

R Markdown

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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

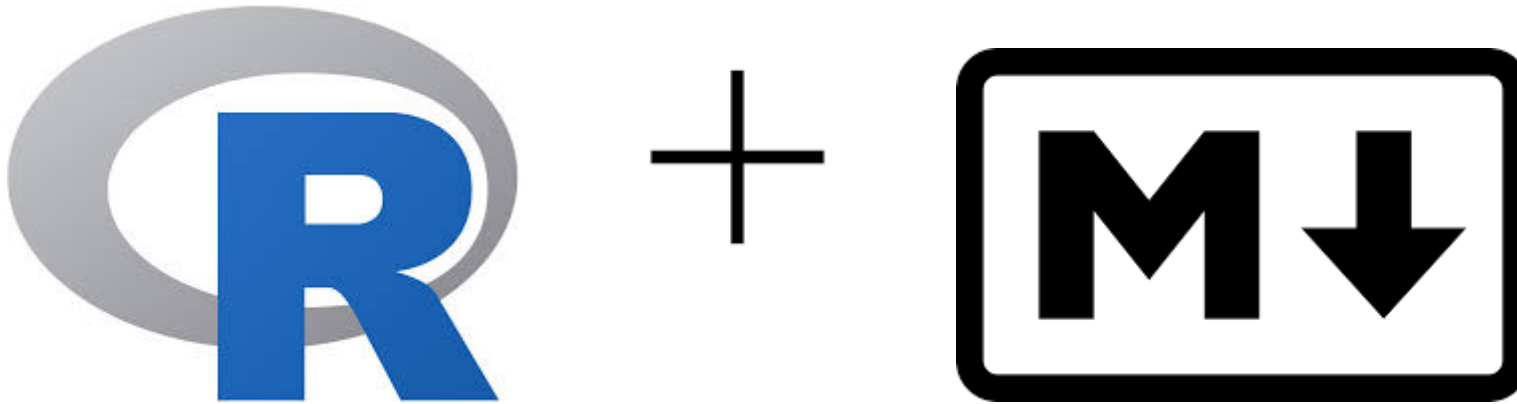
1. What is **R Markdown**?
2. What can you use **R Markdown** for?
3. How does it work?

Outline

Lecture + Tutorial

Make your own **R Markdown** document

What is **R Markdown**?



More specifically:

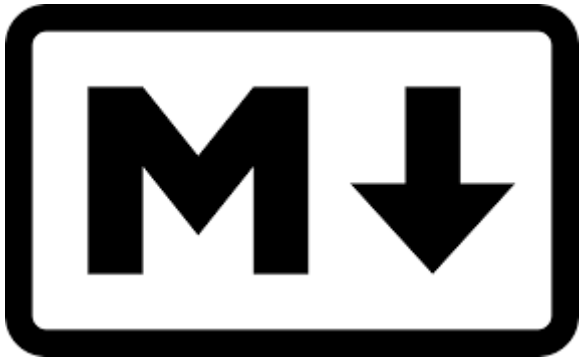
Text + R output + graphics (+ R code) into a single document

