Dissertation

submitted to the

Combined Faculty of Natural Sciences and Mathematics

of the Ruperto Carola University Heidelberg, Germany

for the degree of

Doctor of Natural Sciences

Presented by

M. Sc. Your Name Here

born in Somewhere

Oral examination: MMMM dd, yyyy

Thesis Title

Referees: Prof. Dr. Ref Eree the 1st

Prof. Dr. Ref Eree the 2nd

To my pet Fred

Acknowledgements

I want to thank a few people.

List of publications

Thesis related

- Einstein et al. 1918
- ...

Other contributions

- Newton et al. 1687
- ...

Manuscripts in preparation / under review

Zusammenfassung

Das ist eine Vorlage für eine Dissertation an der Fakultät für Biowissenschaften an der Universität Heidelberg...

Abstract

This is the template for a thesis at the Faculty of Biosciences at Heidelberg University. A popular approach to write a thesis or a paper is the IMRAD method (Introduction, Methods, Results and Discussion). This approach is not mandatory! You can find more information about formal requirements here.

Table of Contents

List of Abbreviations

ATP	Adenosine triphosphate	SDS	Sodium dodecyl sulfate
BS	Bisulfite	TMT	Tandem mass tags

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About this Thesis Template

Welcome to the Heidelberg biosciences thesis template. This template is based on the famous two mandatory
pages that the Faculty of Biosciences at Heidelberg University requires for dissertations. It was adapted from phister/huwiwidown that in turn is based on ismayc/thesisdown.

Why use R Markdown?

R Markdown creates a simple and straightforward way to interface with the beauty of LaTeX. Packages have been written in **R** to work directly with LaTeX to produce nicely formatting tables and paragraphs.

R Markdown also allows you to read in your data, to analyze it and to visualize it using **R** functions, and also to provide the documentation and commentary on the results of your project. Using *R Markdown* will also allow you to easily keep track of your analyses in **R** chunks of code, with the resulting plots and output included as well.

Chapter 1

Introduction

- What is the subject of the study? Describe the economic/econometric problem.
- What is the purpose of the study (working hypothesis)?
- What do we already know about the subject (literature review)? Use citations: Lingenfelser, Wagner, and André (2011) shows that... Alternative Forms of the Wald test are considered (Kuncheva 2004).
- What is the innovation of the study?
- Provide an overview of your results.
- Outline of the paper:
  The paper is organized as follows. The next section describes the model under investigation. Section "Data" describes the data set and Section "Results" presents the results. Finally, Section "Conclusion" concludes.
- The introduction should not be longer than 4 pages.

Chapter 2

Methodology

- How was the data analyzed ?
- Present the underlying economic model/theory and give reasons why it is suitable to answer the given problem[1].
- Present econometric/statistical estimation method and give reasons why it is suitable to answer the given problem.
- Allows the reader to judge the validity of the study and its findings.
- Depending on the topic this section can also be split up into separate sections.

[1] Here is an example of a footnote.

Chapter 3

Data

- Describe the data and its quality.
- How was the data sample selected?
- Provide descriptive statistics such as:
  - time period,
  - item number of observations, data frequency,
  - item mean, median,
  - item min, max, standard deviation,
  - item skewness, kurtosis, Jarque–Bera statistic,
  - item time series plots, histogram.
- For example (you can decide whether you want to display the code below or not by setting `echo=TRUE` or `echo=FALSE`, respectively, in the code chunk header):

```
col_names <- c(
  "3m", "6m", "1yr", "2yr", "3yr", "5yr", "7yr", "10yr", "12yr", "15yr"
)
```

```r
means     <- c(
  3.138, 3.191, 3.307, 3.544, 3.756, 4.093, 4.354, 4.621, 4.741, 4.878
)
stddev    <- c(
  0.915, 0.919, 0.935, 0.910, 0.876, 0.825, 0.803, 0.776, 0.768, 0.762
)
row_names <- c("Mean", "StD")

df <- matrix(data = c(means, stddev), nrow = 2, byrow = T)
rownames(df) <- row_names
colnames(df) <- col_names
df <- data.frame(df)
knitr::kable(
  df,
  booktabs = TRUE,
  caption = "Detailed descriptive statistics of location and dispersion for 2100 observed
  col.names = col_names,
  escape = FALSE
) %>%
kable_styling(latex_options = c("HOLD_position")) %>%
row_spec(2, hline_after = T)
```

	3m	6m	1yr	2yr	3yr	5yr	7yr	10yr	12yr	15yr
Mean	3.138	3.191	3.307	3.544	3.756	4.093	4.354	4.621	4.741	4.878
StD	0.915	0.919	0.935	0.910	0.876	0.825	0.803	0.776	0.768	0.762

Table 3.1: Detailed descriptive statistics of location and dispersion for 2100 observed swap rates for the period from February 15, 1999 to March 2, 2007. Swap rates measured as 3.12 (instead of 0.0312).

- Allows the reader to judge whether the sample is biased or to evaluate possible impacts of outliers, for example.
- Here tables can be easily integrated using the `kable()` function in the `knitr` package (with perhaps some additional help from the `kableExtra` package). `kable()` will automatically generate a label for the table environment. That way you don't have to manually enter in the table in LaTex, you can embed tables from R code.
- Tables can be referenced using `\@ref(label)`, where `label` is `tab:<name>`, where `<name>` is the code chunk label.
- The appearance may look different to tables directly typed with LaTex, due to limitations in `kable()`. To compare:

	3m	6m	1yr	2yr	3yr	5yr	7yr	10yr	12yr	15yr
Mean	3.138	3.191	3.307	3.544	3.756	4.093	4.354	4.621	4.741	4.878
StD	0.915	0.919	0.935	0.910	0.876	0.825	0.803	0.776	0.768	0.762

Table 3.2: This table was handwritten with LaTeX.

