variety but worse for another. Thus the treatments and the varieties are "interacting." If no interaction is present and treatment A is better than treatment B, then it is better for all varieties.

One comment about terminology may be in order. Normally, the term "analysis of variance" is used when one continuous variable is affected by one or several extraneous factors, whereas the term "multivariate analysis" is used when there are several variables, which may or may not be influenced by extraneous factors. Multivariate analysis of variance is a symbiosis of the two. The definition of interaction might be quite different for analysis of variance and for multivariate analysis. Discrete multivariate analysis and discrete multivariate analysis of variance are discrete analogs of the continuous versions. In this sense, the present book perhaps would be more aptly entitled "Discrete Multivariate Analysis of Variance."

The book is primarily a research handbook, and as such will be extremely useful. It was not really meant as a textbook and should not be considered as such. Although it could be useful for a seminar, its primary value is as a guide for the applied statistician. A review of the topics and contents of some of the chapters will help show the development of the subject.

Chapter 2 sets forth models for which the contingency-table format may be used. Of particular concern is the log-linear model. The reason for this is that under certain simplifying assumptions the logarithm of counts yields an additive model, so that there is an analogy with the analysis of variance. This analogy is exploited both notationally and in terms of the usual analysis-of-variance table in which there is an analysis of interactions.

Chapter 3 concerns estimation of the parameters by the method of maximum likelihood. Maximum likelihood estimates can be calculated by hand for relatively simple models, but a computer is almost essential for more complicated models. Some iterative calculation procedures are discussed.

Given the model and a method for estimating parameters, chapter 4 continues with a discussion of testing whether the actual data fit the model, that is, of performing a goodness-of-fit test. This procedure implies that an alternative model exists. Again there is a similarity with the analysis of variance in that the procedure is to test for higher-order interactions first and to continue in a hierarchical manner until the simplest structure that gives an adequate explanation of the observations has been obtained.

At this point the description of the method of analysis is complete. This much of the book is adequate for many, perhaps most, problems that confront the researcher. However, there are several additional technical problems that need to be dealt with.

The first problem is that there may be a good fit except for several aberrant cells. It is now generally accepted that between 5 and 10 percent of data collected are poor data, and in some instances the percentages may be as high as 20. Some discussion of outliers is provided in chapter 4.

A second problem concerns finding maximum likelihood estimators for models with structural zeros. Individual cell counts may be zero for either of two reasons. There may, by chance, be no observations in a cell, or a particular combination may be impossible. The latter case is called a structural zero. For example, a particular blood type may never occur with a particular racial composition. Estimation when structural zeros are present increases the complexity of the numerical analysis, and this is the subject matter of chapters 5 and 6.

In some disciplines—sociology, for example—models of change over time based on Markov chains have been of interest. Chapter 7 provides contingency table analyses for such problems. These models have already appeared in the applied literature in some fields, and are available in some textbooks.

Chapter 8 deals with a cross-classification-type contingency table in which the rows and columns represent similar categories. This occurs, for example, when the row represents a category for the right eye and the column a category for the left eye.

Chapter 9 provides some general discussion of practical aspects of selection of models and assessment of closeness of fit, including some do's and don't's. For example, on occasion a very excellent fit may be observed—indeed, too good a fit. The researcher should be wary if this occurs and check whether too many parameters have been fitted.

There are over 50 worked examples in the book, many of which are taken from research in which the authors participated. In almost every instance the examples are new and interesting, and they cover a wide range of applications. Computer programs are not included in the text. Some programs are available (as is noted in the text), but one has to know where to obtain these. It would be most helpful if the authors would publish their programs in a standard journal or make them available to interested readers. This would avoid a tremendous amount of redundant effort, as well as allow the practitioner to assess the numerical accuracy of the computations.

In summary, this book is the first that gives a general account of the analysis of multidimensional contingency tables. It provides a comprehensive coverage of the subject with numerous examples that can serve as models for the reader. The book is at a sophisticated level and requires reasonable familiarity with statistical theory, yet it is readable. Both the professional and the applied statistician will want to review the techniques covered in it and make them part of the standard repertoire. In the future a number of texts on this subject will no doubt be written, some at a more elementary level, but the present book will almost certainly serve as a foundation for them.

