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BOOK REVIEW

Linear mixed models. A practical guide using statistical software

by Brady T. West, Kathleen B. Welch, Andrzej T. Gałecki, third edition, New York: Chapman & Hall/CRC. 2022. 489 pages. ISBN: 978-1-0031-8106-4. List price: £ 84.99

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Linear mixed models (LMM) are a standard approach for analyzing clustered and longitudinal data. A series of software packages and in different languages are available for this task. The book title promises to provide a practical guide to LMMs. And the book offers what is promised. As before, it is shown how LMMs can be fitted using HLM, R, SAS, SPSS, and Stata. This time in its third edition. The two previous editions have been discussed before in this journal; see Czado (2009) and Burghoff (2016) for the first and second editions, respectively.

Major changes concern the provided code. All examples have been thoroughly updated, and approaches for visualizing and interpreting results have been added. A new chapter on power and sample size calculations is also available.

The basic structure of the book remains unchanged. After a short introduction and a brief history, chapter 2 provides a 50-page long overview on the theory of LMMs. This chapter has been expanded and covers practical modern topics compared to the previous version of the book. All other chapters deal with practical aspects of LMMs. Analysis chapters 2–8 always follow the following section structure: (1) introduction, (2) the data, (3) overview of data analysis, (4) analysis steps in the software (SAS, SPSS, R, Stata, HLM), (5) results, (6) comparison between software packages, (7) parameter interpretation, (8) model diagnostics, (9) software notes, (10) other analytic approaches, and (11) recommendations. This clear structure and the focus on R and SAS make this book very useful for practitioners. As a real dataset always motivates a specific statistical approach for data analysis at the beginning of a chapter, a chapter may be worked through independent of other chapters.

Only the new chapter 9 on sample size and power calculations deviates from the structure laid out. This chapter has only two code-based sections. The first utilizes the availability of closed formulae, while the second code–based section provides examples for sample size and power calculations using simulated subject-level data. It appears to the reviewer that this section is a collection of several specific examples. While all packages from SAS to HLM were used for real data analysis in the other chapters, only few software programs were employed in chapter 9. Specifically, only SAS was used to illustrate simulation-based sample size and power calculations. The authors have referred to other books, such as Gałecki and Burzykowski (2013), for simulation-based sample size and power calculations involving R. In a future edition of the book, the authors might wish to follow the clear structured approach of topic-specific sections even in the chapter on sample size and power calculations. The inclusion of simulation-based sample size and power calculations beyond SAS would be highly relevant.

The book is a success for more than 15 years. The reviewer finds it extremely helpful for statisticians who want to apply LMMs, especially with complex data structures. If a statistician has to use different software packages, this book is probably the best available because it provides code and illustrations for five different statistical programs. Alternative

books exist when the focus is on a single program. Specifically, Gałecki and Burzykowski (2013) illustrate LMMs with R; Gałecki is the last author of the book discussed here. However, Gałecki and Burzykowski's (2013) book is already a decade old. Recent software and theoretical developments are only covered by the here-presented book.

In summary, this book is perfect for readers who are looking for a quick reference to all kinds of situations in which LMMs are to be used. In the opinion of the reviewer, either this book or the Gałecki and Burzykowski (2013) book are a must for the practical statistician working with R. And the reviewer finds it helpful to have both on the shelf. For readers with a great need to incorporate novel data visualization approaches in their analyses and the need to improve result interpretation, the third edition is clearly superior to the second edition.

CONFLICT OF INTEREST STATEMENT

A.Z. is the book review editor and associate editor of the *Biometrical Journal*. A.Z. is listed as co-inventor of an international patent on the use of a computing device to estimate the probability of myocardial infarction (International Publication Number WO2022043229A1). Cardio-CARE and A.Z. are shareholders of the ART-EMIS Hamburg GmbH.

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