AJA ONLINE PUBLICATIONS: BOOK REVIEW

Statistics for Archaeologists: A Common Sense Approach

By Robert D. Drennan. 2nd ed. Pp. xv + 333, figs. 30. Springer, New York 2009. $159. ISBN 978-1-4419-0412-6 (cloth).

Statistics is often perceived as something mysterious and hostile, and this holds particularly true for archaeologists. Nonetheless, every scholar would agree that archaeological data are often numerical in nature, and this is the very reason why one can never escape the minefield of statistics. The merit of Drennan's work is that he takes readers by the hand and gently guides them through that minefield, letting them discover that statistics can be a matter easily approached and understood from a commonsense perspective. It is not by chance that the book rests on the author's experience teaching courses at undergraduate and graduate levels.

Fourteen years after the first edition (reviewed by G. Lock in *AJA* 101 [1997] 628–29), a number of important new topics are added. They provide the reader with useful tools to explore archaeological data as the data progressively become multivariate. A number of points discussed in the first edition deserve special attention and are stressed here, since they are particularly useful for archaeological data analyses.

Part 1 deals with the numerical exploration of data. The author provides an easy-to-follow description of the ways in which data can be analyzed to get insight into features such as shape, variability, and central tendency. Issues such as sample comparison and graphical display are addressed as well, with particular attention to box-plots as means of summarizing important features of data. In this reviewer's opinion, one aspect that deserves special note is the attention devoted to the issue of resistance to extreme values (outliers). When data does not meet the normality assumption, outliers can, among other things, negatively affect the estimation of central tendency and variability. To circumvent this limitation, Drennan stresses the importance of robust statistics such as the median, trimmed mean, and trimmed standard deviation (19–23, 32–4), and he suggests in what circumstances they can be used (23, 34–6). It has to be noted that, to the best of this reviewer's knowledge, the trimmed mean and trimmed standard deviation are statistics not frequently used by archaeologists and that their rationale is not based on an undue dropping of extreme values (as one might first believe) but on deep mathematical grounds (R.R. Wilcox, *Fundamentals of Modern Statistical Methods: Substantially Improving Power and Accuracy* [New York 2001] 141–49). An interesting and revisited passage is one devoted to categorical variables (69–76), a kind of data with which archaeologists often grapple. The author shows how to extract structured information from contingency tables by means of column and row proportions, average and density figures, and bar graphs.

Part 2 covers an important array of topics, from the mechanics of sampling (79–96) to the estimation of a population mean on the basis of the sample mean (107–32). The estimation of population proportion on the basis of the proportion of categories in the sample at hand is also covered (139–43). An important new section deals with the median and bootstrap procedure (136–38). The bootstrap (in its percentile method version), a computer-intensive resampling technique, is treated by Drennan as a way to attach a kind of error range to the median. Bootstrapped confidence intervals for the median are useful in cases of skewed distributions, when the mean becomes a poor estimator of the central tendency. It should be noted that other ways to calculate error ranges attachable to the median have also been put

forward (D. Bonett and R.M. Price, "Statistical Inference for a Linear Function of Medians: Confidence Intervals, Hypothesis Testing, and Sample Size Requirement," *Psychological Methods* 7 [2003] 370–83).

Parts 3 and 4, respectively, deal with the relationship between two variables and special sampling topics. T-test, one-way ANOVA, chi-square test, parametric (Pearson's r) correlation, and nonparametric (Spearman's rs) correlation are discussed. Again, Drennan emphasizes robustness: since the t-test is affected by extreme values, the author proposes a useful modification that uses the trimmed mean and trimmed standard deviation (161). The utility of the so-called bullet graph is also stressed. It comes in two versions: one assesses the significance of the difference in mean between two samples (149); the other provides the same information for the median (161). The graph based on the median—and the confidence intervals (80%, 95%, 99%) attached to it—turns out to be useful exactly in those situations in which the t-test is of no use. This reviewer did not manage to find any software statistics package ("statpack") that provides this interesting graph. Fortunately, this limitation can be overcome by the use of notched box-plots (161–62), which are more routinely available.

Part 5 is new to this edition and marks a shift from bivariate to multivariate analysis. The author deals with techniques aimed at the exploration of complex data sets in search of patterns. He focuses on multidimensional scaling (285–97), principal components (299–307), and cluster analysis (308–20). Since all these techniques work on similarity matrices, the author preliminarily explains what similarity is and provides a basis for grasping the mechanics of some similarity/dissimilarity coefficients (271–84). Each section uses the same case study and data set, thus enhancing the comparability of the techniques. The author's attention ranges from the mechanics of analyses to the interpretation of results. Useful hints are provided about statpacks' use and optimal results reporting. Dealing with multivariate techniques means facing difficult concepts such as multidimensional spaces (i.e., spaces where each dimension represents some data attribute). Here, as in other parts of the book, Drennan successfully conveys complex concepts in simple ways, and the topic of extracting principal components is a case in point (302–3). Perhaps the only critique that can be put forward for this section of the book is the absence of correspondence analysis, the popularity of which has progressively risen as a means to explore the relation between categorical variables. Explanation of this technique could have benefited from the sensible way in which the author deals with row/column proportion in part 1.

The closing section of the book contains an updated list of suggested reading. Both students and scholars will surely welcome this gentle introduction to statistics, wherein simplicity does not detract from scientific precision. It provides the reader with a fresh, intriguing, and demystifying picture of statistics applied to archaeology. It makes us realize that a deeper and sounder understanding of numerical data is not beyond possibility. Finally, since the book stimulates experimentation, the present reviewer would like to point out two free computer utilities: the PAST program, developed by Hammer and Harper, which includes statistical, plotting, and modeling functions (http://folk.uio.no/ohammer/past/); and an Excel template developed by this reviewer, which incorporates some of the ideas discussed in Drennan's book, such as robust measures of central tendency and variability, the robust version of the t-test, and bullet graphs for mean and median (downloadable from http://xoomer.virgilio.it/gianmarco.alberti/index_file/Page395.htm).

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