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Feeding Behavior

The Ethology of Predation. EBERHARD CURIO. Springer-Verlag, New York, 1976. x, 252 pp., illus. $29.60. Zoophysiology and Ecology, vol. 7.

The study of how and why animals feed the way they do is central to an understanding of ecological processes at all levels. Eberhard Curio restricts his book mostly to animals that feed on other animals of similar or lesser size. At the beginning, Curio explicitly adopts the inductive rather than the hypotheticodeductive approach. What results is a virtually complete catalog of the facts of predation. The assembling of this information is a great service to research specialists, but while most aficionados probably will wish to own the book, few will read it in toto. Indeed, the voracious reader may contract indigestion.

Its five chapters unfold as in a predatory sequence: motivation, search, recognition, selection, and "hunting" (this last covers all behavior subsequent to a decision to attempt to feed on a particular item). I found several discussions especially intriguing. The choice of prey can be made item by item (as is the case

with most predators), before a hunt (hyenas will tailor pack size to the demands of hunting a given type of prey), or ontogenetically (the protozoan *Glaucoma vorax*, rotund and slothful when absorbing yeast, can change to a streamlined tailed form and entrap bacteria or can ascend the food chain as a cannibalistic one-celled colossus). Seemingly capricious modes of recognition may have reason: moving prey are more likely to be recognized by a part, stationary prey by the whole. The curious preference of some predators for the "odd" may be due to such prey's being more conspicuous, more vulnerable, or necessary to balance the diet. Prey specialization usually lasts a matter of days, rather than weeks or longer. Individual members of euryphagous populations are far more likely to be slightly differing generalists than to be widely differing specialists. Many predators, so precisely fashioned to their trophic role, spend only one-sixth of their time feeding.

Despite its cover's statement that the book emphasizes "topics that link ethological results with modern ecology, e.g., 'optimal foraging theory' " Curio writes, "The predictions made by generalized optimal foraging models are on the whole too simplistic to provide much guidance in studying behavioral mechanisms." Given that such models can have a dozen or more parameters, the claim of simplicity is astonishing. Moreover, I counted 16 places where interpretations of behavior using the variables of foraging theory are suggested, frequently in a unifactorial, nonrigorous manner. To evaluate completely the predictions of optimal feeding theory, one must measure the temporal and often the energetic costs of feeding activities, the assimilable energy from various foods, and the distribution of the food resource. The necessary combination of ecological, physiological, and mathematical, as well as behavioral, methods is currently being applied successfully to a variety of organisms (an example is the work on nectivores by Wolf, Hainsworth, Gill, Stiles, and others), and it could move many of the book's hypotheses from their tenuous footings. For example, various birds provision nestlings with prey larger than they themselves eat. Curio tries a foraging-economics argument to explain this: "longer flights . . . are profitably counterbalanced by larger prey." But the argument is not precise enough to explain why the adults do not also eat only the supposedly more profitable food, or indeed why larger and larger food need be more and more profitable.

Because of the nonconceptual orientation of this book, we cannot discern what role Curio believes ethologists will play in the future development of the study of predation. From the comment quoted above we might expect that he sees the illumination of behavioral mechanisms as an objective of ethology. Yet the reflection in behavioral acts of neurophysiological mechanisms, hypothesized so frequently by ethologists in the 1950's, is virtually absent here.

The potential link to ecology would seem stronger. Some data reported by Curio, however, seem contrary to assumptions of existing foraging models. For example, various animals seem to have a search image, feeding disproportionately on the most commonly encountered prey, not necessarily on the most profitable. Chicks of certain piscivorous birds, when fed too small pieces of food, starve rather than eat more. Some animals perform "surplus killing," slaughtering more prey than they eat, or "vacuum feeding," both seeming wastes of energy and time. Certain birds seem to discriminate between good food sources and a variety of poor ones, but not among the poor sources.

