

Knitting to PDF

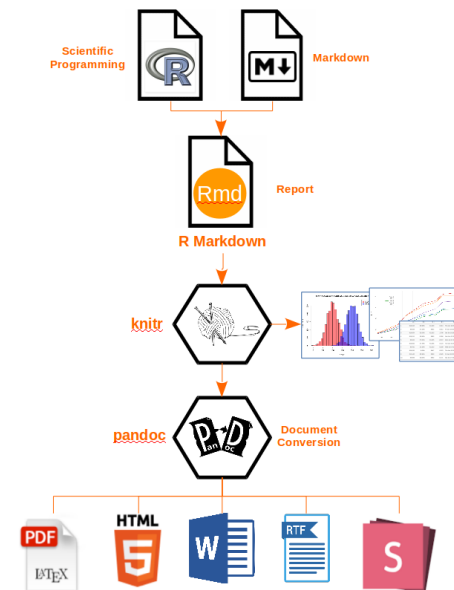
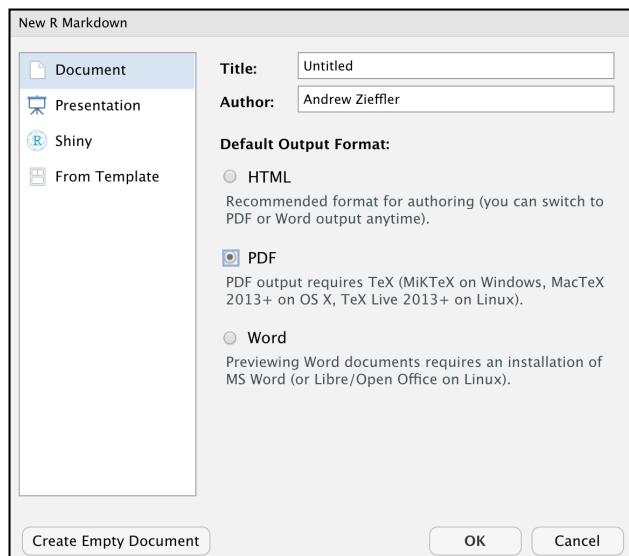
Andrew Zieffler



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We can use RMarkdown to produce a PDF document, but we need to install a TeX distribution.

Image credit: Horn, B. (2019). Project reporting with RMarkdown. *Applied R code*.
<http://applied-r.com/project-reporting-template/>

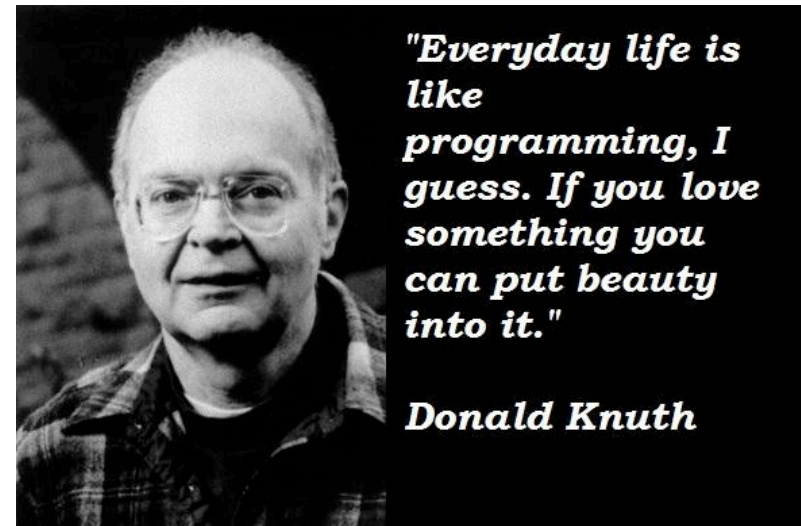


The **pandoc** application uses one of the engines installed as part of the TeX distribution to render the markdown into a PDF.

What is a TeX distribution?

A TeX (pronounced like 'tech') distribution is simply a "collections of packages and programs (compilers, fonts, and macro packages) that enable you to typeset without having to manually fetch files and configure things."

One of the sets of macro packages included in the TeX distribution is LaTeX (pronounced either Lah-tech or Lay-tech; there is a controversy), which is a document preparation system.



LaTeX was written by computer scientist Donald Knuth when we got frustrated by how ugly the typesetting was for his *Art of Computer Programming* books. He put his research on hiatus and wrote a typesetting program which would look great, follow typographic standards, and deal with his own academic work. (This took ~10 years!)

