Introduction to R Markdown

Saghir Bashir

24th October 2019

https://github.com/saghirb/Rmarkdown-Intro-Workshop

Relax

Experiment

Make Mistakes

Learn

Enjoy

Outline

R Markdown Examples

What is R Markdown?

HTML & PDF Documents

Pretty Tables

Summary

Prerequisites

Latest versions of:

1. R: https://cran.r-project.org
2. RStudio: https://www.rstudio.com/products/rstudio

R Markdown Examples

HTML "Analysis" Document

Read in the data

First load the `data.table` package (hint: use the `library()` function). Then use the `fread()` function to read in the data file `World-Population.csv` in an object called `un`. Finally look at the `un` dataset using the `str()` function.

```
library(data.table)
un <- fread("World-Population.csv")
un
```

```
##        continent    Location Time AgeGrp AgeGrpStart PopFemale PopMale
##     1:      Asia Afghanistan 1950    0-4           0    661.58  630.04
##     2:      Asia Afghanistan 1950    5-9           5    487.33  516.21
##     3:      Asia Afghanistan 1950  10-14          10    423.33  461.38
##     4:      Asia Afghanistan 1950  15-19          15    369.36  414.37
##     5:      Asia Afghanistan 1950  20-24          20    318.39  374.11
##    ---
## 47942:    Africa      Zambia 2015  80-84          80     23.30   16.10
## 47943:    Africa      Zambia 2015  85-89          85      9.17    5.84
## 47944:    Africa      Zambia 2015  90-94          90      2.40    1.30
## 47945:    Africa      Zambia 2015  95-99          95      0.35    0.16
## 47946:    Africa      Zambia 2015   100+         100      0.03    0.01
```

```
str(un)
```

```
## Classes 'data.table' and 'data.frame':   47946 obs. of  7 variables:
##  $ continent  : chr  "Asia" "Asia" "Asia" "Asia" ...
##  $ Location   : chr  "Afghanistan" "Afghanistan" "Afghanistan" "Afghanistan" ...
##  $ Time       : int  1950 1950 1950 1950 1950 1950 1950 1950 1950 1950 ...
##  $ AgeGrp     : chr  "0-4" "5-9" "10-14" "15-19" ...
##  $ AgeGrpStart: int  0 5 10 15 20 25 30 35 40 45 ...
##  $ PopFemale  : num  662 487 423 369 318 ...
```

HTML Website

https://dsup.org 120%

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Data Science Unplugged

A community for data science

Lisbon

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12 TAGS

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2018-06-05 · 441 WORDS · 3 MINUTE READ BLOG

IMPOSTER SYNDROME · STATISTICS · CRITICAL THINKING · LEARNING

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TAGS

- accessibility (1)
- critical-thinking (2)
- data-science (5)
- events (2)
- food (1)
- imposter-syndrome (1)
- latex (1)
- learning (4)
- r-language (3)
- r-markdown (1)

HTML Book

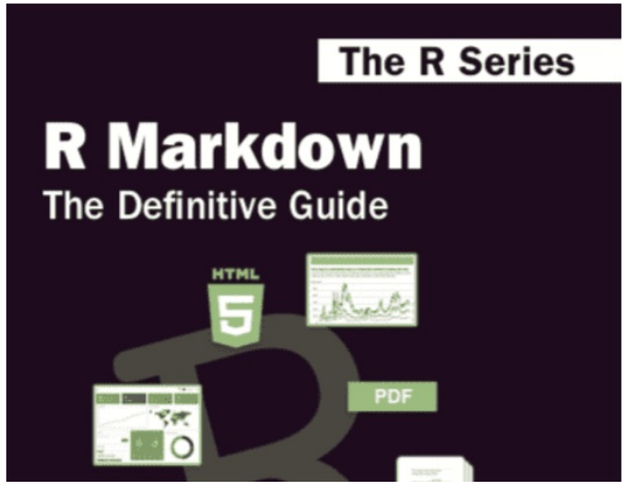
R Markdown: The Definitive Guide

Yihui Xie, J. J. Allaire, Garrett Grolemund

2019-06-03

Preface

Note: This book has been published by Chapman & Hall/CRC. The online version of this book is free to read here (thanks to Chapman & Hall/CRC), and licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.



PDF Article

Women in Parliament – data.table

Saghir Bashir

This version was compiled on April 16, 2019

We will use the World Bank's indicator data for "Women in Parliament" as a case study when working with the data.table R package. We will guide you through the geographical and time trends for the percentage of women in national parliaments. We will start by learning about and understanding the raw data, which we will then process ("wrangle") in preparation for some exploratory analysis.

Women in Parliament | World Bank Indicator | data.table | Tinyverse

1. Preface

We present a real-life case study for the data.table[1] package using the World Bank's "Women in Parliament" indicator data. To get the most out of this case-study guide, repeat the examples and do the exercises whilst reading it.

Guide materials. You can download materials for this guide from this link:

- https://ilustat.com/shared/WiP-rdatatable.zip

Unzip the file, which contains the data, this guide and an R script exercise file. We advise you to work with "`WiP-Exercise.R`" file to follow the examples and do the exercises. If you are using RStudio, you can double click on "`WiP-dt.Rproj`" to get started.

Data limitations. Take caution when interpreting these data, as parliamentary systems vary from country to country, and in some cases over time. Some of the issues to consider include:

- Who has, and who does not have, the right to become a Member of Parliament (MP)?
- How does someone become an MP? Through democratic elections? How is "democratic election" defined?
- What is the real power of MPs and their parliament? Can MPs make a difference?

Data definitions & assumptions.

"Women". The definition for "women" is not given, so we will assume that it refers to a binary classification for gender (sex).

"Country (Region)". The definition of countries and regions can change over time. (e.g. formation of new countries after conflicts, new member states joining a pre-existing collective). How are these changes reflected in the data? How do they affect the interpretation?

Pro tip. Understand the limitations of your data before anybody else points them out to you.

4. About the data file

PDF Book

Chapter 3

Tables, Graphics, References, and Labels

3.1 Tables

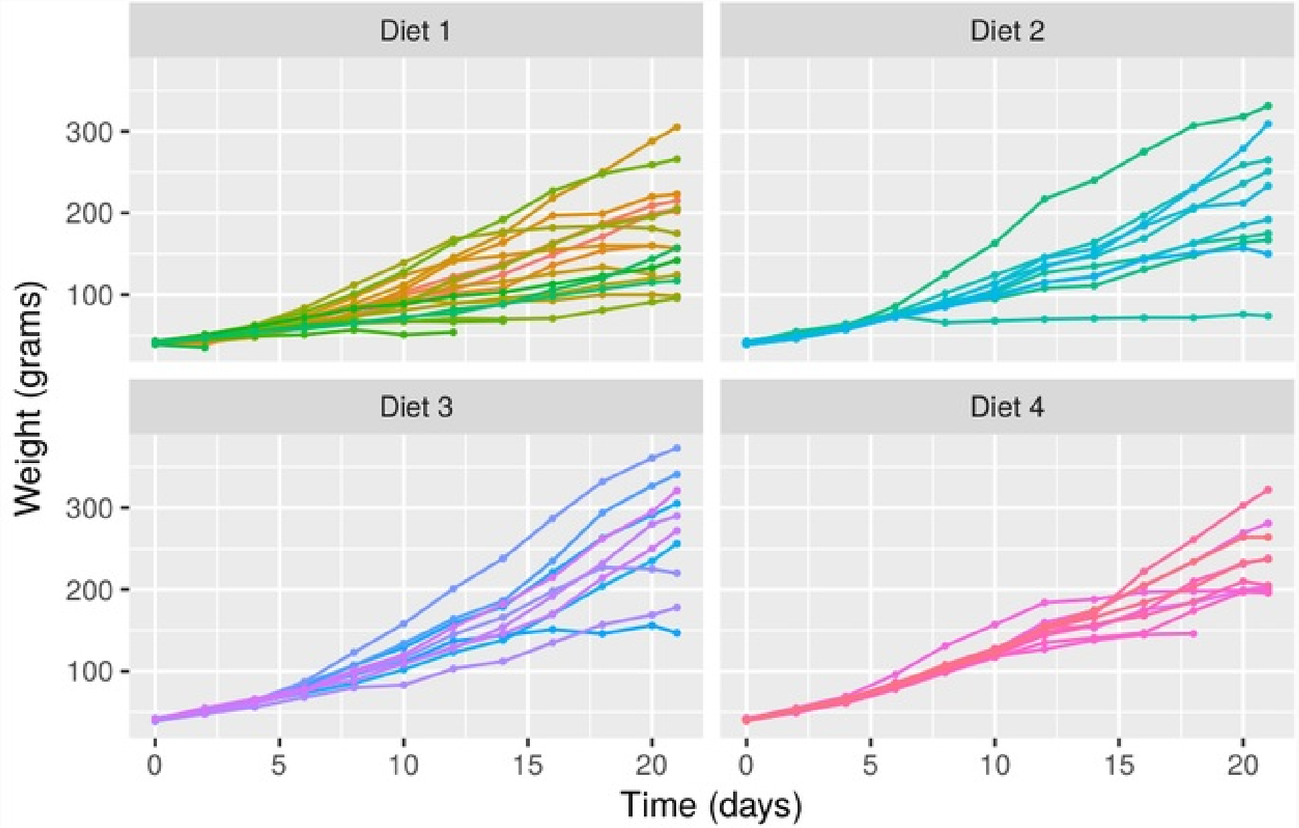
In addition to the tables that can be automatically generated from a data frame in **R** that you saw in R Markdown Basics using the `kable` function, you can also create tables using *pandoc*. (More information is available at `http://pandoc.org/README.html#tables`.) This might be useful if you don't have values specifically stored in **R**, but you'd like to display them in table form. Below is an example. Pay careful attention to the alignment in the table and hyphens to create the rows and columns.

