STATISTICAL LABORATORY

established 1933

annual report

July 1, 1981 to June 30, 1982

IOWA STATE UNIVERSITY, AMES

Contents

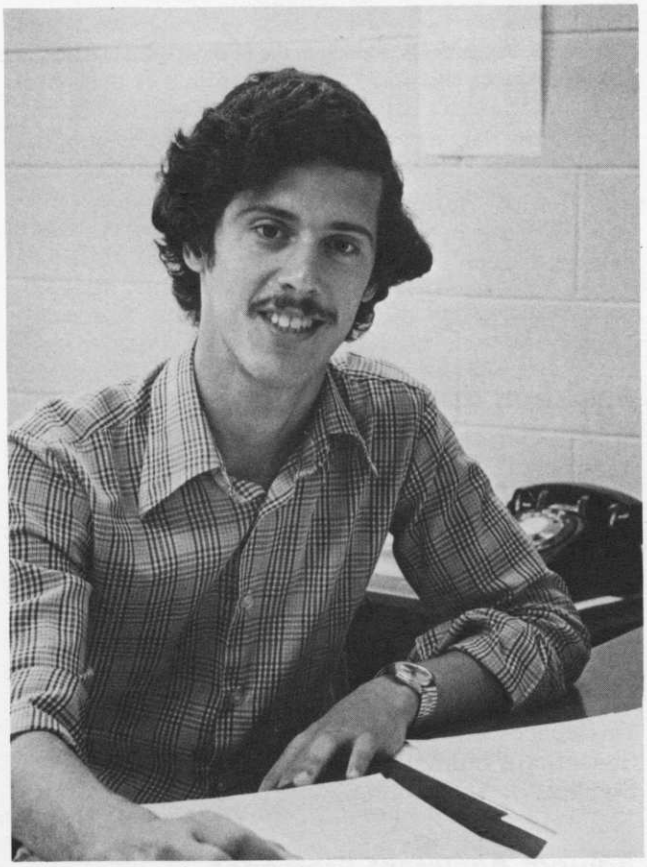
THE STATISTICAL LABORATORY
Iowa State University
1981-82 Annual Report

Personnel

Iowa State University's Statistical Center is directed by H. A. David. The center consists of the Statistical Laboratory, an institute under President Parks' office, the Department of Statistics in the College of Sciences and Humanities, the Statistics Department of the Agriculture and Home Economics Experiment Station, and the statistics participants in the Sciences and Humanities and Engineering Research Institutes. Many of the faculty members have duties in more than one of the center's components.

Two new assistant professors, previously announced, joined the faculty in July 1981, Ronaldo Iachan in the area of survey sampling and Stephen Vardeman in engineering statistics. Chien-Pai Han resigned in January to take a position as professor of mathematics, University of Texas at Arlington. Malay Ghosh will be leaving in August for a position as professor of statistics, University of Florida. Both have made significant contributions to the department, in teaching and through their active research programs.

A number of visiting scholars and visiting scientists spent part of the year in the Department of Statistics and the Statistical Laboratory. In the summer of 1981 C. R. Henderson arrived for a month of lecturing and consulting on statistical problems arising in animal breeding. The visit also meant renewing early associations with the Statistical Laboratory. He received his Ph.D. degree in genetics and animal breeding, with a minor in mathematical statistics, at Iowa State and is professor emeritus, Cornell University Department of Animal Science.



Ronaldo Iachan is assuming a leading role in the teaching of courses in survey sampling.

Songsri Pithayaratna and Montha Puavilai, both associate professors of statistics at Chulalongkorn University, Bangkok, Thailand, came for the first and second semesters of the academic year, respectively. Wing-Yue Wong arrived in December from the University of Malaya for a five-month stay. He was on sabbatical leave from his duties as lecturer, Department of Mathematics.

Ping Fang, from Nanjing Agricultural College, Nanjing, People's Republic of China, came in mid-February for two years of study and research under the guidance of Oscar Kempthorne. Particular interests are biometry and quantitative genetics. Yong-Quan Yin came from China to spend four months of the spring semester, working with Edward Pollak in quantitative genetics; he was on leave from positions as professor, Department of Mathematics, Graduate College, China University of Science and Technology, Peking, and professor (part-time), Department of Applied Mathematics, Tsing Hua University, Peking.

Alan Fenech, associate professor in the Division of Statistics, University of California—Davis, was here for two months in the spring to work with David Harville on mixed model theory.

In July 1981 Arthur D. Kuhl joined the Statistical Laboratory as resident collaborator for the USDA Soil Conservation Service, to serve as liaison between its national office and the Survey Group in soils inventory and monitoring activities. He had been state soil scientist in Pennsylvania since 1976. Howard Hughes retired from the Survey Section at the end of 1981.

Yasuo Amemiya was appointed assistant professor of statistics following a search for a specialist in multivariate analysis to replace Dr. Han. Amemiya received a B.S. degree in applied mathematics at the Science University of Tokyo in 1977. After special studies at the Institute of Statistical Mathematics in Tokyo, he came to Iowa State in 1978, received his master's degree in statistics in 1980 and is now completing the doctorate under Wayne Fuller. Amemiya's record at Iowa State has been quite outstanding and includes a Snedecor Award. The appointment is to take effect fall 1982.

The coming year brings several other changes. Ted Bailey has been promoted to full professor. Dan Scott joins the staff in August as a temporary assistant professor after completing a Ph.D. degree in operations research at Stanford. John T. Webster, professor of statistics at Southern Methodist University, will spend the fall semester here as visiting professor. Emmanuel Yashchin, now at Technion, the Israel Institute of Technology in Haifa, will hold a visiting assistant professorship for the coming academic year to work and teach in the area of engineering statistics.

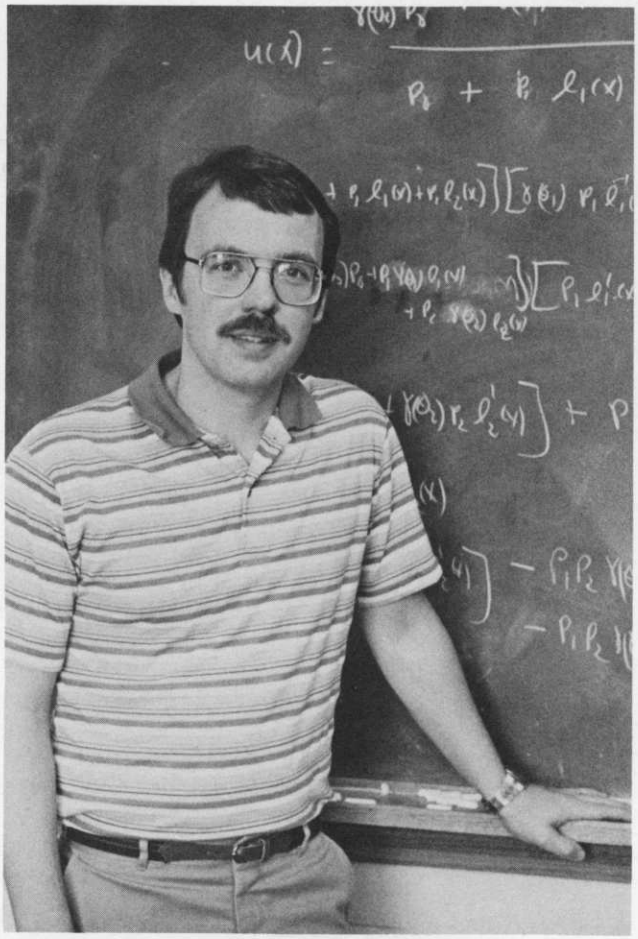
Wayne Fuller was elected a Fellow of the Institute of Mathematical Statistics. Beginning May 1 he spent six weeks doing research in survey sampling at the University of Southampton, England.

Statistical Laboratory Staff—Fiscal Year 1981-82 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

Krishna B. Athreya, joint appointment with Department of Mathematics
T. A. Bancroft, professor emeritus
C. Philip Cox
David F. Cox
Herbert A. David, Distinguished Professor in Sciences and Humanities
Herbert T. David, joint appointment with Department of Industrial Engineering
Wayne A. Fuller, faculty status also in Department of Economics
Malay Ghosh
Richard Groeneveld
Chien-Pai Han, through January 14
David A. Harville
Charles R. Henderson, visiting
Roy D. Hickman
Paul Hinz, faculty status also in Department of Forestry
Donald K. Hotchkiss
David V. Huntsberger, professor emeritus
Dean Isaacson, joint appointment with Department of Mathematics
Oscar Kempthorne, Distinguished Professor in Sciences and Humanities
William J. Kennedy
Glen Meeden
William Q. Meeker, Jr.
Edward Pollak, joint appointment with Department of Genetics
Vincent A. Sposito, joint appointment with Computation Center
Robert F. Strahan, joint appointment with Department of Psychology
Norman Strand, professor emeritus
Leroy Wolins, joint appointment with Department of Psychology



Stephen B. Vardeman is working in the fields of general theory and operations research.

Associate Professors

Theodore B. Bailey, Jr.
Alan P. Fenech, visiting
Kenneth Koehler
Leone Low, visiting
Wing-Yue Wong, visiting

Assistant Professors

Harold D. Baker
J. Jeffery Goebel
Ronaldo Iachan
Robert Johnson, joint appointment with Department of Sociology and Anthropology
Fred Lorenz, joint appointment with Department of Sociology and Anthropology
Mervyn Marasinghe
Mack C. Shelley II, joint appointment with Department of Political Science
W. Robert Stephenson
Shashikala Sukhatme
Stephen B. Vardeman

Adjunct Assistant Professor

Thomas Bubolz

Visiting Scholars and Scientists

Ping Fang
Songsri Pithayaratna
Montha Puavilai
Yong-Quan Yin

Resident Collaborator

Arthur D. Kuhl, USDA Soil Conservation Service, joint appointment with Department of Agronomy

Research Associates

Cheryl Enger Auer, through August 15
David K. Blough
Richard Dorsch

Graduate Assistants

The status of graduate students often changes. Students who held regular appointments as graduate assistants during the year are listed here.

Yasuo Amemiya
Kevin Anderson (**)
Robert J. Arnold
Craig A. Beam
Geoffrey Bergeron (*)
George Bloor (*)
Dennis L. Brandon
Terrance P. Callanan
David L. Cassell
Stephen Fu-Chung Chang
Janella Chapline
Sze Wai Cheung
Peter D. Christenson
Tin-Chiu Chua
Stephen V. Crowder
Jeanne A. Devin
Luis Alberto Escobar (*)
Steven Fahrenholtz (*)
Charles M. Farmer
Victor Filos
Carol A. Francisco
Margarita Guerrero
Rachel Harter
Merlon Hines (*)
Hsien-Ming Hung
David Jacobson
Daniel Jeske
John Marcus Jobe
Lee Ann Josvanger
Sallie Keller
Cynthia Keune
Byung Chun Kim
Lawrence Kinyon
Kevin Kramer (**)
Edward Henry Lee (*)
Moun-Shen Carl Lee
Youngjo Lee
Char-Lung Charles Lin
Sharon K. Loubert
Cindy Martin
Siamak Noorbaloochi
Julia Oñate
George Ostrouchov
G. Sastry Pantula
Gilda Pareja
Jerome Paulissen
Julio Peixoto
Lakshmi Rangachari
John Raudsep (**)
Di-Ou Ray
Ahmad Razmpour
Michael P. Rogers
Soetarto Sastrosoewignjo (*)
Daniel J. Schnell
Debra Schroeder
Tai-Tao Titus Shih
Fernando Silva
David L. Silvis
Bradley Skarpness (*)
Charles A. Smyth (**)
Pamela Stangl (*)
Michael Tveite
Jan van Schaik
Woon Bang Yeo
Jin-ying Yu

* summer 1981 only
** summer 1982

Supported Graduate Students

Yasmin Abdul-Aziz—Malaysian Government
Edi Abdurachman—USAID, Indonesia
Mohamed Ab-Ghaffar—Malaysian Embassy
Noorani Ahmad—Malaysian Government (*)
Kevin Anderson—Department of Mathematics, ISU
Victoria Black—Department of Mathematics, ISU
Steven Fahrenholtz—Engineering Research Institute, ISU
Victor Filos—Fulbright Scholarship, Tanzania
Fah Fatt Gan—Department of Mathematics, ISU
Chung Man Fred Ho—Engineering Research Institute, ISU (*)
Leigh Ihnen—Department of Entomology, ISU
Arunee Kumlung—Chulalongkorn University, Thailand
Juha Lappi—Rotary Fellowship, Finland
Cherng-Tarng Tony Lin—Engineering Research Institute, ISU
Paul McGovern—Graduate College, ISU
Mark McNulty—Department of Economics, ISU
Reda Mazloum—Egyptian Government
Edina Miazaki—Universidade Federal de São Carlos, Brazil
Jorge Morel—University of Costa Rica
Ronald P. Mowers—Department of Agronomy, ISU (*)
Paul T. Nkansah—Department of Mathematics, ISU, and Iowa Department of Transportation
Byung Sul Park—Korean Army
Ademir Petenate—Universidade de Campinas, São Paulo, Brazil
Juan Enrique Ramos—Mexican Government
John Raudsep—Department of Mathematics, ISU
Saad Eldin M. Saad Eldin—University of Gezira, Sudan
Shaharuddin Saadun—Malaysian Government
Fernando R. Silva—Inter-American Institute for Development of Agricultural Science, Chile
Slamet—Surabaya Institute of Technology Project, Indonesia
Hon Richard Tachia—University of Jos, Nigeria
Sergio Torreblanca—Consejo Nacional de Ciencia y Technologia, Mexico
Stavroula Tsokou—Department of Mathematics, ISU
Kanlaya Vanichbuncha—Chulalongkorn University, Thailand
Tilaka Vijithakumara—University of Peradeniya, Sri Lanka
W. N. Wickremasinghe—USAID and Sri Lanka Government
Jeffrey R. Wilson—Department of Mathematics, ISU
Francisco Zamudio—Consejo Nacional de Ciencia y Technologia, Mexico

Self-Supporting Graduate Students

Adnan Bin Ahmad
Robert J. Arnold
Richard Auer (*)
Geoffrey Bergeron
George Bloor
José Calcaño-Collazo
Promod Kumar Chandhok
Mirna Janet Gazaui

Michael D. Hale
Shawn D. Jacobson
Byung Hwee Kim
Chiho Kim
Jerry Lewis
Anthony Lui
Robert W. Mee
Thomas Mischke
Grecia F. Morel
Minoo Niknian
David D. Pohl
Wendell Ponder
Di-Ou Ray
Kendra Rohlk
Pamela Stangl
Jin-ying Yu

Undergraduate Teaching Assistants

Carolyn Connor
Kevin Kramer
Stephanie Ann Leonard
Linda Nollen

Survey Section

Glenda Ashley, key entry operator
Mary Lou Borts, survey supervisor until September
Julie Ann Cummings, statistical clerk
Dorothy Edwards, statistical clerk
Margaret Fowler, statistical clerk
Mary Genalo, survey supervisor
Evelyn Green, survey supervisor
Vimlesh Gupta, key entry operator
Esther Harmison, survey supervisor
John Highland, research assistant
Howard Hughes, research assistant through December
Sylvia McNulty, account clerk
Helen Nelson, secretary
Donna Omundson, statistical clerk
Kathie Reinertson, statistical clerk
Susan Ridnour, statistical clerk
Jasmine Seagrave, statistical clerk
Jeanne Sorenson-Wright, statistical data processor
Marilyn Sporrer, statistical clerk beginning in February
Jane Stowe, clerk typist
Harvey Terpstra, junior systems analyst
Sue Trexel, statistical clerk
Elaine J. Widmann, key entry operator

Statistical Data Processing Service

Bud J. Meador, supervisor
Kathleen Shelley, junior data analyst

General Office Staff

Avonelle C. Hefflefinger, administrative assistant
Betty Ibrahim, account specialist
Nancy J. Barry, information specialist through July
Jauvanta Walker, information specialist beginning in September
Frances Bradley, secretary
Audrey Burton, secretary from September through January
Phyllis Carr, secretary—Experimental Design Genetic Statistics Section
Norma Elwick, secretary
Judith LaMotte, secretary beginning in March
Marylou Nelson, secretary
Janice Peters, secretary
Sharon Shepard, secretary
Darlene Wicks, secretary—Statistical Numerical Analysis and Data Processing Section

When the Stat Women met at the home of Dola Ghosh November 9, 1981, attention centered on international cooking. Grecia Morel (foreground), from the Dominican Republic, explains her preparation of plantain. In the background (l. to r.) are Dola Ghosh (India), Julia Oñate (Philippines), Rani Athreya (India), president Anne Callanan (U.S.), Marjukka Lappi (Finland), and Estrham Said (Sudan). Membership in Stat Women is open to all statistics faculty, staff and graduate student women and the spouses of their male counterparts at Iowa State.