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

Markdown - input

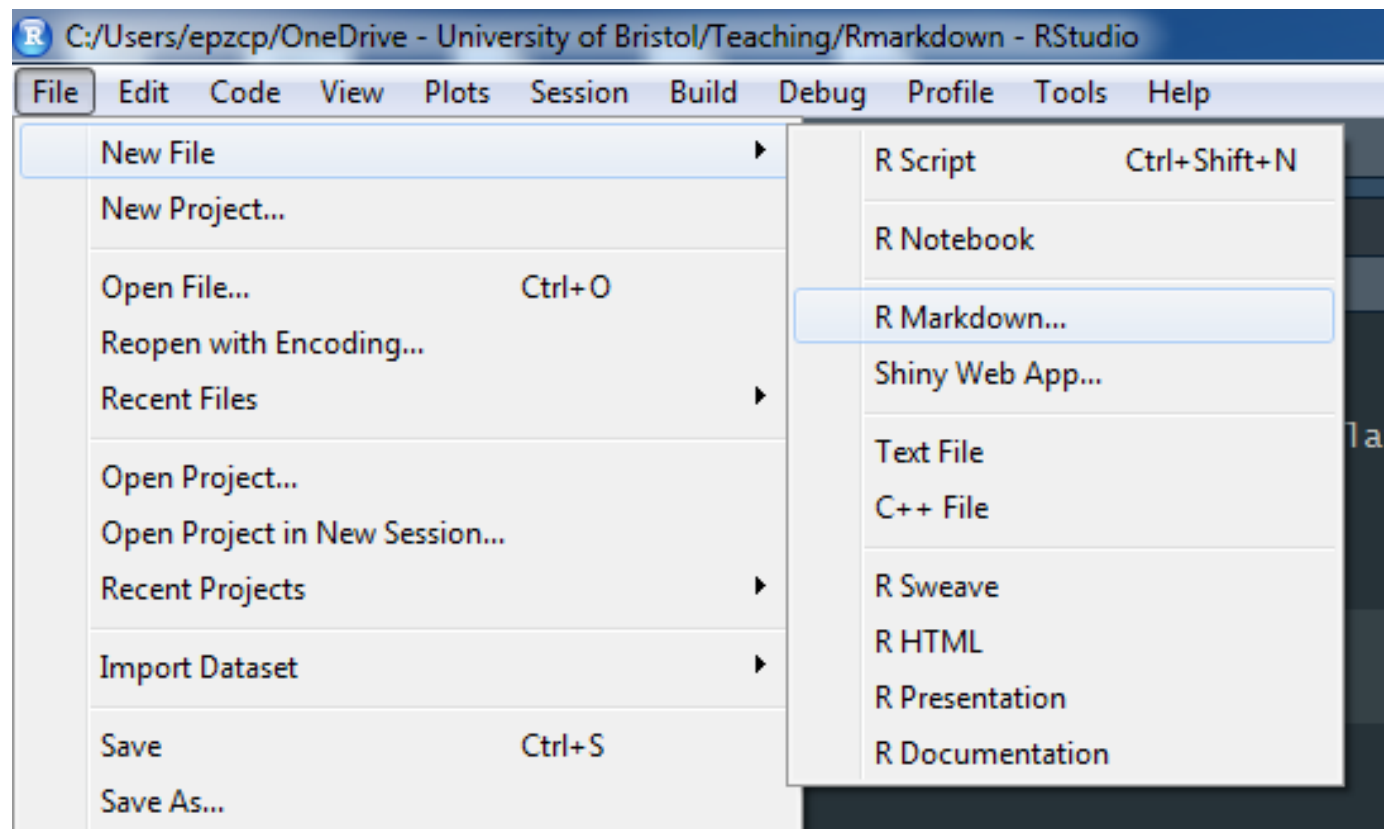
Markdown - output

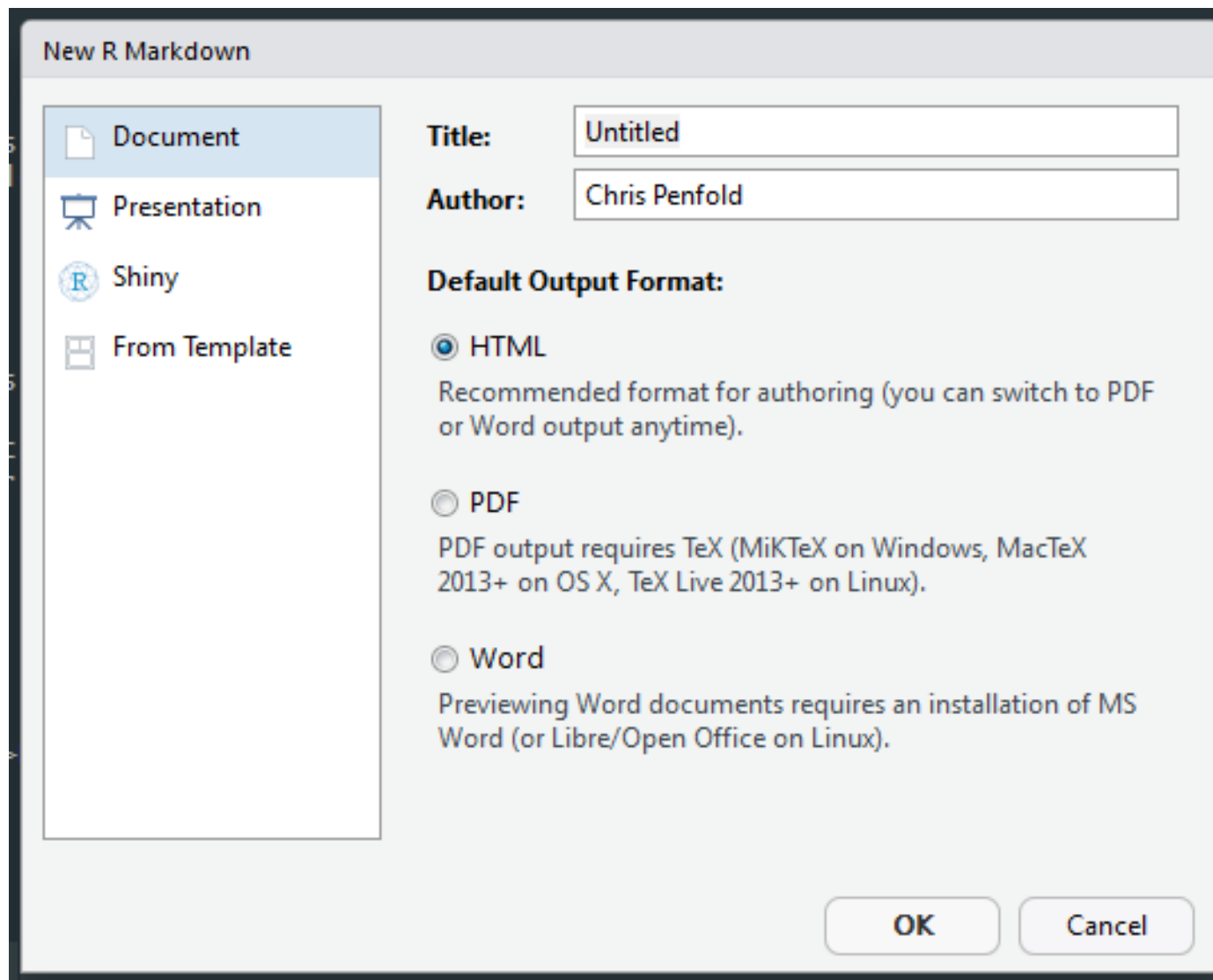
Rmd to output





Making a **R Markdown** file





R Markdown anatomy

YAML (aka *header*)

```
1 ---  
2 title: "Untitled"  
3 author: "Chris Penfold"  
4 date: "7 December 2018"  
5 output: html_document  
6 ---
```


