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BOOK REVIEWS

Edited by DAVID I. STEINBERG

The Book Review Section is a regular feature of *COMPUTERS & MATHEMATICS with applications*. Reviews are invited of books which are of particular interest to the Journal's readers. A review should ordinarily not exceed two typed (double spaced) pages, and should be approximately 70–50% descriptive and 30–50% evaluative in nature. Manuscripts of reviews as well as books submitted for review should be sent to: Prof. David I. Steinberg, Dept. of Mathematical Studies, Southern Illinois University, Edwardsville, IL 62026.

The Heat Equation by D. V. WIDDER. Academic Press, New York, 1975. 267 pp. $22.50

This is a long-awaited book from one of the most important contributors to what might be termed the Theory of Heat Functions—in somewhat of an analogy to the Theory of Complex Functions. It is *not* a book for those who would wish to consult it to solve, for instance, various boundary value problems for the heat equation; nor for those who are looking for generalizations involving nonconstant coefficients, nonlinearities, or the like.

We have here, essentially, a beautifully arranged condensation of the author's (and of his associates' and students') work during the past few decades, relating to the theory of the one dimensional heat equation

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$$

While this theory has its obvious physical origins, and indeed one of Widder's earliest published papers, 'Positive Temperatures on an Infinite Rod' (1944) has also a satisfying physical content besides its mathematical importance, the book nevertheless does not concern itself with physical background. Instead, its principal thrust is to develop a theory of those functions which are solutions of the heat equation in various regions of the x–t plane.

An essential part of this development is to establish the necessary connections between these solutions and Laplace, Weierstrass or more general convolution transforms. Included here are things such as representation theorems, considerations of analyticity, solutions of integral equations (inversion of transforms), addition theorems for solutions, and the like.

Bounded and positive temperature functions play a prominent role in the development, and two chapters of the book are devoted to them. These and the previously mentioned subject seem to culminate, in Chapter X, in the subject of series expansions of temperature functions. It is this chapter which, in some ways, seems to be the most fundamentally important for the book; for it gives the analogy of expanding classes of solutions of the heat equation in series which have their counterparts in the theory of a complex variable as Laurent series.

Many other subjects are covered in this book. Theta functions, the Huygens property, Appell transformation, higher dimensions and homogeneous temperature functions are only a few that we could mention.

The book's written in the elegant style one has learned to expect from Widder: concise statements, logical development and excellent readability. Since the material in it, in many places, consists of simplified versions of results which appeared earlier in research papers, it is accessible to anyone with a good grasp of only complex function theory. No other background is assumed; either physical or mathematical.

This book can be recommended very highly to any serious student of the heat equation; and indeed, to anyone who wishes to have an excellent self-contained account of this equation.

Washington University
St. Louis, Missouri 63130

ERVIN Y. RODIN

Mathematics and Computers in Archaeology. By J. E. DORAN and F. R. HODSON. Harvard University Press, Cambridge, Massachusetts, 1975. 381 pp. $18.00.

With *Mathematics and Computers in Archaeology*, J. E. Doran and F. R. Hodson have made an exceedingly useful and important contribution to the discipline. This book is a thoroughly competent and readable elucidation of the use and misuse of mathematics and computers in archaeology. At a more philosophical level, the authors present an interesting and important general viewpoint on their subject.

Of the three parts of the book, the first is devoted to a lucid and complete development of the mathematical concepts needed to understand the subsequent discussion of archaeological data analysis. The second part is the heart of the book, wherein important topics in archaeological data analysis are explained and evaluated. In the third and final part of the book, the authors survey and comment on some current ideas in the mathematical analysis of archaeological data.

An introductory chapter generally outlines the authors' approach to archaeology and the relevance of mathematics to that approach. In the following three chapters of Part 1, the authors clearly and logically introduce basic concepts in mathematics, probability, statistics and computer science. Worthy of particular mention is the fact that these subjects are presented in a unified framework which underlines many of their inter-relationships which generally are neglected. Reading of this section requires only a minimal high school background in mathematics, yet it should be appreciated even by mathematically sophisticated readers.

In Part 2, Doran and Hodson systematically discuss most of the techniques which have been used in the mathematical analysis of archaeological data, in the context of the more general issues to which they apply. Chapters are devoted to: "The initial quantification of archaeological evidence", "Measures of similarity and correlation", "Automatic classification" "Taxonomy and typology" and "Other methods of multivariate analysis".

