MY PREDISSERTATION PAPER

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Pre-dissertation Paper

Quantitative Methods in Education

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University of Minnesota

Abstract

Enter you abstract here. This is my abstract. It is about 150–300 words long.

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Introduction I

To use the QME Predissertation template you need to have a recent version of RStudio installed on your computer. This will ensure that Pandoc is installed for you and will allow you to compile your predissertation into a PDF file.

1.1 LaTeX Distribution

You will also need to install a LaTeX distribution system (that includes X∃LaTeX). If you already have TeXLive or MikTeX installed you are set. If not, the easiest way to install LaTeX on any platform is via the `tinytex` R package. Enter the following commands in the RStudio console to install `tinytex`:

```r
install.packages(c('tinytex', 'rmarkdown'))
tinytex::install_tinytex()

# after restarting RStudio, confirm that you have LaTeX with
tinytex:::is_tinytex()
```

The template also relies on several LaTeX packages for styling your predissertation paper. If you installed `tinytex`, the installation should happen automatically the first time you compile your document. If you have a LaTeX distribution that you previously installed, you will need to install the following packages:

- `memoir` (CTAN: https://ctan.org/pkg/memoir): Primary document/style class
- `adforn` (CTAN: https://ctan.org/pkg/adforn): Provides ornamentation on the title page.
- `amsthm` (CTAN: https://ctan.org/pkg/amsthm): Facilitates better typesetting of mathematics
- `booktabs` (Installed as part of the `memoir` class): Facilitates better typesetting of tables
- `datetime` (CTAN: https://ctan.org/pkg/datetime): Formats date

- `float` (CTAN: https://ctan.org/pkg/float): Improves interface for floating objects
- `hyperref` (CTAN: https://ctan.org/pkg/hyperref): Adds support for hypertext
- `microtype` (CTAN: https://ctan.org/pkg/microtype): Facilitates "subliminal refinements towards typographical perfection"
- `xcolor` (CTAN: https://ctan.org/pkg/xcolor): Extends color palettes
- `xltxtra` (CTAN: https://ctan.org/pkg/xltxtra): Adds several features to X∃LATEX

1.2 Fonts

The QME Predissertation Paper template requires that a few specific fonts also be installed on your computer:

- EB Garamond,
- Source Code Pro, and
- Lato

You need to install these before proceeding, either by using your usual method of installing fonts (the fonts are included in this repository inside the `fonts` folder), or following these instructions:

On a Linux system here's the simplest way to install the fonts:

```
git clone https://github.com/benmarwick/huskydown
cp huskydown/inst/fonts -r /usr/local/share/fonts
sudo fc-cache -f -v
```

On an OSX system you can download a copy of the fonts in this repository with https://github.com/benmarwick/huskydown/raw/master/fonts.zip, unzip and move them to your fonts directory, or, assuming homebrew is installed and updated, this will get you the fonts needed for this template:

```
brew update
brew tap caskroom/fonts
brew cask install font-eb-garamond font-source-code-pro font-lato
```

On Windows the usual pointing and clicking is required to install the fonts listed above. You can download a copy of the fonts in this repository at https://github.com/benmarwick/huskydown/raw/master/fonts.zip, unzip and move them to your fonts directory.

1.3 R Packages

The QME Predissertation Paper template relies on several R packages. Install (or update) the following R packages:

- bookdown
- devtools
- dplyr
- ggplot2
- kableExtra
- knitr
- readr

Executing the syntax below in your R console will check that these packages are installed.

```r
# List of packages required for this analysis
pkg <- c("dplyr", "ggplot2", "knitr", "bookdown", "devtools")

# Check if packages are not installed and assign the
# names of the packages not installed to the variable new.pkg
new.pkg <- pkg[!(pkg %in% installed.packages())]

# If there are any packages in the list that aren't installed,
# install them
if (length(new.pkg))
  install.packages(new.pkg, repos = "http://cran.rstudio.com")
```

1.4 Credits, Notes, and Thanks

The QME Predissertation Paper template draws inspiration from several places. This list is likely incomplete, but attempts to credit those that came before. "If I have seen further, it is because I stand on the shoulders of giants."

- Michael Ekstrand [github] for his inspired use of the `memoir` class to format scholarly work, the University of Minnesota thesis in particular.
- Ben Marwick for his work on `huskydown` (a thesis template for the University of Washington), especially the font choice.
- Yihui Xie for his work on `bookdown`, the work-horse beneath the template.
- RStudio Team for their vision in creating RStudio, their continued resources in building educational resources, and their willingness to share all of it with the world.

