REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS

77[1].—R. V. Gamkrelidze, Editor, *Progress in Mathematics*, Vol. I: *Mathematical Analysis*, Translated from Russian, Plenum Press, New York, 1968, ix + 246 pp., 24 cm. Price $15.00.

The original was published in 1966 for the All-Union Institute of Scientific and Technical Information in Moscow as a volume of Itogi Nauki-Seriya Matematika. It contains three survey articles, each with extensive references to the literature. The first, by V. A. Ditkin and A. P. Prudnikov, is on *Operational Calculus*, the second, by V. P. Khavin, on *Spaces of Analytic Functions*, and the third, by V. V. Nemytskii, M. M. Vainberg and R. S. Gusarova, on *Operational Differential Equations*. Readers of this journal might be interested in a section on numerical methods for inverting the Laplace transform, which appears in the first article.

W. G.

78[2.05, 2.10, 2.15, 2.20, 2.55, 3, 4, 5, 8, 12, 13.15, 13.35, 13.40].—Melvin Klerer & Granino A. Korn, Editors, *Digital Computer User's Handbook*, McGraw-Hill Book Co., New York, 1967, xii + 922 pp., 24 cm. Price $27.50.

Quoting the editors of this massive tome, "We have aimed at a comprehensive single-volume work treating practical and currently applicable methods of programming, numerical analysis and leading fields of computer applications." In our opinion, they have not succeeded; and it is doubtful that any such venture would succeed. What emerges here is another anthology of 31 separate articles, ranging in quality from excellent to poor and misleading, and in form from mathematical essay (e.g., Wilkinson) to tables of formulae (e.g., Karplus and Vemuri). It is difficult to imagine the buyer who would find this a useful investment at the purchase price required.

The book is divided evenly into three parts: Programming, Numerical and Statistical Methods, and Applications.

Programming. Elements of Programming, M. Klerer; Computer Number Systems and Arithmetic, M. Klerer; Errors, Loss of Significance, and Data Presentation, M. Klerer; Computer Characteristics Table, Charles W. Adams Associates; Algorithmic Compiler Design, A. A. Grau; Structure and Use of ALGOL 60, H. Bottenbruch; List-processing Languages, Paul W. Abrahams; Computer Languages for System Simulation, Howard S. Krasnow; PERT/CPM, William C. Geoghan; Sorting and Merging, Martin A. Goetz.

Numerical and Statistical Methods. A Survey of Function-approximation Techniques, Granino A. Korn; Solution of Linear Algebraic Equations and Matrix Problems by Direct Method, James H. Wilkinson; Solution of Nonlinear Equations, Royce E. Beckett; Interpolation, Curve Fitting, and Differentiation, Kaiser S. Kunz; Numerical Integration, A. H. Stroud; Numerical Solution of Ordinary Differential Equations, R. W. Hamming; Numerical Solution of Partial Differential Equations, Walter J. Karplus and Venkateswararao Vemuri; Introduction to Statistical Methods, Granino A. Korn; Statistical Techniques and Computations, Henry Tucker; Computation of Power Spectra, Melvin Klerer; Random-Number Generation and Monte-Carlo Methods, T. E. Hull.

Applications. Symbolic Logic and Practical Applications, J. V. Wait; Information Theory and Codes, Harvey L. Garner; Linear Programming, Lloyd Rosenberg; Nonlinear Programming, E. M. L. Beale; Commercial Data Processing, Robert V. Head; Digital Computers for Logical Design, Richard E. Merwin and Jere L. Sanborn; Information Retrieval, Jack Belzer and Orrin E. Taulbee; Some Parameter-optimization Techniques, Robert B. McGhee; Scheduling and Inventory Control, Jerry L. Sanders; Real-time Operations with Small General-purpose Computers, Barbara W. Stephenson.

J. M. O.
E. J. Schweppe

University of Maryland
Computer Science Center
College Park, Maryland 20740

79[2.05, 2.10, 2.15, 2.35, 2.55, 3, 4].—David G. Moursund & Charles S. Duris, *Elementary Theory and Application of Numerical Analysis*, McGraw-Hill Book Co., New York, 1967, xi + 297 pp., 24 cm. Price $8.95.