Table 3.1: Correlation of Inheritance Factors for Parents and Child

Factors	Correlation between Parents & Child	Inherited
Education	-0.49	Yes
Socio-Economic Status	0.28	Slight
Income	0.08	No
Family Size	0.18	Slight

PDF Presentation

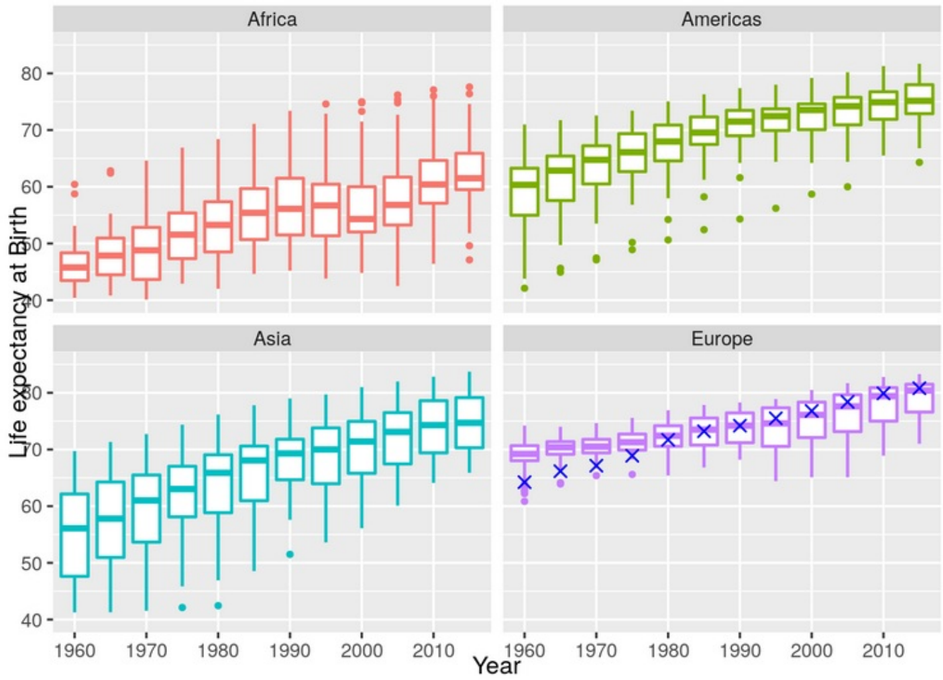
Analysis - By Chick Plot



27

Life Expectancy - By Continent

```
gm[continent!="Oceania"] %>%
ggplot(aes(fyear, lifeexp,
           colour = continent)) +
geom_boxplot(outlier.size = .5) +
geom_point(data=gmPT,
           shape = 4,
           colour="blue") +
scale_x_discrete(
  breaks=seq(1960, 2010, 10)) +
scale_y_continuous(limits=c(40,85)) +
facet_wrap(~continent) +
xlab("Year") +
ylab("Life expectancy at Birth") +
theme(legend.position = "none")
```



More R Markdown

Formats

- HTML
- PDF
- Word & ODF
- Power Point & ODF

Other

- Dashboards
- Web Applications
- HTML Notebooks
- CVs

What is R Markdown?

What is Markdown?

Special computer language ("Markup")

- Plain text file with special syntax.
- Human readable.
- "Tags" define Structure & elements.
- Converts to HTML, PDF, ...

Markdown Example


```
# Markdown Example

Paragraphs are separated by a blank line.

## Format text

Some _italic_, **bold** and `monospace` text.

Bullet list
+ Apples.
+ Oranges.
+ Pears

An [example link](https://github.com/saghirb)..
```

Markdown Example

Paragraphs are separated by a blank line.

Format text

Some *italic*, **bold** and `monospace` text.

Bullet list

- Apples.
- Oranges.
- Pears

An example link.

What is R Markdown?

A mix of R programming and markdown.

- R code and documentation in one place.
- Great for doing reproducible research.
- Great for collaborating and sharing.
- Converts to HTML, PDF, websites, article, books, ...

R Markdown Example

````
---
title: "R Markdown Demo"
author: "Saghir Bashir"
date: "13/06/2019"
output: html_document
---

_Using_  **R** as a calculator.

```{r Rcalc}
2+5
8**2
```

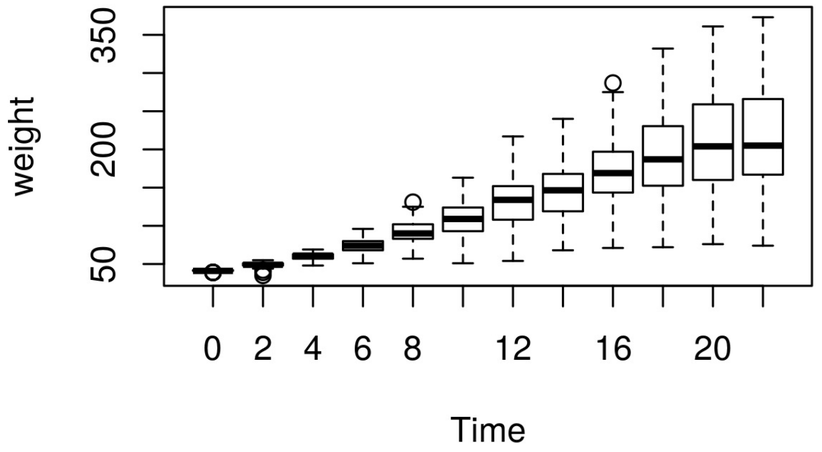
Plot the `ChickWeight` data.
```{r plotCW, echo=FALSE, out.width="80%"}
with(ChickWeight, boxplot(weight ~ Time))
```
````

Using **R** as a calculator.

```
(2+5)**2
```

```
## [1] 49
```

Plot the `ChickWeight` data.



R Markdown Explained - YAML


```
---
title: "R Markdown Demo"
author: "Saghir Bashir"
date: "13/06/2019"
output: html_document
---

_Using_  **R** as a calculator.

```{r Rcalc}
2+5
8**2
```

Plot the `ChickWeight` data.

```{r plotCW, echo=FALSE, out.width="80%"}
with(ChickWeight, boxplot(weight ~ Time))
```
```

File extension is `.Rmd`

- **e.g.** `My-Report.Rmd`

Top is YAML header

- **Descriptive information.**
- **Format & Style.**

R Markdown Explained - Markdown


````
---
title: "R Markdown Demo"
author: "Saghir Bashir"
date: "13/06/2019"
output: html_document
---

_Using_  **R** as a calculator.

```{r Rcalc}
2+5
8**2
```

Plot the `ChickWeight` data.

```{r plotCW, echo=FALSE, out.width="80%"}
with(ChickWeight, boxplot(weight ~ Time))
```
````

Below the YAML header

- Markdown code.

R Markdown Explained - R Chunks

````
---
title: "R Markdown Demo"
author: "Saghir Bashir"
date: "13/06/2019"
output: html_document
---

_Using_  **R** as a calculator.

```{r Rcalc}
2+5
8**2
```

Plot the `ChickWeight` data.

```{r plotCW, echo=FALSE, out.width="80%"}
with(ChickWeight, boxplot(weight ~ Time))
```
````

Below the YAML header

- Markdown code.
- R code chunks with:
    - unique names.
    - chunk options.

