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Meta-Analysis with R

Guido Schwarzer, James R. Carpenter, Gerta Rücker
Springer-Verlag, New York, 2015.
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http://meta-analysis-with-r.org/

When we watch the news, it has become common to see conflicting scientific reports. One week coffee is bad for you and red wine is good for you. A few weeks later, neither is good for you and shortly after that, both are critical for preventing imminent death. Statistical analysis allows for error. We acknowledge there is potential error though, and we guess at the error likelihood using p-values. Many studies are carried out using a similar design and if multiple studies ask the same question and provide sufficiently similar framework, then it would be beneficial if we could aggregate those studies in our search for statistical truth.

This is where meta-analysis comes in (Borenstein, Hedges, Higgins, and Rothstein 2009). More likely, rather than contradictory studies, we will see one study says something causes a one percent increase in some risk and a different study shows a twenty percent increase in risk from the same activity. Depending on the outcome, for instance, death, a very small increase in risk does not affect my behavior while a one in five increase in risk may cause instantaneous change. Meta-analysis is a set of analytical tools that allows us to collect multiple different results into what can be thought of as a weighted average of the individual studies' results.

As simple as a weighted average is, the underlying statistics is not. In *Meta-Analysis with R*, Schwarzer, Carptenter, and Rücker present the tools and techniques for doing meta-analyses in R. The text begins with a standard chapter on using R. Unlike some texts, it is brief and really only introduces the core functions of loading data, managing a dataset, and running scripts, all essential to the rest of the book. The section closes out with a very quick meta-analysis example. At only two pages, the example serves as an introduction rather than a how-to.

Following this introduction, the authors provide three chapters, as part two, on standard methods for meta-analysis: fixed and random effects models, binary outcomes, and meta-regression. They also, importantly, introduce the **meta** package, created by Schwarzer. The **meta** package provides a suite of tools to support meta-analysis including fixed and random effects models and forest plots to visualizing the distinctions among studies. Specialized versions of the fixed and random effects models for meta-analysis with binary outcomes are

also explored. Finally, this part closes with examples of meta-regression and tests for subgroup analysis are introduced along with examples from the **metafor** package for meta-regression across studies.

The second half of the book makes up part three, reassuringly named "Advanced Topics." This section covers small-study effects, missing data, multivariate meta-analysis, mixed treatment meta-analysis, and diagnostic test accuracy meta-analysis. Each of these chapters covers unique and complicating circumstances that can arise in practical meta-analysis. Importantly, the authors again introduce critical R functions and packages to support the analyses they are describing. For instance, the chapter on small-study effects shows practical examples of funnel and radial plots drawn by the **meta** package. Similarly, Rücker and Schwarzer's **netmeta** package is described to support mixed treatment meta analysis, and diagnostic test accuracy meta analyses are supported by Philipp Doebler's **mada** package. In this way, the authors describe packages they created and are therefore familiar with, but without omitting important packages by other authors.

The book closes with a brief appendix on installing R and a list of relevant packages a statistician practicing meta-analysis in the field may require.

The book has several outstanding features. The collection of working examples throughout the book is its best feature. Fully worked code examples are provided for almost every problem. Using inline code examples, as has become common for books in R, the authors provide code examples for loading and analyzing datasets. Further, they demonstrate the graphs and other outputs the meta-analysis packages can provide. One of the best chapters in this book is the chapter on missing data. There are a number of packages for resolving missing data in R, but rather than introducing more packages, the authors here walk through the key methods and ideas. Several approaches are shown and discussion of the relative merits is given.

The biggest drawback in this book is also the worked examples. After reading the book, I believe every worked example came from the medical field. For medical and allied health practitioners, this is clearly a benefit. If you are a social scientist looking to apply meta-analysis to your field, you may be turned off. While the methods do not change, interpretation and meaning is dervied from the institutional field, and this can interfere with the reader's learning opportunities. In addition, there are no problems included with the text. This may be a problem for professors interested in adopting the text for a dedicated class on meta-analysis or using the book as supplementary reading in an advanced applied statistics course.

These drawbacks are minor. The book is a great introduction to performing meta-analysis in R. However, the book does not provide any real introduction to meta-analysis itself. This is not to the detriment of the book, but does mean if you are not already familiar with the methods, additional reading may be required. In addition to the previously mentioned Borenstein *et al.* (2009), this book is well-complemented by Card (2015) or Cooper (2016). Together with a generalized introduction to meta-analysis, an experienced statistician should be able to perform an analysis in R with this book.

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