Bayesian Analysis for Multi-Environment Trials

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1 Introduction

Configure the YAML header including the following elements:

- `title`: Title
- `subtitle`: Subitle; remove option completely, if you don't need a subtitle.
- `author`: Character of single or multiple author(s)
- `header_left`: A running title as left header; remove option to leave blank.
- `header_right`: A second right header (e.g. authors); remove option to leave blank.
- `date`: The date; by default `\date`, will populate the date automatically.
- `fontsize`: Font size for body text; choose between `10pt`, `11pt` (default), and `12pt`.
- `linkcolor`, `filecolor`, `citecolor`, `urlcolor`: Specify here colors for internal links, external links, citation links, and linked URLs, respectively, if you don't want the default colors; use options allowed by xcolor, including the dvipsnames, svgnames, and x11names lists.
- `german`: If option is set to `true`, the table and figure caption as well as the abstract and reference header will be in German; default is `false` (i.e., English).
- `bibliography`: A path to the bibliography file(s) to use for references (BibTeX *.bib* file). This template uses the bibliography-related package natbib. The current file 'references.bib' in the 'bib/' folder includes 3 dummy references; either insert your references into this file or replace the file with your own.
- `bibliographystyle`: The style is provided in the bibstyle.bst file, which adopts the SAGE Harvard reference style. Just leave the file as it is.
- `abstract`: Write here your abstract or remove option if you don't want to include an abstract.
- `output`: The nested fields for the output field are based on the arguments of the output function. Since `UHHformats::pdf_simple` is based on `rmarkdown::pdf_document`, see its help page for more options. Current default settings are
  - `number_sections: TRUE`
  - `highlight: "kate"`
  - `font = "Helvetica"`
  - `citation_package: "natbib"`
  - `latex_engine: "xelatex"`
- `header_includes`: Here you can add additional LaTeXcode to include in the header, before the `\\begin\{document\}` statement.
- If you want to add additional LaTeX code to include before the `\\end\{document\}` statement use the field `include_after`.

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"`. To use another font, simply use the setting "other" and replace the 'font_XXX.ttf' files in the working directory with your own files. Please note, that you have to name these files exactly as the template font files.

2 Methods

2.1 R Markdown syntax vs LaTeXsyntax

As with any .Rmd file you can write the entire report in the R Markdown syntax. However, if you are familiar with LaTeXyou can also mix both:

2.1.1 R Markdown subsection

This is a dummy text to show you how to write in **bold** and in *italics*.

2.1.2 LaTeX subsection

This is a dummy text to show you that you can also write in **bold** and in *italics* with LaTeX.

2.2 Cross-referencing within the report

To cross-references figures or tables you have to have a:

- **caption to your figure (or table)**:
  - NOTE: figures without a caption will be included directly as images and will therefore not be a numbered figure
- **labeled code chunk**: this provides the identifier for referencing the figure or table generated by the chunk.

Cross-references within the text can then be made using the standard LaTeXsyntax `\@ref{type:label}`, where label is the chunk label and type is the environment being referenced (e.g. tab, fig, or eq). Examples are given in the sections below (e.g. in R Markdown table).

To cross-reference sections simply put the section header in square brackets, e.g. R output via `[R output]`.

2.3 Mathematics

Use mathematics as usual with the dollar sign `$`; either in inline mode with one dollar sign, e.g. $E = mc^2$, or in display mode with two:

$$E = mc^2$$

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

Alternatively, you can use LaTeXfor more control, e.g. for setting equation numbers that can be cross-referenced:

$$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n} \tag{1}$$

You may refer to this equation using `\ref{eq:label}`, e.g., see Equation 1

3 Results

3.1 R output

R output is typically shown in the monospace font (here an example with the `mtcars` dataset in the subfolder `data/`):

```
##       mpg             cyl             disp             hp
##  Min.   :10.40   Min.   :4.000   Min.   : 71.1   Min.   : 52.0
##  1st Qu.:15.43   1st Qu.:4.000   1st Qu.:120.8   1st Qu.: 96.5
##  Median :19.20   Median :6.000   Median :196.3   Median :123.0
##  Mean   :20.09   Mean   :6.188   Mean   :230.7   Mean   :146.7
##  3rd Qu.:22.80   3rd Qu.:8.000   3rd Qu.:326.0   3rd Qu.:180.0
##  Max.   :33.90   Max.   :8.000   Max.   :472.0   Max.   :335.0
```

3.2 Tables

3.2.1 R Markdown table

Table 1 is a R Markdown table including a caption (note: the table number is automatically assigned) and label for cross-referencing:

Table 1: Your Caption

A	New	Table
left-aligned	center-aligned	right-aligned
$123	$456	$789
italics		**boldface**

3.2.2 Tables generated with R

3.2.2.1 Using the *knitr* and *kableExtra* packages Table 2 is an example when using `knitr::kable()` to generate the table and *kableExtra* functions to modify it:

Table 2: A table produced with knitr and kableextra

	Group 5				**Group 6**	
	Group 1		Group 2		Group 3	Group 4
	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

Note:
Your comments go here.

3.2.2.2 The *xtable* package Another useful package for tables for PDF output is xtable. The following code will produce an example table if the *xtable* package is installed. Note that you

need to add the chunk option `results = "asis"` inside `{r}` otherwise the PDF will contain the LaTeXcode of the table!