HTML Document

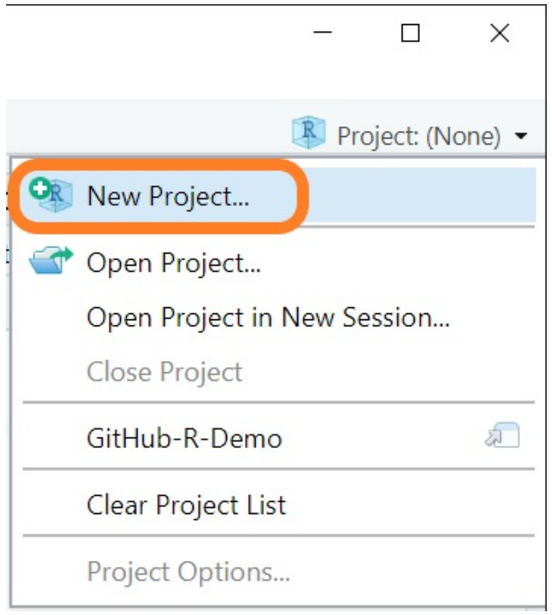
```
install.packages("kableExtra")

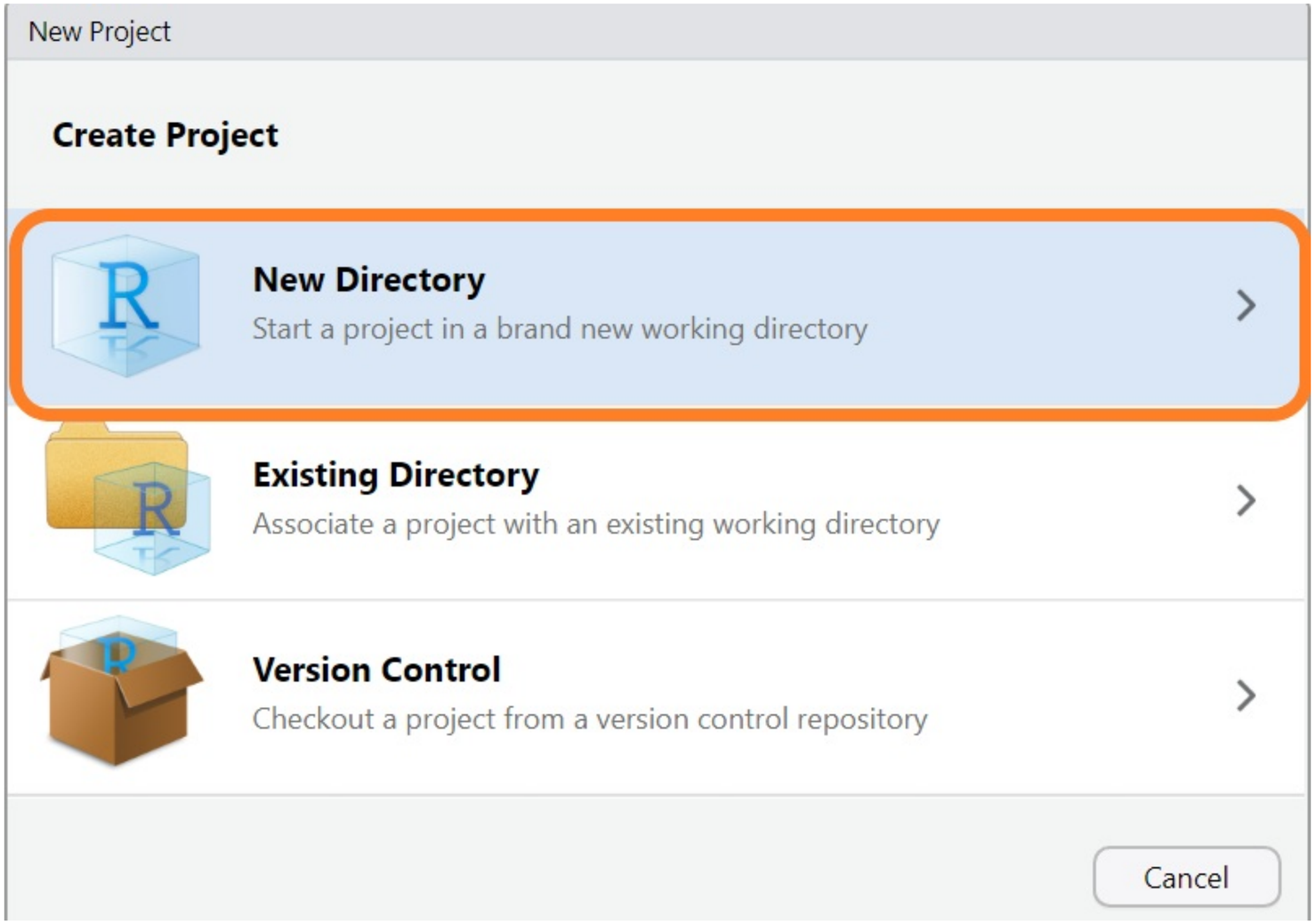
install.packages("rticles")

install.packages("tinytex")

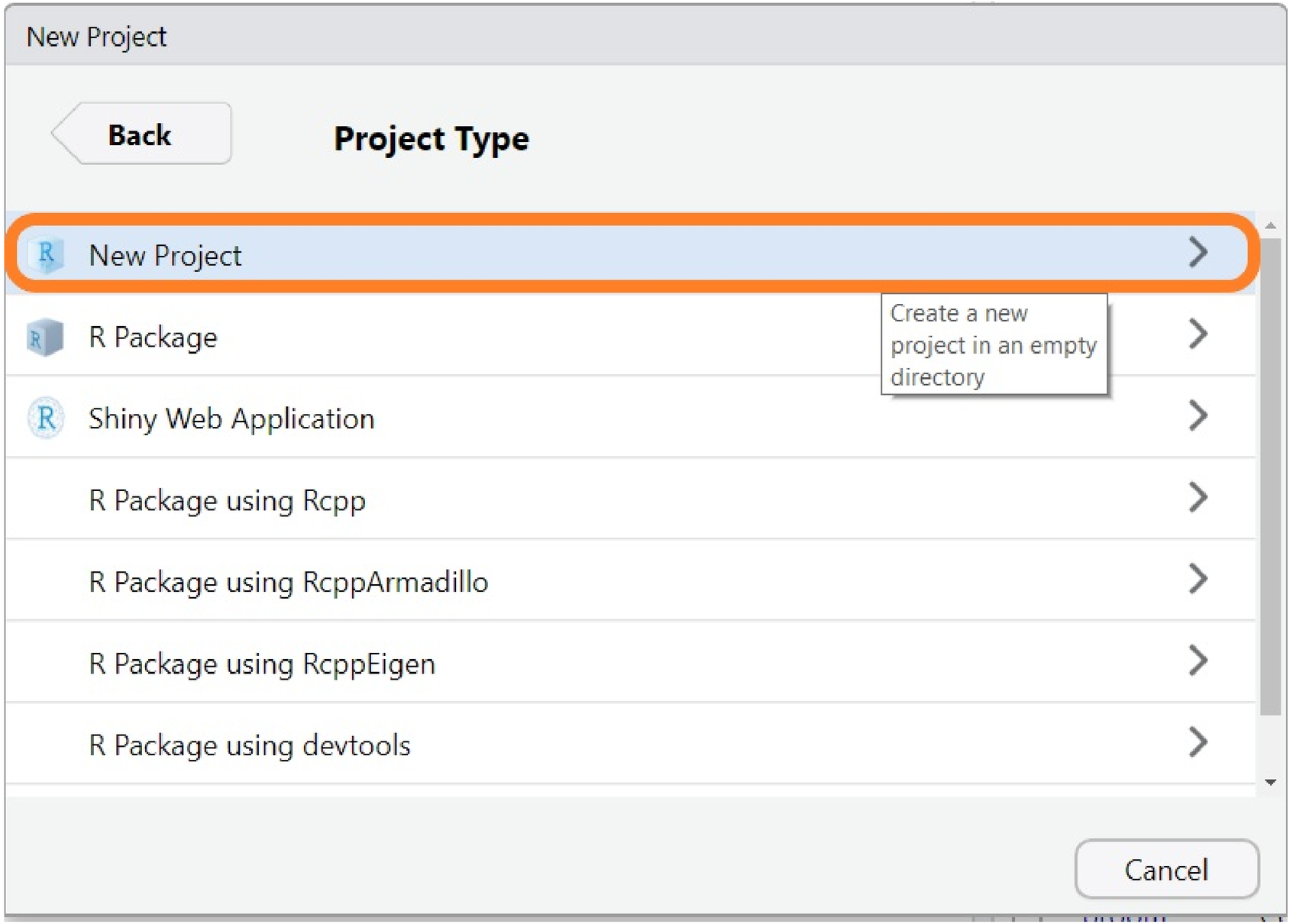
tinytex::install_tinytex()
```