Review of the Literature 2

The directory/file structure for the QME Predissertation Paper template is below.

```
├── 01-intro.Rmd
├── 02-literature.Rmd
├── 03-method.Rmd
├── 04-results.Rmd
├── 05-discussion.Rmd
├── 06-references.Rmd
├── DESCRIPTION
├── LICENSE
├── _book
│   ├── predissertation.pdf
│   └── predissertation.tex
├── _bookdown.yml
├── _bookdown_files
│   └── predissertation_files
│       └── figure-latex
│           ├── delaysboxplot-1.pdf
│           ├── march3plot-1.pdf
│           ├── nice-fig-1.pdf
│           └── pressure-1.pdf
├── _build.sh
├── _deploy.sh
├── _output.yml
├── bib
│   ├── book.bib
│   └── packages.bib
├── data
│   ├── flights.csv
```

```
│       └── tab-gopher-women-sports.csv
├── figures
│   └── goldy.png
├── frontmatter
│   └── 00-abstract.Rmd
├── index.Rmd
├── predissertation.Rproj
├── scripts
│   ├── knit-chapters-to-docx.R
│   └── thesis-style-ref.docx
├── style
│   ├── frontmatter.tex
│   ├── preamble.tex
│   └── template.tex
└── thesis.lol
```

Most of these files you do not need to touch at all. The best way to work with these files is to open the `predissertation.Rproj` file. This will open an R Project called `predissertation` in RStudio and you can select individual files by clicking on them under the `Files` tab.

2.1 index.Rmd

The file `index.Rmd` is the file that is like the master file. Compiling this file calls all of the content files (see below), puts them in to a single predissertation document, and styles them appropriately.

In this file, you can change the YAML metadata to provide the `title`, `author`, and `description` of your predissertation paper. You should not need to change anything else (unless you add an additional BIB file; see section below).

2.2 Building the Predissertation Paper

To actually compile your predissertation paper into a PDF file, click the `Build Book` button under the `Build` tab in RStudio. (Or select `Build All` from the `Build` menu.) Clicking `Knit` will only compile the chapter you are currently working on and will likely put PLACEHOLDERS in for other chapters. Building, not knitting, is how the entire document is created.

The predissertation paper is then compiled into a TeX document (`predissertation.tex`) and a PDF file (`predissertation.pdf`). Both of these are created and placed in the `_book` directory.

2.3 Adding Content

The primary files you need to edit will be the actual chapter RMD files (those that begin with a number). The following files will hold the content of each chapter (major section) in your predissertation paper:

- `01-introduction.Rmd`
- `02-literature.Rmd`
- `03-method.Rmd`
- `04-results.Rmd`
- `05-discussion.Rmd`

The first line in these files begins with a hashtag and gives the chapter title. (You do not have to change these chapter titles unless you want to.) Add content to these files as you write your paper.

The file `00-abstract.Rmd` in the `frontmatter` directory is where you can include your predissertation paper's abstract. This document should not include a chapter/section title. The formatting of the LaTeX will add this automatically.

2.4 Figures, Data, and BIB Files

The `figures`, `data`, and `bib` directories are repository folders to store figures, data, and BIB files you want to include in your predissertation paper. While they don't need to be placed in these folders, doing so will keep your predissertation project more organized.

The BIB files are where we include the metadata (using BIBTeX) for the references. If you include additional BIB files, you also need to include those in the YAML section of `index.Rmd`.

2.5 Word Document for your Advisor

You can send the PDF file of your predissertation paper to your advisor for comments and edits. However, most advisors are more comfortable using Word to edit and make comments. There is an R script file (`knit-chapters-to-docx.R`) in the `scripts` folder that you can run to compile each chapter into a separate DOCX document.

Methods 3

As promised, here we reference the previous chapter, Chapter 2, using the chapter ID.

