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List of Symbols

Symbol	Explanation
H_0 :	Null Hypothesis
H_1 :	Alternative Hypothesis
I_n :	Identity Matrix of dimension n
k	Number of independent variables
n :	Sample Size
p	Number of Parameters
R^2 :	Coefficient of Determination
\bar{R}^2 :	Adjusted Coefficient of Determination
$\beta_1, \beta_2, \dots, \beta_k$:	Unknown parameters

List of Acronyms

AIC Akaike Information Criteria

BLUE Best Linear Unbiased Estimator

i.i.d. independent and identically distributed

OLS Ordinary Least Squares

Note:

The List of Acronyms should include abbreviations that are used **more than once** in the thesis and are also **clearly defined**.

Abbreviations from everyday use (like *e.g.* or *i.e.*) do **not** have to be added to the List of Acronyms. At the **first mention** in the thesis, the abbreviations should be **written out** once.

Abstract

The abstract is an **explicit summary** of the thesis that states the **problem**, the **methods** used and the major **results and conclusions**. The abstract should only summarize the **substantive results** of the work and not merely list topics to be discussed. It should also **not** include scientific symbols, acronyms, numbers, bullets or lists. The abstract should be **single-spaced**, written in **10-point type size** and should not exceed the **limitation of 100 words**.

The first part of the abstract states the **issue** you set out to explore or to solve (e.g., a research question, an economic, financial or societal concern, etc.). Thus, it should explain your **rationale** for pursuing the project and how you went about solving the problem or exploring the identified issue. The abstract also contains a concise description of the **research methods** with which the research has been conducted. In a next step, the abstract should list the **results or outcomes** of your work. In case the project is not yet complete, you may include **preliminary results** or **hypotheses** about what the results might be. To close the abstract, give a statement about the **project's implications and contributions** to its field to convince readers that the project is interesting and valuable.

1 Before writing a Text

1.1 Introduction

\LaTeX is a word processing program with which mathematic texts can be easily written. The text processing is a two-stage process where in a first step the main text is written in an editor using particular commands, that are pre-defined by \LaTeX . In a second step these commands are compiled by a formatting program into several file formats.

This template is only a short summary of \LaTeX including the simplest functions for writing a seminar paper or thesis with \LaTeX . It provides an overview of basic commands to structure the document, to use mathematic formulas or to generate the main lists.

Further information like special commands, broader structural options or practical examples can be found on the internet and are mostly self-explanatory (Link to \LaTeX -website: <https://www.latex-project.org/>).

1.2 Commands

It is important that all \LaTeX -commands always start with a backslash (\backslash) that can be extended by parameters in braces ($\{\}$) and also optional parameters in squared brackets ($[\]$). Thus, a command can look as follows:

```
 $\backslash$ command[optional parameter]{parameter}.
```

A collection of useful and important \LaTeX -commands can be found here: <https://www.giss.nasa.gov/tools/latex/ltx-2.html>.

1.3 Packages

Before writing the text and using specific commands or functions, the corresponding \LaTeX -packages must be installed and activated at the beginning of the document. This can be done using the command `\usepackage{}` where the package's name has to be indicated within the braces.

The most important packages are already pre-defined in this document. Further packages for more specific applications and their options can be found on the internet: <https://ctan.org/pkg/>.

2 Structure and Text Elements

2.1 Structure

The document has to be embedded in an appropriate environment by defining the beginning and the end of the document using the commands `\begin{document}` and `\end{document}`, respectively. All text elements that are located between these two commands will be printed in the compiled document. Structural and graphical settings or the installation of packages should be done before the beginning the document, so that they won't appear in the compiled text but just in the \LaTeX -document.

The commands `\chapter{}` (for chapters), `\section{}` and `\subsection{}` (for subchapters) can be used in order to structure the text. There is no need to number the chapters and sections since the nummeration is automatically done by \LaTeX .

In order to begin a new line in the compiled text, the \LaTeX -document has to contain a blank line between the two parts of the text. This can be done by pressing the *enter*-key twice.

