The Book of N3C

N3C Educational Committee

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Contents

Chapter 1

Welcome

The Book of N3C is designed to guide research with the National COVID Cohort Collaborative (N3C).

1.1 Contributing Content

The N3C and its domain teams are healthiest when assimilating contributions from reseachers of different skills (*e.g.*, clinicians & informaticians), specialties (*e.g.*, endocrinology & gerontology), programming languages (*e.g.*, Python, R, & SQL) and experiences (*e.g.*, students & PIs).

Accordingly, the book-of-n3c-v1 repository welcomes input from you.

If you see a small mistake or unclear language, we invite you to inform us in a new issue or to edit the source and submitting a pull request. When an editor reviews and accepts your change, the website will be updated within minutes.

If you have an idea for something more substantial such as a chapter or section, please start a new issue and the N3C Educational Committee will coordinate with you where it fits best.

1.2 Platform

To make small changes like spelling corrections, we recommend editing the source directly in GitHub. It handles the details without your knowledge (like starting a fork and prompting your pull request). From the appropriate page of the book, click on the "Edit this page " button and type your change in the GitHub editor.

Substantial edits and writing are better accommodated by a text editor on your local machine that can preview the rendered content as you type. We suggest RStudio or Visual Studio Code.

You don't have to understand the rest to contribute, but for those interested:

- The majority of this book is written in a collection of markdown documents and assembled by the bookdown package. See Yihui's book for the authoritative details.
- After your change is pushed to GitHub, a GitHub Action spawns a small VM that (a) collects all the markdown documents, (b) calls bookdown to convert them to html, and (c) moves the compiled products to the "gh-pages" branch.
- GitHub Pages serves the contents of the "docs/" directory to anyone with a browser.

1.3 Funding

The N3C is supported by NIH National Center for Advancing Translational Sciences (NCATS).

Sample Chapters

Chapter 2

About

(*This sample bookdown bs4 chapter is helping configure the settings. It will be removed shortly.)

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

2.1 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.

2.2 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/.

2.3 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()
```

Chapter 3

Hello bookdown

(*This sample bookdown bs4 chapter is helping configure the settings. It will be removed shortly.)

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.

3.1 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 4

Cross-references

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

4.1 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 4.
    - If you prefer text as the link instead of a numbered reference use: any text you want can go here.

4.2 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 **??**.

```
{r nice-fig, fig.cap='Here is a nice figure!', out.width='80%',
fig.asp=.75, fig.align='center', fig.alt='Plot with connected
points showing that vapor pressure of mercury increases exponentially
as temperature increases.'} par(mar = c(4, 4, .1, .1)) plot(pressure,
type = 'b', pch = 19)
```

Don't miss Table **??**.

```
{r nice-tab, tidy=FALSE} knitr::kable(   head(pressure, 10),
caption = 'Here is a nice table!',   booktabs = TRUE )
```

Chapter 5

Parts

(*This sample bookdown bs4 chapter is helping configure the settings. It will be removed shortly.)

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 6

Footnotes and citations

(*This sample bookdown bs4 chapter is helping configure the settings. It will be removed shortly.)

6.1 Footnotes

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

6.2 Citations

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

For example, we are using the **bookdown** package (Xie, 2021) (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 `bs4_book` theme makes footnotes appear inline when you click on them. In this example book, we added `csl: chicago-fullnote-bibliography.csl` to the `index.Rmd` YAML, and include the `.csl` file. To download a new style, we recommend: https://www.zotero.org/styles/

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

[1] This is a footnote.

Chapter 7

Blocks

(*This sample bookdown bs4 chapter is helping configure the settings. It will be removed shortly.)

7.1 Equations

Here is an equation.

$$f\left(k\right) = \binom{n}{k} p^k \left(1-p\right)^{n-k} \tag{7.1}$$

You may refer to using `\@ref(eq:binom)`, like see Equation (7.1).

7.2 Theorems and proofs

Labeled theorems can be referenced in text using `\@ref(thm:tri)`, for example, check out this smart theorem 7.1.

Theorem 7.1. *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.

7.3 Callout blocks

The `bs4_book` theme also includes special callout blocks, like this `.rmdnote`.

You can use **markdown** inside a block.

`{r collapse=TRUE} head(beaver1, n = 5)`

It is up to the user to define the appearance of these blocks for LaTeX output.

You may also use: `.rmdcaution`, `.rmdimportant`, `.rmdtip`, or `.rmdwarning` as the block name.

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 8

Sharing your book

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8.1 Publishing

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

8.2 404 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.

8.3 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 `bs4_book` provides enhanced metadata for social sharing, so that each chapter shared will have a unique description, auto-generated based on the content.

Specify your book's source repository on GitHub as the `repo` in the `_output.yml` file, which allows users to view each chapter's source file or suggest an edit. Read more about the features of this output format here:

https://pkgs.rstudio.com/bookdown/reference/bs4_book.html

Or use:

```
{r eval=FALSE} ?bookdown::bs4_book
```

Bibliography

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

Xie, Y. (2021). *bookdown: Authoring Books and Technical Documents with R Markdown*. R package version 0.24.