My Thesis

by

Your R. Name

A thesis submitted to the

Department of Excellence

in conformity with the requirements for

the degree of Winner of Science

Queen's University

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Abstract

The preface pretty much says it all.

Second paragraph of abstract starts here.

Acknowledgements

Thank your pals. Thank your profs. Thank your mom.

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Chapter 1

Introduction

1.1 Welcome

Welcome to the **gaelsdown** guide! This document is intended to get you up and running with writing your thesis in R markdown so that it can be published in a variety of formats, most importantly a .pdf with formatting specifications in the TeX language.

In this **introduction chapter**, I'll go through the benefits of adopting **gaelsdown** into your writing process and what to expect, then explain the basics of how you get from a R markdown to a formatted pdf. Then, in the **first chapter** of the guide, I'll provide you with all the basic tools to put together a document with formatting, figures and tables, and a structure appropriate to your thesis. In the **second chapter**, I'll get into some of the more advanced methods for figures and tables, specifying formatting inline, and more. Finally, in the **third chapter**, I'll go over some common issues and how you can address them, as well as providing more resources and approaches for troubleshooting.

1.2 Motivation

The purpose of **gaelsdown** is to enable you to write your thesis in R markdown so that you can focus on the content of your thesis. With R markdown, you can insert code for figures, tables, and references at ease, then transform the markdown file into a finished, formatted document that meets the specifications provided by the School of Graduate Studies. This is a departure from what may be a more familiar approach of using R to generate tables and figures separately, then inserting those into a "What-You-See-Is-What-You-Get" (WYSIWYG) editor like Microsoft Word.

There's a number of **advantages** to this approach over using a WYSIWYG editor, including:

- Your R code and writing are streamlined into one document, so that changes to figures and tables are automatically integrated whenever you knit your document, and the bibliography and table of contents are automatically generated.

- R markdown is a much more lightweight format, which reduces the load on your computer significantly if your thesis has hundreds of pages and includes many figures.

- The files making up your thesis are in plain text formats that can be easily transferred between platforms and require only free, open source software.

- By using LaTeX to generate your document, you have access to a wide range of packages to support different types of mathematical and scientific formulas and a professional-quality typesetting engine.

- Many journals make .tex templates available for authors, which can help with submission. There are also several options for converting from a LaTeX document to a Word-compatible format.

- If you're writing a thesis for Queen's University, the formatting of the pdf output already conforms to the specifications that the school has published. If you're writing for another school, or if you'd like to change some of the formatting, changes can be made in one place that apply to the whole document.

However, there are some potential challenges with writing your thesis in R markdown, especially if this is a new approach for you. This guide will help with avoiding or anticipating some of these challenges, but be aware of the following:

- Introducing formatting changes into a LaTeX document is a different process than in a WYSIWYG editor, and involves a bit of a learning curve. However, by using a template such as **gaelsdown**, you can avoid much of the LaTeX editing and focus on the content of your thesis.

- **gaelsdown** relies on a few different programs when it knits together your document, which means there's a few different steps at which an error can be introduced. I'll explain what these steps are, and tips for addressing any issues encountered at each step.

1.3 Structure

To understand how **gaelsdown** and similar template packages work, you need to understand the different software involved:

- **knitr** converts your R markdown file (.Rmd) into a markdown file (.md). The different between a R markdown file is that it includes R code chunks that need to be rendered as images for them to be markdown compatible.

- **pandoc** is included with your RStudio install and is capable of converting between a large number of different text formats, including markdown, Word (.docx), web browser compatible (.html), and LaTeX (.tex).

- **LaTeX** renders a typeset format such as PDF from .tex files—if you knit into another format such as gitbook or Word, LaTeX will not have been involved.

Here's a visualization of how it all flows together:

If you knitted this document locally from the **gaelsdown** package and watched the console carefully, then you've already seen all these steps in action! You can run the knit again if you want to review it.

1.4   Acknowledgements

The preface pretty much says it all.

Second paragraph of abstract starts here.

Chapter 2

Getting started

If you've reached this step, you should have already installed the **gaelsdown** and **tinytex** packages and knit your first document (this one!). If not, first take a look at the README for instructions explaining these steps.

2.1 Writing in markdown

In **RStudio**, you write in **Pandoc Markdown** to generate publishable documents. That means this is a valuable skill even if you're not using a LaTeX template, and it's also an easy skill to pick up. The basic principle behind markdown is that it should be easy to read even in plain text, and it accomplishes this by using special characters in intuitive ways.

For example, to *italicize* (emphasis) a word or line of text, you place it inside a pair of underscores or asterisks like so: `_italicize_`. To make a line **boldface** (strong emphasis), you put with two underscores or asterisks: `__boldface__`.

