STATISTICAL LABORATORY

established 1933

annual report

Contents

THE STATISTICAL LABORATORY
Iowa State University
1975-76 Annual Report

Personnel

H. A. David directs the Statistical Laboratory, an institute under the president's office, and heads the Department of Statistics in the College of Sciences and Humanities. Also under Dr. David's direction are the statistics participants in the Agriculture and Home Economics Experiment Station, the Science and Humanities Research Institute, and the Engineering Research Institute. Staff members are shared among all components of the statistical complex.

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Three associate professors have been promoted to professors effective July 1, 1976: Roy Hickman, Dean Isaacson, and Robert Strahan.

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Chien-Pai Han was on Faculty Improvement Leave fall and winter quarters conducting research in multivariate analysis with the Statistics Department, Stanford University. D. F. Cox was a visiting professor in the Department of Agronomy and Range Sciences, University of California, at Davis. January 1-June 30; he was invited to teach and to assist in the planning and establishing of an applied statistics program. Glen Meeden will be on Faculty Improvement Leave for the 1976-77 academic year. He will be teaching and conducting research at Florida State University, Tallahassee.

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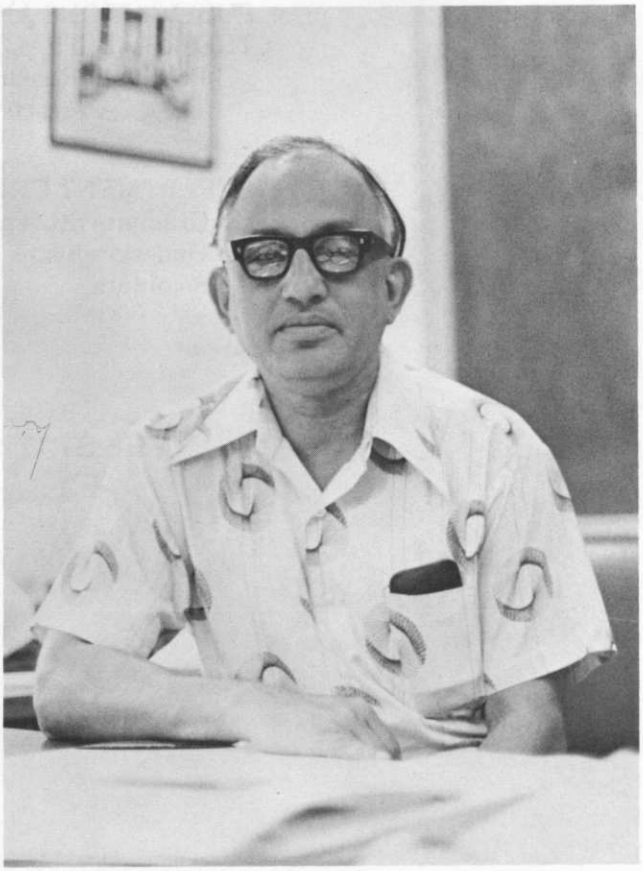
Summer, 1976, offered opportunities for various staff members to travel and present statistical lectures or to be employed by other universities or organizations. H. A. David will be going on a lecture tour to Australia under the auspices of CSIRO July 15-August 15. Richard Mensing is on leave without pay for the summer and is teaching in the Department of Statistics, Oregon State University, Corvallis. Barry Arnold is employed for the summer by the National Assessment of Educational Progress, Denver, Colorado. B. V. and Shashikala Sukhatme visited India during June and July. B. V. gave a series of lectures in designing surveys and analysis of survey data at the Institute of Agricultural Research Statistics, New Delhi, and Poona University. Mrs. Sukhatme presented seminars at Bombay and Poona.

During June and July, 1976, Dr. Debabrata (Dev) Basu joined the Statistical Laboratory as a visiting professor from Florida State University. His series of lectures, Foundations of Statistics, aroused wide interest, among both faculty and students. The course, apart from some more recent material, was based on his major Sankhȳa 1975 paper "Statistical Information and Likelihood."

Other visiting staff who participated in the teaching and research of the Statistical Laboratory for various periods during the year were: Bruce Bowerman, James Cornette, John Ingram, Prem Narain, C. Z. Roux, Robin Thompson and Mauritz van Aarde. Dr. Bowerman, Miami University, Oxford, Ohio, assisted H. T. David in teaching Statistics 644, SSII, 1975. Drs. Cornette, Mathematics Department, ISU; Narain, Institute of Agricultural Research in Statistics, New Delhi, India; Roux, Animal and Dairy Science Research Institute, Pretoria, South Africa; Thompson, University of Edinburgh, Scotland; and van Aarde, University of Stellenbosch, South Africa, were engaged in research in mathematical and statistical genetics for NIH and AES project 1669 under Drs. Kempthorne and Pollak. Dr. Ingram, Florida Technological University, Orlando, was employed by the Survey Section this past year as a postdoctoral associate.



Dr. Debabrata (Dev) Basu, Florida State University, was a visiting professor at the Statistical Laboratory during the summer of 1976.

A resignation was accepted from Michael Coveyou, joint Political Science-Statistics effective June 1. After July 1, Mr. Coveyou will be employed as an Operations and Program Analyst in the Research and Budget Office of the city of Des Moines, Iowa.

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Staff members for 1976-77 include Malay Ghosh who will continue as a visiting associate professor on leave from the Indian Statistical Institute.

Jeffery Goebel's appointment as assistant professor in the Survey Section begins July 1. Dr. Goebel received his B.A. degree in Mathematics from Bradley University, Peoria, in 1967 and M.S. and Ph.D. degrees in Statistics from Iowa State University in 1969 and 1974, respectively. Dr. Goebel was employed for 1½ years in industry working in the area of reliability analysis. For the past two years he has been a visiting assistant professor in the Survey Section of the Statistical Laboratory where his primary duties have been coordinating the design and analysis of regional and national survey projects with the Soil Conservation Service.

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Looking ahead to September 1, Barton A. Bixenstine will join the Statistical Laboratory in a joint appointment with Political Science. Kent State University awarded him the A.B. degree in 1971. Dr. Bixenstine earned the M.S. degree, 1973, and the Ph.D. degree, 1976, in Political Science from Indiana University, Bloomington. His areas of specialty are empirical political theory, methodology, American politics and political psychology. He has been employed as an associate instructor at Indiana University by the Political Science Department, 1972-1974, and by the Mathematics Department, 1975-76.

Statistical Laboratory Staff—Fiscal Year 1975-76 under the administrative direction of:

W. Robert Parks, Ph.D.—President of the University
Daniel J. Zaffarano, Ph.D.—Vice President for Research; Dean of the Graduate College
Wallace A. Russell, Ph.D.—Dean, College of Sciences and Humanities
Lee R. Kolmer, Ph.D.—Dean, College of Agriculture; Director, Iowa Agriculture and Home Economics Experiment Station
Herbert A. David, Ph.D.—Director, Statistical Laboratory; Head, Department of Statistics; Head, Statistics Department, Iowa Agriculture and Home Economics Experiment Station

Professors

Barry C. Arnold—joint appointment with Department of Mathematics
T. A. Bancroft
C. Philip Cox
David F. Cox
Herbert A. David
Herbert T. David—joint appointment with Department of Industrial Engineering
Wayne A. Fuller—faculty status in Economics as well as Statistics
Richard Groeneveld
Chien-Pai Han
David A. Harville
Donald K. Hotchkiss
David V. Huntsberger
Oscar Kempthorne—Distinguished Professor, College of Sciences and Humanities
Edward Pollak—joint appointment with Department of Genetics
Norman Strand—Professor Emeritus
B. V. Sukhatme
Richard D. Warren—joint appointment with Department of Sociology and Anthropology
Leroy Wolins—joint appointment with Department of Psychology
Debabrata Basu—visiting, summer 1976
James L. Cornette—visiting, summer 1975
William F. Taylor—Collaborator, in residence at Mayo Clinic

Associate Professors

Carol E. (Holly) Fuchs (temporary—December through May)
Malay Ghosh—visiting
Roy D. Hickman
Paul N. Hinz—faculty status in Forestry as well as Statistics
Dean L. Isaacson—joint appointment with Department of Mathematics
William J. Kennedy
Glen D. Meeden
Richard W. Mensing
Vincent A. Sposito—joint appointment with Computation Center
Robert F. Strahan—joint appointment with Department of Psychology

Assistant Professors

Theodore B. Bailey
Harold D. Baker
Mohamed El-Sabbagh (temporary—March through May)
James E. Gentle
Jeffery J. Goebel

William Meeker—beginning September 1
Lawrence Promnitz—faculty status in Statistics as well as Forestry
Shashikala B. Sukhatme

Gordon Booth—USDA Collaborator
Benny Levikson—visiting, summer, 1975
Peter C. O'Brien—Collaborator, in residence at Mayo Clinic

Instructors and Associates

John Aleong, through August
Tom Bubolz
Michael Coveyou—joint appointment with Department of Political Science
Richard Dorsch
Paul DuBose
Ted Emigh
Wendell Ponder
Barry Simon
Dale Umbach

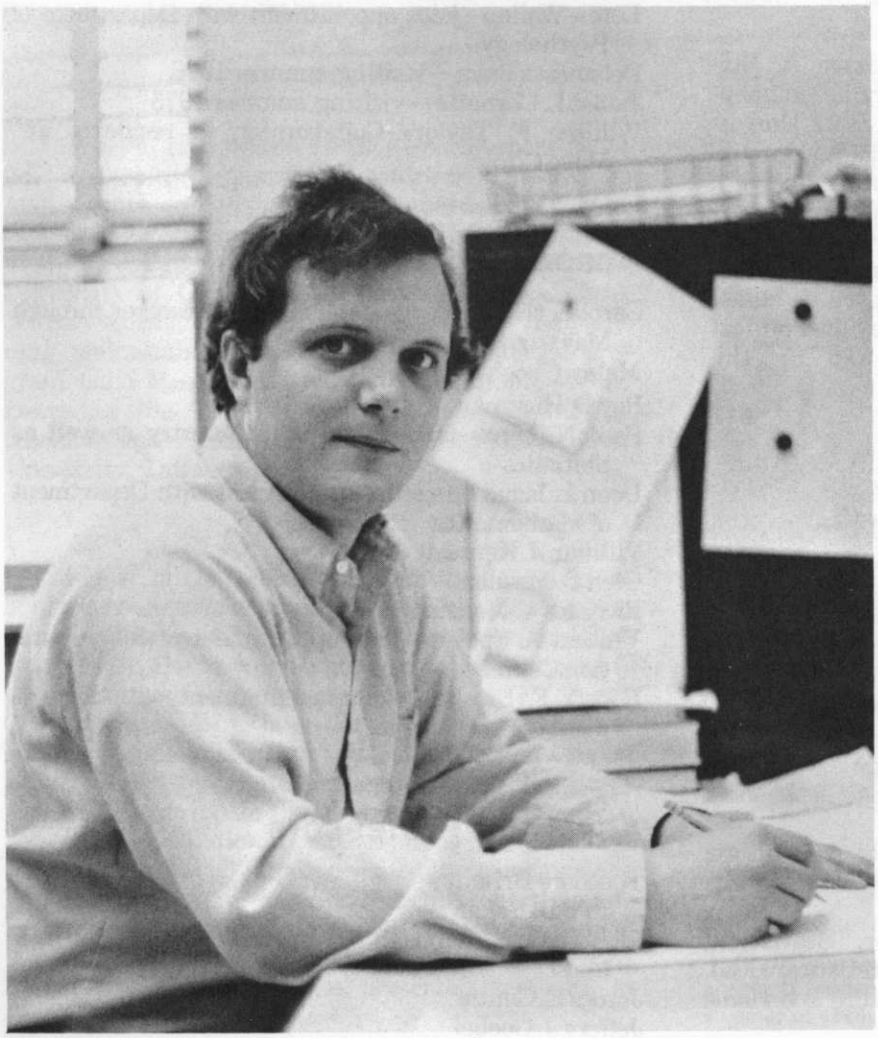
Robin Thompson—visiting, summer 1975

Postdoctoral Associates

Chaturvedula Asok
Bruce Bowerman—visiting, summer 1975
John Ingram—visiting, beginning July 1
Prem Narain—visiting, February-March
C. Z. Roux—visiting, December-January
Mauritz van Aarde—visiting, December-January

Collaborator

Charles Graham—USDA Collaborator



Dr. William Meeker, who joined the Statistical Laboratory September 1, has had teaching responsibilities primarily in the area of business statistics for undergraduate Industrial Administration majors. He has also been active in research in industrial and business statistics.

Bill's hobbies include stamp collecting, electronics and amateur radio. He has built parts of his own radio station which he uses to communicate with other homes in places as far away as Australia and Japan.

Graduate Assistants

(The status of graduate students often changes. Students who have held the title of graduate assistant during the year are listed here.)

Anderson, Keaven (undergraduate)
Andriano, Kim
Antonovitz, Frances
Arnold, Robert
Auer, Richard
Barron, Donald
Bhattacharyay, Biswanath
Biyani, Shriram
Carter, Randy
Chang, Yen F.
Chen, Jengrong
Chen, Mon-Gy
Clarkson, Brenda
Diaz, Francis
Dickey, David
Gust, Cathryn
Hand, Michael
Hanley, Janet
Hanson, Thomas
Hasza, David
Heavlin, William (undergraduate)
Ho, Chung Man
Hsieh, Wen Tai
Hsu, Shun-Hsia (Dorothy)
Iwuora, Grace
Kackar, Raghunath
Kim, Geung Ho
Klemm, Rebecca
Lam, Wai Chung
Lamyordmakpol, Anuchit
Lewis, Jerry
Midha, Chand
Mo, Wing-hung (David)
Motoyama, Tetsuro
Pinski, Kenneth
Sallas, William
Scholl, Lorie
Scott, Mark
Sedcole, Richard
Shenk, Debra
Shu, Ven-Shion
Skalland, Kent
Tai, Kuen-Jing (Joyce)
Tam, Kenneth
Toft, Nancee (undergraduate)
Tu, Ching-Tsao
Tuenge, Tsuru Matsui
Turner, Lana
Werner, Neil
Williams, Ricky
Yang, Shie-Shien (Winston)
Yen, Jenn Yung (George)

Supported Graduate Students

Alders, Dean—Department of Mathematics, ISU
Anselmi, Luis—Government of Venezuela
Arends, William—USDA
Aziz, Mohammad—Ag. Developmental Council Fellowship
Carvalho, José—University of S. Paulo, Brazil
Chang, Yen Fook—Department of Mathematics, ISU
Crouse, Ken—Ames Lab, ISU
Ervan, Mohamad, FAO
Galmes, Miguel Angel—FAO Fellow
Gomez, Santiago—USAID
Hale, Michael—Department of Mathematics, ISU
Herrera-Haro, José—Nat. Council of Sci. and Tech. and Ford Foundation
Huang, Cheng-Chi—Department of Mathematics, ISU
Islam, Shaikh—FAO
Iwuora, Grace—University of Nigeria
Khuantham, Ananchai—Kasetsart University
Kiregyera, Ben—Government of Uganda
Lamyordmakpol, Anuchit—Government of Thailand
Leelasuwanich, Thawach—USAID
Liberty, T. Edward—UNDP Fellowhip
Noorboloochi, Siamok—Iranian Government
Osho, Johnson—Nigerian Government
Pareja, Gilda—USAID
Parsian, Ahmad—Pahlavi Univ.—Iran
Pashazadeh-Monajemi, M. B.—Iran Min. of Sci. and Higher Education
Rockwell, Dwight—USDA
Sainumtip, Nida—Thai Government
Sirisukdi, Vannapha—USAID
Sotres, David—Nat. Council of Sci. and Tech. and Ford Foundation
Stangenhaus, Gabriela—University of S. Paulo, Brazil
Sung, Chang Sup—Department of Industrial Engineering, ISU
Tajdari, Parviz—Ministry of Science and Higher Education , Iran
Villaseñor, José—Ford Foundation, Mexico
Viroonsri, Boonchai—USAID
You, Young-Kyun—Korean Government

Self-supporting Graduate Students

Akin, Donald
Aziz, Salman
Bernhardt, Vicki
Bondy, Eric
Butcher, Dale
Chandhok, Promod Kumar
Chang, Shen-Lan Chu
Clark, Cynthia
David, Jeffrey
Dehghan-Nayeri, Majid
Doctor, Pamela
Fernandez, Irma
Glosemeyer, William
Johnson, Ervin
Martinez, Daniel
Mellon, James
Mowry, Daniel
Perez, Margarita
Sung, Bok Park
Wang, George
Young, Shirley
zum Brunnen, James

Margaret Kirwin Receives Superior Service Award

At the Iowa State University Alumni Convocation June 5, Margaret Kirwin was awarded an Alumni Association's Superior Service Award for nonacademic employees. Margaret began her career at Iowa State University in 1925 as a secretary in the College of Home Economics. Before joining the Statistical Laboratory in 1946, she was employed at various times by the Departments of Chemical Engineering and Dairy Industry and the Extension Service.

