

# Writing a Report

## Information

Name

```
print("TYPE_NAME_HERE")
```

```
## [1] "TYPE_NAME_HERE"
```

System Information

```
Sys.info()[1]
```

```
##  sysname  
##  "Windows"
```

## Introduction

This document contains basic information in writing a report in RMarkdown. The information in this document is tailored to creating PDF's; however, many concepts introduced can be used for other file formats.

## Chunk Options

The code chunks in R have options that will alter how the code or the output is rendered. The chunk options can be set either globally to affect the entire R Markdown document or locally to affect only an individual chunk. For more information about chunk options visit <https://yihui.name/knitr/options/>

### Global Chunk Options

To set up chunk options globally, create a chunk at the beginning and use the `knitr::opts_chunk$set()` function to set chunk options.

```
knitr::opts_chunk$set(cache = T)
```

A couple of recommended chunk options set globally are `cache=T` and `tidy=T`. These options make rendering the document easier. The `cache=T` option tells RStudio to run the chunk and save the output in an `RData` file when it is rendered. When re-rendering a document, RStudio will only run chunks that are new or chunks that were altered. All other chunks' output will be obtained from the `RData` file. This speeds up the rendering process by not running code that was not altered.

The other chunk option is `tidy=T`. More specifically: `tidy.opts=list(width.cutoff=60)` and `tidy=TRUE`. This tells RStudio to prevent code from printing off the page. For example, look at the output of this chunk:

```
## This comment is designed to show what happens when all your code is in 1 line. This is fine when you
```

Notice the comment being printed off the page. Using the options `tidy.opts=list(width.cutoff=60)` and `tidy=TRUE`, the chunk is rendered as

```
## This comment is designed to show what happens when all  
## your code is in 1 line. This is fine when you are  
## coding, but when you are putting it in a report, it will  
## run off the page.
```

Notice the comment being printed on 4 lines of code instead of 1. The `width.cutoff=60` option may need to be adjusted to get all the code on the page. To use this tidy option, install the `formatR` package once:

```
install.packages("formatR")
```

To set these two options as global options, place this in a setup chunk at the beginning of the document.

```
knitr::opts_chunk$set(cache = T)  
knitr::opts_chunk$set(tidy.opts = list(width.cutoff = 60), tidy = TRUE)
```

**Note:** Sometimes, the cutoff may stop working and your code is running off the page. To fix this, change the value for the `width.cutoff`. Then change it back.

One last option to include is `options(digits=2)`. This is used for inline code. This is discussed later in the document.

## Local Chunk Options

There are local chunk options that may be beneficial to put in each individual chunk. Each option is placed in `{r}` separated by commas.

One option is the `eval` option. When set to `FALSE`, RStudio will only display the code but not run the line. For example, this chunk contains `{r,eval=FALSE}`:

```
mean(mtcars$mpg)
```

Nothing is printed out. When the chunk contains `{r,eval=TRUE}`:

```
mean(mtcars$mpg)
```

```
## [1] 20
```

Another option is the `echo` option. When set to `FALSE`, the code will disappear from the document. This next chunk contains `{r,echo=TRUE}`:

```
mean(mtcars$mpg)
```

```
## [1] 20
```

Everything looks the same. Now the chunk contains `{r,echo=FALSE}`

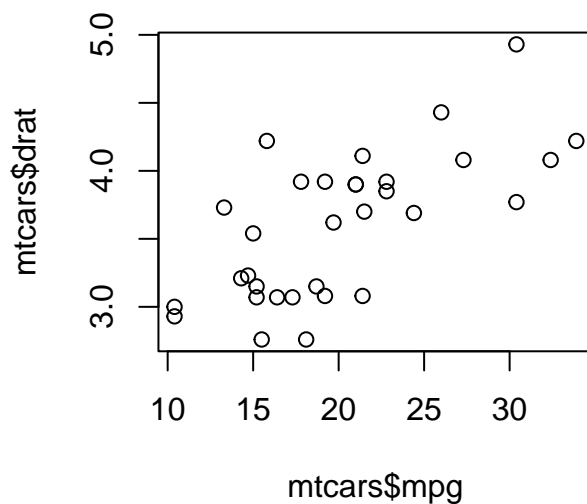
```
## [1] 20
```

The R Code disappears.

There are chunk options for figures as well. A few options are `fig.height`, `fig.width`, `fig.align`, and `fig.cap`.

This chunk contains `{r,fig.height=3.5,fig.width=3.5,fig.align='left'}`.

```
plot(mtcars$mpg, mtcars$drat)
```



The chunk options tells RStudio to create an image that is 3.5 inches in height and width, and align the image to the left.