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'

```
18 ▾ ```{r cars}
19   summary(cars)
20   ```
```

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

```
26 ▾ ```{r pressure, echo=FALSE}
27   plot(pressure)
28   ```
```

```
```{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

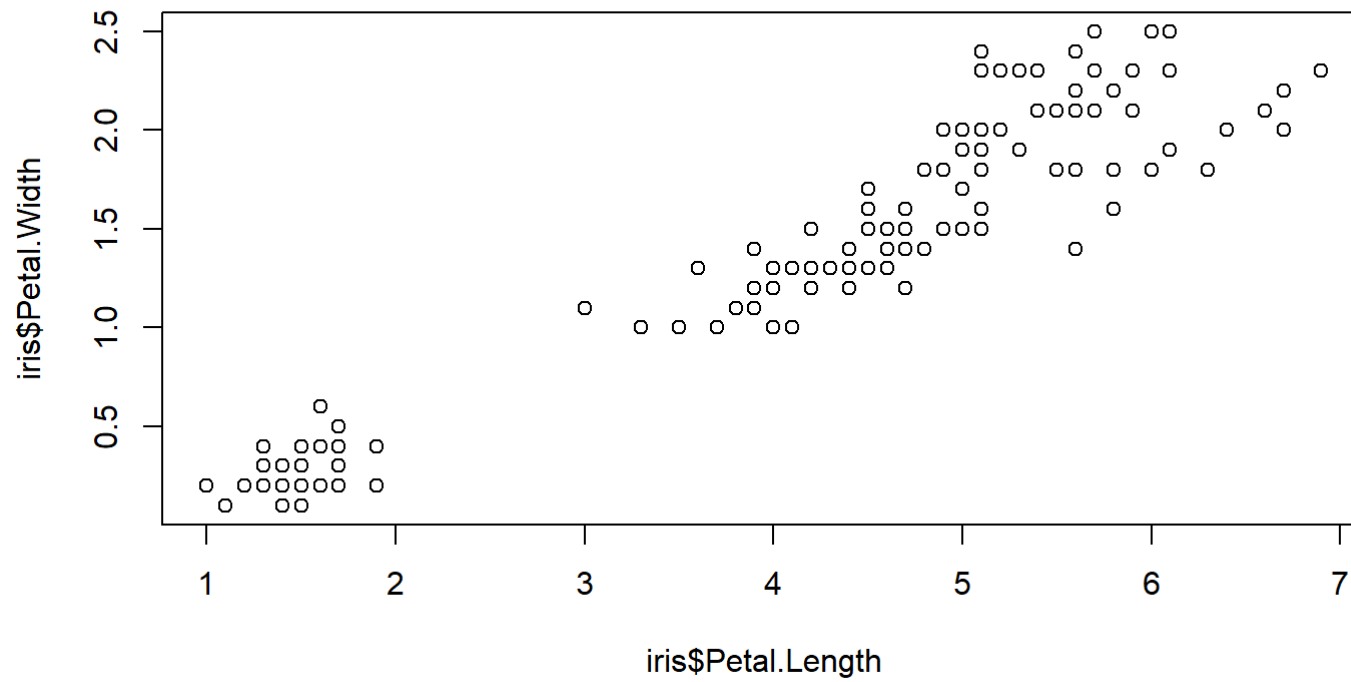
Slide with R Output

```
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)
```

