100   1st Qu.:2.800   1st Qu.:1.600   1st Qu.:0.300
##  Median :5.800   Median :3.000   Median :4.350   Median :1.300
##  Mean   :5.843   Mean   :3.057   Mean   :3.758   Mean   :1.199
##  3rd Qu.:6.400   3rd Qu.:3.300   3rd Qu.:5.100   3rd Qu.:1.800
##  Max.   :7.900   Max.   :4.400   Max.   :6.900   Max.   :2.500
##        Species
##  setosa    :50
##  versicolor:50
##  virginica :50
##
##
##
```

Formatted table

```
library(arsenal)
table_one <- tableby(Species ~ .,
                     data = iris,
                     test=FALSE,
                     total=FALSE)
summary(table_one)
```

Formatted table

```
print(

|  | setosa (N=50) | versicolor (N=50) | virginica (N=50) |
|:-----------------|:-------:|:-------:|:-------:|
|**Sepal.Length**            |      |       |       |
|Mean (SD) | 5.006 (0.352) |   5.936 (0.516)   |  6.588 (0.636)   |
|Range     | 4.300 - 5.800 |   4.900 - 7.000   |  4.900 - 7.900   |
|**Sepal.Width**             |       |        |    |
|Mean (SD) | 3.428 (0.379) |   2.770 (0.314)   |  2.974 (0.322)   |
|Range     | 2.300 - 4.400 |   2.000 - 3.400   |  2.200 - 3.800   |
|**Petal.Length**            |       |        |    |
|Mean (SD) | 1.462 (0.174) |   4.260 (0.470)   |  5.552 (0.552)   |
|Range     | 1.000 - 1.900 |   3.000 - 5.100   |  4.500 - 6.900   |
|**Petal.Width**             |       |        |    |
|Mean (SD) | 0.246 (0.105) |   1.326 (0.198)   |  2.026 (0.275)   |
|Range     | 0.100 - 0.600 |   1.000 - 1.800   |  1.400 - 2.500   |

)
```

Formatted table

	setosa (N=50)	versicolor (N=50)	virginica (N=50)
Sepal.Length			
Mean (SD)	5.006 (0.352)	5.936 (0.516)	6.588 (0.636)
Range	4.300 - 5.800	4.900 - 7.000	4.900 - 7.900
Sepal.Width			
Mean (SD)	3.428 (0.379)	2.770 (0.314)	2.974 (0.322)
Range	2.300 - 4.400	2.000 - 3.400	2.200 - 3.800
Petal.Length			
Mean (SD)	1.462 (0.174)	4.260 (0.470)	5.552 (0.552)
Range	1.000 - 1.900	3.000 - 5.100	4.500 - 6.900
Petal.Width			
Mean (SD)	0.246 (0.105)	1.326 (0.198)	2.026 (0.275)
Range	0.100 - 0.600	1.000 - 1.800	1.400 - 2.500

Inline maths

- You can insert results of R code using 3 backticks ```