Create a New RStudio Project

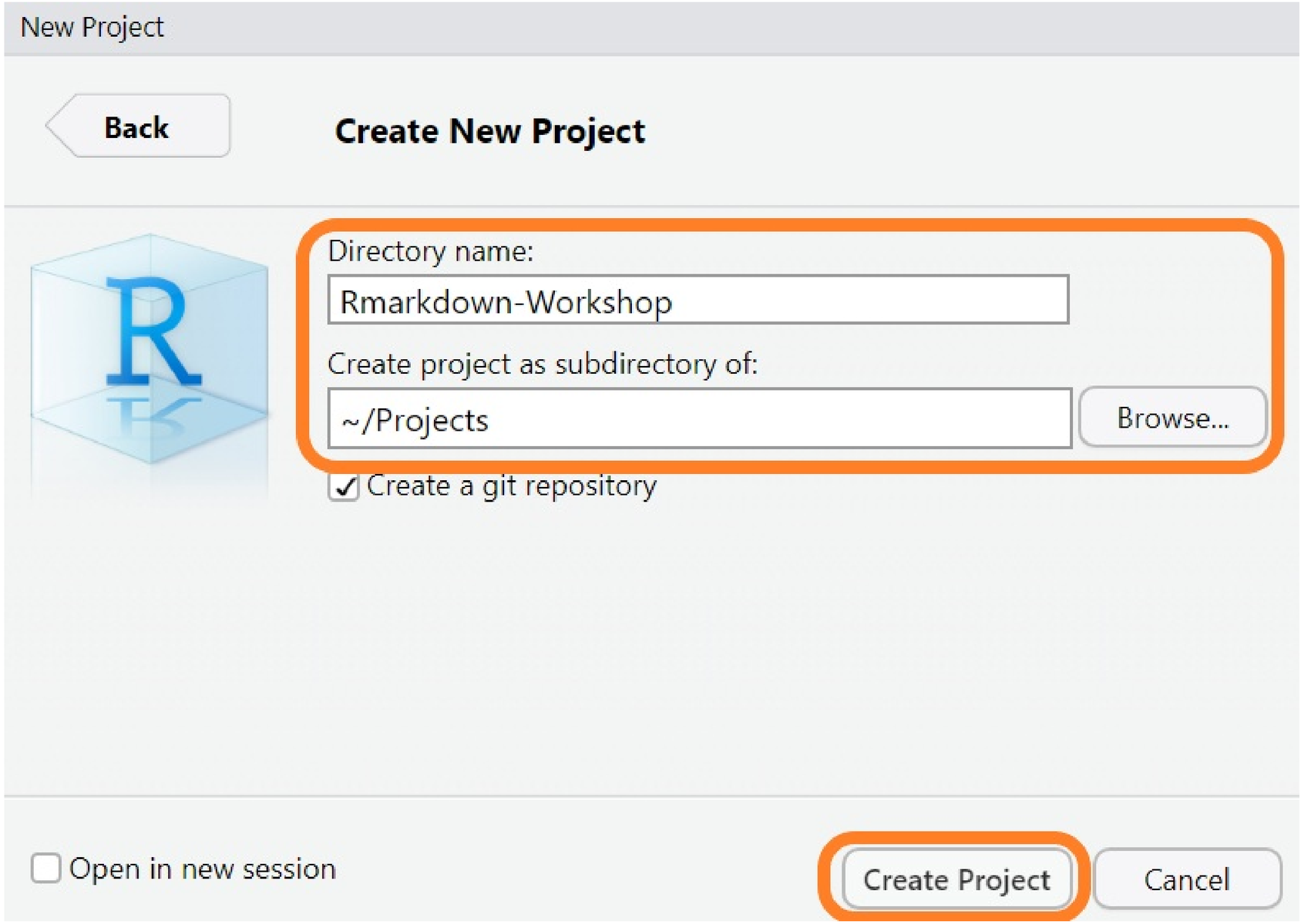




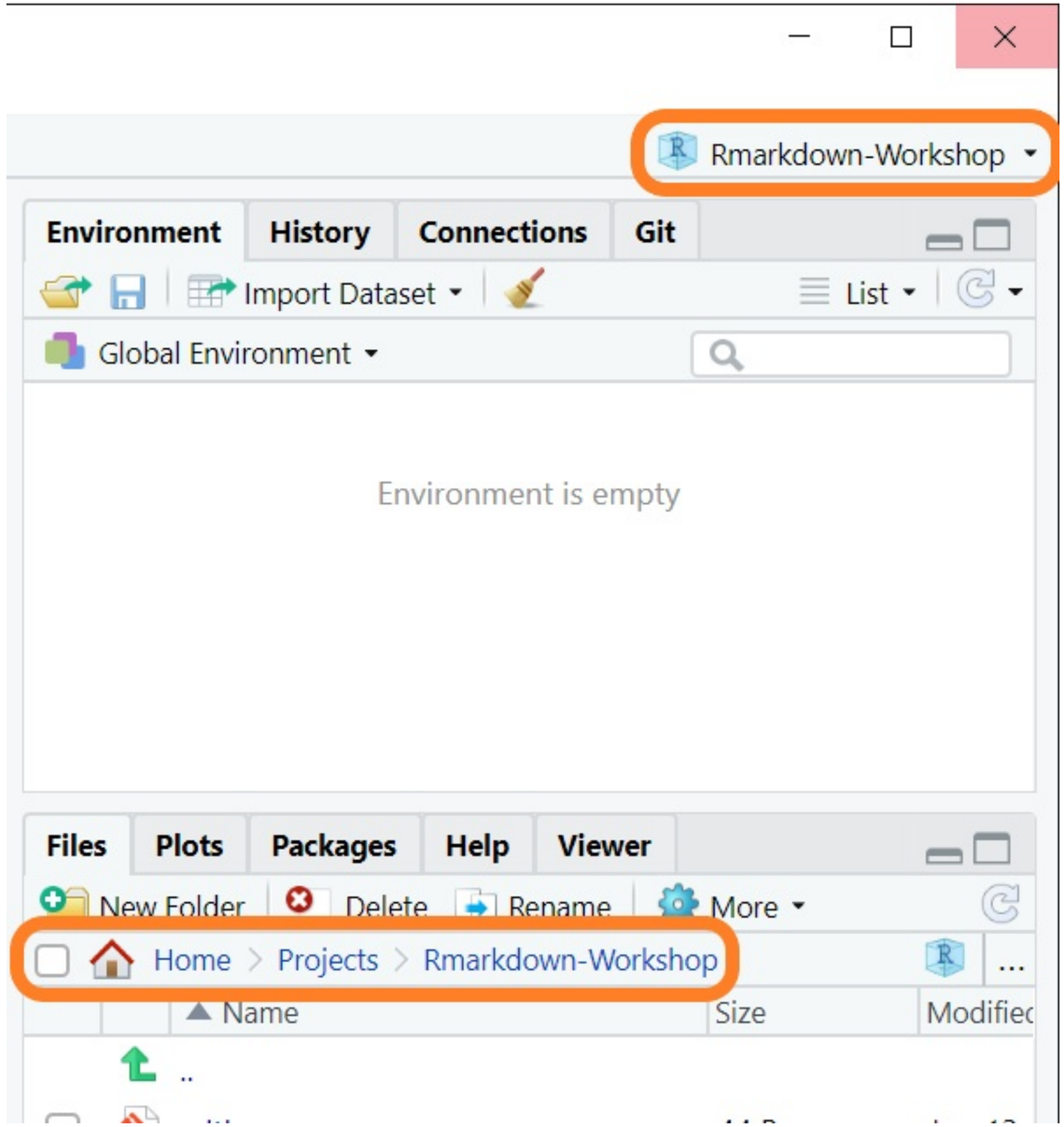
Select "New Project"



