# CASA dissertation using Bookdown

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CASA0010, MSc Smart Cities Dissertation

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Repository: https://andrewmaclachlan.github.io/CASA0005repo/

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# Abstract

Some abstract text

# Declaration

I hereby declare that this dissertation is all my own original work and that all sources have been acknowledged. It is xxx words in length

# Acknowledgements

I would like to thank blah blah

# Contents

# List of Figures

# List of Tables

# Abbreviations

| Term | Abbreviation |
|---|---|
| Digital Elevation Model | DEM |
| Digital Surface Model | DSM |
| Digital Terrain Model | DTM |

# Chapter 1

# Bookdown basics

Bookdown enables us to take raw text files (e.g. Rmarkdown files) and output them into a number of different formats with ease. This is more useful than LaTex as you can create a word version for comments from your supervisor, a pdf for final submission and an online book for your own portfolio.

## 1.1 Structure

A bookdown book simply combines multiple Rmarkdown files into .pdf, html or .epub (but i've disabled epub here).

All Rmakdown files must be located in the base (or root) of the project. For example, don't got putting the .Rmd in a folder called chapters and then wonder why it's not working. They all must be in the same folder as the project file. You can however put output figure images into a folder (e.g. figures) then call them in.

## 1.2 Building the book

You will need the packages: `bookdown, kabble, knitr`

You also need to install `tinytex::install_tinytex()` for generating .pdfs from your book.

Once installed you can build the book by clicking the Build Book icon under the build tab in the top right quadrant.

To export the book to word follow the code below from Edd Berry:

```
bookdown::preview_chapter("01-intro.Rmd",
                output_format = "bookdown::word_document2",
                output_file = paste0("thesis-intro-",
                                     format(Sys.Date(),
                                            ("%d-%m-%y")),
                                     ".docx"),
                output_dir = "chapter-previews")
```

You can also setup a reference document if you wish that word will style it on. To do so:

1. export to word using the code above.
2. change the headings styles in word
3. save the document
4. add the `output_options()` function to the code above

See Custom Word Templates for more detailed instructions.

```
bookdown::preview_chapter("01-intro.Rmd",
                output_format = "bookdown::word_document2",
                output_file = paste0("thesis-intro-",
                                     format(Sys.Date(),
                                            ("%d-%m-%y")),
                                     ".docx"),
```

```
                output_dir = "chapter-previews",
                output_options = list(reference_docx = "word-style-ref.docx"))
```

You can also export the whole document as word by clicking Build Book and selecting it. However, note that tables built with `Kabble` don't work with word, so you have the following options

- create the html (gitbook) and copy the tables into word
- either exclude them (`eval=FALSE`) in the code chunk header
- use .pdf.

## 1.3 YAMLs

You will see some files with a `.yml` extension. These stand for yet another markup language.

Open the `_output.yml` and `_bookdown.yml`.

The `_output.yml` controls the settings for each outputted format.

The `_bookdown.yml` controls the order in which the files are made into chapters - you can also change the `Chapter` title if you wish here.

I have set these up to create nice outputs, so there is really no need to change anything, unless you want to add a new chapter and include it in the list. To do so, simply create a new Rmarkdown document, delete all the default content, add a first level heading, and the then add it to where you want it to appear in the document in the `_bookdown.yml`.

## 1.4 Formatting

You'll notice in the `_output.yml` that the various formats (html (or gitbook) and pdf) are calling styling codes. The gitbook calls `style.css` and the `pdf_book`

calls `preamble.tex`. These files just style the various outputs.

I have copied in a basic styling with a CASA logo in the table of contents, you can replace this with other variations of the file if you wish or look at the minimal bookdown example or my CASA0005 .css file.

The best place to learn more about styling is the RStudio for education bookdown guide

For the .pdf version in the `preamble.tex` we have to use LaTex code. I am by no means an expert in this. If you Google each package it will tell you what it does. There isn't much here really, but all the header stuff refers to the headings at the top of each page.