In the Statistical Laboratory Margaret has held positions as secretary-bookkeeper, 1946-56, and administrative assistant, 1956-present. Since 1973 she has been working on a half-time basis. For 9 years she served on the Board of Directors of the Iowa State University Employees Credit Union. She is an active member of the 25-year club, having served as secretary of the organization since 1970. On July 1, 1971, an appreciation award for 25 years of meritorious service was presented to her by the Statistical Laboratory.

Margaret was nominated for the alumni award by the Honors and Awards Committee of the Statistical Laboratory in recognition of her many years of outstanding service to the Laboratory and the university community.

Survey Section

Carroll Arthur, Statistical Data Processor
Melinda Boyd, Key Punch Operator, beginning July 1
Karen Bruce, Statistical Clerk
Hazel Cook, Survey Supervisor
Sheryl Davis, Secretary, beginning April 8
Mary Farr, Statistical Clerk
Evelyn Green, Survey Supervisor
Ava Klopf, Statistical Clerk—through December
Sylvia Larson, Statistical Clerk
Glenda Love, Key Punch operator, beginning August 6
Marion Martin, Statistical Data Processor
Marjorie Mason, Survey Supervisor
Sylvia McNulty, Secretary-Bookkeeper
Margaret Nichols, Secretary
Donna Omundson, Statistical Clerk
Florence Osam, Statistical Clerk
Dallis Sonksen, Secretary—through March
Harvey Terpstra, Jr. System Analyst
Margaret Whitehill, Statistical Clerk—beginning November
Anna Woodrow, Survey Supervisor, through March 31

General Office Staff

Margaret G. Kirwin, Administrative Assistant
Avonelle Jacobson, Program Coordinator
Betty Ibrahim, Accountant
Kathleen Shaver, Information Assistant
Phyllis Carr, Secretary—Experimental Design—Genetic Statistics Section
Jan Ellsworth, Secretary—through March
Norma Elwick, Secretary
Karen Gogerty, Secretary
Peggy Nelson, Secretary
Nancy Piersol, Secretary—Statistical Numerical Analysis and Data Processing Section
Dallis Sonksen, Secretary—beginning April
Beverly Upchurch, Secretary

Statistical Data Processing Service

Bud J. Meador, Supervisor
Tu, Heitsu Chou, Data Analyst

Consulting and Cooperative Research

Statistical Laboratory consultants are available to assist Iowa State University faculty members and students with the various statistical aspects of their research projects. A variety of contracts and arrangements enable consultants and supporting staff to serve off-campus agencies. Assistance may be given during any stage of the research beginning with the design of an experiment, selection of a sample population and preparation of data collection instruments to the ending activities of data analysis and interpretation of results.

Some members of the Statistical Laboratory faculty and some graduate students are budgeted primarily in the consulting area. In addition to consulting, these individuals are developing new software and improving available statistical techniques.

In the following paragraphs, a representative sample of the range of consulting and related research done this past year is presented.

Agriculture, Home Economics, Social Sciences, Genetics

Richard Warren, joint appointment with Sociology and Anthropology, served as a consultant for research studies conducted by faculty members and students primarily in sociology, education, family environment and economics. Discussions were held regarding data collection, analysis and processing. Statistical techniques used included multiple regression, analysis of variance, analysis of covariance, path analysis, repeat measure analysis, split-plot, estimation of reliability, and scale and index construction. Some of the topic areas included components of perceived counselor credibility, alternative life styles for marriage and family relationships, shopping patterns, alternative teaching methods, teacher program evaluation, housing quality and satisfaction, reading achievement, attractiveness of counselors, one-parent family research, transportation study, counselor training, adoption, power structure, student perceptions, self-concept, aging, leisure research, organizational effectiveness, interorganizational relationships, and social indicators.

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Leroy Wolins, joint appointment with Psychology, consults primarily in the social-behavioral science areas. He assisted approximately 50 graduate students and 10 faculty members each quarter this past year. Several times each quarter students from Drake University and the University of Iowa used his consulting services.

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Michael Coveyou, joint appointment with Political Science, consulted on about 20 projects. Some representative topics were: comparative state legislative projects, trade-offs between defense and social welfare expenditures in Latin America, the role of the governor in the legislative process, and characteristics of middle-level political party activists. His assistance involved questionnaire construction, multiple regression analysis, Durbin-Watson statistic, and use of SPSS.

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Edward Pollak, joint appointment with Genetics, consulted with staff members and students in that department. In one project, advice was given on how to compute estimates of recombination frequencies and standard errors of the estimates from data on the F_2 generation. In connection with a second experiment, it was shown how to compute the standard error of the number of nuclei in fusion products in a large population of cells.

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David Harville gave assistance to a staff member in the Animal Science Department on the estimation of variance components by maximum likelihood and by related techniques.

Engineering Research Institute

The Engineering Research Institute partially supports H. T. David and Richard Mensing who serve as statistical consultants for faculty members and students in the College of Engineering. Examples follow which show the diversity of current research within some of the departments of this college.

Agricultural Engineering: (1) Comparing different varieties of corn for percentage of damaged kernels. Comparison was made by measuring the amount of dye absorbed by the kernels under different moisture levels.

(2) Analyzing the effect of storage conditions on the moisture content of corn stored in bulk quantities.

Chemical Engineering: (1) Modeling the distribution curves of rare earth metals.

(2) Measuring the effect of gas, temperature and type of coal on several physical properties of coal char.

Electrical Engineering: Constructing a multiple regression model for estimating the distance between a transmitter and receiver over the earth's surface (particularly applicable over water).

Industrial Engineering: Modeling the bed requirements for five different units in a hospital.

Agriculture and Home Economics Experiment Station

Statistical consulting services for the Colleges of Agriculture and Home Economics are partially financed through the Iowa Agriculture and Home Economics Experiment Station. Staff members and students from many departments within these two colleges were assisted on a regular and continuing basis by Statistical Laboratory faculty members Ted Bailey, D. F. Cox, Paul Hinz, and Donald Hotchkiss; graduate assistants Frances Antonovitz, Brenda Clarkson, Neil Werner, Rick Williams and George Yen; and research associates John Aleong and Paul DuBose.

This consulting involves a wide variety of projects and requires an equally wide variety of statistical methods. Several examples of this year's research studies are reported below.

Paul Hinz collaborated with Wayne Fuller and Harold Baker to devise a sampling plan to estimate the production of aquatic vegetation in some freshwater ponds in Montana. The ponds will be in the downwind path of smoke-stacks of coal-burning electric generating plants. Changes in the composition of plant species, dry matter production, and concentration of heavy metals will be monitored in time by use of this sampling plan.

Data collected to assess the effects of stream channelization projects in Iowa were analyzed by Rick Williams and Brenda Clarkson. Measurements such as percent of cropland, percent ground cover, etc., were made before and after channelization. Regression methods were used to evaluate whether there were any statistically important changes in these measurements with time after channelization.

George Yen analyzed data from a large field trial of a vaccine used to control turbinate atrophy in pigs. Analysis of variance techniques were used to account for variation due to litter and sex differences when vaccinated and control pigs were compared. The vaccine reduced the amount of atrophy and significantly decreased the number of days to market in one of the three locations included in the trials.

Factorial experiments were used to study the effects of undernourishment on various measures of rat growth. By looking at the diet by time interaction it was found that if undernourished rats are placed on a normal diet within a specified time, then their overall growth rate will become the same as rats that have always been on a normal diet.

Multidimensional contingency tables were used to study the interrelationships between four tests used to detect pig pneumonia. These tests included two blood serum tests recently developed at Iowa State University. Recommendations were made for the number of pigs needed for the next phase of experimentation.

Estimates of the amount of a hormone called Relaxin found in the constituent parts of cells from a pig gland were made using bioassay techniques. The experiment measured the amount of muscle stretching induced by experimental and standard preparations. Confidence intervals for these estimates were also obtained. Paul DuBose was the statistical consultant for this project.

Analysis of variance techniques were used in two European corn borer studies. A split-plot design was used to study the effectiveness of a chemical treatment on several corn varieties. Another study was conducted to determine which chromosome arms of a corn variety have genes contributing to borer resistance.

Statistical Numerical Analysis and Data Processing Section

The Statistical Numerical Analysis and Data Processing Section, directed by William J. Kennedy, is responsible for providing consultation and operational assistance to classroom and research applications of digital computers. Faculty members of the section also conduct research and teach courses in statistical computing.

Section personnel were actively involved in work on many different projects during the year. The majority of these projects were in support of research conducted on campus. A brief description of a few of these projects is contained in succeeding paragraphs. Additionally, the consulting workload continued to increase during the past year due to factors such as an expanding computer user base and the introduction of larger, more sophisticated scientific computer software systems.

One major project undertaken by the section during the year involved development of a data storage and retrieval system for swine breeders. This system is designed to provide periodic reports about animal performance, and schedule treatments for sows from breeding through weaning of litter. In addition to these reports, which aid the farm operator in handling individual animals, the system also produces summary statistics about the herd. Bud Meador was directly responsible for design and implementation of system software. Kim Andriano, Tom Hanson, Kenneth Pinski, Kenneth Tam, and Helen Tu assisted on this project.

Bud Meador, James Chen, Lana Turner, and Ted Motoyama worked on procedures, software and data processing for several different animal disease studies conducted by the College of Veterinary Medicine. Included in this work was the production of recurring reports for animal disease laboratories located in several states in the midwest.

A project to develop a record-keeping system for the Iowa Hospital Association was recently completed. The system provides patient status reports and facility characteristic reports for long-term patient care facilities. Tom Bubolz, Joyce Tai, and Geung-Ho Kim worked on this project.

The Iowa Farm Accident Survey is part of a multistate standardized farm accident reporting program developed by the National Safety Council. During the past year the Section has organized the data from over 3000 survey reports, each collected on a quarterly basis. The data have been stored in machine readable form and a preliminary analysis is currently underway. A major objective of the study is to provide information useful in developing farm-safety training programs. Individuals who have been involved in the project include Tom Bubolz, Joyce Tai, and Joan Kempthorne.

The section assisted in analyzing data collected in a pilot study to evaluate the effectiveness of the Iowa Congregate Meal Program. The pilot study was conducted by the Food and Nutrition Department at Iowa State University. The study's goal was the development of appropriate methods and techniques for evaluating the nutritional health of participants throughout the state of Iowa. Section personnel involved in this project were Janet Hanley, Tom Bubolz, and Michael Hand.

The section was engaged in programming and data analysis for a number of research projects sponsored by the Iowa State Conservation Commission. The intent of these projects is to provide a better understanding about the growth of fish and wildlife populations, and to assist in developing conservation management policies to be applied in coming years. Persons who contributed to these projects include Michael Hand, Janet Hanley, and Tom Bubolz.

Tom Bubolz and Joyce Tai developed algorithms and software which permitted an ISU history professor to analyze kinship patterns of 19th century European peasants. A major objective of the research was the demonstration that the peasantry was embedded in a very complex form of social organization.

The installation of WYLBUR, a text editing system containing the RJE/RJO capability in the ISU Computation Center, in April, proved to be very beneficial in that section personnel began making extensive use of this remote computing capability. The net effect of this usage was to significantly reduce job turnaround time. The section currently has five remote printer-type terminals, and future plans call for purchase of two CRT terminals.

V. A. Sposito and Ken Baum have developed a large-scale simulation-linear programming software package for the Center for Agricultural and Rural Development. The object of this project was to interface *for the first time* a recursive, econometric equation simulation model of U.S. agriculture with a linear programming sector of national crop production to assist in accurately explaining and predicting at a low cost differential land and supply response in U.S. agriculture. Specifically, this program will be used to track and accurately simulate for the years 1968-1973, and to predict for the years 1974-1980, the regional locus and level of production activities of barley, oats, grain sorghum, corn, wheat, soybeans and cotton. National livestock and tobacco production activities can also be simulated. The importance of this model lies in its ability to delineate in detail the long and short run regional shifts in the spatial distribution of agricultural activities and impacts on income due to price, technological resource, yield or cost changes and other hypothetical parameter changes, say, perhaps in the level of export demand. Hence, an enormously flexible tool for detailed analysis of regional and national impacts of different agricultural policies enacted at the national or regional level will be available at CARD for use in planning U.S. agricultural policy and for empirical research.

Off-Campus

H. A. David served as consultant for the review of the graduate program in statistics, University of Connecticut, Storrs, December 8-10.

Survey Section

The Survey Section has the responsibility of providing consultation and direct operational assistance to research workers in sample design and the planning and execution of sample surveys. Staff members assist with questionnaire design and construction; sample design and selection; organization and supervision of field data collection by personal interview, telephone or mail; editing and coding of data for processing; and data summarization and analysis. Professional staff members also conduct research and teach courses in the areas of sampling, survey design, and statistical methods.

A sample of Iowans twelve years of age and older was selected for the 1975 Iowa Conservation Commission outdoor recreation study. Respondents were contacted quarterly by telephone and asked to provide a detailed account of their outdoor recreational activities from March, 1975, to February, 1976. The information obtained included the type of outdoor activity, the number of days spent in the activity, and the location where the activity took place. The data has been edited and coded, and statewide estimates of outdoor recreational activity are being computed. As a part of a study conducted by the Wildlife Research Unit, a short telephone interview was used to randomly select a member from each of a sample of Iowa households. A questionnaire was then mailed to the selected member asking for opinions relating to the uses of our environment. Richard Dorsch assumed primary responsibility for these two projects.

An assessment of the child care needs of Iowa families was the subject of a project conducted for the Governor's Task Force on Early Childhood Development. Assistance was provided in the construction of the questionnaire to be used; a statewide sample was drawn, and personal interviews were completed with 312 eligible households. Editing and coding of the data were completed, and analysis was carried out by the reseachers.

A sample of open country residents of Iowa was selected for researchers in Agronomy for the purpose of conducting a mail survey of farmers to discover which corn hybrids are being widely planted. This is a continuing project in which persons responding are retained in the sample for two additional mailings. Results of the study will influence the selection of hybrids to be included in the Iowa Corn Yield Tests carried out by the University.

A sample of households was selected from the open country area of Kansas for researchers in Family and Child Development at Kansas State University. The purpose of this regional longitudinal study is to investigate whether the mental and emotional development of children in a rural environment differs from that of children in other environments. A self-weighting, stratified, multistage area sample of households was selected. Ultimately the study sample will consist only of those households which meet certain criteria. Eligibility will be determined by means of a screening process applied as part of the field procedure. The sample was designed to yield about 150 eligible cooperating families. Harold Baker had major responsibility for this project.

Survey Section, continued page 28

Shown (l. to r.) are Survey Section personnel Pam Hildebrand, Marty Whitehill, and Dr. Jeff Goebel examining two styles of maps used to identify sample locations. These maps were produced by Marty and Pam on a DuPont Chromalin color display system that has recently been placed in the Survey Section by the Soil Conservation Service for experimental purposes. The maps presently being made are part of a study concerned with improving the sampling procedures used in large-scale surveys and determining the cost effects of various forms of clustering.

Current Research

Research in statistical theory and methodology is a continuing activity of the Statistical Laboratory. Projects which are of specific interest to regular university research programs are supported by the Statistical Laboratory's budget. The Agriculture and Home Economics Experiment Station, cooperating campus research institutes, and off-campus contracts and grants continue to be major sources of research funds.

Research sponsored by government contracts, as well as individual staff members' personal research, is reported in this section.

AES Project 2039

Joint research with the U.S. Bureau of the Census is currently being conducted under Project 2039 of the Agriculture Experiment Station with Wayne Fuller the principal investigator. Others working on the project were Jeffery Goebel, Randy Carter and David Dickey. Research topics included the analysis of nonstationary time series and the estimation of regression equations in the presence of measurement error.

The instrumental variable-maximum likelihood estimator for the errors-in-variables model was studied, and explicit expressions for the estimator when the estimator falls on the boundary of the parameter space were obtained. The limiting distribution of the regression coefficients calculated from a correlation matrix that has been corrected for attenuation was obtained. Methods of estimating the covariance matrix of the vector of regression coefficients also were derived.

The distribution of the estimated first order autoregressive coefficient was studied, given that the true parameter is one. Tables of the percentage points for three estimators of the autoregressive coefficient were constructed.

Order Statistics and Nonparametric Statistics

S. S. (Winston) Yang has continued work on concomitants of order statistics under the direction of H. A. David, principal investigator of the Army Research Office Grant with the above title. Topics considered include multivariate generalizations, an application to Round Robin tournaments, and the use of concomitants in parameter estimation.

A short monograph, The Theory of Competing Risks, has been completed by Dr. David, with M. L. Moeschberger of the University of Missouri as coauthor.

Malay Ghosh, Visiting Associate Professor, has prepared several articles for publication with support of the grant. Subjects covered include the nonattainability of Chebyshev bounds, minimax estimation of the mean (both with Glen Meeden) and the Bahadur representation of quantiles in nonregular cases (with Shashikala Sukhatme).