The authors' objectives are to provide an introduction to modern numerical analysis at the sophomore-junior level, to describe a few selected but important methods and algorithms with mathematical rigor, paying due regard to error analysis, and concurrently, to review and solidify some basic relevant concepts of elementary calculus. These objectives have been attained to a remarkable degree, and the book can be highly recommended for its intended use. The chapter headings are: 1. Solution of equations by fixed-point iteration, 2. Matrix computations and solution of linear equations, 3. Iterative solution of systems of equations, 4. Polynomials, Taylor's series, and interpolation theory, 5. Errors and floating-point arithmetic, 6. Numerical differentiation and integration, 7. Introduction to the numerical solution of ordinary differential equations, 8. Numerical solution of ordinary differential equations. Each chapter contains numerous numerical examples, programs in FORTRAN with sample outputs, and a large number of exercises, mostly of the "drill" type.

W. G.

80[2.05, 6, 7].—Martin Avery Snyder, *Chebyshev Methods in Numerical Approximation*, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1966, x + 114 pp., 24 cm. Price $7.50.

This is another volume of the Prentice-Hall Series in Automatic Computation. It is concerned with methods for constructing polynomial and rational approximations to functions. Emphasis is given to those methods employing Chebyshev polynomials (Chebyshev series, economization of power series, Lanczos' τ-method, Maehly's method, economization of continued fractions), although other miscellaneous methods are also considered (Padé approximation, Kopal's method, Thiele's continued fraction). Contrary to what the title might suggest, minimax approximation is discussed only incidentally. There are two introductory chapters, one devoted to general remarks on approximation, the other to properties of Chebyshev polynomials, and an appendix with some material on linear difference equations with constant coefficients and Bessel functions. The book concludes with a list of formulas.

Unfortunately, the quality of the exposition does not live up to the standards one has come to expect from this series. Not only is the treatment inexcusably superficial, but the author is given to loose terminology, and inaccurate, sometimes misleading, or even faulty, statements. When discussing Chebyshev expansions, for example, the discrete orthogonality property of Chebyshev polynomials is stated incompletely (p. 30), and as stated does not yield the expression for the expansion coefficients given later. Further on, the author derives the Chebyshev expansion for b^{zx}, not noting that it follows directly from the previously derived expansion for e^{zx} (by replacing z by $z \ln b$). On p. 66, in connection with the equivalence of power series and continued fractions (Euler's formulas) the author states that by taking the first few convergents of the continued fraction, one obtains "rational approximations to any function that has a power series expansion," apparently unaware that the convergents are identical with the partial sums of the power series. The remark that follows, concerning convergence of continued fractions, is entirely out of place in this context. The list of inadequacies, such as these, could be continued at some length.

According to the preface, the "book is intended to be used either as a textbook at the advanced undergraduate or graduate level or as a handbook for people actively engaged in the field." It seems to this writer that the serious shortcomings of the exposition preclude classroom use of the book, and as a reference book it is lacking in precision and completeness.

W. G.

81[2.10, 2.25, 3, 4, 5, 6, 7, 8, 12, 13.05, 13.15].—BERTRAM MOND, Editor, *Blanch Anniversary Volume*, Aerospace Research Laboratories, Office of Aerospace Research, United States Air Force, 1967, 379 pp., 29 cm. Unbound copies of this volume can be purchased at $3.00 per copy from Clearing House for Federal, Scientific and Technical Information, Springfield, Virginia 22151.

