THE ANNALS
of
PROBABILITY

AN OFFICIAL JOURNAL OF
THE INSTITUTE OF MATHEMATICAL STATISTICS

Articles

Short Communications

Vol. 11, No. 1—February 1983

THE INSTITUTE OF MATHEMATICAL STATISTICS

(Organized September 12, 1935)

The purpose of the Institute of Mathematical Statistics is to encourage the development, dissemination, and application of mathematical statistics.

OFFICERS

NOTICE

Beginning with the calendar year 1982, the two journals of The Institute of Mathematical Statistics are printed quarterly. The total numbers of pages per volume are approximately the same as before. Months of publication for 1982 and 1983 are as follows.

Annals of Probability: February, May, August and November

Annals of Statistics: March, June, September and December

THE ANNALS
OF PROBABILITY

INSTRUCTIONS FOR AUTHORS

Submission of Papers. Papers to be submitted for publication should be sent to the Editor of the *Annals of Probability*. (For current address, see the latest issue of the *Annals*.) The original (or xerox copy) should be submitted with two additional copies on paper that will take ink corrections. The manuscript will *not* normally be returned to the author; when expressly requested by the author, one copy of the manuscript will be returned.

Preparation of Manuscripts. Manuscripts should be typewritten, entirely double-spaced, including references, with wide margins at sides, top and bottom. Dittoed or mimeographed papers are acceptable only if completely legible; xerox copies are preferable. When technical reports are submitted, all extraneous sheets and covers should be removed.

Submission of Reference Papers. Copies (preferably two) of unpublished or not easily available papers cited in the manuscript should be submitted with the manuscript.

Title and Abbreviated Title. This title should be descriptive and as concise as is feasible, i.e., it should indicate the topic of the paper as clearly as possible, but every word in it should be pertinent. An abbreviated title to be used as a running head is also required, and should be given below the main title. This should normally not exceed 35 characters. For example, a title might be "A Limit Theorem for Conditioned Recurrent Random Walk Attracted to a Stable Law," with the running head "Limit Theorem for Recurrent Random Walk" or possibly "Recurrent Random Walk Attracted to a Stable Law," depending on the emphasis to be conveyed.

Summary. Each manuscript is required to contain a summary which will be printed immediately after the title, clearly separated from the rest of the paper. Its main purpose is to inform the reader quickly of the nature and results of the paper; it may also be used as an aid in retrieving information. The length of a summary will clearly depend on the length and difficulty of the paper, but in general it should not exceed 150 words. It should be typed on a separate page, under the heading "Summary," followed by the title of the paper. Formulas should be used as sparingly as possible. The summary should not make reference to results or formulas in the body of the paper—it should be self-contained.

Footnotes. Footnotes should be reduced to a minimum and, where possible, should be replaced by remarks in the text or in the references; formulas in footnotes should be avoided. Footnotes in the text should be identified by superscript numbers and typed together, double-spaced on a separate page.

Key Words. Included as the first footnote on page 1 should be the headings:

American Mathematical Society 1980 subject classifications. Primary —; Secondary—.
Key words and phrases.

The classification numbers representing the primary and secondary subjects of the article may be found with instructions for its use in the *Mathematical Reviews Annual Subject Index-1980*. The key words and phrases should describe the subject matter of the article; generally they should be taken from the body of the paper.

Identification of Symbols. Manuscripts for publication should be clearly prepared to insure that all symbols are properly identified. Distinguish between "oh" and "zero"; "ell" and "one"; "epsilon" and "element of"; "kappa" and "kay," etc. Indicate also when special type is required (Greek, German, script, boldface, etc.); other letters will be set in italics. Acronyms should be introduced sparingly.

Figures and Tables. Figures, charts, and diagrams should be prepared in a form suitable for photographic reproduction and should be professionally drawn twice the size they are to be printed. (These need not be submitted until the paper has been accepted for publication.) Tables should be typed on separate pages with accompanying footnotes immediately below the table.

Formulas. Fractions in the text are preferably written with the solidus or negative exponent; thus, $(a + b)/(c + d)$ is preferred to $\dfrac{a + b}{c + d}$, and

$(2\pi)^{-1}$ or $1/(2\pi)$ to $\dfrac{1}{2\pi}$. Also, $a^{b(c)}$ and $a_{b(c)}$ are preferred to a^{b_c} and a_{b_i}, respectively. Complicated exponentials should be represented with the symbol exp. A fractional exponent is preferable to a radical sign.