Consulting and Cooperative Research

Individual researchers, faculty, and students throughout Iowa State University come to Snedecor Hall for advice on statistical aspects of their research. On occasion, these associations lead to coauthorship of journal articles. The volume and complexity of assistance requests make statistical consulting and cooperative research a major activity for specific faculty members and graduate research assistants in statistics. Funding for consulting is provided mainly by the Statistical Laboratory and the Statistics Department of the Agriculture and Home Economics Experiment Station. Also the Engineering Research Institute supports some assistantships. Through grants, contracts, and cooperative agreements, various federal, state, and local agencies receive additional help.

Examples of this year's consulting problems follow.

Agriculture and Home Economics Experiment Station

The statistical consulting work of the Agriculture and Home Economics Experiment Station continues with a full range of problems generated by the research workers in the station. Statistics graduate assistants assigned to this section, under the supervision of D. F. Cox, Paul Hinz, Ted Bailey, and Donald Hotchkiss, carry most of the consulting load.

David Blough has been involved with the work of agricultural climatologists throughout the year and has handled other work in such areas as plant physiology, where studies of plant hormones were undertaken, and animal physiology, where a swine disorder was under investigation as a possible model for a particular problem in human medicine.

Cynthia Keune in 1981 and Janella Chapline in 1982 carried major responsibility for work from the Veterinary Medical Research Institute. Typical problems in that area involve studies on lactation and reproduction in swine and the immunobiological problems related to the development and use of vaccines.

There is a continuing interest in the effects of exercise on health. The section has consulted on work from exercise physiologists who work with human subjects, and research from the Department of Food and Nutrition where rats are studied under various combinations of diet and exercise regimes. Dan Jeske, Terry Callanan, and Carl Lee have helped in these studies.

Bob Wilson, former graduate student in statistics, had worked with the human nutrition research staff to try to relate numerous physiological measures (skinfold thickness, leg girth, etc.) to overweightness in adult women. His work was continued by using a revised scale of desired body weight to determine if the "best" physiological predictors were changed with the new equation. Cooperation between the Numerical Analysis Section and statistical consultants resulted in a comparative least squares multiple regression model.

The section has also been involved in design and analysis of work from the departments of Horticulture, Animal Science, Animal Ecology, Agronomy, and Weed Science.

A veterinary anatomy problem required help in comparing cell structure of different types of mucosal tissue from the noses of dogs. Because of major differences in replication at different sites, four broad regions of the nose area were grouped and shown to differ significantly. Subsequent comparison contrasted subregions within one of the four major regions.

Consultants assisted students in using grafted polynomials to describe how response variables changed with time where there was a natural interruption in the biological phenomena. One study of characteristics of hybrid corn involved response over four generations where selections were made for stalk rot resistance, followed by three generations of selection for stalk strength. For a comparison of gonad development over time for fish in different streams, a grafted polynomial was used to identify the point (K) where spawning activity changed the growth rate of the gonads for each stream.

A graduate student in earth science used the assistance of the consultants to identify what characteristics in appearance and location of gypsum could be used to predict the type of crystallization that occurred as the salts were deposited.

Students in institution management have been studying temperature preference among young children and among adults. Each participant was asked to decide which of three serving temperatures was found just right, too warm, or too cool. Assistance was provided in designing the study to reduce the carryover effects and to identify the overall preferred temperature.

Evaluation of nitrous oxide emissions from soil to the troposphere is of concern because the nitrous oxide may cause partial destruction of the stratospheric ozone layer and add to the atmospheric greenhouse effect. George Bloor analyzed data on emission rates from 25 areas in central Iowa. He obtained estimates of the amount of nitrous oxide emitted yearly and showed that emission rates from fertilized soils are substantially higher than from unfertilized soils.

The yield of a soybean field can be estimated knowing the number of plants in a foot of row, the number of pods on a plant, and the average weight of seed in a pod. Dan Jeske evaluated how two different ways of estimating number of pods and number of plants affect the precision of the total yield estimate. The methodology is of interest because it can be adapted to provide yield estimates of fields with immature plants.

Many recurrent selection methods are available to plant breeders for the purpose of making genetic

Wayne Fuller and Helen Nelson inspect the new dual-head Qume printer for the NBI word processor newly installed in the Survey Section.

improvements in populations. Ted Bailey consulted with a graduate student on his study of agronomic evaluation of four maize populations after recurrent selection for yield. The study also involved an evaluation of selected inbred lines from these populations.

Bailey assisted in design, analysis and interpretations of a study on the mode of inheritance of quantitative characters in chili peppers. The objective was to investigate the inheritance of yield components in peppers. A full diallel (five parents) was made using five randomly selected pepper inbreds. The results were interpreted in terms of breeding procedures applicable to pepper improvement.

Another investigation concerned the effects of soil moisture (drought) stress on yield and yield components of soybeans. An experiment was conducted using the ISU weather shelter at the Hinds Research Farm near Ames. The weather shelter is a large building built on a set of tracks so that it can be moved to cover the research plots whenever desired. With this facility, along with their irrigation equipment, researchers are able to control the amount and timing of water received by plots. Consultation with the researcher resulted in the decision to use a randomized complete block design, with seven treatments being randomized within each of sixteen blocks. Several measurements were taken to evaluate the effects of the treatments.

Survey Section

The Survey Section has been cooperating with the University of Iowa and the National Cancer Institute (NCI) on five case-control studies of cancer incidence in Iowa. Data collection is nearing completion in a five-year epidemiologic study designed to identify familial and environmental factors that are associated with the occurrence of brain tumors in children. Data have been collected on 61 cases and 183 randomly selected controls matched with cases on age, sex, and geographic area. Cases were identified by the Iowa Cancer Registry. The Survey Section has been in charge of control selection, field interviewing of parents of cases and controls, and initial data edit. Data analysis will be completed by researchers at the Children's Hospital Medical Center in Boston.

Another study, designed to assess association of oral contraceptive use and subsequent development of breast, endometrial, and ovarian cancer in women, is in its second year. Over the course of the study, personal interviews will be conducted with approximately 1,200 cases and 800 controls. Controls are selected by random digit dialing (RDD) methods. Survey Section personnel will interview cases and controls and edit and validate the data.

NCI is also studying long-term survivors of childhood cancer. The study cases, identified by the Iowa Cancer Registry, were diagnosed as having cancer between birth and age 19, had survived at least five years, and had attained age 21 by December 31, 1979. Sibling controls are also being studied to compare psychosocial morbidity of the survivors and these closely matched controls. Data were collected on 238 cases and 370 controls by either personal or telephone interview. The Survey Section was responsible for field interviewing, and editing and validation of the completed questionnaires. Analyses will be conducted by NCI researchers. Mary Genalo met with personnel at the National Cancer Institute May 18-21, in connection with this project.

Two epidemiologic studies of leukemia cases in Iowa are in progress. The first is a study of 215 acute lymphoid leukemia cases diagnosed from 1970 to 1980 in 80 rural Iowa counties. The research objective is to investigate a possible cause-effect relationship of acute lymphoid leukemia virus in humans to exposure to cattle, bovine leukemia virus, and other

factors in the rural agricultural environment. Two controls were matched with each case on age, sex, and geographic area. Controls for live cases were selected by the Survey Section using RDD methods, while proxies for deceased cases were selected by University of Iowa staff. The section assisted with construction of the questionnaire and field forms and was responsible for live control selection, interviewing of all cases and controls, and initial editing of the questionnaires.

A study of environmental factors associated with the origin of leukemia and non-Hodgkins lymphoma (NHL) among adult white males is also in progress. The objective of the study is to develop a better understanding of the established relationship between leukemia, NHL, and rural agricultural residency by searching for associations among these diseases and specific elements of agricultural practice. Six hundred cases and 600 controls matched to cases by age, sex, and race are to be interviewed. The section will select controls for live cases, while controls for deceased cases will be selected by researchers at the University of Iowa. The Survey Section will interview cases and controls, perform an initial data edit, and validate 10 percent of the completed interviews.

A sample of names was selected from farm and ranch directories of 23 Iowa counties for a group of researchers in the Department of Sociology. The sample was expected to yield about 425 interviews with operators of farms greater than 80 acres. A uniform sampling rate was applied to the directories. Screening of the sample names for eligible persons and interviewing were conducted by telephone. Study objectives concerned the adoption and diffusion of new farming practices and, in particular, farm operators' opinions about and usage of conservation tillage practices. Section staff also edited, coded, and keypunched the data. Analyses will be completed by Department of Sociology researchers.

A snowball sampling scheme was used in a study of citizen participation in community action, conducted for the Department of Economics. Data were collected from 130 community leaders involved in various issues within an Iowa community. The goal of the study was to determine which types of people provide leadership skills in a community and how those skills are used to help the community to effectively deal with issues and problems that arise. Section staff completed personal interviews with the selected leaders.

The Survey Section conducted the school census for the Ames Community School District. The census is conducted every two years as required by state law. Its primary purpose is to obtain an accurate count of the number of persons less than 21 years of age residing in the school district. In addition to data collection, section staff will process the data and produce desired summary tables.

For the third year, the Survey Section worked with the Iowa Conservation Commission on a study of duck and goose hunting on public hunting grounds in Iowa. A sample of observation periods during which Commission personnel collected data on each hunting party was selected for each hunting site during the season. The days of the hunting season were stratified by opening weekend, other weekends, and week days. If a hunting site had more than one access point, the sample was allocated at random to access points. Days were divided into three hunting periods and the sample balanced over these periods within strata. Data were collected by Commission personnel, while Survey Section staff processed the data and produced population estimates using SUPER CARP.

Assistance was given to a researcher in the Department of Textiles and Clothing in selecting a sample of licensed pesticide applicators. The researcher was not able to obtain a list of all pesticide applicators in the state, of which there were approximately 60,000, but was provided a list of the number of licensed applicators in each county. The counties were ordered geographically within extension areas, and a sample of 20 counties was selected systematically with probabilities proportional to their sizes in terms of the number of licensed applicators. The researcher will be able to obtain lists of applicators for the 20 sample counties. A fixed take of $n' = n/20$ applicators will be selected from each sample county, where n is the total sample size desired. The subject of the investigation is the disposal of pesticide-contaminated clothing.

A sample of names from farm and ranch directories of 16 southwestern Iowa counties was selected for a researcher in the Department of Sociology. The sample is expected to yield about 600 telephone interviews with farm operators. The study objective is to determine the extent of use of certain tillage practices.

An area sample of households was selected from a portion of Warren County for a researcher in Community and Regional Planning interested in studying shopping patterns. A sample of approximately 10,000 names was selected from farm and ranch directories of all counties in Iowa to be used in a mail survey seeking information about varieties of corn being planted.

A spontaneous quartet performs on toy harmonicas during a farewell function in honor of Chien-Pai Han. L. to r.: Donald Hotchkiss, Herbert T. David, Harold Baker, and Roy Hickman.

Assistance in questionnaire construction was given to a representative of the Iowa State University Professional and Scientific (P&S) Council interested in studying P&S employee attitudes toward performance appraisal, an agronomy student studying crop scouting, a professor in the Department of English studying the English proficiency of foreign students, a member of CIRAS studying the business outlook of Iowa manufacturers, a researcher in computer science studying on-campus needs for computer graphics, and a researcher in veterinary medicine studying incidence of rabies in Story County. The latter was also given assistance in selecting a sample of Story County households from telephone directories to serve as the basis for a mail survey.

Statistical Numerical Analysis and Data Processing Section

Each of the section's two major groups, supervised by Bud Meador and Tom Bubolz, was actively involved in several large projects relating to installation, maintenance, and consulting on major supporting software systems. Research activities within the section were supervised by William J. Kennedy, Vince Sposito, and Mervyn Marasinghe.

New releases of BMDP, MINITAB, SAS, and SPSS were installed on the NAS/6 computing system. A new package program, SAS/ETS, was obtained for researchers needing the capability to analyze econometric and time-series data.

Two major software systems, designed and developed for the Iowa State Forest Nursery, have reached production status. An order-entry/inventory management system successfully completed a full year of processing without significant down time. A significant new addition to this system's capability was the development, by Tom Bubolz and Matthew Garrett, of a subsystem to select orders to be processed and minimize the number of shipping containers needed for each order.

The second system is designed to estimate costs and find optimum methods for growing up to 50 species of trees. Jan van Schaik and Dan Schnell were major contributors. In the latter part of 1982, portions of the system will be updated to accommodate an expansion to a nursery being developed in southeast Iowa.

During the year, V. A. Sposito assisted various members of the ISU Center for Agricultural and Rural Development (CARD) in solving large-scale linear and quadratic programming problems. A recently completed project for CARD involved applying Separable Programming techniques to solve a certain nonlinear U.S. agricultural model.

Also during the year V. A. Sposito assisted Richard D. Warren, ISU Research Institute for Studies in Education, in setting up a linear programming problem to analyze the most efficient assignment of students in certain elementary schools. This project will be extended in the near future to cover additional grades and schools.

Steve Chang was responsible for analyzing data from the deer and small game harvest surveys taken by the Iowa Conservation Commission. Steve also completed a preliminary analysis of kinship and friendship linkages among witness-to-marriage contracts in 17th-century France. This programming was done in support of an investigation into the role of marriage as a vehicle for social mobility.

Sallie Keller, working with Andrejs Plakans, professor of history, developed a set of programs that plot diagrams of family trees for up to seven generations. Data come from census archives of 17th-century middle-European peasant communities. The programs employ lookup tables that were prepared using a direct access storage arrangement.

Youngjo Lee has written a program to assist educational researchers in the analysis of teacher performance evaluation questions. Output from this program is used as "feedback material" to assist educators in developing accurate and consistent evaluative abilities.

Operations of the group supervised by Bud Meador included an additional dimension with respect to the data entry phase of data analysis and statistical computations. One project from the College of Veterinary Medicine involved the processing of observational units that were digitized by a test instrument and transferred through two levels of disk storage prior to extensive edit and analysis. A number of the group's projects from the Department of Agronomy are structured toward some alternative to the key-entry process for recording observational units. The alternatives are mostly characterized as computer-to-computer transfer of data.

Kathy Shelley worked on general projects from Child Development, Agronomy, and other university departments. She also performed work for The Garst Company and the ILIS Corporation.

Char-Lung Lin continued to handle several projects for Veterinary Medicine and Engineering Extension during the year. To provide the needed support he wrote one or more programs in the following languages: COBOL, FORTRAN, PL/1, and SAS.

Titus Shih worked on projects in 1981 from Food and Nutrition, Family Environment, and other departments, as well as from private enterprises.

Lee Ann Josvanger handled a series of related projects for the Plant Introduction Station and others in agronomy. She also converted a time-series software package, developed at the University of Wisconsin, to run on the ISU Computation Center's AS/6 Computer.

Engineering Research Institute

H. T. David, Stephen B. Vardeman, and Steven Fahrenholtz consulted on research problems in engineering. Fahrenholtz's consulting assistantship was supported by the Engineering Research Institute.

Work with civil engineering staff included exploring the probabilistic modeling of filtration via per-

colation processes, a study comparing the strengths of beams made with regular and light-weight concrete, and ANOVA analyses of oil BOD characteristics and of nitrification inhibitors.