Designing Sample Surveys and Analysis of Survey Data

B. V. Sukhatme, principal investigator, continued research on problems in designing surveys and analysis of survey data supported by the U. S. Office of Education, Department of Health, Education and Welfare.

Further work was done in evolving sampling schemes for unequal probability sampling without replacement which can be operated easily and are also efficient. In particular, the role of random stratification has been investigated in developing such schemes. A paper continuing these results and written jointly with C. Asok was presented at the annual meeting of the American Statistical Association in August, 1975. An abstract of the paper appears in the publication section of this report.

Work also continued concerning the use of auxiliary data in respect to several variables in the construction of ratio-type estimators. In particular, two classes of estimators (1) chain-type ratio estimators and (2) unbiased ratio-type estimators have been investigated with respect to their bias and mean square error for two auxiliary variables and results extended to multi-stage designs and stratified sampling.

Mathematical and Statistical Genetics

The National Institutes of Health and Agriculture Experiment Station Project 1669 support research in mathematical and statistical genetics. The project is under the leadership of Oscar Kempthorne and Edward Pollak. Abstracts of papers which report some of this work appear in the publications section.

Drs. Pollak and Kempthorne investigated the nature of equilibria under simple fitness models for populations with nonoverlapping generations. Dr. Kempthorne also has worked on the development of theory for upper truncation selection for infinite populations having an infinity of loci with small effects.

T. H. Emigh and O. Kempthorne did some residual work on the role of heredity and environment in human measurements. They also completed some work on goodness of fit of populations to structures to be expected under random mating.

T. H. Emigh, and Drs. Pollak and Kempthorne have investigated effects of finite population size on genetic populations with several age groups. It has been found that:

(1) After a long time the joint distribution of gene frequencies in the age groups becomes nearly univariate.

(2) The behavior of the population can be closely approximated by that of a population with nonoverlapping generations with time measured in generations; i.e., the change in a population with nonoverlapping generations in one time unit is much the same as the change in one generation in a population with overlapping generations and the same effective population size.

Dr. P. Narain and E. Pollak considered the problem of computing the probability of fixation of a particular allele in a finite monoecious population with two alleles, when there is random fluctuation of selective effects. By using properties of finite Markov chains, an approximate but general expression for this probability is obtained and the results obtained by previous authors are shown to be special cases of this result.

Dr. B. Levikson finished some research on a situation in which there is a finite population with two alleles, in which the selective pressures change with time. Expressions were derived for the probability of the ultimate fixation of one allele and the expected time until loss of one or the other of the alleles. The diffusion approximation was used. In a second investigation, Dr. Levikson derived the probability a given allele in a finite population is the oldest, if all gene frequencies are known.

Dr. C. Z. Roux developed theory for populations in which the two sexes may differ in frequencies of recombination between two loci. He showed that if there is multiplicative gene action the usual conditions for stability (with no sex differences in recombination) hold when the mean of gamete frequencies for the two sexes is used. For additive gene action between loci and for neutral alleles it was shown that after one generation of random mating the gene frequencies for gametes of male and female origin are the same. These results imply that if there is additivity the mean fitness increases over time and that with neutral alleles there is an approach to a Hardy-Weinberg equilibrium if there is some recombination in one or both sexes.

Dr. I. M. R. van Aarde initiated research on quantitative genetics theory for endosperm characters. Various direct effects and interactions were defined and it was then possible to partition the total genotypic variance into meaningful and informative components. In addition this led to expressions for covariances between relatives in terms of these components. The analysis applies both to random mating populations and populations in which parents are derived from a Hardy-Weinberg population by a regular system of inbreeding.

R. Thompson has developed a multivariate method for the estimation of maternal genetic variances and applied it to data on Tribolium and to data from designs in the literature for estimating these variances. Modifications for the case of selection of parents are given. Thompson also worked on the design of experiments to estimate heritability when data on both parent and offspring are available. Methods of estimation and optimal designs are developed.

J. R. Sedcole has investigated three approximate methods for determining the number of plants a plant breeder must examine to have a specified high probability of recovering at least a certain desired number of plants possessing a trait. It is assumed that the occurrence of this trait among the progeny has a known probability. The most accurate approximation was found to give a solution correct to within one percent of the exact solution that is obtainable, tediously, from the cumulative binomial distribution. He is also preparing a critical survey of the voluminous literature on heterosis.

AES Project 2155

Research in sample design and estimation techniques for soil and farm characteristics was continued in the Survey Section under Agriculture Experiment Station Project 2155, with Roy D. Hickman as principal investigator. The cooperative work with the Soil Conservation Service, USDA, includes development of variance estimation procedures for two-way tables of acreage estimates. Review of the sampling procedures used in the 1967 Conservation Needs Inventory continued, and trial investigations of sampling alternatives was initiated in a small number of test counties. A DuPont Chromalin color display system, placed in the Survey Section by the SCS, is to be used in the development of procedures to place area sampling units and strata boundaries on multicolor cartographic materials. These materials will be used by SCS field personnel in data collection for land inventory and monitoring studies. Jeff Goebel and Margaret Whitehill are in charge of design and production of these sampling materials.

Final tables for the potential cropland study were sent to the SCS for reproduction and distribution. National estimates of potential cropland acreages were made by land capability class and subclass, 1975 land use and necessary development categories.

Area samples have been selected within three U. S. Land Resource Regions for the first stage of the Cooperative Wind Erosion Study in the Great Plains Region. Four hundred and seventeen 160-acre units in nine states were drawn. SCS personnel will obtain land use and wind erosion group field sketches of the sampling units, after which Survey Section staff will select sites for the placement of mechanical erosion samplers.

Work continued on the storage, retrieval, and manipulation of the interpretive data of soil series in the United States. Soil interpretations for nearly 8,000 series are now on file. The output of tabular analyses of these data continues, and the first soil survey manuscript containing these tables was published by the SCS. A program to generate soil interpretations for specified uses has become operational and is used by SCS field staff in checking interpretations presently in computer storage. Revisions in the interpretive data now on file have greatly increased due to the various data editing programs now operational. Harvey Terpstra, who has primary direction of the soil interpretations project, continues to work closely with federal and regional SCS personnel in the design and development of this extensive data storage and analysis system.

Construction of area sampling frames and stratification techniques continued under a cooperative agreement with the Statistical Reporting Service, USDA. Sampling frames formed on the basis of degree and type of cultivation will enable the SRS to design agricultural surveys which result in reduced variance of characteristics to be estimated. Sampling frames were completed for the states of Michigan, Indiana, Wisconsin and Kentucky.

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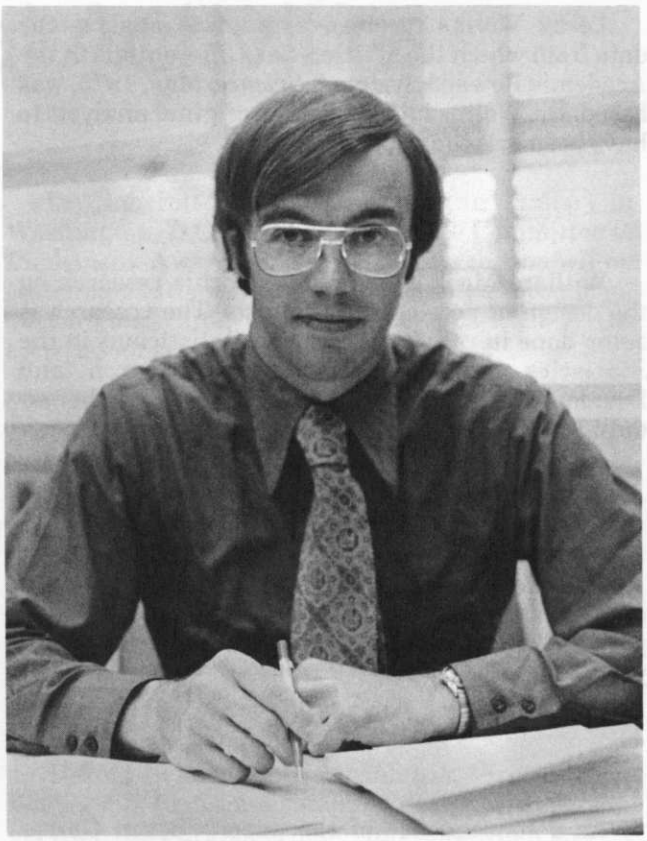
T. A. Bancroft and C. P. Han have been doing research as a team on a paper "Inference Based on Conditional Specification: A Note and a Bibliography." An attempt is made to justify the use of inference procedures based on the use of preliminary tests, pooling, etc., under a seemingly more appropriate designation and to present a bibliography of such papers through June 30, 1976.

Research has been completed for a paper "A Pooling Methodology for Regressions in Prediction" by J. P. Johnson and Drs. Bancroft and Han; *Biometrics* has accepted it for publication.



On July 1, Dr. David Harville began his duties with the Statistical Laboratory. Linear models and experimental design are his areas of expertise.

David's interests include the role of statistics in sports, both professionally and as a hobby.

David Harville continued his research on linear models. He investigated a new approach to the problem of estimating those unknown parameters that enter in the variance-covariance matrix. Particular cases of this problem include the estimation of variance components and the estimation of the parameters of Kalman-filtering models. The new approach mimics maximum likelihood but is simpler computationally. It requires the iterative solution of a set of equations that play a role analogous to the likelihood equations. The numerical difficulties involved in implementing the approach are being investigated in the context of the rating of high school or college football teams and in the context of the prediction of the outcomes of college and professional football games. The basis for the ratings and predictions is a linear model that is applied to the point spreads. This model contains variances and certain autoregressive parameters that must be estimated. Part of this work is described in the manuscript "The Use of Linear-Model Methodology to Rate High School or College Football Teams."

Leroy Wolins received a grant to analyze the data from which the article, "Sex Differentials in the Academic Reward System," *Science,* May, 1975, was based. Dr. Wolins has judged the original analysis to have been less than optimum.

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William Meeker has continued his research on the design of accelerated life tests. The research is being done in collaboration with statisticians in the Statistics Program, Corporate Research and Development, General Electric Company, Schenectady, New York.

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Richard Mensing is continuing research in the area of estimating the life distribution of industrial property where the data are number of failures per year.

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As a consequence of the paper, "Seven Games Series in Sport," Richard Groeneveld and Barry Arnold have considered limit laws for random variables arising in the best of 2n - 1 Bernouli trials.

Tom Bubolz is a principal investigator in a study to determine attitudes and motivational factors associated with environmental issues in Iowa. The study, funded June, 1975-June, 1977, is supported by the Iowa Conservation Commission, U. S. Fisheries and Wildlife Service, and the Wildlife Management Institute.

Two populations are being surveyed: a representative sample of Iowans 18 years of age or older, and a sample of persons possessing characteristics of avid hunters. Pretests have been completed. Main surveys will be undertaken in summer, 1976. Roy Hickman is handling the sampling for the survey of the general population. Drs. Bubolz and Vernon Wright, Illinois Department of Conservation, are drawing the sample for the hunter population.

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Barry Arnold is researching the definitions and properties of generalized and multivariate Pareto distributions with applications to income data.

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Michael Coveyou continued research on sources and content of citizens' perceptions of political parties in Anglo-American democracies and an eleven-state comparative study of state legislators' views of parties, governors, legislative norms, and other topics.

ISU Hosts International Conference on Quantitative Genetics

Edward Pollak, Oscar Kempthorne, and Theodore B. Bailey (l. to r.) organized an International Conference on Quantitative Genetics to be held at Iowa State University August 16-21. Approximately thirty speakers including internationally recognized geneticists, accepted invitations to participate in this conference.

Emphasis will be directed toward general theory, the relevance and impact of modern molecular biology, applications in plants and animals, applications in humans, and statistical aspects of the theories.

Professional Activities

David Harville was elected a Fellow of the American Statistical Association at the annual meeting in Atlanta, August 25-28. He was cited for his research accomplishments in statistics, and especially for his contributions to linear statistical models and for his work as an Associate Editor of *Biometrics*.

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Holly Fuchs is completing a three-year term as national president of Mu Sigma Rho, statistics honorary for faculty and students.

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H. A. David has been appointed to membership of the Committee on National Statistics, a committee of the National Research Council. He continues as a member of the Committee on Fellows and of the Council of the Institute of Mathematical Statistics.

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In January, 1975, H. T. David began serving as Director of the Visiting Lecturer Program of the United States statistical societies.

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For the American Statistical Association: Wayne Fuller is secretary-treasurer of the Business and Economic Statistics Section; James Gentle is secretary-treasurer of the Statistical Computing Section for the calendar year 1976. Richard Mensing is the current president of the Iowa Chapter of A. S. A. and a member of the A. S. A. Membership Committee. William Kennedy is program chairman of the Statistical Computing Section for the August, 1976, meetings. Dr. Kennedy is also chairman of a committee on methods for evaluation of numerical algorithms. Wayne Fuller attended a meeting of the review panel of the Statistical Survey Institute May 11-12 at the A. S. A. office in Washington, D.C.

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T. A. Bancroft was selected by the Faculty Improvement Leave Committee to receive a Wilton Park award. He attended a 2-week conference at Wiston House, Steyning, Sussex, England, May 16-29. Primary emphasis of the sessions was "Social cohesion in the West: Employment, inflation, and consumer protection: The rights of the citizen."

Dr. Bancroft attended a meeting in January in Washington, D.C., as a member of the Committee to Implement Awards (National Research Council on National Statistics) to frame a detailed recommendation concerning awards to be presented to the societies for consideration.

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Harvey Terpstra was in Chicago July 30-August 1 to discuss the use of the soil interpretation data in computer storage at ISU by the Argonne Laboratory and the Northeastern Illinois Planning Commission. From March 29-April 2, he was in Washington, D.C., to discuss problems with computer printed tables for soil survey manuscripts for the Soil Conservation Service.

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Harold Baker was in Alexandria, Virginia, September 4-5, to discuss sampling design with personnel from the Farmer's Home Administration and the Office of Management and Budget in connection with the small town housing study being conducted for Dean Prestemon, Forestry Department, ISU.

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Barry Arnold chaired a session, "Asymptotic Distribution Theory," May 17-21, at the Institute of Mathematical Statistics, Central Regional meetings, Lafayette, Indiana.

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Jeff Goebel went to Phoenix, Arizona, November 2-5, to plan with Soil Conservation Service personnel for a forthcoming survey for the Land Inventory and Monitoring Division to study the effects of alternate sampling schemes.

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Richard Warren served as a member of the membership committee for the Rural Sociological Society.

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Dr. Warren is chairman of the search committee to select a chairman of the Department of Sociology and Anthropology and briefly served as acting head of that department.

John Ingram was a sponsored participant at the NSF conference, "Recent Developments in the Theory of Sampling and Its Applications," at Charleston, South Carolina, July 27-August 1.

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Don Hotchkiss and Paul DuBose were initiated into the ISU chapter of Phi Kappa Phi, national honorary society, at the spring meeting.

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Statistics personnel appointed to 1975-76 Iowa State University standing committees were: Don Hotchkiss, chairperson, Academic Standards Committee and a member of the Council on Instruction and the Learning Environment Improvement Committee; Chien-Pai Han, member of the Faculty Council; Herbert T. David, member, Annuities and Insurance Committee.

Papers, Lectures and Seminars

At the 1975 joint meetings of the American Statistical Association, the Biometric Society, and the Institute of Mathematical Statistics, Atlanta, Georgia, August 24-28:

Asok, Chaturvedula and B. V. Sukhatme: "Unequal Probability Sampling with Random Stratification";

Cox, C. Philip and T. Keefe, "A Sequential Test for Mean Vector Adjusted for Covariates";

O'Connell, M. J. and **H. A. David:** "Distribution and Expected Value of the Rank of a Concomitant of an Order Statistic."

Fuller, Wayne and K. M. Wolter: "Estimating a Nonlinear Errors-In-Variable Model with Singular Error Covariance Matrix";

Gentle, James E.: "Comparisons of Statistical Packages by Users with Some Experience in Statistics and Computing";

Gentle, James E. and Prem Talwar: "Robust Tests for Coincidence of Regressions";

Ghosh, Malay: "Admissibility of Linear Estimators in the One-Parameter Exponential Family";

Meeker, William Q., Jr., and Wayne Nelson: "Optimum Accelerated Life-Tests for the Weibull and Extreme Value Distributions";

Aroian, Leo A., **William Q. Meeker, Jr.,** and Alan Kusinitz: "Another Look at the New York Stock Market or How to Recover Past Losses";

Oscar Kempthorne was a member of two panels: "The Use of Mean Separation Techniques on nxn Set of Means (interaction means) Resulting from a Cross Classified Analysis of Variance" and "For What Use Are Tests of Hypotheses and Tests of Significance?" **John Ingram** chaired a session and participated as a member of the A.S.A. Council. **William Kennedy** also chaired a session.

