Selected Bibliography of Statistical Literature, 1930 to 1957: III. Limit Theorems

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This is the third in a series of bibliographies dealing with various specific subjects in the field of statistics. References and titles of important contributions concerning limiting distributions have been taken from technical journals published throughout the world since 1930.

Complete coverage is not claimed in this series of bibliographies. It is believed, however, that the two prominent reviewing journals whose abstracts serve as our source material, have selected for review the writings of major statistical importance from technical journals and publishing houses throughout the world.

This particular subject classification on *Limit Theorems* follows two earlier ones on *Correlation and Regression Theory* and *Time Series*.[1] The 675 references have been extracted from a card file of abstracts taken from *Zentralblatt für Mathematik* for the years 1930 to 1939, and from *Mathematical Reviews* for 1940 through 1957. This file of abstracts is maintained on a current basis in the NBS Statistical Engineering Laboratory. The abstracts are coded into categories of subject matter by the subject classification used in *Mathematical Reviews*. One abstract may be classified under several subjects, hence may appear in more than one place in this series of bibliographies.

To transcribe the material given here from the abstracts, the references were punched onto 80-column cards thereby necessitating severe and unconventional abbreviations in many cases.

The following information is extracted directly from the abstracts:

Author: The author's surname is followed by initials only. In the case of complicated surnames, we have used the first capitalized word given in the reviewing journal. Multiple authorship is denoted by the symbol ♦ preceding the surname. The journal reference appears after each author's name but the title of the paper is given with the first author only.

Title: This is given exactly as in the reviewing journal. Titles of separately bound publications (books, reports, etc.) are italicized, and are followed by the publisher's name and address.

Reference to literature: The name of the journal in italics, the number of the volume in bold face, the initial page number, and the date of publication in parentheses comprise the reference to the original article.

Reference to the abstract: The final symbols M (for *Mathematical Reviews*) and Z (for *Zentralblatt für Mathematik*) followed by a volume number and a page number refer to the abstract of the article or book appearing in the reviewing journal.

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(Paper 64B3–34)

Publications of the National Bureau of Standards*

(Including papers in outside journals)

Selected Abstracts

Propagation at oblique incidence over cylindrical obstacles, M. P. Bachynski, *J. Research NBS* **64D**, *No. 4, 311 (1960)*. Investigations of propagation of short electromagnetic waves at oblique incidence over smooth, perfectly conducting cylindrical obstacles are described. It is shown that the effect of oblique incidence can be considered as a change in the effective radius of curvature of the diffracting obstacle. The power in the shadow region of a cylindrical obstacle decreases with angle of obliqueness for horizontally polarized waves and can decrease, remain constant, or increase with angle of obliqueness for vertically polarized waves depending on the geometry of the propagation link. In all cases, vertical polarization gives a stronger field in the shadow region than horizontal polarization. In addition it is shown that the diffracted field behind an obstruction of uniform radius of curvature is the same as that behind an obstacle of uniformly varying radius of curvature, provided the effective radius is the same.

Diffraction by smooth conical obstacles, H. E. J. Neugebauer and M. P. Bachynski, *J. Research NBS* **64D**, *No. 4, 317 (1960)*. Expressions, obtained earlier for the calculation of diffraction due to conducting obstacles with smooth cylindrical surfaces, are generalized to oblique incidence and to surfaces of conical shape. The derivation is based on a generalized concept of the Green's function and on the use of corrective factors that take the same place as corrections introduced by other authors into the theory of diffraction by apertures. The final expressions for conical obstacles and oblique incidence are very similar to those for cylindrical obstacles. The results are compared with scale model measurements.

Mode theory and the propagation of ELF radio waves, J. R. Wait, *J. Research NBS* **64D**, *No. 4, 387 (1960)*. The mode theory of propagation of electromagnetic waves at extremely-low-frequencies (1.0 to 3000 c/s) is treated in this paper. Starting with the representation of the field as a sum of modes, approximate formulas are presented for the attenuation and phase constants. Certain alternate representations of the individual modes are mentioned. These are used as a basis for describing the physical behavior of the field at large distances from the source, particularly near the antipode of the source. At the shorter distances, where the range is comparable to the wavelength, the spherical-earth mode series is best transformed to a series involving cylindrical wave functions. This latter form is used to evaluate the near field behavior of the various field components. The effect of the earth's magnetic field is also evaluated using a quasi-longitudinal approximation. In general it is indicated that if the gyrofrequency is less than the effective value of the collision frequency, the presence of the earth's magnetic field may be neglected for ELF. When this condition is not met the attenuation may be increased somewhat. The influence of an inhomogeneous ionosphere is also briefly considered and, finally, the propagation of ELF pulses are treated. It is suggested that certain observed characteristics of ELF waveforms may be attributed to the inclination of the current channel in the lightning discharge.

