Mathematics of Ring-bearing: Problem Set 1

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1 Problem 1: Escaping the Shire

Solving problem sets will be a weekly ritual at IHEID if you are taking quantitative courses at the Graduate Institute.`{iheiddown}`'s problem set template lets you focus on solving the problem set rather than wasting time on formatting (Hollway 2020). Furthermore, since your documents will be written in RMarkdown, you won't need to learn the more complex Latex syntax. Finally, it allows you to code and interpret the your results at the same time which will again speed up your workflow!

2 Problem 2: Hiding in forests

Your problem sets will contain some text, probably the solution to a strange mathematical model and maybe even some pretty graphs. The good news is that you can type that really easily in your RMarkdown file!

2.1 Tables

The following example shows a simple way to estimate several models and summarize them in a clear way using the `{modelsummary}` package.

```
####################
## Tables Example ##
####################

# Loading the required packages
library(modelsummary)
library(kableExtra)
```

```
##
## Attaching package: 'kableExtra'
```

```
## The following object is masked from 'package:dplyr':
##
##     group_rows
```

```
library(gt)
```

```
##
## Attaching package: 'gt'
```

	OLS 1	Poisson 1	OLS 2	Poisson 2	OLS 3
(Intercept)	7948.667	8.241	16 259.384	9.876	11 243.544
	(2078.276)	(0.006)	(2611.140)	(0.003)	(1011.240)
Literacy	−39.121	0.003	3.680	−0.0003	−68.507
	(37.052)	(0.000 09)	(46.552)	(0.000 05)	(18.029)
Clergy	15.257		77.148		−16.376
	(25.735)		(32.334)		(12.522)
Commerce		0.011		0.0006	
		(0.000 06)		(0.000 04)	
Num.Obs.	86	86	86	86	86
R2	0.020		0.065		0.152
R2 Adj.	−0.003		0.043		0.132
AIC	1740.8	274 160.8	1780.0	257 564.4	1616.9
BIC	1750.6	274 168.2	1789.9	257 571.7	1626.7
Log.Lik.	−866.392	−137 077.401	−886.021	−128 779.186	−804.441
RMSE	5740.99	5491.61	7212.97	7451.70	2793.43

```
## The following object is masked from 'package:modelsummary':
##
##      escape_latex
```

```r
#Extracting example data
url <- "https://vincentarelbundock.github.io/Rdatasets/csv/HistData/Guerry.csv"
dat <- read.csv(url)

# Creating a list of the different models
models <- list(
  "OLS 1"     = lm(Donations ~ Literacy + Clergy, data = dat),
  "Poisson 1" = glm(Donations ~ Literacy + Commerce,
                family = poisson,
                data = dat),
  "OLS 2"     = lm(Crime_pers ~ Literacy + Clergy, data = dat),
  "Poisson 2" = glm(Crime_pers ~ Literacy + Commerce,
                family = poisson,
                data = dat),
  "OLS 3"     = lm(Crime_prop ~ Literacy + Clergy, data = dat)
)

# Creating a summary of the different models
modelsummary(models)
```
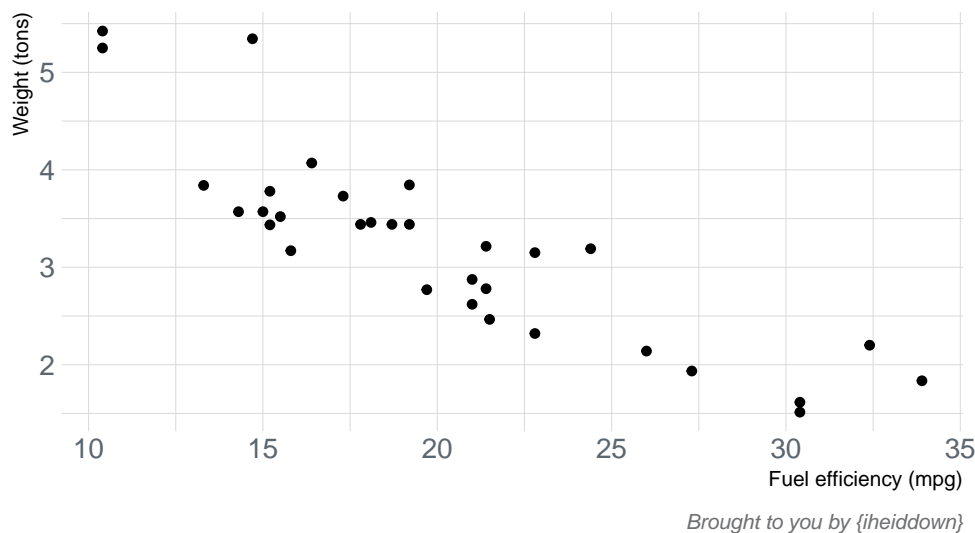
2.2   Graphs