Work for the engineering administration involved a salary study of engineering staff. Work with industrial engineering staff involved an investigation of optimum uniqueness in a multi-product scheduling problem, and a problem on prior distribution selection in Bayes acceptance sampling.

Nuclear engineering staff consulted on the setting of bounds for system reliability and a problem in the updating of regression coefficient estimates using auxiliary data. Collaboration with chemical engineering staff continued, on the probabilistic modeling of crystal growth. K. Athreya also participated in this study.

Work with agricultural engineering staff led to regression analyses of factors involving starch conversion to glucose, and of factors affecting gasohol production. A climatological problem called for gamma and Weibull plotting of rainfall data. A thermodynamical problem in mechanical engineering involved multivariable optimization under experimental variability.

Social Sciences

Mack C. Shelley II consulted with students and faculty in the departments of Political Science, Family Environment, History, Journalism and Mass Communication, Agronomy, Industrial Education, and the School of Business. Special consulting projects concerned analysis of survey data regarding the lifestyles and attitudes of mothers incarcerated in a women's prison, and population projections for small areas. Other topics concerned the analysis of colonial American legislative voting records, a survey of small rubber farmers' attitudes in Malaysia, time series intervention and transfer function analysis of banking finances, a survey of consumers' knowledge of and needs for information on alternative energy sources, and a survey of consumers' attitudes toward market conditions.

Frederick O. Lorenz regularly consulted on statistical and methodological problems with faculty and graduate students from Sociology, Family Environment, and related departments. One outcome is a joint paper on modernity and fertility preferences in Taiwan.

Robert A. Johnson consulted on statistical aspects of various sociological problems. Examples are the following: probabilistic models for social network data, measurement and analysis of psychological depression among married couples, analysis of Costa Rican social survey data, and the research design for a longitudinal study of psychological stress in the family life cycle. He also advised members of the Chinese Overseas Student Association on the planning of a survey of Iowa State University students' knowledge of and attitudes toward China and the Chinese.

Leroy Wolins assisted a graduate student in education on doctoral research on faculty evaluations by students. The study involved about 1900 students in 89 classrooms, multiple sections of about 30 courses. The results indicate that when sex of student was controlled, most of the variability between courses was due to sections or teachers rather than courses, but courses having primarily females enrolled obtained substantially higher ratings than those having primarily males enrolled. The correlation between course grades and student evaluations of instructors was about 0.5 between courses and about 0.3 within courses. Interpretation of the results was difficult because the females, more so than males, tended to have higher grades and take courses as "elective" rather than "required."

Robert Strahan consulted with students and faculty in psychology, child development, education, physical education, industrial education, industrial relations, and industrial engineering.

Other Consulting

C. Philip Cox consulted with graduate students in animal science and animal ecology on heterospermic insemination procedures to evaluate boar semen, and on procedures for examining birds' nesting habits in relation to habit variates, respectively.

During the spring semester, Ted Bailey met weekly with two visiting professors of agronomy, from the People's Republic of China and Brazil, to discuss the general problem of how to achieve genetic improvement in self-pollinating species. The study group has been especially concerned with the identification and comparison of breeding systems using the principles of quantitative genetics. The meetings are continuing into the summer.

One of the larger projects Kenneth J. Koehler consulted on was with members of the Department of Animal Ecology and the Iowa Conservation Commission. It concerned statistical analysis of data from two surveys, one on coyote predation, the other on the impact of bow hunters on the Iowa deer population. In another project Koehler aided a Department of English faculty member in the design and analysis of an observational study to evaluate the importance of various factors involved in teaching English to students for whom English is not a native language.

Stephen B. Vardeman provided assistance on a problem in earth science concerning the analysis of data describing magnetic properties of rock samples taken at various depths below the earth's surface. Ronaldo Iachan consulted with an animal ecology student interested in the redesign of bottom trawl surveys by the National Marine Fisheries Service. Efficient stratification based on depth and location was considered in detail.

Off-campus, T. A. Bancroft consulted with statisticians at the University of Alabama at Tuskaloosa relative to the growth and development of the Mu Sigma Rho chapter there. Oscar Kempthorne discussed design and analysis of experiments at the University of Rochester.

Current Research

A brief summary of research sponsored by contracts, as well as individual research, is reported in this section. Research funds are made available through the budgets of the Statistical Laboratory, the Agriculture and Home Economics Experiment Station, the Engineering and the Sciences and Humanities Research Institutes, and several government contracts and grants. Papers arising from the work are in part listed in the section on Professional Activities.

AES Project 890

Several directions have been followed by Oscar Kempthorne. The foundations of statistics continue to be controversial. It may be suggested that it is essential to differentiate between assessing evidence given by data and the making of decisions based on data, with some data-based prior probabilities being necessary for the latter. A second direction is an attempt to give a rational structure to the vague area of statistics that has come to be known as data analysis. A third direction is randomization in comparative experiments, with the view that proper use of this procedure requires an explicit or implicit listing of experimental plans that are considered to be reasonable, on a subjective or objective basis; then one uses one of these at random, and all subsequent statistical procedures would be based on randomization testing using the list of acceptable plans. This direction of thought leads to the idea that testing of hypotheses rather than estimation is the ultimate basis for obtaining a quantification of evidence given by a comparative experiment. Some work has been done on the nature of linear models for a data set that possesses a classificatory structure.

Also, there has been collaboration with Leroy Wolins on the theory and practice of mental testing, in relation to the book by Arthur Jensen on this topic. The question is whether commonly used mental tests are biased against identifiable subgroups of the population. It is concluded that the tests are not so biased. The clear fact that subgroups differ is not an artifact of measurement resulting from deficiencies of the tests produced by constructors of the tests.

Small Area Estimation

Cooperative research with the Statistical Reporting Service, United States Department of Agriculture, continued under the direction of Wayne A. Fuller. Graduate assistants working on the project are Rachel Harter, Hsien-Ming Hung, and Yasuo Amemiya. The objective of the study is to improve methods of combining satellite information and sample survey information to construct estimates of crop acreages for small areas such as counties. Regression estimation in which the independent variable is a function of the satellite information is the basic technique being considered. Alternative procedures for incorporating the satellite information into regression estimation are under study. The nested error model containing within-county and between-county components of variance is being used as a model for the deviations about the regression line. Because estimates will be constructed on a yearly basis, methods of incorporating information from previous years into the estimation procedure are being developed. The effect of the type of sampling and of measurement error in the satellite readings is being investigated.

A paper presented at the 1981 American Statistical Association meetings by George Battese and Wayne Fuller was based upon this research.

AES Project 2155

Research in agriculture-related sample survey methodology continued in the Survey Section under Roy D. Hickman's leadership. This work is supported by the U.S. Department of Agriculture through Project 2155 with the Iowa Agriculture and Home Economics Experiment Station. Primary focus is on cooperative research with the Soil Conservation Service (SCS), dealing with inventorying and maintaining data on the nation's soil, water, and related resources. Roy D. Hickman, Jeff Goebel, and Harold Baker serve as coinvestigators. Also involved are Wayne Fuller, Survey Section staff members Richard Dorsch and John Highland, and research assistants Jeanne Devin and Tin-Chiu Chua. Data manipulation and editing, sample selection, mapping, and coding also require the efforts of a number of Survey Section clerical personnel.

A major portion of this project during the past year has centered around the 1982 National Resources Inventory, a national survey that includes over 800,000 specific sample sites. Data are being collected on land use and cover, wind and water erosion, characteristics of soils, conservation needs, prime farmland, wetlands, and other natural resources. These data are needed by all levels of government and by researchers in many disciplines to help make inferences as to the present and future state of our country's natural resources.

Because of the importance of this national inventory and the need for liaison between the Statistical Laboratory and state and national SCS offices, the SCS placed Arthur Kuhl, a professional soil scientist, at the Laboratory beginning July 1981. Kuhl is a career employee of the SCS, most recently serving as the state soil scientist for Pennsylvania. He has also served in Nebraska, Kentucky, and New York. At Iowa State University, Kuhl holds collaborator status in the departments of Agronomy and Statistics.

Cooperative research with the SCS has included analyzing data from past surveys to estimate variance components and improvement of sampling designs and estimation techniques. Determining efficient methods for maintaining data quality has been a major undertaking. This involved the development of extensive computer edit techniques and the use of

the computer to transmit information from remote sites via telephone lines. Also being studied are procedures for conveying to data users the accuracy of estimates derived from large-scale natural resource inventories. This has involved the preparation of tables and monographs and the presentation of seminars to SCS scientists and administrators.

The storage, retrieval, and analysis of the interpretation data of soil series in the United States continues as part of the SCS cooperative work. This data file has now expanded to more than 18,000 records. The rate of updating interpretative records has again increased as the SCS field staff attempts to keep the data current. Printing tables for published soil survey reports continues to be a primary use of these data. Work is now underway on edit checking to ensure a match between interpretation records and the 1982 National Resource Inventory data set. This matching will add another dimension to the information available from the Inventory. Soil interpretation information is being accessed remotely by the SCS state and national offices via their remote job entry stations. An important addition this year is the accessibility to SCS state offices of the farmland criteria table, which lists data items important in the determination of prime farmland. This table is used by the SCS in current prime farmland assessment. Harvey Terpstra continues to work with SCS personnel in the development and use of this data system.

Wayne Fuller, Roy Hickman, and/or J. Jeffery Goebel conferred with Soil Conservation Service personnel in Washington, D.C., December 13-16, concerning the university's cooperative agreement with the U.S. Department of Agriculture. Goebel had visited Little Rock, Arkansas, October 6-8 and Alexandria, Louisiana, November 16-19 to consult with Soil Conservation Service officials from Arkansas, Louisiana, the South Technical Service Center, and the national office on problems and possibilities of their Resource Information Data Systems and the National Resources Inventory work. He went to Washington, D.C., and Philadelphia, Pennsylvania, March 28-April 2 to discuss with SCS officials possible sampling designs for studying erosion sources not currently being inventoried, and to discuss with the U.S. Forest Service cooperative efforts with SCS regarding inventorying natural resources in the state of Maine. Harvey Terpstra visited Lanham, Maryland, April 25-30 to discuss future SCS needs for storage of their soil interpretations data file.

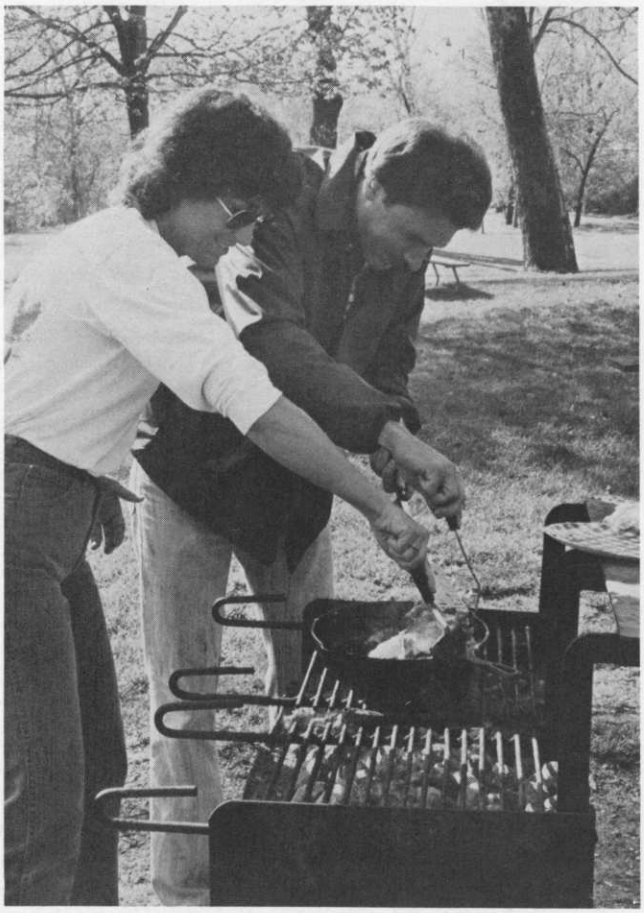
AES Project 2383

The U.S. Bureau of the Census and the Iowa Agriculture and Home Economics Experiment Station supported joint research in measurement error models, time series, and survey design. Support from the Bureau of the Census was through Joint Statistical Agreement J.S.A. 81-14. This support terminated on February 28, 1982. Personnel working on the project include Wayne Fuller, principal investigator, Yasuo Amemiya, Tin-Chiu Chua, Hsien-Ming Hung, and Sastry Pantula.

Models for the reponse error associated with the classification of individuals at two points in time were developed. This problem is of interest in the estimation of the fraction of persons unemployed for two consecutive months. Realistic models are rather complicated, and nonlinear methods are required for estimation of parameters. The parameters of preliminary models have been estimated for interview-reinterview data collected by the Census Bureau as a part of the Current Population Survey.

Research was conducted on linear and nonlinear models in which the explanatory variables are subject to measurement error. Asymptotic properties of estimators were studied under a number of alternative assumptions. Explicit expressions for the large sample covariance matrix of the estimators of the multivariate model and of the large sample covariance matrix of the estimators of the factor model were derived.

Sastry Pantula prepared a computer program for the construction of estimators of the parameters of the factor analysis model. This program, written in MATRIX of SAS, computes estimates and the estimated covariance matrix of the estimators. It can be used to obtain estimators and their estimated covariance matrix for the multivariate linear errors-in-variable model. Hsien-Ming Hung developed a subroutine that can be used to select a subset of the



Sallie Keller and Richard Dorsch debate the probability of flipping a stupendous omelet at the Statistical Laboratory annual spring breakfast.

original variables, whose true values will be treated as the factors in the model.

Order Statistics and Nonparametric Statistics

H. A. David, principal investigator of a grant from the U.S. Army Research Office, completed research, joint with Michael Rogers, on order statistics in overlapping samples. This work has applications to moving order statistics and throws light on some previous results for U-statistics expressible as linear functions of order statistics. A short paper was also prepared, with computing assistance from Larry Kinyon, on the probability that at least r out of n events occur within time span t ($r \geq n - 2$). Woon Bang Yeo is working under David's direction on a Ph.D. dissertation dealing with subset selection through an associated characteristic. This approach is readily applied to the selection of the k best treatments out of n under various components of variance models.

Malay Ghosh, coinvestigator, is currently examining asymptotic properties of bootstrapped U-statistics and von Mises' functionals. The results are applied to the Model II one-way analysis of variance and to certain nested models. Possible applications of the general results to cross-classificatory models are being explored. Also under investigation is the rate of convergence to normality for jackknifed and bootstrapped U-statistics, and concomitants of order statistics. Ghosh, in addition, has studied unimodality and strong unimodality of order statistics.

Mathematical and Statistical Genetics

Research in mathematical and statistical genetics is supported by AES Project 1669 and the National Institutes of Health. Edward Pollak is the principal investigator. Oscar Kempthorne has also worked on the project during the period of this report.

Pollak studied the rate of mutant substitution to be expected in age-structured populations observed at times 0,1,2,..., if at each time there is the same number of individuals of a particular sex and age group and an offspring of a specified sex has at all times the same probability of having a parent of a particular age and sex. He found that the mutation rate in populations with discrete generations must be replaced by $\bar{v}/L$, where $\bar{v}$ is the mean fraction of mutants among gametes that succeed in forming newborn individuals and L is the mean age of reproduction. Thus, if there is no selection, $\bar{v}/L$ is the rate of substitution per unit time. Implications of these results have been examined.

Kempthorne has written a partial evaluation or critique of the state of population genetics theory. The theory, in his view, must include concepts of fitness with demonstrated epistemic correlations, life tables, mating, fecundity, finite niche size, as well as Mendelism and mutation. It must in the end also include varying environment and competition between species. The extent to which these desiderata are met is discussed. Major shortcomings of current theory are the inadequate treatment of fitness and the ignoring of niche capacity. Integration of ideas of simple Mendelism, quantitative genetic variation, and ecology is the big task ahead.