This is a collection of papers on a variety of subjects presented to Dr. Gertrude Blanch on the occasion of her retirement as a senior scientist from the Aerospace Research Laboratories at Wright-Patterson Air Force Base. The contributors and their titles are as follows:

Gaetano Fichera, Dedication

John V. Armitage, The Lax-Wendroff method applied to axial-symmetric swirl flow

Henry E. Fettis, Calculation of toroidal harmonics without recourse to elliptic integrals

Gaetano Fichera, Generalized biharmonic problems and related eigenvalue problems

Karl G. Guderley and Marian Valentine, On error bounds for the solution of systems of ordinary differential equations

H. Leon Harter, Series expansions for the incomplete gamma function and its derivatives

Charles L. Keller and Mark C. Breiter, Bounds on the value of a Dirichlet integral representing a coefficient of apparent mass

Paruchuri R. Krishnaiah, Selection procedures based on covariance matrices of multivariate normal populations

Yudell L. Luke, Recursion formulas for polynomials in rational approximations to generalized hypergeometric functions

Mary D. Lum, On degradation of combination locks and the maximum time to open them

Robert E. Lynch, Generalized trapezoid formulas and errors in Romberg quadrature

Knox Millsaps and Norman L. Soong, Heat transfer in a plane incompressible laminar jet

Bertram Mond and Donald S. Clemm, Some computational aspects of the tensor product of linear programs

Bertram Mond and Oved Shisha, A difference inequality for operators in Hilbert space

Ida Rhodes, The mighty man-computer team

Paul R. Rider, Products and quotients of generalized Cauchy variables

Max G. Scherberg, Explorations of supersonic shear flow over a cavity

Henry C. Thacher, Jr., Computation of the complex error function by continued fractions

Peter Wynn, Transformations to accelerate the convergence of Fourier series.

It might have been fitting, for this occasion, to include a scientific biography of Dr. Blanch and a list of her publications. Even so, Dr. Blanch's own interests, influence, and guidance, are reflected in a good many of the papers presented.

W. G.

82[3, 4, 5, 13.15, 13.35].—DONALD GREENSPAN, Editor, *Numerical Solutions of Nonlinear Differential Equations*, John Wiley & Sons, Inc., New York, 1966, x + 347 pp., 24 cm. Price $7.75.

These are the proceedings of an Advanced Symposium conducted by the Mathematics Research Center, U. S. Army, at the University of Wisconsin, May 9–11, 1966, containing fourteen lectures by invited speakers, and 24 abstracts of contributed papers.

The principal authors and their titles are as follows:

Garrett Birkhoff, Numerical solution of the reactor kinetics equations

J. R. Cannon, Some numerical results for the solution of the heat equation backwards in time

C. W. Clenshaw, The solution of van der Pol's equation in Chebyshev series

L. Collatz, Monotonicity and related methods in non-linear differential equations problems

Germund G. Dahlquist, On rigorous error bounds in the numerical solution of ordinary differential equations

Stuart E. Dreyfus, The numerical solution of non-linear optimal control problems

H. B. Keller and H. Takami, Numerical studies of steady viscous flow about cylinders

Heinz-Otto Kreiss, Difference approximations for the initial-boundary value problem for hyperbolic differential equations

M. Lees and M. H. Schultz, A Leray-Schauder principle for A-compact mappings and the numerical solution of non-linear two-point boundary value problems

William F. Noh, A general theory for the numerical solution of the equations of hydrodynamics

Seymour V. Parter, Maximal solutions of mildly non-linear elliptic equations

L. E. Payne, On some non-well-posed problems for partial differential equations

J. B. Rosen, Approximate computational solution of non-linear parabolic partial differential equations by linear programming

Minoru Urabe, Galerkin's procedure for non-linear periodic systems and its extension to multi-point boundary value problems for general non-linear systems.

