

Recommended reading for the Analysis of Change workshop:

**“Introducing Multilevel Modeling” by Ita Kreft & Jan DeLeeuw; published in 1998 by Sage.**

Comments: This book is very clearly written, and aimed at introducing these models in a non-technical manner. You do need some familiarity with general linear models (GLMs), especially multiple regression. In particular, go back to my slides that show the formula for the GLM where the intercept and slope are discussed (it’s your basic formula  $y = \mathbf{mx} + \mathbf{b}$ , with an error or residual term thrown in, and the  $m$  &  $b$  in this formula is traded for  $\beta$  and  $\alpha$ , respectively). The authors talk you through some examples and compare them to plain ol’ multiple regression and variations on that. Some of my presentation was based on information from this book.

**“Longitudinal Data Analysis: Designs, Models and Methods” by Catrien CJH Bijleveld & Leo J. Th. Van der Kamp, with Mooijaart, van der Kloot, van der Leeden & van der Burg; published in 1998 by Sage**

Comments: This book is also clearly written, and provides an excellent background in different repeated measures designs and the appropriate models for those designs. We only talked about longitudinal panel data (more subjects than repeated measures) in our workshop. However, many of you may have repeated measures data that are more suitable for other types of change models that I did not cover. This book also does a nice job comparing traditional ANOVA family models for analyzing change (e.g., MANOVA) with Multilevel models. Some chapters are more technical than the previous book, depending on the purpose of the chapter. I found chapters 1, 3, 4 & 5 most helpful when addressing longitudinal panel data of the sort we discussed in our workshop.

**“Hierarchical Linear Models” by Anthony Bryk & Stephen Raudenbush; published in 1992 by Sage.**

Comments: This text is part of the Advanced Quantitative Techniques in the Social Sciences series published by Sage. It is THE central text for HLMs and if you want to understand “best practices” for carrying out HLMs (also known as multilevel models) and reporting results, this is the text to have. Nearly every methodologist that discusses using HLMs refers to Bryk & Raudenbush. If you plan on using these types of models, this is a good book to have. I’d start with Kreft & DeLeeuw, however, if you’re not very familiar with multilevel modeling. This is a more technical book, especially as you get further in.

**“Using SAS PROC MIXED to fit Multilevel Models, Hierarchical Models, and Individual Growth Models” by Judith Singer; Published in the Journal of Educational and Behavioral Statistics, and available online at <http://gseweb.harvard.edu/~faculty/singer/> (she asks that you email her to let her know you’ve downloaded it and where you heard about the paper).**

Comments: This paper is very helpful in showing you HOW to carry out multilevel modeling. Dr. Singer has a mission to make multilevel modeling more accessible to educational and social science researchers. She describes these models clearly and then takes you through step-by-step how you'd specify them in SAS using the mixed effects models procedure (a.k.a. "PROC MIXED"). She also talks you step-by-step through how to interpret results and report them. I found that very helpful when first learning how to run these models for my dissertation.

**Other useful websites:**

Judith Singer and UCLA colleagues have a great web site for mixed models with syntax and output for most of the major packages running a series of models described in her classic article on SAS Proc Mixed (cited above).

<http://www.ats.ucla.edu/stat/paperexamples/singer/default.htm>

<http://www.ats.ucla.edu/stat/hlm/>

John Painter has a document on his web site implementing the same models in SPSS Mixed.

<http://www.unc.edu/~painter/SPSSMixed/SPSSMixedModels.PDF>

See also Peugh and Enders (2005) Educ and Psych Measurement v65 no 5 for another article based on Singer's Proc Mixed article.

Singer also provides data and syntax to accompany her wonderful book "Applied Longitudinal Data Analysis" (as described on her website, cited above).

SPSS has a "white paper" on Mixed on their web site.