References and Photo Credit:

Wikipedia. Latex/Installation. <https://en.wikibooks.org/wiki/LaTeX>

Just what is TeX? <https://www.tug.org/whatis.html>

[Words on images.](#)

TeX distributions

There are several TeX distributions you can install, many of which are free. Probably the most well-maintained of the free distributions is [TeXLive](#). For R users, however, I recommend using the TeX distribution [TinyTeX](#). This is a smaller version of the TeXLive distribution that can be installed using functions from the **tinytex** R package.

TinyTeX includes everything you need to get started typesetting PDF documents. It comes with:

- pdflatex
- xelatex
- lualatex

pdflatex is a modern TeX engine that is the default engine used when we knit our PDF documents. The latter two TeX engines make it easier to use system fonts with TeX and have additional bells-and-whistles that extend LaTeX.

Installing TinyTeX

To install the TinyTeX distribution:

- Install the **tinytex** R package.
- After the package is installed, load it and run the function:
`install_tinytex()`

This might take a few minutes to install. You should only have to do this once. You can do all of this using syntax.



```
# Syntax to install tinytex package
> install.packages('tinytex')

# Syntax to run install_tinytex() function
> tinytex::install_tinytex()
```

Protip: The double colon (`::`) allows you to use a function from an installed package without loading it; you don't have to use `library(tinytex)` to use the `install_tinytex()` function.

Basic PDF Document

We can set many of the same YAML key-value field we did in the RMD document for HTML output. The difference is the `output:` field will be `pdf_document` rather than `html_document`.

```
1 ---
2 title: "Untitled"
3 author: "Andrew Zieffler"
4 date: "1/8/2021"
5 output: pdf_document
6 bibliography: "myBibliography.bib"
7 csl: "apa-single-spaced.csl"
8 ---
```

Then we can use the same markdown commands we did previously.

```
12
13 # Some R Syntax
14
15 ```{r summary_cars}
16 summary(cars)
17 ```
18
19
20 # Adding Citations
21
22 Add multiple references by including multiple citation identifiers separated by a semicolon
23 [e.g., @ross_racial_2020; @carmichael_laziness_1954]
24
25 # An Equation
26
27 The regression equation is:
28
29 $$
30 Y_i = \beta_0 + \beta_1(X_i) + \epsilon_i
31 $$
32
33
34 # References
35
```

$$Y_i = \beta_0 + \beta_1(X_i) + \epsilon_i$$

The output is a
PDF file.

Untitled

Andrew Zieffler

1/8/2021

Some R Syntax

```
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

Adding Citations

Add multiple references by including multiple citation identifiers separated by a semicolon (Carmichael, 1954; e.g., Ross et al., 2020)

An Equation

The regression equation is:

$$Y_i = \beta_0 + \beta_1(X_i) + \epsilon_i$$

References

Carmichael, L. (1954). Laziness and the scholarly life. *The Scientific Monthly*, 78(4), 208-213.

Ross, C. T., Winterhalter, B., & McElreath, R. (2020). Racial disparities in police use of deadly force against unarmed individuals persist after appropriately benchmarking shooting data on violent crime rates. *Social Psychological and Personality Science*, 194855062091607. <https://doi.org/10.1177/1948550620916071>

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Adding YAML Options

We can include options in the YAML associated with the PDF document in the same way we did for the HTML option. Here I show the `latex_engine:` and `highlight:` keys. (Note that `latex_engine: pdflatex` is the default used; you would get the same thing if this key were not included.

```
1 ---
2 title: "Untitled"
3 author: "Andrew Zieffler"
4 date: "1/8/2021"
5 output:
6   pdf_document:
7     | latex_engine: pdflatex
8     | highlight: zenburn
9 bibliography: "myBibliography.bib"
10 csl: "apa-single-spaced.csl"
11 ---
```

The `highlight:` key changed the look of the R syntax shown in the PDF document.

Untitled

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Some R Syntax

```
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

Adding Citations

Add multiple references by including multiple citation identifiers separated by a semicolon (Carmichael, 1954; e.g., Ross et al., 2020)

An Equation

The regression equation is:

$$Y_i = \beta_0 + \beta_1(X_i) + \epsilon_i$$

References

Carmichael, L. (1954). Laziness and the scholarly life. *The Scientific Monthly*, 78(4), 208-213.

