42[F].—A. Gloden, *Table des Solutions de la Congruence* $x^4 + 1 \equiv 0 \pmod p$ *pour* $800\,000 \leqq p \leqq 1\,000\,000$, published by the author, rue Jean Jaurès, 11, Luxembourg, 1959, 22p., 30 cm., mimeographed. Price 150 Belgian francs.

This volume represents the culmination of independent efforts of table-makers such as Cunningham, Hoppenot, Delfeld, and the author, extending over a period of several decades. The foreword contains an extensive list of references to earlier publications of this type, which combined with the tables under review give the two least positive solutions of the congruence $x^4 + 1 \equiv 0 \pmod p$ for all admissible primes less than one million. [See RMT **109,** *MTAC*, v. 11, 1957, p. 274 for a similar list of references.]

Professor Gloden has used such congruence tables in the construction of manuscript factor tables of integers $N^4 + 1$, which now extend to $N = 40\,000$, with certain omissions. The bibliography in the present set of tables also contains references to this work. Numerous references to these factor tables are also listed in RMT **2,** *MTAC*, v. 12, 1958, p. 63.

J. W. W.

43[G, X].—F. R. Gantmacher, *Applications of the Theory of Matrices*, translated by J. L. Brenner, Interscience Pub., New York, 1959, ix + 317 p., 24 cm. Price $9.00.

This is a remarkable book containing material, not easily available elsewhere, related to the analysis of matrices as opposed to the algebra of matrices. In this I use the word analysis to mean broadly that part of mathematics largely dependent upon inequalities (and limits) as opposed to algebra, which depends largely on equalities.

In particular, the material in this book is directed largely toward studies of stability of solution of linear differential equations (in Chapters IV and V) and of matrices with nonnegative elements (in Chapter III).

Several aspects of the book will be useful to numerical analysts. These include some parts of the chapter on matrices with nonnegative elements, the implications of the chapters on stability of solutions of differential equations to the stability of numerical methods of solving differential equations, and (as the author points out) a numerically feasible method of finding the roots of polynomials.

Many topics included in this text are not easily available elsewhere. For example, product integration is expounded; this is an amusing version of Euler's method applied to the solution of linear first-order homogeneous differential equations. Most of the other exposition is unique in one way or another, and on the whole the book is a valuable contribution to literature.

This is a translation, augmented to some extent by bibliographic and other notes, of the second part of a successful Russian book. It is interesting to note that another publisher has announced the impending publication of translations of both parts.

The printing is good, and the reviewer noticed no serious errors. There are four short appendices devoted to standard elementary theorems, a bibliography with seventy-two entries, and a useful index. The chapter headings follow:

Chapter I. Complex Symmetric, Antisymmetric and Orthogonal Matrices
Chapter II. Singular Bundles of Matrices
Chapter III. Matrices with Nonnegative Elements
Chapter IV. Applications of the Theory of Matrices to the Study of Systems of Linear Differential Equations
Chapter V. The Routh-Hurwitz Problem and Related Questions.

C. B. T.

44[K].—JOSEPH BERKSON, "Tables for use in estimating the normal distribution by normit analysis," *Biometrika*, v. 44, 1957, p. 411–435.

In a quantal response assay a number of independent tests are made at each of a number of dose levels, and the result of each test is graded as "success" or "failure". If the probability of "success" at dose metameter value x is assumed to follow the "normal" law

$$P(x) = 1/\sqrt{2\pi} \int_{-\infty}^{(x-\mu)/\sigma} e^{-t^2/2}\, dt$$

the method of "normit analysis" is proposed by Berkson as a replacement for the familiar (iterative) method of "probit analysis" for estimating the parameters μ and σ.

Suppose that the dose metameter values used are $x_1, \cdots, x_k$, that n_i tests are made at level x_i, and that r_i of these tests result in success. Let

$$p_i = \begin{cases} 1/(2n_i) \text{ if } r_i = 0 \\ r_i/n_i \text{ if } 0 < r_i < n_i \\ 1 - 1/(2n_i) \text{ if } r_i = n_i, \end{cases}$$

$X_i = X(p_i)$, where $X(p)$ is defined by the relation

$$p = (1/\sqrt{2\pi}) \int_{-\infty}^{X(p)} e^{-u^2/2}\, du,$$

$$Z_i = (1/\sqrt{2\pi})\, e^{-X_i^2/2},$$

$$w_i = Z_i^2/p_i(1 - p_i).$$

The method consists of a weighted regression analysis, which is facilitated by tables which give for each p_i the corresponding values of w_i and w_iX_i.

In table 2 w_i and w_iX_i are given to $6D$ for $p = 0.001(0.001)0.500$. (For $p > \frac{1}{2}$, $w(p) = w(1 - p)$ and $wX(p) = -wX(1 - p)$.) For moderate n_i interpolation may be avoided by use of Table 1, which gives w_i and w_iX_i, also to $6D$, for all combinations of r_i and n_i for which $1 < n_i \leqq 50$ and $0 \leqq r_i \leqq n/2$. (For $r > n/2$, $w(r, n) = w(n - r, n)$ and $wX(r, n) = -wX(n - r, n)$.) It is stated that the entries in both tables are correct to within ± 1 in the final digit.

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