Examples (*continued*):

special instructions (essentially repetitive instructions for dealing with the 24 diseases simultaneously) were used.

Running times: Part 1, 25 hours; Part 2 (marginal totals and printing only required), 40 mins.

From the above examples it will be seen that the running time for large-scale jobs is very considerable. Magnetic tape (for storing data when more than one run is required, and for the storage of intermediate results) and more adequate card-reading facilities would improve matters substantially, but faster computing speeds are also desirable.

Nevertheless, even with the present equipment, the program is proving of great value in enabling very varied survey analyses to be made without special programming.

Reference

YATES, F., and SIMPSON, H. R. (1960). "A General Program for the Analysis of Surveys," *The Computer Journal*, Vol. 3, p. 136

Book Reviews

Exponentially Distributed Random Numbers, by C. E. CLARK and B. W. HOLZ, 1961; 249 pages. (Baltimore: *Johns Hopkins Press;* London: *Oxford University Press*, 52s. 0d.)

The probability density function e^{-x}, $0 \leqslant x < \infty$, is commonly used in reliability studies, queuing problems and other branches of applied statistics. Artificial sampling work in these fields will be facilitated by this table of 100,000 sample values for the corresponding distribution. The numbers are given to four decimal places and are grouped into 1,000 sub-samples of 100 each. The mean and second moment and certain other statistics of each sub-sample are also tabulated; apart from identifying exceptional sub-samples, the authors suggest that these quantities might be used to obtain stratified samples from the distribution. The numbers were generated on a Remington Rand 1103A computer by an ingenious method due to von Neumann. Besides being based on pseudo-random numbers obtained by a well-known technique, the printed numbers were subjected to various tests of randomness with excellent results.

The book consists of pages reproduced from typescript held together by a somewhat flimsy plastic ring-binder. In view of this, the price seems rather high.

M. J. R. HEALY.

Methods of Feasible Directions. A Study in Linear and Non-linear Programming, by G. ZOUTENDIJK, 1960; 132 pages. (London: *D. Van Nostrand Company Ltd.*, 30s. 0d.; Amsterdam: *Elsevier Publishing Company*).

The methods described in this monograph are methods for optimizing functions of many variables subject to constraints on these variables—procedures often described as "programming" in the economic sense. More particularly, the problem is that of maximizing a concave function over a convex region. A well-known special case is that of Linear Programming, and the most popular method for solving it, the simplex procedure, turns out to be a special case of feasible direction methods. However, this applies as well to a number of other methods devised to solve this and related problems, such as the primal-dual method, Rosen's gradient projection method, Beale's quadratic programming method, and Frank and Wolfe's method for non-linear programming with linear constraints.

All these procedures can be obtained from the general scheme by specializing the requirements for the starting point (the initial solution), the direction in which the steps approaching the optimum are taken, and the length of these steps. There exists thus an analogy with results obtained by Hestenes and Stiefel who showed that several methods for solving systems of linear equations are actually methods of conjugated directions and differ only in the way that these directions are fixed.

The first six chapters of the book are taken up with a thorough and clear introduction to the theory of convex programming, a detailed discussion of existing methods, and a comparison of the various algorithms (yielding as a by-product an improved version of the product-form scheme). Chapter 7 introduces the methods of feasible directions, explains the rules for finding an initial solution and for determining the direction and length of the steps, and discusses the question of convergence. The remaining four chapters deal mainly with the various special forms obtained by different normalization procedures as outlined above. Of particular practical value is the fact that these methods can be applied to the solution of very large problems of special structure by reducing them to a sequence of smaller sub-problems.

The language of the book is clear and rigorous, the notation concise and systematic, but this is no book for beginners. The printing is too closely spaced for comfort, and there are irritating details such as the use of a handwritten l, and of a sub- and superscript (ν) which appears larger than the symbols it is affixed to. One is left wishing that the whole book could be reprinted by a publisher having better facilities for the type-setting of mathematical symbols and being more generous in his use of paper—even at a somewhat increased price.

D. G. PRINZ.