Ross, C. T., Winterhalder, B., & McElreath, R. (2020). Racial disparities in police use of deadly force against unarmed individuals persist after appropriately benchmarking shooting data on violent crime rates. *Social Psychological and Personality Science*, 194855062091607. <https://doi.org/10.1177/1948550620916071>

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Changing Fonts

If you want to use a different font you need to use the xetex engine. Then you can set the fonts for different aspects of the document in the YAML.

```
1 ---
2 title: "Untitled"
3 author: "Andrew Zieffler"
4 date: "1/8/2021"
5 output:
6   pdf_document:
7     | latex_engine: xelatex
8     | highlight: zenburn
9 mainfont: "Bradley Hand"
10 monofont: "Inconsolata"
11 mathfont: "Bembo Std"
12 bibliography: "myBibliography.bib"
13 csl: "apa-single-spaced.csl"
14 ---
15
```

The `mainfont:` key changes the primary font used in the document. Note that this affects the text, the headings, title, author, and date. The `monofont:` key changes the font used in the R syntax and output. The `mathfont:` key changes the font used in the equations. (There is also a `sansfont:` key that isn't as useful for most RMD documents.)

Untitled

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Some R Syntax

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

Adding Citations

Add multiple references by including multiple citation identifiers separated by a semicolon (Carmichael, 1954; e.g., Ross et al., 2020)

An Equation

The regression equation is:

$$Y_i = \beta_0 + \beta_1(X_i) + \epsilon_i$$

References

Carmichael, L. (1954). Laziness and the scholarly life. *The Scientific Monthly*, 78(4), 208-213.

Ross, C. T., Winterhalter, B., & McElreath, R. (2020). Racial disparities in police use of deadly force against unarmed individuals persist after appropriately benchmarking shooting data on violent crime rates. *Social Psychological and Personality Science*, 194855062091607. <https://doi.org/10.1177/1948550620916071>

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In my experience, using different fonts with TeX can cause all sorts of headaches. Here are some things to be aware of:

- The fonts you call need to be installed on your computer.
- Moreover they need to be of the format TTF or OTF. Some fonts on your Mac or Windows machine may not be in this format.
- Fonts that have a name that includes a space must be declared in quotation marks. For example `mainfont: "Bradley Hand"`.
- Even if you get all of this right, it may still not work. This is especially true if you are using a Windows machine.



Using LaTeX Packages

TeX has many add on packages that add functionality to the base TeX distribution, similar to how R packages add functionality to R. To load a package we include some additional syntax in our YAML.

```
1 ---
2 title: "Untitled"
3 author: "Andrew Zieffler"
4 date: "1/8/2021"
5 output:
6   pdf_document:
7     | highlight: zenburn
8 header-includes:
9   - \usepackage{caption}
10 bibliography: "myBibliography.bib"
11 csl: "apa-single-spaced.csl"
12 ---
13
```

Here we loaded the `caption` package.
`\usepackage{}` is the TeX equivalent of `library()`.

Including it after the `header-includes:` key puts the syntax in the preamble (the header) of our LaTeX document; which is where we load packages.

The hyphen in front of `\usepackage{caption}` just tells our document that this is LaTeX syntax.

The nice thing about TinyTeX is that when it encounters a LaTeX package in `\usepackage{}` that is not already installed on your computer it will automatically install it from the [Comprehensive TeX Archive Network \(CTAN\)](https://www.ctan.org/).

Any other LaTeX syntax that needs to be included in the preamble can also be included under the `header-includes:` key.

```
1 ---
2 title: "Untitled"
3 author: "Andrew Zieffler"
4 date: "1/8/2021"
5 output:
6   pdf_document:
7     | highlight: zenburn
8 header-includes:
9   - \usepackage{caption}
10  - \captionsetup[table]{textfont={it}, labelfont={bf}, singlelinecheck=false, labelsep=newline}
11  - \captionsetup[figure]{textfont={it}, labelfont={bf}, singlelinecheck=false, labelsep=newline}
12  - \usepackage{floatrow}
13  - \floatsetup[figure]{capposition=top}
14  - \floatsetup[table]{capposition=top}
15 bibliography: "myBibliography.bib"
16 csl: "apa-single-spaced.csl"
17 ---
```

In addition to loading the `caption` and `floatrow` packages, the `\captionsetup{}` and `\floatsetup{}` syntax will be included in the LaTeX document's preamble. These functions set the caption formatting and position of the caption for tables and figures.