A new page can be started by using the command `\newpage`.

2.2 Enumeration and Itemization

It is also possible to structure the text with ordered (using numbers and letters) and unordered (using just bullet points) lists. For ordered lists, \LaTeX provides the `\enumerate`-environment and for unordered lists there is the `\itemize`-environment.

The elements within both environments have to be declared beginning with the command `\item` to indicate a new item in the corresponding list. The following examples show how to use the most common types of lists.

For an ordered list the code

```
The subjects are:
\begin{enumerate}
\item Time-Series Econometrics
\item Statistics
\item Asset Pricing.
\end{enumerate}
```

is depicted as

"The subjects are:"

1. Time-Series Econometrics
2. Statistics
3. Asset Pricing.

And for an unordered list the code

```
We offer:
\begin{itemize}
\item Tea
```

```
\item Coffee  
\item Water.  
\end{itemize}
```

is shown as

"We offer:"

- Tea
- Coffee
- Water.

Moreover, nested lists can be generated by using the `\enumerate`-command within an already existing `\enumerate`-environment. The code

The subjects are:

```
\begin{enumerate}  
\item Time-Series Econometrics  
\item Statistics  
\begin{enumerate}  
\item Descriptive Statistics  
\item Analytical Statistics  
\end{enumerate}  
\item Asset Pricing.  
\end{enumerate}
```

looks as follows:

"The subjects are:"

1. Time-Series Econometrics
2. Statistics

- a) Descriptive Statistics
 - b) Analytical Statistics
3. Asset Pricing.

2.3 Mathematic Formulas

Mathematic formulas, symbols or numbers that appear in the text must be embedded in a *math*-mode, indicated by two $\$$ -signs to the left and to the right of the mathematic expression ($\$...\$$).

Mathematic formulas can also be structured and numbered if they are embedded in an **$\backslash\text{equation}$** -environment using the command **$\backslash\text{eqnarray}\{\}$** where they do not have to be surrounded by the $\$$ -signs.

The following example shows an application of the code

```
\begin{eqnarray}
y = x^2 + 5\\
z = x^3 - 2.
\end{eqnarray}
```

and its output

$$y = x^2 + 5 \tag{2.3.1}$$

$$z = x^3 - 2. \tag{2.3.2}$$

In order to include mathematic formulas without numbering, the command **$\backslash\text{equation}^*\{\}$** can be used:

```
\begin{equation*}
(a+b)^2 = a^2 + 2ab + b^2.
\end{equation*}
```

$$(a + b)^2 = a^2 + 2ab + b^2.$$

A detailed list with common mathematical signs, symbols and operators can be found here:
https://de.wikipedia.org/wiki/Liste_mathematischer_Symbole.

2.4 Footnotes

Footnotes can be used to add annotations, further explanations, translations, references, etc. to the text. The command `\footnote{}` produces a footnote in the compiled text at exactly the position where the command is placed in the \LaTeX -document. The text that should be printed in the footnote can be defined within the braces. All footnotes are numbered automatically by \LaTeX .

The code

```
Here you can add a footnote.\footnote{This is a footnote.}
```

is printed as

"Here you can add a footnote.¹"

¹This is a footnote.

2.5 Typeface

To visually highlight specific words or parts of the text, the standard typefaces can be used by the commands `\textbf{}` (bold), `\textit{}` (italic) and `\underline{}` (underlined) where the corresponding text can be defined within the braces.

Moreover the text can be written in a defined color with the command `textcolor{color}{text}` as the example shows:

```
\textbf{This} is an \underline{important} and \textcolor{red}{colorful}
section called \textit{typeface}.
```

"**This** is an important and colorful section called *typeface*".

2.6 Comments

Words, sentences or paragraphs that should not be printed in text can be commented out, so that they only appear in the \LaTeX -file but not in the compiled document. For this, a %-sign can be put in front of the corresponding text element. These elements can also be structured by using more than one %-sign to visually indicate different text levels.

Such invisible text elements can be used to add comments to your document that can only be read in the \LaTeX -document or they can also be used as hidden content that can easily be included into the compiled text later by just removing the %-sign.

