
MR1719513 (2001k:62001)
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★**Statistical regression with measurement error. (English summary)**

Kendall's Library of Statistics, 6.
Arnold, London; *co-published by Oxford University Press, New York*, 1999. *xiv*+262 *pp*. $55.00.
ISBN 0-340-61461-7
62-02 (62F05 62J05)

References: 0 **Reference Citations: 0** **Review Citations: 0**

This book is intended to be an extension of the subject of measurement error models in the three-volume series *Kendall's advanced theory of statistics* written in various editions. Specifically, the book expands the topics covered in Chapter 29 of Volume 2 in [M. Kendall and A. Stuart, *The advanced theory of statistics. Vol. 2: inference and relationship*, fourth edition, Griffin, London, 1979; Zbl 416.62001 (pp. 399–443)]. The book covers measurement error models, also called errors-in-variables models, and a closely related model called the Berkson model. Three basic types of measurement error models are discussed: the structural model, the functional model and the ultrastructural model. Models with and without equation errors are covered and some emphasis is placed on polynomial models. As pointed out in the introduction, it is intended to be accessible to readers who have a background equivalent to a year's course in probability and theoretical statistics. The presentation is in a somewhat different format than in the companion books by W. A. Fuller [*Measurement error models*, Wiley, New York, 1987; MR0898653 (89a:62160)] and R. J. Carroll, D. Ruppert and L. A. Stefanski [*Measurement error in nonlinear models*, Chapman & Hall, London, 1995; MR1630517 (2000c:62001)], intended to cover linear and nonlinear models, respectively. A few problems are included at the end of each chapter. Throughout the book, the ideas are illustrated by a number of examples, a few based on real data problems and others on simulated data sets. Chapter 1 presents an interesting discussion of the main issues in measurement error models, like identifiability in structural models and unboundedness of the likelihood function in functional models leading to inconsistent estimators. The necessity of additional information, expressed in terms of knowledge of functions of the model parameters or by means of replicated observations, is emphasized. Properties of estimators of the model parameters are covered in Chapter 2. It includes discussions of their moments, consistency, asymptotic distributions and confidence intervals for both functional and structural models. Chapter 3 presents interesting discussions on relationships between the models. Whether to use the functional, the structural or the ultrastructural model is an important issue. Ultrastructural models are close to functional models because both have incidental parameters which increase the sample size. It is important to keep in mind that there are close relationships between the models and close relationships between the behaviors of the estimators. Generalized (or orthogonal) least squares are considered as a generalization of the ordinary least squares procedure which minimizes the square of the vertical distances of the observed points to the estimated line. On the other hand, the generalized least squares method minimizes the square of the distance of the observed points to the estimated line. A brief discussion of unbiased estimating equations for measurement error models is also given. Alternative approaches for obtaining consistent estimators are considered in Chapter 4. The approaches include instrumental variables estimation and also grouping methods. Chapter 5 presents extensions to vector-valued explanatory variables. Point estimators and asymptotic properties of the estimators are considered. Chapter 6 presents polynomial measurement error models. As pointed out in the book polynomial measurement error models can be seen as a special case of nonlinear measurement error models. This is one of the chapters in the book with no parallel in the other books cited above and, moreover, it includes a discussion on Berkson polynomial models. It presents a simple and interesting approach for fitting any order functional polynomial model. Asymptotic properties of the estimators like consistency and asymptotic normality follow from M-estimation theory. Robust estimation in measurement error models is treated in Chapter 7. Robust estimation in measurement error models is important if one is concerned about contaminated data or violation of model assumptions. As mentioned in the book, parameter estimates for measurement error models are even less robust than ordinary least squares estimators, which are quite nonrobust. The chapter includes breakdown points for measurement error models and also robust estimation by using M-estimators. Chapter 8 presents a discussion of some other topics like the estimation of the true variables, which can be used in model checking and diagnostic analysis. A brief discussion of how to by-pass unidentifiability by using replicated observations is also considered. Overall, the book provides an interesting review of the main issues of linear and polynomial measurement error models and it will be extremely valuable to those who intend to initiate work on the subject.

Reviewed by *Heleno Bolfarine*