Vital Statistics

Biometrical Interpretation. By N. Gilbert. Pp. 125. (Clarendon Press: Oxford; Oxford University Press: London, May 1973.) £3 boards; £1.30 paper.

Introduction to Biostatistics. By R. R. Sokal and F. J. Rohlf. Pp. xiii+368. (W. H. Freeman: San Francisco, May 1973.) £4.10.

As stated in the preface to *Biometrical Interpretation*, "this book is addressed to biologists who use biometrical methods as a tool". Instead of justifying mathematically, or leaving unjustified, the statistical methods presented, it describes plainly, thoroughly and concisely how a set of quantitative biological data can be broken down and analysed to show its salient structural features. In a properly designed study these features will correspond as answers to the biologist's questions and thus provide a natural basis for interpretation. This book is therefore refreshingly different from the many "recipe books" already available for the relatively non-numerate user of routine statistical methods. Just because it is written to give the user an intelligent understanding of the way in which an appropriate statistical analysis has built in to itself the structural features of his particular problem, it is less easy to read (but far more rewarding) than a cook-book of bland instructions and formulae.

Although from the preface "the book assumes some familiarity with elementary statistical methods", the author has in fact explained most of the important ideas himself where necessary. In the first six chapters a unified treatment is adopted, centred on least squares estimation of linear relationships and additive effects in the presence of Normally distributed residuals. Discussion of means and variances is naturally followed by an account of correlations, multiple regressions and prediction. A minor criticism is that principal component analysis is described (page 40) as attempting to summarize the correlation, rather than (as I think is conventional) the covariance, structure of a set of variables; readers may therefore find the discussion of principal components and factor analysis confusing. The importance of assumptions of additivity and linearity is clearly stated: common transformations to linearity and additivity are described, as is the use of polynomial and other mathematical functions—some useful notes on curve fitting are also given in chapter 13. Significance testing is explained, with examples of normal theory tests on means, variances and contingency tables.

Chapters 7 to 11 cover varied topics. The Fisherian and Bayesian views of basic statistical theory are contrasted in chapter 7 and we are warned to temper with common sense our adherence to any particular approach. Chapter 8 stresses randomization and the appropriate design of experiments. Chapters 9, 10 and 11 discuss briefly uses of statistics in problems of particular interest to biologists: indices of diversity, quantitative genetics and population dynamics. No account is given of probit analysis, however. The book ends with a plea for correct analysis (or else no analysis at all), a valuable summary of how to tackle a specific problem by quantitative experimentation, and lucid answers to most of the 40-odd examples set. Whoever masters this slim volume should have a clear and sound understanding of most basic statistical methods and the circumstances (not only biological) in which each is appropriate. I strongly recommend this book.

I find little, on the other hand, to distinguish *Introduction to Biostatistics* from many other introductory texts.

It is an elementary introduction to statistics, illustrated by examples drawn from biological applications, · and requiring only an elementary knowledge of mathematics. The layout of the book is conventional: it begins by explaining the nature of quantitative data and how their distributions may be summarized by descriptive statistics. Next, simple probability theory is followed by discussion of the binomial, Poisson and normal distributions. Estimation, confidence intervals and tests of hypothesis are discussed, mainly in the context of normally distributed data. One and two way analyses of variance are discussed, with the inclusion of a chapter dealing with the assumptions underlying such analyses, possible transformations of the data and the use of two-sample and paired-comparisons nonparametric tests. Other topics treated are simple linear regression ($y = a + bx$), simple correlations, and χ^2 tests of goodness of fit and independence in contingency tables.

A possible disadvantage of this book is that answers are given to only a few of the examples set ; however, many worked examples are presented with full details throughout the text. On the credit side, I welcome the distinction made between hypotheses formulated before and after inspection of the data (page 179). In the discussion of tabular χ^2 tests, the use of the log (likelihood ratio) statistic (page 293) instead of the traditional χ^2 statistic (page 290) is an interesting innovation. For an elementary text the book also contains a wide range of statistical tables. Although about three times as long as *Biometrical Interpretation*, it compares if anything unfavourably with Gilbert's book in respect of the extent and depth of ground covered. For a discursive and informal presentation, the longer book might be preferred. Among users of statistics, however, not only the researcher but also the competent undergraduate would in my view find the shorter and cheaper book far better value.

K. L. Q. READ

Flowers of the Field

An Ecological Atlas of Grassland Plants. By J. Philip Grime and Philip S. Lloyd. Pp. 192. (Edward Arnold: London, 1973.) £6.

THIS book collates data from an intensive survey of grassland sites in the Sheffield region of Northern England. The authors adopt an autecological approach to vegetation, so that the book tends to be an analysis rather than a synthesis of grassland types. For each of the ninety-four species considered an attempt is made to correlate distribution and frequency with a number of environmental variables.

The survey covered sixty-seven sampling sites in which a total of 630 m² quadrats were selected at random. The sites included a variety of geological substrates, including limestones, millstone grit and bunter sandstone. Within each quadrat a "frequency" value was obtained for each species, being the percentage of 10 cm × 10 cm subunits in which the species was found rooted. These data form the basis for the analysis of the requirements of the individual species which comprises the bulk of the book.

Summaries of the data available for each species are set out most clearly in the form of tables (covering pH variations on the various geological substrates), histograms (showing species constancy against surface pH and slope) and whole page ordination diagrams in which species frequency is shown on aspect/slope axes. These display a great deal of information in a visual form which is very easy to interpret. The book is thus not an atlas in the conventional sense of demonstrating spatial distributions of species, but it does construct spatial models which illustrate ecological preferences and limits.

Perhaps the greatest weakness of this book is its title, which possesses encyclopaedic, authoritative overtones not justified by its contents. Although the grassland survey is intensive, it is limited in its geographical extent. As a result one must be extremely cautious in applying its findings to other parts of the country. For example, *Viola hirta* is recorded as a species of southerly aspect by this survey. This may be true in the Sheffield area, where this species of southerly geographical distribution could be under climatic stress. In South-