Introduction to R Markdown

STA 418/518 - Statistical Computing and Graphics with R

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Complete the following activity using R Markdown and then submit your .Rmd file on Blackboard.

Learning Objectives

1. Knitting R Markdown to different formats
2. Understanding fundamental Markdown syntax
3. Using code chunks in R Markdown
4. Using code chunk options
5. Including plots & tables in R Markdown

➡️ First, create a new R Markdown document with *File > New File > R Markdown…* Knit it by clicking the  Knit button (top left).

- Knit it by using the appropriate keyboard shortcut (**Mac**: *Command + Shift + K*, **Windows**: *Crtl + Shift + K*).
- Verify that you can modify the input in the YAML specifying the output file format and see the output update after reknitting the document.

➡️ Create one new R Markdown document for each of the three most-common formats: HTML, PDF and Word. Knit  each of the three documents.

- How does the output differ?
- How does the input differ?

Note: For PDF output you may need to install LaTeX if knitting to PDF causes an error. This is done by installing the `tinytex` package and then typing `tinytex::install_tinytex()` into the Console and pressing return / enter.

For the rest of the activity, we will focus on the R Markdown document that is knitting to a HTML format.

Markdown

Markdown is a lightweight set of conventions for formatting plain text files. It is designed to be easy to read and write, so not very customizable but can be learned quickly.

Headings

Headings and subheadings can be included in a document to organize the document.

- `# 1st Level Header`
- `## 2nd Level Header`
- `### 3rd Level Header`

➡️ Include a first-level header, second-level header, and third-level header in your R Markdown document naming them Section 1, Section 2, and Section 3, respectively.

Links and Images

Hyperlinks and external images / GIFs can be included in R Markdown documents as well.

- `<https://www.gvsu.edu>`
- `[linked phrase](https://www.gvsu.edu)`
- `![optional caption text](path/to/img.png)`

➡️ Include a hyperlink in the R Markdown document linking to the Google homepage.

Text Formatting

Basic formatting of text, such as italicizing, bolding, superscripts and subscripts can be implemented as well.

Raw text input	Output
`*italic*`	*italic*
`**bold**`	**bold**
`` `code` ``	`code`
`superscript^2^`	superscript^2

Raw text input	Output
`subscript~2~`	subscript$_2$

➡️ Include an italicized word or phrase, a bolded word or phrase, a word styled showing it is code, a superscript, and a subscript in your R Markdown document.

Code Chunks

The real power of R Markdown comes from the ability to add **code chunks** to the document, which allow us to run R code inside our document:

```r
# Sophisticated calculation
pi * exp(1)

## [1] 8.539734
```

Three ways to insert a code chunk:

1. The keyboard shortcut Cmd/Ctrl + Alt + I (recommended)
2. The "Insert" button icon  in the editor toolbar (top right).
3. By manually typing the chunk delimiters ```` ```{r} ```` and ```` ``` ````.

➡️ Add a new code chunk at the bottom of the R Markdown document, naming the chunk `uptownChunk`. In the chunk, use the `include_graphics()` function from the `knitr` package to include the image at the following URL:
https://github.com/dilernia/STA418-518/blob/main/uptownFunk.png?raw=true

Code chunks have multiple **options** which control how they are displayed. Some of the most commonly used:

- `eval`
- `echo`
- `include`
- `warning` and `error`
- `fig.width` and `fig.height`
- `fig.align`

See `str(knitr::opts_chunk$get())` for a list of all default chunk options.

