

GARRETT M. FITZMAURICE, NAN M. LAIRD, AND JAMES H. WARE, **Applied Longitudinal Analysis**. Hoboken: Wiley

This second edition of a classic by experts in the field remains one of the most introspective expositions on longitudinal analysis, making it a leading reference and educational book. The new edition has expanded the targeted audience from quantitative scientists to health researchers. What I have always liked about the book is its ease of readability. Complex bothersome issues are explained in a near popular science book fashion, yet the necessary formulas and notation are provided throughout without overwhelming the reader. And so, sections of Chapter 3 are devoted to the subtle distinction between substantive and nuisance parameters as well as historical approaches to the field, while the troubling issue of determination of degrees of freedom is brought down to earth in Chapter 4. Self-contained subsections with clear headers in large fonts without too much numbering make it easy for the weary time-constrained reader to leaf through the book and focus on relevant parts. Useful exercises continue to be provided at the end of each chapter and a comprehensive set of slides for teaching are provided on the website, making the book ever more amenable for graduate instruction.

In addition to expanding the contents of the first edition with additional chapters on generalized estimating equations, missing data, approximate methods, and power calculations, the new edition has added a much needed Chapter 9 to address the timeless gnarly question of when one should use a fixed versus random effects model as well as a new Chapter 19 on methods for smoothing longitudinal data.

The book remains committed to SAS and provides code at the end of most chapters. R and Stata code are also provided

on the website. Given that R is so widely used in academia and becoming more so professionally, it might be time to relegate even the SAS code to the website in order to focus more attention in the book on the foundational concepts. The emergence of *ggplot* and other high-level visualization techniques for big data in R offer many new opportunities for viewing longitudinal data via colored heatmaps and the like. These are not to be found in this book and the graphics remain more or less the same as in the previous edition. There are undoubtedly a large number of other books on multivariate visualization in R that can be referenced for those interested, and as the field is so rapidly changing, best left to other sources.

There are very few books that sit on my desk rather than on the bookshelf both during and outside of the academic semester period, but this is one of them. As a researcher and teacher of longitudinal data analysis, I have come to rely on this book because it explains concepts in plain language while being rigorous in proper definitions and implementation, even when it runs counter to the defaults provided in statistical packages. Although the examples in the book are taken from the public health field, I have used it seamlessly for applications in ecology and climate change, and the concepts transfer readily to all fields measuring unbalanced moderate-sized longitudinal data. The authors are to be congratulated for providing such an outstanding resource for scientists of all disciplines, this piece of work is one of the many important contributions of James Ware to the field.

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