

Book review

Linear Mixed Models – A Practical Guide Using Statistical Software. B. T. West, K. B. Welch and A. T. Galecki (2006). London: Chapman & Hall/CRC. ISBN: 978-1-584-88480-4.

Modelling clustered and longitudinal data with and without nested factors has gained importance in recent years. Early expositions are the books by Searle, Casella, and McCulloch (1992), Verbeke and Molenberghs (2001) and McCulloch and Searle (2001), which deal primarily with linear mixed models (LMM). Hierarchical linear model (HLM) or multi-level formulations are discussed in Raudenbush and Bryk (2001), which can be rewritten as LMMs. Extensions to generalized LMM (GLMM) are considered in Molenberghs and Verbeke (2005), Fitzmaurice, Laird and Ware (2004) and an up-to-date mathematical treatment is given by Jiang (2007). A Bayesian perspective of HLM's is taken in Gelman and Hill (2006).

Many software packages have been developed to fit LMMs. The aim of the present book is to show how LMMs can be fitted using SAS, HLM, SPSS, R/S-PLUS and Stata. The authors also compare these different software packages and explain differences in the results.

Since the emphasis is on the use of statistical software, the theoretical exposition of LMMs contained in Chapter 2 is only brief. The authors set the scene for random effects in clustered and longitudinal/repeated-measures data and discuss major estimation methods such as maximum likelihood (ML) and restricted ML (REML). Strategies for model selection, model building, diagnostics and prediction are given. Computational issues such as fitting algorithms and positive definiteness of covariance matrices are raised and discussed. Unfortunately, HLMs are not introduced in general, but only illustrated in examples in the following chapters. This makes the exposition on model building difficult to follow.

The following chapters are centered around specific data sets illustrating two-level and three-level models for clustered data, models for repeated-measures data, random-coefficient models for longitudinal data and models for clustered longitudinal data. In each of these chapters, first an exploratory analysis of the illustrating data set is given. A different statistical software package is used in each chapter to fit an LMM. A final model is built step-by-step, interpreted and diagnosed. The analysis with other software packages is discussed in a special section. Software differences in model fit and hypothesis testing are highlighted and explained.

In my opinion, the book is particularly successful if the reader has a theoretical background on LMMs. The book could be enhanced if some easy theoretical derivations would have been included, for example, the variance covariance matrix in the marginal model and step-by-step reformulation of a HLM as a general LMM. In summary, the book is very useful for the well-informed practitioner, who wants to fit LMMs and needs to make a choice about the specific statistical software to use. Finally, a publication of a similar software-oriented book on GLMMs with sufficient theoretical background would be very much appreciated.

Claudia Czado*
Technische Universität München
Zentrum Mathematik
Lehrstuhl für Mathematische Statistik
Boltzmannstr. 3
85747 Garching
Germany

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* e-mail: cczado@ma.tum.de, Phone: +498928917428, Fax: +498928917435