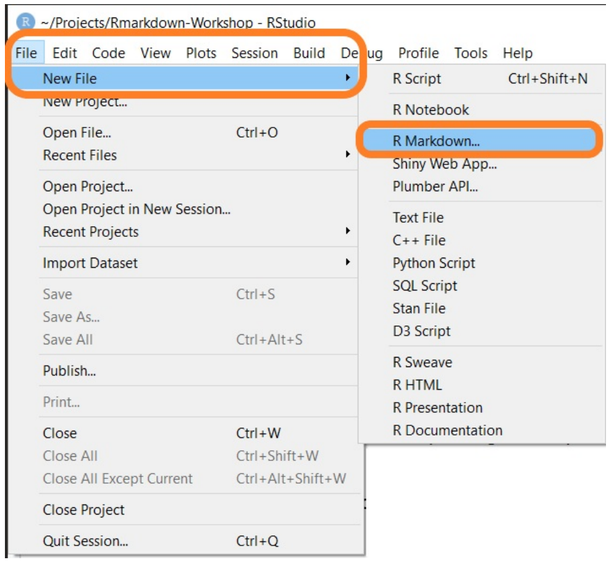
Define Directory Location

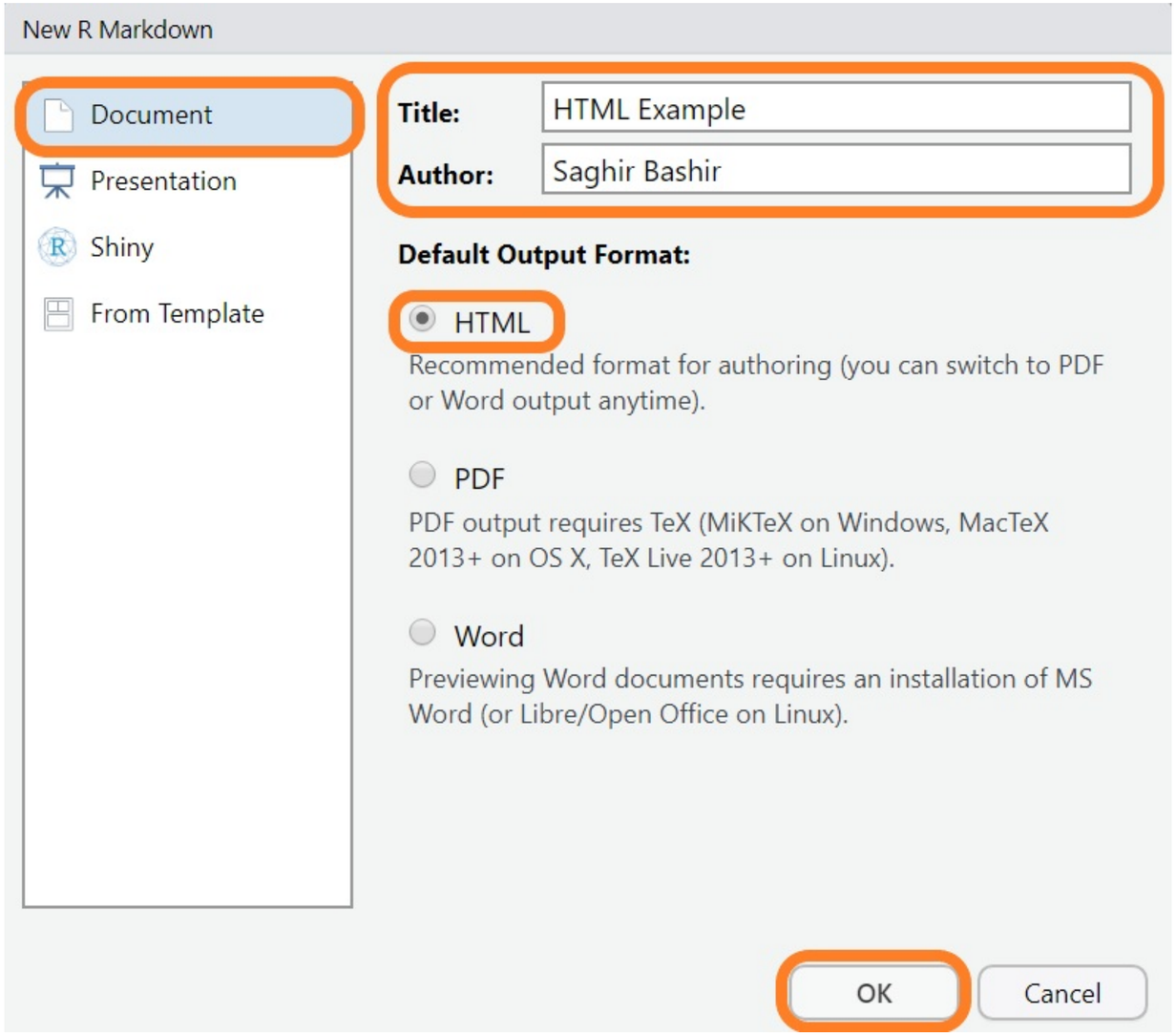


New Project Created

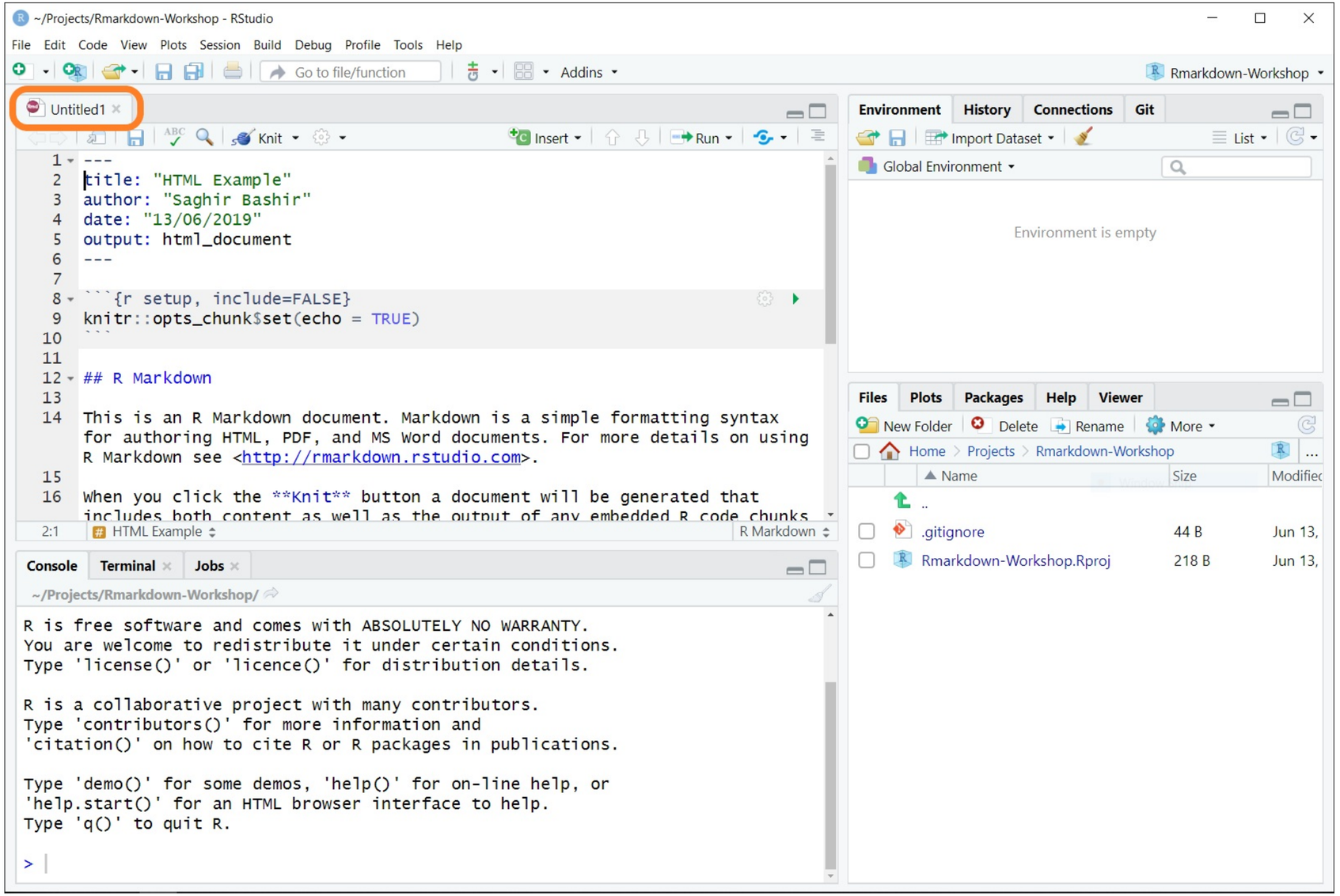


Create R Markdown Document

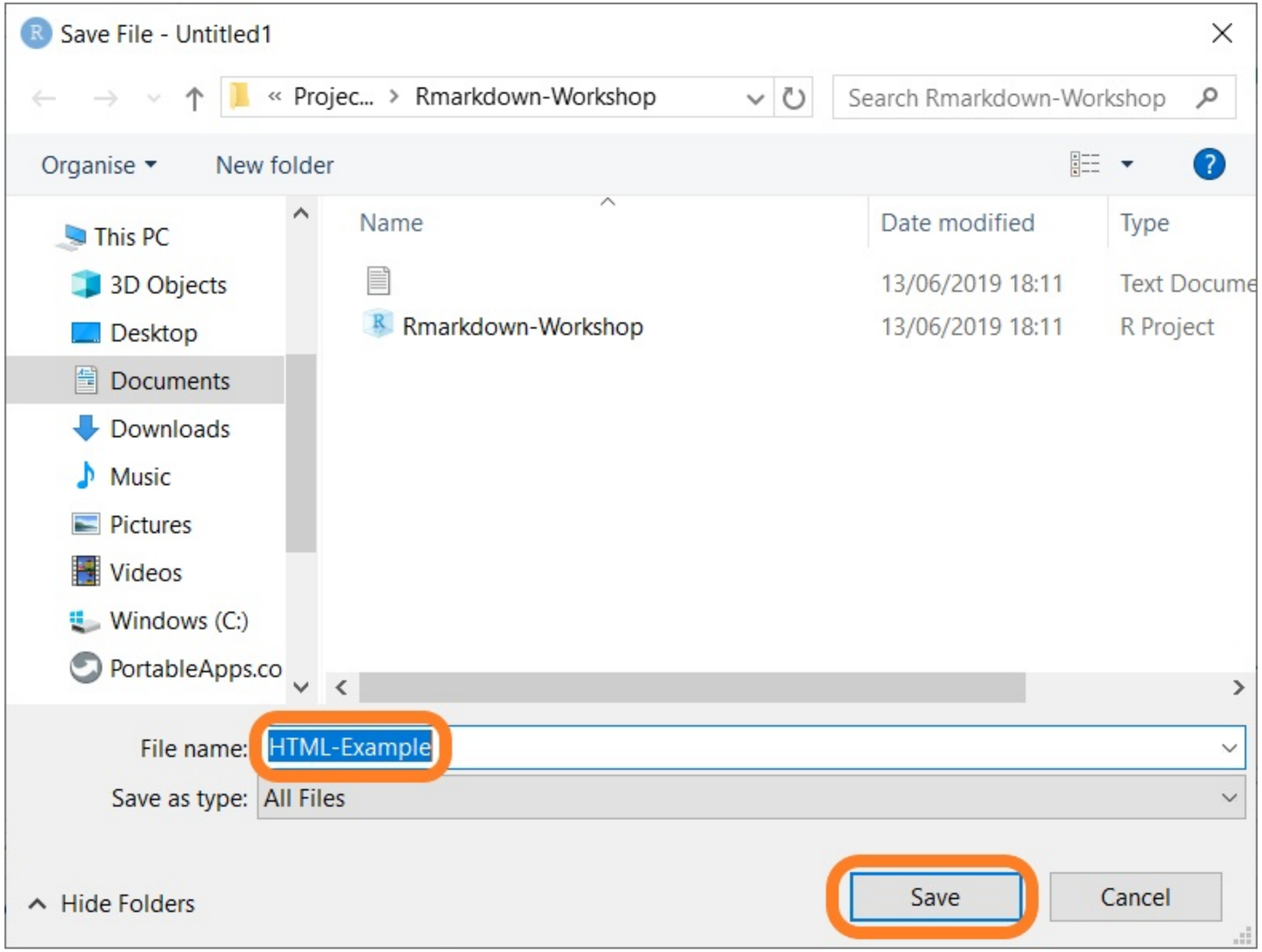




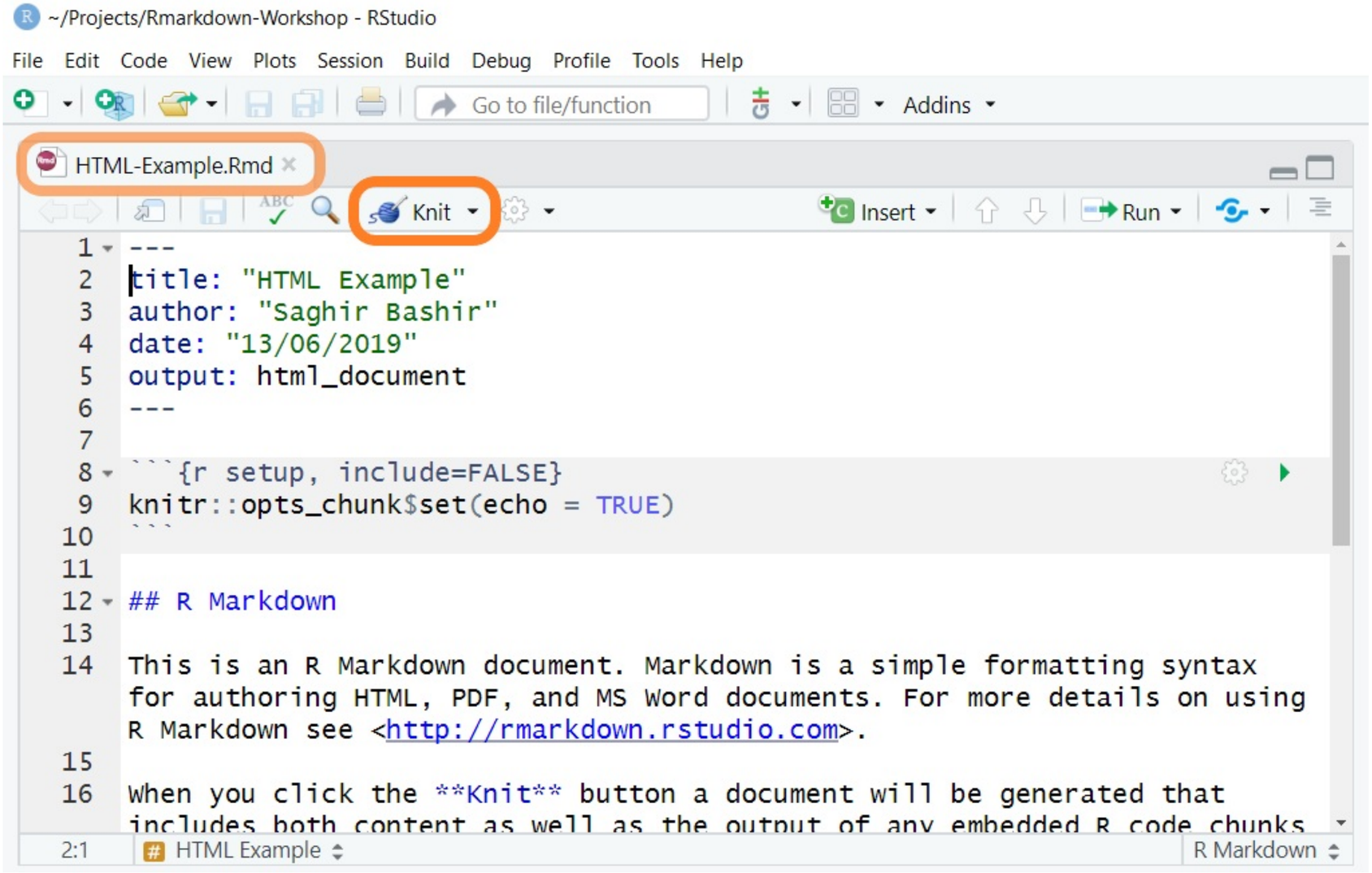
Untitled and Unsaved



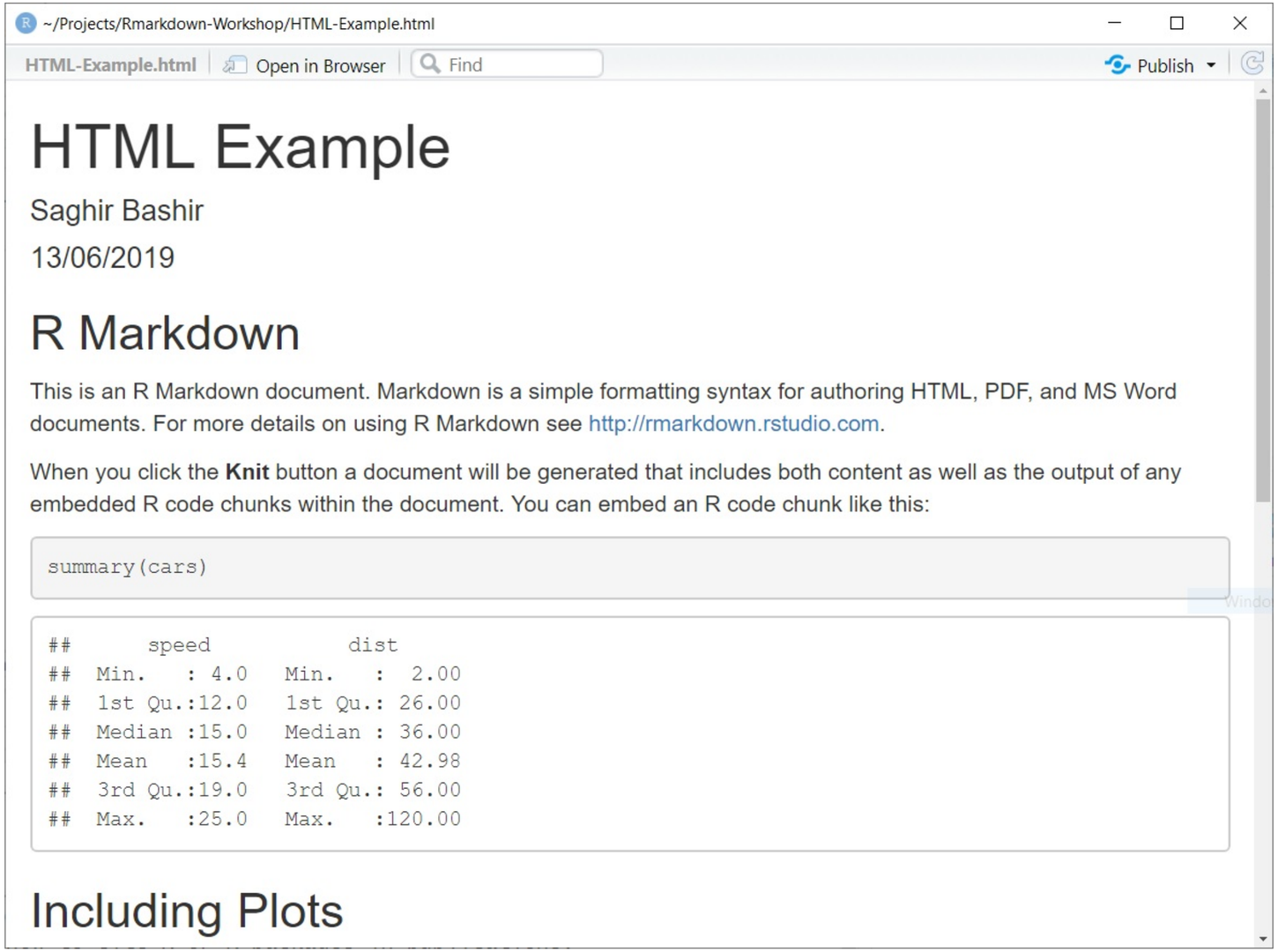
Save as .Rmd


Save File - Untitled1
« Projec... > Rmarkdown-Workshop
Search Rmarkdown-Workshop
Organise