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At the meetings of the Rural Sociological Society, San Francisco, California, August, 1975:

Warren, Richard D., Charles L. Mulford, George M. Beal and Frederick T. Evers: "The Parsonian Functional Imperatives: Operationalization of the System";

Warren, Richard D., Charles L. Mulford and Gerald E. Klonglan: "The Moderating Effect of Size on Etzioni's Compliance Model."

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At the joint national meeting of the Operations Research Society of America and the Institute of Management Science, Las Vegas, Nevada, November 19-20:

Gentle, James E.: "A Survey of Variance Reduction and Robust Procedures in Monte Carlo Analysis";

Kennedy, William J.: "Recent Advances in Techniques for Generating Pseudo-Random Numbers";

Sposito, V. and J. Trzeciak: "On Efficient Points for Vector Maximization Problem."

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At the joint meetings of the American Statistical Association, Biometric Society, and the Institute of Mathematical Statistics, Texas A & M University, College Station, March 8-10:

David, H. A., W. J. Kennedy and **V. S. Shu:** "Robustness of Linear Functions of Order Statistics in the Presence of an Outlier";

Gentle, James and **William J. Kennedy:** "Consultation for Statistical Computing: Is It Necessary?"

At the 1976 annual meetings of the Midwest Sociological Society, St. Louis, Missouri, April 21-24:

Chang, H. C. and **Richard D. Warren:** "Social Indication of Human Reproduction";

Eckard, Eugenia and **Richard D. Warren:** "Analysis of Covariance Considered for Use in Sociological Research."

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At the Central-Eastern Regional Meetings, Institute of Mathematical Statistics, Lafayette, Indiana, May 18-20:

Bowerman, Bruce, **H. T. David,** and **Dean Isaacson:** "The Convergence of Cesaro Averages for Certain Nonstationary Markov Chains";

Meeden, Glen: "Admissibility of the MLE of the Normal Integer Mean."

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Bancroft, T. A.: "A Pooling Methodology for Regression in Prediction," C.I.E.N.E.S., Inter-American Center for Statistical Education, Santiago, Chile, summer, 1975;

"The Dual Nature of Statistics and the Role of a Complete Statistical Center in a Large University," Catholic University of Chile, Santiago, summer, 1975.

Coveyou, Michael R. and James E. Piereson: "Ideological Perceptions and Political Judgment: Some Problems of Concept and Measurement," at the annual meeting of the Political Science Association, San Francisco, California, August 31;

Coveyou, Michael R., Charles W. Wiggins, and E. Lee Bernick, "State Senators' Party Imagery: A Comparative Reconnaissance," at the annual meeting of the Southwestern Political Science Association, Dallas, Texas, April 7-10;

E. Lee Bernick, **Michael R. Coveyou,** and Charles W. Wiggins, "Leader, Partner, or Adversary? A Multi-State Analysis of Legislators' Views of the Governor," at the annual meeting of the Midwest Political Science Association, Chicago, Illinois, May 1.

David, H. A.: "The Theory of Competing Risks," (seminar) Purdue University, West Lafayette, Indiana, April 15.

David, H. T.: "The Science of Ignorance," (after dinner talk) Iowa Section of the American Society of Chemical Engineers, Iowa State University, March 19;

"Statistics and Mathematical Programming," (mathematics colloquium) Queen's University, Kingston, Ontario, April 1;

"Statistics and Mathematical Programming," (statistics colloquium) University of Missouri, Columbia, April 7.

Dubose, Paul: "Numerical Solutions of Normal Equations," Statistical Section of the Mathematics Department, Portland State University, Portland, Oregon, May 27.

Fuller, Wayne and **George H. K. Wang:** "Estimators for a Simultaneous Equation Model with Lagged Endogenous Variables and Autocorrelated Errors," Third World Congress of the Econometric Society, Toronto, Canada, August 20-26.

Ghosh, Malay: "On Two Fundamental Problems of Sequential Estimation," (seminar) Department of Statistics, University of Missouri, Columbia, March 3.

Han, Chien-Pai: "A Pooling Methodology for Regressions in Prediction," (seminar) National Tsing Hwa University, Institute of Applied Mathematics, Shinchu, Taiwan, December 23.

Harville, David: "What Statisticians Do on the Job" and "An Application of Probability Theory in Pari-Mutuel Betting," Mankato State College, Mankato, Minnesota, March 30;

"Assigning Patients to Treatments in Medical Trials" and "What Statisticians Do on the Job," Doane College, Crete, Nebraska, April 6.

Kempthorne, Oscar: "Inference and Randomization," Gordon Research Conference on Statistics in Chemistry and Chemical Engineering, New Hampton, New Hampshire, July 7-11.

"Experimental Inference," Southwest Missouri State University, Springfield, October 5;

"Limitations of Quantitative Genetics Theory," Regional Poultry Breeding Technical Committee Annual Conference, Iowa State University, October 23;

"Sampling Inference, Experimental Inference and Observation Inference," Grinnell College, Grinnell, Iowa, November 11;

"Why Randomize?" (seminar) Department of Statistics, University of Minnesota, St. Paul, December 2;

"Why Randomize?" New York Chapter of the American Statistical Association, William Peterson College, Wayne, New Jersey, January 26;

"Linear Algebra and the Analysis of Variance," (seminar) Swarthmore College, Swarthmore, Pennsylvania, January 27;

"Environment-Heredity Controversy on IQ" and "Linear Algebra and Analysis of Variances," University of Missouri, St. Louis, February 18-19;

"What Is Statistical Thinking?" and "The Analysis of Variance," Simpson College, Indianola, Iowa, March 2;

"Statistics Without Probability" and "Heredity and Environment in IQ," University of North Dakota, Grand Forks, April 8 and North Dakota State University, Fargo, April 8 and 9;

"Heredity and Environment in IQ," University of Wisconsin, Green Bay, May 4.

Kennedy, William: "The Evolution of Statistical Computing," at the Southern Regional Education Board meetings on statistics, Winter Park, Florida, June 18.

Lewis, Jerry: "Two Parts of the Fundamental Theorem of Calculus," at the conference on Undergraduate Mathematics, Guilford College, Greensboro, North Carolina, November 14.

Hahn, Gerald J., **William Q. Meeker, Jr.,** and Paul I. Feder: "The Evaluation and Comparison of Experimental Designs for Fitting Regression Relationships," at the 32nd annual conference, Rochester section, American Society for Quality Control, Rochester, New York, March 9.

Mensing, Richard E.: "Statistical Quality Control," Egg Products Quality Control School, Iowa State University, October;

"Experimental Design and Analysis," (1-day seminar), Iowa Section of American Institute of Chemical Engineers, April;

Quality control 2-day short course, Engineering Extension, Iowa State University, May.

Sposito, Vincent and John Trzeciak: "Maximization of Signomials over Prototype Constraints," at the 47th National ORSA meetings and TIMS 1975 North American meetings, Chicago, Illinois, May 1.

Strahan, R. F. and K. C. Gerbasi: "The Marlowe-Crowne Social Desirability Scale: Is There Really Just One?" at the American Psychological Association Convention, Chicago, Illinois, summer, 1975.

Sukhatme, B. V.: "Unequal Probability Sampling without Replacement," and "Preliminary Testing in Designing Surveys and Analysis of Survey Data," Department of Mathematics, University of Maryland, College Park, February 25.

T. A. Bancroft Assists in Organizing a New Statistical Center, Catholic University, Santiago, Chile

T. A. Bancroft visited the Catholic University, Santiago, Chile, during July, 1975, to assist with the organization and implementation of a statistical center at this university. Included are an expanded consulting center; service courses for students in engineering, sociology, geography, nursing, and education; and a bachelor's degree program which formally opened in December, 1975. Plans are projected to begin a graduate program in Statistics in 1978.

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Professor Carlos Prado Compos, Director of this new Department of Statistics, visited Iowa State's Statistical Laboratory March 11-16. Professor Prado was primarily observing the consulting arms of five statistical laboratories in the United States, as well as visiting the offices of the American Statistical Association, Census Bureau, and Bureau of Standards in Washington, D.C., to broaden his background for his current position. Professor Prado's trip was partially supported by the American Statistical Association's program, "Closer Communication Interchange and Joint Development of Statistics and the Statistical Profession in Latin America and the United States,"

Publications and Theses Abstracts

Four books published this year were authored or coauthored by Statistical Laboratory staff members. V. A. Sposito is the author of *Linear and Nonlinear Programming.* Coauthors are: Dean L. Isaacson, *Markov Chains: Theory and Applications;* D. V. Huntsberger, *Elements of Statistical Inference for Education and Psychology;* and Richard Mensing, *Statistics in Research.*

Editorial and administrative duties on journal staffs were assumed by faculty members as follows: David Harville and Oscar Kempthorne are associate editors of *Biometrics. Mathematical Reviews* has seven reviewers from the Statistical Laboratory: Barry Arnold, T. A. Bancroft, H. T. David, C. P. Han, Dean Isaacson, Glen Meeden, and Edward Pollak. Drs. Kempthorne and Bancroft are members of the editorial advisory board for the *Journal of Statistical Computation and Simulation.* Dr. Kempthorne is an associate editor for *Theoretical Population Biology.* C. P. Han serves on the editorial board of *Communications in Statistics.* H. T. David is a member of the management committee of *Technometrics.* H. T. David and Wayne Fuller are associate editors of the *Journal of the American Statistical Association.* William Kennedy is an associate editor of *The American Statistician.*

Abstracts of papers and books published by staff members and graduate students, theses abstracts and books reviewed are included in this section. When research was conducted at Iowa State but the author has since accepted a new position, his current location is listed in parentheses after his name. Some of these publications are included in the Statistical Laboratory's Reprint Series (SLRS), and copies are available upon request. These are indicated by an asterisk (*).

Published Research

*__Arnold, Barry:__ "A Characterization of the Exponential Distribution by Multivariate Geometric Compounding," *Sankhȳa* 37 Series A:1 (1975) 164-173. SLRS 374.

A multivariate geometric distribution is defined with reference to the waiting times for k different outcomes in a sequence of multinomial trials. Attention is then directed to multivariate geometric sums of independent identically distributed random variables. In general, the marginal distributions of such multivariate compound distributions are dependent. It is shown that independent marginals are encountered if and only if the compounded random variables are of the form $\pm X$ where X is exponentially distributed. The characterization is related to and motivated by known results about Poisson processes. A more general multivariate geometric distribution is introduced and is shown to lead in a natural way to the Marshall-Olkin multivariate exponential distribution.

*__Arnold, Barry C.:__ "Significant Category Clustering in Free Recall," *Psychometrika* 40:4 (1975) 579-581. SLRS 369.

Frender and Doubilet suggest that Bousfield's ratio of repetitions (RR) is the best measure of clustering in free recall presently available. Conditioning only on the number of words recalled, they determine the mean of RR in the absence of clustering. In this note the null variance of RR is presented. This permits development of conservative significance tests based on the Cramér inequality.

*__Asok, C. and B. V. Sukhatme:__ "Unequal Probability Sampling with Random Stratification," *Social Statistics Section, Proceedings of the American Statistical Association* (1975) 283-288. SLRS 372.

For estimating the population total of the characteristic under study in the case of unequal probabilities and without replacement procedure, it is often advantageous to select the units such that the inclusion probability of each unit is proportional to its size. Such sampling schemes are called Inclusion Probability Proportional to its Size (I. P. P. S.) Schemes. However, there is a scarcity of such schemes in the literature which are practically useful for sample size $n > 2$. In this article, use of random stratification has been examined in devising I. P. P. S. procedures for sample size $n > 2$ by using the procedures for sample size 2. In particular, an alternate generalization of Durbin's procedure for $n > 2$ has been suggested which is adoptable with much ease in practice and which yields a more efficient estimator than the Sampford procedure.

*__Bailey Theodore B., Jr.__ and R. E. Comstock: "Linkage and the Synthesis of Better Genotypes in Self-fertilizing Species," *Crop Science* 16 (1976) 363-370. SLRS 377.

The basic task of the breeder of self-fertilized species is the aggregation of superior alleles in a single pure line or cultivar. This study focused on the model problem of collecting into one line all the favorable alleles present in one or the other of any pair of pure lines. Background theory and simulation data are present.

*Mead, Ronald, **T. A. Bancroft** and **Chien-Pai Han:** "Power of Analysis of Variance Test Procedures for Incompletely Specified Fixed Models," *The Annals of Statistics* 3:4 (1975) 797-808. SLRS 361.

Derivations are given of the size and power of a test of a hypothesis for an incompletely specified fixed linear model. Such a testing procedure involves a test of a hypothesis of main interest subsequent to a preliminary test to determine the inclusion or not of a term in the tentatively specified complete fixed linear model. An evaluation of the formulas of the size and power was made over a wide range of values of the parameters involved and recommendations concerning the choice of a proper significance level are given. One important objective of this study for the fixed model was to parallel as nearly as feasible the study given by Bozivich, H., Bancroft, T. A. and Hartley, H. O., (1956), *Annals of Mathematical Statistics* 27, 1017-1043, for the random model, and to compare the two. It should be noted that the results and recommendations for the fixed model are quite different from those given in the 1956 paper for the random model.

***Cornette, James L.** (Department of Mathematics, ISU): "Some Basic Elements of Continuous Selection Models," *Theoretical Population Biology* 8:3 (1975) 301-313. SLRS 375.

We present a general framework for the discussion of continuous population genetic models of monoecious diploid populations that incorporate one or more of age structure, mortality selection, mating structure, and fertility of matings. Within this framework, we then develop the specific models recently presented by Charlesworth (1970, Models 1 and 2) and Nagylaki and Crow (1974) and establish conditions under which the Malthusian parameters of these papers are equivalent.

Hogg, Alex, Richard F. Ross and **David F. Cox:** "Joint Changes in Lameness of Confined Swine," *American Journal of Veterinary Research* 36:7 (1975) 965-970.

Joints of spontaneously lame Hampshire swine reared in confinement were compared with normal Hampshire and normal Yorkshire swine. Specific areas of study and comparison were: gross or microscopic appearance of synovial membranes, volume of synovia per joint, somatic cell count in synovia, total protein and total lactic dehydrogenase (LDH), y-globulin and LDH_5, and structure of muscles.

Ross, R. F., Barbara J. Zimmerman, W. C. Wagner and **D. F. Cox:** "A Field Study of Coliform Mastitis in Sows," *Journal of the American Veterinary Medical Association* 167:3 (1975) 231-235.

Three sows with agalactia and mastitis were compared with 3 normally lactating sows at 8, 16, 24, and 32 hours postpartum. Bacteriologic examination of milk resulted in isolation of *Klebsiella pneumoniae* or *Escherichia coli* from affected glands of all 3 agalactic sows. Milk from clinically normal glands of affected sows and from glands of normal sows was culture-negative for coliforms. White blood cell counts, plasma protein/fibrinogen ratios and plasma hormone content of the sows were all evaluated in this study. A comparison was made between mean weights of the pigs farrowed by each group of sows.

***Emigh, Ted H.** and **Oscar Kempthorne:** "A Note on Goodness of Fit of a Population to Hardy-Weinberg Structure," *The American Journal of Human Genetics* 27:6 (1975) 778-783. SLRS 366.

Journal paper No. J-8105, Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 1669; supported by the National Institutes of Health, Grant GM-13827-08.

This paper examines the problem of testing the goodness of fit of a genetic population to Hardy-Weinberg equilibrium structure. In particular, the paper examines the test suggested by Haldane in 1949 in light of criticisms by Cannings and Edwards in 1969 that the test is not valid for sexually reproducing populations. The errors in logic of Cannings and Edwards are exhibited and analyzed. The Haldane test is shown to conform to the generally accepted method of goodness of fit testing while the Cannings and Edwards test is irrelevant for testing the goodness of fit of the population to Hardy-Weinberg structure.

Galambos, J. (Temple University, Philadelphia): "Characterizations of Probability Distributions by Properties of Order Statistics II," in Patil,et al. (eds.) *Statistical Distributions in Scientific Work* Vol. 3 (1975) 89-101.

This paper is a continuation of the work with the same title of the present author. With emphasis on discrete distributions, the aim here is the same as in the first paper: to unify and to expand the theory of characterizing probability distributions by properties of order statistics.

Galambos, Janos (Temple University, Philadelphia): "Order Statistics of Samples from Multivariate Distributions," *Journal of the American Statistical Association* 70:351(1975)674-680.

Let $(X_{1j}, X_{2j}, \ldots, X_{mj})$, $j = 1, 2, \ldots, n$, be a sample of size n on an m-dimensional vector $(X_1, X_2, \ldots, X_m)$, $m \geq 2$. Let the order statistics of the rth component be denoted by $X_{r,1}^* \leq X_{r,2}^* \leq \ldots \leq X_{r,n}^*$. In this article we investigate the distribution of the vector $(X_{1,n-i1}^*, X_{2,n-i2}^*, \ldots, X_{m,n-im}^*)$ for $(i_1, i_2, \ldots, i_m)$ not depending on n. The major emphasis is on asymptotic theory and a general formula is given for the asymptotic distribution of the vector above when each $i_j = 0$. Necessary and sufficient condition is also given for the asymptotic independence of the components of the vector investigated. This extends results known for $m = 2$.