Chapter 4

Results

- Organize material and present results.
- Use tables, figures (but prefer visual presentation):
  - Tables and figures should supplement (and not duplicate) the text.
  - Tables and figures should be provided with legends.
  - *Figure 4.1 shows how to include and reference graphics. The graphic must be labelled before. Files must be in* ***.eps*** *format. You can do this really easily in R Markdown with* `knitr::include_graphics()`!
  - Figures can be referenced with `\@ref(fig:<name>)`, where `<name>` is the name of the code chunk.
- Tables and graphics may appear in the text or in the appendix, especially if there are many simulation results tabulated, but is also depends on the study and number of tables resp. figures. The key graphs and tables must appear in the text!
- R Markdown can also supports math equations just like *LaTeX*!

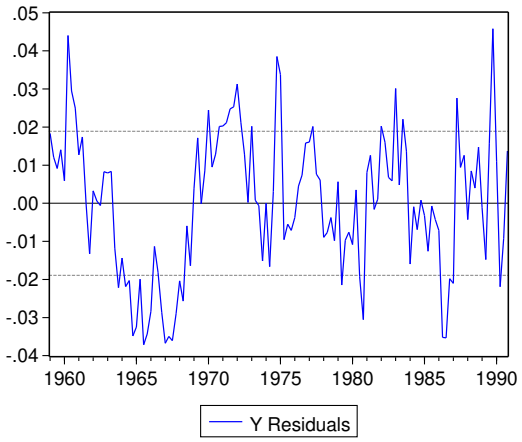

Figure 4.1: Estimated residuals from model XXX. ...

– *Equation* (4.1) *represents the ACs of a stationary stochastic process:*

$$f_y(\lambda) = (2\pi)^{-1} \sum_{j=-\infty}^{\infty} \gamma_j e^{-i\lambda j} = (2\pi)^{-1} \left(\gamma_0 + 2 \sum_{j=1}^{\infty} \gamma_j \cos(\lambda j) \right) \tag{4.1}$$

where $i = \sqrt{-1}$ *is the imaginary unit,* $\lambda \in [-\pi, \pi]$ *is the frequency and the* γ_j *are the autocovariances of* y_t.

– Equations can be referenced with `\@ref(eq:<name>)`, where name is defined by adding `(\#eq:<name>)` in the line immediately before `\end{equation}`.

4.1 Review of Results

- Do the results support or do they contradict economic theory ?
- What does the reader learn from the results?
- Try to give an intuition for your results.
- Provide robustness checks.
- Compare to previous research.

Chapter 5

Conclusion

- Give a short summary of what has been done and what has been found.
- Expose results concisely.
- Draw conclusions about the problem studied. What are the implications of your findings?
- Point out some limitations of study (assist reader in judging validity of findings).
- Suggest issues for future research.

References

Kuncheva, Ludmila I. 2004. *Combining Pattern Classifiers: Methods and Algorithms.* John Wiley & Sons.

Lingenfelser, Florian, Johannes Wagner, and Elisabeth André. 2011. "A Systematic Discussion of Fusion Techniques for Multi-Modal Affect Recognition Tasks." In *Proceedings of the 13th International Conference on Multimodal Interfaces*, 19–26. ACM.

Here goes the appendix!

Figures

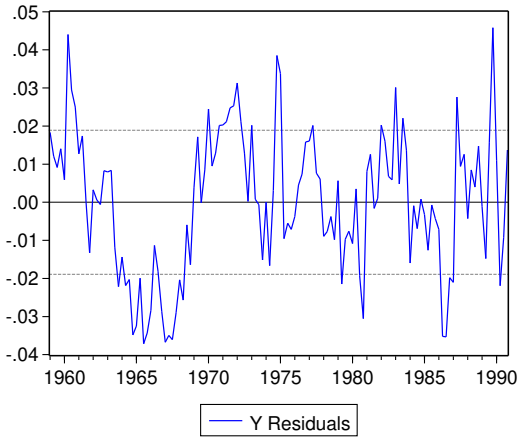

Figure 1: Estimated residuals (2) from model XXX. ...

Tables

	3m	6m	1yr	2yr	3yr	5yr	7yr	10yr	12yr	15yr
Mean	3.138	3.191	3.307	3.544	3.756	4.093	4.354	4.621	4.741	4.878
Median	3.013	3.109	3.228	3.490	3.680	3.906	4.117	4.420	4.575	4.759
Min	1.984	1.950	1.956	2.010	2.240	2.615	2.850	3.120	3.250	3.395
Max	5.211	5.274	5.415	5.583	5.698	5.805	5.900	6.031	6.150	6.295
StD	0.915	0.919	0.935	0.910	0.876	0.825	0.803	0.776	0.768	0.762

Table 1: Detailed descriptive statistics of location and dispersion for 2100 observed swap rates for the period from February 15, 1999 to March 2, 2007. Swap rates measured as 3.12 (instead of 0.0312).