Statistical Methods. *George W. Snedecor.* Ames, Iowa: The Iowa State College Press, Inc., 1946; pp. xvi, 485. $4.50.

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Statistical Methods is a non-mathematical treatment of modern experimental statistics. Few non-mathematical books are available that treat such topics as confidence limits, use of transformations, and analysis of variance and covariance in the detail presented by Snedecor. The examples are largely, but not entirely, drawn from agriculture and animal husbandry. The exercises for students are extensive and thought-provoking.

Unlike most non-mathematical texts the book under review does not spend pages and pages on methods of recording frequencies and methods of computing countless moments which are seldom used in the later developments of the text. There is no long exasperating discussion of kurtosis and skewness; and there is no parade of qualitative Greek names for categorizing frequency distributions.

The reviewer has used this book for teaching a second course in statistics to social science majors with reasonable success. The main disadvantage was the biological nature of most of the examples, but until some author writes a comparable book using social science examples, the reviewer will continue to use Snedecor's material for a large part of the course.

The main differences between the Third and Fourth Editions of this text have been adequately summarized by Snedecor:

"(i) greater emphasis has been placed on the theoretical conditions in which the various statistical methods have validity, and concurrently (ii) on the conduct of the experiment so as to incorporate in the data the information desired; (iii) estimates and fiducial statements have been brought into equal prominence with tests of hypotheses; (iv) there is increased reliance on experimental samplings to exemplify distribution theory; (v) the treatment of correlation and of experimental designs has been expanded; and (vi) the methods for disproportionate subclass numbers have been extended to include all those necessary for ordinary needs." Some more obvious changes in the Fourth Edition are the entirely new type and summaries which are included at the end of some of the chapters. The practice of using random sampling numbers (iv) to help explain theory has long been employed by teachers of statistics, but few authors have taken as much advantage of this technique as has Snedecor. In the Fourth Edition confidence intervals are widely used (iii). The author uses the adjectives "confidence" and "fiducial" more or less interchangeably, but it is the reviewer's opinion that it is the Neyman concept rather than the Fisherian that predominates. It should be remarked that this is one of the few texts that give the students the idea that in linear regression we do not predict y with the same accuracy for every x even when linearity and homoscedasticity hold (v).

The main emphasis of the book is on the analysis of variance. The author succeeds extremely well in showing the student how to carry out the analysis

even at rather complex levels. On some other points he was not quite so successful. For example, the reviewer feels that the meaning of "interaction" was never gotten across, and that for the student the higher order interactions are still just things to be computed. Furthermore in attempting to make sure that the student understands how to do the computation the author often does not encourage the student to take any overall view of the data before blindly starting to compute. In addition, reasons for doing the experiment are sometimes vague and the conclusions are often couched only in the jargon of analysis of variance. Therefore, the student seldom gets an opportunity to find out what kinds of recommendations might reasonably be made as the result of an experiment. Perhaps the worst example is on pages 275–280. Here the experiment deals with yield of wheat in 48 pots, with two series of soil treatments, humus and chemical. Anyone glancing over the results of the experiment will be startled to find that every yield from pots with "no humus treatment" (12 observations) is greater than any yield with "humus treatment" (36 observations). The reader will be further startled to find that all the evidence tends to support the notion that "no chemical treatment" is at least as fruitful as any of the chemical treatments tried. However, Snedecor says "The striking feature of this experiment is the discrepance among the subclasses. The chemicals applied to one humus treatment produced yields out of accord with those from other humus treatments." Snedecor then pushes on to a more subtle analysis. The reviewer feels that here as elsewhere in the book the author occasionally forgets that the extended analysis looks rather ridiculous unless the practicality of applying the technique is discussed. The example considered here is one in which the point could profitably be made that everyone can see from a visual examination of the data what the results of the experiment show. The analysis backs up the student's common sense appraisal of the situation and gives him more confidence in and understanding of the method when it is applied in more delicate situations. It seems to the reviewer that too many times the application of the analysis of variance obfuscates the main point of the experiment. In the haste to get to the computations and the comparisons of interactions and errors the author frequently neglects to impress the student with the fundamental differences between means and their ultimate interpretation. However, the author does bring out clearly the notion of the various estimates of variance, a subject frequently neglected.

In the next to last chapter the binomial and Poisson distributions are discussed. In this connection the inverse sine and the square root transformations are treated briefly, as is the logarithmic transformation. It is surprising that no indication is given of the theoretical variances when the inverse sine and square root transformations are used. The theoretical discussion of the transformation is limited to the remark that these transformations tend to make the variance independent of the means, but there is no indication of the further advantages. This is surprising because in a much earlier chapter the use of Fisher's transformation for correlation coefficients was treated quite adequately. It seems

to the reviewer that in a later edition the use of transformation might well be moved forward in the book, and that the theoretical and practical implications might be treated more thoroughly.

As in most other texts the final chapter "Design and Analysis of Samplings" needs very considerable expansion.

The book begins (Chapter 1) with a consideration of the sampling of attributes, inferences that can be drawn about the population, confidence limits, use of chi-square in a 1 x 2 table, and some discussion of the use of ratios, rates, and percentages. Measurement data is then (Chapter 2) discussed including the computation and application of the mean, range, standard deviation, probable deviation, median, and quartiles. The concepts of null hypothesis and confidence limits are introduced in Chapter 2 and elaborated in Chapter 3 which concerns sampling from a normally distributed population, random samples, distribution of the mean, variance, standard deviation, and of t. The comparison of two groups in contrast to individuals is treated in Chapter 4 including groups with different numbers of individuals. Chapter 5 provides material on short cut methods of computation using calculating machines, code numbers are explained, suggestions about significant numbers and rates and percentages are given, and the use of the ratio range/sigma is introduced.

After considering linear regression and correlation (Chapters 6, 7) the author relates the two notions, and then goes on to consider some interesting special cases of correlation. Chapter 8 deals with large sample methods. Chapter 9 concerns enumeration data with more than one degree of freedom, discusses adjustments of chi-square and its computation with large numbers of degrees of freedom, and describes the analysis of 2 x 2 x 2, R x 2, and R x C tables. The computation of the analysis of variance for two or more groups of measurement data and with two or more criteria of classification: variance ratio F, use of Latin square, analysis with disproportionate subclass numbers, and the use of randomized blocks are considered in Chapter 10 and 11, while analysis of covariance is treated in Chapter 12 (22 pages). Multiple regression including partial and multiple correlation coefficients, tests of significance and confidence limits are handled in Chapter 13 and curvilinear regression considered in Chapter 15. Chapter 16 deals with binomial and Poisson data, and Chapter 17 discusses the design and analysis of sampling, including sampling from a homogeneous or small population and the effectiveness of stratification.

It seems to the reviewer that at the present time one would be hard put to find a better statistics text written at this level.