Gentle, James E., Ralph L. Kodell, and Patricia L. Smith: "On the Distribution of the Studentized Bivariate Range," *Technometrics* 17:4 (1975) 501-506.

The studentized bivariate range, R_s, in a sample from a circular normal distribution is expressed as the maximum of a set of F variables. Bonferroni inequalities are used to determine bounds for the critical values of R_s, and intervals in the upper range of R_s are found in which these bounds are attained. The upper tail distribution of R_s is then obtained from the F distribution. The use of the statistics in testing for homogeneity of variance is considered.

Gentle, James E. and **V. A. Sposito:** "On the Invariance of Certain Estimators," *Bulletin of the Australian Mathematical Society* 14 (1976) 405-408.

L_p estimators for the parameters in the linear model $y = X\beta$ are considered. It is shown that these estimators are invariant under scale transformations on the dependent variable, but that the invariance property does not hold for more general transformations on y nor for general nonlinear models.

***Ghai, G. L.** (Department of Mathematical Sciences, Florida International University, Miami) and **E. Pollak:** "On Some Results for a Bivariate Branching Process," *Biometrics* 31:3 (1975) 761-763. SLRS 362.

Journal Paper No. J-7709, Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 1669.

Some results given by previous authors for a haploid model with individuals of two types, reproducing independently according to the Poisson progeny distribution, are generalized. It is shown that the limitation to the Poisson distribution can be overcome very easily, and the results can be developed for arbitrary offspring distributions that may even differ for different types. Asymptotic expressions are derived for the probability that both types are still present at time n. Conditions are also given for the finiteness of the mean and second moment of the time until one type is lost from the population.

Ghosh, Malay: "Admissibility and Minimaxity of some Maximum Likelihood Estimators when the Parameter Space Is Restricted to Integers," *The Journal of the Royal Statistical Society, Series B (Methodological)* 37:2 (1975) 264-271.

The present note studies the admissibility and minimaxity of maximum likelihood estimators in certain examples where the parameter space is restricted to integers.

Ghosh, Malay: "Probabilities of Moderate Deviations of Non-stationary m-dependent Processes with Unbounded m," *Cal. Statist. Assoc. Bulletin* 24(1975)1-11.

For each $k = 1,2, \ldots$ let $X_1^{(k)}, \ldots, X_n^{(k)}$ be an m-dependent sequence of (possibly non-stationary) random variables, where $n = n(k)$, $m = m(k)$. It is assumed that

$$\lim_{k \to \infty} n^{-1} V\left(\sum_1^n X_i^{(k)}\right) = v^2$$

exists and is non-zero. Under the above and other assumptions, it is proved that for every $c > 0$,

$$P\{n^{-1} \sum_{i=1}^{n} (X_i^{(k)} - EX_i^{(k)}) > cv(\log n/n)^{1/2}\} \sim (c^2 2\pi \log n)^{-1/2} n^{-1/2c^2}$$

and

$$P\{n^{-1} \mid \sum_{i=1}^{n} (X_i^{(k)} - EX_i^{(k)}) \mid > cv(\log n/n)^{1/2}\} \sim 2(c^2 2\pi \log n)^{-1/2} n^{-1/2c^2}$$

as $k \to \infty$. The above probabilities of moderate deviations results generalize similar findings of Ghosh (1974 Canadian Journal of Statistics, 2, 157-168) for stationary m-dependent sequences with fixed m.

***Ghosh, Malay** and **Edward Pollak:** "Some Properties of Multivariate Distributions with PDFs Constant on Ellipsoids," *Communications in Statistics* 4:12, 1975, 1157-1160. SLRS 373.

For random variables $X_1, \ldots, X_{k+1}$ with unbounded support, having a joint pdf constant on ellipsoids, the joint distribution of the ratios $Y_i = X_i/X_{k+1}$ $(1 \leq i \leq k)$ is obtained. If the X_i's have a spherically symmetric probability density function, the Y_i's have a multivariate Cauchy distribution. The condition of unbounded support of the X_i's is not necessary, although it cannot always be relaxed.

*Ghosh, Malay, Gutti Jogesh Babu and Nitis Mukhopadhyay: "Almost Sure Convergence of Sums of Maxima and Minima of Positive Random Variables," *Z. Wahrscheinlichkeitstheorie verw.* Geb. 33 (1975) 49-54. SLRS 365.

For a sequence of independent and identically distributed positive random variables, the almost sure convergence of sums of maxima (when suitably normalized) to appropriate constants is proved for both bounded and unbounded random variables. A similar result is also proved for sums of minima of such variables.

Ghosh, Malay and Nitis Mukhopadhyay: "Sequential Point Estimation of the Parameter of a Rectangular Distribution," *Cal. Statist. Assoc. Bull.* 24 (1975) 117-122.

For a sequence of independent and identically distributed random variables from a uniform $(0, \Theta)$ distribution, a sequential procedure for point estimation of Θ is suggested, the loss being absolute error plus cost. Asymptotic and moderate sample behaviors of the procedure are studied.

Ghosh, Malay, Bimal K. Sinha and Nitis Mukhopadhyay: "Multivariate Sequential Point Estimation," *J. Multivariate Analysis* 6 (1976) 281-294.

For a multivariate normal distribution with unknown mean vector and unknown dispersion matrix, a sequential procedure for estimating the unknown mean vector is suggested. The procedure is shown to be asymptotically "risk efficient" in the sense of Starr (*Ann. Math. Statist.* (1966), 1173-1185), and the asymptotic order of the "regret" (see Starr and Woodroofe, *Proc. Nat. Acad. Sci.* 63, (1969) 285-288) is given. Moderate sample behavior of the procedure using Monte-Carlo techniques is also studied. Finally, the asymptotic normality of the stopping time is proved.

*Groeneveld, Richard and Glen Meeden: "Seven Game Series in Sports," *Mathematics Magazine* 48:4 (1975) 187-192. SLRS 367.

Consider a series in which the first contestant to win four games is declared the victor. Examples of these are the World Series in baseball and the Stanley Cup Playoffs in hockey. It is noted that the standard Bernoulli trials model does not give a good fit to the lengths of the 66 seven game World Series from 1903-1973. A variation of this model, taking account of the lack of independence of the outcomes is proposed. This two-parameter model is shown to give a good fit to the lengths of 66 World Series, 83 National Hockey League series and 118 basketball series. Various comparisons are made between the properties of this model and the Bernoulli trials model.

*Han, Chien-Pai: "Testing the Equality of Covariance Matrices under Intraclass Correlation Models," *Annals of the Institute of Statistical Mathematics* 27 (1975) 349-356. SLRS 368.

The modified likelihood ratio test for the equality of covariance matrices under intraclass correlation models is obtained and its asymptotic distributions are derived. This test is compared with the test derived by using Roy's union-intersection principle by a Monte Carlo study. It is found that in general the modified likelihood ratio test has a larger power. When the covariance matrices are such that one has small eigenvalues, one has large eigenvalues and the eigenvalues of the rest are in the middle, the two tests have about the same power.

Harville, David A.: "Confidence Intervals and Sets for Linear Combinations of Fixed and Random Effects," *Biometrics* 32:2 (1976) 403-407.

Confidence regions are constructed for linear combinations of fixed effects and realized or sample values of random effects. These regions can be used in instances where the ratios of the variance components can be regarded as known. They have the prescribed long-run frequency of coverage when there is repeated sampling of the random effects as well as the residual effects. They have smaller expected volume than confidence regions obtained by proceeding as though the random effects are fixed effects.

Harville, David: "Extension of the Gauss-Markov Theorem to Include the Estimation of Random Effects," *The Annals of Statistics* 4:2 (1976) 384-395.

In the general mixed linear model, each data point is represented as some linear combination of fixed and random effects plus a random error. The problem considered is that of estimating a linear function of the model's fixed effects and the realized or sample values of its random effects. Attention is restricted to linear estimators that are unconditionally unbiased. It is assumed that the covariance matrices of the random effects and of the random errors are known. An estimator is presented whose unconditional mean squared error is uniformly smaller than that of any other linear unconditionally unbiased estimator. It is shown that this estimator can be expressed in terms of the solution to any of a certain class of linear systems, and that doing so facilitates the exploitation, for computational purposes, of the kind of structure associated with analysis-of-variance models. The results can be viewed as an extension of the Gauss-Markov theorem. They can also be applied in a certain Bayesian setting.

*Hinz, Paul and Howard A. Eagles: "Estimation of a Transformation for the Analysis of Some Agronomic and Genetic Experiments," *Crop Science* 16:2 (1975) 280-283. SLRS 376.

Crop plants are often compared in replicated trials over a wide range of environments. The average yield and residual variance estimated in individual environments are often related. This interferes with the statistical tests usually required in such data. A method is described here that uses the means and residual variances from the individual environments to find a transformation of the original scale to one that reduces the dependence of the means and the variances.

Rey, C. R., A. A. Kraft, D. G. Topel, F. C. Parrish, Jr. and **D. K. Hotchkiss:** "Microbiology of Pale, Dark and Normal Pork," *Journal of Food Science* 41 (1976) 111-116.

Pale, soft, exudative (PSE), dark cutting, and normal colored pork were compared to determine differences in susceptibility to microbial growth. Chops were packaged and stored under simulated retail conditions. Color, marbling, pH, numbers of total aerobic mesophiles, psychrotrophs, proteolytic and lipolytic bacteria and fluorescent *Pseudomonas* and incidence of *Salmonella* and coagulase positive *Staphylococcus* were recorded for pork chops as storage time progressed.

After aging, normal chops had significantly higher pH values than PSE chops; dark chops were significantly higher than normal chops. Development of microorganisms during storage was influenced by pH; most rapid bacterial growth occurred on dark meat, slowest on PSE pork. Marbling of the meat did not influence growth of lipolytic bacteria. Relevance of various stages of processing as sources of contamination for the meat is discussed.

Lynch, M. D. and **D. V. Huntsberger,** *Elements of Statistical Inference for Education and Psychology,* Boston, Allyn and Bacon, Inc., 1976, 437 pages.

This book has two purposes: to be used (1) as a text for introductory courses in statistics for education and psychology students and (2) as an elementary reference source of statistical techniques for research workers in education and psychology.

The text contains enough material for a one-semester course at either the graduate or undergraduate level. Mathematical prerequisites are minimal with arithmetic and elementary skills in algebra sufficient. Problems and examples have been chosen to demonstrate statistical computations and concepts and may be computed by hand or with a calculator.

Isaacson, Dean L. and Richard Madsen: *Markov Chains: Theory and Application,* John Wiley and Sons, Inc. (1976) 256 pages.

This book deals entirely with the topic of Markov chains with most of the emphasis being given to discrete time chains. Stationary Markov chains are presented using three approaches: classical or traditional, algebraic, and computer. Each approach considers the basic questions of reducibility, persistency, periodicity, and ergodicity.

The problem of ergodicity for non-stationary Markov chains is considered using the ergodic coefficient. Conditions for weak and strong ergodicity are given for several classes of non-stationary chains.

Finally the continuous time Markov chains are introduced and presented as an approach to the study of birth and death processes.

The book is designed for advanced undergraduates or first year graduate students. The main results are presented in the form of proofs and examples so the reader can take a theoretical or applied approach to the topic.

Klemm, R. J., V. A. Sposito and D. Pyne: "Useful Least Squares Solutions over Inequality Restrictions," *Journal of Statistical Research* 8:2 (1974) 80-95.

This paper derives closed form solutions for least squares problems constrained by simple lower bounds. Moreover, for some problems with constraints of the type $A'\beta \geq P$, closed form solutions are established utilizing optimality conditions.

*Kempthorne, Oscar: "Fixed and Mixed Models in the Analysis of Variance," *Biometrics* 31 (1975) 473-486. SLRS 360.

Journal Paper No. J-8095, Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 890; partial support by National Science Foundation, Grant GP-24614 and National Institutes of Health, Grant GM-13827-08.

A brief background of analysis of variance is given. Tests of significance for a two-factor situation are presented and discussed. The case of nonfixed factors and the role of interaction are examined. Several questions about the use of analysis of variance and tests of significance are posed and discussed. Alternative approaches are mentioned briefly.

Kempthorne, Oscar: "Statistics and the Philosophers," in Harper and Hooker (eds.) *Foundations of Probability Theory, Statistical Inference, and Statistical Theories of Science,* Vol. II, D. Reidel Publishing Company, Dordrecht, Holland (1975), 273-314.

Kempthorne, Oscar: "The Analysis of Variance and Factorial Design," in Owen (ed.) *On the History of Statistics and Probability,* Marcel Dekker, Inc., New York (1976) 27-54.

Maurer, Willi (Wirtschafts-Mathematik A. G., Zurich, Switzerland): "On Most Effective Tournament Plans with Fewer Games than Competitors," *The Annals of Statistics* 3:3 (1975) 717-727.

***McCormick, G. F.** (John Deere, Hanover, Illinois) and **V. A. Sposito:** "A note on L_1 estimation based on the median positive quotient," *The Journal of the Royal Statistical Society Series C (Applied Statistics)* 24:3 (1975) 347-50. SLRS 370.

In this note it is shown that a modification of Barrodale and Young's algorithm for estimation under L_1 (minimizing the sum of absolute deviations) which uses the median of the positive quotients can result in a problem which will cycle.

***Meeden, Glen:** "A Special Property of Linear Estimates of the Normal Mean," *The Annals of Statistics* 4:3 (1976) 649-650. SLRS 375.

Let X be a normal random variable with mean Θ and variance 1 and consider the problem of estimating Θ with squared error loss. If $\delta(x) = ax + b$ is a linear estimate with $0 \leq a \leq 1$ then it is well known that $\lambda\delta$ is an admissible proper Bayes estimate for $\lambda \in (0,1)$. That is, all contractions of δ are proper Bayes estimates. In this note we show that no other estimates have this property.

Meeker, William Q. and Wayne Nelson: "Optimum Accelerated Life-Tests for the Weibull and Extreme Value Distributions," *IEEE Transactions on Reliability* R-24:5 (1975) 321-332.

This paper presents charts for the optimum accelerated life-test plans for estimating a simple linear relationship between an accelerating stress and product life, which has a Weibull or smallest extreme value distribution, when the data are to be analyzed before all test units fail. The plans show that one need not run all test units to failure and that more units ought to be tested at low test stresses than at high ones. The plans are illustrated with a voltage-accelerated life test of an electrical insulating fluid.

Meeker, William Q. and Wayne Nelson: "Maximum Likelihood Variances and Confidence Limits for Weibull Percentiles from Censored Data," *IEEE Transactions and Reliability* R-25:1 (1976) 20-24.

This paper presents a simple chart that provides approximate confidence limits for the percentiles of a Weibull life distribution estimated by maximum likelihood from singly censored data. The chart can also be used to determine the appropriate sample size and length of a life test. The methods are illustrated with life data on a locomotive control.

Mensing, Richard and Bernard Ostle: *Statistics in Research,* 3rd Edition. Iowa State Press, 1976. 624 pages.

The basic concepts and techniques vital to the use of statistics in research are presented in detail in the third edition of this book. Treatment is carefully balanced between descriptive statistics, mathematical statistics, statistical methods, and design and analysis of experiments. The text is designed so that it can be used by research workers or other users of statistical methods or by students taking courses in statistics. A theoretical background and many examples from varied fields of application are provided. The increasing use of the computer in research is given special coverage.

***Pollak, Edward** and **Barry C. Arnold:** "On Sojourn Times at Particular Gene Frequencies," *Genet. Res., Camb.* 25 (1975) 89-94. SLRS 363.

Journal Paper No. J-7887, Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 1669; partial support by National Institutes of Health, Grant GM-13827.

The distribution of visits to a particular gene frequency in a finite population of size N with nonoverlapping generations is derived. It is shown, by using well-known results from the theory of finite Markov chains, that all such distributions are geometric, with parameters dependent only on the set of b_{ij} s where b_{ij} is the mean number of visits to frequency $j/2N$, given initial frequency $i/2N$. The variance of such a distribution does not agree with the value suggested by the diffusion method. An improved approximation is derived.

Promnitz, Lawrence C.: "Sampling and Statistical Problems in Growth Analysis," 183-195 In: *Proceedings, Third American Forest Biology Workshop,* Colorado State University, Ft. Collins, 1975.

Sposito, V. A.: *Linear and Nonlinear Programming.* Iowa State University Press, Ames, Iowa (1975) 269 pages.

A rigorous development of the theories of linear and nonlinear programming is presented in this text. Com-

putational techniques such as sensitivity analysis and parametric programming are discussed in a manner students and professionals from many disciplines can easily grasp. A chapter on statistical applications fills a gap that exists in comparable texts. Some other special features of the book are the coverage of quadratic and geometric programming, as well as an appendix concerning the use of computer software packages available at most computation centers. The section on computers is sure to be useful to anyone who requires a solution to a linear programming problem larger than the common textbook variety. The first four chapters deal with basic concepts, methods, and theories of linear and nonlinear programming. In Chapter 5 linear and nonlinear programming theory and algorithms are linked to well-known statistical topics such as regression and least squares.