Birkhoff proposes a combination of singular perturbation and numerical integration for dealing with the notoriously delicate reactor kinetics equations. Cannon reports on some numerical experiments of continuing a solution of the heat equation backwards in time. Clenshaw describes a doubly iterative scheme for computing the periodic solution of the van der Pol equation to high accuracy, noting certain advantages of economy resulting from the use of Chebyshev series. Collatz gives many examples to show how ideas from functional analysis, notably monotonicity principles and fixed-point theorems, can fruitfully be employed to obtain error bounds for the approximate solution of complicated nonlinear problems. Dahlquist explores the use of majorant functions to construct rigorous error bounds in the numerical solution of ordinary differential equations. Dreyfus discusses the solution of general nonlinear optimal control problems using second-order variational analysis and dynamic programming. Keller and Takami present detailed results for the numerical solution of the Navier-Stokes equations. They consider steady two-dimensional incompressible viscous flow about a circular cylinder and report on successful calculations for Reynold numbers as high as 15. Kreiss investigates L_2-stability of difference approximations to hyperbolic partial differential equations with variable coefficients. Lees and Schultz formulate two fixed-point theorems for "approximately compact" mappings, analogous to the Leray-Schauder principle for completely continuous mappings, and apply them to obtain existence and convergence theorems for the solution of two-point boundary value problems by finite difference methods. Noh discusses difference schemes for the numerical solution of flow problems involving contact discontinuities. Striking numerical results are presented for the case of a hyper-velocity pellet impacting on a target. Parter examines the stability, and approximation by difference methods, of maximal solutions to nonlinear boundary value problems admitting more than one solution. Payne discusses stabilization procedures for solutions of non-well-posed problems for second order systems of partial differential equations. Rosen investigates the application of linear programming to the approximate solution of nonlinear parabolic differential equations and reports on the results for a number of test problems. Urabe studies the solution of multipoint boundary value problems for systems of nonlinear ordinary differential equations by Galerkin's method using finite Fourier and Chebyshev series. In particular, he gives convergence theorems, and conditions under which the existence of a solution can be ascertained from computed approximate solutions.

Rapid progress in computer technology, in recent years, has made it possible to attack nonlinear differential equations problems of great complexity, and thus has led to a renewed interest in the design and analysis of relevant computational methods. The present volume provides a well-balanced, and well-documented, survey of current research in this area.

W. G.

83[4, 6].—Louis Brand, *Differential and Difference Equations*, John Wiley & Sons, Inc., New York, 1966, xvi + 698 pp., 24 cm. Price $11.95.

This is a skillfully written introductory book on the more classical parts of the subject. Its distinguishing features are the conscious effort made to bring out the formal analogies and interplays between differential and difference equations, the generous consideration given to applications in the physical sciences, and the inclusion of Mikusiński's operational calculus, both for functions of a continuous and a discrete variable. The chapter headings are: 1. Differential equations of the first order, 2. Important types of first-order equations, 3. Linear equations of the second order, 4. Linear equations with constant coefficients, 5. Systems of equations, 6. Applications, 7. Laplace transform, 8. Linear difference equations, 9. Linear difference equations with constant coefficients, 10. Solutions in series, 11. Mikusiński's operational calculus, 12. Existence and uniqueness theorems, 13. Interpolation and numerical integration, 14. Numerical methods.

W. G.

84[7].—Aldo Ascari, *A Table of the Repeated Integrals of the Error Function*, Internal Report S/6339, Società Richerche Impianti Nucleari (SORIN), Nuclear Research Center, Saluggia, Vercelli, Italy, 1968, v + 104 pp., 31 cm. Deposited in UMT file.

This table consists of 10S unrounded values (in floating-point form) of the normalized repeated integrals, $A_n i^n$ erfc x, of the complementary error function $2\pi^{-1/2} \int_x^\infty e^{-t^2}\, dt$, for the range $n = 1(1)24$, $x = 0(0.01)5.20$.

The corresponding values of $A_n = 2^n \Gamma((n/2) + 1)$ and its reciprocal are listed to 12S (also unrounded) in a preliminary table.

We are informed in the introduction that this table evolved as a by-product of the numerical solution of a specific diffusion problem, obtained on an Olivetti-Elea 6001/S computer at the Center.

The computation of the successive integrals was performed by means of the standard three-term recurrence formula, which was decomposed into a system of two first-order recurrences. The author states that several recurrent checks were applied to random entries, and were found invariably to be satisfied to at least 9S.