New folder
This PC
3D Objects
Desktop
Documents
Downloads
Music
Pictures
Videos
Windows (C:)
PortableApps.co
Name
Date modified
Type
13/06/2019 18:11
Text Docume
Rmarkdown-Workshop
13/06/2019 18:11
R Project
File name:
HTML-Example
Save as type:
All Files
Hide Folders
Save
Cancel

Click "Knit" to Create HTML File



HTML Document - Top



HTML Document - Bottom

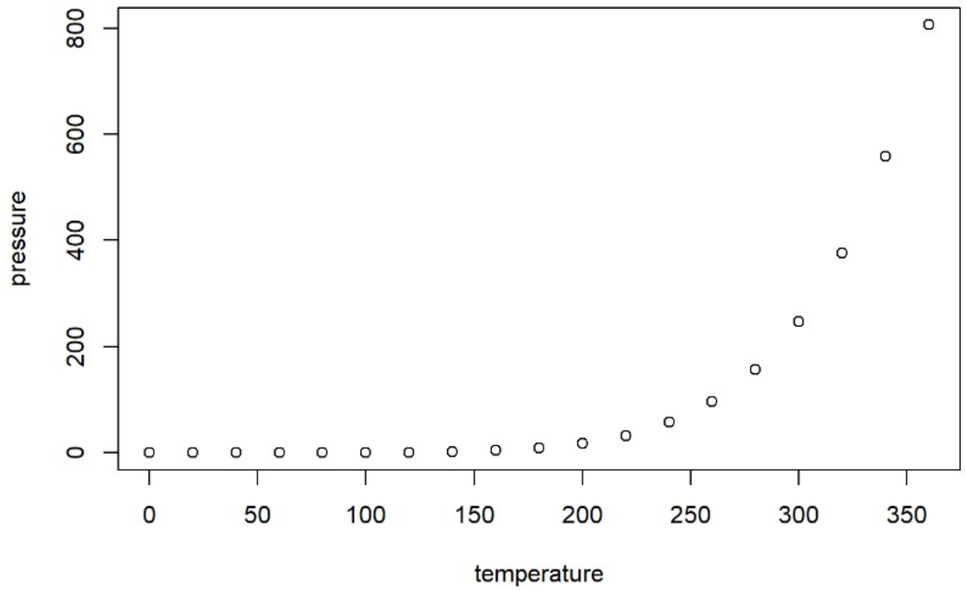
~/Projects/Rmarkdown-Workshop/HTML-Example.html