Sposito, V. A.: "Minimizing the maximum absolute deviation," *SIGMAP* 20 (1976) 51-53.

Under the L_∞ criterion, one can formulate this problem as a linear programming problem. Several properties under L_∞ are discussed.

Hexem, Roger W., **V. A. Sposito,** and Earl O. Heady: "Applications of a two-variable Mitscherlich function in the analysis of yield-water-fertilizer relationships for corn," *Water Resources Research* 12:1 (1976) 6-10.

Variations of models developed by E. A. Mitscherlich in the early part of this century are periodically used for estimating input-output relationships for plants. Mitscherlich's work focused on a single variable. While these exponential models incorporate features of theoretical appeal, the procedures for quantifying the models are relatively complex when two or more independent variables are included. It is shown that in fits of Mitscherlich and polynomial forms to yield-water-fertilizer data for corn grown under experimental conditions in Colorado and Kansas, test statistics for the polynomial forms are as good as or better than those for the more complex Mitscherlich models.

Strahan, R. F.: "Remarks on Bem's Measurement of Psychological Androgyny: Alternative Methods and a Supplementary Analysis," *Journal of Consulting and Clinical Psychology* 43 (1975) 568-571.

The drawbacks of a t ratio measure of psychological androgyny are discussed. Other measurement approaches are indicated, and a substantive issue is addressed.

Strahan, R. and H. Huth: "Relations between Embedded Figures Test Performance and Dimensions of the I-E Scale," *Journal of Personality Assessment* 39 (1975) 523-524.

Relations between an embedded figures measure of field independence and various dimensions of Rotter's internal-external locus of control scale were investigated. The general absence of significant correlations suggests that these variables are essentially unrelated.

***van Aarde, I. M. R.** (Faculty of Agriculture, University of Stellenbosch, C.P., South Africa) "The Covariance of Relatives Derived from Random Mating Population," *Theoretical Population Biology* 8:2 (1975) 166-183. SLRS 364.

Journal Paper No. J-8046, Agriculture and Home Economics Experiment Station, Ames, Iowa. Project No. 1669; supported by the National Institutes of Health, Grant No. 13827.

Attention is drawn to errors common in the derivation of forms for the genotypic covariance of noninbred relatives from a Hardy-Weinberg population of diploids. A synthesis of Fisher's least-squares method of partitioning the genotypic variance and Malecot's probability method of expressing kinship, yields a general form. For one locus, the form is

$$(P_{ss} + P_{sd} + P_{ds} + P_{dd})\tfrac{1}{2}\sigma_a^2 + (P_{ss}P_{dd} + P_{sd}P_{ds})\sigma_d^2$$

where σ_a^2 is the additive genetic variance, σ_d^2 is the variance of dominance deviations, P_{ij} is the probability that parental gamete i is identical by descent to parental gamete j, $i = s, d$ indexes the parents of one relative, and $j = s, d$ indexes those of the other. The form provides a framework for obtaining the covariance of relatives from an equilibrium population with linkage.

Firebaugh, Francille M., C. R. Weaver, and **Richard D. Warren**: "Reliability of Value Orientation Scales," *Home Economics Research Journal* 4:2 (1975) 74-89.

Data originating from an interregional project concerned with patterns of living of disadvantaged families were examined with two purposes: 1) to estimate internal reliability of value orientation scales as a basis for further analysis, and 2) to consider differences in the selection of scale items for single states or for all states included in the study. Scales for four value orientations (abstractness-concreteness, control-fatalism, equalitarianism-authoritarianism, and integration-alienation) were developed for both an education and a job focus. Data consisting of five items for

each of the eight scales were available from 12 states. To check reliability, a Guttman's lambda 2 was computed for each scale using 26 combinations of individual items. Combinations were ranked by magnitude of the lambda 2 value. Items consistently appearing in combinations of highest reliability were selected for further study. The reliability check yielded scales of three or four items for each value orientation except equalitarianism-authoritarianism: education. Reliabilities varied among the 12 states as well as between groups of rural and urban states. Differences between maximum and minimum reliabilities were generally reduced when samples were grouped. It is suggested that identifiable population parameters may be associated with varying reliability.

Book Reviews

Pollak, Edward: *Proceedings of the Sixth Berkeley Symposium on Mathematical Statistics and Probability, Vol. V: Darwinian, Neo-Darwinian and Non-Darwinian Evolution,* Lucien M. LeCam, Jerzy Neyman and Elizabeth L. Scott (eds.). University of California Press, Berkeley, 1972, 369 pages. in *Journal of the American Statistical Association* 70:350 (1975) 484.

Strahan, R. F. *Statistical Analysis* by Allen L. Edwards, 4th ed., in *Journal of the American Statistical Association* 71 (1975) 251.

Theses Abstracts

Aleong, John: "Aspects of Simultaneous Inference," Ph.D. thesis, Iowa State University Library, August, 1975.

In this dissertation the multiple comparison problem is considered. The model investigated is the one-way classification with errors that are normally and independently distributed with zero mean and a common unknown variance σ_e^2. The observations are denoted by X_{ij} and the model is

$$X_{ij} = u_i + e_{ij} \quad i = 1,\ldots n, \quad j = 1,\ldots,r_i$$

where the u_i are unknown true means or parameters and e_{ij} are the errors. From the sample mean $(\overline{X}_1,\ldots,\overline{X}_n)$ and the sample variance s^2, we want to give some substance to the notion of evidence with respect to $u_1,\ldots u_n$ and σ_e^2.

A critical review of existing multiple comparison procedures is given. An extension of the Duncan and the Student-Newman-Keuls procedure is proposed. The exact distribution of the maximum gap in a sample of size n from a standard normal distribution is given. With this distribution, the exact distribution of the studentized maximum gap statistic is used to formalize a procedure proposed by Tukey (1949) for grouping a set of observed means.

These procedures differ in their mode of approach. The motivation for the main approach in the thesis is that the choice of a procedure must be based in some way on prior opinions or guesses about the true means. The non-Bayesian procedures use a concept of error rate, α, of assertions derived from the data with regard to parameter values. It was hoped to develop some partial logic for the choice of error rates by the incorporation of prior opinions. This led to the development of Bayes rules for making of assertions on differences among the true means.

An extension of the Lindley-Savage argument, using a Waller-Duncan type decision theoretic formulation of the multiple comparison problem is given. Characterizing our beliefs or prognosis and using an additive linear loss function, we gave an improved Bayes rule for the multiple comparison problem in the one-way classification model stated above.

Bayes estimates of u_i were also given. Under certain conditions these estimates have a similar structure to those of Stein (1962) and Lindley (1971a), though with different weights.

Extensions of the above Bayes rules were also indicated for the one-way classification model with a control treatment and for the case where data arise from a complete balanced block design.

Doctor, Pamela: "Some Sequential Inference Problems," Ph.D. thesis, Iowa State University Library, May, 1976.

Consider Polya sampling from a dichotomous population; that is, from an urn initially containing W white and B black balls, balls are successively drawn, their color noted, and $\beta + 1$ balls of the color drawn added to the urn. The outcome after n draws is the path segment $\underline{X}_n = (X_1, \ldots, X_n)$, where $X_i = 1$ (resp., 0) if the drawn ball is white (resp., black). A stop rule S is the set of path segments for which sampling is stopped. The set $\tau_n = \{ \underline{x}_n \in S \}$, $n = 1, \ldots$, may be partitioned into a finite number of subsets $\gamma_{n1}, \ldots, \gamma_{nk_n}$; for example, let

$$\gamma_{nj} = \{ \underline{x}_n \in \tau_n : \sum_{i=1}^{n} x_i = j \}.$$

The set $S_\pi = \{ \gamma_{11}, \ldots, \gamma_{1n_1}, \ldots, \gamma_{n1}, \ldots, \gamma_{nk_n}, \ldots \}$ is called the stop rule partition.

The stop rule partitions studied by Girshick, Mosteller, and Savage (GMS) in the context of sequential Bernoulli sampling and later by David and Olkin for sequential hypergeometric sampling can be represented as "boundaries" in the

$(n, \sum_{i=1}^{n} x_i)$ - plane; this is due to the fact that GMS stop rule partitions have the following two properties: (i) Letting $\underline{X}_k$ denote the sub-segment $(X_1, \ldots, X_k)$ of $\underline{X}_n$, if $\underline{X}_n \in \gamma$,

then a permutation $\sigma(\underline{X}_n)$ of $\underline{X}_n$ is contained in γ unless $\sigma(\underline{X}_k) \in S$, for every $1 \leq k \leq n-1$, and (ii) $\underline{X}_{n_1} \in \gamma$, and $\underline{X}'_{n_2} \in \gamma$, then $n_1 = n_2$ and

$$\sum_{i=1}^{n} X_{1i} \neq \sum_{i=1}^{n} X_{2i}.$$

Properties of stop rules under Polya sampling are related to those under Bernoulli and hypergeometric sampling. Both a single sampling and a sequential sampling generalization of the finite population correction are discussed.

A sufficient condition for the closure of an arbitrary stop rule under Polya sampling is presented, and it is shown that the GMS stop rule partition defined by the SPRT under Polya sampling is not closed.

Conditions for completeness of an arbitrary stop rule under Polya sampling are derived, and along with "minimality" and "sufficiency" of a stop rule partition, they guarantee the existence of the UMVU estimate of

$$p = \frac{W}{W+B} \text{ under Polya sampling.}$$

Tuenge, Tusru Matsui: "Some Kinetic Models in Biology," M.S. thesis, Iowa State University Library, November, 1975.

The development and application of some kinetic models are discussed. It is shown that a commonly used model with one exponential term, where the rate of change is independent of time, is a special case of a generalized model with the time dependent on the rate of change.

The unknown parameters in these models can be roughly estimated by graphical methods; however, they can be determined more precisely by nonlinear regression procedures. The Modified Gauss-Newton Method by Hartley is reviewed, and its application to test for the dependency of the rate of change on time is discussed.

When the rate of change is found to be time dependent, although it is known to be constant over time by some previous knowledge, then it is possible the biological system is made up of two or more compartments. The estimation procedures and interpretation of unknown parameters in a two-compartment model are discussed in this work.

Villaseñor, José Aurelio: "On Univariate and Bivariate Extreme Value Theory," Ph.D. thesis, Iowa State University Library, March, 1976.

In the univariate case domains of attraction of convolutions are investigated.

A distribution function F is said to be attracted to the extreme distribution G if there are constants

$\{a_n > 0\}_{n=1}^{\infty}$ and $\{b_n\}_{n=1}^{\infty}$ such that

$\lim_{n \to \infty} F^n(a_n x + b_n) = G(x)$

(i.e., if suitably normalized maxima of samples from F converge in distribution to G).

Let $F_1 * F_2$ denote the convolution of F_1 and F_2. The extreme distribution to which $F_1 * F_2$ is attracted is identified, assuming knowledge of the distributions to which F_1 and F_2 are attracted. These results are used in the study of limiting distributions of bivariate maxima.

In the bivariate case, consideration is given to the problem of asymptotic independence of the marginal maxima, to the problem of characterization of domains of attraction, and to the problem of finding the extreme distributions for dependent bivariate samples.

Let F(x, y) be a bivariate distribution function. Then G(x, y) is a bivariate extreme distribution if there are constants

$\{a_n > 0\}_{n=1}^{\infty}$, $\{c_n > 0\}_{n=1}^{\infty}$, $\{b_n\}_{n=1}^{\infty}$ and $\{d_n\}_{n=1}^{\infty}$ such that

$\lim_{n \to \infty} F^n(a_n x + b_n, c_n y + d_n) = G(x, y)$.

In this case F is said to be attracted to G.

If $G(x,y) = G_1(x)G_2(y)$ where G_i $(i = 1, 2)$ are extreme distributions, the marginal maxima are said to be asymptotically independent.

Some classes of bivariate distributions F(x, y) are shown to have asymptotic independent marginal maxima.

The domains of attraction of

$G(x, y) = \exp\{-e^{-x} - e^{-y} + w(x, y)\}$

is characterized and sufficient conditions are given for attraction to

$G(x, y) = \exp\{-2^{-\alpha}(-x - y - \min(x, y))^{\alpha}\}$.

The domains of attraction of certain other bivariate distributions are investigated.

Finally, attention is given to exchangeable sequences of bivariate random variables. Under certain conditions, the corresponding limiting joint distributions of the marginal maxima are identified.

Wang, George H. K.: "Estimators for the Simultaneous Equation Model with Lagged Endogenous Variables and Autocorrelated Errors: with Application to the U. S. Farm Labor Market," Ph.D. thesis, Iowa State University Library, May, 1975.

This dissertation is composed of two parts: (1) a study of the estimation for the simultaneous equation model with lagged endogenous variables and autocorrelated errors; and (2) an econometric study of the U. S. farm labor market.

Several asymptotically efficient full information and limited information estimators are proposed. Consistent estimators of the standard errors of the estimators are given by the inverse matrix obtained at the last stage of computation. The estimators share features of the two-step Gauss-Newton procedure and of Aitken generalized least squares. The main difference among the methods is in the estimated endogenous variables used in the later stages of computation.

The asymptotic properties of the proposed estimators are obtained and the asymptotic covariance matrix of the restricted reduced form coefficients is derived. The small sample properties of the estimators are investigated by means of a Monte Carlo experiment.

Dynamic econometric models for the U. S. farm labor market are constructed and estimated using data from the period 1940 to 1973. The result of family farm labor market supports the hypotheses: (1) the demand for family farm labor depends on the price of family farm labor and the parity ratio; (2) the supply of family farm labor is a function of the price of family farm labor and the adjusted non-farm wage rate; and (3) the response to changes in economic stimuli take several time periods to complete. The main empirical results for hired farm labor market are (1) the demand for hired farm labor is a function of the price of hired farm labor and the parity ratio and (2) the signs of the coefficients of the supply function are consistent with prior expectations but the coefficient of price of hired farm labor is not statistically significant in this sample period.

Structural elasticities, impact multipliers, and dynamic multipliers in both markets are computed and analyzed. Forecasts of family and hired farm labor employment for 1985 are generated from the estimated models under three sets of assumed future values for the exogenous variables.

Cochran Retirement Announcement

W. G. Cochran, Professor of Statistics, Harvard University, 1957-76, retired at the end of the 75-76 academic year. He was a professor of mathematics at Iowa State University during the seven years 1939-46. Alumni and staff members in attendance at that time may recall personal associations with this illustrious statistician.

Professor Cochran, who was a statistician at the Rothamsted Experimental Station in England, 1934-39, was invited by Professor G. W. Snedecor to join him at Iowa State to assist in the consulting activities of the Statistical Laboratory and to further develop the graduate program of study in statistics through the Mathematics Department. The Department of Statistics, as an independent department, was not established at I.S.U. until 1947.

Glasgow University awarded Professor Cochran an M.A. degree and honorary L.L.D.; he received a B.A. and M.A. from Cambridge. Iowa State staff members, alumni, and friends express their appreciation to Professor Cochran on this occasion of his retirement for his important contribution to Statistics at Iowa State.

Survey Section, continued from page 10

Almost 600 Iowa families of moderate income, living in smaller rural towns, were asked to express their attitudes about various types of housing in a study carried out by the Forestry Department. Staff members assisted in questionnaire design, sample design and selection, organization and supervision of field data collection by personal interview, and editing and coding of data for processing. Results of this project will be used in the planning and implementation of housing programs in Iowa.

A statewide sample of owners of Iowa farmland was selected in a study of the problems of acquiring and transferring farm ownership. Mail questionnaires were sent to approximately 4,300 land owners. A subsample of the non-respondents were then contacted and interviewed by telephone. The Survey Section assisted Economics researchers in analysis of the resulting data. John Ingram directed this project within the Section.

A sample of Iowa industries was designed and drawn for the Iowa Departments of Environmental Quality and Public Instruction in a study of hazardous waste production and handling. Also of interest in this study will be the development of recommendations for training programs for employees who regularly handle hazardous substances. Data from sample firms will be processed and analysis completed by Survey Section staff.

A study of sick leave usage by the faculty and staff of the University was carried out for the administration. A sample of 656 employees was drawn and departments requested to furnish sick leave information on their selected employees. Estimates of sick leave usage were made for various classes of employees within the University.

For the second year, the Survey Group has assisted the Office of Program and Planning with the evaluation phase of the Iowa CETA (Comprehensive Employment and Training Act) program. Interviews were conducted with a sample of the enrollees at the end of the program. Analysis of the data included all other enrollee and employer data collected throughout the duration of the program.

A sample of central Iowa farmers were asked for their attitudes toward selected aspects of grain and farm supply marketing in a study conducted in cooperation with the Economics Department. Field interviewing services were provided the Farmer Cooperative Service of the USDA in a study to investigate the growth of farm supply cooperatives in the past ten years, their merchandising practices and future growth problems they may face.