On the diffraction of electromagnetic pulses by curved conducting surfaces, J. R. Wait and A. M. Conda, *Can. J. Phys.* **37**, *1384 (1959)*. Starting with the known steady-state solutions for diffraction by a perfectly conducting convex surface, the corresponding transient responses are derived using Fourier-Laplace inversion. Explicit results are given for an incident wave which varies with time as a step function.

Leonard Euler's integral: A historical profile of the gamma function, P. J. Davis, *Am. Math. Mo.* **66**, *849 (1959)*. This survey article shows how the gamma function grew in concept and in content from the time of Euler to the recent treatise of Bourbaki and how in this growth it partook of the general development of mathematics over the past two and a quarter centuries.

Confidence intervals for the expectation of a Poisson variable, E. L. Crow and R. S. Gardner, *Biometrika* **46**, *441 (1959)*. A table of "optimum" two-sided confidence intervals for the mean of a Poisson variable is presented for confidence coefficients 80, 90, 95, 99, and 99.9 percent and all values of the variable from 0 through 300. The intervals are compared in length with other existing or possible systems of intervals for the Poisson mean. The method of calculation is stated, and an interesting property of Poisson probability sums useful in the calculation is derived.

Use of the equation of hydrostatic equilibrium in determining the temperature distribution in the outer solar atmosphere, S. R. Pottasch, *Astrophys. J.* **131**, *No. 1, 68 (1960)*. The temperature distribution from 1.0043 (3000 km) to 20 solar radii in the sun's atmosphere is computed from the observed density distribution in this region and the assumption of hydrostatic equilibrium. The temperature distribution shows a maximum between 1.1 and 3 solar radii and a decrease in temperature thereafter. This decrease in temperature is consistent with Chapman's suggestion of thermal conduction only if loss of energy by radiation is included. Inclusion of a radiative energy loss also is shown to invalidate Parker's argument against hydrostatic equilibrium out to large distances from the sun.

On the convergence of the Rayleigh quotient iteration for the computation of characteristic roots and vectors, VI. (Usual Rayleigh quotient for nonlinear elementary divisors), A. M. Ostrowski, *Arch. Rat. Mech. Anal.* **4**, *No. 2, 153 (1959)*. In this paper the classical Rayleigh quotient iteration is discussed for eigenvalues with non-linear elementary divisors. The convergence of the method is only then satisfactory, if it is combined with the accelerating methods of Steffensen and Householder, but in this last case it turns out to be at least as good as the method of the generalized Rayleigh quotient.

Tables for the statistical prediction of radio ray bending and elevation angle error using surface values of the refractive index, B. R. Bean, B. A. Cahoon, and G. D. Thayer, *NBS Tech. Note 44 (PB151403) (1960) 50 cents.*

Radio ray bending, τ, and elevation angle error, ϵ, have been calculated for a wide range of meteorological conditions at 13 climatically diverse U.S. radiosonde stations. The parameters in the observed linear regression equations of τ and ϵ upon the surface value of the refractive index are given for heights of 0.1 to 70 kilometers and initial elevation angles of the ray from 0 to 900 milliradians.

Weighted restricted partitions, M. Newman, *Acta Arith.* **V**, *371 (1959)*.

Let $q_1(n)$ be the number of partitions of n into parts not divisible by q, and define $q_s(n)$ by $\{\Sigma q_1(n)x^n\}^s = \Sigma q_s(n)x^n$. In this article recurrence formulas for these coefficients of lengths independent of n are derived when q is any of the primes, 2, 3, 5, 7, 13.

A continuous poker game, A. J. Goldman and J. J. Stone, *Duke Math. J.* **27**, No. 1, 41 (1960).

In this paper we derive the solutions of a zero-sum two-person poker game in which the players' hands are independent random numbers from the intervals [0, 1]. The game involves two bet levels a, b and an ante of 1 unit $(a > b > 1)$. The players act alternately, and one of them is permitted a single raise.

Our model subsumes the alternating-bid von Neumann poker game of [4] as well as the model solved by Bellman [1]. The former arises from the limiting case $b = 1$, the latter as the "equal increments" case $a - b = b - 1$. (Karlin and Restrepo [3] have recently solved the equal increments game with n rounds of bidding.) The solution exhibits qualitative features like those of [4] and [1] and turns out to depend on a decomposition of [0, 1] into three subintervals corresponding to low hands, intermediate hands and high hands. Optimal strategies for the players are distinguished among the *semioptimal* strategies (those which achieve the value of the game against every optimal strategy of the opponent) by a specification of the average frequency of bluffing over the range of low hands and (for one player) by an integral sublinearity condition on the frequency of seeing a raise when holding an intermediate hand.

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