Review of *Statistical Ecology*

by

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BU-988-M August 1988

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Ludwig, John A. and Reynolds, James F.
Statistical Ecology: A Primer on Methods and Computing
John Wiley and Sons
1988
xviii+337 pp.

Statistical Ecology is a book whose goal, in the author's words, "is to provide the beginning student with an introduction to some of the current statistical topics in community ecology." It consists of seven main parts: ecological community data, spatial pattern analysis, species-abundance relations, species affinity, community classification, community ordination, and community interpretation. Except for the introductory part, each part is divided into several chapters, the first of which contains an introduction, a matrix view of the data to be considered in that part and a listing of selected literature using the techniques to be considered. In addition to the text, a collection of programs for performing many of the analyses in the book are included. The programs are written in the BASIC computer language and are intended for IBM-PCs and compatibles.

The intended (and achieved) emphasis throughout the book is on introducing methods and their computational aspects. There is very little in the way of assumptions necessary for the analyses to be valid or possible pitfalls in interpretation. I feel these are serious omissions if the intended audience is the beginning student. As the authors themselves state (p. 85), "As is true for most methods, it is relatively simple to obtain rudimentary knowledge and then forge ahead with computations; it is much more of a challenge to obtain a critical perspective." The authors have succeeded fairly well at achieving their goals of presenting methodology and illustrating the computations, but much less well at creating a critical perspective in

the reader's minds.

First let me describe the aspects of the book that I liked. The computational approach to describe statistical methods is well suited to beginning students and the authors have chosen a number of illustrative, simple examples to get across basic ideas. In addition, a number of references to the literature, coded by which methods are used, are included at the beginning of each part. There are also some real or realistic data sets analyzed in the book.

At the end of each chapter is a Summary and Recommendations section. These often contain good, practical advice for the use of the methods, e.g., the first recommendation at the end of the chapter on diversity indices:

> Be aware of the limitations of all diversity measures. This includes richness indices, rarefaction models, diversity indices, and evenness indices. These measures are easy to compute, but are usually difficult to interpret.

Another good point is the inclusion of a collection of BASIC programs to calculate many of the statistics presented in the book. For small data sets, this will make many of the techniques much more accessible.

Unfortunately, the book also contains some serious deficiencies. Perhaps most alarming was the large number of conceptual errors. Some of the more blatant ones:

> The statement (p. 146) that Spearman's rank correlation coefficient assumes a linear relationship.
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> The discussion (p. 232) of the "total variance of the observations" after standardizing and performing principal components analysis on the correlation matrix.
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> The statement (p. 240) that principal components analysis on the variance covariance matrix "will give results similar to that for

> a correlation matrix, differing only in scale, since the only difference is the value of the divisor F_i." This is often false when the variables differ in standard deviation (e.g., Gnanadesikan, 1977, p. 12).
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> The treatment of a statistically significant relationship as being equivalent to an adequate fit (p. 260, Step 3).
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> The statement (p. 290) that multigroup discriminant analysis is weakened by the inclusion of a noncontributing variable while multiple linear regression is not. In fact, multigroup discriminant analysis can be viewed as a generalization of multiple linear regression and just as the R^2 always increases as variables are added to a regression, the canonical correlation always increases for discriminant analysis. Of course, similar to the authors "relative percentage contribution to D^2", there are many statistics for multiple regression that do not necessarily increase with the addition of variables.

In addition to the errors, there were a number of inconsistencies or misleading statements. One example is the following. On p.143 the authors make a good recommendation:

> There are two distinct components for the determination of a species association. First there is the test of species independence, and, second, there is a measure of the degree of strength association. We recommend that studies of interspecific association should include both components.

This is an excellent suggestion, since in cases where the association is high, but not statistically significant, it may argue for an additional study with a larger sample size (as the authors state at the bottom of p. 139). However, on p. 136 they state, "Since species 1 and 3 were found to be independent (not associated), a measure of the strength of association is meaningless."

There simply is not enough coverage of assumptions and interpretations. The authors briefly mention sampling in the introduction, but what is really needed is a specific set of assumptions relevant to each of the particular techniques presented.

Examples of the lack of emphasis on assumptions and interpretations:

> In Section 23.4 data is analyzed which requires the assumption of multivariate normality (e.g., the F-test on p. 290). Yet the data are count data with 50% zeros!
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> I was looking forward to the author's insight on proper interpretation of correspondence analysis axes, since this is a difficult and controversial area. Yet, when they analyzed the first data set in that section they state, "For these data, the patterns of the sampling units in the correspondence analysis are only somewhat comparable to those for principal components analysis (see Figure 19.5) and we exercise the option of leaving it to the student to try to interpret the differences!" This is unpardonable in a text aimed at beginning students and can only lead to misinterpretations of a technique which the students now know how to compute and will undoubtedly misapply.

I also feel the authors should have been more selective in their presentation of topics. Methods which are clearly inferior should be mentioned but not presented nor programs provided for their computation. The presentation of examples with batteries of analyses, even with disclaimers about the inappropriateness of some of them, can only lead to students trying the same and perhaps settling on the one that gives the "right" answer.

The authors also do not take full advantage of the fact that they are supplying programs with the text. Notable is the failure to include Fisher's exact test for 2x2 tables, but the inclusion of a warning when the sample sizes are too small and then printing that the test is "biased" (an incorrect use of the statistical term). Also conspicuously absent is some mention of newer, computationally intensive methods like the bootstrap. Such techniques are important, even to beginners.

This book has many good points, but I think before it can be considered a good text for beginning students, much more emphasis must be placed on the proper usage and interpretation of these methods, not just their computation.

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Reference

Gnanadesikan, R. (1977). Methods for Statistical Analysis of Multivariate Observations. Wiley. New York.