Where you start to get into real power of markdown is the ability to structure a document, such as by using headers. I mark the beginning of this chapter with a level-one header, `# Getting started`, and the beginning of this section with a level-two header, `## Writing in markdown`. If, say, we wanted to jump to another chapter, I could include a link using the header name `[Introduction]`: Introduction.

For a full primer on the features available in Pandoc Markdown, including the ability to insert lists, blockquotes, code chunks, and math, read this tutorial.

2.2 Figures and tables in R markdown

If you looked through the Pandoc Markdown tutorial, you may have noticed that there are features to include tables and images. However, the beauty of R markdown is that you can insert tables and figures using R code, then allow **knitr** to convert this code into a markdown format. To do this, I'll first need to load some R packages:

```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")
# Load packages (This can be accomplished by just loading gaelsdown)
library(gaelsdown)
```

Once the packages are loaded, I can assemble a basic table with R like so:

```
mtcars %>% head() %>% kable()
```

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1

Alternatively, I may want to produce a plot:

```
ggplot(data = mtcars, aes(x = wt, y = mpg)) +
  geom_point() +
  theme_classic()
```
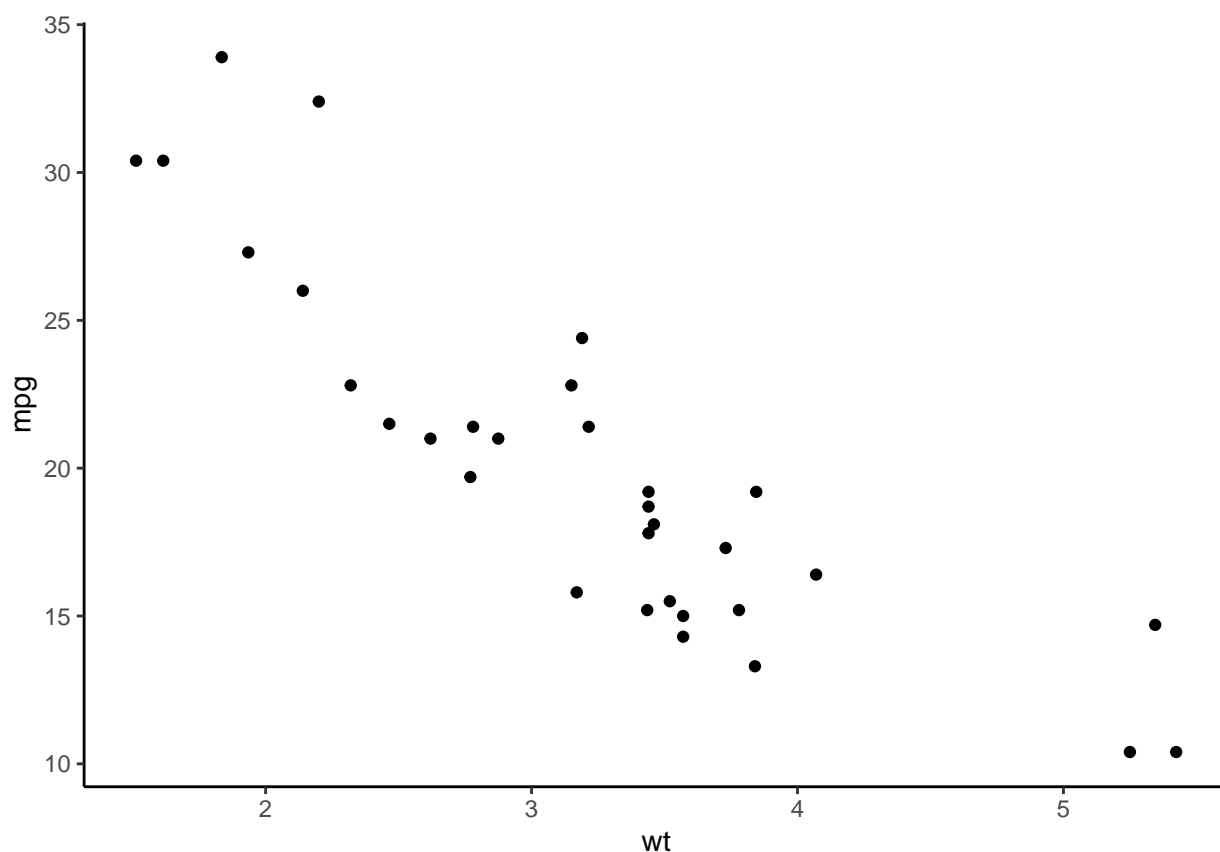
I'll have some tips on how to make your tables and figures look great in the next chapter on [Advanced methods].

2.3   Assembling your thesis

Although the final product you obtain using **gaelsdown** will likely be a single document contained in one file, there are multiple files that go into creating this document. There's a simplicity to this in that each individual file has a specific function within the larger document, and I'll explain how you can customize the structure of your thesis by adding or removing certain files or sections.