Observations like these, while possibly consistent with present foraging theory broadly construed, intimate how behavioral limitations can restrict a predator's performance. Indeed, ethology's major role for ecology might be to delineate the constraints imposed by degrees of behavioral organization. In places Curio does this, sometimes explicitly, more often implicitly. For example, we learn that not only mammals but lizards and even spiders detour when stalking prey, moving away eventually to draw nearer. A more stimulating science would result were such information incorporated into foraging theory rather than accumulated in isolation. All foraging models have constraints, and a variety of models can be devised that incorporate a variety of behavioral limitations. Such models can be tested one by one against the performance of a predator and rejected if the animal seems unable to behave "optimally." The psychologist Collier and others have already made a promising start in this direction. I predict an ever more fertile union of ethologists, ecologists, and psychologists as this field advances.

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Advances in Child Development and Behavior. Vol. 11. Hayne W. Reese, Ed. Academic Press, New York, 1976. xii, 282 pp. $18.

Advances in the Study of Behavior. Vol. 7. Jay S. Rosenblatt, Robert A. Kinde, Evelyn Shaw, and Colin Beer, Eds. Academic Press, New York, 1976. xvi, 396 pp. illus. $24.50.

Anionic Surfactants. Part 2. Warner M. Linfield, Ed. Dekker, New York, 1976. xiv + pp. 315–674, illus. $39.75.

Annual Review of Ecology and Systematics. Vol. 7. Richard F. Johnston. Peter W. Frank, and Charles D. Michener, Eds. Annual Reviews, Palo Alto, Calif., 1976. viii, 540 pp. $17.

Annual Review of Physical Chemistry. Vol. 27. B. S. Rabinovitch, H. S. Johnston, and J. M. Schurr, Eds. Annual Reviews, Palo Alto, Calif., 1976. x, 630 pp., illus. $17.

An Anthropological Analysis of Food-Getting Technology. Wendell H. Oswalt with the assistance of Gloria Mann and Leonn Satterthwait. Illustrated by Patrick Finnerty. Wiley-Interscience, New York, 1976. xviii, 310 pp. $17.50. *To order this book circle No. 361 on Readers' Service Card*

Artesanías y Capitalismo en México. Victoria Novelo. Centro de Investigaciones Superiores, Tlalpan, Mexico, 1976. 272 pp. Paper, $2.

Basic Psychological Therapies. Comparative Effectiveness. A. James Fix and E. A. Haffke. Human Sciences Press (Behavioral Publications), New York, 1976. 286 pp. $14.95. Psychotherapy Series.

Biomechanics V. Proceedings of a congress, Jyväskylä, Finland, June 1975. Paavo V. Komi, Ed. University Park Press, Baltimore, 1976. Two parts, illus. Part A. xxiv, 550 pp. Part B. xxiv, 516 pp. Each volume, $32.50; the set, $59.50. International Series on Biomechanics, vols. 1A and 1B.

Calculus for the Life Sciences. An Introduction. Murray A. Katz. Dekker, New York, 1976. xii, 258 pp., illus. $13.75. Biology, vol. 1.

The California Coastal Plan. A Critique. Eugene Bardach and ten others. Institute for Contemporary Studies, San Francisco, 1976, x, 200 pp. Cloth, $12.50; paper, $3.95.

Characteristic Classes of Foliations. H. V. Pittie. Pitman, San Francisco, 1976. viii, 108 pp. Paper, $8.75.

Charles Sanders Peirce: Contributions to *The Nation*. Part 1, 1869–1893. Compiled and annotated by Kenneth Laine Ketner and James Edward Cook. Texas Tech Press, Lubbock, 1975. 208 pp. Cloth, $15; paper, $6. Graduate Studies No. 10.

Chemical Applications of Graph Theory. A. T. Balaban, Ed. Academic Press, New York, 1976. xii, 390 pp., illus. $31.75.

Chemisorption. An Experimental Approach. Gerd Wedler. Translated from the

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