# Markdown/Bookdown Tutorial

Catarina Pien

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# Contents

The **bookdown** package can be installed from CRAN or Github:

```
install.packages("bookdown")
# or the development version
# devtools::install_github("rstudio/bookdown")
```

# Chapter 1

# Introduction

## 1.1 Directions to start a book (after downloading packages described)

1. Open R Studio
2. File - New Project - New Directory - New Book Project
3. Save where you think it should be.
4. To compile this example to PDF, you need XeLaTeX. You are recommended to install TinyTeX (which includes XeLaTeX): https://yihui.org/tinytex/.
5. If you have errors when trying to compile the book, go to the debug website provided in your warnings.

## 1.2 Structure of book

- There will be multiple Rmd (R Markdown) files - one for each chapter.
- File naming:
  - index.Rmd
  - 01-yourchapter1title.Rmd
  - 02-yourchapter2title.Rmd

- Each Rmd file contains one and only one chapter, and a chapter is defined by the first-level heading `#`.

## 1.3 Publishing the book to share with others

- See https://bookdown.org/yihui/bookdown/github.html for how to publish book
  - All html output and source files (CSS, images, javascript) need to be in the docs folder.
    - Option A: Add a "docs" folder to the folder all your Rmd files are in, then in your _bookdown.yml file, add the line output_dir: "docs"
    - Option B: Change the directory "_book" to "docs"
  - Also add a .nojekyll fill to your docs folder
- To compile your book:
  - Option A: Use the "Build" tab (next to Environment and History) and click "Build Book"
  - Option B: Create a .R file and use the command "render_book" to render your book (see RunBook.R) in my GitHub.
- Connect your book project to GitHub if you haven't already.
- Add all files to GitHub.
- In your GitHub repo, go to Settings, GitHub Pages, change Source to master/ and /docs
- Your shareable link is displayed under GitHub Pages!

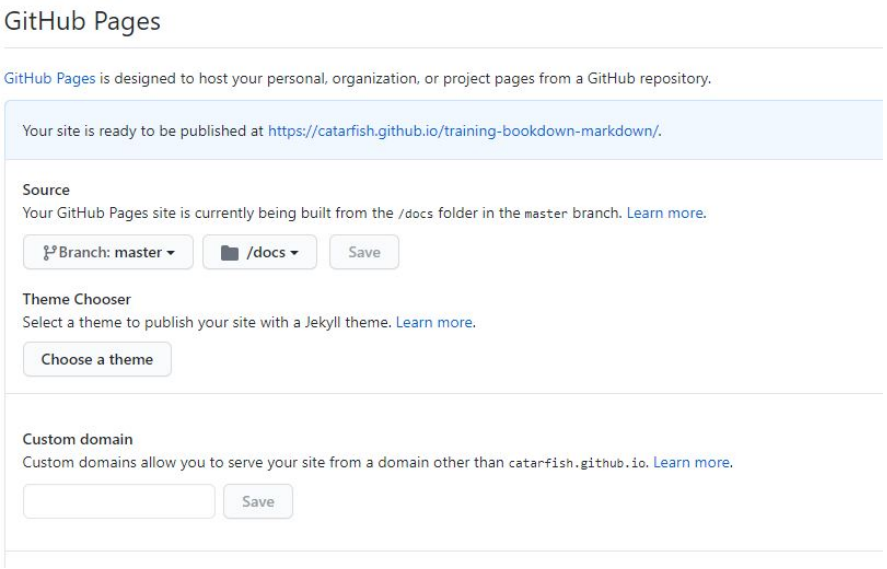



Figure 1.1: GitHub Pages Instructions

## 1.4 Other tips

If your book is not running and your error message is to do with latex: * In your _output.yml file: delete “bookdown::pdf_book: includes: in_header: preamble.tex latex_engine: xelatex citation_package: natbib keep_tex: yes” and replace the “bookdown::epub: default” with “bookdown::html_document2: default” * In your index.Rmd file, add “always_allow_html: yes” to the options at the top * epub: kindle books, probably don’t need this * default: if you don’t specify in “render_book” it will create your default

# Chapter 2

# Rmd Basics for crafting your document

## 2.1 Display

### 2.1.1 Font

- *Italics*: `_text_` or `*text*`
- **Bold**: `__text__` (two underscores) or `**text**`
- Subscripts e.g. $H_2O$ `H~2~O`