2.3.1 YAML Ain't Markup Language

Every thesis generated using this template has an **index.Rmd** file. This is the file you use to knit the document, and it contains your **YAML** section (recursively named, "YAML Ain't Markup Language"). Information from the **YAML** is passed onto **Pandoc**, and may include specifications for the output format and other options. You can also include *frontmatter* material here, such as your abstract.

Open up **index.Rmd** in RStudio to see what the YAML looks like. It's the section at the beginning bracketed by three dashes:

```
---

---
```

You need to be particularly attentive to the spaces in the YAML, so make sure when uncommenting lines you only remove the `#` and not the spaces!

At the top of the YAML are some pieces of information that get passed along to the title page, such as the title and author name. Since the format for title pages are set for Queen's University, you'll want to change the answers to these entries, but not which lines are included (To change the format of the title page, you'd have to go into the .tex template).

Following this you'll find your `output` options. Here, you have the option of either PDF, gitbook (web page), Word, and EPUB; to change the format, just comment out the active line and uncomment the appropriate line. After this are lines for your introductory material: abstract, acknowledgements, glossary, etc. These sections are *frontmatter*, will appear before the Table of Contents, are numbered with Roman instead of Arabic numerals, and won't be labelled as chapters.

Frontmatter is a bit quirky in that it needs to be read directly into LaTeX, so the frontmatter sections have to be defined in the .tex template and the YAML. I've defined all of the required and optional frontmatter sections specified for Queen's University theses, with some of them commented out. If you want to include frontmatter in another output format such as Word, then it has to be defined in the body of the .Rmd file, not the YAML.

After this are instructions for your references section. There's some defaults here for this document but you'll want to specify your own **bib** and **csl** file. The process for using these are the same as in **bookdown**, so for instructions on how to specify the `bibliography` and `csl` sections, follow Yihui Xie's tutorial here.

2.3.2 Folders and files

Upon creating your *gaelsdown* project in RStudio, your folder will have the following files and folders:

bib/

In here is your .bib file, specified in the YAML.

csl/

In here is your .csl file, specified in the YAML.

data/ and figure/

These are just folders for example data and figures; you can set the folders as you wish for scripts, etc.

_bookdown.yml

Configuration file for **bookdown**, the package underlying **gaelsdown**. You can change the output file and chapter prefixes here; see the bookdown reference for more information.

01-chap1.Rmd, 02-chap2.Rmd. . .

These are the main chapters of your thesis, which **gaelsdown** will join into one document. The .Rmd files in your main directory will all be knit together, so you can add as many files as you need and it's not necessary to follow this naming format (it just makes things easier to read).

98-references.Rmd

Your references come after every section apart from the appendix.

99-appendix.Rmd

The appendices come after the references. You can add as many appendix sections as necessary.

2.3.3 Library calls and importing data

To

2.4 Summary

In this section, I've covered

Within your

- Index.Rmd: YAML

  - frontmatter

  - yaml instructions

  - bib and cls files

- Library calls and data import

- Folder structure

Diagram!

Chapter 3

Additional methods

This section is still in the works.

3.1   Version control

3.2   kableExtra

Chapter 4

Understanding how gaelsdown works and troubleshooting

This section is still in the works.

Conclusion

If we don't want Conclusion to have a chapter number next to it, we can add the {-} attribute.

More info

And here's some other random info: the first paragraph after a chapter title or section head *shouldn't be* indented, because indents are to tell the reader that you're starting a new paragraph. Since that's obvious after a chapter or section title, proper typesetting doesn't add an indent there.

References

Angel, E. (2000). *Interactive computer graphics : A top-down approach with OpenGL.* Boston, MA: Addison Wesley Longman.

Angel, E. (2001a). *Batch-file computer graphics : A bottom-up approach with Quick-Time.* Boston, MA: Wesley Addison Longman.

Angel, E. (2001b). *Test second book by angel.* Boston, MA: Wesley Addison Longman.

Appendix A

The First Appendix

This first appendix includes all of the R chunks of code that were hidden throughout the document (using the `include = FALSE` chunk tag) to help with readability and/or setup.

In the main Rmd file

```r
# By default tinytex only compiles once; compiling multiple
# times is necessary to ensure the List of Figures and List of
#     Tables
# page numbers are correct if listed in the Table of Contents
options(tinytex.compile.min_times = 3)


# This chunk ensures that the gaelsdown package is
# installed and loaded. This gaelsdown package includes
# the template files for the thesis.
if(!require(devtools))
  install.packages("devtools", repos = "http://cran.rstudio.com")
if(!require(gaelsdown))
  devtools::install_github("eugenesit/gaelsdown")
library(gaelsdown)
```

In Chapter ??:

Appendix B

The Second Appendix, for Fun