Seminal ggplot2 scatterplot example

A plot that is only useful for demonstration purposes

Brought to you by {iheiddown}

3   Problem 3: Resisting the power of the Ring

Writing equations is straightforward too! They follow the standard Latex syntax as shown below. Also see this great guide for a more comprehensive overview of the math syntax in Latex.

$$E("Escaping"|"Magic") = \frac{a}{b}$$

4   Problem 4: Melting things in volcanoes

Inserting images is easy! Place the image in your main folder and use the following syntax (see the RMarkdown file).

Figure 1: Ideal place for melting rings

5 Appendix:

Note that you can reference previous code chunks at the end of the code for full transparency. This is a good way to avoid cluttering your main body with code while still allowing your reader to see the code you executed to get your results. Let us demonstrate this feature by inserting the un-evaluated code of all chunks used in this document.

```r
# Set initial knitr options
knitr::opts_chunk$set(eval = TRUE, echo = FALSE,
                      fig.align = "center",
                      fig.asp = 0.7,
                      dpi = 300,
                      out.width = "80%",
                      fig.pos = "!H",
                      out.extra = "")
####################
## Tables Example ##
####################

# Loading the required packages
library(modelsummary)
library(kableExtra)
library(gt)

#Extracting example data
url <- "https://vincentarelbundock.github.io/Rdatasets/csv/HistData/Guerry.csv"
dat <- read.csv(url)

# Creating a list of the different models
models <- list(
  "OLS 1"     = lm(Donations ~ Literacy + Clergy, data = dat),
  "Poisson 1" = glm(Donations ~ Literacy + Commerce,
                family = poisson,
                data = dat),
```

```
  "OLS 2"     = lm(Crime_pers ~ Literacy + Clergy, data = dat),
  "Poisson 2" = glm(Crime_pers ~ Literacy + Commerce,
                    family = poisson,
                    data = dat),
  "OLS 3"     = lm(Crime_prop ~ Literacy + Clergy, data = dat)
)

# Creating a summary of the different models
modelsummary(models)
###################
## Graph Example ##
###################

library(ggplot2)
ggplot(mtcars, aes(mpg, wt)) +
  geom_point() +
  labs(x="Fuel efficiency (mpg)", y="Weight (tons)",
       title="Seminal ggplot2 scatterplot example",
       subtitle="A plot that is only useful for demonstration purposes",
       caption="Brought to you by {iheiddown}") +
  theme_iheid()
###############################
## Citing all loaded packages ##
###############################
knitr::write_bib(c(.packages(), "bookdown"), "packages.bib")
```

```
## Warning in utils::citation(..., lib.loc = lib.loc): no date field in DESCRIPTION
## file of package 'ganttrify'
```

6   References:

Arel-Bundock, Vincent. 2022a. "modelsummary: Data and Model Summaries in R." *Journal of Statistical Software* 103 (1): 1–23. https://doi.org/10.18637/jss.v103.i01.

