This is my thesis

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The abstract should outline the main approach and findings of the thesis and must not be more than 500 words.

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The material in Chapter 1 has been submitted to the journal *Journal of Impossible Results* for possible publication.

The contribution in Chapter 2 of this thesis was presented in the International Symposium on Nonsense held in Dublin, Ireland, in July 2022.

Reproducibility statement

This thesis is written using Quarto with renv (Ushey, 2022) to create a reproducible environment. All materials (including the data sets and source files) required to reproduce this document can be found at the Github repository `github.com/egouldo/quarto-thesis`.

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I would like to thank my pet goldfish for ...

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Chapter 1

Introduction

This is where you introduce the main ideas of your thesis, and an overview of the context and background.

In a PhD, Chapter 2 would normally contain a literature review. Typically, Chapters 3–5 would contain your own contributions. Think of each of these as potential papers to be submitted to journals. Finally, Chapter 6 provides some concluding remarks, discussion, ideas for future research, and so on. Appendixes can contain additional material that don't fit into any chapters, but that you want to put on record. For example, additional tables, output, etc.

1.1 Quarto

In this template, the rest of the chapter shows how to use quarto. The big advantage of using quarto is that it allows you to include your R or Python code directly into your thesis, to ensure there are no errors in copying and pasting, and that everything is reproducible. It also helps you stay better organized.

For details on using Quarto, see `http://quarto.org`.

1.2 Data

Included in this template is a file called `sales.csv`. This contains quarterly data on Sales and Advertising budget for a small company over the period 1981–2005. It also contains the GDP

(gross domestic product) over the same period. All series have been adjusted for inflation. We can load in this data set using the following code:

```
sales <- readr::read_csv(here::here("data/sales.csv")) %>%
  rename(Quarter = `...1`) %>%
  mutate(
    Quarter = as.Date(paste0("01-", Quarter), "%d-%b-%y"),
    Quarter = yearquarter(Quarter)
  ) %>%
  as_tsibble(index = Quarter)
```

```
New names:
Rows: 100 Columns: 4
-- Column specification
-------------------------------------------------------- Delimiter: "," chr
(1): ...1 dbl (3): Sales, AdBudget, GDP
i Use ‘spec()‘ to retrieve the full column specification for this data. i
Specify the column types or set ‘show_col_types = FALSE‘ to quiet this message.
* ‘‘ -> ‘...1‘
```

Any data you use in your thesis can go into the `data` directory. The data should be in exactly the format you obtained it. Do no editing or manipulation of the data prior to including it in the `data` directory. Any data munging should be scripted and form part of your thesis files (possibly hidden in the output).

1.3 Figures

Figure 1.1 shows time plots of the data we just loaded. Notice how figure captions and references work. Chunk names can be used as figure labels with `fig-` prefixed. Never manually type figure numbers, as they can change when you add or delete figures. This way, the figure numbering is always correct.