## 1.5 Index file

Open up the `index.Rmd` this `Rmd` must be called first in the `_bookdown.yml` list. There are a number of options here, but i've set them all up to be compliant with the CASA thesis requirements.

You will need to change your title and name etc. Make sure you leave the a space here: `| Andrew MacLachlan` this won't work `|Andrew MacLachlan`

If you were to be printing your work, you'd want to change the `classoption` to `twosides` and make sure the `geometry margins` were correct. `linestrech` refers to the line spacing and the bibliography stuff we come on to later.

Input your GitHub repo and add a description.

If you ever wanted to just create a report and not a thesis you can change the `documentclass` to other options such `report`, `article` or `letter`

## 1.6 Preamble

Open the `preable.Rmd` and you will see all the sections that are required before the main text (e.g. Declaration and so on). At the top of the page i've used a code chunk set to LaTex, saying to use Roman numbering as we don't want page 1 to be the Declaration, we want it to be the first page of the Introduction. There are two conditions for each of the sections that state if output to HTML (gitbook) then do this, if output to LaTex then do this. This is the only place we have this. In our bookdown HTML we want to be able to click these sections, but in our LaTex .pdf we don't want them to appear in the table of contents. This is what this code is doing.

The Abstract is on the `index.Rmd` the same code condition applies to it, with Roman numbering also specified.

If you look back in the `_output.yml` you'll also see the `toc` (table of contents) is set to false. By default this appears right after the title, but we want this to come after our `preable.Rmd`. You'll see that i've called `\tableofcontents`, `\listoffigures` and `\listoftables` in the correct place again using a LaTex code chunk. These aren't required for the bookdown output.

The last section here is the abbreviations. To make this really easy, i've created an excel document to add them into. The code here will load that and then use the `kable` package to make a table. More on this later.I've also done the same for the research log in the appendix — excel sheet called `research_log`.

## 1.7 Change this to a thesis

Easy. Just change all the titles to what you want (e.g. Introduction, Literature Review, Methodology, Discussion, Conclusion). Some of the latter `.Rmds` (Discussion etc) are ready to go!

## 1.8 Adding a pdf

If you wish to add another .pdf as an Appendix (in your .pdf) then again we need a bit of LaTex code

```
\includepdf[pages={-}]{mypdf.pdf}
```

If you look in the `08-Appendix.Rmd` then you will see another if LaTex section, simply add in the line of code above, replacing `mypdf.pdf` with your pdf title in the main project folder. It will then be appended to the thesis. Of course, this isn't required in the online book, but you just link to them on GitHub or embed .pdfs using:

You'd need a condition around this like in the `preamble.Rmd` but a link is fine. I embedded a .pdf in the assignment resources of CASA0005

## 1.9 Writing code

Use one project for your thesis and another for your analysis. Don't try and do it all in a thesis project. You can set your output folder from your main analysis project to the thesis project and then easily load the figures in.

# Chapter 2

# Cross referencing

## 2.1 Chapters or sections

Always give you sections an additional reference…e.g. `# Cross referencing {#crossref}` This gives us two reference points. The first we can use to reference the section name…

1. We want to say see the Introduction (or other section label)we use … `[Cross referencing]` giving Cross referencing

But what if we want to reference the section number (e.g. Chapter 1 or section 4.2)

1. Just reference the label we gave to the section….see Chapter `\@ref(crossref)` giving see Chapter 2

## 2.2 Figures, tables, even code chunks

### 2.2.1 Figures

When you create a figure, table or code chunk there is an option to name the chunk something. Do it!. Don't be like me and not! Be warned that these chunk names can't have any fancy or strange characters in them e.g. _. I think a - is allowed, but i'd keep it simple. Here is a figure. In the chunk options after `r` i have specified `nice-fig, echo=FALSE, fig.cap='Here is a nice figure!', out.width='80%'`