### 2.1.2 Blockquotes

Use `>`

```
> "To sustainably manage the water resources of California, in cooperation with
> other agencies, to benefit the state's people and protect, restore, and enhance the
> natural and human environments."
>
> --- DWR
```

> "To sustainably manage the water resources of California, in cooperation with other agencies, to benefit the state's people and protect, restore, and enhance the natural and human environments."
>
> — DWR

### 2.1.3 Indent Text

Use `|`

```
| Here you can
|  indent and separate
|   lines
|    for fun
|   patterns
|  like
| this
```

Here you can
 indent and separate
  lines
   for fun
  patterns
 like
this

### 2.1.4 Text in a gray block

Enclose in ``` or indent by 4 spaces

````
```
Here is a chunk of code
```
````

Result:

```
Here is a chunk of code
```

### 2.1.5 Equations

Equations
Surround with `$`

```
$a^2 + b^2 = c^2$
```

$a^2 + b^2 = c^2$.

Alternatively for a more complicated equation:

```
\begin{equation}
  f\left(k\right) = \binom{n}{k} p^k\left(1-p\right)^{n-k}
  \label{eq:binom}
\end{equation}
```

(The #eq:binom can be used to reference this equation later)

$$f\left(k\right) = \binom{n}{k} p^k \left(1-p\right)^{n-k} \tag{2.1}$$

## 2.2 Organization

### 2.2.1 Headers:

```
# Header 1 (Largest)
## Header 2
### Header 3
```

### Header with no numbering:

```
### Header {-}
```

### 2.2.2 Lists:

#### 2.2.2.1 Use *, -, or +

```
* peas
* apples
* carrots
  * baby
  * large
    * colored
    * orange
```

- peas
- apples
- carrots
  - baby
  - large
    * colored
    * orange

#### 2.2.2.2 Use numbers:

```
1. Enter data
2. QAQC
3. Publish Data
```

1. Enter data
2. QAQC
3. Publish Data

### 2.2.3 Tabs

Use `{.tabset}` and header levels. Sub-headers (exactly one level down) will become tabs.

```
### Project {.tabset}
#### Part A
#### Part B
```