At the conclusion of the introductory remarks it is stated that the tabular entries were all obtained by chopping the 14S computer results to 10S. This, of course, means that terminal-digit errors can range up to nearly a unit.

Included in the appended list of six references are the tables of Berlyand et al. [1], which the present author has found unreliable, confirming the evaluation thereof made by this reviewer. He also refers to the comparatively brief, but useful, table of Gautschi [2].

In the opinion of this reviewer, the present table supersedes all previous tables of this type, and consequently represents a significant contribution to the related tabular literature.

J. W. W.

1. O. S. Berlyand, R. I. Gavrilova & A. P. Prudnikov, *Tables of Integral Error Functions and Hermite Polynomials,* Pergamon Press, Oxford, 1962. (See *Math. Comp.,* v. 17, 1963, pp. 470–471, RMT **80.**)
2. M. Abramowitz & I. A. Stegun, Editors, *Handbook of Mathematical Functions with Formulas, Graphs, and Mathematical Tables,* National Bureau of Standards, Applied Mathematics Series, No. 55, U. S. Government Printing Office, Washington, D. C., 1964, pp. 317–318, Table 7.4.

85[7].—M. Lal & W. Russell, *Table of Factorials 0! to 9999!*, Department of Mathematics, Memorial University of Newfoundland, St. John's, Newfoundland, September 1967. Ms. of 3 + 200 pp., 28 cm. Deposited in the UMT file. Price $10.00.

This attractively printed, bound table consists of 50S unrounded values of $n!$ for $n = 0(1)9999$, arranged in floating-point form. Exact values of the first 48 entries can be read from the table.

The introduction contains a statement that the underlying calculations were performed on an IBM 1620 and the tabular output was printed on an IBM 407, Model E8. Appended to the introduction is a one-page Fortran listing of the program used in the initial calculation, which extended to 23S. This program was subsequently modified to permit the handling of 100S products. The authors express the belief that their results were probably correct to at least 90S before reduction to 50S in the final printout.

Reference is made in the introduction to earlier, closely related tables by Reitwiesner [1], Salzer [2], and Reid & Montpetit [3]. To this list there should be added the tables of Giannesini & Rouits [4]. These tables are all of much lower precision than the one under review.

It seems appropriate to this reviewer to mention here the existence of extensive manuscript tables [5] of exact factorials by these same authors.

J. W. W.

1. G. W. Reitwiesner, *A Table of Factorial Numbers and their Reciprocals from 1! through 1000! to 20 Significant Digits,* Ballistic Research Laboratories, Technical Note No. 381, Aberdeen Proving Ground, Maryland, 1951. (*MTAC,* v. 6, 1952, p. 32, RMT **955.**)
2. H. E. Salzer, *Tables of n! and* $\Gamma(n + 1/2)$ *for the First Thousand Values of n,* National Bureau of Standards, AMS 16, Washington, D. C., 1951. (*MTAC,* v. 6, 1952, p. 33, RMT **957.**)
3. J. B. Reid & G. Montpetit, *Table of Factorials 0! to 9999!*, Publication 1039, National Academy of Sciences—National Research Council, Washington, D. C., 1962. (*Math. Comp.,* v. 17, 1963, p. 459, RMT **67.**)
4. F. Giannesini & J. P. Rouits, *Tables des coefficients du binôme et des factorielles,* Dunod, Paris, 1963. (*Math. Comp.,* v. 18, 1964, p. 326, RMT **40.**)
5. M. Lal, *Exact Values of Factorials 200! to 550!*; and M. Lal & W. Russell, *Exact Values of Factorials 500! to 1000!*, Department of Mathematics, Memorial University of Newfoundland, St. John's, Newfoundland; the first dated August 1967, the second undated. (*Math. Comp.,* v. 22, 1968, pp. 686–687, UMT **67, 68.**)

86[7, 9].—M. Lal & W. F. Lunnon, *Expansion of* $\sqrt{2}$ *to 100,000 Decimals,* University of Manchester, Manchester, England, December 10, 1967. Computer output deposited in the UMT file.

