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Hierarchical Linear Models: Applications and Data Analysis Methods. By Anthony S. Bryk and Stephen W. Raudenbush. Newbury Park, Calif.: Sage Publications, 1992. Pp. xvi + 265.

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For a long time the connection of micro and macro levels created some difficulties in statistical modeling. In sociology, the term "ecological fal-

lacy" refers to problems that may occur in the context of deriving individual features from aggregate data. On the other hand, it is well known that the behavior of a system is often more than the sum of its parts.

This monograph offers a careful introduction to models designed to deal with interactions between individual and contextual effects. The so-called hierarchical linear models (or, random coefficient models in the econometric literature, covariance components models or Bayesian linear models in the statistical literature) represent a class of multistage regression models.

Chapter 2 introduces the general logic behind these models. Starting from exogenous microlevel data, individual effects are estimated first. Then, the estimated parameters are explained on the basis of characteristic features from the next higher hierarchical level. This procedure is necessary because two fundamental assumptions of the OLS model will be violated if system characteristics are directly introduced into a microlevel equation: (*a*) variance homogeneity and (*b*) independent error terms.

There are at least two essential methodological improvements of the suggested procedure. First, the deterministic effects of the influential macroeffects can be separated. Second, it is possible to include stochastic macroeffects into the analysis. Put differently, the usual individual error terms of linear models are extended by error terms associated with the macro level. This approach makes it possible to systematically analyze the overall variance components. The total variance of the dependent variable from single-level data analysis can be decomposed into the "within group" and the "between group" variation. The interaction of the individual and the contextual effects as well as the variation of the estimated coefficients then can be identified in an analysis of the covariance of the error terms.

Chapter 3 presents an introduction to the relevant statistical techniques. Point and interval estimators of the first and second hierarchical levels are derived. Regression estimation techniques (OLS, WLS, GLS) are described. There is also a presentation of Bayes estimation as well as full and restricted maximum-likelihood techniques for estimating variance and covariance components.

Chapter 4 illustrates the statistical procedure by theoretical examples. This chapter does not add anything new, but rather reformulates the general approach in a less technical way so that statistically less advanced readers get access to the approach.

Chapters 5–8 apply the general statistical method to empirical data. Those applications come from the domain of educational research. They show that the advantage of the method indeed lies in the possibility to separate the variance explaining the effects of different levels of analysis.

The last two chapters are written for the statistically more advanced audience. Chapter 9 assesses the statistical adequacy of the method. The last chapter is a mathematical appendix. It derives the statistical model and requires knowledge of matrix algebra. Additionally, it describes

Bryk and Raudenbush's computer program and an algorithm for the data analysis.

This book is an important contribution to the analysis of hierarchical data. It presents the material in sufficient depth without ignoring the demands of nonspecialists. The general approach can be applied to both cross-sectional and longitudinal data. The authors exemplify the analysis of panel data by an application of their approach to linear and quadratic growth models (chap. 6). This type of analysis certainly can be extended by relating, for example, hierarchical models to methods of survival analysis. Thus, the present study also may serve as a starting point for tackling the macro-micro problem in a dynamic context.