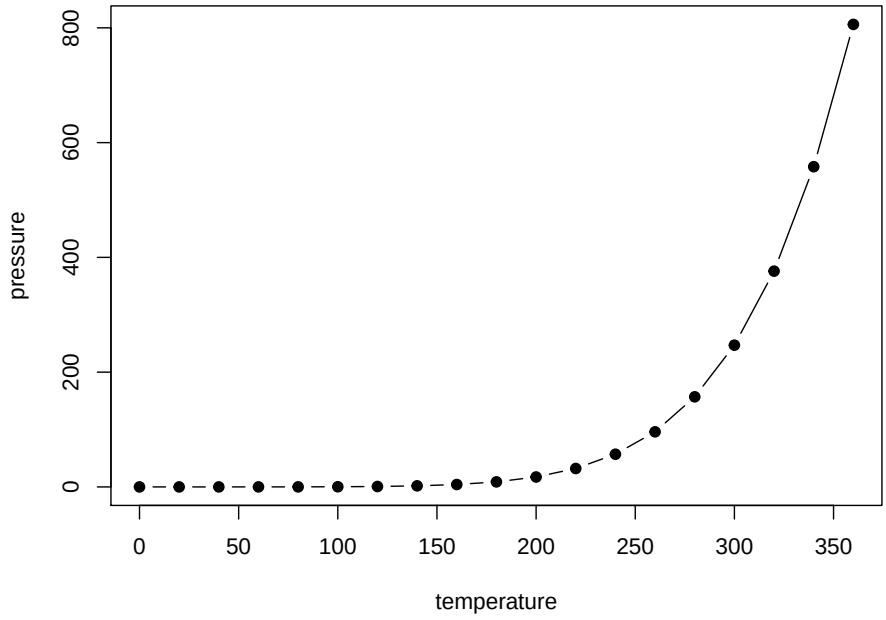


Figure 2.1: Here is a nice figure!

To cross reference this just include Figure `\@ref(fig:nice-fig)` which gives…Figure 2.1.

### 2.2.2 Tables

For tables i'd recommend using the `kable` package. Here is an example table, same deal as the Figures section with naming the code chunk.

Table 2.1: Here is a nice table!

| 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 |
| 4.6 | 3.4 | 1.4 | 0.3 | setosa |
| 5.0 | 3.4 | 1.5 | 0.2 | setosa |
| 4.4 | 2.9 | 1.4 | 0.2 | setosa |
| 4.9 | 3.1 | 1.5 | 0.1 | setosa |
| 5.4 | 3.7 | 1.5 | 0.2 | setosa |
| 4.8 | 3.4 | 1.6 | 0.2 | setosa |
| 4.8 | 3.0 | 1.4 | 0.1 | setosa |
| 4.3 | 3.0 | 1.1 | 0.1 | setosa |
| 5.8 | 4.0 | 1.2 | 0.2 | setosa |
| 5.7 | 4.4 | 1.5 | 0.4 | setosa |
| 5.4 | 3.9 | 1.3 | 0.4 | setosa |
| 5.1 | 3.5 | 1.4 | 0.3 | setosa |
| 5.7 | 3.8 | 1.7 | 0.3 | setosa |
| 5.1 | 3.8 | 1.5 | 0.3 | setosa |

```
knitr::kable(
  head(iris, 20), caption = 'Here is a nice table!',
  booktabs = TRUE
)
```

Now to cite the table it's just Table `\@ref(tab:nice-tab)`, giving Table 2.1

## 2.3 Citing documents

To cite documents they need to be in a `.bib` file, that must be loaded within your `index.Rmd`. Have a look at my `index.Rmd` and you will see there are three such files, two that were provided as an example here `book.bib`, `packages.bib` and

one that i added `test.bib`. I can simply cite the papers within them using the citation key e.g. `[@xie2015]` giving (Xie, 2015). Make sure you remove the ones you don't need.