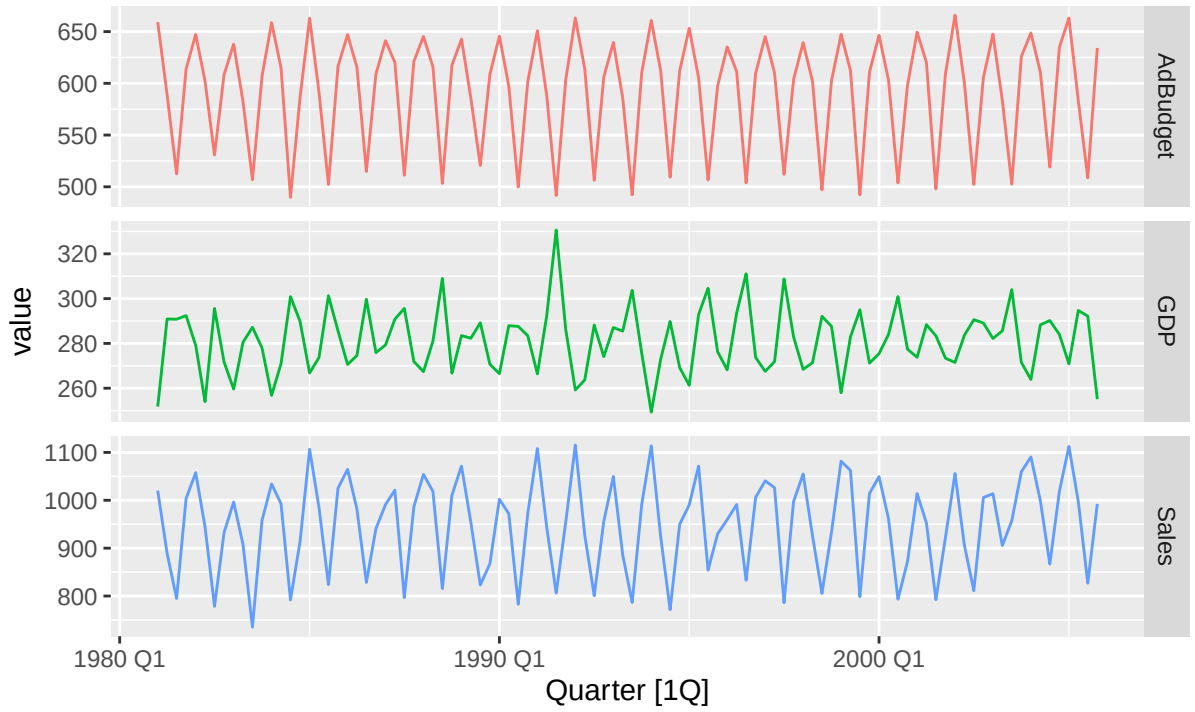

Figure 1.1: *Quarterly sales, advertising and GDP data.*

1.4 Results from analyses

We can fit a dynamic regression model to the sales data.

```
Series: Sales
Model: LM w/ ARIMA(1,0,0)(0,1,1)[4] errors

Coefficients:
         ar1     sma1     GDP  AdBudget
      0.2189  -0.9016  0.9742    2.2824
s.e.  0.1022   0.0715  0.4387    0.3930

sigma^2 estimated as 1677:  log likelihood=-493.94
AIC=997.87   AICc=998.54   BIC=1010.69
```

If y_t denotes the sales in quarter t, x_t denotes the corresponding advertising budget and z_t denotes the GDP, then the resulting model is:

$$y_t - y_{t-4} = \beta(x_t - x_{t-4}) + \gamma(z_t - z_{t-4}) + \phi_1(y_{t-1} - y_{t-5}) + \Theta_1\varepsilon_{t-4} + \varepsilon_t \tag{1.1}$$

where $\beta = 2.28$, $\gamma = 0.97$, $\phi_1 = 0.22$, and $\Theta_1 = -0.90$. We can reference this equation using Equation 1.1.

1.5 Tables

Let's assume future advertising spend and GDP are at the current levels. Then forecasts for the next year are given in Table 1.1.

Table 1.1: *Forecasts for the next year assuming Advertising budget and GDP are unchanged.*

Quarter	Sales forecast
2006 Q1	1000.2
2006 Q2	1013.1
2006 Q3	1076.7
2006 Q4	1003.5

Again, notice the use of labels and references to automatically generate table numbers.

Chapter 2

Literature Review

This chapter contains a summary of the context in which your research is set.

Imagine you are writing for your fellow PhD students. Topics that are well-known to them do not have to be included here. But things that they may not know about should be included.

Resist the temptation to discuss everything you've read in the last few years. And you are not writing a textbook either. This chapter is meant to provide the background necessary to understand the material in subsequent chapters. Stick to that.

You will need to organize the literature review around themes, and within each theme provide a story explaining the development of ideas to date. In each theme, you should get to the point where your ideas will fit in. But leave your ideas to later chapters. This way it is clear what has been done beforehand, and what new contributions you are making to the research field.

All citations should be done using markdown notation as shown below. This way, your bibliography will be compiled automatically and correctly.

2.1 Exponential smoothing

Exponential smoothing methods were originally developed in the late 1950s (Brown, 1959, 1963; Holt, 1957; Winters, 1960). Because of their computational simplicity and interpretability, they became widely used in practice.

Empirical studies by Makridakis & Hibon (1979) and Makridakis et al. (1982) found little difference in forecast accuracy between exponential smoothing and ARIMA models. This made

the family of exponential smoothing procedures an attractive proposition (see Chatfield et al., 2001).

The methods were less popular in academic circles until Ord et al. (1997) introduced a state space formulation of some of the methods, which was extended in Hyndman et al. (2002) to cover the full range of exponential smoothing methods.

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Appendix A

Additional stuff

You might put some computer output here, or maybe additional tables. It is possible to have multiple appendices. Just list them in the appropriate place within `_quarto.yml`.