transform, is followed by one on functions of more than one variable. In this the authors have managed to include an account of information theory. Another chapter is devoted to differential equations both ordinary and partial. The Laplace transform and Fourier series methods of solutions are given as well as others.

Throughout the book there are many illustrations from and applications to problems in biology and medicine, e.g. the law of allometric growth and the cupulogram in otology to select two sections at random. Every effort has been made to make the text intelligible to the student and the authors have not hesitated to advise the students not to worry about a derivation where the introduction of rigour would obscure the point of the argument. Altogether, the book should be very helpful in teaching the biologist and doctor.

D. S. JONES

CUNNINGHAM, W. J., *Introduction to Nonlinear Analysis* (McGraw-Hill, New York, 1959), 348 pp., 70s.

This book gives an account of numerical, graphical and analytical methods of solving ordinary non-linear differential equations. The level of presentation is determined by the fact that the book is based on a graduate course in electrical engineering given by the author at Yale. It will be of little interest to mathematicians except to provide useful illustrations to those lecturing to engineering students on differential equations.

I. N. SNEDDON

ALDER, H. L., AND ROESSLER, E. B., *Introduction to Probability and Statistics* (W. H. Freeman & Co., San Francisco & London, 1960), pp. 252+xi, 20s.

This is intended as a textbook for a 45-hour introductory course in probability and statistics. It is based on lectures given for several years to students in the agricultural sciences, business administration, economics, home economics, psychology, sociology, geology and the medical sciences. The only mathematical knowledge assumed in the reader is school algebra, so that students of science subjects in this country might find the pace, particularly at the beginning, rather slow. But often students who have for years lost contact with formal mathematics find a need to acquire a knowledge of statistical methods: for them the gradual introduction of this book to algebra may be very suitable.

The topics covered are organisation of data, measures of central tendency and of dispersion, elementary probability, the binomial and normal distributions, large sample methods, testing hypotheses, confidence limits, the t-test, the sign test, regression and correlation, the χ^2-distribution, index numbers, and time series. The treatment of these last two topics is designed for economics students: otherwise there is no emphasis on any particular application.

For its purpose the book should be quite satisfactory. It introduces to readers of very modest attainments quite a number of standard statistical methods, well illustrated by worked examples. The exposition is clear enough, and where proofs are omitted the fact is clearly stated. There is a good selection of exercises at the end of each chapter, including " practical " ones from a variety of fields of application. Since the answers to half of them are given, the book could conceivably be used for self-study.

Such defects as have been noticed are not serious. The most striking omission is the Poisson distribution, which receives only a mention. The word " variate " is used in a sense which appears to be unusual, even in America, to denote what would more ordinarily be called a " variate-value ".

Of the tables provided, those of ordinates of the normal curve and squares and square roots seem unnecessarily full. A brief classified bibliography should prove useful to those who wish to go further in the subject: some of its entries evidently look forward to considerable progress on the part of the student.

The book is well printed and produced and the price is reasonable.

A. J. HOWIE

RICHTMEYER, R. D., *Difference Methods for Initial-Value Problems* (Interscience, New York, 1958), 238 pp., $7.25

The theory and practice of replacing partial differential equations by systems of finite-difference equations and solving them by a step-wise process are treated in this well-written and attractive volume. Part I is devoted to the theory. Here the convergence of the approximate solution to the true solution of the differential equation is discussed as well as such topics as the rates of convergence and stability of systems of difference equations, and methods of solving implicit difference systems. The general theory is based on Lax's theorem on the connexion between stability and convergence. It is then applied to initial-value problems for equations with constant coefficients. Part II, which forms the larger part of the book, is devoted to the study of special problems in mathematical physics.

This excellent book can be recommended to those interested in the theory of partial differential equations (as well as in applied mathematics) and particularly to research workers using high-speed computers to obtain solutions of initial-value problems.

I. N. SNEDDON

HASELGROVE, C. B., AND MILLER, J. C. P. *Tables of the Riemann Zeta Function*, Royal Society Math. Tables, No. 6 (Cambridge, 1960), 50s.

This volume contains tables of the following functions: (i) $\mathscr{R}\zeta(\frac{1}{2}+it)$, $\mathscr{I}\zeta(\frac{1}{2}+it)$, $Z(t)$, $\theta(t)$, $\mathscr{R}\zeta(1+it)$, $\mathscr{I}\zeta(1+it)$ to six decimals over the range $t = 0(0{\cdot}1)100$. (ii) $Z(t)$ to six decimals for $t = 100(0{\cdot}1)1000$. (iii) The first 1600 zeros γ_n of $\zeta(\frac{1}{2}+it)$ $(t<2090{\cdot}4)$ to six decimals, with various auxiliary quantities such as $|\zeta'(\frac{1}{2}+i\gamma_n)|$. (iv) Values of $Z(t)$ for miscellaneous ranges of t, namely 7000(0·1)7025, 17120(0·1)17145, 100000(0·1) 100025 and 250000(0·1)250025 to illustrate various irregularities; thus the largest value of $|Z(t)|$ so far found, of approximately 19, occurs near $t = 17123$. (v) $\pi^{-1}\mathrm{ph}\Gamma(\frac{1}{2}+it)$ to six decimals for $t = 0(0{\cdot}1)50(1)600(2)1000$.

Here $Z(t) = \pm|\zeta(\frac{1}{2}+it)|$, the sign being changed as t passes through each zero, and

$$\theta(t) = \frac{1}{\pi}\,\mathrm{ph}\left\{\pi^{-\frac{1}{2}it}\,\Gamma(\tfrac{1}{4}+\tfrac{1}{2}it)\right\}.$$

The use of the notation ph (for *phase*) in place of the customary somewhat ambiguous notations of arg and amp will be observed.

The methods of computation used are fully described. The work was carried out on the Cambridge EDSAC and Manchester Mark I machines and was checked by independent calculations using different formulae. Information of the kind given in the tables has already been used by Dr. Haselgrove to disprove a conjecture of Pólya; it is to be hoped that the tables will prove to be of further use in settling other unsolved problems in the theory of numbers.

The following errors were noted: On p. xi, line 6 from bottom, read 0 for (0); on p. xii, line 5, read $\zeta'(\rho_n)$ for $\zeta(\rho_n)$.

R. A. RANKIN

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