If you remove the citation from the `[]` it will give Xie (2015).

When citing multiple authors use a ; `[@xie2015; @maclachlan2017urban]` = (MacLachlan et al., 2017; Xie, 2015)

To remove the author add a minus sign `-@maclachlan2017urban` = (2017)

## 2.4 Citing using software

Zotero can now continuously update your `.bib` file.

To do so:

1. Download the latest release — the `.xpi` file: https://github.com/retorquere/zotero-better-bibtex/releases/tag/v5.2.108
2. In Zotero > Tools > Add ons > Extensions
3. Select the cog > Install add on from file
4. Select the `.xip` > restart Zotero.

On the restart select the default naming convention.

To export the library

1. File > export
2. Select Better BibLaTex
3. Click keep updated
4. Select the file to save into your Thesis project

5. Make sure you have the file listed in your `bibliography` in the `index.Rmd` file

You can also manage references using `citr` which makes finding them to cite much easier. In RStudio go: Addins (top tool bar) > insert citations.

## 2.5 Footnotes

To add a footnote use `^[This is a footnote]` to create [1].

[1] This is a footnote

# Chapter 3

# Equations and direct quotes

This section will focus on equations and direct quotes

## 3.1 Equations

You need to include equations with some LaTeX. The easiest way to do this is to use an online tool such as: https://latex.codecogs.com/eqneditor/editor.php. It can be a real pain to get these right, but once you've worked it out it will be much easier than dealing with word equation editor.

$$p = h\frac{c}{\varrho} \tag{3.1}$$

To reference this in the text we use: (3.1)

You can also test your code in your RMarkdown document using `$` e.g.

$$p = h\frac{c}{\varrho}$$

However, this won't generate an equation number and you can't cross reference it. But we can use this logic to define the parameters within the equation e.g. where $h$ is Plank's constant, $6.626 \times 10^{-}34Js$

`$$` puts it on a new line, single `$` keeps it on the same line (in the text)

## 3.2 Block quotes (or direct quotes)

You may wish to quote a large section from a source, to do this use a block quote. Simply input a `>` before the text. For example `> This is a quote`.

> "This is a direct quote"

You can also provide an attribution at the footer of the quote using `tufte::quote_footer()`, either a name or a reference. You'll need to install the `tufte` package to use this. For example, `> [include only r here] tufte::quote_footer('--- Joe Martin')` or `> [include only r here] tufte::quote_footer('--- @xie2015')`

Giving…

> — Joe Martin
>
> — Xie (2015)

Instead you could just include the reference at the end of the quote, using the same method to reference as we've seen before..e.g. `> "This is a direct quote" @xie2015, Equation \@ref(eq:test)`…giving

> "This is a direct quote" Xie (2015) (3.1)

# Chapter 4

# Figures, tables, hosting GitBook

This section is going to focus including figures and creating tables

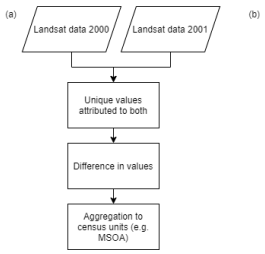


Figure 4.1: Summary of methdological procedure for (a).... and (b)....

## 4.1 Including figures and tables

### 4.1.1 Figures

To include the figure above use the code `knitr::include_graphics(here::here('general_image` within a code chunk. In the chunk options you can specify the width and figure captions e.g. `out.width="100pt", fig.cap="Summary of methdological procedure for (a).... and (b)...."`. However, if you do show the code with `echo=TRUE` then you can't specify the `out.width`.