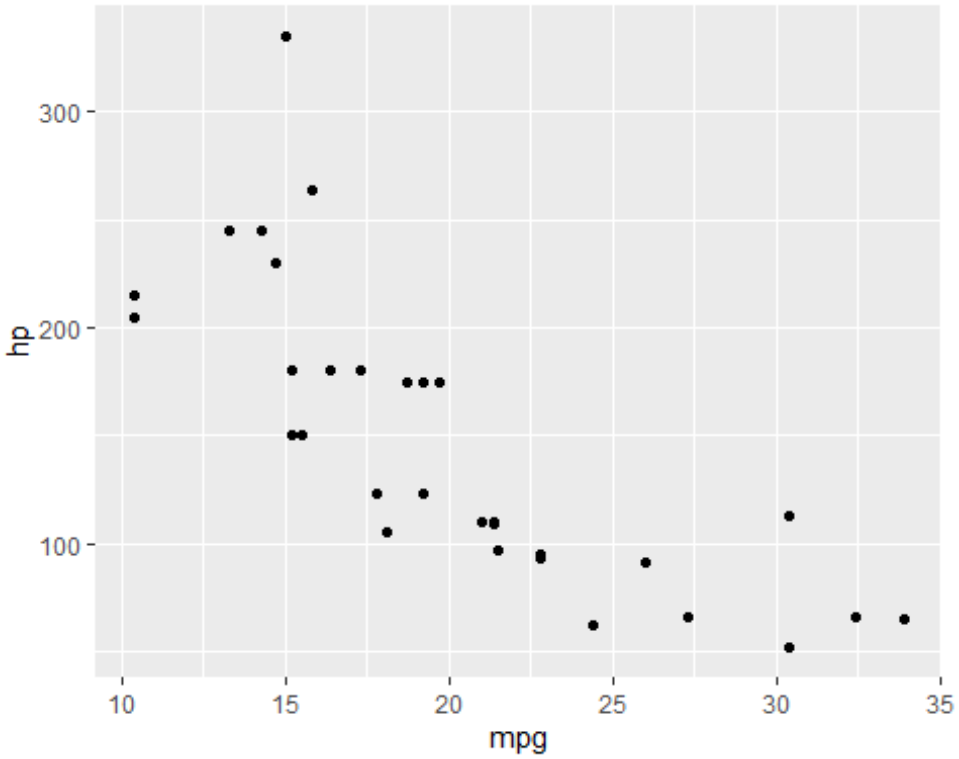
➡️ Modify `uptownChunk` by setting the `echo` chunk option to be `FALSE`.

Toggle the `include` and `eval` chunk options for the `uptownChunk` chunk and see what happens.

Including Plots

Using R code inside chunks that produces plots allows graphics to be directly included in the output document.

```
library(tidyverse)
mtcars %>% ggplot(aes(x = mpg, y = hp)) + geom_point()
```



➡️ Include the code to create a scatter plot above in a new chunk at the bottom of the R Markdown document.

➡️ Toggle the `fig.height`, `fig.width`, and `fig.align` chunk options, exploring their effect on the output.

Inline Code

R Markdown also allows you to call R within a paragraph of text to do calculations and output values:

```
xbar <- 2
se <- 1.3
```

The following R Markdown syntax:

```
The 95% confidence interval for the mean is (`r xbar - 1.96*se`, `r xbar + 1.96*se`)
```

produces:

The 95% confidence interval for the mean is (-0.548, 4.548).

➡️ Include a chunk of R code and after that in-line R code at the bottom of the document to reproduce the sentence containing the confidence interval results above.

Tables

R Markdown allows you to produce nice tables (that also work in MS Word!) using the `kable` function:

```
# Nicely format column names
my.table <- mtcars[1:5, 1:4]
colnames(my.table) <- c("MPG", "Cylinders",
                        "Displacement", "Horsepower")
knitr::kable(my.table, digits = c(1, 0, 0, 0),
             align = c('l', 'r', 'r', 'r'),
             row.names = TRUE)
```

	MPG	Cylinders	Displacement	Horsepower
Mazda RX4	21.0	6	160	110
Mazda RX4 Wag	21.0	6	160	110
Datsun 710	22.8	4	108	93
Hornet 4 Drive	21.4	6	258	110
Hornet Sportabout	18.7	8	360	175

The `flextable` package also outputs nice tables to all formats including Word, with many options for customization:

```r
# Install package if needed
install.packages('flextable')

# Nicely format column names
flextable::flextable(my.table, cwidth = 1.15)
```

MPG	Cylinders	Displacement	Horsepower
21.0	6	160	110
21.0	6	160	110
22.8	4	108	93
21.4	6	258	110
18.7	8	360	175

➡️ Include a chunk of R code and after that in-line R code at the bottom of the document to reproduce the table above using both `kable()` from the `knitr` package and `flextable()` from the `flextable` package.

Word Templates

- Organizations, such as the US Department of Agriculture, can have weekly or monthly reports that change as data / other inputs are updated.
- R Markdown to Word can use Word doc templates for consistent formatting, headers, etc. while updating charts & tables

Much More!

- For the equivalent of this class I took in graduate school at Minnesota, I created an HTML document, and made it available online here.
- This activity was made using R Markdown.
- This R Markdown Cheat Sheet describes additional features and fundamentals of R Markdown