The Survey Section carried out the biennial school census for the Ames Community School District as it has done numerous times previously. The primary purpose of this census, which is required by State law, is to obtain an accurate count of the number of persons less than 21 years old residing in the district.

Department of Statistics

The Department of Statistics through the College of Sciences and Humanities offers three degrees, B.S., M.S. and Ph.D. A specialized program of study in biometry can lead to a B.S. degree conferred by the College of Agriculture.

Undergraduates are prepared through a combination of theory and application courses for employment in business or governmental agencies or to pursue graduate studies.

In the graduate curriculum, each student is assisted by his/her major professor and advisory committee to design an individualized course of study. Required courses are kept to a minimum, and the student chooses a combination of theory and application courses to meet his/her objectives. Specialization may be pursued in the areas of experimental design, general methods, general theory, probability, statistical computing, survey sampling, or an area of application. Joint majors with other departments may be arranged. An M.S. candidate may elect the thesis or nonthesis option. Currently, the trend is in favor of the nonthesis option which requires six additional credits including a "creative component" of at least three credits of individual work.

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Seven essentially new courses were offered during the year. Richard Mensing taught a two-quarter sequence on probability and statistical inference for junior and senior engineering students fall and winter quarters. Statistics 331 emphasized applied probability models with applications in operations research and engineering design. Statistical inference as applied to engineering analysis was the topic of 332.

A one-credit course in statistical consulting, Statistics 590, was offered by Gordon Booth winter quarter. Consulting philosophies of various statisticians were considered. Biological applications were studied. There was a special emphasis on eliciting appropriate information from the consultee and preparing written reports.

Fall quarter William Kennedy and Vincent Sposito jointly prepared a three-credit course, Statistics 680, Topics on Statistical Computations. The course covered computational algorithms for determining regression coefficients under various criteria.

Statistics 648 was offered three times during the year. During the second summer session H. A. David gave a one-credit course, The Theory of Competing Risks. Each student completed a small theoretical or computational project.

Malay Ghosh presented 648 as a three-credit course on Sequential Analysis in the spring quarter. The course covered some of the classical aspects of the subject as well as some of the more recent advances. It started with an extensive discussion of the general area of Sequential Probability Ratio Tests and was followed by discussion on sequential Bayes decision rules with applications to estimation and hypothesis testing. In the area of sequential estimation, attention was also focused on some problems of point and interval estimation not solvable by any fixed sample procedure and requiring some purely sequential sampling scheme.

Glen Meeden taught 648 SSI which was a three-credit course in Bayesian statistics.

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1975-76 Course Offerings in Statistics

Courses for Undergraduate Students Only

100	Orientation in Statistics	R	F	Hotchkiss
101	Principles in Statistics	5	F,W,S	Groeneveld Ponder Simon Umbach
104	Introduction to Statistics	5	W,S,SSI	Hotchkiss Sedcole Shenk Simon S. Sukhatme Tu Yang
105	Introduction to Statistics	3	F,S	Han Huntsberger Meeker Mensing S. Sukhatme
127	Business Administration Statistics	5	F,W,S	Barron Isaacson Meeker Scholl
305	Engineering Statistics	3	F	Mensing
327	Elementary Business Statistics	4	F,W,S	Groeneveld El Sabbagh Meeker Werner
331	Probability for Engineers	3	F	Mensing
332	Statistics Inference for Engineering Data	3	W	Mensing
341	Introduction to Theory of Probability and Statistics	3	F,W	Huntsberger
342	Introduction to Theory of Probability and Statistics	3	W,S	Huntsberger
343	Introduction to Theory of Probability and Statistics	3	S	Huntsberger
380	Statistical Applications of Digital Computers	3	F,W,S	Bubolz Gentle

Courses for Graduate Minors and Undergraduates

401	Statistical Methods for Research Workers	4	SSII,F, W,SSI	Aleong Bailey Bancroft Coveyou C. P. Cox D. Cox Gentle Groeneveld Hickman Hinz Hotchkiss Meeden Strahan Warren
402	Statistical Methods for Research Workers	4	SSII,F, W,S	Bailey Coveyou C. P. Cox Han Harville Hickman Meeden Strahan Warren Wolins
407	Methods of Multivariate Analysis	3	F	Hinz
411	Experimental Design for Research Workers	3	S,SSI	Bailey Harville Hotchkiss Strahan Wolins
421	Survey Designs for Research Workers	4	SSII,S	B. Sukhatme
422	Survey Sampling for Social Scientists	4	W	Baker
431	Elementary Statistical Quality Control	3	S	Mensing
432	Applied Probability Models	3	W	Mensing
436	Genetic Statistics for Research Workers	3	F	Bailey
446	Statistical Theory for Research Workers	3	F	Huntsberger
447	Statistical Theory for Research Workers	3	W,SSI	Fuchs Mensing
448	Statistical Theory for Research Workers	3	SSII,S	Fuchs Huntsberger
481	Processing of Statistical Data	3	W	Gentle
482	Processing of Statistical Data	3	S	Gentle
490	Special Problems	Arr.	F,W	Gentle Hotchkiss
508	Econometric Statistics	3	F	Warren
511	Design of Experiments	3	S	Kempthorne
512	Design of Experiments	3	F	Harville
521	Design of Surveys	3	W	B. Sukhatme
522	Design of Surveys	3	S	Han
533	Industrial Statistics: Reliability	3	F	Mensing
535	Biological Statistics	3	S	C. P. Cox
536	Genetic Statistics	3	F	Pollak
537	Genetic Statistics	3	W	Pollak
538	Genetic Statistics	3	F	Fuller
539	Operations Research	3	W	H. T. David
540	Operations Research Methods and Economic Analysis	3	SSI	Sposito
541	Theory of Probability and Statistics	3	F	H. A. David
542	Theory of Probability and Statistics	3	W	Ghosh
543	Theory of Probability and Statistics	3	S	Meeden
545	Stochastic Processes	3	SSII	Isaacson
546	Nonparametric Statistical Theory	3	S	S. Sukhatme
549	Mathematical Programming	3	S	Sposito
580	Statistical Computations on Digital Computers I	3	W	Kennedy
581	Statistical Computations on Digital Computers II	3	S	Kennedy
590	Special Problems	Arr.	SSII,F,W, S,SSI	Bancroft Booth C. P. Cox H. A. David H. T. David Gentle Harville Hickman Hinz Hotchkiss Isaacson Kempthorne Kennedy Mensing Pollak Sposito Strahan B. Sukhatme Warren Wolins

Courses Primarily for Graduate Students, Major and Minor

500	Statistical Methods	4	W	Hinz
501	Intermediate Statistical Methods	3	F	Bancroft

Courses for Graduate Students, Major or Minor

601	Advanced Statistical Methods	3	F	C. P. Cox
621	Advanced Design of Surveys	3	W	B. Sukhatme

622	Seminar on Design of Surveys	3	S	B. Sukhatme
638	Advanced Econometric Statistics	3	W	Fuller
639	Stochastic and Continuous Programming	3	F	H. T. David
641	General Theory of Linear Hypotheses	3	F	Ghosh
642	Probability and Distribution Theory	3	W	Meeden
643	Theory of Estimation and Testing of Hypotheses	3	S	Arnold
644	Sequential Statistical Decision Theory	3	SSII	H. T. David
645	Order Statistics	3	W	H. A. David
647	Multivariate Analysis	3	F	Arnold
648	The Theory of Competing Risks	1	SSII	H. A. David
	Sequential Analysis	3	S	Ghosh
	Bayesian Inference	3	SSI	Meeden
680	Seminar on Statistical Computations	3	F	Kennedy Sposito
699	Research	Arr.	SSII,F,W, S,SSI	Booth C. P. Cox D. Cox H. A. David H. T. David Fuller Ghosh Han Hinz Isaacson Kempthorne Meeden Pollak Spositio Wolins

Graduate Students

M.S. degrees were earned by twenty students this year and Ph.D. degrees by four. Abstracts of theses written in partial fulfillment of the graduation requirements appear in the publication section. If educational or employment plans are known, a brief account for each student is given.

M.S. Recipients (Nonthesis except for asterisked name)

Don Akin (Winter, 1976, under Paul Hinz) is a Management Trainee in the Statistical Research Department of the A. C. Nielsen Company, Northbrook, Illinois. His primary responsibilities are research in sample design, methods, and analysis in the area of media audience measurement.

Clarence Alders (Winter, 1976, under Vincent Sposito) continues his leave from Mankato State University, Mankato, Minnesota, to pursue the Ph.D. degree under Dr. Sposito. Clarence's field of concentration is generalized convex programming.

William Arends (Fall, 1975, under Roy Hickman) continues employment with the Statistical Reporting Service of the U. S. Department of Agriculture, Washington, D.C., as a Mathematical Statistician in the Sampling Frame Section of the Research Division. His major responsibility is designing and testing an automated Record Linkage System to identify duplication among list sampling frame sources.

Don Barron (Winter, 1976, under Paul Hinz) is employed by General Motors Proving Grounds, Milford, Michigan.

Jengrong James Chen (Winter, 1976, under William Kennedy) continues his graduate studies in the Department of Statistics working toward a Ph.D. degree under James Gentle.

Brenda C. Clarkson (Spring, 1976, under D. F. Cox) is a statistical consultant in Moretown, Vermont.

Santiago Gómez (Fall, 1975, under Vincent Sposito) is teaching and doing research in the Department de Matematicas, Institute de Ciencias, Universidad Nacional, San Lorenzo, Paraguay.

Chung Man Ho (Spring, 1976, under James Gentle) is planning a joint Ph.D. in Statistics and Industrial Engineering at ISU.

Ben Kiregyera (Summer, 1975, under B. V. Sukhatme) returned to Uganda to teach undergraduate statistics courses in the areas of sample surveys and experimental designs. He is a lecturer at the Institute of Statistics and Applied Economics, Makerere University, Kampala, Uganda.

Wai Chung Lam (Winter, 1976, under William Kennedy) has returned to Hong Kong.

Anuchit Lamyordmakpol (Summer, 1975, under Dean Isaacson) remains in the Department studying toward a Ph.D. degree.

Gilda Piaggio Pareja (Spring, 1976, under Oscar Kempthorne) will return to Uruguay this fall and will be employed as a consultant statistician by the Centro de Inv Agric 'A. Boerger' (Ministry of Agriculture), Uruguay.

Monajemi Pashazadeh (Winter, 1976, under Dean Isaacson) returned to his home country, Iran.

Kenneth Pinski (Winter, 1976, under Vincent Sposito) is employed by Trane Company, LaCrosse, Wisconsin, as an applied statistician.

Wendell Ponder (Spring, 1976, under C. Philip Cox) is continuing his graduate studies in the Department under C. P. Cox. Next year Wendell will be a research assistant in the AES consulting group. His area of research emphasis is methods in biostatistics.

Dwight Rockwell (Fall, 1976, under Roy Hickman) is employed by the Sample Survey Research Branch, Research Division of Statistical Reporting Service of the United States Department of Agriculture. He is a Mathematical Statistician working in the Washington, D.C., headquarters office.

Ven Shion Shu (Spring, 1976, under H. A. David) will continue graduate study in the Department under H. A. David with an area of emphasis in robust estimation.

***Tsuru Matsui Tuenge** (Fall, 1975, under Gordon Booth) accepted employment as a Senior Planning Analyst at the American Express Company in Phoenix, Arizona. She is responsible for planning the projects and budget for the Division of Systems and Data Processing.

Lana Turner (Winter, 1976, under William Kennedy) has begun work as a Mathematical Analyst in the Management Science Unit of the Upjohn Company, Kalamazoo, Michigan. She serves as a consultant in statistical applications (primarily in the operations research area) to various departments within the Upjohn Company.

James zum Brunnen (Summer, 1975, under William Kennedy) is the Associate Director of the Statistical Analysis Unit, Department of Statistics, Colorado State University, Ft. Collins. His duties include consulting with researchers, supervising undergraduates in data analysis and computer programming, and teaching in the Department.

Ph.D. Recipients

John Aleong (Summer, 1975, under Oscar Kempthorne) was a visiting Assistant Professor in the Mathematics Department, Concordia University, Montreal, for one year. He is now employed as a statistician at the Vermont Agricultural Experiment Station and is a faculty member of the Department of Mathematics, College of Engineering, Mathematics and Business Administration, University of Vermont, Burlington.

Pam Doctor (Spring, 1976, under Barry Arnold and H. T. David) accepted a position as a Research Scientist with Batelle Memorial Institute, Pacific Northwest Laboratories, Richland, Washington. She is working on problems in environmental sampling with respect to the study of plutonium and other transuranic concentrations as they work themselves through an ecosystem.

José Villasenor (Winter, 1976, under Dean Isaacson) is a Professor and Investigator in the Statistics Department, Colegio de Postgraduados in Chapingo, Mexico. He teaches courses in statistical theory, advises master's degree candidates, consults with researchers from other departments in the Colegio, and conducts research.

George H. K. Wang (Spring, 1976, joint statistics and economics, under Wayne A. Fuller and Earl O. Heady) is employed by the Research Division, Transportation Systems Center, U. S. Department of Transportation, Cambridge, Massachusetts. He is currently working on Quarterly Forecasting Models of Transportation Aggregates: parametric time series models and dynamic regression models with time series errors. His current research is involved with empirical comparison of alternative procedures in testing casualty among paired economic time series.

Snedecor Award

Shie-Shien (Winston) Yang was selected by the graduate faculty in Statistics as recipient of the 1976 George W. Snedecor award.

Established in 1954 to honor Professor George W. Snedecor, founder and first director of the Statistical Laboratory, the award is presented annually to the most outstanding Ph.D. candidate in the Department of Statistics. The award consists of a year's membership in the Institute of Mathematical Statistics and a cash prize.

Yang received the B.A. degree in Mathematics from Iowa State University in 1969. He was a teaching assistant at the University of Wisconsin, Milwaukee, in the Department of Mathematics and received his M.A. degree there. Returning to Iowa State, he earned the M.S. degree in Statistics and has been a teaching and research assistant in the Department of Statistics since 1973.

M.S. Candidates

Akin, Donald
Anselmi, Luis
Antonovitz, Frances
Arends, William
Arnold, Robert
Auer, Richard
Aziz, Salman
Barron, Donald
Bernhardt, Vicki
Bhattacharyay, Biswanath
Bondy, Eric
Butcher, Dale
Chandhok, Promod Kumar
Chang, Shen-Lan Chu
Chen, Mon-Gy
Clarkson, Brenda
David, Jeffrey
Dehghan-Nayeri, Majid
Diaz, Francis
Ervan, Mahamad
Fernandez, Irma
Galmes, Miguel Angel
Glossmeyer, William
Gomez, Santiago
Gust, Cathryn
Hale, Michael
Hand, Michael
Hanley, Janet
Hanson, Thomas
Herrera-Haro, Jose
Ho, Chung Man
Hsieh, Wen Tai
Hsu, Shun-Hsia (Dorothy)
Islam, Shaikh
Johnson, Ervin
Kackar, Raghunath
Khuantham, Ananchai (joint forestry-statistics)
Kiregyera, Ben
Lam, Wai Chung
Leelasuwanich, Thawach (joint economics-statistics)
Lewis, Jerry
Liberty, T. Edward
Mo, Wing-hung (David)
Mowrey, Daniel
Noorboloochi, Siamok
Osho, Johnson
Pareja, Gilda
Pashazadeh-Monajemi, M. B.
Perez, Margarita
Pinski, Kenneth
Rockwell, Dwight
Sainumtip, Nida
Sallas, William
Scholl, Lorie
Shenk, Debra
Sirisukdi, Vannapha
Skalland, Kent
Sung, Bok Park
Sung, Chang Sup (joint industrial engineering-statistics)
Tai, Kuen-Jing (Joyce)
Tajdari, Parvis
Tam, Kenneth
Tuenge, Tsuru Matsui
Turner, Lana
Viroonsri, Boonchai
Werner, Neil
Williams, Ricky
You, Young-Kyun
Young, Shirley
zum Brunnen, James

Mu Sigma Rho

At the winter meeting of the local chapter, Dave Dickey, Paul DuBose, Ted Emigh and Becky Klemm gave short presentations on their areas of research.

Dr. H. O. Hartley, Texas A & M University, was the speaker at the May 17 initiation meeting. His topic was "The Impact of Computers on Statistical Research." Eleven students were initiated into the honorary, and Dr. Hartley was extended an honorary membership.

Keaven Anderson, senior statistics major, and Becky Klemm, statistics graduate student, were recipients of the Mu Sigma Rho annual award. In recognition of their academic excellence as well as contributions to the department and Mu Sigma Rho, their names have been engraved on a plaque which is displayed in the main office of the Statistical Laboratory.

