Numerical Mathematical Analysis. By J. B. Scarborough. Baltimore, The Johns Hopkins Press, 1930. xiv+416 pp.

Mathematics has been defined as the science of avoiding computation, and in many fields of pure mathematics the ideal is to achieve results by reasoning which involves no computation. In recent years numerical mathematics has grown rapidly in connection with statistics, biology, and other sciences, and computation is a necessary consequence. It is in the fields of applied mathematics where numerical results are demanded that it becomes most desirable to avoid unnecessary and inaccurate computation. The object of Professor Scarborough's book "is to set forth in systematic manner and as clearly as possible the most important principles, methods, and processes used for obtaining numerical results; and also methods and means for estimating the accuracy of such results."

The book is not a treatise on computation in the sense of convenient forms and efficient arrangements. These are usually highly specialized and the fundamental principles with which the book deals are not so specialized. Notations peculiar to certain subjects have been avoided and the treatment has been made as elementary as is consistent with soundness. Assuming only a knowledge of elementary calculus, the author has succeeded in giving an excellent presentation of his material. Specialists in some of the topics may disagree with the choice of material and may regret the omission of a few methods like that of divided differences in the standard formulas of interpolation, but the author has made his choice with a definite view in mind. He has "tried everywhere to clear up the difficulties before the student meets them, so that no teacher or other source of information will be needed."

This ideal in the matter of explanation is particularly laudable in a work of this character because its greatest usefulness will be as a reference book when one needs to use methods which are not very familiar to him. After an exposition of the theory underlying a formula, the reader is shown how to use it and its limitations are carefully pointed out. The book would serve well as a classroom text. At the present time no large number of students pursue such a course, but an increasing number of mathematicians and scientists are performing work for which the methods here treated are essential. Since it seems likely that the book will be most widely used for individual study without the guidance of a teacher, its value would be increased if answers were given to most of the problems.

The following list of chapter headings will indicate the contents. 1. The accuracy of approximate calculations. 2. Interpolation (Newton's formulas). 3. Interpolation (central-difference formulas). 4. Interpolation (Lagrange's formula. Inverse interpolation). 5. The accuracy of interpolation formulas. 6. Interpolation with two independent variables. Trigonometric interpolation. 7. Numerical differentiation and integration. 8. The accuracy of quadrature formulas. 9. The solution of numerical algebraic and transcendental equations. 10. Graeffe's root-squaring method for solving algebraic equations. 11. The numerical solution of differential equations (method of successive approximations). 12. Convergence and accuracy of the iteration process. 13. Other methods for the numerical solution of differential equations (J. C. Adams, Runge-

Rutta, Milne). 14. The normal law of error and the principle of least squares. 15. The precision of measurements. 16. Empirical formulas. 17. Harmonic analysis of empirical functions.

Problems are given at the end of every chapter and a table of values of the probability integral is given in an appendix. Of particular importance for a work of reference is the adequate index.

W. R. LONGLEY

The Mathematical Part of Elementary Statistics. By Burton Howard Camp. New York, D. C. Heath and Company, 1931. 409 pp.

Professor Camp's new book is a most thoroughly worked out and comprehensive textbook for teaching the student with the minimum of mathematical preparation the maximum about the mathematical tools of statistical analysis. In fact the extent to which mathematical formulas and results which depend on mathematical considerations of a more or less advanced character for their complete understanding are explained and made available to students whose mathematical equipment is not supposed to go beyond analytic geometry, almost makes this book a new departure in its class.

The book is divided into three parts, the third part being tables with an introduction to them. The first part covers a minimum course for one semester and avoids the more difficult notions of Part II. Part II takes up the point binomial, the Gram-Charlier series, sampling, the Tchebycheff inequality and modifications of it, the X-square test, and a more thorough discussion of correlation including an admirable geometrical explanation of multiple correlation. There is also an introductory chapter on finite differences. A feature of the tables is their adaptability to the problem of easily getting a good approximation to the sum of a group of consecutive terms of a skew point binomial.

Most texts on statistics are sadly lacking in problems; every teacher of statistics knows how hard they are to get up, and Professor Camp is to be congratulated on the full and excellent tests he has provided.

Because of the author's wide first-hand knowledge of the subject, what he has to say about mathematical statistics is accurate. (It seems at least doubtful to the reviewer whether the logical difficulties involved in any attempt to define probability should be mentioned in a book of this character. The author does not mention them.) But the reviewer cannot feel entirely comfortable about teaching so much more about the subject than can be taught of it. He is thoroughly convinced of the value of the study of mathematical statistics and probability as a discipline, of its value for its own sake as a branch of mathematics. And he confesses to being dubious about the practical utility of the knowledge one can gain at second-hand about matters as complex as many of those dealt with in the second half of Professor Camp's book. Perhaps it should be stated explicitly here that this review is written from the point of view of one interested in mathematical statistics for its own sake. But there is great pressure from outside upon mathematics departments to teach the practical methods of mathematical statistics to students of small mathematical preparation and maturity, and wherever this is undertaken Professor Camp's book will be a very valuable aid.

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