3 Lists, Table of Contents and Bibliography

3.1 Tables

The list of tables is generated automatically if the tables are embedded in the `\table`-environment. The table's caption can be specified using the command `\caption{}` and defining the title within the braces. A table can be generated as follows:

```
\begin{table}
\centering
\begin{tabular}{|c|c|c|}
\hline
\textbf{Column 1} & \textbf{Column 2} & \textbf{Column 3} \\
\hline
Content 1 & Content 2 & Content 3 \\
\hline
Content 4 & Content 5 & Content 6 \\
\hline
\end{tabular}
\caption{Example of creating a table.}
\end{table}
```

This table is depicted as:

Column 1	Column 2	Column 3
Content 1	Content 2	Content 3
Content 4	Content 5	Content 6

Tabelle 3.1: Example of creating a table.

3.2 Figures

The list of figures is generated automatically if the figures are embedded in the `\figure-` environment. A figure can be included into the text with the command `\includegraphics [width]{}` where the argument **width** can be used to scale the figure. The name of the figure should be written within the braces while the corresponding graphic has to be located in the same folder as the \LaTeX -document. The figure's caption can be defined using the command `\caption{}` and specifying the title within the braces. A figure can be included as follows:

```
\begin{figure}
\centering
\includegraphics[width=0.5 \textwidth]{euleMT.pdf}
\caption{Example of including a figure.}
\end{figure}
```

and is depicted like this:



Abbildung 3.1: Example of including a figure.

3.3 Acronyms

In order to generate a list of acronyms, the package *acronym* should be used. First of all the required acronyms have to be defined embedded in the `\acronym`-environment. This can be done using the command `\acro{label}[acronym]{full term}` where the shortcut **label** references the acronym in the document, the argument **acronym** is the acronym itself and **full term** represents the full term the acronym denotes.

The following example demonstrates the application:

```
\begin{acronym}
\acro{aic}[AIC]{Akaike Information Criteria}
\end{acronym}
```

To use the defined acronyms in the text, the command `\ac{label}` can be used. The following code

The `\ac{aic}` is an estimator of prediction error.

is written out as *"The Akaike Information Criteria (AIC) is an estimator of prediction error."* if the acronym is used for the first time in the text and is written out as *"The AIC is an estimator of prediction error."* for all subsequent cases.

3.4 Table of Contents

The table of contents is generated automatically by \LaTeX . The captions, that are supposed to be included in the table of contents, must be specified by the commands `\chapter{}` (for chapters), `\section{}` and `\subsection{}` (for subchapters). There is no need to number the chapters and sections since the nummeration is automatically done by \LaTeX .

If several chapters should not to be numbered or listed in the table of contents, the commands `\chapter*{}`, `\section*{}` and `\subsection*{}` can be used for the corresponding captions.

It is also possible to set references to specific chapters in the text. This can be done by assigning labels to the chapters with the command `\label{label name}`.

If this chapter about the *Table of Contents* was labeled with `\label{ToC}`, it can be referenced in the text by using the command `\ref{label}` with the corresponding label:

```
\section{Table of Contents}\label{ToC}
```

This chapter `\ref{ToC}` gives a short summary about important issues when generating a table of contents.

This appears in the text as

"This chapter 3.4 gives a short summary about important issues when generating a table of contents."

3.5 Bibliography

3.5.1 The Literature File

The bibliography is generated automatically by \LaTeX . All references have to be collected in a file named *literature.bib*.

\LaTeX offers several templates to different kinds of references (e.g. books, articles, working papers, manuals, etc.) with predefined entry fields to specify the most important data (e.g. title, author, year, publisher, etc.) of each reference. These templates can directly be inserted into the bibliography via the \LaTeX toolbar using the button *Bibliography*.

Usually, websites that provide publications also offer such \LaTeX templates with already completed entry fields that can just be copied into the *literature.bib*-file.

Moreover, a list of possible types of references with the required entry fields can be found here: https://de.wikibooks.org/wiki/LaTeX-Kompendium:_Zitieren_mit_BibTeX.