3.1 Mathematics

TeX is the best way to typeset mathematics. Donald Knuth designed TeX when he got frustrated at how long it was taking the typesetters to finish his book, which contained a lot of mathematics. One nice feature of *R Markdown* is its ability to read LaTeX code directly.

$$\sum_{j=1}^{n} (\delta\theta_j)^2 \leq \frac{\beta_i^2}{\delta_i^2 + \rho_i^2} \left[2\rho_i^2 + \frac{\delta_i^2 \beta_i^2}{\delta_i^2 + \rho_i^2} \right] \equiv \omega_i^2$$

From Informational Dynamics, we have the following (Dave Braden):

After *n* such encounters the posterior density for θ is

$$\pi(\theta | X_1 < y_1, \ldots, X_n < y_n) \propto \pi(\theta) \prod_{i=1}^{n} \int_{-\infty}^{y_i} \exp\left(-\frac{(x-\theta)^2}{2\sigma^2} \right) dx \qquad (3.1)$$

Another equation:

$$\det \begin{vmatrix} c_0 & c_1 & c_2 & \ldots & c_n \\ c_1 & c_2 & c_3 & \ldots & c_{n+1} \\ c_2 & c_3 & c_4 & \ldots & c_{n+2} \\ \vdots & \vdots & \vdots & & \vdots \\ c_n & c_{n+1} & c_{n+2} & \ldots & c_{2n} \end{vmatrix} > 0$$

Lapidus and Pindar, Numerical Solution of Partial Differential Equations in Science and Engineering. Page 54

$$\int_t \left\{ \sum_{j=1}^{3} T_j \left(\frac{d\phi_j}{dt} + k\phi_j \right) - kT_e \right\} w_i(t)\, dt = 0, \qquad i = 1, 2, 3.$$

L&P Galerkin method weighting functions. Page 55

$$\sum_{j=1}^{3} T_j \int_0^1 \left\{ \frac{d\phi_j}{dt} + k\phi_j \right\} \phi_i\, dt = \int_0^1 k\, T_e \phi_i dt, \qquad i = 1, 2, 3$$

Another L&P (p145)

$$\int_{-1}^{1}\int_{-1}^{1}\int_{-1}^{1} f\left(\xi, \eta, \zeta\right) = \sum_{k=1}^{n}\sum_{j=1}^{n}\sum_{i=1}^{n} w_i w_j w_k f\left(\xi, \eta, \zeta\right).$$

Another L&P (p126)

$$\int_{A_e} (\,\cdot\,) dx dy = \int_{-1}^{1}\int_{-1}^{1} (\,\cdot\,) \det[J] d\xi d\eta.$$

3.2 Figures

Figures and tables with captions will be placed in `figure` and `table` environments, respectively.

```r
par(mar = c(4, 4, .1, .1))
plot(pressure, type = 'b', pch = 19)
```
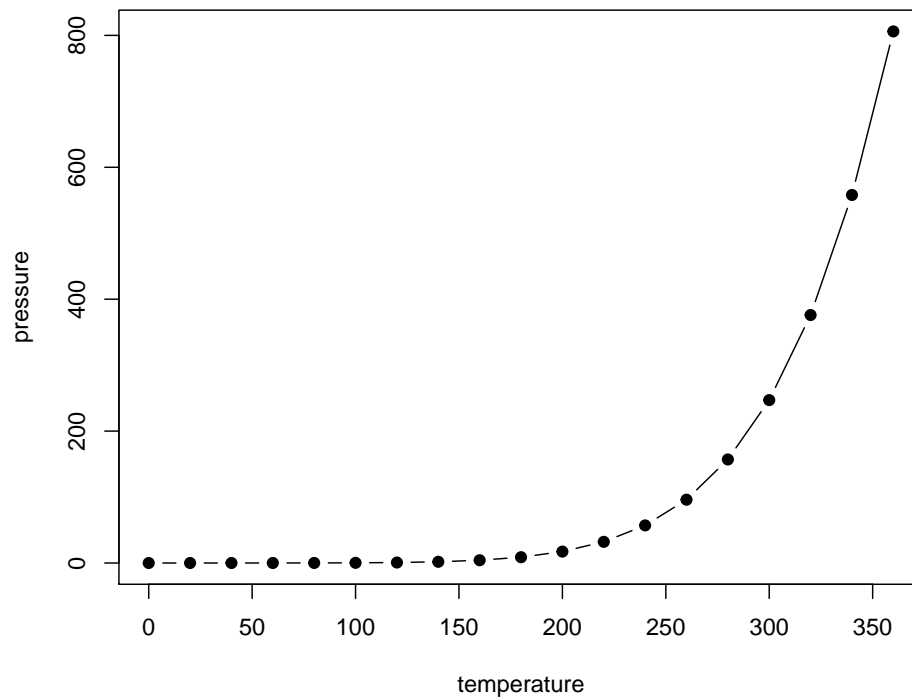
Figure 3.1: Here is a nice figure!