Jerry W. Lewis and E. Pollak used mathematical work initiated by Lewis, and discussed in the previous report, to calculate probabilities of identity in state of sets of genes in finite subdivided populations when there is an infinite number of neutral alleles. When sets of four genes are involved and there are two equal-sized subpopulations with equal migration rates between them, such probabilities can be used to obtain approximations to the steady-state variances of Nei's normalized genetic identity and genetic distance. These methods can also be extended to more general population structures.

Pollak and Terrance P. Callanan completed work begun by Callanan on two-laws theory for infinite random-mating age-structured populations. Two situations were considered. In one, there is random mating throughout the population and the number of matings at any time is proportional to the number of mature females at that time. In the second, mating is entirely between individuals of the same age group, and the number of couples of a particular age group at a time t is proportional to the number of adults in that age group at that time. In the long run, the gametic disequilibrium approaches zero at a rate comparable to that found in discrete generation theory, with the "generation interval" being well approximated by the mean age of parents.

Admissibility in Multiparameter Estimation and in Finite Population Sampling

Research by Malay Ghosh and Glen Meeden is in progress regarding the development of various forms of shrinkage estimates for discrete and absolutely continuous exponential families of distributions. Important special cases are the normal, Poisson, gamma, and the negative binomial. Also, various versions of Bayes, empirical Bayes, and trimmed estimates are developed. In finite population sampling, the admissibility of various estimators and the uniform admissibility of estimators along with possible sampling designs are being considered. This work was supported by grants from the National Science Foundation.

Statistical Optimization Problems

H. T. David and V. A. Sposito continued work, in the areas of optimum estimation, begun under a contract with the U.S. Air Force, Office of Scientific Research. During the year, a paper entitled "On the Unbiasedness of L_p Norm Estimators" by Sposito was accepted for publication in the *Journal of the American Statistical Association*; this paper extends an ingenious computational scheme for generating unbiased L_1 or L_∞ regression estimators previously developed by Sielken and Hartley.

A related study in L_p estimation, has shown how the sample kurtosis can be used to determine an appropriate L_p norm for $p \in [1,\infty)$.

Sciences and Humanities Research Institute (SHRI)

SHRI funds help to support the research activities of Krishna Athreya, Chien-Pai Han (until his resignation in January), Dean Isaacson, Mervyn Marasinghe, and Glen Meeden. Areas of research covered by these faculty members include probability (Athreya and Isaacson), multivariate analysis (Han), statistical inference (Han and Meeden), and sample survey theory (Meeden).

Krishna Athreya investigated several problems in probability theory including theoretical aspects of branching processes and bootstrap methods. The latter are fairly new techniques, made possible by the computer, for artificially augmenting the size of a sample. A grant from the National Science Foundation, beginning June 1, will provide support for research on limit theorems for branching processes and Markov chains. Athreya also obtained an elementary proof of a famous theorem of Nikodym. With R. V. Rao, visiting faculty member in mathematics, he studied a problem with applications to transport theory and, jointly with a graduate student in chemical engineering, he constructed a mathematical model for crystal growth.

Dean Isaacson completed previous projects on Markov chains and processes. He has also been collaborating on a new research problem in this area.

Mervyn Marasinghe investigated extensions of his thesis on the multiplicative interaction model, this being a model in which the interaction effect of two factors is proportional to the product of the two individual effects. In conjunction with W. J. Kennedy, he completed work on a problem in statistical computing on direct methods for generating extreme characteristic roots of certain random matrices. He is continuing research on computations associated with noncentral distributions, outlier detection in design situations, and robust estimation of dispersion.

Glen Meeden's primary research interest has continued to be the study of the properties (especially admissibility) of various estimators used in finite population sampling. This work was done jointly with M. Ghosh and Stephen Vardeman. In conjunction with R. A. Groeneveld he has studied sensible measures of skewness.

Nonparametric Regression and Correlation

W. Robert Stephenson received a university research grant for 1981-82 to conduct research in the theory and application of nonparametric regression and correlation analysis. The research focuses on alternatives to least squares estimation of the slope and intercept in simple linear regression. Similarities between certain nonparametric techniques and L_1 estimation were examined. An offshoot of this research involving the rank transformation has been incorporated into Steven Crowder's creative component. Results of this latter investigation will be presented at the annual statistical meetings in Cincinnati.

Other Research

Research by C. Philip Cox and Chien-Pai Han has been conducted on the topic of testing multivariate means when the covariance matrix has intraclass correlation structure. It was shown that Fisher's method of combining independent tests provides a test procedure which, as shown by Monte Carlo studies, is appreciably more powerful than Hotelling's T^2-test in both one- and two-sample situations.

In experiments when different treatments or groups are unequally replicated, standard inter-treatment contrasts of the Helmert type are not orthogonal while, conversely, imposition of orthogonality constraints will usually give contrasts not having useful interpretations. For such situations, a canonical set of orthogonal contrasts has been defined by C. P. Cox that has potential application in investigations of threshold dose-response curve studies.

William Q. Meeker, Jr., has continued his research on statistical models for life data and on planning accelerated life tests. Stephen Vardeman worked on problems in general theory and operations research.

Collaborative research was begun by David Harville and Alan Fenech on problems of estimation and interval construction in a mixed linear model setting. Wing-Yue Wong studied the properties of the Pareto distribution as an income distribution, by means of conditional probability and conditional expectations. It was assumed that individuals may underreport their true incomes.

Wayne A. Fuller has been conducting research in the general area of regression estimation for survey samples, particularly estimation of models in which the independent variables contain measurement error. Ronaldo Iachan continued research on some issues of asymptotics and robustness in survey sampling. He also initiated research in the area of response errors, in particular nonresponse problems, in repeated surveys.

Robert Strahan's current research interests are in psychometrics and statistical methods generally, intuitive statistical behavior, psychological androgyny, personality assessment, journal publication behavior, and psychophysiology. Robert A. Johnson is currently engaged in research on patterns of marital selection in human populations. Three types of marital sorting models are being compared and synthesized. He is also studying the measurement of trends in attitudes toward legal abortion in the U.S. Research by Frederick O. Lorenz focused on the demand of local government for technical assistance from regional councils of government, and the impact of federal grant programs on local governments.

Professional Activities

Vice president in 1981, H. A. David began a two-year term as president of the Biometric Society in 1982. Wayne Fuller became chairman of the Business and Economic Statistics Section of the American Statistical Association for 1982, while Bill Meeker is secretary-treasurer for the section. Fuller continued to chair the ASA Ad Hoc Standby Advisory Committee on Appointments to Senior Federal Statistical Positions and served on the IMSL, Inc., Advisory Board. ASA committee memberships include the following: H. A. David, Ad Hoc Committee on Filming of Distinguished Statisticians; Herbert T. David, Committee on Publications; Leroy Wolins, *Journal of Educational Statistics* Management Committee.

Oscar Kempthorne continued to chair the R. A. Fisher Award Committee under the Committee of Presidents of Statistical Societies (COPSS). He also served on a program committee for the Bernoulli Society of the International Statistical Institute for 1981, and completed his term as chairman of Section U for the American Association for the Advancement of Science.

Jauvanta Walker was president of the Iowa State Association, National League of American Pen Women, and, in 1981, treasurer of the Iowa Poetry Association.

Donald Hotchkiss was secretary-treasurer for the local chapter of Phi Kappa Phi and will be vice president (president-elect) during the coming year. J. Jeffery Goebel was vice president of the Iowa chapter of the American Statistical Association.

Professional activities include service on departmental and higher-level committees. For the College of Sciences and Humanities, William Q. Meeker, Jr., chairs its Academic Standards Committee, while William J. Kennedy chairs its Computer Advisory Committee and serves on a similar university one.

Several staff members participated in international conferences or spent longer periods abroad. In August, Krishna Athreya and Wayne Fuller gave papers at the Canadian Mathematical Society's 1981 annual seminar in Montreal. Malay Ghosh spent the period from mid-December to January 6 in Calcutta, India, and presented a paper at the Golden Jubilee Conference of the Indian Statistical Institute. On May 1, 1982 Wayne Fuller left for the University of Southampton, England, for six weeks to conduct research with Profs. T. M. F. Smith and D. Holt on estimation for survey samples. Afterwards he attended the International Meeting on Analysis of Sample Survey Data and Sequential Analysis in Israel and gave a paper there. Donald Hotchkiss left for San José, Costa Rica, May 29 to spend two months under a faculty exchange program between Iowa State University and the University of Costa Rica.

Ted Bailey participated in the NCR-2 meetings in Chicago, Illinois, March 2-3. These annual meetings, concerned with research topics in quantitative genetics and plant breeding, are a planning and work conference for researchers in maize breeding in the North Central Region.

David F. Cox went to Johns Hopkins University July 15-17 for a site visit for the Special Studies Section, National Institutes of Health. On October 31, he and other members of the Iowa Agriculture and Home Economics Experiment Station visited the research facilities at DeSoto Bend National Wildlife Refuge, Missouri Valley, Iowa. He attended the 7th annual meeting of the Statistical Analysis System Users Group, held in San Francisco, California, February 14-17.

H. A. David served as a member of a panel reviewing the Mathematics Research Center, University of Wisconsin-Madison, on September 13-15 for the U.S. Army Research Office. Malay Ghosh and Glen Meeden participated in a conference on Scientific Inference, Data Analysis and Robustness, organized by the center and held there November 3-5. The central theme of the conference was the controversy between Bayesian and non-Bayesian inference.

Roy Hickman went to Washington, D.C., May 17-19 to serve as consultant to a National Academy of Sciences Task Force studying the Soil Conservation Service's National Resources Inventory and monitoring procedures.

For the U.S. Department of Health and Human Services, Paul Hinz served on a panel in Bethesda, Maryland, November 18-20 to review applications concerning the immunotoxicology of environmental agents.

Robert A. Johnson participated in the National Opinion Research Center Summer Workshop on Longitudinal Data Analysis, held at the University of Chicago July 6-11.

Glen Meeden attended the 24th meeting of the NBER-NSF Seminar on Bayesian Inference in Econometrics, held in Albany, New York, May 7-8.

Edward Pollak met with other committee members in St. Louis, Missouri, May 7, to evaluate a funding proposal for the National Institutes of Health.

Papers Presented, Lectures, and Seminars

At the 1981 joint annual meeting of the American Statistical Association and the Biometric Society (ENAR, WNAR), Detroit, Michigan, August 7-13:

Battese, George E., and **Wayne A. FULLER:** "Prediction of county crop areas using survey and satellite data";

Chandhok, Promod, and **Chien-Pai HAN:** "Ratio estimators with measurement errors";

Dahm, P. Fred, and **Wayne A. FULLER:** "Estimation of the multivariate errors in variables model";

Drew, James H., and **Wayne A. FULLER:** "Nonresponse in complex multiphase surveys";

MEEKER, William Q., Jr.: "Life tests with units from a limited-failure population"; roundtable discussion leader for the topic, "Teaching time series to business and economics students";

Motoyama, Tetsuro, and **Leroy WOLINS:** "Analysis of covariance when the groups are formed on the basis of the covariate";

POLLAK, E., and **J. W. Lewis:** "The frequency spectrum and Ewens' sampling formula in subdivided populations"; and

SHELLEY, Mack C., II: "ARIMA models for revenue forecasting in the Iowa Department of Transportation."

At the 1981 annual meeting of the Institute of Mathematical Statistics, Vail, Colorado, August 16-20:

GHOSH, Malay: "Estimates of multiple Poisson means: Bayes and empirical Bayes";

HAN, Chien-Pai, and **John L. G. Wang:** "A formula for the noncentral F distribution";

IACHAN, Ronaldo: "An asymptotic theory of systematic sampling";

ISAACSON, D., and E. Seneta: "Ergodic behavior for homogeneous and inhomogeneous Markov chains";

Royalty, Dan R., J. Colby Kegley, **H. T. DAVID,** and R. W. Berger: "An asymptotic stochastic view of a noisy duel";

Sastrosoewignjo, Soetarto: "Conditions for asymptotic independence in bivariate CDF iteration"; and

SUKHATME, Shashikala: "Asymptotic properties of some modified goodness-of-fit statistics."

At the Canadian Mathematical Society's 1981 annual Mathematical Statistics Seminar, Ottawa, Ontario, Canada, August 14-21:

ATHREYA, Krishna: "Renewal techniques for Markov chains";

FULLER, W. A.: "Response errors" and "Regression analysis with survey data."

At the 1982 spring meetings of the Institute of Mathematical Statistics, Central Region, and the Biometric Society (ENAR), San Antonio, Texas, March 14-17:

Dahm, P. Frederick, Bryan E. Melton, and **Wayne A. FULLER:** "Generalized least squares estimation of a genotypic covariance matrix";

DAVID, Herbert A.: "The probability that at least r out of n events occur within time span t ($r \geq n - 2$)"; and

Mee, Robert W., and **David A. HARVILLE:** "Maximum likelihood estimation for an ordered categorical response model."

At other locations:

ATHREYA, Krishna: "A new approach to Markov chains on general state spaces," at Queen's University, Kingston, Ontario, Canada, July 27.

"Laws of large numbers for bootstrapped means and U-statistics," by Athreya, **Malay GHOSH** and **Leone Y. LOW,** at the 178th meeting of the Institute of Mathematical Statistics, on Special Topics on Survival Analysis, Columbus, Ohio, October 26.

DAVID, Herbert A.: "Some applications of order statistics," at the 25th Annual Fall Technical Conference in Gatlinburg, Tennessee, co-sponsored by the American Society for Quality Control and the American Statistical Association, October 28-30.

"Theory and applications of order statistics" and "Statistical fallacies and paradoxes," at the University of Wisconsin—Stout, Menominee, April 23. These seminars were presented under the Visiting Lecturer Program in Statistics.

DAVID, Herbert T.: "Buehler bounds and coherence," a Reliability seminar for the Bell Laboratories, South Plainfield, New Jersey, June 9.

FULLER, Wayne A.: discussant, Conference on Applied Time Series Analysis of Economic Data, held by the American Statistical Association, U.S. Bureau of the Census, and the National Bureau for Economic Research, Washington, D.C., October 12-15.

"Estimation for nonstationary autoregressive time series," at a meeting held at the University of Kentucky, November 11-13; at the University of Southampton, England, May 13.

"Measurement error models," at Louisiana State University, February 8; at the National Bureau of Standards, Washington, D.C., March 18; at the University of Southampton, May 27; at the Imperial College, London, England, June 2.

"Time series," for the American Statistical Association chapter at Dallas, Texas, February 9.

"Estimation for nonstationary autoregressive processes," at Southern Methodist University, February 10.

"Errors in variables," at the University of North Carolina, Chapel Hill, March 17.

"Regression estimation and estimation of regressions for survey data," at the University of Southampton, May 20.

"Estimation of measurement error models from complex surveys," at the Israel Statistical Association International Meeting on Analysis of Sample Survey Data and on Sequential Analysis, Jerusalem, Israel, June 17.

GHOSH, Malay: "Finite admissibility and finite population sampling," by **Glen MEEDEN** and Ghosh, at the Golden Jubilee International Conference on Statistics: Applications and New Directions, Indian Statistical Institute, Calcutta, India, December 18; at the University of Florida, January 25.

"On the derivation and characterization of certain distributions," at Presidency College, Calcutta, January 4.

"Estimates of multiple Poisson means," at the University of Manitoba, Winnipeg, Canada, March 16.

GOEBEL, J. Jeffery: "Quality control and evaluation for national resource inventories," by Goebel and Keith O. Schmude, at the National Workshop on In-Place Resource Inventories: Principles and Practices, Orono, Maine, held on August 8-15.

"The 1982 National Resources Inventory—developing and ensuring statistical quality," at a task force meeting of the National Resource Council Board on Agricultural and Renewable Resources, Washington, D.C., May 17.

HARVILLE, David A.: "Mixed model techniques for estimation and prediction," and "Maximum-likelihood and pseudo-Bayesian approaches to variance component estimation," at the Engineering Department of DuPont, Wilmington, Delaware, December 18.