———. 2022b. *Modelsummary: Summary Tables and Plots for Statistical Models and Data: Beautiful, Customizable, and Publication-Ready.* https://vincentarelbundock.github.io/modelsummary/.

Comai (OBCT/CCI), Giorgio. 2022. *Ganttrify: Create Beautiful Gantt Charts with Ggplot2.* https://github.com/giocomai/ganttrify.

Darwin, Charles. 1859. *On the Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life.* London: John Murray.

Goethe, Johann Wolfgang von. 1829. *Wilhelm Meisters Wanderjahre Oder Die Entsagenden.* Cotta.

Hollway, James. 2020. *Iheiddown: A Rmarkdown Class for Iheid Dissertations.* https://github.com/jhollway/iheiddown.

Iannone, Richard, Joe Cheng, Barret Schloerke, and Ellis Hughes. 2022. *Gt: Easily Create Presentation-Ready Display Tables.* https://CRAN.R-project.org/package=gt.

Lottridge, Danielle, Eli Marschner, Ellen Wang, Maria Romanovsky, and Clifford Nass. 2012.

"Browser design impacts multitasking." In *Proceedings of the Human Factors and Ergonomics Society 56th Annual Meeting.* https://doi.org/10.1177/1071181312561289.

R Core Team. 2022. *R: A Language and Environment for Statistical Computing.* Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.

Satchell, Christine, and Paul Dourish. 2009. "Beyond The User: Use And Non-Use in HCI." *Proceedings of the Annual Conference of the Australian Computer-Human Interaction Special Interest Group (OZCHI '09)*, no. November: 9–16. https://doi.org/10.1145/1738826.1738829.

Shea, Nicholas, Annika Boldt, Dan Bang, Nick Yeung, Cecilia Heyes, and Chris D Frith. 2014. "Supra-personal cognitive control and metacognition." *Trends in Cognitive Sciences* 18 (4): 186–93. https://doi.org/10.1016/j.tics.2014.01.006.

Wickham, Hadley. 2016. *Ggplot2: Elegant Graphics for Data Analysis.* Springer-Verlag New York. https://ggplot2.tidyverse.org.

Wickham, Hadley, Winston Chang, Lionel Henry, Thomas Lin Pedersen, Kohske Takahashi, Claus Wilke, Kara Woo, Hiroaki Yutani, and Dewey Dunnington. 2022. *Ggplot2: Create Elegant Data Visualisations Using the Grammar of Graphics.* https://CRAN.R-project.org/package=ggplot2.

Wickham, Hadley, Romain François, Lionel Henry, and Kirill Müller. 2022. *Dplyr: A Grammar of Data Manipulation.* https://CRAN.R-project.org/package=dplyr.

Wu, Tim. 2016. *The Attention Merchants: The Epic Scramble to Get Inside Our Heads.* Knopf Publishing Group.

Xie, Yihui. 2014. "Knitr: A Comprehensive Tool for Reproducible Research in R." In *Implementing Reproducible Computational Research*, edited by Victoria Stodden, Friedrich Leisch, and Roger D. Peng. Chapman; Hall/CRC. http://www.crcpress.com/product/isbn/9781466561595.

———. 2015. *Dynamic Documents with R and Knitr.* 2nd ed. Boca Raton, Florida: Chapman; Hall/CRC. https://yihui.org/knitr/.

———. 2016. *Bookdown: Authoring Books and Technical Documents with R Markdown.* Boca Raton, Florida: Chapman; Hall/CRC. https://bookdown.org/yihui/bookdown.

———. 2022a. *Bookdown: Authoring Books and Technical Documents with R Markdown.* https://CRAN.R-project.org/package=bookdown.

———. 2022b. *Knitr: A General-Purpose Package for Dynamic Report Generation in R.* https://yihui.org/knitr/.

Zhu, Hao. 2021. *KableExtra: Construct Complex Table with Kable and Pipe Syntax.* https://CRAN.R-project.org/package=kableExtra.