For making flow diagrams have a look at

1. Lucidchart
2. Draw.io

### 4.1.2 Tables

For creating tables i'd suggest creating either an excel file or `.csv` and then reading the data into R and using the `kabble` package to format it how you wish. The example below is from the abbreviations section

```
library(tidyverse)
library(knitr)
library(kableExtra)
library(readxl)
library(fs)
library(here)

#read in data
read_excel(here("tables", "abbreviations.xlsx"))%>%
  arrange(Term) %>% # i.e. alphabetical order by Term
  # booktab = T gives us a pretty APA-ish table
  knitr::kable(booktabs = TRUE)%>%
  kable_styling(position = "center")%>%
  # any specifc row changes you want
    row_spec(.,
  row=0,
  bold = TRUE)
```

| Term | Abbreviation |
|---|---|
| Digital Elevation Model | DEM |
| Digital Surface Model | DSM |
| Digital Terrain Model | DTM |

Here is a more advanced table from GIS assignment outline. Notice that in the excel file where i wanted the same data replicated in the table here (e.g. weeks 2 and 3) i simply copied it in a new cell - in other words each tow has all the information and then it's styled in R.

You do loads of things with kabble including adding small visulisations within the table - consult the documentation for more info.

If in doubt, keep it simple.

```
library(readxl)
library(kableExtra)
timeline <- read_excel(here('tables',
                            'timeline.xlsx'))
kable(timeline,
      align=(c('c', 'l')),
      valign="middle") %>%
    kable_styling(bootstrap_options = c("striped",
                                        "hover",
                                        "condensed",
                                        "responsive")) %>%
    row_spec(0,
             align = "c") %>%
    column_spec(1, bold = T,
                border_right = T) %>%
    collapse_rows(columns = 1:2)
```

| Week | |
|---|---|
| **1** | Undertake wider data exploration and reading to find a topic you might |
| **2** | Assess the validity of your topic in terms of data suitability, then sketch |
| **3** | |
| **4** | Based on your knowledge of available data and literature compose a rese |
| **5** | Create a draft of the methodology / initial ideas that can be expanded o |
| **6** | Learn and practice analysis from the course and identify appropriate tec |
| **7** | |
| **8** | |
| **9** | |
| **10 to deadline** | Undertake your analysis, then write up your discussion and conclusion (t |
| **Before submission** | Check that your assignment follows the standard model of scientific inve |

## 4.2 Hosting the book

You will need to create a new GitHub repository to host your book online using GitHub pages — like the example is. GitHub pages takes a load of `.html` files and makes a website.

To do so you need to set up a few things

1. Go to the `_bookdown.yml` file and make sue that that you have this line of code: `output_dir: docs` (it should be there)
2. In the same file make sure your `book_filename` doesn't have any spaces use `-` or `_` e.g. `CASA-Thesis`
3. Build your book locally
4. Save, stage changes, commit and then push to GitHub
5. On your GitHub repository > settings > GitHub pages > select the source as main and the folder as docs

# Chapter 5

# Discussion

Short introduction to the chapter, reviewing the previous chapter and detailing what this one aims to achieve and build upon.

## 5.1 Research significance

### 5.1.1 Global development goals

### 5.1.2 Local policy

### 5.1.3 Academic research

## 5.2 Limitations

## 5.3 Transferability

# Chapter 6

# Conclusion

Short introduction to the chapter, reviewing the previous chapter and detailing what this one aims to achieve and build upon.

## 6.1 Recommedations

1. Adapt policy x
2. Undertake data informed targeted greening
3. Further work into this area

# Bibliography

MacLachlan, A., Biggs, E., Roberts, G., & Boruff, B. (2017). Urban growth dynamics in perth, western australia: Using applied remote sensing for sustainable future planning. *Land*, *6*(1), 9.

Xie, Y. (2015). *Dynamic documents with R and knitr* (2nd) [ISBN 978-1498716963]. Chapman; Hall/CRC. http://yihui.name/knitr/

# Appendix A Research log

## subsection

### sub sub section

| Date | Task |
|---|---|
| 31st May 2020 | data search, commenced literature review |
| 7th June 2020 | revised literature in the direction of x |

# Appendix B Proposal