HTML-Example.html | Open in Browser | Find | Publish

```
##  Max.   :25.0   Max.   :120.00
```

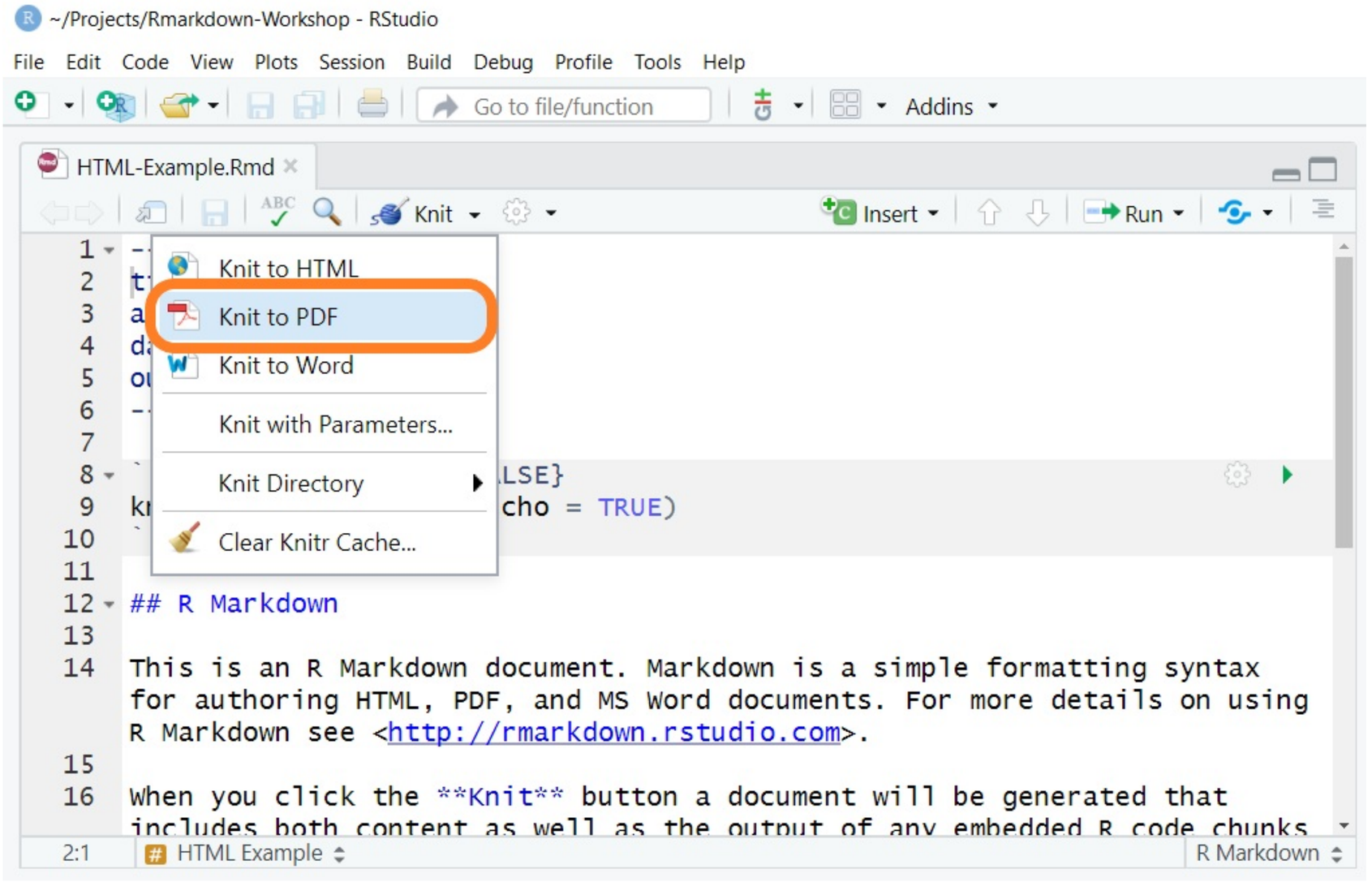
Including Plots

You can also embed plots, for example:



Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.

You Can "Knit" to PDF



PDF Document

HTML Example

Saghir Bashir

13/06/2019

R Markdown

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.

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:

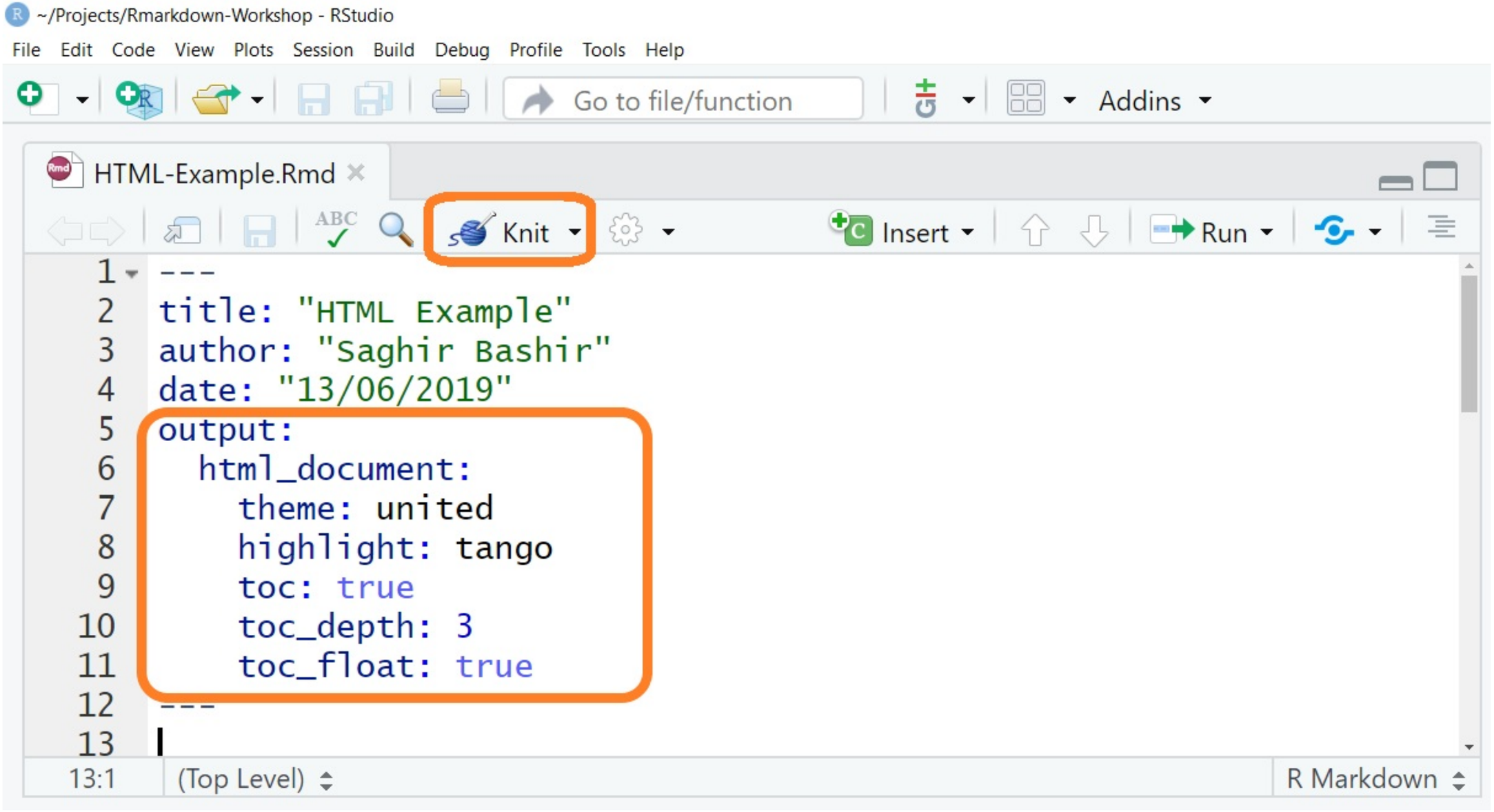
```
summary(cars)
```

```
##      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
```