References. References should be typed double-spaced and should follow the style:

[5] Doob, J. L. (1944). The elementary Gaussian processes. *Ann. Math. Statist.* **15** 229–282.

In textual material, the format "... Doob (1944) ..." is normally preferred to "... Doob [5] ..." Multiple references can be distinguished as "... Doob (1944a) ..." Abbreviations for journals should be taken from a current index issue of *Mathematical Reviews*.

Proofs. Author will ordinarily receive galley proofs. Corrected galley proofs should be sent to the Managing Editor of the *Annals of Probability*. (For current address, see the latest issue of the *Annals*.)

EDITORIAL POLICY

The main purpose of the *Annals of Probability* and the *Annals of Statistics* is to publish contributions to the theory of probability and statistics and to their applications. The emphasis is on importance and interest, not formal novelty and correctness. Especially appropriate are authoritative expository papers and surveys of areas in vigorous development. All papers are refereed.

IMS INSTITUTIONAL MEMBERS

AEROSPACE CORPORATION
El Segundo, California

ARIZONA STATE UNIVERSITY
Tempe, Arizona

BELL TELEPHONE LABORATORIES, TECHNICAL
LIBRARY
Murray Hill, N.J.

BOWLING GREEN STATE UNIVERSITY, DEPT.
OF MATHEMATICS
Bowling Green, Ohio

CALIFORNIA STATE UNIVERSITY, FULLERTON,
DEPARTMENT OF MATHEMATICS
Fullerton, California

CASE WESTERN RESERVE UNIVERSITY, DE-
PARTMENT OF MATHEMATICS
Cleveland, Ohio

CORNELL UNIVERSITY, DEPARTMENT OF
MATHEMATICS
Ithaca, New York

FLORIDA STATE UNIVERSITY, DEPARTMENT OF
STATISTICS
Tallahassee, Florida

GENERAL MOTORS CORPORATION, RESEARCH
LABORATORIES
Warren, Michigan

GEORGE WASHINGTON UNIVERSITY, DEPART-
MENT OF STATISTICS
Washington, D.C.

INDIANA UNIVERSITY, MATHEMATICS DEPT.
Bloomington, Indiana

INTERNATIONAL BUSINESS MACHINES CORPO-
RATION
Armonk, New York

IOWA STATE UNIVERSITY, STATISTICAL LABO-
RATORY
Ames, Iowa

JOHNS HOPKINS UNIVERSITY, DEPARTMENT OF
BIOSTATISTICS, DEPARTMENT OF MATHE-
MATICAL SCIENCES
Baltimore, Maryland

KANSAS STATE UNIVERSITY, STATISTICS DE-
PARTMENT
Manhattan, Kansas

MARQUETTE UNIVERSITY, MATHEMATICS AND
STATISTICS DEPARTMENT
Milwaukee, Wisconsin

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
MATHEMATICS DEPARTMENT
Cambridge, Massachusetts

MIAMI UNIVERSITY, DEPARTMENT OF MATH-
EMATICS
Oxford, Ohio

MICHIGAN STATE UNIVERSITY, DEPARTMENT
OF STATISTICS AND PROBABILITY
East Lansing, Michigan

NATIONAL SECURITY AGENCY
Fort George G. Meade, Maryland

NEW MEXICO STATE UNIVERSITY, DEPART-
MENT OF MATHEMATICAL SCIENCES
Las Cruces, New Mexico

NORTH CAROLINA STATE UNIVERSITY, DE-
PARTMENT OF STATISTICS
Raleigh, North Carolina

NORTHERN ILLINOIS UNIVERSITY, DEPART-
MENT OF MATHEMATICAL SCIENCES
De Kalb, Illinois

NORTHWESTERN UNIVERSITY, DEPARTMENT
OF MATHEMATICS
Evanston, Illinois

OHIO STATE UNIVERSITY, DEPARTMENT OF
STATISTICS
Columbus, Ohio

OREGON STATE UNIVERSITY, DEPARTMENT OF
STATISTICS
Corvallis, Oregon

PENNSYLVANIA STATE UNIVERSITY, DEPART-
MENT OF STATISTICS
University Park, Pennsylvania

PRINCETON UNIVERSITY, DEPARTMENT OF
STATISTICS
Princeton, New Jersey

PURDUE UNIVERSITY LIBRARIES
Lafayette, Indiana

QUEEN'S UNIVERSITY, DEPT. OF MATHEMATICS
AND STATISTICS
Kingston, Ontario, Canada