TeX has many add on packages that add functionality to the base TeX distribution, similar to how R packages add functionality to R. To load a package we include some additional syntax in our YAML.

```
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12 ---
13
```

Here we loaded the caption package. `\usepackage{}` is the TeX equivalent of `library()`. Including it after the `header-includes:` key puts the syntax in the preamble (the header) of our LaTeX document; which is where we load packages. The hyphen in front of `\usepackage{caption}` just tells our document that this is LaTeX syntax.

Learning More

There are many more things you can do with LaTeX and there are many resources for learning the LaTeX syntax if you are interested. Here are a few resources:

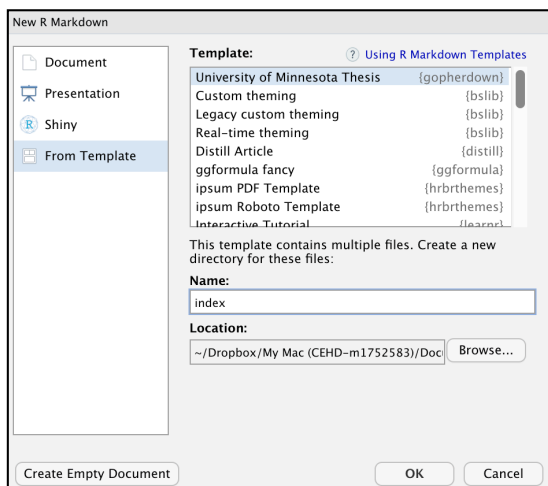
- All of the assignments for the course that I give you will be knitted to PDF. I will also provide the RMD files. If you see something in the PDF file you want to learn how to do, look at the RMD file to see how I did it. (Also feel free to ask me for additional insight; sometimes the syntax is quite complex!)
- There are numerous online resources for learning LaTeX. Just google “learn LaTeX” and the results are overwhelming. One I can recommend is Overleaf, which is an online, collaborative LaTeX editor (think Google Docs for LaTeX) that has an amazing [documentation site](#).
- The UMN library has many books on learning LaTeX, several of which are available electronically (e.g., [Learning LaTeX](#) by Griffiths et al.).

Just be aware that there are some differences in how we use LaTeX within an RMD document and when we are just writing in a LaTeX editor.

gopherdown

The `{gopherdown}` package allows you to write your thesis (MA, PhD, or Plan B paper) using R Markdown and it does all the formatting for you. Check it out at <https://github.com/zief0002/gopherdown>.

- This uses the xelatex engine to knit to PDF
- There is a link to an example thesis (Andy's PhD thesis) showing how `{gopherdown}` can be used.
- It will automatically create the signature page, title page, table of contents, list of figures, list of tables, and references (so long as you use R Markdowns citations).



```
1 # ---
2 #
3 # ----- Required Information -----
4 #
5 title: "An Analysis of Something"
6 author: "Kelly Rajanigandha Kapoor" # Student's full legal name
7 month: "December" # The month and year that degree requirements were met
8 year: "2021"
9 advisor: "Michael G. Scott"
10 # coadvisor: "James Halpert" # Un-comment this line if you have a co-advisor
11 #
12 # ----- Degree -----
13 #
14 phd: true # Change to phd: false if you are formatting a MA Thesis/Plan B Paper
15 plan_b: false # Change to plan_b: true if you are formatting a MA Plan B Paper
16 #
17 # ----- Rendering Options -----
18 #
19 knit: "bookdown::render_book"
20 output:
21   gopherdown::thesis_pdf:
22     latex-engine: xelatex
23 #
24 # ----- Fonts -----
25 #
26 mainfont: "Times New Roman"
27 sansfont: "Arial"
28 monofont: "Courier"
29 #
30 # ----- Link Highlighting -----
31 #
32 link-citations: true # make citations clickable
33 colored-not-bordered-links: true # use colored links; no border
34 # Set link colors using HEX.
35 # If printing a physical version of your thesis, you'll want to comment out the next three lines.
36 unicolor-hex: "2C6D4C" # web addresses
37 citecolor-hex: "2C6D4C" # citations
38 linkcolor-hex: "2C6D4C" # links to sections in your thesis
39 #
40 # ----- Bibliography/References -----
41 #
42 bibliography: ["bib/references.bib", "bib/packages.bib"]
43 csl: "csl/apa.csl"
44 #citation-package: "biblatex"
```