Continuing the computation in [1] and [2], the authors have now extended the $\sqrt{2}$ to 100,000D by the use of the Atlas Computer in Manchester. The Newton-

Raphson method was used, as in [2] and [3], and the computation required about 2 hours. The result is elegantly printed on 40 pages.

The decimal-digit frequency and a computed χ^2 is given for each block of 1000 digits. These 100 values of χ^2 were examined by the undersigned for their own distribution—theoretically, 10% should lie between 0 and 4.168, 10% between 4.168 and 5.380, etc. The actual distribution is

10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
11	14	11	7	8	14	7	5	8	15

which itself has a χ^2 of 11 with 9 degrees of freedom. This is a thoroughly satisfactory test for randomness.

The authors also counted runs of like digits. These counts were made with the convention of disregarding the digits immediately before and after the counted run; thus, the eight digits 32412–32419D are 54444442 and are counted as one sextuple, two quintuples, three quadruples, and four triples. There are 1023 triplets, 105 quadruples, 11 quintuples, and two sextuples. These run counts, therefore, also satisfactorily agree with the predictions based upon an hypothesis of randomness. Compare the earlier suggestions that the $\sqrt{2}$ may not be normal that are mentioned in the review of [1].

D. S.

1. *Math. Comp.*, v. 21, 1967, pp. 258–259, UMT 17.
2. *Math. Comp.*, v. 22, 1968, p. 226, UMT 12.
3. *Math. Comp.*, v. 22, 1968, p. 234, UMT 22.

87[7, 10].—Peter H. Roosen-Runge, *A Table of Bell Polynomials*: Y_1 *to* Y_{16}, Communication 212, Mental Health Research Institute, The University of Michigan, Ann Arbor, Michigan, August 1967, 23 pp., 28 cm.

The polynomials tabulated in this report were first studied by Bell [1] as a generalization of his exponential numbers [2]. They are presented here in the form

$$Y_n = \sum_{k=1}^{n} f_k A_{n,k}(g_1, \cdots, g_n) .$$

In his introductory text the author identifies Y_n with the nth derivative of a composite function $Y = f(g)$, where subscripts are used to designate the orders of the respective derivatives of f and g.

The computation of the present table was performed on an IBM 7090 system, using recurrence relations incorporated in a program written in SNOBOL. This program is appended to the explanatory text.

The author also shows the connection between the Bell polynomials and certain combinatorial problems, as revealed by the formula of Faà di Bruno [3].

Three applications of these polynomials to the evaluation of the coefficients of exponential generating functions are described; two of these are attributed to Riordan [3].

The first eight and ten polynomials, respectively, were checked against the corresponding tables in Riordan [3, p. 49] and the NBS *Handbook* [4]. The author found that a table of the first 11 polynomials by Hsieh & Zopf [5] has several errors in the entries for Y_{10} and Y_{11}. In spite of the precautions taken to insure complete accuracy of the present table, the reviewer has detected a typographical error: In Y_9 the coefficient of the second term in $A_{9,3}$ should read 1260 instead of 126. Four additional typographical errors, subsequently discovered by the author, have also been corrected in the copy of this table deposited in the UMT file.

This useful and attractively printed table represents one of the more interesting applications of electronic computers to tablemaking.

J. W. W.

1. E. T. Bell, "Exponential polynomials," *Ann. of Math.*, v. 35, 1934, pp. 258–277.
2. E. T. Bell, "Exponential numbers," *Amer. Math. Monthly*, v. 41, 1934, pp. 411–419.
3. J. Riordan, *An Introduction to Combinatorial Analysis*, John Wiley & Sons, New York, 1958.
4. M. Abramowitz & I. A. Stegun, Editors, *Handbook of Mathematical Functions with Formulas, Graphs, and Mathematical Tables*, National Bureau of Standards, Applied Mathematics Series No. 55, U. S. Government Printing Office, Washington, D. C., 1964, Table 24.2, pp. 831–832.
5. H. S. Hsieh & G. W. Zopf, *Determination of Equivalence Classes by Orthogonal Properties*, Technical Report No. 2, Project No. 60(8–7232), Electrical Engineering Research Laboratory, University of Illinois, 1962.