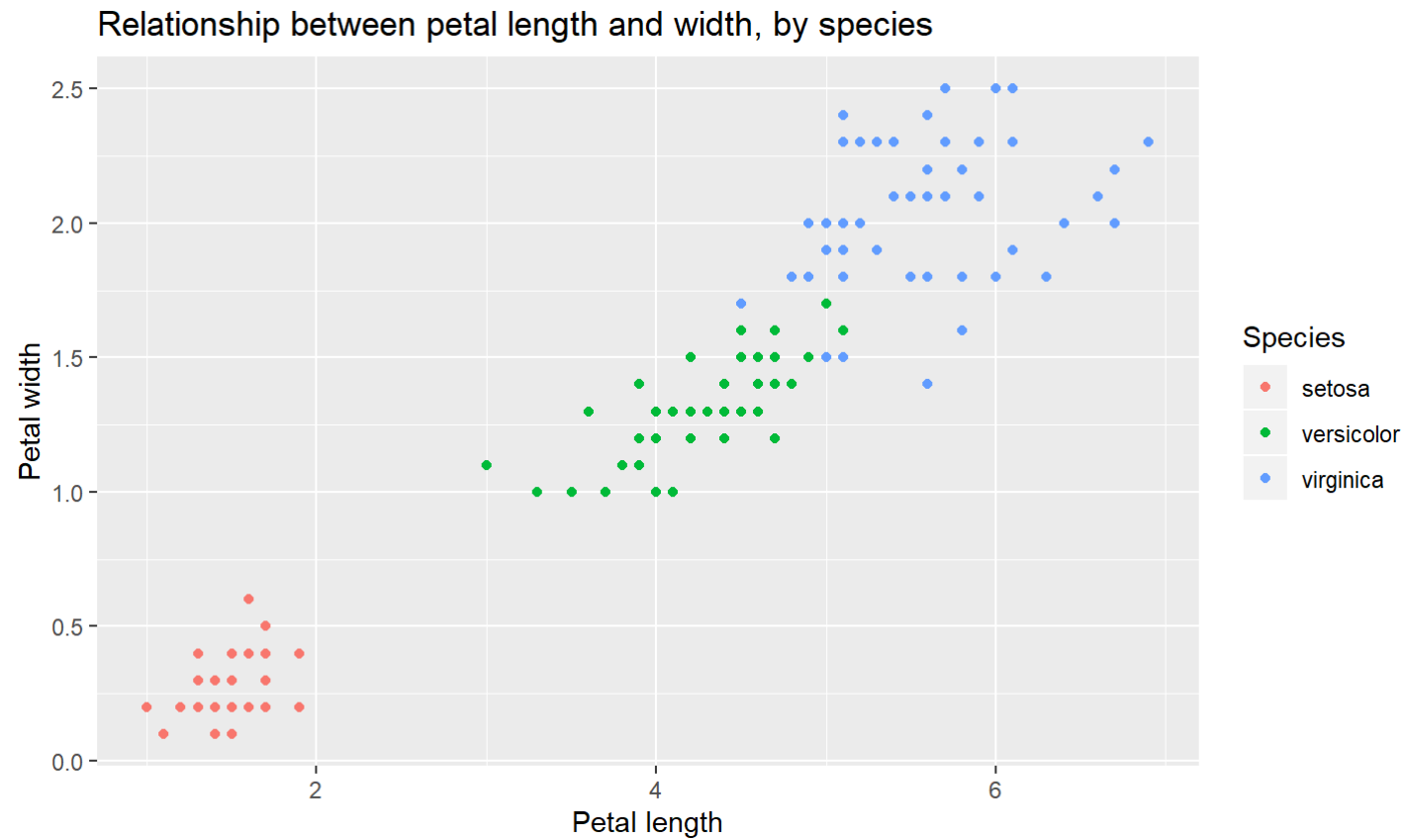


Slide with ggplot2

```
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

```
## Warning: package 'ggplot2' was built under R version 3.5.3
```



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

Warning: package 'arsenal' was built under R version 3.5.3

| | 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

$$\text{` } r^2 + 3 \text{ `}$$

But only the results are shown:

- 5

Equations

You can get nicely formatted equations using MathJax:

E.g. population regression line

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

$$\text{var}(y) = \sigma^2$$

