Document title

Subtitle of document

Author name(s)

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# Introduction

## YAML header

Configure the YAML header including the following elements:

* *title*: Title
* *subtitle*: Subtitle; remove option completely, if you don’t need a subtitle.
* *author*: Character of single or multiple author(s)
* *date*: A date
* *abstract*: The abstract will be shown right after the title in smaller font size.
* *bibliography*: A path to the bibliography file to use for references (BibTeX *.bib* file). The current file includes 3 dummy references; either insert your references into this file or replace the file with your own.
* *csl*: The style is provided in the ‘sage-harvard.csl’ file, which adopts the [SAGE Harvard](https://uk.sagepub.com/sites/default/files/sage_harvard_reference_style_0.pdf) reference style. Just leave the file as it is.
* *output*: The nested fields for the output field are based on the arguments of the output function. Since *UHHformats::word\_doc* is based on *bookdown::word\_document2*, see its help page for more options. Current default settings are
  + *toc: FALSE*
  + *toc\_depth: 4*
  + *number\_sections: FALSE*
  + *highlight: “default”*
  + *reference\_docx: “uhh-template”*
  + *font = “Helvetica”*
  + *language: “en”*
  + *dpi: 144*
* *toc-title*: If the setting is *toc: TRUE*, MS Word automatically generates a table of content with an English title. If the language is German (*language: “de”*) you should specify here a German title.

By default *UHHformats::word\_doc* uses a ‘uhh-template.docx’ template file, which is based on the [standard template file](https://www.kus.uni-hamburg.de/themen/oeffentlichkeitsarbeit/corporate-design/vorlagen.html) of the University of Hamburg (UHH) except for the font type, which is by default ‘Helvetica’. If you are associated with the UHH you can also use the University’s own font “TheSansUHH”. In that case replace *font = “Helvetica”* with *font = “TheSansUHH”*.

However, if you feel like using your own template or the standard Word template (i.e. the Normal.dot file), simply provide the path to your file or write “default” for the latter case (*reference\_docx: “default”*). For further options see also the documentation of the *bookdown::word\_document2* function, which is internally called.

If you set the language to German, a configuration file named ’\_bookdown.yml’ is copied into the working directory, which defines the labels of the figure legend and table captions. If you want to use other labels (e.g. ‘Abb.’ instead of ‘Abbildung’) feel free to modify the file.

## The bookdown package

If you are new to working with [bookdown](https://bookdown.org/) or even to [rmarkdown](https://rmarkdown.rstudio.com/), please read over this documentation. To learn more about the *bookdown* and *rmarkdown* packages in general, I highly recommend the following two online books:

* [R Markdown: The Definitive Guide](https://bookdown.org/yihui/rmarkdown/) by Yihui Xie, J. J. Allaire, and Garrett Grolemund
* [bookdown: Authoring Books and Technical Documents with R Markdown](https://bookdown.org/yihui/bookdown/) by Yihui Xie

# Methods

## Cross-references

External images and R figures can be referenced with ‘@ref(fig:)’, where ‘’ is the name of the code chunk. These label names should **not contain underscores** to separate words, use hyphens here instead. Note that figures need to have a caption to be numbered and for cross-referencing, The caption is also set in the chunk option with ‘fig.cap=“Your caption”’.

Cross-references to individual sections can simply be made by placing the name of the section into squared brackets, e.g. a link to the [Figures](#figures) is made via ‘[Figures](#figures)’.

Tables require also a label and table caption for cross-referencing like figures. But here, the cross-reference contains a ‘tab:’ in ‘@ref(tab:)’) instead of a ‘fig:’. Also, captions of tables produced with R cannot be set in the chunk options as for figures but in the R functions directly (see examples in the [Results](#results)).

This is for example a cross-reference to table 1 in the [Using the *knitr* package](#using-the-knitr-package) chapter.

## Mathematical equations

Use mathematics as usual with the dollar sign $ at the beginning and end of the equation; either in **inline mode** with one dollar sign such as or in **display mode** with two dollar signs:

Important to note: do not leave a space between the ‘$’ and your mathematical notation.

Alternatively, you can use LaTeX for more control and when equations are more complicated. LaTeX equations are also automatically numbered if you define a label within the equation environment, which is useful if you have many equations and want to cross-reference them. The equation label needs to be written with ‘#eq:label’ before the end of the equation (see eq. (1)):

Formulas and corresponding explanations should be integrated into the sentence and, thus, end with a comma or period. Here comes an example:

If the random variable follows a standard normal distribution, i.e. , it’s density function can be described with

represents the circle number or Ludolph’s number. The function

represents then the distribution function of (2).

The numbering of equations, as in (2), should only be done if they are referred to in the rest of the text. Especially if there are many equations in the thesis, the use of LaTeX seems to make more sense.

# Results

## R output

R output is typically shown in the monospace font (here an example with the iris dataset):

Sepal.Length Sepal.Width Petal.Length   
 Min. :4.300 Min. :2.000 Min. :1.000   
 1st Qu.:5.100 1st Qu.:2.800 1st Qu.:1.600   
 Median :5.800 Median :3.000 Median :4.350   
 Mean :5.843 Mean :3.057 Mean :3.758   
 3rd Qu.:6.400 3rd Qu.:3.300 3rd Qu.:5.100   
 Max. :7.900 Max. :4.400 Max. :6.900

## Tables

If the output format is Word tables are generated best using R packages instead of R Markdown syntax. The following two sections demonstrate some useful packages.

### Using the *knitr* package

Table 1 is an example of using *knitr::kable()* to generate the table. The function has an explicit argument named ‘caption’ where you can place your caption text.