IACHAN, Ronaldo: "Optimal payment and recall period in repeated surveys," at the 181st meeting of the Institute of Mathematical Statistics, held with the Biometric Society (WNAR), La Jolla, California, June 21-23.

ISAACSON, Dean: "Markov chains and their applications," at Carleton College, October 30.

JOHNSON, Robert A.: "Community field theory and social network analysis," by Johnson, V. Ryan, and B. Anderson, at the Midwest Sociological meetings, Des Moines, Iowa, April 6.

KEMPTHORNE, Oscar: "Nature and roles of data analysis," while at North Carolina State University, October 28-30.

"Evaluation of current population genetics theory," at an American Society of Zoologists Symposium: The Interface of Quantitative Genetics, Life-history Evolution, and Whole-organism Ontogeny, held in Dallas, Texas, December 27-29.

"Data analysis: old or new? Useful or useless?" at the University of Rochester, April 1982.

LORENZ, Frederick O.: "City utilization of regional council technical assistance," at the Midwest Sociological Society meeting, Des Moines, Iowa, April 6.

MEEDEN, Glen: "Proving admissibility and uniform admissibility in finite population sampling," at Ohio State University, May 6.

MEEKER, William Q., Jr.: "An introduction to applied time series analysis," at Louisiana State University, October 19.

"Statistical aspects of planning accelerated life tests," at the University of South Carolina, October 20.

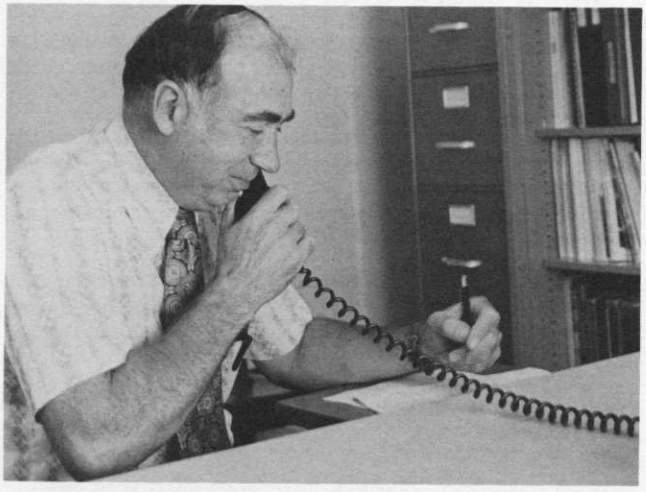
POLLAK, Edward: "The rate of mutant substitution in populations with overlapping generations," at a Conference on Evolution in 1981, jointly sponsored by the American Society of Naturalists and the Society for the Study of Evolution, held at the University of Iowa, June 28-July 2, 1981.

SPOSITO, Vincent A.: "A comparison of two approaches to the discriminant problem: conventional statistics with linear programming," by Rebecca J. Klemm and Sposito, at the joint national meetings of the Operations Research Society of America and The Institute of Management Sciences, Houston, Texas, October 11-14.

"Properties of L_p-norm estimators," at North Carolina State University, December 4.

STRAHAN, Robert F.: "On the relation between shyness and sociability," at the annual convention of the Midwestern Psychological Association, Minneapolis, Minnesota, May.

SUKHATME, Shashikala: "A new look at modified goodness-of-fit tests," at the University of Bombay, India, August 5.



USDA resident collaborator Arthur Kuhl provides liaison for the Statistical Laboratory and the Soil Conservation Service on inventorying and monitoring national resources.

Publications and Dissertation Abstracts

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

Editorial responsibilities are an ongoing concern of many of the staff and range from refereeing to serving as editor-in-chief. The principal positions are mentioned below.

Krishna Athreya is an associate editor of *Zeitschrift für Wahrscheinlichkeitstheorie*, and a member of the editorial board of *Statistics & Probability Letters.*

Herbert T. David is book review editor, *Journal of the American Statistical Association.* Sharon Shepard is editorial assistant for the Book Reviews Section.

Wayne A. Fuller is an associate editor of the new *Journal of Business and Economic Statistics,* and associate editor of *The American Statistician.*

Malay Ghosh is a journal committee member for *Sankhyā* A and B; associate editor for Book Reviews, *Journal of the American Statistical Association;* a member of the editorial board of *Communications in Statistics (Series C): Sequential Analysis*; and an advisory board member for *Statistics and Decisions* (first issue Summer 1982).

Chien-Pai Han has been an editorial board member for *Communications in Statistics: Part A—Theory and Methods.*

Paul N. Hinz continues as associate editor, *Iowa State Journal of Research.*

Robert A. Johnson is an associate editor of *Sociological Methodology,* an annual series of books sponsored by the American Sociological Association.

Oscar Kempthorne is a member of the editorial board, *Journal of Statistical Planning and Inference*; and of the editorial advisory board, *Journal of Statistical Computation and Simulation.*

William J. Kennedy is editor, Section on New Developments in Statistical Computing, and associate editor, *The American Statistician*; coeditor, *Selected Tables in Mathematical Statistics*; a member of the editorial board, and coeditor of the Algorithms Section, *Communications in Statistics: Part B—Simulation and Computation.*

Glen Meeden is an associate editor for Book Reviews, *Journal of the American Statistical Association.*

William Q. Meeker, Jr. is associate editor, *Technometrics,* and a member of the editorial board for *Selected Tables in Mathematical Statistics.*

Leroy Wolins is a member of the board of editors for *Educational and Psychological Measurement,* and of the management board, *Educational Statistics.*

Wing-Yue Wong is editor-in-chief, *Menumui Matematik,* and editor, *Bulletin of the Malaysia Mathematical Society, Second Series.*

Books

BANCROFT, T. A., and **Chien-Pai HAN.** *Statistical Theory and Inference in Research.* Statistics: Textbooks and Monograph Series, Vol. 39. Marcel Dekker (New York) 1981. xvi + 372 pp.

Statistical Theory and Inference in Research develops basic statistical theory and inference for researchers and students (both undergraduate and graduate) in any of the applied disciplines that use statistics to augment the scientific method. The first six chapters introduce the reader to concepts and principles of probability and then develop the fundamental properties of basic population and sampling distributions of use in descriptive and analytical statistics. Chapters 7 through 14 are concerned with the development of statistical inference theory, i.e., point and interval estimation and tests of hypotheses. In addition, these later chapters include material on nonparametric inference, regression analysis, and the analysis of variance. Inference based on conditional specification, Bayesian methods, sampling from finite populations, order statistics, and robust estimation are all discussed, as well as the more traditional array of basic and useful topics.

HUNTSBERGER, David V., and Patrick Billingsley. *Elements of Statistical Inference,* 5th Edition. Allyn and Bacon, Inc. (Boston) 1981. 416 pp.

HUNTSBERGER, David V., D. James Croft, and Patrick Billingsley. *Statistical Inference for Management and Economics,* 2nd Edition. Allyn and Bacon, Inc. (Boston) 1980. xiv + 690 pp.

Sellers, Gene R., and **Stephen B. VARDEMAN.** *Elementary Statistics,* 2nd Edition. Saunders College Publishing (Philadelphia) 1982. x + 598 pp.

This is a revision of Seller's 1977 textbook. As in the first edition, extensive use is made of material from newspapers and magazines in an effort to establish the relevance of the ideas of elementary statistics in everyday life. In this second edition increased attention is paid to clear and correct exposition concerning the principles and methods covered in typical pre-calculus introductory statistics courses. The text contains an unusually large number of exercises and is suitable for use in courses taught for "general" audiences.

WOLINS, Leroy. *Research Mistakes in the Social and Behavioral Sciences.* The Iowa State University Press (Ames) 1982. x + 85 pp.

Perusal of the social science literature, mostly in psychology, suggested that many mistakes in the design and analysis of research could be classified into five categories: power, sufficiency, admissibility problems where the major problem is that the information in a data set is not fully retrieved because of poor analytical procedures; regression errors due to failure to recognize that measurement error biases slope downward and produce noncomparability of scales that have unequal measurement error; scale dependent mistakes resulting from attempts to compare differences or changes that occur over different parts of a scale with the intervals not necessarily equal; variable and observational unit mistakes where inferences are made about differences among groups but the analysis does not recognize these group differences separately from individual differences; and data exploitation mistakes where significance tests are applied after ransacking the data. Examples for each kind of mistake are presented along with a discussion of the illogic that seems to produce them.

Published Research

ATHREYA, K. B. Strong law for the bootstrap. *Carleton Mathematical Series* No. 181. Carleton University (Ottawa, Ontario, Canada) July 1981, 9 pp.

Let $X_1, X_2, X_3, \ldots$ be i.i.d. r.v. with $E \mid X_1 \mid < \infty$, $EX_1 = \mu$. Given a realization $\underset{\sim}{X} = (X_1, X_2, X_3, \ldots)$ let $Y_{n,i}$ for $i = 1, 2, \ldots, k_n$ be i.i.d. r.v. with distribution $P^*(Y_{n,i} = X_j) = \frac{1}{n}$ for $1 \leq j \leq n$ (P^* denotes the conditional measure given $\underset{\sim}{X}$). We prove the following limit theorems.

Theorem 1. Let $\underline{\lim}\, k_n \rho^{-n} > 0$ for some $\rho > 1$.

Then, $\frac{1}{k_n} \sum_{i=1}^{k_n} Y_{n,i} \to \mu$ w.p.1.

Theorem 2. Let $\underline{\lim}\, k_n n^{-\beta} > 0$. Let $E \mid X_1 \mid^{\theta} < \infty$ for $\theta \geq 1$.

If $\beta\, \theta > 1$, then $\frac{1}{k_n} \sum_{1}^{k_n} Y_{ni} \to \mu$ w.p.1.

Theorem 3. Let $k_n \uparrow \infty$. Then $\frac{1}{k_n} \sum_{1}^{k_n} Y_{n,i} \to \mu$ in probability.

ATHREYA, Krishna B., and Peter Ney. A renewal approach to the Perron-Frobenius theory of nonnegative kernels on general state spaces. *Mathematische Zeitschrift* 179 (1982) 507-529.

Let $(S, \mathcal{S})$ be a measurable space and $K = S \times \mathcal{S} \to R^+$ be a kernel in the sense that, for each s in S, $K(s, \cdot)$ is a σ-finite measure on $\mathcal{S}$ and, for each E in $\mathcal{S}$, $K(\cdot, E)$ is an $\mathcal{S}$ measurable function. Under an appropriate hypothesis of irreducibility and recurrence the method of regeneration is exploited to yield (i) a characterization of the Perron-Frobenius root as the radius of convergence of an appropriate series involving the iterates of the given kernel at an adjoined atom, (ii) simple and explicit construction of invariant measures and functions, and (iii) a general ergodic theorem asserting the existence of constants U_n such that $\frac{1}{U_n} \sum_{\beta}^{n} (K^{j_\beta})(x)$ converges pointwise a.e.

ATHREYA, K. B., and P. Ney. Some aspects of ergodic theory and laws of large numbers for Harris-recurrent Markov chains. In *Colloquia Mathematica Societatis, Janos Bolyai Society,* Vol. 32 [Nonparametric Statistics]—Proceedings of the Symposium on Nonparametric Statistics, Budapest, Hungary, held in June 1980 (1982).

We first show that all Harris-recurrent Markov chains have a recurrent atom and then take advantage of the embedded renewal sequence of return times to this atom. We use this to give simple proofs of Orey's ergodic theorem, weak (Cesaro-mean) ratio theorems for the transition probabilities, individual (strong) ratio theorems, ergodic theorems for semi-Markov processes as well as extensions to general nonnegative kernels.

***CORNETTE, James L.** Deterministic genetic models in varying environments. *Journal of Mathematical Biology* 12:2 (1981) 173-186. SLRS 529.

Journal Paper No. J-10136 of the Iowa Agriculture and Home Economics Experiment Station, Project 1669; partial support by National Institutes of Health, Grant GM 13827.

J. B. S. Haldane and S. D. Jayakar [*Journal of Genetics* 58 (1963) 237-242] argue that, when genotype fitnesses fluctuate from generation to generation, if the geometric and arithmetic means of the fitnesses satisfy certain inequalities, there will be a protected polymorphism. Their assertions are biologically interesting, but their mathematical analysis is not sufficient to support their conclusions. The current paper presents a firm mathematical analysis and several examples that demonstrate the need for stronger hypotheses and, in some cases, weaker conclusions.

***COX, C. Philip.** An alternative way of calculating the χ^2 independence or association test statistic for a $2 \times k$ contingency table. *The American Statistician* 36:2 (1982) 133. SLRS 551.

An alternative to the usual formula for calculating the χ^2-test statistic in a $2 \times k$ contingency table, which nearly halves the number of summations required, is presented. The alternative formula also nicely shows that the test statistic is necessarily less than or equal to the total number of items classified, with equality, indicating complete association, being achieved if and only if one of the two cell counts in each column is zero.

Zirakparvar, M. E., D. C. Norton, and **C. P. COX.** Population increase of *Pratylenchus hexincisus* on corn as related to soil temperature and type. *Journal of Nematology* 12 (1980) 313-318.

The nematode *P. hexincisus* can have important adverse effects on corn production. A factorial growth chamber experiment to investigate relations between nematode population growth, soil temperature, and soil type was designed and analyzed. Good precision was achieved so that hitherto unreported effects and interactions were detected.

G. L. Reed, W. D. Guthrie, W. B. Showers, B. D. Barry, and **D. F. COX.** Sex-linked inheritance of diapause in the European corn borer: its significance to diapause physiology and environmental response of the insect. *Annals of the Entomological Society of America* 74:1 (1981) 1-8.

Joint contribution: AR-SEA-USDA, and Journal Paper No. 9152 of the Iowa Agriculture and Home Economics Experiment Station.

A study of the inheritance of the diapause trait in the European corn borer, *Ostrinia nubilalis* (Hübner), showed evidence for sex linkage.

Ross, R. F., A. P. Orning, R. D. Woods, B. J. Zimmerman, **D. F. COX,** and D. L. Harris. Bacteriologic study of sow agalactia. *American Journal of Veterinary Research* 42:6 (1981) 949-955.

The processes involved in sow agalactia, a disease that causes starvation and reduced growth rates in young pigs, are studied through comparison of data collected on affected and clinically normal sows.

***DAVID, H. A.,** and **R. A. GROENEVELD.** Measures of local variation in a distribution: Expected length of spacings and variances of order statistics. *Biometrika* 69:1 (1982) 227-232. SLRS 546.

Two measures of variation about the r^{th} order statistic $X_{r:n}$ are studied: the expected value of the spacing $X_{r+1:n} - X_{r:n}$ and the variance of $X_{r:n}$. The nature of the dependence of these measures on r, for n fixed, is examined for various classes of distributions. In the case of the variance of $X_{r:n}$ the situations considered are supplemented by some asymptotic results.

***DAVID, H. A.** Concomitants of order statistics: theory and applications. In *Some Recent Advances in Statistics*, pp. 89-100. J. Tiago de Oliveira and B. Epstein, editors. Academic Press, Inc. (London) 1982. SLRS 549.

An integrated account is given of the literature on concomitants of order statistics. Exact and asymptotic distribution theory is developed. Applications to the following situations are described: selection, estimation of regression coefficient, estimation for censored bivariate data, and double sampling.

DAVID, H. T., and Walter Morris. Chance (I). In *Encyclopedia of Statistical Sciences,* Vol. 1—*A to Circular Probable Error,* pp. 403-405. Samuel Kotz and Norman L. Johnson, editors-in-chief. John Wiley & Sons, Inc. (New York). 1982.

Though "chance" defies definition, proponents of it as a dominant feature of the universe have been pitted against "determinists" from classical times to the present. That conflict is briefly sketched. Also touched on are (a) the less controversial, relatively recent, idea of probabilistic modeling, and (b) the older but continuing recourse to chance moves and decisions. In the case of the latter, chance is counted on, for example, to break impasses (heads this, tails that), confound opponents (bluffing strategies in the theory of games), ensure even-handedness (randomized variety trials), or simplify normative theories of decision (convexity).

