

# Notes on econometrics

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# Chapter 1

## About

Welcome to this **econometrics study guide**, a resource designed to support undergraduate students in their journey to understanding econometrics. These personal notes are based on lectures attended at **Universidad Panamericana**, alongside additional materials such as lecture notes, websites, books, and other sources.

While this guide is crafted to offer a quick and accessible approach to the subject, it is strongly recommended that students consult the original resources for a more comprehensive understanding.

### 1.1 Purpose

This site serves as a developing repository of knowledge, aimed at supplementing students' studies. Please note that the material is continually updated, so your patience is appreciated as we work on corrections and add new content.

### 1.2 Feedback

Your input is valuable! If you have comments, recommendations, or corrections, please reach out to us at **0251520@up.edu.mx**. We aim to address feedback and update the content promptly.

### 1.3 Support

If you find this project helpful and wish to support it, you can make a donation at [buymeacoffee.com/jadrk040507](https://buymeacoffee.com/jadrk040507). Your generosity is greatly appreciated!

Thank you for visiting, and happy learning!

## Chapter 2

# Hello bookdown

All chapters start with a first-level heading followed by your chapter title, like the line above. There should be only one first-level heading (#) per .Rmd file.

### 2.1 A section

All chapter sections start with a second-level (##) or higher heading followed by your section title, like the sections above and below here. You can have as many as you want within a chapter.

#### An unnumbered section

Chapters and sections are numbered by default. To un-number a heading, add a {.unnumbered} or the shorter {-} at the end of the heading, like in this section.





## Chapter 3

# Cross-references

Cross-references make it easier for your readers to find and link to elements in your book.

### 3.1 Chapters and sub-chapters

There are two steps to cross-reference any heading:

1. Label the heading: `# Hello world {#nice-label}`.
  - Leave the label off if you like the automated heading generated based on your heading title: for example, `# Hello world = # Hello world {#hello-world}`.
  - To label an un-numbered heading, use: `# Hello world {-#nice-label}` or `{# Hello world .unnumbered}`.
2. Next, reference the labeled heading anywhere in the text using `\@ref(nice-label)`; for example, please see Chapter 3.
  - If you prefer text as the link instead of a numbered reference use: any text you want can go here.

### 3.2 Captioned figures and tables

Figures and tables *with captions* can also be cross-referenced from elsewhere in your book using `\@ref(fig:chunk-label)` and `\@ref(tab:chunk-label)`, respectively.

See Figure 3.1.

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

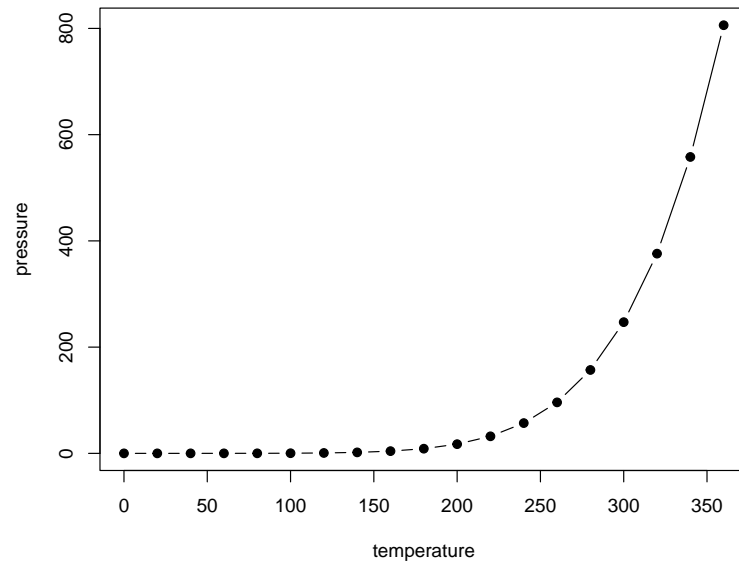


Figure 3.1: Here is a nice figure!

Don't miss Table 3.1.

```
knitr::kable(  
  head(pressure, 10), caption = 'Here is a nice table!',  
  booktabs = TRUE  
)
```

Table 3.1: Here is a nice table!

temperature	pressure
0	0.0002
20	0.0012
40	0.0060
60	0.0300
80	0.0900
100	0.2700
120	0.7500
140	1.8500
160	4.2000
180	8.8000



## Chapter 4

# Parts

You can add parts to organize one or more book chapters together. Parts can be inserted at the top of an .Rmd file, before the first-level chapter heading in that same file.

Add a numbered part: `# (PART) Act one {-}` (followed by `# A chapter`)

Add an unnumbered part: `# (PART\*) Act one {-}` (followed by `# A chapter`)

Add an appendix as a special kind of un-numbered part: `# (APPENDIX) Other stuff {-}` (followed by `# A chapter`). Chapters in an appendix are prepended with letters instead of numbers.



## Chapter 5

# Footnotes and citations

### 5.1 Footnotes

Footnotes are put inside the square brackets after a caret `^[]`. Like this one <sup>1</sup>.

### 5.2 Citations

Reference items in your bibliography file(s) using `@key`.

For example, we are using the **bookdown** package [Xie, 2024] (check out the last code chunk in `index.Rmd` to see how this citation key was added) in this sample book, which was built on top of R Markdown and **knitr** [Xie, 2015] (this citation was added manually in an external file `book.bib`). Note that the `.bib` files need to be listed in the `index.Rmd` with the YAML `bibliography` key.