Table 1: This is a table produced with knitr::kable().

|  | mpg | cyl | disp | hp | drat | wt |
| --- | --- | --- | --- | --- | --- | --- |
| Mazda RX4 | 21.0 | 6 | 160 | 110 | 3.90 | 2.620 |
| Mazda RX4 Wag | 21.0 | 6 | 160 | 110 | 3.90 | 2.875 |
| Datsun 710 | 22.8 | 4 | 108 | 93 | 3.85 | 2.320 |
| Hornet 4 Drive | 21.4 | 6 | 258 | 110 | 3.08 | 3.215 |
| Hornet Sportabout | 18.7 | 8 | 360 | 175 | 3.15 | 3.440 |

### The *huxtable* package

If you are interested in further table adaptations for Word output, I highly recommend a look at the R package [‘huxtable’](https://hughjonesd.github.io/huxtable/index.html). The following code will produce an example table if the *huxtable* package is installed:

Table 2: Overview of the first lines and columns in the mtcars dataset.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **model** | **mpg** | **cyl** | **disp** | **hp** | **drat** | **wt** |
| Mazda RX4.00 | 21.00 | 6.00 | 160.00 | 110.00 | 3.90 | 2.62 |
| Mazda RX4.00 Wag | 21.00 | 6.00 | 160.00 | 110.00 | 3.90 | 2.88 |
| Datsun 710.00 | 22.80 | 4.00 | 108.00 | 93.00 | 3.85 | 2.32 |
| Hornet 4.00 Drive | 21.40 | 6.00 | 258.00 | 110.00 | 3.08 | 3.21 |
| Hornet Sportabout | 18.70 | 8.00 | 360.00 | 175.00 | 3.15 | 3.44 |

## Figures

Figures can directly be produced with R and displayed here. Similar to external images, figure captions and labels are placed inside the chunk options for cross-referencing (see Fig. 1).



Figure 1: Relationship between horsepower and fuel economy.

Here for comparison a boxplot with a different image height (Fig. 2).

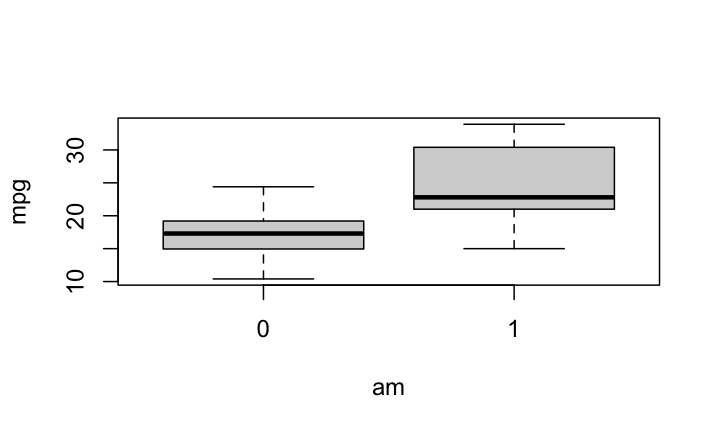


Figure 2: Fuel differences between transmission types (0 = automatic, 1 = manual).

By the way, illustrations, regardless of whether they are external images or diagrams created in R, are always displayed across the entire width in the Word document. Unfortunately, settings via the code chunk options ‘fig.height’ and ‘out.width’ do not currently work in Word! For external images adjust the width via the size of the image file itself.

# Adding citations and bibliography

Link a .bib document via the YAML header, and the bibliography will be printed at the very end (as usual). The default bibliography style is provided in the sage-harvard.csl file, which adopts the [SAGE Harvard](https://uk.sagepub.com/sites/default/files/sage_harvard_reference_style_0.pdf) reference style.

References can be cited directly within the document using the R Markdown equivalent of the LaTeX citation system [@key], where key is the citation key in the first line of the entry in the .bib file. Example: (Taylor and Green, 1937). To cite multiple entries, separate the keys by semicolons (e.g., (Kamm, 2000; Knupp, 1999).

There is also the package [citr](https://github.com/crsh/citr), which I highly recommend: *citr* provides functions and an RStudio add-in to search a BibTeX-file to create and insert formatted Markdown citations into the current document. If you are using the reference manager [Zotero](https://www.zotero.org/) the add-in can access your reference database directly.

## Software

If you want to include a paragraph on the software used, here is some example text/code to get the current R and package versions. The code to create a separate bibliography file named ‘packages.bib’ with all package references has already been added at the beginning of this script (code chunk ‘generate-package-refs’).

All analyses were performed using the statistical software R (version 4.1.2) (R Core Team, 2021). This thesis, including tables, was generated using the packages ‘bookdown’ (version 0.27) (Xie, 2022a), ‘rmarkdown’ (version 2.14) (Allaire et al., 2022), and ‘knitr’ (version 1.39) (Xie, 2022b).

# References

Allaire J, Xie Y, McPherson J, et al. (2022) *Rmarkdown: Dynamic Documents for r*. Available at: <https://CRAN.R-project.org/package=rmarkdown>.

Kamm J (2000) *Evaluation of the Sedov-von Neumann-Taylor blast wave solution*. Technical Report LA-UR-00-6055. Los Alamos National Laboratory.

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R Core Team (2021) *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. Available at: <https://www.R-project.org/>.

Taylor G and Green A (1937) Mechanism of the production of small eddies from large ones. *P Roy Soc Lond A Mat* 158(895): 499–521.

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Xie Y (2022b) *Knitr: A General-Purpose Package for Dynamic Report Generation in r*. Available at: <https://yihui.org/knitr/>.