Reference a figure by its code chunk label with the `fig:` prefix, e.g., see Figure 3.1.

3.3 Tables

The easiest way to create a table is to use Excel to input the information for your table and save it as a CSV file. Then you can read in the CSV file, and use the `kable()` function from knitr to style the table.

```
#Read in data
gopher = readr::read_csv("data/tab-gopher-women-sports.csv")
```

```
## Parsed with column specification:
## cols(
##   Sport = col_character(),
##   `Ticket Sales` = col_integer(),
##   `Total Operating Revenue` = col_integer()
## )
```

Table 3.1: 2017 Ticket Sales and Operating Revenue for the University of Minnesota Women's Athletic Teams

Sport	Ticket Sales	Total Operating Revenue
Basketball	252009	873843
Cross Country		
Golf		45197
Gymnastics	38287	58288
Hockey	110926	389769
Rowing		45454
Soccer	14868	33374
Softball	42074	98003
Swimming & Diving		74894
Tennis		11392
Track and Field		24101
Volleyball	337492	485157

```
# Create table
knitr::kable(
  gopher,
  caption = "2017 Ticket Sales and Operating Revenue for the University of Minnesota
  booktabs = TRUE
)
```

Further table styling can be carried out via the kableExtra package; see https://haozhu233.github.io/kableExtra/awesome_table_in_pdf.pdf. Below we demonstrate some of that functionality.

```
library(kableExtra)

knitr::kable(
  gopher,
  caption = "2017 Ticket Sales and Operating Revenue for the University of Minnesota
  booktabs = TRUE,
  format = "latex"
  ) %>%
  footnote(general = "Data obtained from the 2017 NCAA Financial Report")
```

Table 3.2: 2017 Ticket Sales and Operating Revenue for the University of Minnesota Women's Athletic Teams

Sport	Ticket Sales	Total Operating Revenue
Basketball	252009	873843
Cross Country		
Golf		45197
Gymnastics	38287	58288
Hockey	110926	389769
Rowing		45454
Soccer	14868	33374
Softball	42074	98003
Swimming & Diving		74894
Tennis		11392
Track and Field		24101
Volleyball	337492	485157

Note:
Data obtained from the 2017 NCAA Financial Report

You can also create the table from within R itself and then use `kable()`.

```
tab = flights %>%
  filter(month == 12, day == 24) %>%
  group_by(carrier_name) %>%
  summarize(
    Departure = mean(dep_delay),
    Arrival = mean(arr_delay)
    ) %>%
  select(Carrier = carrier_name, Departure, Arrival)

knitr::kable(
  tab,
  caption = "Average Departure and Arrival Delay (in Minutes) by Carrier on Decemebr
  booktabs = TRUE,
  format = "latex",
  digits = 2
  )
```

Table 3.3: Average Departure and Arrival Delay (in Minutes) by Carrier on Decemebr 24

Carrier	Departure	Arrival
Alaska Airlines Inc.	-2.65	-0.39
American Airlines Inc.	-6.25	-18.75
Delta Air Lines Inc.	-0.36	-4.55
Frontier Airlines Inc.	-9.67	-20.33
Hawaiian Airlines Inc.	-2.00	22.00
JetBlue Airways	-6.67	-14.33
SkyWest Airlines Inc.	-6.43	-10.86
Southwest Airlines Co.	16.83	9.04
United Air Lines Inc.	9.55	3.00
US Airways Inc.	-2.17	-0.50
Virgin America	-2.00	4.00

You can also reference tables generated from `knitr::kable()`, e.g., see Table 3.1.

Results 4

This chapter includes your analyses and results. It should include:

- General data analysis and results
- Data results specific to each hypothesis are presented
- Chapter review

4.1 Figures

If your thesis has a lot of figures, *R Markdown* might behave better for you than that other word processor. One perk is that it will automatically number the figures accordingly in each chapter. You'll also be able to create a label for each figure, add a caption, and then reference the figure in a way similar to what we saw with tables earlier. If you label your figures, you can move the figures around and *R Markdown* will automatically adjust the numbering for you. No need for you to remember! So that you don't have to get too far into LaTeX to do this, a couple R functions have been created for you to assist. You'll see their use below.