The RStudio Visual Markdown Editor can also make it easier to insert citations: <https://rstudio.github.io/visual-markdown-editing/#/citations>

---

<sup>1</sup>This is a footnote.





## Chapter 6

# Blocks

### 6.1 Equations

Here is an equation.

$$f(k) = \binom{n}{k} p^k (1-p)^{n-k} \quad (6.1)$$

You may refer to using `\@ref{eq:binom}`, like see Equation (6.1).

### 6.2 Theorems and proofs

Labeled theorems can be referenced in text using `\@ref{thm:tri}`, for example, check out this smart theorem 6.1.

**Theorem 6.1.** *For a right triangle, if  $c$  denotes the length of the hypotenuse and  $a$  and  $b$  denote the lengths of the **other** two sides, we have*

$$a^2 + b^2 = c^2$$

Read more here <https://bookdown.org/yihui/bookdown/markdown-extensions-by-bookdown.html>.

### 6.3 Callout blocks

The R Markdown Cookbook provides more help on how to use custom blocks to design your own callouts: <https://bookdown.org/yihui/rmarkdown-cookbook/custom-blocks.html>



## Chapter 7

# Sharing your book

### 7.1 Publishing

HTML books can be published online, see: <https://bookdown.org/yihui/bookdown/publishing.html>

### 7.2 404 pages

By default, users will be directed to a 404 page if they try to access a webpage that cannot be found. If you'd like to customize your 404 page instead of using the default, you may add either a `_404.Rmd` or `_404.md` file to your project root and use code and/or Markdown syntax.

### 7.3 Metadata for sharing

Bookdown HTML books will provide HTML metadata for social sharing on platforms like Twitter, Facebook, and LinkedIn, using information you provide in the `index.Rmd` YAML. To setup, set the `url` for your book and the path to your `cover-image` file. Your book's `title` and `description` are also used.

This `gitbook` uses the same social sharing data across all chapters in your book—all links shared will look the same.

Specify your book's source repository on GitHub using the `edit` key under the configuration options in the `_output.yml` file, which allows users to suggest an edit by linking to a chapter's source file.

Read more about the features of this output format here:

<https://pkgs.rstudio.com/bookdown/reference/gitbook.html>

Or use:

```
?bookdown::gitbook
```

## Chapter 8

# Linear Algebra

### 8.1 Similar Matrices

Recall that given the basis for an  $n$  dimensional vector space  $V$ , we can represent a linear transformation

$$T : V \rightarrow V$$

as an  $n \times n$  matrix  $A$ . Unfortunately, if you choose a different basis for  $V$ , the matrix representing the linear transformation  $T$  will be quite different from the original matrix  $A$ . This section's goal is to find out a clean criterion for when two matrices actually represent the same linear transformation but under different choice of bases.

Two  $n \times n$  matrices  $A$  and  $B$  are similar if there is an invertible matrix  $C$  such that

$$A = C^{-1}BC$$

We want to see that two matrices are similar precisely when they represent the same linear transformation. Choose two bases for the vector space  $V$ , say  $v_1, \dots, v_n$  (the  $v$  basis) and  $w_1, \dots, w_n$  (the  $w$  basis). Let  $A$  be the matrix representing the linear transformation  $T$  for the  $v$  basis and let  $B$  be the matrix representing the linear transformation for the  $w$  basis. We want to construct the matrix  $C$  so that  $A = C^{-1}BC$ .

Recall that given the  $v$  basis, we can write each vector  $z \in V$  as an  $n \times 1$  column vector as follows: we know that there are unique scalars  $a_1, \dots, a_n$  with

$$z = a_1v_1 + \dots + a_nv_n$$

We then write  $z$ , with respect to the  $v$  basis, as the column vector:

$$\begin{pmatrix} a_1 \\ \vdots \\ a_n \end{pmatrix}$$

Similarly, there are unique scalars  $w_1, \dots, w_n$  so that

$$z = b_1 w_1 + \dots + b_n w_n,$$

meaning that with respect to the  $w$  basis, the vector  $z$  is the column vector:

$$\begin{pmatrix} b_1 \\ \vdots \\ b_n \end{pmatrix}$$

The desired matrix  $C$  will be the matrix such that

$$C \begin{pmatrix} a_1 \\ \vdots \\ a_n \end{pmatrix} = \begin{pmatrix} b_1 \\ \vdots \\ b_n \end{pmatrix}.$$

If  $C = (c_{ij})$ , then the entries  $c_{ij}$  are precisely the numbers which yield:

$$w_i = c_{i1} v_1 + \dots + c_{in} v_n.$$

To commute, meaning that  $CA = BC$  or

$$A = C^{-1}BC,$$

as desired. Determining two matrices are similar is a type of result that shows throughout math and physics. Regularly you must choose some coordinate system (some basis) in order to write down anything at all, but the underlying math or physics that you are interested in is independent of the initial choice. The key question becomes: what is preserved when the coordinate system is changed? Similar matrices allow us to understand these questions. ??

## 8.2 Eigenvalues and Eigenvectors

# Bibliography

Yihui Xie. *Dynamic Documents with R and knitr*. Chapman and Hall/CRC, Boca Raton, Florida, 2nd edition, 2015. URL <http://yihui.org/knitr/>. ISBN 978-1498716963.

Yihui Xie. *bookdown: Authoring Books and Technical Documents with R Markdown*, 2024. URL <https://github.com/rstudio/bookdown>. R package version 0.41.