### 2.2.4 Code, Plotting, Captions

#### 2.2.4.1 Code

- Insert R Chunk
- Write code in chunk

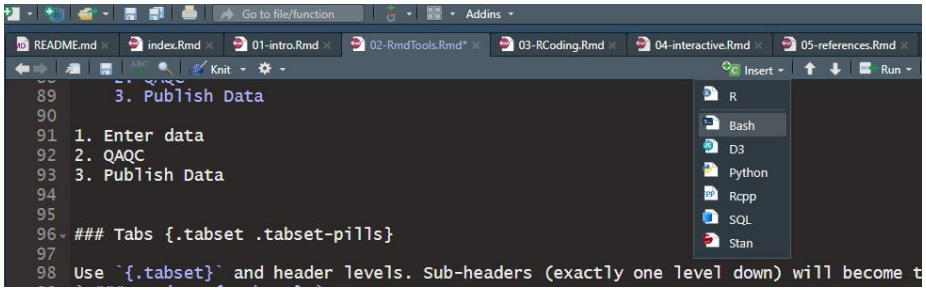


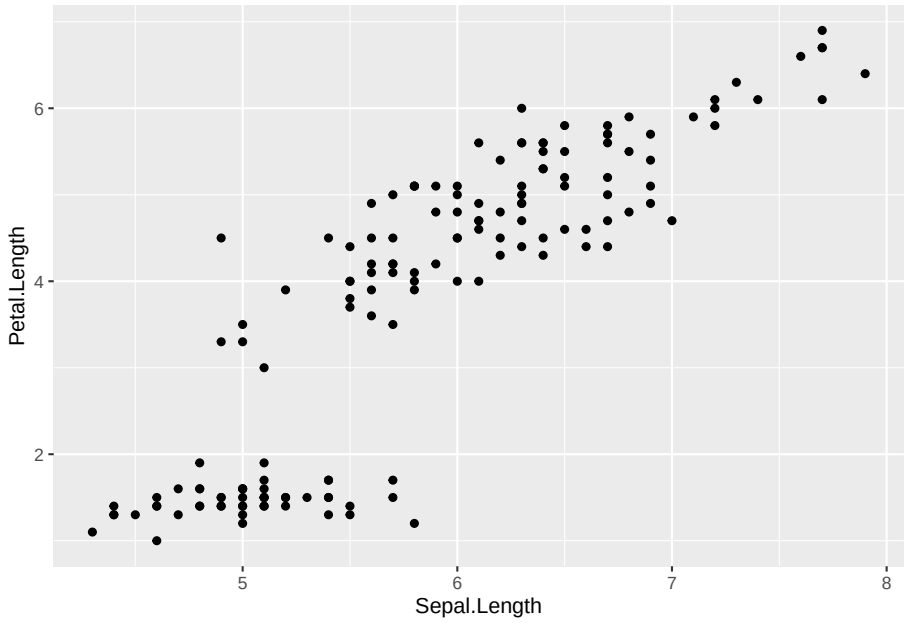

Figure 2.1: Inserting R Chunk

```
data("iris")
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
##
##
##
```

#### 2.2.4.2 Plot

```
library(ggplot2)
ggplot(iris, aes(x = Sepal.Length, y = Petal.Length)) + geom_point()
```




#### 2.2.4.3 Figure options

- fig.align = “center” “right” “left”

- fig.asp = ratio of width:height, height is calculated from fig.width*fig.asp
- fig.margin = TRUE (place figure in figure margin)
- fig.fullwidth = TRUE (figure is across full width)
- fig.width
- fig.height
- fig.dim = c(8,6) (width, height)
- fig.link - add a link to the figure
- fig.cap = figure caption
- out.width, out.height - specify output size
  - out.width = "50%" (can then include two figures side by side)
  - out.width = 8
- out.extra - miscellaneous
  - out.extra = 'angle=90'

#### 2.2.4.4 Image caption

````
A normal paragraph.



```
{r iris-fig, fig.cap='A scatterplot of the data `cars` using **base** R graphics. '}
plot(cars)  # a scatterplot
```
````

A normal paragraph.

A scatterplot of the data 'cars' using **base** R graphics. A scatterplot of the data `iris` using **ggplot.**

```
ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width)) + geom_point()
```

## 2.3 Tables

Use `kable`

```
library(knitr)
knitr::kable(head(iris), "simple",  caption = "Table with caption")
```

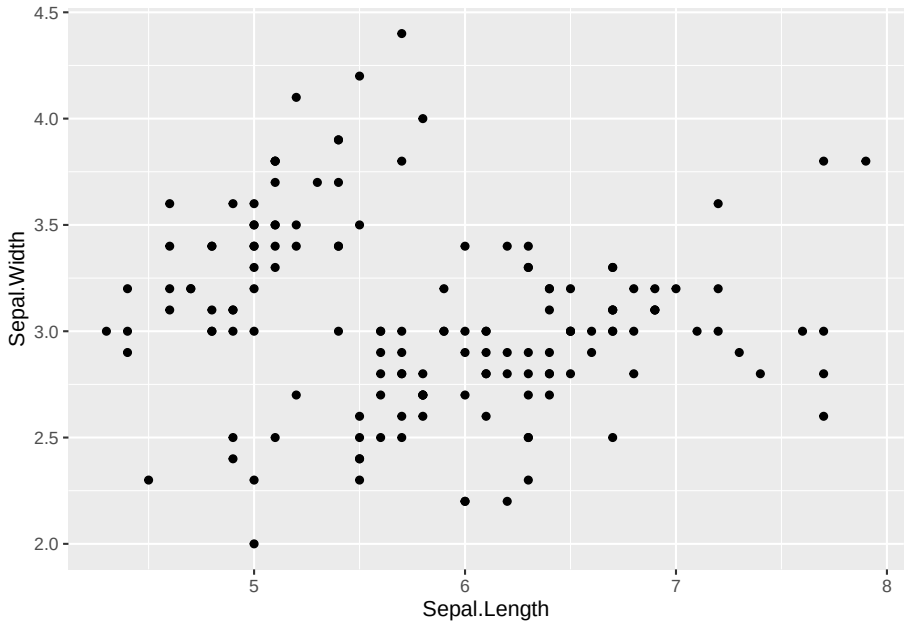



Figure 2.2: A scatterplot of the data ‘cars‘ using **base** R graphics.