RICE UNIVERSITY, DEPARTMENT OF MATHE-
MATICAL SCIENCES
Houston, Texas

THE ROCKEFELLER UNIVERSITY
New York, New York

SIMON FRASER UNIVERSITY, MATHEMATICS
DEPARTMENT
Burnaby, Canada

SOUTHERN ILLINOIS UNIVERSITY, MATHEMAT-
ICAL STUDIES
Edwardsville, Illinois

SOUTHERN METHODIST UNIVERSITY, DEPART-
MENT OF STATISTICS
Dallas, Texas

STANFORD UNIVERSITY, GIRSHICK MEMORIAL
LIBRARY
Stanford, California

STATE UNIVERSITY OF NEW YORK, BUFFALO,
DEPARTMENT OF STATISTICS
Amherst, New York

TEMPLE UNIVERSITY, MATHEMATICS DEPART-
MENT
Philadelphia, Pa

TEXAS TECH UNIVERSITY, DEPARTMENT OF
MATHEMATICS
Lubbock, Texas 79409

YORK UNIVERSITY, DEPARTMENT OF MATHE-
MATICS
Downsview, Ontario, Canada

THE TOBACCO INSTITUTE
Washington, D.C.

UNION OIL COMPANY OF CALIFORNIA, UNION
RESEARCH CENTER
Brea, California

UNIVERSITY OF ARIZONA, DEPARTMENT OF
MATHEMATICS AND COMMITTEE ON STA-
TISTICS
Tucson, Arizona

UNIVERSITY OF BRITISH COLUMBIA, DEPART-
MENT OF MATHEMATICS
Vancouver, B.C., Canada

UNIVERSITY OF CALGARY, MATHEMATICS DE-
PARTMENT
Calgary 44, Alberta, Canada

UNIVERSITY OF CALIFORNIA, BERKELEY, STA-
TISTICAL LABORATORY
Berkeley, California

UNIVERSITY OF CALIFORNIA, DAVIS, DIVISION
OF STATISTICS
Davis, California

UNIVERSITY OF GUELPH, MATHEMATICS AND
STATISTICS DEPARTMENT
Guelph, Ontario, Canada

UNIVERSITY OF ILLINOIS AT CHICAGO CIRCLE,
DEPARTMENT OF MATHEMATICS
Chicago, Illinois

UNIVERSITY OF ILLINOIS, MATHEMATICS DEPT.
Urbana, Illinois

UNIVERSITY OF IOWA, DIVISION OF MATHE-
MATICAL SCIENCES
Iowa City, Iowa

UNIVERSITY OF MANITOBA, DEPARTMENT OF
STATISTICS
Winnipeg, Manitoba, Canada

UNIVERSITY OF MARYLAND, DEPARTMENT OF
MATHEMATICS
College Park, Maryland

UNIVERSITY OF MASSACHUSETTS, DEPART-
MENT OF MATHEMATICS AND STATISTICS
Amherst, Massachusetts

UNIVERSITY OF MICHIGAN, DEPARTMENT OF
STATISTICS
Ann Arbor, Michigan

UNIVERSITY OF MINNESOTA, SCHOOL OF STA-
TISTICS
Minneapolis, Minnesota

UNIVERSITY OF MISSOURI, DEPARTMENT OF
STATISTICS
Columbia, Missouri

UNIVERSITY OF MISSOURI AT ROLLA, DEPART-
MENT OF MATHEMATICS
Rolla, Missouri

UNIVERSITY OF MONTREAL, DEPARTMENT OF
MATHEMATICS
Montreal, Quebec, Canada

UNIVERSITY OF NEBRASKA, MATHEMATICS
AND STATISTICS DEPARTMENT
Lincoln, Nebraska

UNIVERSITY OF NEW MEXICO, DEPARTMENT
OF MATHEMATICS AND STATISTICS
Albuquerque, New Mexico

UNIVERSITY OF NORTH CAROLINA, DEPART-
MENT OF STATISTICS
Chapel Hill, North Carolina

UNIVERSITY OF OREGON, MATHEMATICS DE-
PARTMENT
Eugene, Oregon

UNIVERSITY OF OTTAWA, DEPARTMENT OF
MATHEMATICS
Ottawa, Ontario, Canada

UNIVERSITY OF SOUTH CAROLINA, DEPART-
MENT OF MATHEMATICS AND COMPUTER
SCIENCE
Columbia, South Carolina