The following chunk contains `{r, fig.height=3.5, fig.width=3.5, fig.align='center', fig.cap="\\label{fig1}This is a scatter plot of MTCARS' MPG and DRAT"}`.

```
plot(mtcars$mpg, mtcars$drat)
```

This figure may be placed on a different page. The chunk contains an additional option: `fig.cap="\\label{fig1}This is a scatter plot of MTCARS' MPG and DRAT"`. It adds a caption to the figure. At the beginning of the caption, the option contains `\\label{fig1}`. This labels the plot to be referenced later in the document. Figure 1 can be referenced with `\\ref{fig1}`.

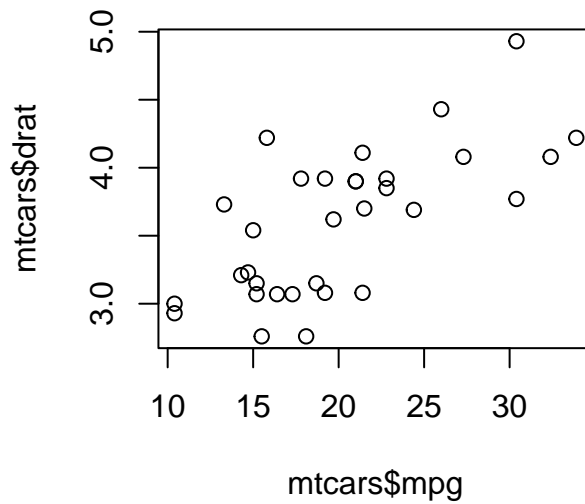


Figure 1: This is a scatter plot of MTCARS' MPG and DRAT

## Formatting

R Markdown contain basic formatting capabilities. The use of the # followed by text creates a heading. Using two or more # symbols will create subheadings based on the number of #. A text is *italicized* by surrounding the text with one asterisk (*\*italicized\**). A text is **boldfaced** by surrounding it with 2 asterisk (**\*\*boldfaced\*\***).

To create an unordered list, use the + symbol at the beginning of each line. To create a sub-item, press the tab button twice (4 spaces), then the + symbol. Repeat this method for further sub-items.

- First Item
- Second Item
  - First Sub-Item
    - \* First Sub-Sub-Item
      - First Sub-Sub-Sub-Item

To create an ordered list, type the number followed by a period for each line. To create sub-lists, press the tab button twice and order them appropriately.

1. First
2. Second
  - a. First
  - b. Second
    - 1) First
    - 2) Second

A block quote is created with the `>` symbol at the beginning of a line.

R Markdown allows a table to be constructed in 2 ways, manually or with the `xtable` package. A table is manually created by using `|`, `:`, and `-`. The first line contains `|` and the column names in between. The second line contains `|-|:-|` which indicates how the table is aligned. The location of `:` symbol just tells RStudio about the alignment. Go to the math section for more elaborate examples.

The `xtable::xtable` function creates a table from a dataframe or R object. Here is an example a table using the `mtcars` dataset.

```
print(xtable::xtable(head(mtcars), caption = "The MTCARS Dataset",
  label = "mtcarsdata", digits = 1, align = c("l", rep("c",
    11))), comment = F)
```

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6.0	160.0	110.0	3.9	2.6	16.5	0.0	1.0	4.0	4.0
Mazda RX4 Wag	21.0	6.0	160.0	110.0	3.9	2.9	17.0	0.0	1.0	4.0	4.0
Datsun 710	22.8	4.0	108.0	93.0	3.8	2.3	18.6	1.0	1.0	4.0	1.0
Hornet 4 Drive	21.4	6.0	258.0	110.0	3.1	3.2	19.4	1.0	0.0	3.0	1.0
Hornet Sportabout	18.7	8.0	360.0	175.0	3.1	3.4	17.0	0.0	0.0	3.0	2.0
Valiant	18.1	6.0	225.0	105.0	2.8	3.5	20.2	1.0	0.0	3.0	1.0

Table 1: The MTCARS Dataset

Notice that Table 1 is produced easily. Table 1 is referenced by using the label created in the function and the `\ref{mtcarsdata}`. The `xtable::xtable()` function can be used to create tables from commonly used R functions such as `lm()`. The `xtable` requires the `print()` function and `comment=F` argument to prevent a note from printing. Additionally, the chunk options `results='asis'` is needed. To install `xtable` run the following line:

```
install.packages("xtable")
```

RMarkdown allows links to be embedded in the document. Links are embedded with a combination of square brackets and parenthesis: `[ ]()`. Put the displayed text in square brackets and the link in the parenthesis. For example, we can link to UCR's website with this: `[UCR](https://www.ucr.edu/)` creates **UCR**. Note, if `https://` is not specified, the link will not work: `[UCR](www.ucr.edu/)` **UCR**.