In the R chunk below, we will load in a picture stored as `goldy.png` in our `figures` directory. We then give it the caption of "Goldy rendered as a pencil drawing.", the label of "goldy", and specify that this is a figure. Make note of the different R chunk options that are given in the R Markdown file (not shown in the knitted document).

```
include_graphics(path = "figures/goldy.png")
```

Here is a reference to the Goldy image: Figure 4.1. Note the use of the `fig:` code here. By naming the R chunk that contains the figure, we can then reference that figure later as done in the first sentence here. We can also specify the caption for the figure via the R chunk option `fig.cap`.

Notice the figure was floated to the top of the page. To override this, we use the chunk option `pos="H"`. That will override the float and place the figure exactly where the code chunk is.

Figure 4.1: Goldy rendered as a pencil drawing.

```
include_graphics(path = "figures/goldy.png")
```


Figure 4.2: Goldy still rendered as a pencil drawing. This time we overrode the float using the 'H' option.

Below we will investigate how to save the output of an R plot and label it in a way similar to that done above. Recall the `flights` dataset from Chapter ??. (Note that we've shown a different way to reference a section or chapter here.) We will next explore a bar graph with the mean flight departure delays by airline from Portland for 2014. Note also the use of the `scale` parameter which is discussed on the next page.

```
flights %>% group_by(carrier) %>%
 summarize(mean_dep_delay = mean(dep_delay)) %>%
 ggplot(aes(x = carrier, y = mean_dep_delay)) +
 geom_bar(position = "identity", stat = "identity", fill = "red")
```

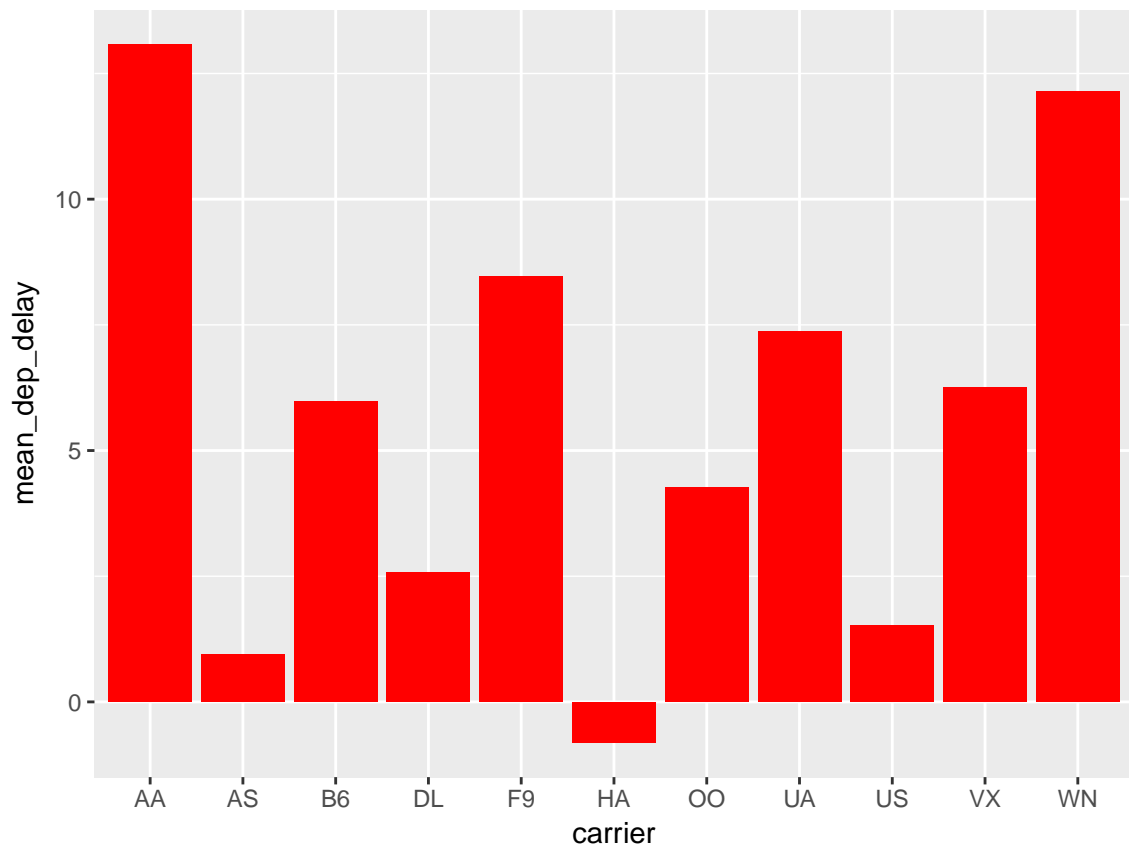Here is a reference to this image: Figure 4.3.

