Lab notes for *Statistics for Social Sciences II: Multivariate Techniques*

Bachelor in International Studies, Carlos III University of Madrid

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2016-09-02

Contents

Preface

What are these notes for?

These notes **are neither an exhaustive, rigorous nor comprehensive treatment** of the broad statiscal branch know as Multivariate Analysis. Instead, they are a compact description of the key points and insights of the theory throught the help of computer, providing t the same time an effective way of delivering

Software required

- `R`, *a free software environment for statistical computing and graphics.*
- `Deducer`, a *free easy to use alternative to proprietary data analysis software* that *provides an intuitive graphical user interface (GUI) for* `R`*, encouraging non-technical users to learn and perform analyses without programming getting in their way.*

Logistics

- Lessons in Computer Lab
- Doubts regarding theory -> Jose
- Doubts regarding implementation -> Eduardo

Regarding

Chapter 1

Simple linear regression

1.1 Motivation; model formulation; examples; applications; assumptions

Simple linear regression

$$Y_i = a + bX_i + \varepsilon, \quad i = 1, \ldots, n.$$

1.2 Estimation of model parameters; least squares; inference for model parameters; forecasting.

1.3 Assessing model fit; ANOVA; model validation; model diagnostics; handling nonlinear relationships.

You can label chapter and section titles using `{#label}` after them, e.g., we can reference Chapter **??**. If you do not manually label them, there will be automatic labels anyway, e.g., Chapter **??**.

Figures and tables with captions will be placed in `figure` and `table` environments, respectively.

```
par(mar = c(4, 4, .1, .1))
plot(pressure, type = 'b', pch = 19)
```

Reference a figure by its code chunk label with the `fig:` prefix, e.g., see Figure 1.1. Similarly, you can reference tables generated from `knitr::kable()`, e.g., see Table 1.1.

```
knitr::kable(
  head(iris, 20), caption = 'Here is a nice table!',
  booktabs = TRUE
)
```

You can write citations, too. For example, we are using the **bookdown** package (Xie, 2016) in this sample book, which was built on top of R Markdown and **knitr** (Xie, 2015).

This is a *sample* book written in **Markdown**. You can use anything that Pandoc's Markdown supports, e.g., a math equation $a^2 + b^2 = c^2$.

For now, you have to install the development versions of **bookdown** from Github:

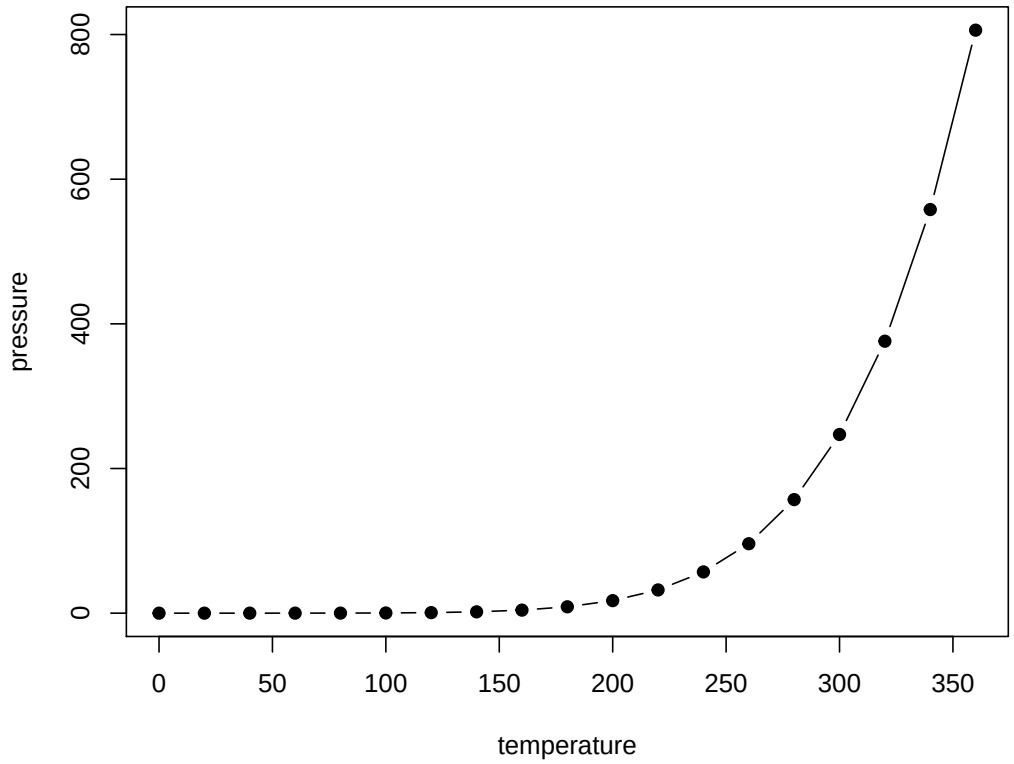

Figure 1.1: Here is a nice figure!

Table 1.1: Here is a nice table!

Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species
5.1	3.5	1.4	0.2	setosa
4.9	3.0	1.4	0.2	setosa
4.7	3.2	1.3	0.2	setosa
4.6	3.1	1.5	0.2	setosa
5.0	3.6	1.4	0.2	setosa
5.4	3.9	1.7	0.4	setosa
4.6	3.4	1.4	0.3	setosa
5.0	3.4	1.5	0.2	setosa
4.4	2.9	1.4	0.2	setosa
4.9	3.1	1.5	0.1	setosa
5.4	3.7	1.5	0.2	setosa
4.8	3.4	1.6	0.2	setosa
4.8	3.0	1.4	0.1	setosa
4.3	3.0	1.1	0.1	setosa
5.8	4.0	1.2	0.2	setosa
5.7	4.4	1.5	0.4	setosa
5.4	3.9	1.3	0.4	setosa
5.1	3.5	1.4	0.3	setosa
5.7	3.8	1.7	0.3	setosa
5.1	3.8	1.5	0.3	setosa

```
devtools::install_github("rstudio/bookdown")
```

Remember each Rmd file contains one and only one chapter, and a chapter is defined by the first-level heading `#`.

To compile this example to PDF, you need to install XeLaTeX.

Chapter 2

Multiple linear regression

2.1 Motivation; model formulation; examples; applications; assumptions.

2.2 Estimation of model parameters; least squares; inference for model parameters; forecasting.

2.3 Assessing model fit; ANOVA; model validation.

2.4 Multicollinearity; model diagnostics.

You can label chapter and section titles using `{#label}` after them

Chapter 3

Binomial logistic regression

3.1 Motivation; model formulation; examples; applications; assumptions.

3.2 Parameter estimation; assessing model fit; significance testing; interpreting coefficients.

TODO

Chapter 4

Factor analysis and principal component analysis

4.1 Motivation; formulations; examples; applications; assumptions.

4.2 Principal components analysis; choosing the number of factors; analysis and interpretation.

4.3 Exploratory factor analysis; design, analysis and interpretation; rotation of factors.

You can label chapter and section titles using `{#label}` after them

Chapter 5

Cluster analysis

5.1 Motivation; examples; applications; hierarchical agglomerative clustering; dendrogram.

5.2 Choosing the number of clusters; assessing fit; interpretation of clusters.

TODO

Bibliography

Xie, Y. (2015). *Dynamic Documents with R and knitr*. Chapman and Hall/CRC, Boca Raton, Florida, 2nd edition. ISBN 978-1498716963.

Xie, Y. (2016). *bookdown: Authoring Books with R Markdown*. R package version 0.1.6.