DAVID, Herbert T. Discussion of remarks by Lyle Calvin, Brian Joiner, and Gerald Van Belle. In *Teaching of Statistics and Statistical Consulting,* pp. 367-370. Jagdish S. Rustagi and Douglas A. Wolfe, editors. Academic Press, Inc. (New York). 1982.

FULLER, Wayne A., and Cary T. Isaki. Survey design under superpopulation models. In *Current Topics in Survey Sampling,* pp. 199-226. D. Krewski, J. N. K. Rao, and R. Platek, editors. Academic Press, Inc. (New York). 1981.

Sample designs and predictors that minimize the approximate anticipated variance are developed. Anticipated variance is the variance of the predictor computed with respect to the sampling design and the superpopulation model. The designer's information is expressed in terms of the parameters of a regression superpopulation model from which the finite population is a (conceptual) random sample. The limiting distribution of the estimator is presented.

FULLER, W. A. Area sampling. In *Encyclopedia of Statistical Sciences,* Vol. 1—*A to Circular Probable Error,* pp. 124-126. Samuel Kotz and Norman L. Johnson, editors-in-chief. John Wiley & Sons, Inc. (New York). 1982.

The method of using fractions of the earth's surface as sampling units is described. A brief history of the method is given.

*Dickey, David A., and **Wayne A. FULLER.** Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica* 49:4 (1981) 1057-1071. SLRS 530.

Let the time series Y_t satisfy $Y_t = \alpha + \rho Y_{t-1} + e_t$, where Y_1 is fixed and the e_t are normal independent $(0, \sigma^2)$ random variables. The likelihood ratio test of the hypothesis that $(\alpha, \rho) = (0, 1)$ is investigated, and a limit representation for the test statistic is presented. Percentage points for the limiting distribution and for finite sample distributions are estimated. The distribution of the least squares estimator of α is also discussed. A similar investigation is conducted for the model containing a time trend.

*Isaki, Cary T., and **Wayne A. FULLER.** Survey design under the regression superpopulation model. *Journal of the American Statistical Association* 77:377 (1982) 89-96. SLRS 544.

The construction of sample designs and estimators under a linear regression superpopulation model is considered. The anticipated variance, the variance of the predictor computed with respect to the sampling design and the superpopulation model, is used as a criterion for evaluating probability designs and model-unbiased predictors. Regression predictors that are model unbiased and design consistent are constructed.

Mowers, R. P. (Louisiana State University), **W. A. FULLER,** and W. D. Shrader. Comparison of meadow-kill treatments on a corn-oats-meadow-meadow rotation in northwestern Iowa. *Iowa Agriculture and Home Economics Experiment Station Research Bulletin* 593. 20 pp. July 1981.

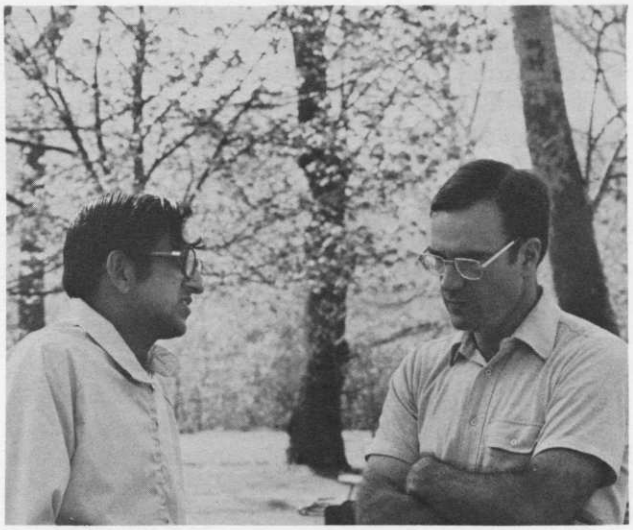
Twenty years (1958-1977) of data from a yield experiment at the Moody Research Center were analyzed. The experiment utilized a corn-oats-meadow-meadow rotation with meadow-kill treatments applied to the second-year meadow at various times of the growing season. In the control treatment, the second-year meadow was harvested two or three times. The second treatment was a "short fallow" treatment, in which second-year meadow was killed with herbicides in the early fall after the second cutting of hay. The third treatment was a longer fallow treatment, with meadow kill in midsummer after the first hay cutting. The treatments resulted in different amounts of stored soil moisture available to the following corn crop. A corn-moisture response curve was estimated with preseason stored moisture and a weather index as explanatory variables. The measurement error associated with determinations of soil moisture was recognized in the estimation procedure.

*Wolter, Kirk M., and **Wayne A. FULLER.** Estimation of the quadratic errors-in-variables model. *Biometrika* 69:1 (1982) 175-182. SLRS 550.

An estimator is presented for the coefficients of the quadratic functional relationship in which the error variables are known. The estimator is shown to be asymptotically normally distributed as the sample size increases. In deriving this result it is not assumed that replication occurs. A Monte Carlo study demonstrates that the small sample behavior agrees well with the asymptotic results. An example from the earth sciences is analyzed.

*Wolter, Kirk M., and **Wayne A. FULLER.** Estimation of nonlinear errors-in-variables models. *The Annals of Statistics* 10:2 (1982) 539-548. SLRS 552.

An estimation procedure is presented for the coefficients of the nonlinear functional relation, where observations are subject to measurement error. The distributional properties of the estimators are derived, and a consistent estimator of the covariance matrix is given. In deriving the results it is assumed that the covariance matrix of the observational errors



Malay Ghosh (l.) confers with visiting associate professor Alan Fenech in Brookside Park during the annual spring breakfast.

Sen, Pranab Kumar, and **Malay GHOSH.** Sequential point estimation of estimable parameters based on U-statistics. *Sankhyā* A 43:3 (1981) 331-344. SLRS 537.

Asymptotically risk-efficient sequential point estimation of regular functionals of distribution functions based on U-statistics is considered under appropriate regularity conditions. Some auxiliary results on U-statistics are also considered in this context.

GOEBEL, J. Jeffery, and Keith O. Schmude. Planning the SCS National Resources Inventory. In *Arid Land Resources Inventories: Developing Cost Efficient Methods,* U.S. Department of Agriculture, Forest Service General Technical Report WO-28 (1981) 148-153.

This paper discusses the data needs, data collection methods, sampling schemes, the quality control, data reliability, and monitoring activities associated with the National Resources Inventory, 1982. Also highlighted are previous Soil Conservation Service resource inventories.

Arnold, Barry C., and **Richard A. GROENEVELD.** On excess life in certain renewal processes. *Journal of Applied Probability* 18 (1981) 378-389.

Excess life distributions for discrete renewal processes may be computed by using elementary discrete Markov chain concepts involving absorption probabilities. Excess life distributions in general may then be obtained by approximating the renewal process under study by a suitably chosen sequence of discrete renewal processes. The technique is illustrated in the cases of renewal processes with interarrival distributions which are a linear combination of two exponentials and uniform [0,1]. A related algorithm is described for computer-generated approximations of excess life distributions corresponding to continuous interarrival time distributions with an increasing c.d.f. Conditions for convergence of this algorithm are examined.

***Smith, Wendell C.** (Eli Lilly and Company, Indianapolis, Indiana), and **Chien-Pai HAN.** Error rate for testing a contrast after a significant F test. *Communications in Statistics, Part B—Simulation and Computation,* B10:6 (1981) 545-556. SLRS 540.

In statistical applications an experimenter often tests a particular contrast after a significant F test for the equality of means. This paper evaluates the family error rate for that testing procedure. A formula is derived for a bivariate distribution function involving ratios of χ^2 variates.

***Tu, Ching-Tsao** (Social Security Administration), and **Chien-Pai HAN.** Discriminant analysis based on binary and continuous variables. *Journal of the American Statistical Association* 77:378 (1982) 447-454. SLRS 553.

An observation consisting of both binary and continuous variables may be classified into one of two populations by the double-discriminant function based on the point-biserial model. When the parameters are unknown or partially known, a sample double-discriminant function is obtained by replacing the unknown parameters by their sample estimates. A sampling scheme referred to as the double inverse sampling is proposed to ensure nonsingularity of the sample covariance matrices. An asymptotic expansion for the distribution of the sample double-discriminant function is given under the double inverse sampling scheme.

Comparisons of three classification procedures—double-discriminant function, X-out procedure, and X-continuous procedure—are made. Based on these comparisons, we found that the X-out procedure should not be used; the double-discriminant function procedure is better than the X-continuous procedure when the Mahalanobis distance is large and the probabilities of the binary variable are not close to each other for the two populations.

Kackar, Raghu N. (Bell Laboratories), and **David A. HARVILLE.** Unbiasedness of two-stage estimation and prediction procedures for mixed linear models. *Communications in Statistics: Theory and Methods* A10:13 (1981) 1249-1261.

The traditional method for estimating or predicting linear combinations of the fixed effects and realized values of the random effects in mixed linear models is first to estimate the variance components and then to proceed as if the estimated values of the variance components were the true values. This two-stage procedure gives unbiased estimators or predictors of the linear combinations provided the data vector is symmetrically distributed about its expected value and provided the variance component estimators are translation-invariant and are even functions of the data vector. The standard procedures for estimating the variance components yield even, translation-invariant estimators.

Sallas, William M. (University of Houston), and **David A. HARVILLE.** Best linear recursive estimation for mixed linear models. *Journal of the American Statistical Association* 76:376 (1981) 860-869.

Recursive estimation techniques for fixed and completely random models are extended to mixed linear models. The Kalman filter is used to obtain recursive estimators for a two-part random model where the second random factor obeys a generalized autoregressive process. By passing to the limit in an appropriate way, recursions for the mixed model are derived.

Bergman, M. K., J. J. Tollefson, and **P. N. HINZ.** Sampling scheme for estimating populations of corn rootworm larvae. *Environmental Entomology* 10:6 (1981) 986-990.

Journal Paper No. J-9877 of the Iowa Agriculture and Home Economics Experiment Station, Projects 2250 and 2280, in part supported by Environmental Protection Agency, Grant R-805-429-01.

Core and cube sample units were used to sample 16 central Iowa cornfields for corn rootworm larvae. A washing-sieving-flotation technique was superior to visual searching or Tullgren funnels for recovering larvae from soil samples. Storage at subfreezing temperatures provided the best means of preserving samples. Optimal sampling plans were calculated for both sample units from variance components and cost estimates. Sample sizes are presented for specified levels of precision.

Kraft, A. A., K. V. Reddy, J. G. Sebranek, R. E. Rust, and **D. K. HOTCHKISS.** Effect of combinations of fresh and frozen beef on microbial flora of ground beef patties. *Journal of Food Protection* 44:11 (1981) 870-873.

Beef patties composed of fresh beef, blast frozen beef, or combinations of fresh and frozen beef were frozen by liquid nitrogen (LN_2) or liquid carbon dioxide (LCO_2) and stored at -20 C for six months. Analyses of log counts for various bacteria were made at monthly intervals of storage. The factorial combination of treatments was analyzed as a split-plot study with the mixture of the frozen-fresh hamburger as the whole-plot treatment. The 100% fresh beef product had the lowest bacteria count, which was significantly lower than for products containing frozen beef. The 50:50 combination of fresh and frozen beef had a significantly higher bacteria count than the other mixtures. No difference was observed from the use of liquid nitrogen or carbon dioxide. No health hazard was evident as a result of the above combinations over the six-month storage period.

ISAACSON, Dean, and Peter Colwell. Levels of null persistency for Markov chains. *Journal of Applied Probability* 19:2 (1982) 425-429.

In the study of null-persistent Markov chains the sequence

$$U_N = \sum_{n=1}^{N} p_{11}^{(n)}$$

plays an important role. In this paper we consider the rate of growth of U_N to ∞ as $N \to \infty$. This rate of growth is related to the rate of growth of

$$\sum_{n=1}^{\infty} p_{11}^{(n)} ((N-1)/N)^n \text{ as } N \to \infty.$$

***KEMPTHORNE, Oscar.** Classificatory data structures and associated linear models. In *Statistics and Probability: Essays in Honor of C. R. Rao,* pp. 397-410. G. Kallianpur, P. R. Krishnaiah, J. K. Ghosh, editors. North-Holland Publishing Company (New York, Amsterdam) 1982. SLRS 543.

It is suggested that linear model theory grew out of the analysis of comparative experiments, in which an observation is viewed as made up additively of contributions associated with factors of classification of the individuals being observed. Various methods of data fitting and what is called the geometry of least squares fitting are discussed. Then the nature of complex classificatory structures and linear models that may be associated with such structures is exposited. The adjoining of conditions on parameters to make resulting linear models fully identified is also discussed.

KENNEDY, William J., Jr. The statistical computing portion of a graduate educational program in statistics. In *Teaching of Statistics and Statistical Consulting,* pp. 233-245. Jagdish S. Rustagi and Douglas A. Wolfe, editors. Academic Press, Inc. (New York). 1982.

The elements of a suggested computer-related education and training program for statistics graduate students are given. The program features an initial orientation to the basics of computer and statistical program package use, continuing reinforcement of this training in a wide variety of other statistics courses, special elective courses specific to statistical computing, and possibly practical work experience in the area.

***KOEHLER, Kenneth J.** An improvement of a Monte Carlo technique using asymptotic moments with an application to the likelihood ratio statistic. *Communications in Statistics, Part B—Simulation and Computation* B10:4 (1981) 343-357. SLRS 524.

The use of asymptotic moments to increase the precision of the control variate technique for Monte Carlo estimation is discussed. An application is made to the estimation of the mean and variance of the likelihood ratio goodness-of-fit statistic with the Pearson statistic used as a control variate. Estimates of the variance reductions are given.

Hess, J. L., D. M. McCurnin, M. G. Riley, and **K. J. KOEHLER.** Pilot study for comparison of chromic catgut suture and mechanically applied staples in enteroanastomoses. *Journal of the American Animal Hospital Association* 17:3 (1981) 409-414.

This study found that the tissue healing rate for wounds sutured with mechanically applied stainless steel staples was similar to the healing rate of wounds sutured with more traditional biologically absorbable material. Paired comparisons were made for 16 dogs. The statistical analysis was complicated by the presence of unequal variances and missing

data. The major advantages of using staples are that they can be applied more consistently and they require substantially less surgical time.

*Lewis, Jerry W. (Louisiana State University). On the coevolution of pathogen and host: I. General theory of discrete time coevolution. *Journal of Theoretical Biology* 93:4 (1981) 927-951. SLRS 541.

Journal Paper No. J-10236 of the Iowa Agriculture and Home Economics Experiment Station, Project 1669; partial support by National Institutes of Health, Grant GM 13827.

The theory of discrete time models of genetically conditioned coevolution is considered as an extension of classical population genetics theory. Strengths and weaknesses of the underlying assumptions are critically discussed in the context of host-pathogen interactions. Convenient formulae are provided to analyze the stability of equilibria. Some conclusions are drawn, which depend only on fairly general assumptions about the nature of host-pathogen coevolution.

*Lewis, Jerry W. On the coevolution of pathogen and host: II. Selfing hosts and haploid pathogens. *Journal of Theoretical Biology* 93:4 (1981) 953-985. SLRS 542.

Journal Paper No. J-10237 of the Iowa Agriculture and Home Economics Experiment Station, Project 1669; partial support by National Institutes of Health, Grant GM 13827.

The theory of discrete time coevolution is applied to the problem of maintenance of genetic polymorphism with selfing hosts and haploid pathogens. It is shown that the usual simplifying assumption, discrete synchronized generations with no intraspecific frequency-dependent selection, precludes stability. This situation is not corrected by the incorporation of special features such as mutation, alternate hosts, partial outcrossing of the hosts, or genetic recombination in the pathogen population.

*Lewis, Jerry W. Inversion of tridiagonal matrices. *Numerische Mathematik* 38 (1982) 333-345. SLRS 545.

