A Book Chapter Example

Your Name

Contents

Chapter 1

An Introduction to Nonparametric Methods: Schistosomiasis

Using statistics is no substitute for thinking about the problem -Douglas Montgomery[1]

Randomization tests, permutation tests, and bootstrap methods are quickly gaining in popularity as methods for conduct statistical inference. Why? These nonparametric methods require fewer assumptions and provide results that are often more accurate than those from traditional techniques using well-known distributions (such as the normal, t, or F distribution). These methods are based on computer simulations instead of distributional assumptions and thus are particularly useful when the sample data are skewed or if the sample size is small. In addition, nonparametric methods can be extended to other parameters of interest, such as the median or standard deviation, while the well known parametric methods described in introductory statistics courses are often restricted to just inference for the population mean.

We begin this chapter by comparing two treatments for a potentially deadly disease called Schistosomiasis (shis-tuh-soh-mahy-uh-sis). We illustrate the basic concepts behind nonparametric methods by using randomization tests to:

- Provide an intuitive description of statistical inference.
- Conduct a randomization test by hand
- Use software to conduct a randomization test
- Compare one-sided and two-sided hypothesis tests

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[1]Douglas Montgomery, Design and Analysis of Experiments, Fifth edition, Wiley, 2003, page 21.

- Making connections between randomization tests and conventional terminology

After working through the schistosomiasis investigation, you will have the opportunity to analyze several other data sets using randomization tests, permutation tests, bootstrap methods, and rank-based nonparametric tests.

1.1 Investigation: Can a New Drug Reduce the Spread of Schistosomiasis?

Schistosomiasis is a disease occurring in humans caused by parasitic flatworms called schistosomes (skis'-tuhsohms). Schistosomiasis affects about 200 million people worldwide and is a serious problem in sub-Saharan Africa, South America, China, and Southeast Asia. The disease can cause death, but more commonly results in chronic and debilitating symptoms, arising primarily from the body's immune reaction to parasite eggs lodged in the liver, spleen, and intestines.

Currently there is one drug, praziquantel (prā'zǐ-kwän'těl'), in common use for treatment of schistosomiasis; it is cheap and effective. However many organizations are worried about relying on a single drug to treat a serious disease which affects so many people worldwide. Drug resistance may have prompted a 1990s outbreak in Senegal, where cure rates were low. In 2007, several researchers published work involving a promising drug called K11777 that, in theory, might also treat schistosomiasis.

In this chapter, we will analyze data from this study where the researchers wanted to find out whether K11777 helps to stop schistosome worms from growing. In one phase of the study, 10 female laboratory mice and 10 male laboratory mice were deliberately infected with the schistosome parasite. Seven days after being infected with schistosomiasis, each mouse was given injections every day for 28 days. Within each sex, 5 mice were randomly assigned to a treatment of K11777 whereas the other 5 mice formed a control group injected with an equal volume of plain water. At day 49, the researchers euthanized the mice and measured both the number of eggs and the numbers of worms in the mice livers. Both numbers were expected to be lower if the drug was effective.

Table 1.1 gives the worm count for each mouse. An individual value plot of the data is shown in Figure 1.1. Notice that the treatment group has fewer worms than the control group for both females and males.

Table 1.1: Worm count data for the schistosomiasis study. Treatment is a regimen of K11777 injections from day 7 to day 35. Control is the same regimen, but with a water solution only.

Female		Male	
Treatment	Control	Treatment	Control
1	16	3.0	31
2	10	5.0	26
2	10	9.0	28
10	7	10.0	13
7	17	6.0	47
Mean 4.4	**12**	**6.6**	**29**

NOTE There is a difference between individual value plots and dotplots. In dotplots (such as Figures 1.3 and 1.4 shown later in this chapter), each observation is represented by a dot along a number line (x-axis). When values are close or the same, the dots are stacked. Dotplots can be used in place of histograms when the sample size is small. Individual value plots, as shown in Figure 1.1, are used to simultaneously display each observation for multiple groups. They can be used instead of boxplots to identify outliers and distribution shape, especially when there are relatively few observations.
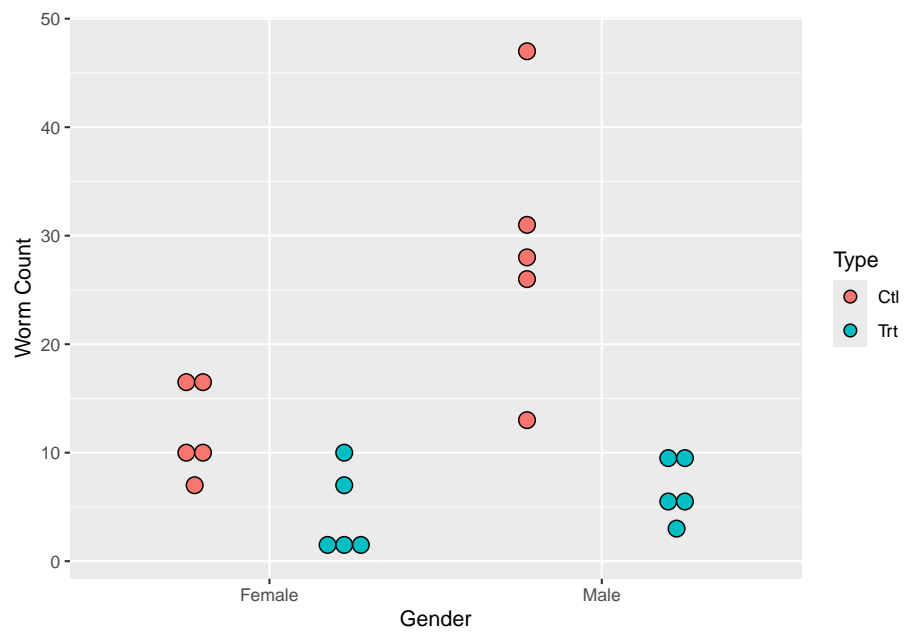
Figure 1.1: Individual value plot of the worm count data

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.

```r
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.

```r
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 [1].

5.2 Citations

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

For example, we are using the **bookdown** package (Xie, 2025) (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

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[1]This is a footnote.

Chapter 6

Blocks

6.1 Equations

Here is an equation.

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

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

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

```
head(beaver1, n = 5)
#>   day time  temp activ
#> 1 346  840 36.33     0
#> 2 346  850 36.34     0
#> 3 346  900 36.35     0
#> 4 346  910 36.42     0
#> 5 346  920 36.55     0
```

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 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 `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:

```
?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. (2025). *bookdown: Authoring Books and Technical Documents with R Markdown*. R package version 0.43.