88[8].—Roy C. Milton, *Rank Order Probabilities: Two-Sample Normal Shift Alternatives*, University of Minnesota, Department of Statistics, Technical Report No. 53, Minneapolis, Minnesota, 1965.

Let $X_1, \cdots, X_m$ and $Y_1, \cdots, Y_n$ be samples drawn from two different populations. Nonparametric tests for equality of the two populations are based on the rank order statistic $\mathbf{Z} = (Z_1, \cdots, Z_N)$, $N = n + m$, where Z_j is 1 or 0 according as the jth smallest observation is a Y or an X.

The distribution of $\mathbf{Z}$ under the null hypothesis is well known: $\mathbf{Z}$ takes on each of its possible values with probability $m!n!/N!$. Milton's tables give the distribution of $\mathbf{Z}$ under the alternative hypothesis that $X_1, \cdots, X_m, Y_1, \cdots, Y_n$ are Gaussian with variances all equal to σ^2 and means μ_1 for the X's and μ_2 for the Y's. The distribution of $\mathbf{Z}$ depends only on m, n and $\Delta = (\mu_2 - \mu_1)/\sigma$. In fact if $\mathbf{z} = (z_1, \cdots, z_N)$ is a vector of m zeros and n ones in some order then the probability that $\mathbf{Z}$ takes on the value $\mathbf{z}$ is

$$P_{m,n}(\mathbf{z}|\Delta) = m!n! \int \cdot \quad \cdot \quad \cdot \int_{-\infty < t_1 < \cdots < t_N < \infty} \prod_{j=1}^{N} \phi(t_j - \Delta z_j) dt_j ,$$

where $\phi(t) = (2\pi)^{-1/2} \exp(-t^2/2)$ is the standard Gaussian density function. Milton tabulates $P_{m,n}(\mathbf{z}|\Delta)$ for all choices of $\mathbf{z}$ and for $1 \leqq m \leqq 7$, $1 \leqq n \leqq 7$, $\Delta = .2(.2)1.0,1.5,2.0,3.0$.

The tables also contain values of the Wilcoxon statistic, the Fisher-Yates c_1 and c_2 statistics. The sections are arranged according to increasing values of $m + n$. The values of $P_{m,n}(\mathbf{z}|\Delta)$ for a given small value of $m + n$ appear on one double spread page; values for large $m + n$ are listed on successive pages; the columns are indexed by values of $\mathbf{z}$ and are arranged in decreasing order of the c_1 statistic with ties broken by the c_2 statistic.

Various applications of the table are discussed in the introduction; the most obvious application is to the computation of power functions of nonparametric tests which in the reviewer's experience can be done quite easily with these tables. These tables permitting detailed small sample comparisons between parametric and nonparametric tests are a major contribution to research in mathematical statistics.

George G. Woodworth

Stanford University
Stanford, California 94305

89[12].—James A. Saxon, Herman S. Englander & William R. Englander, *System 360 Programming*, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1968, vii + 231 pp., 27 cm. Price $5.75 (Paper bound).

This is a self-instruction manual designed by the authors to enable the beginning programmer to become acquainted with the elements of IBM 360 programming. In addition to being suitable for self-study, this manual could also be used in the class situation.

After each topic is covered, there is a "work area." The answers to questions in this section are found on the back of the page so that the correct answers are not seen until the page is physically turned.

The reader is immediately introduced to the current nomenclature of bits, bytes, words and the hexadecimal system, etc. so that a previous exposure to programming is definitely helpful and is, in fact, recommended.

As the authors rightly state, the reader will not become an expert computer programmer after having studied this book, but it is fair to add that it provides a well designed course which most intelligent folk will find both challenging and rewarding.

Henry Mullish

Courant Institute of Mathematical Sciences
New York University
New York, New York 10012