In the following example an article from *Albert Einstein* should be recorded into the *literature.bib*-file using the common \LaTeX syntax:

```
@article{einstein1905elektrodynamik,  
  author = {Albert Einstein},  
    title = {Zur {E}lektrodynamik bewegter {K}örper},  
  journal = {Annalen der Physik},  
  volume = {322},  
  number = {10},  
  pages = {891--921},  
  year = {1905},  
  DOI = {http://dx.doi.org/10.1002/andp.19053221004},  
  keywords = {physics}  
}
```

A book could be included into the bibliography by

```
@Book{fitzgerald2001realigning,  
  author = {Fitzgerald, B. and Russo, N. and DeGross, J.},  
  title = {Realigning Research and Practice in Information Systems  
Development: The Social and Organizational Perspective},  
  publisher = {Kluwer Academic Press},  
  year = {2001},  
  address = {Boston},  
}
```

while a working paper can be recorded like this:

```
@article{ifo2017market,  
  author = {Brandts, Jordi and Riedl, Arno},  
  journal = {CESifo Working Paper},  
  title = {Market Interaction and Efficient Cooperation},  
  year = {2017}  
}
```

For a manual one can use the entry fields

```
@Manual{RCore2016,  
  title = {R: A Language and Environment for Statistical Computing},  
  author = {R Core Team},  
  organization = {R Foundation for Statistical Computing},  
  address = {Vienna, Austria},  
  year = {2016},  
  url = {https://www.R-project.org/},  
}
```

The first line of each entry above makes clear that every entry in the *literature.bib*-file has to be given an acronym that can be used when citing the corresponding reference in the text.

Note that several authors have to be separated by the word „and“.

In addition, when entering the title, case sensitivity is ignored by default. To allow for capitalization, the corresponding title or word should be written within additional braces.

3.5.2 Citations in the Text

L^AT_EX offers a multitude of different citation methods depending on how (or if) the reference should be displayed in the text:

- `\cite{}`: A textual citation of the reference is displayed.

Einstein (1905) analyzes the electrodynamics of moving things.

- `\citep{see}[p. XX]`: The reference is printed in parentheses.

..., is consistent with the electrodynamics of moving things (see Einstein, 1905, p. 895).

- `\citeauthor{}`: Only the name(s) of the author(s) are printed.

Fitzgerald et al.

- `\citeyear{}`: Only the year of the publication is printed.

1905

- `\nocite{}`: A reference can be included into the bibliography without having cited it in the text (e.g. a manual).

For all commands listed above, the acronym corresponding to the reference in the literature file has to be written within the braces.

The manual from the example above, that is not cited in the text, can be included into the bibliography by using the command

```
\nocite{RCore2016}.
```

Literaturverzeichnis

Brandts, J., & Riedl, A. (2017). Market interaction and efficient cooperation. *CESifo Working Paper*.

Einstein, A. (1905). Zur Elektrodynamik bewegter Körper. *Annalen der Physik*, 322(10), 891–921.

Fitzgerald, B., Russo, N., & DeGross, J. (2001). *Realigning Research and Practice in Information Systems Development: The Social and Organizational Perspective*. Boston: Kluwer Academic Press.

Team, R. C. (2016). *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing, Vienna, Austria.

URL <https://www.R-project.org/>

Declaration of Originality

I herewith declare that I have written this thesis on my own and did not use any unnamed sources or aid. Thus, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person except where due reference is made by correct citation. This includes any thoughts taken over directly or indirectly from printed books and articles as well as all kinds of online material. It also includes my own translations from sources in a different language. The work contained in this thesis has not been previously submitted for examination. I also agree that the thesis may be tested for plagiarized content with the help of plagiarism software. I am aware that failure to comply with the rules of good scientific practice has grave consequences and may result in expulsion from the program. In particular, I assure that the text was created by myself and not by an artificial intelligence. Furthermore, I assure that the printed work corresponds to the digital version.

City, the DD. Month YYYY

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(First Name Family Name)