

# Geoestatística com R

## Disciplina do PPGME/UFPA

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# Sobre

Nós idealizamos este material como uma contribuição dos pesquisadores do Laboratório de Modelamento Estatístico-Matemático - LAMEM/UFPA para auxiliar os estudos na disciplina de Geoestatística nas turmas do Programa de Pós-Graduação em Matemática e Estatística - PPGME, Instituto de Ciências Exatas e Naturais - ICEN, da Universidade Federal do Pará - UFPA. Esta disciplina é anualmente ministrada pelo Prof. Dr. João Marcelo Protázio neste programa.

Esperamos que vocês aproveitem este livro. Ele é uma pequena contribuição elaborado com todo cuidado para colaborar com a comunidade dos usuários do R. Consiste numa retribuição a quem muito nos tem ajudado ao longo destes anos de estudos.

Agradecemos qualquer tipo de *feedback*. Eles sempre nos guiarão na melhoria deste livro. Os *e-mails* dos autores estão disponibilizados aqui para contato.

## 0.1 Usage

Each **bookdown** chapter is an .Rmd file, and each .Rmd file can contain one (and only one) chapter. A chapter *must* start with a first-level heading: **# A good chapter**, and can contain one (and only one) first-level heading.

Use second-level and higher headings within chapters like: **## A short section** or **### An even shorter section**.

The **index.Rmd** file is required, and is also your first book chapter. It will be the homepage when you render the book.

## 0.2 Render book

You can render the HTML version of this example book without changing anything:

1. Find the **Build** pane in the RStudio IDE, and

2. Click on **Build Book**, then select your output format, or select “All formats” if you’d like to use multiple formats from the same book source files.

Or build the book from the R console:

```
bookdown::render_book()
```

To render this example to PDF as a `bookdown::pdf_book`, you’ll need to install XeLaTeX. You are recommended to install TinyTeX (which includes XeLaTeX): <https://yihui.org/tinytex/>.

### 0.3 Preview book

As you work, you may start a local server to live preview this HTML book. This preview will update as you edit the book when you save individual .Rmd files. You can start the server in a work session by using the RStudio add-in “Preview book”, or from the R console:

```
bookdown::serve_book()
```

```
# automatically create a bib database for R packages
knitr::write_bib(c(
  .packages(), 'bookdown', 'knitr', 'rmarkdown'
), 'packages.bib')
```

# Chapter 1

## Introdução

Neste curso, seguiremos o roteiro apresentado por ...., nos *slides* disponíveis em: . E o nosso texto-base é o livro de *A Practical Guide to Geostatistical Mapping* de *Tomislav Hengl* disponível gratuitamente no *link* <https://spatial-analyst.net/book/>.

### 1.1 Definições

#### Modelo Universal de Variação

$$Z(\mathbf{s}) = Z^*(\mathbf{s}) + \varepsilon'(\mathbf{s}) + \varepsilon''$$

#### Inverso da distância

$$\hat{z}(s_0) = \sum_{i=1}^n \lambda_i(s_0) z(s_i)$$

#### Variograma

#### Semi-variograma





## Chapter 2

# Código

No início de todo código aconselhamos a organização tal como declarando o autor do código, a disciplina na qual ele foi elaborado e os pacotes utilizados, tais quais como apresentado a seguir.

```
## -----  
## Prof. Dr. Marcelo Protazio  
## Geostatística PPGME  
## -----
```

```
## -----  
## -----  
## [1] Packages  
## -----  
## -----  
  
library(gstat)  
library(sp)  
library(MASS)  
library(spatstat)
```

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

### 2.1 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 ??.
- If you prefer text as the link instead of a numbered reference use: any text you want can go here.

## 2.2 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 2.1.

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

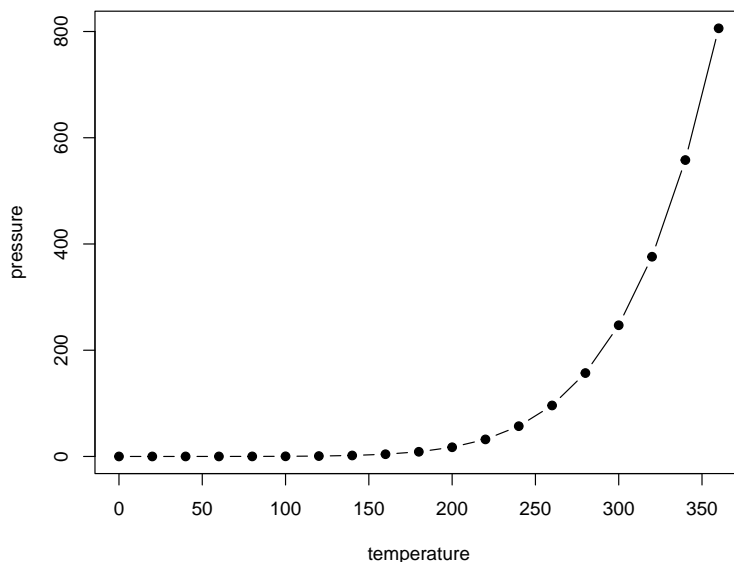


Figure 2.1: Here is a nice figure!

Don't miss Table 2.1.

Table 2.1: 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

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



## Chapter 3

# 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 4

# Footnotes and citations

### 4.1 Footnotes

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

### 4.2 Citations

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

For example, we are using the **bookdown** package [Xie, 2022] (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 5

# Blocks

### 5.1 Equations

Here is an equation.

$$f(k) = \binom{n}{k} p^k (1-p)^{n-k} \quad (5.1)$$

You may refer to using `\@ref{eq:binom}`, like see Equation (5.1).

### 5.2 Theorems and proofs

Labeled theorems can be referenced in text using `\@ref{thm:tri}`, for example, check out this smart theorem 5.1.

**Theorem 5.1.** *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>.

### 5.3 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 6

# Sharing your book

### 6.1 Publishing

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

### 6.2 404 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.

### 6.3 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
```

# 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*, 2022. URL <https://CRAN.R-project.org/package=bookdown>. R package version 0.26.