Journal Paper No. J-10137 of the Iowa Agriculture and Home Economics Experiment Station, Project 1669; partial support by National Institutes of Health, Grant GM 13827.

This paper presents a simple algorithm for inverting nonsymmetric tridiagonal matrices that leads immediately to closed forms when they exist. Ukita's theorem is extended to characterize the class of matrices that have tridiagonal inverses.

LORENZ, Frederick O., Gary D. Nelson, and John L. Tait. County and city utilization of regional council technical assistance in Iowa. *Fourth Annual Proceedings of the Conference on the Small City and Rural Community,* held in Stevens Point, Wisconsin, March 1981. (1982) 469-480.

Regional councils of governments are multicounty planning organizations that make community-planning and grant-application-writing assistance available to member local governments upon request. These forms of assistance are often prerequisite to receipt of federal funds for community projects and programs. The data for a sample of Iowa counties and cities suggest that the extent to which communities utilize regional council assistance is directly related to measures of organizational complexity and inter-organizational relations, but indirectly related to indicators of poverty.

Ryan, Vernon D., and **Frederick O. LORENZ.** A critical review of "Respondents, nonrespondents, and population surveys" . . . and community development research in general. *Journal of the Community Development Society* 12:2 (1981) 12-19.

The article was part of a debate with researchers in New Hampshire on the appropriate analysis of nonresponse bias in sample surveys. The debate centered on procedures for classifying people who return questionnaires unanswered, and discussed appropriate statistical techniques for comparing respondents and nonrespondents.

MARASINGHE, Mervyn G., and Dallas E. Johnson. Testing subhypotheses in the multiplicative interaction model. *Technometrics* 23:4 (1981) 385-393.

The problem of analyzing a two-way cross-classified treatment structure with only one observation per treatment combination is considered. A test procedure is given that will enable the data analyst to determine subareas of the data in which the data are additive. The procedure is developed by assuming that a multiplicative interaction model adequately fits the data. Such a model is given by $y_{ij}=\mu + \tau_i + \beta_j + \lambda \alpha_i\gamma_j + \varepsilon_{ij}$, where $i=1, 2, \ldots, t$ and $j=1, 2, \ldots, b$. It is assumed that the ε_{ij} are distributed independently and normally with mean zero and variance σ^2. The other parameters are assumed to be unknown constants. In general, the problem may be stated as one of testing H_0: $H\alpha=0$ versus H_α: $H\alpha\neq 0$, where $\alpha=(\alpha_1, \ldots, \alpha_t)'$ and H is a $q\times t$ contrast matrix. A likelihood ratio statistic for this testing problem is derived and approximate critical points are given for the cases $q=1$ and $q=2$. The procedures are illustrated with an example.

MARASINGHE, Mervyn G., and Dallas E. Johnson. Estimation of σ^2 in the multiplicative interaction model. *Communications in Statistics—Theory and Methods* 11:3 (1982) 315-324.

Suppose that the model

$$y_{ij}=\mu + \tau_i + \beta_j + \lambda \alpha_i \gamma_j + \varepsilon_{ij}; \quad \begin{matrix} i=1,\ldots,t \\ j=1,\ldots,b \end{matrix}$$

is found to adequately fit two-way cross-classification data with one observation per cell. Johnson and

Graybill [*Journal of the American Statistical Association* 67 (1972) 862-868] proposed an estimator of the error variance σ^2. A test procedure was given by Marasinghe and Johnson [*Technometrics* 23 (1981) 385-393] which enables one to find rows (or columns) in the data which may be additive. In this paper an improved estimator of σ^2 is proposed by making use of that additional information.

***MEEDEN, Glen,** and **Malay GHOSH.** Admissibility in finite problems. *The Annals of Statistics* 9:4 (1981) 846-852. SLRS 532.

Let X be a random variable which takes on only finitely many values $x \in \chi$ with a finite family of possible distributions indexed by some parameter $\theta \in \Theta$. Let $\Pi = \{\pi_x(\cdot): x \in \chi\}$ be a family of possible distributions (termed "inverse probability distributions") on Θ depending on $x \in \chi$. A theorem is given to characterize the admissibility of a decision rule δ which minimizes the expected loss with respect to the distribution $\pi_x(\cdot)$ for each $x \in \chi$. The theorem is partially extended to the case when the sample space and the parameter space are not necessarily finite. Finally a notion of "admissible consistency" is introduced and a necessary and sufficient condition for admissible consistency is provided when the parameter space is finite, while the sample space is countable.

***MEEKER, William Q., Jr.** A conditional sequential test for the equality of two binomial proportions. *The Journal of the Royal Statistical Society, Series C (Applied Statistics)* 30:2 (1981) 109-115. SLRS 533.

This paper suggests a conditional sequential test for the equality of two binomial proportions. The test is a sequential analog of Fisher's exact test. A numerical example is given, and the new test is compared with other tests, both sequential and fixed sample size. The results indicate that the conditional test is easy to use and that it has desirable test properties, even when truncated after a prespecified number of observations. An appendix shows how to compute the exact properties of the test.

***Nagaraja, H. N.** (Ohio State University). Some finite sample results for the selection differential. *Annals of the Institute of Statistical Mathematics* 33:3, A (1981) 437-448. SLRS 548.

The selection differential, $D_{k,n}$, is defined as the difference between the average of the top k order statistics in a sample of size n and the population mean, expressed in population standard deviation units. Some finite sample results for $D_{k,n}$ are obtained in this paper. An expression for its distribution function is given in the random sample case. Several bounds using the Cauchy-Schwarz technique and the techniques of convex transformation are given for $ED_{k,n}$. Numerical comparisons of these bounds are made for the standard normal population. Bounds on $ED_{k,n}$ are established in the dependent sample case also.

Nagaraja, H. N. Record values and extreme value distributions. *Journal of Applied Probability* 19:1 (1982) 233-239.

The limit distribution of the k^{th} maximum from a random sample of size n when $n \to \infty$ is identified as the distribution of the k^{th} lower record value from one of three extreme value distributions. This fact is used in giving a different canonical representation and new proofs of the results of Hall (1978) for this limiting random variable. A characterization of the exponential distribution based on upper record values is given.

Nagaraja, H. N. Some asymptotic results for the induced selection differential. *Journal of Applied Probability* 19:2 (1982) 253-261.

We define induced selection differential and discuss asymptotic distribution theory for this quantity. We also obtain the asymptotic joint distribution of the selection differential and the induced selection differential. These are used as measures of improvement in genetic selection programs. We consider the linear regression model set up in detail to obtain various possible limit laws for the induced selection differential.

SHELLEY, Mack C., II. Forecasting the Federal Budget: univariate strategies. *1980 Social Statistics Section Proceedings of the American Statistical Association* (1980) 517-520.

Several alternative univariate models of historical levels of U.S. government spending are presented and compared according to relevant goodness-of-fit criteria (mean absolute error and standard error of the estimate). The models examined include: (1) ordinary least squares, (2) exponential growth curve, (3) moving average, (4) exponential smoothing, and (5) Box-Jenkins models. The Box-Jenkins ARIMA (0, 2, 2) model is found to produce a better fit to the historical data than the other alternatives considered. Forecasts of future expenditure levels for fiscal years 1982 to 1986 are compared for the five models. The ARIMA model is found to produce the most plausible projected values in light of current budgetary trends. Limitations of each model are discussed.

SHELLEY, Mack C., II. ARIMA models for revenue forecasting in the Iowa Department of Transportation. *1981 Business and Economic Statistics Section Proceedings of the American Statistical Association* (1981) 436-440.

This paper examines practical applications of the Box-Jenkins philosophy of time series analysis to the specific problem of forecasting anticipated revenues for the state of Iowa's Department of Transportation.

Univariate multiplicative and non-multiplicative models are presented for predicting income from the state motor fuel tax, motor vehicle registration fees, and the use tax, which together comprise the state Road Use Tax Fund. Recommendations regarding the general utility of ARIMA models for public revenue forecasting are discussed.

SPOSITO, V. A., A.F.M. Anwarul Haque, and Howard Meeks. Useful distribution-free stopping rules for Monte Carlo sampling. *Journal of Statistical Research* (Bangladesh) 13:1 & 2 (1979) 23-30.

Following a discussion of the general job sequencing or scheduling problem, some existing Monte Carlo techniques used to obtain reasonable scheduling schemes are described. The paper establishes several useful distribution-free stopping rules for halting the Monte Carlo sampling procedure for the general job scheduling problem. These rules are easier to use than techniques previously used in the literature and are especially useful for any nonnormal distribution.

Haque, A.F.M. Anwarul, **V. A. SPOSITO,** and Howard Meeks. Single machine job scheduling via Monte Carlo sampling. *Journal of Statistical Research* 14:1 & 2 (1980) 21-37.

As a followup to the preceding paper, this paper addresses the problem of using distribution-free stopping rules for Monte Carlo sampling for the general job scheduling problem. Generated feasible job scheduling solutions obtained with left-shifting and without left-shifting in a single machine environment are compared with respect to various factors.

***SPOSITO, Vince.** Quadratic programming. Ch. 6 in *Mathematical Programming for Operations Researchers and Computer Scientists,* edited by Albert G. Holzman, pp. 149-171. Marcel Dekker, Inc., New York and Basel. 1981. SLRS 531.

A general survey of the theory of quadratic programming, as well as some of the computational procedures used to solve this class of problems, is presented in this chapter. A key component of the presentation underscores the role of the "Kuhn-Tucker" conditions in quadratic programming. These conditions are used to develop various closed-form solutions of least squares problems for given linear side conditions.

Stangenhaus, G., and **V. A. SPOSITO.** Un criterio para selecao da melhor estimativa no L_p. *Proceedings of the 49th Simposio Nacional de Probabilidade e Estatistica,* a conference held in Rio de Janeiro, Brazil, July 1980. 1982.

Optimal norms are considered in this paper for various symmetric distributions. An expression based on the sample kurtosis is derived.

***STEPHENSON, W. Robert.** A general class of one-sample nonparametric test statistics based on subsamples. *Journal of the American Statistical Association—Theory and Methods Section* 76:376 (1981) 960-966. SLRS 536.

A general class of nonparametric test statistics is constructed by considering the sign of the most extreme value in subsamples of size m taken from n independent observations. The test statistics can be expressed as linear rank statistics and reduce to the sign test statistic for $m = 1$ and a modified Wilcoxon signed-rank test statistic for $m = 2$. Asymptotic normality of properly standardized versions of our statistics is established under general conditions. Small-sample power simulations, as well as Pitman and Bahadur efficiencies, indicate that members of our class do well in comparison with already existing test statistics.

STRAHAN, Robert F. Remarks on scoring androgyny as a single continuous variable. *Psychological Reports* 49:3 (1981) 887-890.

Properties of two newly proposed, continuous measures of psychological androgyny are discussed in relation to an androgyny-relevant measure previously described. The difficulties of reflecting the construct of androgyny in a single variable are noted, and a combination of masculinity and femininity measures, through analysis of variance or multiple regression procedures, is recommended.

STRAHAN, Robert F. Multivariate analysis and the problem of Type I error. *Journal of Counseling Psychology* 29:2 (1982) 175-179.

Leary and Altmaier recommend the general use of multivariate analysis of variance (MANOVA) with several dependent variables in order to control for overall Type I error rate. This paper calls attention to limitations and dangers in routine application of MANOVA, describes some alternative procedures, and laments the necessarily pervasive character of the statistical problem.

STRAHAN, Robert F. On computer program packages: not all things to all people. *American Psychologist* 37:3 (1982) 339.

Lembke, L. L., Richard N. Kniseley, **R. Craig VAN NOSTRAND** (Eastman Kodak Company), and **M. D. Hale.** Precision of the all-glass impinger and the Andersen microbial impactor for air sampling in solid-waste handling facilities. *Applied and Environmental Microbiology* 42:2 (1981) 222-225.

VARDEMAN, Stephen B. $O(N^{-1/2})$ convergence in the general bounded risk two-state sequence compound decision problem. *Sankhyā* A 42:1&2 (1980) 88-102.

This paper treats a sequence version of the general bounded risk finite-state compound decision problem. Bounds are developed for the N problem average risk of the "play Bayes against estimated past empiric distribution" procedure. In the two-state case these are seen to provide $O(N^{-1/2})$ convergence to the Bayes envelope risk.

VARDEMAN, Stephen B. On the small N performance of bootstrap and Bayes extended and unextended set compound rules for classification between N(−1,1) and N(1,1). *Journal of Statistical Computation and Simulation* 13:3&4 (1981) 255-271.

We study a situation in which N independent classifications between N(−1,1) and N(1,1) are to be faced simultaneously. This problem was the featured example in Robbins' (1951) introduction of the compound decision problem and has been used many times since to illustrate various aspects of the developing theory of compound and empirical Bayes decisions. We here study the moderate N risk behavior of recently developed so-called "extended" bootstrap and Bayes procedures for the problem. The behavior of these rules is compared to that of the bootstrap and Bayes rules originally suggested by Robbins.

Swain, Philip H., **Stephen B. VARDEMAN,** and James C. Tilton. Contextual classification of multispectral image data. *Pattern Recognition* 13:6 (1981) 429-441.

Compound decision theory is involved to develop a method for classifying image data using spatial context. Methods for characterizing contextual information in an image are proposed and tested. Experimental results based on both simulated and real multispectral remote sensing data demonstrate the effectiveness of the contextual classifier. A number of practical problems with this approach are discussed and possible solutions are explored.

VARDEMAN, Stephen B. Approximation to minimum k-extended Bayes risk in sequences of finite-state decision problems and games. *Bulletin of the Institute of Mathematics, Academia Sinica (Taipei)* 10:1 (1982) 35-52.

This paper treats a sequence version of the finite state compound decision problem. k-extended standards for the risks of sequence compound procedures are described. Bounds are developed for the risks of a family of procedures employing artificial randomization. In addition it is noted that the given formulation of the problem includes a game theoretic situation, and three additional solutions are offered for this specialization.

WEISSMAN, Ishay (Technion—Israel Institute of Technology). More on Goldberger's predictor. *Belgisch Tijdschrift voor Statistiek, Informatica en Operationeel Onderzoek* 4 (1980) 16-20.

Let X_1, X_2 be two correlated random vectors. A predictor of X_2 based on X_1 was suggested by Goldberger (1962). By differentiating some quadratic forms and equating the results to 0, Leoff and Leclercq (1976) showed that this predictor is optimal by several different criteria. The present paper adopts the coordinate-free approach and obtains these and some new optimal properties using orthogonal projections arguments.

WOLINS, Leroy. Reanalyzing studies of race differences in intelligence: scale dependent mistakes. Chapter 18 in Robert F. Boruch, Paul M. Wortman, David S. Cordray, and Associates: *Reanalyzing Program Evaluations,* pp. 309-321. Jossey-Bass Inc., Publishers (San Francisco, London). 1981.

Scale dependent mistakes, a class of mistakes that is frequent in published reports, are discussed. These are not statistical mistakes, but more often mistakes in inference based on proper statistics, although statistical mistakes may be involved. Spurious findings in research on race differences in IQ are presented. The author delineates the concept holding these spurious findings together. Illustrations are given of necessary procedures for making certain inferences about differences among races or ethnic groups through data analysis.

Galejs, Irma, Jane O'Brien, and **Leroy WOLINS.** Emotionally disturbed and normal children's perceptions of their parents. *Iowa State Journal of Research* 56:2 (1981) 205-212.

Twenty-eight emotionally disturbed children were matched with normal ones on the basis of age, sex, and socioeconomic status. Measures were obtained of each child's perception of his or her parents. Of the many differences explored, the only one that appears to be reliable ($p < .001$) is that the emotionally disturbed children, as compared to normal ones, perceive their parents as exercising more psychological control of them and these perceptions decrease with age. The projective measure, Kinetic Family Drawings, did not discriminate between the two groups in a way consistent with previous research.