For each topic discussed, the issues are thoroughly defined and considerable historical background is often included. The techniques which have been proposed to deal with particular problems presented by the topic are explained, and examples of their use are drawn from the archaeological literature. However, the authors do not simply present a catalog of methods of data analysis. They evaluate the different techniques and their applications in relation to the other techniques available, and in the general context of the topic at hand. Their dry assessments of many published applications are quite informative, as well as being often amusing.

The final chapter of Part 2 presents detailed analyses of some archaeological data, utilizing several of the techniques which its author has found most valuable. These analyses illustrate the progression of analytical steps from the raw data to some rather convincing conclusions. Their clear, complete and precise presentation might serve as a model for the description of mathematical applications in archaeology.

The third and final part of the book extends the discussion of Part 2 to some current and inadequately explored topics involving the use of mathematics and computers in archaeological problems. A chapter is devoted to "Automatic seriation", not because of any hope the authors hold out for its success, but rather because of the extraordinary amount of energy which has thus far been invested in it. Rather more optimistic chapters survey "Mathematical models and computer simulations" and "Computer-based archaeological data banks".

The final chapter is devoted to a spirited review of a few of the more hotly debated topics in contemporary archaeology. In particular, they somewhat skeptically review the discussion of the potential value of General Systems Theory and enter fully into the debate concerning archaeological systematics and the philosophy of science. They cogently argue against the primarily Hempelian view of systematics advanced by the "New Archaeology" saying that they see no evidence that an emphasis on Hempelian terminology and systematics has produced any results which could not have been produced by an otherwise careful and reasoned study. They go on to present a rather more flexible alternative view of archaeological systematics.

What seems to be the principal deficiency of this book is an adequate discussion of the use of probability sampling in archaeology. This is an area of considerable concern and some debate, which deserves a more thorough discussion than it has received. Finally, there are errors in Tables 9.1 and 9.2, and Table 9.11 is inconsistent with the discussion in the text. (For the benefit of readers who may wish to use these data, in Table 9.1, unit 2 variable 13 should have the value 11, and in Table 9.2, unit 17 variable 7 should read 2.068.)

Mathematics and Computers in Archaeology is an extraordinary work which should be read by anyone with a serious interest in the analysis of archaeological data. Professional archaeologists and graduate students will find it invaluable, while it is certainly comprehensible to undergraduates with an interest in the subject. It would make an excellent text for a graduate course in analytical methods. Readers in other social sciences may appreciate the superb mathematical background of Part 1, and the explanations and examples of data analysis techniques (many of which have applications outside archaeology) given in Part 2. If carefully read, it should allow even the mathematically naive reader, at a minimum, to read intelligently and to evaluate virtually any mathematical application in archaeology. Even experts in this area should profit from the wealth of information and the skill with which it is presented.

With *Mathematics and Computers in Archaeology*, Doran and Hodson have skillfully informed us as to the proper use of a variety of useful techniques of data analysis. Yet, they take a rather more cautious view of the use and usefulness of these methods than do many of their colleagues. Above all, they properly emphasize that mathematics and the magical machine are of no value without careful thought throughout the analysis, from the initial coding of the data to the formulation of the conclusions.

Museum of Anthropology, University of Michigan
Ann Arbor, Michigan 48109, *U.S.A.*

KEITH KINTIGH

Multiple Regression and Analysis of Variance by G. O. WESOLOWSKY, Wiley Interscience, New York, 1976. 292 pp. $19.95

This book is concerned with the regression analysis and its applications including its duality with the analysis of variance. What is done is, in general, done well within the confines of the amount of space. The discussion is supplemented by examples and illustrations using the format of a computer printout. In this regard, the book is well-planned in view of the fact that the regression and analysis of variance are usually performed using computers.

The book is clearly directed toward readers in business, economics and related fields; it would seem appropriate for beginning graduate students in these fields. As a text it can be covered in a semester. The book may also be useful as a reference for applied statisticians, especially those engaged in computer analysis. No calculus is required, but some mathematical sophistication is needed to understand the material presented. A basic course in statistics is strongly recommended as a prerequisite.

Chapter 1 reviews statistical concepts but it is too condensed, and without a previous course in statistics, the reader may not be able to comprehend the concepts. Chapters 2 and 3 are concerned with the method of computing, test of hypothesis, interpretation, etc. dealing with multiple regression. One point to be made clear is that $E(b_1') \neq \beta_1$ in the model including two X's, while b_1' is still unbiased in the model containing a single X. Chapter 4 deals with the technique of selecting variables to be included in the regression. The methods described are well known stepwise-type approaches. Chapter 5 shows the idea of transformations of a nonlinear model to a linear regression model and the use of dummy