Table 3: A table made with xtable

	mpg	cyl	disp	hp	drat	wt
Mazda RX4	21.00	6	160.00	110	3.90	2.62
Mazda RX4 Wag	21.00	6	160.00	110	3.90	2.88
Datsun 710	22.80	4	108.00	93	3.85	2.32
Hornet 4 Drive	21.40	6	258.00	110	3.08	3.21
Hornet Sportabout	18.70	8	360.00	175	3.15	3.44

3.3 Figures

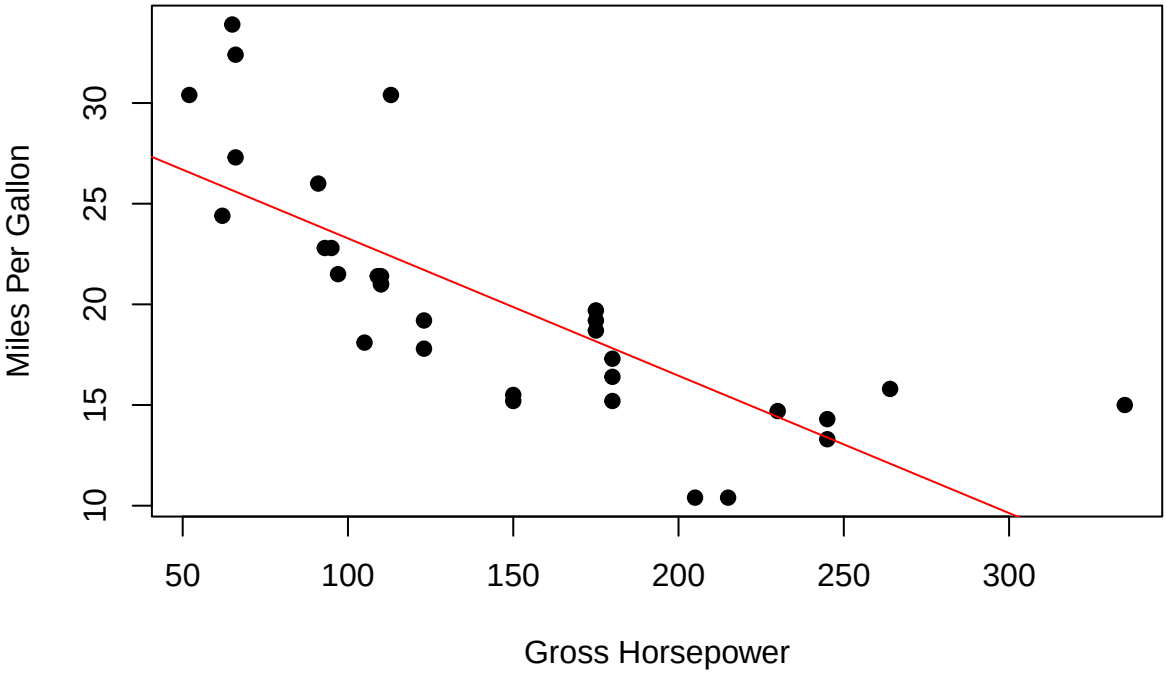

Figure 1: Relationship between horsepower and fuel economy

Figures are supported from R code and can be referenced (see Figure 1) by including the `\\label{}` tag in the `fig.cap` attribute of the R chunk: `fig.cap = "Relationship between horsepower and fuel economy\\label{fig:base-ref}"`. It is a quirky hack at the moment, see here.

Figure 2 shows a boxplot with just half the width and centered:

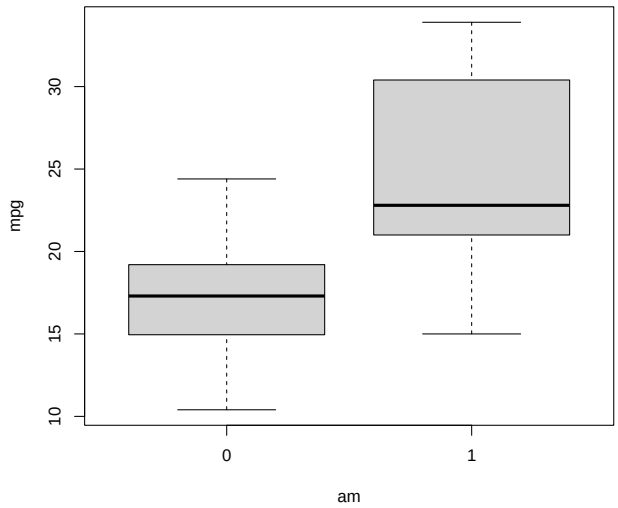

Figure 2: Fuel differences between transmission types (0 = automatic, 1 = manual)

4 Discussion

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5 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 `bib.bst` file (do not delete), which adopts the SAGE Harvard reference style.

References can be cited directly within the document using the R Markdown equivalent of the LaTeXcitation 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., (Knupp, 1999; Kamm, 2000).

There is also the package 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 the add-in can access your reference database directly.

5.1 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 4.4.1) (R Core Team, 2024). This report, including tables and figures, was generated using the packages 'rmarkdown' (version 2.28) (Allaire et al., 2024), 'bookdown' (version 0.40) (Xie, 2024a), 'UHHformats' (version 1.0.0.9000) (Otto, 2022), 'knitr' (version 1.48) (Xie, 2024b), 'kableExtra' (version 1.4.0) (Zhu, 2024), 'xtable' (version 1.8.4) (Dahl et al., 2019), and 'tidyverse' (version 2.0.0) (Wickham, 2023)

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