Officers for the 1976-77 academic year are:
President— Francis Diaz
Vice President— Karen Hallaman Ponder
Secretary-Treasurer— Wendell Ponder
Advisor— Don Hotchkiss

Ph.D. Candidates

Alders, Dean
Aleong, John
Andriano, Kim
Aziz, Mohammad (joint sociology-statistics)
Biyani, Shriram
Carter, Randy
Carvalho, José
Chen, Jengrong
Clark, Cynthia
Crouse, Ken (joint computer science-statistics)
Dickey, David
Doctor, Pamela
DuBose, Paul
Emigh, Ted
Hasza, David
Huang, Cheng-Chi (joint mathematics-statistics)
Iwuora, Grace
Kim, Geung Ho (joint industrial engineering-statistics)
Klemm, Rebecca
Lamyordmakpol, Anuchit
Mellon, James
Midha, Chand
Motoyama, Tetsuro (joint psychology-statistics)
Parsian, Ahmad
Ponder, Wendell
Scott, Mark
Sedcole, Richard (joint agronomy-statistics)
Shu, Ven Shion
Simon, Barry
Sotres, David
Stangenhaus, Gabriela
Tu, Ching-Tsao
Umbach, Dale
Villaseñor, José
Wang, George (joint economics-statistics)
Yang, Shie-Shien (Winston)
Yen, Jenn-Yung (George)

Special Post Doctoral Student

Martinez, Daniel

Bancroft Award

Michael Packard has been named winner of the T. A. Bancroft Statistics Award. Packard was recognized for his outstanding statistics performance among doctoral candidates who have a joint major or declared minor in Statistics. He will receive a year's membership in the Econometric Society and a cash prize.

The award honors T. A. Bancroft, professor of Statistics, and former director of the Statistical Laboratory and head of the Department of Statistics from 1950-72.

Packard received the B.S. degree in Economics from Duke University, Durham, North Carolina, in 1972. He enrolled at Iowa State as a graduate student in the Department of Economics where he has served as a teaching and research assistant since 1972.

Undergraduates

At the May 11 and 12 Scholarship Recognition Dinners, undergraduate statistics majors were well represented. Graduating seniors (last calendar year) with the highest scholastic average from each of the six colleges were recognized as "Graduating Scholars." Nancee Toft, biometry, received this honor in the College of Agriculture. In the College of Sciences and Humanities, Lynn Alper, distributive studies, was a recipient of this recognition. Lynn was a statistics major for two years and transferred to distributive studies with an area of emphasis in statistics. Nancee will be a graduate student in plant physiology at the University of California, Davis, and Lynn will enter Iowa University's pre-med program.

"High Scholarship Students by Curriculum or Major" (seniors graduating within the last calendar year) were honored for achieving the highest scholarship in their various majors. Nancee Toft, biometry, Lynn Alper, distributive studies, and Keaven Anderson, statistics, were among this year's recipients. The upper two percent of students by class in each of the six colleges at the university were designated as "High Scholarship Students by College and Class." In the College of Sciences and Humanities, statistics students receiving this recognition were: Keaven Anderson and Steven Blume, seniors; Jill Ann Lehman, sophomore; Diane Shriver and Robert Sulentic, freshmen. Nancee Toft was among the honorees from the College of Agriculture.

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Keaven Anderson, Nancee Toft, and Mark Olson were initiated into Phi Kappa Phi, all-university scholastic honorary, this spring.

Rex Bennett was elected to membership in Cardinal Key, Iowa State's highest honorary society for junior and senior men.

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National Science Foundation scholarships have been awarded to two seniors, Nancee Toft and William Heavlin. Nancy and Bill will each receive a $3900 annual stipend for a period of three years. In addition to the student stipend, NSF grants $3400 annually to the university selected for graduate study by each scholarship recipient. Approximately 550 of these scholarships were awarded this year, 10 in Iowa.

Nancee will enroll at the University of California, Davis, for a Ph.D. program in plant physiology, with an emphasis in applied statistics. Bill is planning to begin graduate studies this fall in Stanford University's Department of Statistics.

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Nancee Toft received a $400 award from the Goke Estate Advanced Curriculum Scholarship in Agricultural Science for her senior year. She previously was the recipient of $200 and $300 from this fund during her sophomore and junior years, respectively.

Rex Bennett was a student representative on the All-University Council, 1975-76, and also on the University Academic Standards Committee, 1974-76.

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D. V. Huntsberger, Donald K. Hotchkiss and Richard Groeneveld served as undergraduate advisors both for students majoring in statistics and undeclared majors who indicated an interest in mathematical sciences. Students who received the B.S. degree this year are listed below.

Keaven Anderson
Rex Bennett—joint computer science and statistics
Michael Clark
Donald Dumdei
William Heavlin
Martha Johnston
Mark Olson—joint industrial administration and statistics
James Oppedal
Mary Louise Slaninger
Nancy Vance—joint economics and statistics
Gail Vandersee

(continued, page 36)

Statistics Club

Activities for Statistics Club members for the year began with the annual fall picnic at Brookside Park where freshmen met Stat Club members and staff. At the second meeting, a slide presentation was given by Nancee Toft of her summer work in Peru studying ant plants.

Agenda for the winter quarter meeting included a discussion of summer employment opportunities for undergraduates. Francis Diaz spoke on his experiences with G. D. Searle and Company, a pharmaceutical manufacturer in Chicago, after which Keaven Anderson gave an account of his employment with the Atomic Energy Commission, Oak Ridge, Tennessee. Work of the Statistical Reporting Service office in Des Moines was described by Martha Johnston, Nancy Vance, Gaylen Drape and Rex Bennett, all 1975 summer employees of SRS.

Spring quarter activities were initiated with a field trip to the Maytag Company in Newton, Iowa. Participants were given a tour of the engineering laboratory followed by a presentation describing the quality control procedures used at Maytag.

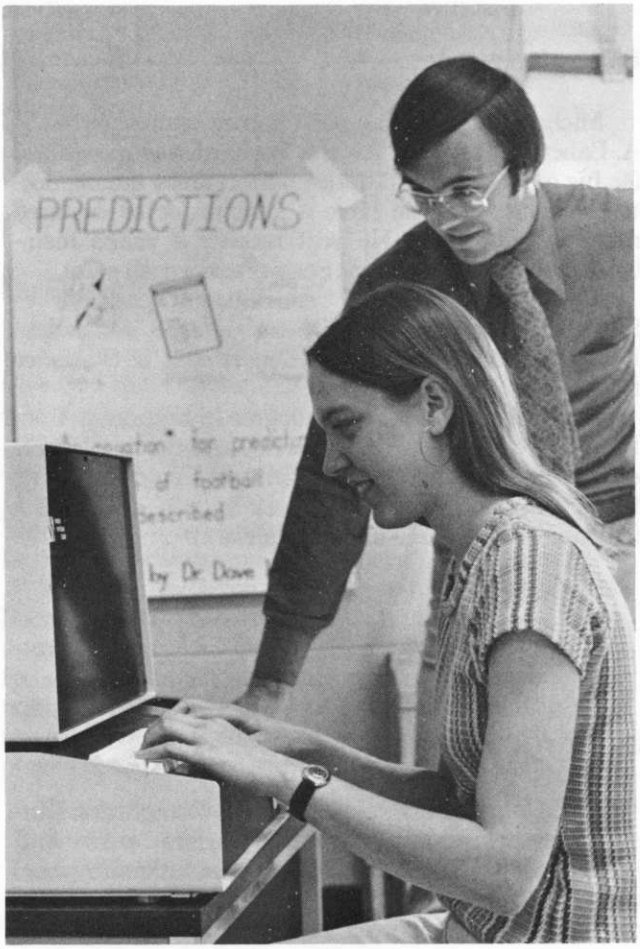
Recipient of the 1976 IBM-Statistics Club scholarship was Steven Blume. The Science Council-Statistics Club scholarship was awarded to Robert Tegels.

Officers for 1976-77:
President—Steve Blume
Vice President—Joe McCormick
Secretary—Dean Ivis
Treasurer—Bob Sulentic
Representative (Statistics Department Curriculum Committee)—Bob Tegels
Advisor—Don Hotchkiss

Statistics Club Sponsors Veishea Display

The theme of this year's Veishea Open House display by the Statistics Department was "Predictions." The exhibit illustrated the model, analysis, and results of a statistical rating system of college football teams prepared by Dr. David Harville. Visitors were given the opportunity to make their own predictions by putting two team names of their choice into a program accessed by a remote terminal.

Nancee Toft, biometry senior, and Dr. Harville examine the computer predictions for the football scores.



Seminars

Statistical Laboratory's weekly, non-credit seminars were planned this year by Edward Pollak, H. T. David, James Gentle and José Carvalho, student representative. Faculty members and students from statistics and related disciplines were invited. Oscar Kempthorne and Edward Pollak organized four quantitative genetics seminars, two sponsored jointly by the Statistical Laboratory.

These seminars featured guest speakers, local faculty members, and students. Professor G. S. Watson, Chairman, Department of Statistics, Princeton University, presented the first George Zyskind Memorial Lecture October 1.

Topics and speakers for this year follow:

Fall Quarter, 1975

September 10	R. A. Fisher's Statistical Methods for Research Workers—50 Years After, H. A. David
September 17	Bivariate Sequential Point Estimation, Malay Ghosh, Visiting Associate Professor, Indian Statistical Institute
September 24	Properties of (2n - 1) - Games Series, R. A. Groeneveld
October 1	The Spectra of Pythagoras, G. S. Watson, Chairman, Department of Statistics, Princeton University, First George Zyskind Memorial Lecture
October 8	Statistical Consulting: Can We Teach It? C. P. Cox, R. Klemm, B. Meador, L. Wolins
October 16	Data Transformation, David Hinkley, Department of Applied Statistics, University of Minnesota
October 20	Robust Estimation in Finite Population Sampling, Ken Brewer, Australian National University
October 29	Birnbaum's Theory of the Likelihood Principle, V. M. Joshi, University of Michigan
November 5	Inferences from Large Data Sets to Individual Cases: Use of Appropriate Conditional Probabilities in Exchangeable Subpopulations, Melvin R. Novick, University of Iowa

Winter Quarter, 1976

December 3	A Priori Mechanical Design to a Reliability Specification, Charles E. Mischke, Mechanical Engineering, ISU
December 10	Some Stopping Rules with Applications, Paul Randolph, Industrial Engineering, ISU
December 17	Optimum Accelerated Life Tests for Weibull and Extreme Value Distributions, William Q. Meeker
January 7	A Model for the Description and Regulation of Growth and Production, C. Z. Roux, Animal and Dairy Science Research Institute, Pretoria, South Africa
January 14	Post-Bayesian Statistical Inference, Arnold Faden, Economics, ISU
January 21	Extreme Distributions, José Villasenor
January 28	Theoretical Variability of Characters Determined by Endosperm, Mauritz van Aarde, University of Stellenbosch, Rep. of South Africa, Joint Statistics-Quantitative Genetics Seminar
February 6	Maximum Likelihood Estimation for Continuous Time Stochastic Processes, Paul Feigin, Statistics Department, Technion, Haifa, Israel
February 11	Generalized Pareto Distributions, Barry C. Arnold
February 18	Some Examples of Blyth's Technique of Proving Admissibility, Glen Meeden

Spring Quarter, 1976

March 10	On the Method of Conditioning the Diffusion Process in Population Genetics, Prem Narain, Institute of Agricultural Research Statistics, New Delhi, India, Joint Statistics-Quantitative Genetics Seminar
March 15	Life Testing Under Progressive Censoring: Some Parametric and Nonparametric Tests, P. K. Sen, University of North Carolina
March 17	Testing Hypotheses About the Covariance Matrix of the Multivariate Normal Distribution, Kareem Nakkash, Ph.D. Candidate, Department of Statistics, The American University, Washington, D.C.
March 24	Estimation and Hypothesis Testing in Non-Stationary Time Series, David Dickey
March 26	Sequential Estimation for Polya Sampling, Pam Doctor
April 2	A Sequential Test for the Mean of a Finite Population, W. J. Hall, Chairman, Department of Statistics, University of Rochester.
April 7	Theory and Applications of Concomitants of Order Statistics, Winston Yang
April 14	The Rate of Convergence of Certain Markov Chains, Dean Isaacson
April 22	Energy Inequalities for Gaussian Processes, G. Kallianpur, Department of Mathematics, University of Minnesota
April 28	The Behavior of the Posterior of a Location Vector for an Extreme Observation, Dale Umbach
May 5	Are Past Failures Forgiven and Past Successes Forgotten? Wayne Fuller
May 12	Instrumental Variable Estimation of the Simple Errors in Variables Model, Randy Carter
May 17	Multiple Frame Methodology and Selected Applications, H. O. Hartley, Distinguished Professor of Statistics and Director, Institute of Statistics, Texas A & M University

Summer Quarter, 1976

June 30	Aspects of Quadratic Programming with Statistical Applications, Rebecca Klemm

Quantitative Genetics Seminars

October 21	Stochastic Selection of Gametes and Zygotes, Daniel L. Hartl, Purdue University, Joint Biology and Quantitative Genetics Seminar
March 25	Statistical Inference in Population Genetic Models, Warren J. Ewens, Department of Biology, University of Pennsylvania, Philadelphia

Undergraduates, continued from page 34

Senior Statistics majors were quite successful in finding positions. Rex Bennett, Gaylen Drape, and Mike Clark all accepted positions with the Crop and Livestock Reporting Service of the USDA. Rex's position is in California, with the others to be assigned later. Nancy Vance accepted a position with Bell Laboratories in Chicago. Martha Johnston also accepted a position in Chicago with the Standard Oil Corporation. Dennis Miller, who will graduate at the end of the summer session 1976, passed the second actuarial exam and plans to work in that field. Mark Olson is working for the Walnut Grove Administrative Services, Inc., James Oppedal for John Deere, Des Moines, Iowa, and Mary Slaninger for the Iowa State Auditor's office.

During this summer Steven Blume and Keaven Anderson will be in Oak Ridge, Tennessee, in the Undergraduate Research Training Program sponsored by the Oak Ridge National Laboratories and Associated Universities. The program is highly selective and gives students opportunities for independent study and research under the guidance of a senior staff member. Robert Tegles, who will be a senior next year, will work this summer in the Biostatistics Department of the Upjohn Company at Kalamazoo, Michigan. Robert's supervisor, Dr. Joseph Assenzo, has been instrumental in providing ISU statistics majors with such opportunities. Patrick Bauer and Donald Saboe will have summer positions with the Crop and Livestock Reporting Service in Des Moines. Duane Skow, Director of the Des Moines office, has also been extremely cooperative in providing opportunities for both summer positions and permanent positions in the Statistical Reporting Service.

Along slightly different lines, Lucinda Tuttle will be studying geography in Pakistan this summer under an ISU foreign study program.

"Stat Lab" Breakfast Tradition Continues

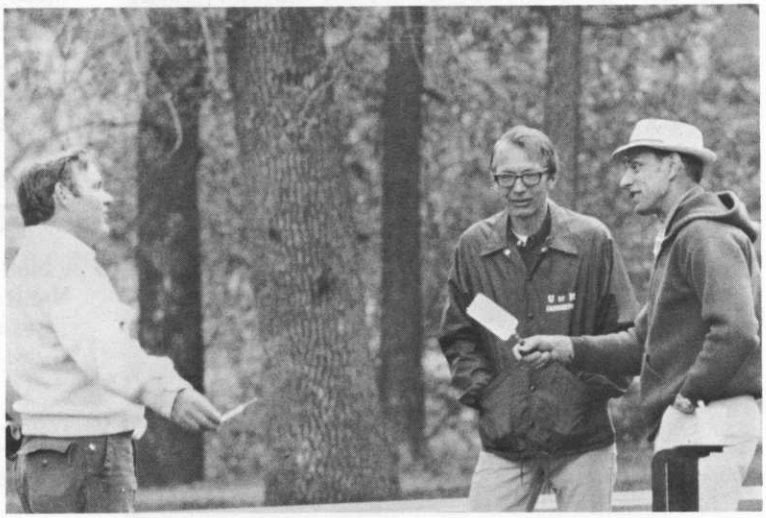
A 25-year social tradition of the Statistical Laboratory, the annual spring breakfast in Brookside Park, has been declared a success throughout the years. "Old-timers" report the breakfast, which has always been held on a Saturday morning, has never been rained out.

Picnics have been organized each year by the Social Committee. Margaret Kirwin, who was a member of this committee for many years, related the menu—hashbrowns, eggs, bacon, juice, rolls and coffee—has remained the same since the picnic's inception. In the days before frozen hashbrown potatoes were available, Margaret and other committee members would arise early to prepare them "from scratch." Open fires were used exclusively for the preparation of all food when the picnic originated. Electric frypans and grills are now a convenient replacement for the blackened pans of early years and have facilitated the addition of pancakes to the menu.

Challenges in horseshoes, volleyball, baseball, and softball continue to provide picnic entertainment for staff members and families. Bud Meador and Don Hotchkiss have been the Social Committee's picnic organizers in recent years. Pictured here are scenes from the 1976 picnic (photos courtesy of Ted Emigh).

Dr. and Mrs. D. V. Huntsberger arrive for the breakfast.

What is the probability that chefs (l. to r.) Kennedy, Hinz, and Hotchkiss will serve breakfast on time?



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