## Greek Letters

RMD is capable of printing greek letters in the document. The table below provides the lowercase greek letters and their code.

Letter	Lowercase	Code
alpha	$\alpha$	<code>\alpha</code>
beta	$\beta$	<code>\beta</code>
gamma	$\gamma$	<code>\gamma</code>
delta	$\delta$	<code>\delta</code>
epsilon	$\epsilon$	<code>\epsilon</code>
zeta	$\zeta$	<code>\zeta</code>
eta	$\eta$	<code>\eta</code>
theta	$\theta$	<code>\theta</code>
iota	$\iota$	<code>\iota</code>

Letter	Lowercase	Code
kappa	$\kappa$	<code>\kappa</code>
lambda	$\lambda$	<code>\lambda</code>
mu	$\mu$	<code>\mu</code>
nu	$\nu$	<code>\nu</code>
xi	$\xi$	<code>\xi</code>
pi	$\pi$	<code>\pi</code>
rho	$\rho$	<code>\rho</code>
sigma	$\sigma$	<code>\sigma</code>
tau	$\tau$	<code>\tau</code>
upsilon	$\upsilon$	<code>\upsilon</code>
phi	$\phi$	<code>\phi</code>
chi	$\chi$	<code>\chi</code>
psi	$\psi$	<code>\psi</code>
omega	$\omega$	<code>\omega</code>
varepsilon	$\varepsilon$	<code>\varepsilon</code>

## TinyTex

An R Markdown can be rendered into either an html file, pdf document or word document. Rendering the R Markdown to an html file or word document is easily done with the knit button above. However, rendering the R Markdown file to a pdf document requires LaTeX. There are two methods to install LaTeX: from the LaTeX website (<https://www.latex-project.org/get/>) or from R. It is recommended to install LaTeX on your computer to ensure your RMD document can execute any LaTeX command. However, using R to install TinyTex will provide the basics to generate a PDF file. You can also install TinyTex from R with:

```
install.packages("tinytex")
tinytex::install_tinytex()
```

You only need to install TinyTex once.

## Tips

- Render your document often so it easier to identify problems with rendering

## References

R Markdown contains capabilities to add citations and a bibliography. For example, to cite your textbook (Mendenhall and Sincich 2012), use the @ symbol followed by a citation identifier from the .bib file surrounded by square brackets, [`@mendenhallSecondCourseStatistics2012`]. To cite your textbook again (2012) without the authors names, use a - sign in front of the @ symbol, [`~-@mendenhallSecondCourseStatistics2012`]. To cite multiple books (Casella and Berger 1990; Rohatgi and Saleh 2015; Resnick 2014; Erich L. Lehmann and Casella 1998; E. L. Lehmann and Romano 2005), add each citation inside the square brackets with the @ symbol and separate them with semicolons, [`@casellaStatisticalInference1990; @rohatgiIntroductionProbabilityStatistics2015; @resnickProbabilityPath2014; @lehmannTheoryPointEstimation1998; @lehmannTestingStatisticalHypotheses2005`].

A reference page can be added at the end of your document by adding the following line: `# References`. R Markdown will automatically add references at the end.

To use citations and references, R Markdown needs to know the references. This is done by providing a `.bib` file containing all the information needed to construct the citations and references. First, save the `.bib` file in the same folder (directory) as your `Rmd` file. Then add the line `bibliography: Example.bib` to the YAML header. Make any changes appropriately to the line, such as the name of the `.bib` file.

## Bib File

The `.bib` file is just a normal text file that contains the extension `.bib`. All you will do is add your references to the file. Open the `Example.bib` file and notice that it contains a bunch of lines indicating certain things about a reference. Creating a `.bib` file is tedious. However, there are reference managers that can help. I recommend **Zotero**. It is an open-source reference manager designed to help with many things. With Zotero, you can import citations easily with their browser extension. Once a citation is in Zotero, you can export your library to a `.bib` file. That's it! A couple tips is to check your citations in Zotero and fix them as needed. Importing citations from UCR's library seem to provide accurate citations. Other online resources may provide weird results.

## Bibliography

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- Resnick, Sidney I. 2014. *A Probability Path*. Modern Birkhäuser Classics. New York: Birkhäuser.
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