  ```{r}
  code here
  ```

- Simple maths example

```
2 + 3
```

```
## [1] 5
```

- To do this I typed

````
```{r}
2 + 3
```
````

Inline maths

- You can also do this 'inline' like this

  `` `r 2 + 3` ``

But only the results are shown:

- 5

Equations

You can get nicely formatted equations using MathJax:

E.g. population regression line

$$E(y) = \alpha + \beta x$$

$$var(y) = \sigma^2$$

These can also be inline: $\hat{y} = a + bx$

Example

"Could you just re-run this with…"

R Notebook - standalone R Markdown documents

- R Notebooks are a specific use of R Markdown
- Code and output are combined in a single document
- R Notebooks can not execute code outside the Notebook (e.g. messy data processing etc.)
- Particularly suited to quick reports where having embedded code is not a problem
- Restricted to **html** output
- Good for archiving analyses and sharing results with collaborators

R Notebook

An R Notebook is a special execution mode of R Markdown with two characteristics that make it very useful for communicating results[2]:

- Rendering a preview of an R Notebook does not execute R code, making it computationally convenient to create reports during or after interactive analyses.
- R Notebooks have an embedded copy of the source code, making it convenient for others to examine your work.

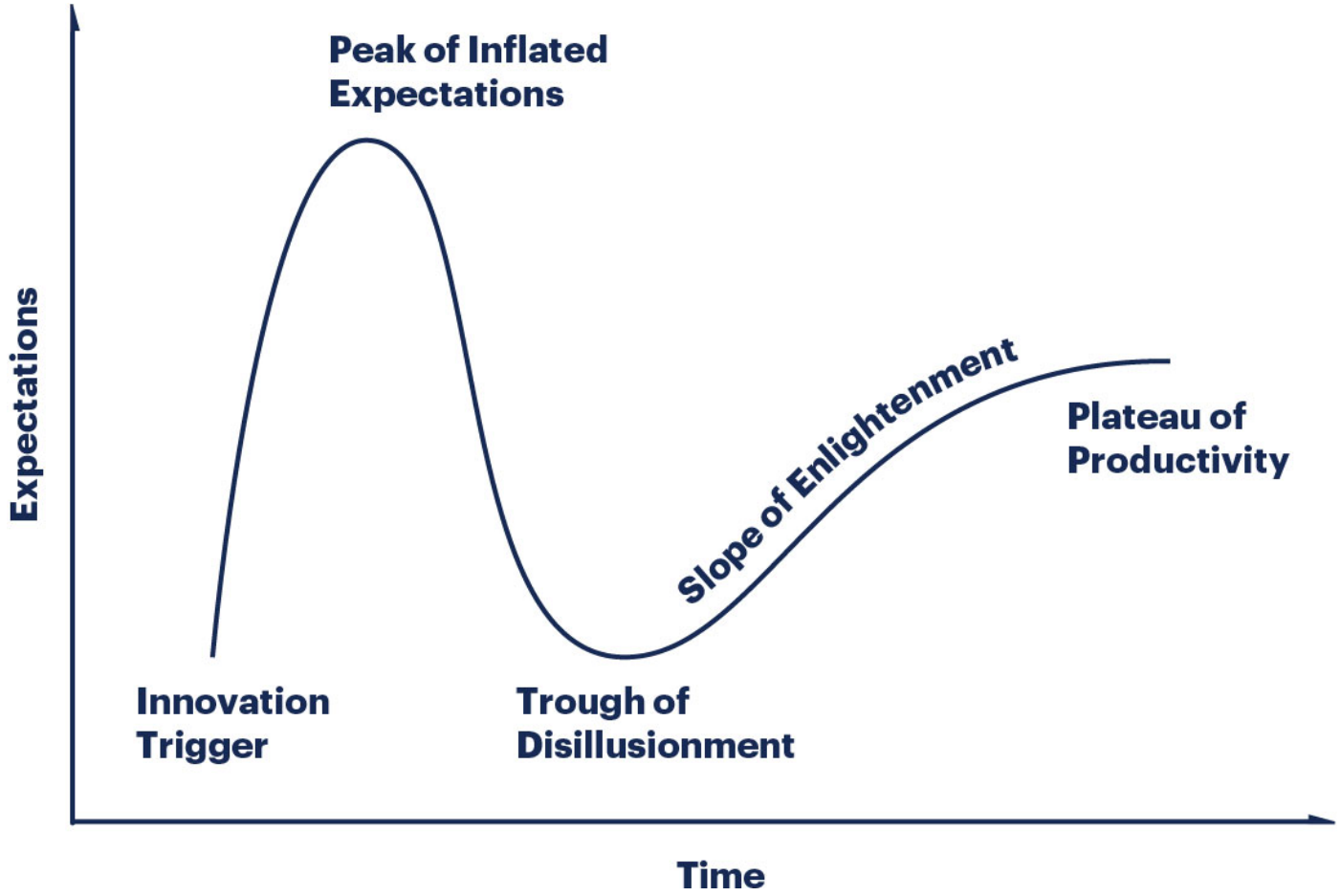
2. from https://www.r-bloggers.com/communicating-results-with-r-markdown/

R Notebook - example

Times to use R Markdown

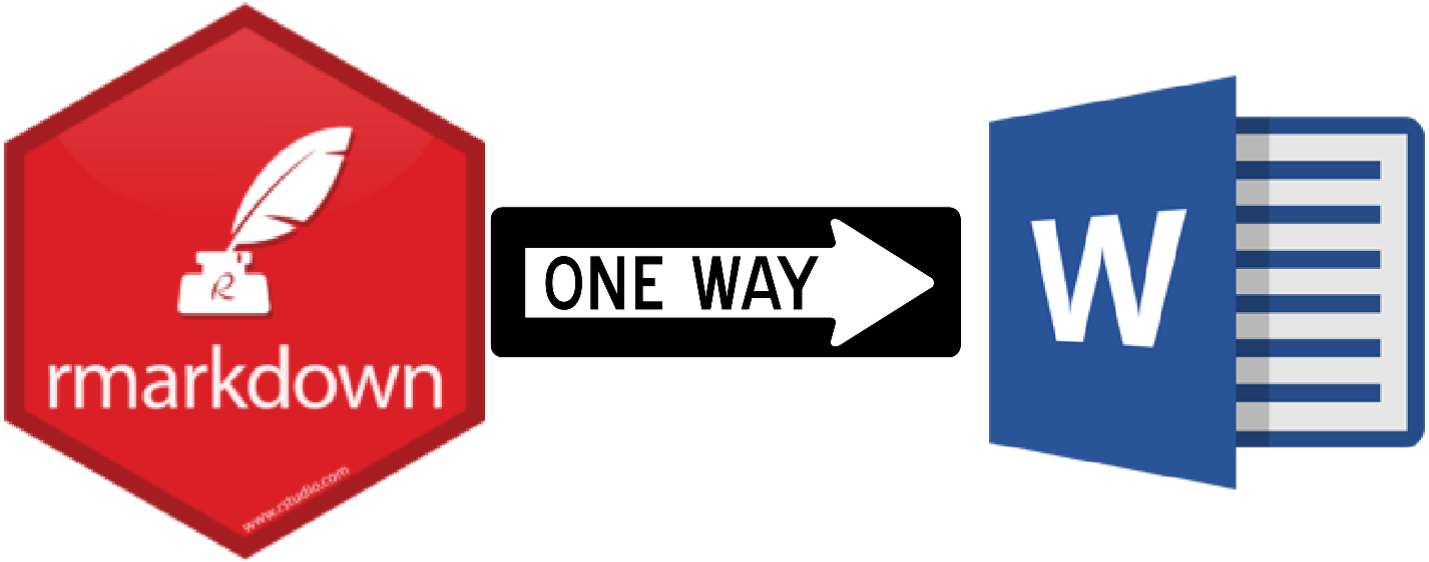
PROBLEM	COMMON TOOL	BETTER TOOL
Share reports and presentations	Microsoft Office	R Markdown
Summarize and share your interactive analyses	R Scripts	R Notebooks

R Markdown - hype check…



R Markdown - Key limitations

- Tables
  - New packages improve this all the time
  - e.g. `arsenal` (+ `broom`)
- How does this fit into a typical paper writing workflow?


rmarkdown
ONE WAY
W

Any questions???

- Slides are available at:
  - Slides available at GitHub:
  - https://github.com/Chris-M-P/Rmarkdown

Useful links

- RStudio R Markdown resources - https://rmarkdown.rstudio.com/
- *R Markdown: The Definitive Guide* - link
- R Markdown cheatsheet - available from RStudio:
  - *Help > Cheatsheets > R Markdown Cheat Sheet*
- Stackoverflow `Rmarkdown` tag - https://stackoverflow.com/questions/tagged/r-markdown