

## Book Review

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CHIME

Title:           **Applied Multivariate Statistics with SAS Software**  
Authors:       Ravindra Khattree and Dayanand N. Naik  
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Applied Multivariate Statistics with SAS Software is a product of the SAS Institute books by Users program. The book is a fairly complex and in-depth treatment of the techniques involved in the field of multivariate statistics. Subjects described in the book include graphical techniques for representing multivariate data, multivariate regression and ANOVA in analysis of experimental data, and an extensive treatment of multivariate analysis of repeated measures data. The authors' intent is to provide a single source for both the basic theory behind the technique and the implementation in SAS. Unlike the SAS/STAT manuals' alphabetic listing of PROCs, the approach taken by this book is problem-centric, focusing on a number of distinct situations and identifying the most appropriate SAS procedure or procedures. All situations are illustrated with examples, usually real data from various fields.

The ability to identify possible cause-effect relationships of variables and differentiate them from fortuitous coincidence makes multivariate statistical analysis a powerful tool for both research and management. This type of analysis is routinely used in fields where meaningful relationships between large numbers of variables must be extracted despite a large degree of underlying variability; these include the social sciences, biomedical research, insurance, pharmaceutical research, healthcare delivery and management, quality control, and business management. Basic uses of multivariate statistics as described in the book include quantifying the correlation between different variables of a dataset, predicting the expected value of a variable as a function of the values of other variables in a dataset, and estimating the true value of a variable or treatment on the basis of repeated measurements of the same subject.

The authors suggest, as a prerequisite for getting the most out of the book, that the reader have experience in applied univariate statistics and regression and some familiarity with matrix algebra notation; they also suggest that some familiarity with the basics of SAS programming would be helpful. As fate would have it, I am currently taking a course in multivariate statistics; but even so I found the book to be quite technical and complex. I would suggest that these prerequisites are somewhat understated, and that the book would be more useful to a reader who was quite comfortable with the basic concepts of general statistics, had already been introduced to multivariate statistics, was familiar with matrix notation, and was already competent with basic SAS programming.

Even after completing a few courses in statistics, I find the official SAS/STAT manuals often leave me confused regarding choice of the proper PROC and options for any given situation. This book is much more of an applied how-to-guide than the official SAS/STAT manuals; however it still seems better suited for the somewhat statistically aware, who already have some understanding of the techniques described than the novice. The book is geared towards instructing those already knowledgeable in the concepts involved as to how to implement them in SAS. It is definitely not a cookbook for choice of the proper SAS PROC and the meaning and significance of the results attained. This is probably for

the best, as statistics is a field where application without full understanding can be dangerous. The authors do stress the need for the user not only to understand the techniques used, but also to discern the best approach and to interpret the results obtained.

In summary, although this book is not a standalone tutorial in applied multivariate statistics for SAS users, for individuals whose knowledge already contains SAS programming and some understanding of multivariate statistics, this book would be value both as a tutorial for combining the two skills and as a future reference.