compute definite events with arbitrarily small frequencies of error despite modular, synaptic, and interconnection errors. The authors prove that, with certain assumptions not previously made, Shannon's noisy-channel coding theorem is applicable to noisy computing devices; and they show that this result leads to novel designs for the construction, out of fallible components and interconnections, of highly reliable finite automata that require smaller redundancies than any systems previously considered.

PERIODICALS

A New Journal

Journal of Mathematical Psychology

The first issue of the *Journal of Mathematical Psychology*, which will appear two times yearly, appeared in February 1964. This new journal will center its attention on mathematically-oriented research in the behavioral sciences, as the contents of the first issue suggest:

R. Duncan Luce and John W. Tukey, "On Simultaneous Conjoint Measurement: A New Type of Fundamental Measurement"

Norman H. Anderson, "Linear Models for Responses Measured on a Continuous Scale"

Donald A. Norman, "Sensory Thresholds, Response Biases, and the Neural Quantum Theory"

Morton P. Friedman and Harold Gelfand, "Transfer Effects in Discrimation Learning"

Tom Trabasso, "Component Learning in the Four-Category Concept Problem"

Helena Chmura Kraemer, "Point Estimation in Learning Models"

Jerome L. Myers and Richard C. Atkinson, "Choice Behavior and Reward Structure"

Roger N. Shepard, "Attention and the Metrice Structure of the Stimulus Space"

The Editor, Richard C. Atkinson of Stanford University, is supported by a Board of Editors consisting of R. R. Bush and R. D. Luce, University of Pennsylvania, W. J. McGill, Columbia University, W. K. Estes and P. Suppes, Stanford University, and G. A. Miller, Harvard University.

The Editor may be addressed at Ventura Hall, Stanford University, Stanford, California; subscription inquiries should be sent to the Academic Press, 111 Fifth Avenue, New York, New York, 10003.

Selected Contents

The Journal of Industrial Engineering, January–February 1964

Frederick S. Hillier, "The Application of Waiting Line Theory to Industrial Problems"

Myles M. Dryden, "How Do Recent Changes in Tax Laws Affect Investment Decisions?"

CECIL R. PHILLIPS, "Fifteen Key Features of Computer Programs for CPM and PERT"

M. E. BRONSON, "Incentive Coverage: When and How Much for a Performance Control System?"

VERNE S. MYERS, "The Reversible Relationships between Gross National Product and Research and Development Performed in Industry"

FORREST CAMPBELL, DONALD PIERCE, AND PAUL E. TORGERSON, "The Maintenance Game"

ARTHUR E. STUKEY, "Work Measurement in Perspective—Universal Time Data"

HAROLD E. SMALLEY, "Comments on 'Work Measurement in Perspective—Universal Time Data'"

Y. H. RUTENBERG, "Calculation of Economical Order Quantities Using Ranges of Setup Cost"

***Revue Française de Recherche Opérationnelle*, No. 28, 3rd Trimester 1963**

M. BOITEUX, "Perspectives nouvelles de la Recherche Operationnelle"

R. DESCAMPS, "Pour une dynamique de la Gestion"

R. ANTZENBERGER AND J. ROUVIÈRE, "Étude d'un jeu à deux coups pénalisés"

***Metra*, Volume 2 (1963), No. 3**

MICHEL ALGAN, PATRICE BERTIER, AND JEAN CERON, "Méthode pratique de détermination d'un plan optimum d'investissement"

EMERIC DEUTSCH, "L' étude psycho-sociologique du distributeur"

CHRISTIAN GOUX, "Le marché du café, du cacao et des bananes dans les pays du Marché Commun"

RENÉ LOUE, GEORGE NAHON, AND CLAUDE SCHERRER, "Étude économique de variantes du plan d' urbanisme de Nantes"

JACQUES LESOURNE, "Il calcolo economico"

REX BROWN, "Credence analysis—A guide to choosing research strategies"

MICHEL SALOMON, "Recherches sur des fonctions de consommation: Application à certains types de fonctions logistiques"

***Ablauf- und Planungsforschung*, Volume 4 (1963), No. 4**

H. WEDEKIND, "Ein linearer Programmansatz für das Fliessbandproblem"

G. TADDAY, "Ein Vorschlag zum Aufstellen eines Abbauzeitplanes für Steinkohlenflöze mit dem Ziel eines optimalen Gesamtergebnisses"

G. MATT, "Die schrittweise Regressionsanalyse und ihre Anwendungsmöglichkeit im kaufmännischen Bereich"

H. MULLER-MERBACH, "Optimale Losgrössen bei mehrstufiger Fertigung"

***Cahiers du Centre d'Études de Recherche Opérationelle*, Volume 5 (1963), No. 3**

J. SONNENSCHEIN, "Existence et unicité de la solution analytique d'un problème de file d'attente"

NICHOLE HENS, "Deux problèmes de la théorie des graphes"

W. BENIEST, "Jeux stochastiques totalement coopératifs arbitrés"

J. PIERRE BRANS, "Quelques aspects du problème de la ruine en théorie collective du risque"

Note

The Spanish statistical journal *Trabajos de Estadistica* will include articles on operations research from now on. To reflect this new interest, effective with the 1963 volume it will be known as *Trabajos de Estadistica y de Investigacion Operativa.*

Issues I and II of Volume XIV (1963) contain the following items of interest to operations-research workers:

J. TALACKO, "Natural Computational Method of Two-person Zero-sum Games"

P. ZOROA, "El Conjunto de Soluciones en la Programación Lineal"

J. M. GARCIA, "Encuesta sobre Utilización de Métodos Estadisticos y de Investigatición Operativa en la Industria"

This journal issues three numbers yearly totalling about 350 pages. For information on both editorial and subscription matters, write to PROF. SIXTO RIOS, Instituto de Investigaciones Estadisticas of the Consejo Superior de Investigaciones Cientificas, Serrano 123, Madrid 6, Spain.

THESIS

***Markovian Decision Processes with Uncertain Transition Probabilities or Rewards*, EDWARD ALLAN SILVER, Doctor of Science, Massachusetts Institute of Technology, August 1963**

IN MOST Markov process studies to date it has been assumed that both the transition probabilities and rewards are known exactly. The primary purpose of this thesis is to study the effects of relaxing these assumptions to allow more realistic models of real world situations. The Bayesian approach used leads to statistical decision frameworks for Markov processes.

The first section is concerned with situations where the transition probabilities are not known exactly.

One approach used incorporates the concept of multimatrix Markov processes, processes where it is assumed that one of several known transition matrices is being utilized, but we only have a probability vector on the various matrices rather than knowing exactly which one is governing the process. An explanation is given of the Bayes modification of the probability vector when some transitions are observed. Next, we determine various quantities of interest, such as mean recurrence times. Finally a discussion is presented of decision making involving multimatrix Markov processes.

The second approach assumes more directly that the transition probabilities themselves are random variables. It is shown that the multidimensional Beta distribution is a most convenient distribution (for Bayes calculations) to place over the probabilities of a single row of the transition matrix. Several important properities of the distribution are displayed. Then a method is suggested for determining the multidimensional Beta prior distributions to use for any particular Markov process. Next we deal with the effects on various quantities of interest of having