Table 2.1: Table with caption

| Sepal.Length | Sepal.Width | Petal.Length | Petal.Width | Species |
|---|---|---|---|---|
| 5.1 | 3.5 | 1.4 | 0.2 | setosa |
| 4.9 | 3.0 | 1.4 | 0.2 | setosa |
| 4.7 | 3.2 | 1.3 | 0.2 | setosa |
| 4.6 | 3.1 | 1.5 | 0.2 | setosa |
| 5.0 | 3.6 | 1.4 | 0.2 | setosa |
| 5.4 | 3.9 | 1.7 | 0.4 | setosa |

## 2.4 Images

```
![Here are some baby salmon](salmon.jpg)
```

```
Figure: \\ref{fig:iris-fig}
Chapter of this book: \\ref{intro}
```

```
```{r iris-fig, fig.cap='(ref:iris-fig)', fig.align = 'center'}
ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width)) + geom_point()
```
```

Figure 2.4: See name of figure (iris-fig)

```
You can label chapter and section titles using `{#label}` after them,
e.g., we can reference Chapter \\ref{intro}.
If you do not manually label them, there will be automatic labels anyway,
e.g., Chapter \\ref{RCoding}.
```

- See table: 2.1
- See figure: 2.2
- Go to intro: 1

### 2.5.2 Citations

You can write citations, too. For example, we are using the **bookdown** package (Xie, 2020) in this sample book, which was built on top of R Markdown and **knitr** (Xie, 2015).

# Chapter 3

# Coding

## 3.1 Chunks

Use “chunks” for code
Surround by tick marks

```
```
Code here
```
## Chunk details
```

See 2 for more info

## 3.2 Chunk details

| Value | What it does |
|---|---|
| eval | whether to evaluate the code |
| echo | whether to display code along with its results |
| warning | whether to display warnings |
| error | whether to display errors |
| message | whether to display messages |
| tidy | whether to reformat code in a tidy way when displaying |
| results | “markup”, “asis”, “hold”, “hide” |
| cache | whether to cache results for future renders |
| comments | comment character to preface results with |
| fig.width | default = 7 |
| fig.height | default = 7 |

# Chapter 4

# Interactive tools

## 4.1 Plotly

Install plotly.

### 4.1.1 Code

```
library(plotly)
data("iris")

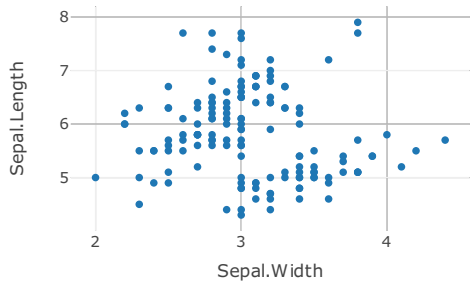
summary(iris)
```

```
##   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
##
##
##
```

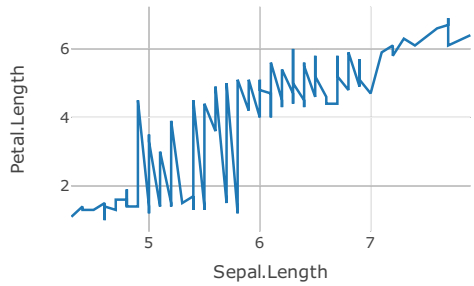
### 4.1.2 Plot

Different ways to code:

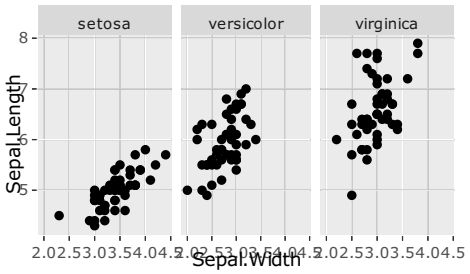
```
plot_ly(iris, x = ~Sepal.Width, y = ~Sepal.Length, type = "scatter",
        hoverinfo = "text",
        text = ~paste('</br> Species: ', Species,
                      '</br> Petal Length: ', Petal.Length,
                      '</br> Petal Width: ', Petal.Width))
```




```
iris %>%
  plot_ly(x = ~Sepal.Length, y = ~Petal.Length) %>%
  add_lines()
```




```
p <- ggplot(iris, aes(x = Sepal.Width, y = Sepal.Length)) + facet_wrap(~Species) +  geom_point()
ggplotly(p)
```




