BOOK REVIEW

Fundamentals of Statistics *Truman Lee Kelley*. Harvard University Press, 1947; pp. xvi, 755. $10.00.

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First, a brief look at the contents: introductory matter, broad classifications of types of data, quantitative and qualitative aspects of data, construction of tables, charts, and graphs—200 pages; location and scale parameters, and moments—75 pages; normal distribution—30 pages; exact sampling distributions based on normal theory—5 pages; binomial distribution, goodness of fit tests, contingency tables, normal approximation to the distribution of the variance ratio, properties of Chi-square—20 pages; correlation and regression—150 pages.

These first 480 pages constitute the essential part of the book and the part that will be commented on here. But there are 270 more pages, the content of which we shall merely note without comment. There is a chapter of 90 pages entitled "Sundry Statistical Issues and Procedures" which discusses fifteen issues such as periodicity, time series, curve fitting, variance error of a coefficient corrected for attenuation, machine extraction of square roots, and sequential analysis. There follows a chapter of 40 pages devoted to no less than twenty-three topics in mathematics, topics such as: matrices and determinants, the square root transformation, expanding a table, spaces of three or more dimensions, and Fourier series. The remaining 140 pages contain numerical tables, references, various indexes, and a test designed to measure the adequacy of students' mathematical preparation.

This then is another book which deals with the descriptive aspects of statistics. Despite its title, it omits discussion of distribution theory, sampling theory, the theory of estimation, tests of hypotheses, or the theory of probability. The phrase "confidence interval" appears not once, I believe, in the entire 750 pages. The discussion of Student's distribution is brief enough to be quoted in its entirety (page 284): "The t-distribution, shown through the courtesy of Dr. Philip J. Rulon, in Chart VIII II, is appropriate for interpreting the significance of means, differences of means, and of regression coefficients, for small samples—say N less than 15. It is the distribution of these statistics computed from small samples drawn from a parent normal distribution."

Thus the author denies any value to the developments in the fundamentals of statistics during the past twenty-five or thirty years. He does this not merely by implication but in so many words; referring to modern statistical inference, he writes (page 13): "A still greater weakness is that it is essentially a deductive procedure and relatively sterile in suggesting new courses—in inspiring creative inferences. It is fundamentally a method of proof and not one of invention."

He is therefore fully aware of his extreme position, and takes great pains to justify it. His thesis is that the main purpose of statistics is to suggest new hypotheses to the scientist. In developing this thesis he writes (page 15): "The physicist observes seemingly irregular changes in x as y changes. He repeats his experiment, controlling more and more of the conditions, and repeats again and again, and, if successful, he reaches a law at the end of his work. He has been using statistics." But his discussion avoids certain relevant questions. Why does the physicist repeat the experiment? Why did he perform it in the first place? Did he suspect before he collected any data that x and y might be related?

At any rate, the opinion of most present-day statisticians is that the primary role of statistics in scientific research is statistical inference. This opinion is certainly well-founded in my own experience. Here at Iowa State College the Statistical Laboratory is intimately implicated in the research programs of all departments—physical, biological, and social. These scientists perform their experiments with a specific purpose in mind—usually the estimation of some parameters, sometimes the testing of a hypothesis. They never seem to seek in a collection of data some new hypothesis by artful selection between the mean, the mode, the geometric mean, the harmonic mean, and the median.

It must be reported that, even as a book on descriptive statistics, it leaves much to be desired. The errors usually found in such books are to be found here as well as many more. There is the long discussion of skewness and kurtosis based on the false notion that moments are determined by the nature of the distribution in the neighborhood of the mean. Certain properties of the normal distribution are imputed to all distributions. Erroneous criteria for selecting amongst the many means are given. The universality of the normal distribution seems exaggerated; thus, for example, referring to deviations from regressions (page 364): "Since the quantities $(x_0 - \bar{x}_0)$ are 'errors' we may regularly assume them to be normally distributed." Population parameters and their estimates are confused. The book contains a great many statements (like the final one in the section on the Student distribution quoted above) which are so carelessly written that they have to be counted as errors. Several of the derivations and arguments are also carelessly constructed; an extreme example of this appears on page 206: "Is the mean an unbiased statistic? $M = (x_a + x_b + x_c + \cdots + x_n)/N$. Since the various x's are independent, there are just N degrees of freedom and M is unbiased."

Students will likely have difficulty with this book. There is an air of artificiality because of the omission of any discussion of population distributions and the notion of random sampling. Without any background of this kind it is hard to motivate the presentation, and the various topics become isolated. Moments are defined in terms of sample observations, and population moments are defined merely as the limits of these moments as the sample size becomes infinite. To introduce the mean, the author writes essentially: let us consider the function $f(b) = [\Sigma x^b/N]^{1/b}$. There is no pointing to the middle of a distribution function, or even a sample, or a histogram. The variance is introduced the same way; one considers the function $\Sigma \mid x_i - x_j \mid^m/(N^2 - N)$. Technical terms are used without definition; for example, in the passage about the mean quoted above, the student suddenly encounters the word "unbiased" without definition or previous discussion and must infer its meaning from the context.

Perhaps the best part of the book are three chapters on correlation and regression. The idea of correlation is here introduced with the discussion of a numerical example, and several other topics are discussed in terms of examples. This part of the bóok is very exhaustive; every sort of correlation coefficient is discussed as is every sort of correction to such coefficients. But still the writing is careless, and there is some confusion of ideas. The worst confusion occurs because the distinction between normal and intraclass correlation is never brought out; the discussion hops back and forth between the two ideas with no hint that they are not the same thing. This part of the book, too, is in the style of statistics of thirty years ago; the emphasis is on correlation coefficients rather than regression coefficients.