UNIVERSITY OF TEXAS, DEPARTMENT OF
MATHEMATICS
Austin, Texas

UNIVERSITY OF TEXAS, MATHEMATICS DEPT.
San Antonio, Texas

UNIVERSITY OF VICTORIA, DEPT. OF MATHE-
MATICS
Victoria, British Columbia, Canada

UNIVERSITY OF VIRGINIA, DEPT. OF MATHE-
MATICS
Charlottesville, Virginia

UNIVERSITY OF WASHINGTON, DEPARTMENT
OF MATHEMATICS
Seattle, Washington

UNIVERSITY OF WATERLOO, STATISTICS DE-
PARTMENT
Waterloo, Ont , Canada

UNIVERSITY OF WISCONSIN, MADISON, DE-
PARTMENT OF STATISTICS
Madison, Wisconsin

UNIVERSITY OF WISCONSIN, MILWAUKEE, DE-
PARTMENT OF MATHEMATICS
Milwaukee, Wisconsin

VIRGINIA COMMONWEALTH UNIVERSITY, DE-
PARTMENT OF MATHEMATICAL SCIENCES
Richmond, Virginia

WAYNE STATE UNIVERSITY, DEPARTMENT OF
MATHEMATICS
Detroit, Michigan

WESTINGHOUSE ELECTRIC CORPORATION, RE-
SEARCH LABORATORIES
Pittsburgh, Pennsylvania

The Writings of Leonard Jimmie Savage
—A Memorial Selection

The American Statistical Association and
The Institute of Mathematical Statistics
announce publication of the selected works of Jimmie Savage

Contents include:

• 45 selected reprints of papers published between 1940–1977, photographed from the original sources

• Biographical sketches and personal insights by W. Allen Wallis, Frederick Mosteller, Francis Anscombe, and William and Esther Sleator

• Scholarly essay, "L.J. Savage—His Work in Probability and Statistics," by D. V. Lindley

• Complete bibliography of all published papers, books, reviews, and discussions by Savage

736 pages, bound in blue kidskin

Papers included:

A Dynamic Problem in Duopoly
On the Crossing of Extremals at Focal Points
Unbiased Estimates for Certain Binomial Sampling Problems with Applications
The Application of Vectorial Methods to Metric Geometry
A Uniqueness Theorem for Unbiased Sequential Binomial Estimation
Abandoning an Experiment Prior to Completion
Planning Experiments Seeking Maxima
Samuelson's Foundations: Its Mathematics
The Utility Analysis of Choices Involving Risk
Application of the Radon-Nikodym Theorem to the Theory of Sufficient Statistics
Bayes and Minimax Estimates for Quadratic Loss Functions
The Theory of Statistical Decision
On the Set of Values of a Nonatomic, Finitely Additive, Finite Measure
The Expected-Utility Hypothesis and the Measurability of Utility
* Une Axiomatisation de Comportement Raisonnable Face a L'Incertitude
Three Problems in Rationing Capital
Symmetric Measures on Cartesian Products

The Nonexistence of Certain Statistical Procedures in Nonparametric Problems
When Different Pairs of Hypotheses Have the Same Family of Likelihood-Ratio Test Regions
Recent Tendencies in the Foundations of Statistics
Optimal Gambling Systems
The Foundations of Statistics Reconsidered
* Sul Modo di Scegliere le Probabilità Iniziali
* Campi di Applicazione e Tecniche della Statistica
* Uno Sguardo Sulla Statistica di Oggi
* Il Problema delle Strategie Ottime di Giòco
Bayesian Statistics
Bayesian Statistical Inference for Psychological Research
A Tchebycheff-Like Inequality for Stochastic Processes
Finite Stopping Time and Finite Expected Stopping Time
Difficulties in the Theory of Personal Probability
Implications of Personal Probability for Induction
A Geometrical Approach to the Special Stable Distributions
Comments on a Weakened Principle of Conditionality
Reading Suggestions for the Foundations of Statistics
A Generalized Unimodality
* Die Bayessche Entwicklungsstufe der Statistischen Schlussweise
Elicitation of Personal Probabilities and Expectations
The Characteristic Function Characterized and the Momentousness of Moments
The Mathematics of Glottochronology Revisited
Diagnosis and the Bayesian Viewpoint
Inequalities on the Probability Content of Convex Regions for Elliptically Contoured Distributions
Probability in Science: A Personalistic Account
On Rereading R.A. Fisher
The Shifting Foundations of Statistics

* Reprinted in original language