## 4.2 Leaflet

Install leaflet.

```
library(leaflet)
library(viridis)
library(lubridate)
Stations <- read.csv("StationsMetadata.csv")
summary(Stations)
```

```
##    Station          StationName        StartDateDataset   EndDateDataset
##  Length:138         Length:138         Length:138         Length:138
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##     Agency             Latitude       Longitude      HydrologicArea
##  Length:138         Min.   :37.65   Min.   :-122.1   Length:138
##  Class :character   1st Qu.:37.84   1st Qu.:-121.7   Class :character
##  Mode  :character   Median :38.04   Median :-121.6   Mode  :character
```

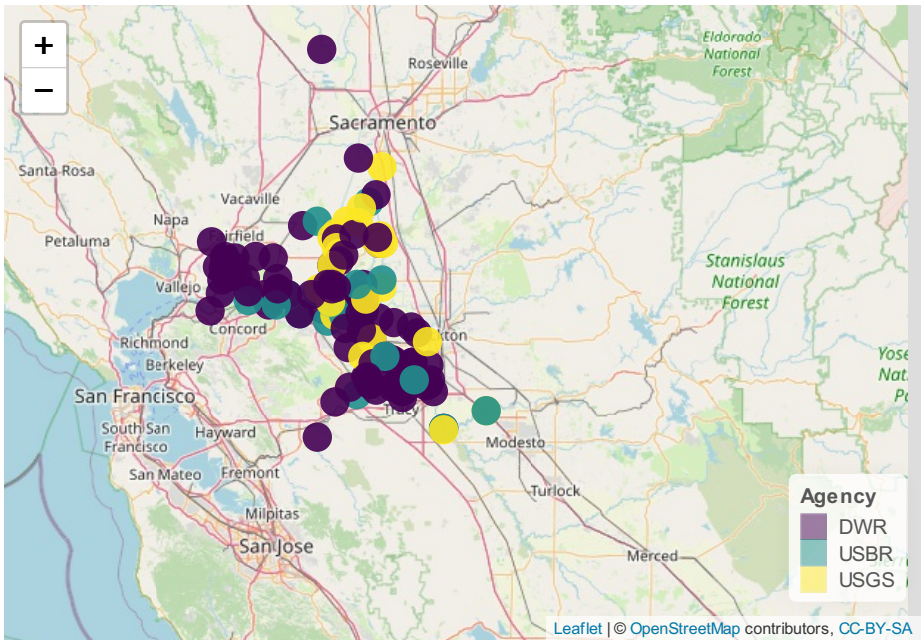
```
##                     Mean   :38.02   Mean   :-121.6
##                     3rd Qu.:38.16   3rd Qu.:-121.5
##                     Max.   :38.79   Max.   :-121.1
##     Basin              County          HabitatType
##  Length:138         Length:138         Length:138
##  Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character
##
##
##
```

```
Station2 <- Stations %>%
  mutate(Year1 = year(as.Date(StartDateDataset, format = "%m/%d/%Y")),
         Year2 = year(as.Date(EndDateDataset, format = "%m/%d/%Y")),
         Range = Year2-Year1)
```