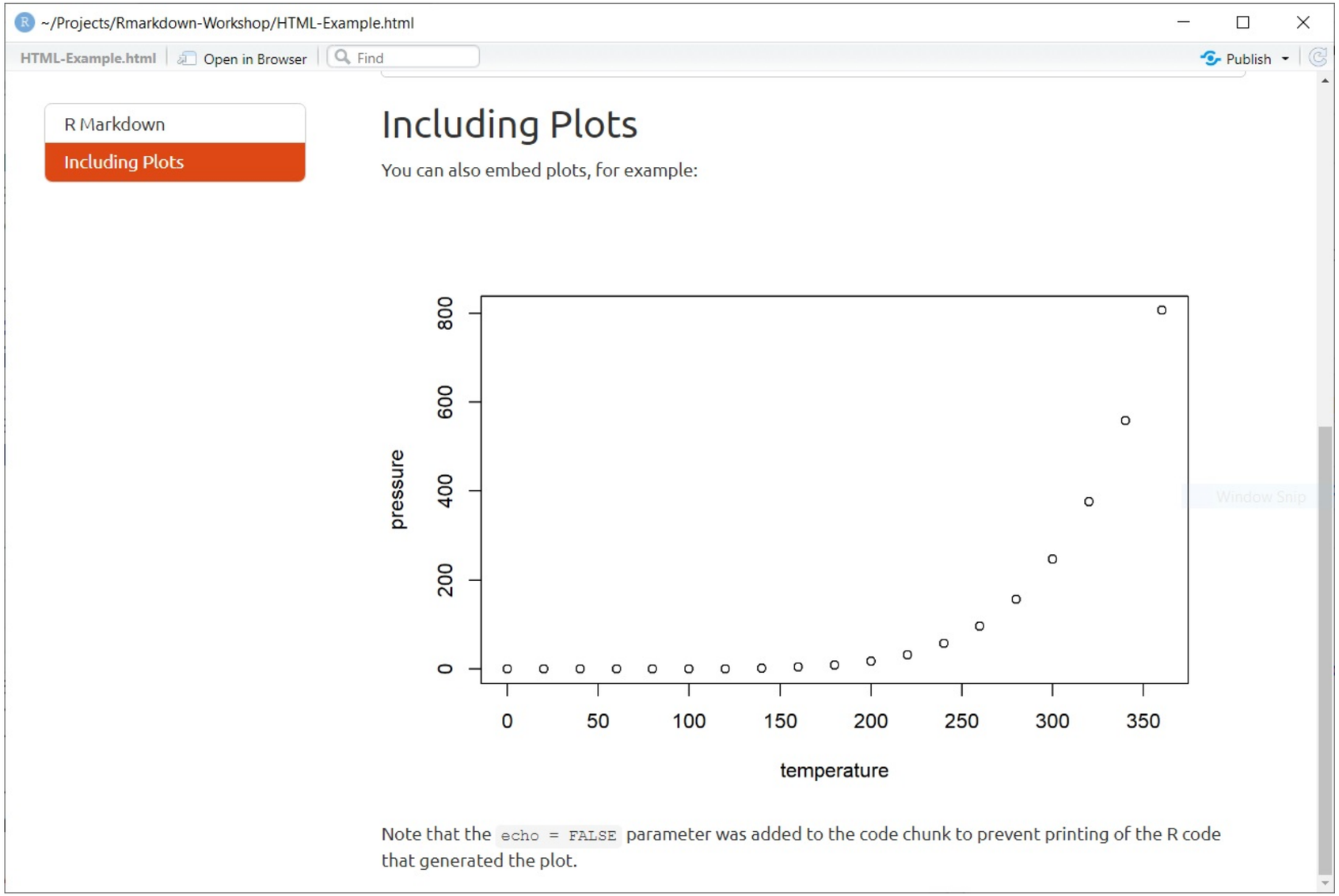
Including Plots

You can also embed plots, for example:

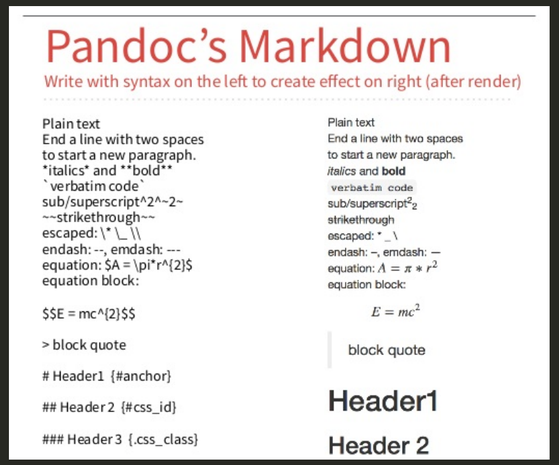
Change Theme & Style



Updated Theme



R Markdown Cheatsheet



Pandoc's Markdown

Write with syntax on the left to create effect on right (after render)

```
Plain text
End a line with two spaces
to start a new paragraph.
*italics* and **bold**
`verbatim code`
sub/superscript^2^~2~
~~strikethrough~~
escaped: \* \_ \\
endash: --, emdash: ---
equation: $A = \pi*r^{2}$
equation block:

$$E = mc^{2}$$

> block quote

# Header1 {#anchor}

## Header 2 {#css_id}

### Header 3 {.css_class}
```

Plain text
End a line with two spaces
to start a new paragraph.
italics and **bold**
`verbatim code`
sub/superscript$^2_2$
~~strikethrough~~
escaped: * _ \
endash: –, emdash: —
equation: $A = \pi * r^2$
equation block:

$$E = mc^2$$

> block quote

Header1

Header 2

- Useful to find R markdown "tags".
- Use it for the exercises.
- Lots of other useful information too.

Source: https://www.rstudio.com/resources/cheatsheets/

Pretty Tables

Objective

Before

```
sData
```

```
##    Treatment    Visit   N Mean S.D.
## 1:   Placebo Baseline 182 27.4 3.23
## 2:   Placebo    Final 157 25.6 4.11
## 3:    Active Baseline 179 26.7 3.45
## 4:    Active    Final 145 20.7 4.27
```

After

Treatment	Visit	N	Mean	S.D.
Placebo	Baseline	182	27.4	3.23
	Final	157	25.6	4.11
Active	Baseline	179	26.7	3.45
	Final	145	20.7	4.27

Use `knitr::kable`

```
library(magrittr)
library(knitr)
sData %>%
  kable()
```

Treatment	Visit	N	Mean	S.D.
Placebo	Baseline	182	27.4	3.23
Placebo	Final	157	25.6	4.11
Active	Baseline	179	26.7	3.45
Active	Final	145	20.7	4.27

```
library(magrittr)
library(knitr)
sData %>%
kable(align="lcrrr", digits=c(0, 0, 0, 1, 2))
```

Treatment	Visit	N	Mean	S.D.
Placebo	Baseline	182	27.4	3.23
Placebo	Final	157	25.6	4.11
Active	Baseline	179	26.7	3.45
Active	Final	145	20.7	4.27

Use kableExtra Package


```
library(magrittr)
library(knitr)
library(kableExtra)
sData %>%
 kable(align="lcrrr", digits=c(0, 0, 0, 1, 2))  %>%
kable_styling(bootstrap_options="striped",
              full_width=TRUE)
```

Treatment	Visit	N	Mean	S.D.
Placebo	Baseline	182	27.4	3.23
Placebo	Final	157	25.6	4.11
Active	Baseline	179	26.7	3.45
Active	Final	145	20.7	4.27

```
library(magrittr)
library(knitr)
library(kableExtra)
sData %>%
 kable(align="lcrrr", digits=c(0, 0, 0, 1, 2))  %>%
 kable_styling(bootstrap_options="striped",
               full_width=TRUE) %>%
column_spec(1:5, width = "4em")
```

Treatment	Visit	N	Mean	S.D.
Placebo	Baseline	182	27.4	3.23
Placebo	Final	157	25.6	4.11
Active	Baseline	179	26.7	3.45
Active	Final	145	20.7	4.27

Final Table

```
library(magrittr)
library(knitr)
library(kableExtra)
sData %>%
 kable(align="lcrrr", digits=c(0, 0, 0, 1, 2))  %>%
 kable_styling(bootstrap_options="striped",
               full_width=TRUE) %>%
 column_spec(1:5, width = "4em") %>%
collapse_rows(1, valign = "top")
```

Treatment	Visit	N	Mean	S.D.
Placebo	Baseline	182	27.4	3.23
	Final	157	25.6	4.11
Active	Baseline	179	26.7	3.45
	Final	145	20.7	4.27

We started with

```
sData
```

```
##    Treatment    Visit   N Mean S.D.
## 1:   Placebo Baseline 182 27.4 3.23
## 2:   Placebo    Final 157 25.6 4.11
## 3:    Active Baseline 179 26.7 3.45
## 4:    Active    Final 145 20.7 4.27
```

Exercise (i)

1) Download https://ilustat.com/shared/RmarkdownWS.zip

2) Unzip and double click "CW-Summary.Rproj" file.

3) Create a new Rmarkdown file called "CW-Report.Rmd"

4) Recreate "CW-Report-Target.html"

Exercise (ii)

Creating a HTML presention

1) Create a new "Presentation" from R Markdown.

2) Select "HTML (ioslides)" style.

3) Save as "CW-Slides.Rmd"

4) Recreate "CW-Slides-Target.html"

Summary

R Markdown

- R code and documentation in one place.
- Great for doing reproducible research.
- Great for collaborating and sharing.
- A big range of possible outputs.
- The rewards and benefits are big!

Feedback

Please send your feedback or comments via:

- https://github.com/saghirb/Rmarkdown-Intro-Workshop or
- https://twitter.com/ilustat

Thanks!

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