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 results²:

- 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.

R Notebook - example

Times to use R Markdown

PROBLEM

Share reports and presentations

Summarize and share your interactive analyses

COMMON TOOL

Microsoft Office

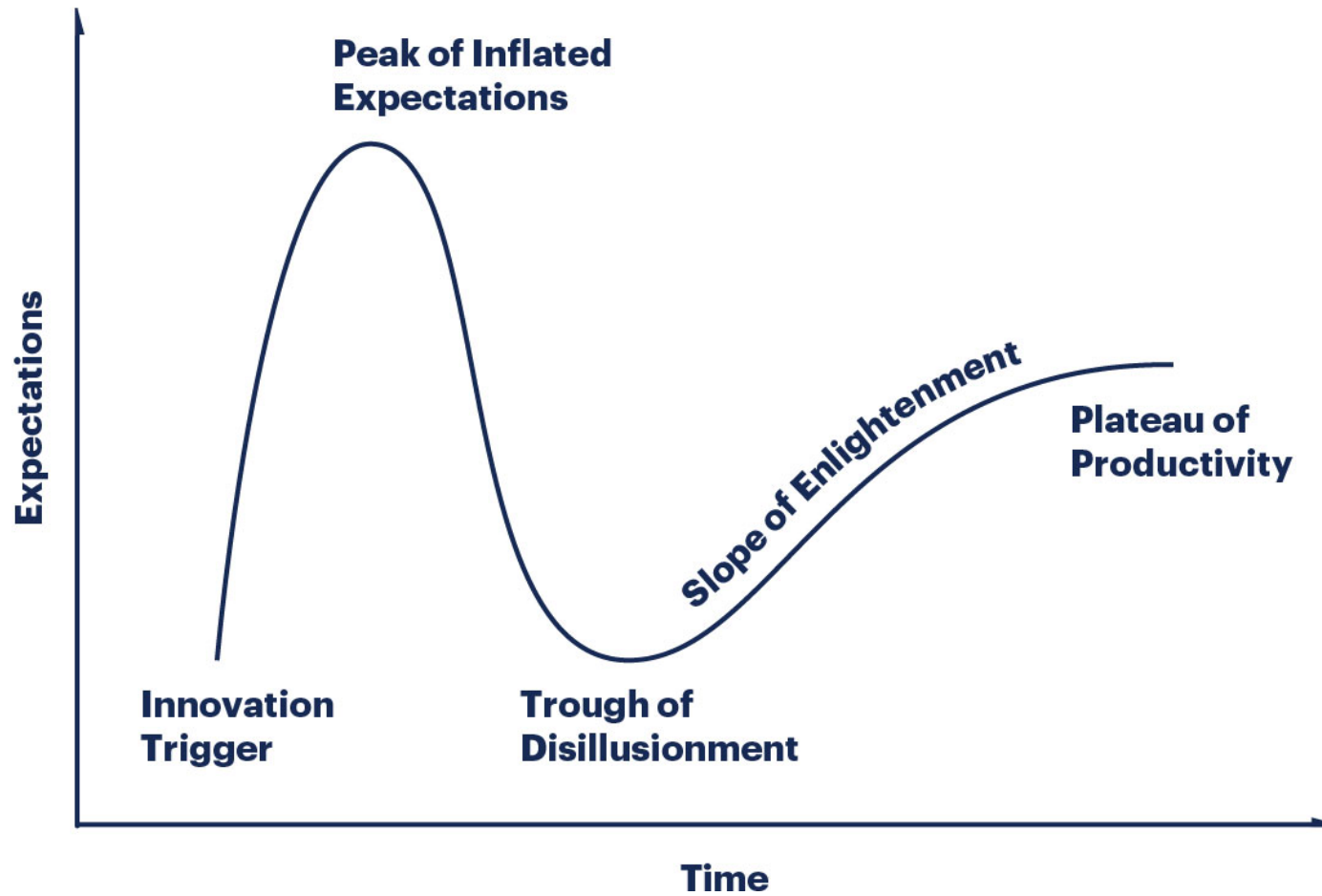
R Scripts

BETTER TOOL

R Markdown

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?


```
## Warning: package 'png' was built under R version 3.5.2
```

```
## Warning: package 'gridExtra' was built under R version 3.5.2
```



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>