Make map - Color by factor

```
# Palette from viridis
  staPal <- colorFactor("viridis", domain = Stations$Agency)

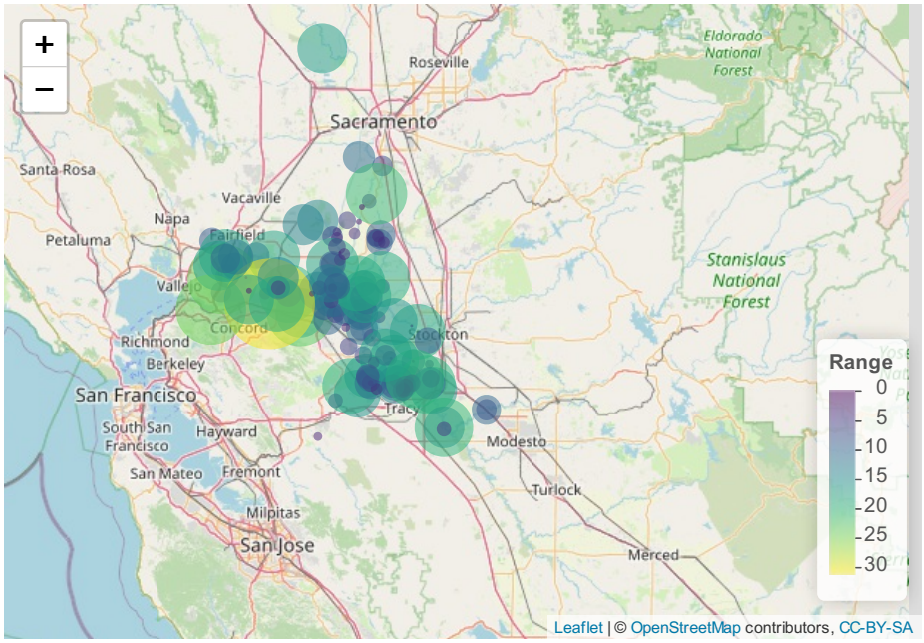
Stations %>% # name of data
  leaflet() %>%
  addTiles() %>%
  addCircleMarkers(
    color = ~staPal(Agency),
    stroke = FALSE,
    fillOpacity = 0.9,
    lng = ~Longitude,
    lat = ~Latitude,
    labelOptions = labelOptions(noHide = F),
    popup = ~paste(Station, ":", StationName, "<br/>",
                   "Agency:", Agency)) %>%
    addLegend(pal = staPal,
              values = ~Agency,
              position = "bottomright")
```




Make map - size and color by numeric

```
staPal2 <- colorNumeric("viridis", domain = Station2$Range)

Station2 %>%
  leaflet() %>%
  addTiles() %>%
  addCircleMarkers(
    color = ~staPal2(Range),
    radius = ~Range,
    stroke = FALSE,
    fillOpacity = 0.5,
    lng = ~Longitude,
    lat = ~Latitude,
    labelOptions = labelOptions(noHide = F),
    popup = ~paste(Station, ":", StationName, "<br/>",
                   "Agency:", Agency)) %>%
    addLegend(pal = staPal2,
              values = ~Range,
              position = "bottomright")
```


+
−
Roseville
Eldorado National Forest
Sacramento
Santa Rosa
Vacaville
Napa
Fairfield
Petaluma
Stanislaus National Forest
Concord
Stockton
Richmond
Berkeley
San Francisco
Tracy
South San Francisco
Hayward
Modesto
San Mateo
Fremont
Turlock
Milpitas
San Jose
Merced
Range
0
5
10
15
20
25
30
Leaflet | © OpenStreetMap contributors, CC-BY-SA

# References

## 4.3 Bookdown

- https://rstudio.com/wp-content/uploads/2015/02/rmarkdown-cheatsheet.pdf
- https://bookdown.org/yihui/rmarkdown/
- https://github.com/rstudio/bookdown-demo

## 4.4 RMarkdown

- Handy cheatsheet: https://rstudio.com/wp-content/uploads/2016/03/rmarkdown-cheatsheet-2.0.pdf
- Rosie's tutorial: https://cawater.sharepoint.com/teams/des-owq-ee/Shared%20Documents/Forms/AllItems.aspx?csf=1&web=1&e=Rzuj2c&cid=3e988094-c52e-4997-bb80-d748370a6d0e&RootFolder=%2Fteams%2Fdes-owq-ee%2FShared%20Documents%2FGuides%20and%20Procedures%2FRMarkdown%20Tutorial&FolderCTID=0x012000D268E5AEEC570C48A762CD4EB78D71AA
- Chunk options: https://yihui.org/knitr/options/

## 4.5 Plotly Annotations and Labels

- https://plotly.com/r/text-and-annotations/

## 4.6 Leaflet

- https://allthisblog.wordpress.com/2016/10/12/r-311-with-leaflet-tutorial/

- https://learn.r-journalism.com/en/mapping/leaflet_maps/leaflet/

## 4.7 Example Book

- https://interagencyecologicalprogram.github.io/Status-and-Trends/Summer.html#recent-trends-summer-2004-2018

# Bibliography

Xie, Y. (2015). *Dynamic Documents with R and knitr*. Chapman and Hall/CRC, Boca Raton, Florida, 2nd edition. ISBN 978-1498716963.

Xie, Y. (2020). *bookdown: Authoring Books and Technical Documents with R Markdown*. R package version 0.20.