Figure 4.3: Mean Delays by Airline

4.2 Citations

You can write citations, too. For example, we are using the bookdown package (Xie, 2018) in this sample book, which was built on top of R Markdown and knitr (Xie, 2015).

4.3 Footnotes and Endnotes

You might want to footnote something. [1] The footnote will be in a smaller font and placed appropriately. Endnotes work in much the same way.

4.4 Bibliographies

Of course you will need to cite things, and you will probably accumulate an armful of sources. There are a variety of tools available for creating a bibliography database (stored with the .bib extension). In addition to BibTeX suggested below, you may want to consider using the free and easy-to-use tool called Zotero. Some Zotero documentation is at http://libguides.reed.edu/citation/zotero. In addition, a tutorial is available from Middlebury College at http://sites.middlebury.edu/zoteromiddlebury/.

R Markdown uses *pandoc* (http://pandoc.org/) to build its bibliographies. One nice caveat of this is that you won't have to do a second compile to load in references as standard LaTeX requires. To cite references in your thesis (after creating your bibliography database), place the reference name inside square brackets and precede it by the "at" symbol. For example, here's a reference to a book about worrying: (Molina and Borkovec, 1994). This `Molina1994` entry appears in a file called `thesis.bib` in the `bib` folder. This bibliography database file was created by a program called BibTeX. You can call this file something else if you like (look at the YAML header in the main .Rmd file) and, by default, is to placed in the `bib` folder.

For more information about BibTeX and bibliographies, see (http://web.reed.edu/cis/help/latex/index.html)[2]. There are three pages on this topic: *bibtex* (which talks about using BibTeX, at http://web.reed.edu/cis/help/latex/bibtex.html), *bibtexstyles* (about how to find and use the bibliography style that best suits your needs, at http://web.reed.edu/cis/help/latex/bibtexstyles.html) and *bibman* (which covers how to make and maintain a bibliography by hand, without BibTeX, at http://web.reed.edu/cis/help/latex/bibman.html). The last page will not be useful unless you have only a few sources.

If you look at the YAML header at the top of the main .Rmd file you can see that we can specify the style of the bibliography by referencing the appropriate csl file. You can download a variety of different style files at https://www.zotero.org/styles. Make sure to download the file into the csl folder.

---

[1] footnote text

[2] Reed College (2007)

Tips for Bibliographies

- Like with thesis formatting, the sooner you start compiling your bibliography for something as large as thesis, the better.
- The cite key (a citation's label) needs to be unique from the other entries.
- When you have more than one author or editor, you need to separate each author's name by the word "and" e.g. `Author = {Noble, Sam and Youngberg, Jessica},`.
- Bibliographies made using BibTeX (whether manually or using a manager) accept LaTeX markup, so you can italicize and add symbols as necessary.
- To force capitalization in an article title or where all lowercase is generally used, bracket the capital letter in curly braces.

Discussion 5

Summarize the entire project including what hypothesis/questions were investigated, why they were investigated, how they were investigated, the major findings, and your conclusions.

1. Discuss the findings and the hypothesis in a holistic and integrated fashion.
2. Explain any extraneous factors that may have led to the results you obtained.
3. Discuss the practical and theoretical implications of your findings and precisely how your research supports each implication.
4. State the conclusions to be drawn from your entire study (including review of the literature and empirical findings; i.e., integrate everything).
5. Discuss suggestion for future research, next stages of research, what others might do to follow up on your study.

5.1 Anything else?

If you would like to see examples of other things in this template, please contact me at ziefo002@umn.edu with your suggestions. I love to see people using *R Markdown* for their theses, and am happy to help.

References

Molina, S. T. and Borkovec, T. D. (1994). The Penn State worry questionnaire: Psychometric properties and associated characteristics. In Davey, G. C. L. and Tallis, F., editors, *Worrying: Perspectives on theory, assessment and treatment*, pages 265–283. Wiley, New York.

Reed College (2007). Latex your document.

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

Xie, Y. (2018). *bookdown: Authoring Books and Technical Documents with R Markdown*. R package version 0.7.