*Motoyama, Tetsuro, and **Leroy WOLINS.** Analysis of covariance when the groups are formed on the basis of the covariate. *1981 Social Statistics Section Proceedings of the American Statistical Association* (1982) 493-496. SLRS 539.

It is widely believed among social scientists that if the treatment groups are formed on the basis of an observed covariate, the initial differences among the groups can be adjusted using analysis of covariance even though the observed covariate is subject to measurement errors, given that the model is correct for the true scores. The discussions that support this belief often use continuous variables with infinite

ranges such as multivariate normal distributions. However, it is rare in social science to obtain such variables because measurement processes almost always result in discrete variables. Examples are given where the aforementioned belief is false when the covariate is discrete even though all other assumptions are met.

Gupta, S. S., and **W. Y. WONG.** Subset selection procedures for the means of normal populations: unequal sample sizes case. *Selecta Statistica Canadiana* 6 (1982) 1-49.

Some subset selection procedures for the largest of the k unknown means of normal populations with unequal variances are studied. The problem of selecting all the normal populations with means better than a control is also considered. An application to testing the equality of k normal means with unequal variances, as in the Behrens-Fisher problem, is described.

Book Reviews

BANCROFT, T. A. *Privacy and Government Data Banks: An International Perspective,* by David H. Flaherty. London: Mansell, 1979. 353 pp. $37.00. Reviewed in *Journal of the American Statistical Association* 76:375 (1981) 744.

BANCROFT, T. A. *American Contributions to Mathematical Statistics in the Nineteenth Century* (Vol. I and II), by Stephen M. Stigler, editor. New York: Arno Press, 1980. $55.00 set. Reviewed in *Journal of the American Statistical Association* 77:377 (1982) 212.

BOOTH, Gordon D. (U.S. Department of Agriculture and ISU). *Principles and Procedures of Statistics: A Biometrical Approach,* by Robert G. D. Steel and James H. Torrie. New York: McGraw-Hill, 1980. xxi + 633 pp. $26.00. Reviewed in *Journal of the American Statistical Association* 76:375 (1981) 753-754.

GROENEVELD, Richard A. *Practical Nonparametric Statistics,* 2nd edition, by W. J. Conover. New York: John Wiley & Sons, 1980. xiv + 493 pp. Reviewed in *Journal of the American Statistical Association* 76:376 (1981) 1011-1012.

HAN, Chien-Pai. *Multivariate Statistical Analysis,* by R. P. Gupta, editor. New York: North-Holland, 1980. viii + 289 pp. $41.50. Reviewed in *Journal of the American Statistical Association* 76:375 (1981) 751-752.

IACHAN, Ronaldo. *Sampling from a Finite Population,* by Jaroslav Hájek. New York: Marcel Dekker, 1981. v + 247 pp. $27.50. Reviewed in *Journal of the American Statistical Association* 77:377 (1982) 213.

KEMPTHORNE, Oscar. *Quantitative Genetic Variation,* edited by James N. Thompson, Jr., and J. M. Thoday. Academic Press, New York, 1979. $19.50. Reviewed in *Social Biology* 27:3 (1980) 241-245.

KEMPTHORNE, Oscar. *Incomplete Block Designs (Lecture Notes in Statistics, Vol. 1),* by Peter W. M. John. New York: Marcel Dekker, 1980. vii + 101 pp. $17.50 (paperback). Reviewed in *Journal of the American Statistical Association* 77:378 (1982) 492.

KOEHLER, Kenneth J. (A review of three books) *Regression Analysis and Its Application: A Data-Oriented Approach,* by Richard F. Gunst and Robert L. Mason. New York: Marcel Dekker, 1980. xiv + 402 pp. $39.75. Also *Applied Linear Regression,* by Sanford Weisberg. New York: John Wiley, 1980. xii + 283 pp. $24.95. Also *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity,* by David A. Belsley, Edwin Kuh, and Roy E. Welsch. New York: John Wiley, 1980. xv + 292 pp. $21.95. Reviewed in *Journal of the American Statistical Association* 77:378 (1982) 494-496.

MEEDEN, Glen. *Philosophical Problems of Statistical Inference,* by Teddy Seidenfeld. Dordrecht, Holland: D. Reidel, 1979. xiii + 245 pp. $37.00. Reviewed in *Journal of the American Statistical Association* 76:375 (1981) 743.

MEEDEN, Glen. *Studies in Subjective Probability* (2nd Ed.), by Henry E. Kyburg, Jr., and Howard E. Smokler, editors. New York: Krieger Publishing Co., Inc., 1980. 262 pp. $9.50 (paperback). Reviewed in *Journal of the American Statistical Association* 76:376 (1981) 1011.

POLLAK, Edward. *Mathematical Population Genetics,* Biomathematics, 9, by Warren J. Ewens. Berlin-New York: Springer-Verlag, 1979. xii + 325 pp. $32.00. Reviewed in *Mathematical Reviews* 13:81f (1981) 2452.

STEPHENSON, W. Robert. *Elementary Statistics,* by Bernard W. Lindgren and Donald A. Berry. New York: Macmillan, 1981. xi + 530 pp. $18.95. Also *Ideas of Statistics,* by J. Leroy Folks. New York: Wiley, 1981. xiii + 368 pp. $17.95. Reviewed in *Journal of the American Statistical Association* 77:377 (1982) 215.

WOLINS, Leroy. *Probabilistic Models for Some Intelligence and Attainment Tests (with a Foreword and Afterword by Benjamin D. Wright),* by Georg Rasch. Chicago, IL: The University of Chicago Press, 1980. xxiii + 199 pp. $21.00 ($9.00 paperback). Reviewed in *Journal of the American Statistical Association* 77:377 (1982) 220.

Thesis Abstracts

Blough, David King. Measures of location and asymmetry in the plane. Ph.D. thesis, Iowa State University Library, May 1982.

K. Doksum [*Scandinavian Journal of Statistics* 2 (1975) 11-22], using three different approaches, considered the problem of defining a location parameter for asymmetric univariate probability distributions. These approaches are extended to the bivariate case. For a given bivariate distribution function F, each approach yields a closed, convex set in the plane, any point of which serves as a measure of location for F.

The first method is to construct a symmetric bivariate distribution function and use it to approximate F from above and below. To do this, three stochastic orderings of bivariate random vectors are introduced: the standard ordering, based on the joint distribution functions, an ordering based on the marginal distribution functions, and an ordering based on both the marginal and the conditional distribution functions. Using each ordering, F (and every rotation of F through an angle α) is approximated from above and below to obtain a location rectangle for F in every direction. These rectangles are rotated back through an angle $-\alpha$, and their intersection defines the location region for F. It is shown that the standard and marginal orderings yield exactly the same sets.

The second approach is axiomatic: four axioms of location are defined and all functionals satisfying these axioms make up the location region for F. Finally, Doksum's function of symmetry is generalized to both marginal and conditional functions of symmetry. The intersection of the respective ranges of these functions in each direction constitutes a third location region for F. As in the univariate case, all three approaches define essentially the same set. The estimation of the location region and the estimate's consistency are discussed for the marginal and conditional orderings. Using a fourth stochastic ordering which is a stronger form of the conditional ordering, it is possible to give examples of location parameters by solving a minimization problem similar in spirit to Bayesian estimation.

Two applications of the location region are given. The first uses the size of the region to characterize the degree of asymmetry in F, and the second uses points in the location region to define stochastic orderings of distribution functions. The multivariate generalization of these results is also discussed.

Janella Chapline and Anne Callanan entertain at the traditional winter party.

Callanan, Terrance Patrick. Consequences of random mating in a population with overlapping generations. M.S. thesis, Iowa State University Library, December 1981.

The Hardy-Weinberg Law holds for large random-mating populations with discrete generations. An analog of the Hardy-Weinberg Law is developed, using a one-locus model, for a population with overlapping generations and discrete age classes. The results confirm those of Charlesworth. However, the derivation in this thesis is based on recurrence equation theory rather than the matrix theory used by Charlesworth. Numerical examples are given to illustrate convergence of allele frequencies.

The behavior of an age-structured population in which two multiallelic loci influence a character is then considered. Sufficient conditions for the approach of the gametic disequilibrium within an age group to zero are given. The results are illustrated with some examples.

The two-locus model is also used to define a measure T of the generation interval. Two approximations of T are given, both of which are functions of the fertile age groups, the life table for those age groups, and the frequency of recombination. The approximations are compared in some examples.

Chandhok, Promod Kumar. A study of the effects of measurement error in survey sampling. Ph.D. thesis, Iowa State University Library, May 1982.

The effects of measurement error in survey sampling are investigated. Let y_{jt} be the value of the characteristic under study for the j^{th} unit in the population, observed at the t^{th} trial. Assume that $y_{jt} = Y_j + e_{jt}$, where Y_j is the true value of the j^{th} unit, and e_{jt} the deviation from the true value. It is desired to estimate the population mean of y. We study two measurement error models. The first model, called the "simple correlation model," is given by

$$E(e_{jt} \mid j) = 0,\ V(e_{jt} \mid j) = \sigma_j^2, \text{ and}$$
$$\mathrm{Cov}(e_{jt}, e_{j't} \mid j, j') = \rho\ \sigma_j\ \sigma_{j'}.$$

The second model, called the "intrasample correlation model," is given by

$$E(e_{jt} \mid j) = 0,\ V(e_{jt} \mid j) = \sigma_j^2, \text{ and}$$
$$E(e_{jt}\ e_{j't}) = \rho_w\ E(e_{jt}^2)$$

for $j \neq j'$, and both j, j' in the sample.

The usual unbiased estimators in equal and unequal probability sampling with replacement are studied under the simple correlation model. The Horvitz-Thompson estimator and the simple mean are also examined under the simple correlation model. Some of these estimators are compared in an empirical study.

The ratio estimator is studied under two sampling schemes, namely, simple random sampling without replacement and Midzuno's scheme. The bias and mean-square error of the ratio estimator under these two sampling schemes and the two measurement error models are derived and compared. The conditions under which one strategy is better than the other, when measurement error is present, are obtained. Also, the comparison is made in an empirical study.

The results are extended to two-stage sampling and stratified sampling.

Escobar, Luis Alberto. Optimum multiple- and single-stress accelerated life tests. Ph.D. thesis, Iowa State University Library, December 1981.

We consider the optimal design of Accelerated Life Tests (ALT) with Type II censored data. It is assumed that the time-to-failure, or a transformation of it, follows a location scale Gumbel distribution. The location parameter of this distribution is assumed to be of the form $\sum_{j=0}^{k} \beta_j f_j(\underline{x})$, where the β_j's are unknown and the f_j's are functions of the stresses $\underline{x}$. The scale parameter, σ, of the distribution is assumed to be independent of the stresses $\underline{x}$.

We estimate the parameters in the model using a linear model in which the dependent variables are observed order statistics at the points of the design. We give general formulae for the Best Linear Unbiased Estimator (BLUE), $\hat{Y}_p$, of the $100p^{th}$ percentile, Y_p, of the Gumbel distribution at the design stress $\underline{x}_D$. Also, a general expression for $Var(\hat{Y}_p)$ is derived.

For designs in $k+1$ points, we use asymptotic theory to express $Var(\hat{Y}_p)$ as a function of the number of allocated units and the proportion of censoring at each of the $k+1$ stress levels in the design. The primary objective is to find designs that minimize $Var(\hat{Y}_p)$. However, this minimization is complicated by the lack of closed-form expressions for the expected values of the order statistics and the variance-covariance matrix of the error term in the linear model. Thus, we propose to restrict the optimization to designs that minimize one of the components of $Var(\hat{Y}_p)$; in practical situations, this component is usually the dominant term of $Var(\hat{Y}_p)$. We prove that the proposed minimization is equivalent to a problem of optimal extrapolation under a linear model with uncorrelated errors.

In the case of a single accelerating stress, we present a characterization of optimal designs in $k+1$ points when the functions $\{f_0,...,f_k\}$ are a T-system in a finite interval [a,b].

In the case of two or more accelerating stresses and uniform proportion of censoring at each point in the design, we present optimal designs for diverse forms of the regression function $\sum_{j=0}^{k} \beta_j f_j(\underline{x})$. In particular, these forms include: regression in two variables with first-order terms and the cross-product, polynomials in r dimensions of degree less than or equal to s, and polynomials in three variables with first-order terms and cross-products of second order.

Hale, Michael D. Attainable bounds for generalized moments via mathematical programming. Ph.D. thesis, Iowa State University Library, May 1982.

This work addresses the generalized Chebyshev problem of bounding $\int_a^b g\,dF$, where g is given and $F \in \Omega_{\mu_1,\mu_2}$: $\{F \mid F$ is a cdf on [a,b] with $\int_a^b x\,dF = \mu_1$, $\int_a^b x^2 dF = \mu_2\}$. Various classes of functions g are given for which a certain weak duality approach necessarily yields a solution. Among these is the class of utility functions with decreasing absolute risk aversion. Other classes, particularly classes useful in reliability applications, are treated.

A typical result is as follows: Consider g absolutely continuous on [a,b], with continuous derivative on (a,b). For each $t \in (a,b)$ let $Q_t(x)$ be the unique quadratic function satisfying $Q_t(a) = g(a)$, $Q_t(t) = g(t)$ and $Q_t'(t) = g'(t)$. If $g' \geq Q_t'$ on [t,b), $\forall\ t \in (a,b)$, then

$$\int_a^b g\,dF \geq \frac{g(a)(\mu_2 - \mu_1^2) + g((\mu_2 - a\mu_1)/(\mu_1 - a))(\mu_1 - a)^2}{(\mu_1 - a)^2 + (\mu_2 - \mu_1)^2}$$

whenever $F \in \Omega_{\mu_1,\mu_2}$.

Ho, Fred Chung Man. Selected topics in computer generation. Ph.D. thesis, Iowa State University Library, August 1981.

In any successful simulation studies, pseudorandom number generators play central roles, in terms of either efficiency or accuracy. Under investigation here are the normal, noncentral, multinomial, and hypergeometric pseudorandom number generators, and a congruential uniform random number generator with arbitrary period lengths.

The newly designed algorithm R-T-T for the normal distribution shows promise in both accuracy and efficiency. This algorithm combines the method of mixtures with the Alias algorithm, resulting in a generation time close to that of the uniform random variates generation.

For noncentral distributions, investigation is focused on the noncentral chi-square distribution. The other noncentrally distributed random variates can be obtained through simple transformations. Four algorithms are suggested, two of which are mo-

ment approximations to the central chi-square distribution, the others being a normal approximation and an exact algorithm.

The class of random multivariates under study here is the multinomial. A decomposition method transforming the multinomials into binomials is employed, in combination with an exact random median method, to yield a very efficient generator.

The hypergeometric distribution can be considered as a binomial distribution in sampling without replacement after each Bernoulli trial. There is no closed-form inverse transformation for this distribution. Two algorithms are devised to increase the efficiency in generation.

Finally, a congruential uniform random number generator with arbitrary period lengths is introduced which utilizes an extended arithmetic approach. The new generator can be used in any computer environment and can duplicate exact sequences generated by other congruential uniform random number generators of different period lengths.

Lee, Edward Henry. Estimation of seasonal autoregressive time series. Ph.D. thesis, Iowa State University Library, December 1981.

Estimation of the parameters of the stationary normal seasonal autoregressive process with seasonal means is studied. For samples of the size frequently encountered in econometrics, the least squares estimators of the autoregressive coefficients are seriously biased. Alternative estimators are studied.

Approximations to the first two moments of the seasonal autoregressive parameter are derived, using large sample theory. The bias expression is used to develop modifications of the least squares estimator with smaller bias for most values of σ. Although the least squares estimator and the proposed modifications are asymptotically equivalent, the small sample behavior of the two estimators is considerably different.

The asymptotic biases of the least squares estimators of the stationary normal second-order seasonal autoregressive parameters are derived. Three bias correction procedures which remove the bias due to the estimation of means are proposed. These procedures are considerably more complex than those developed for the first-order process. The methods of bias correction can be extended to higher-order processes.

A large Monte Carlo study examining the small sample properties of the various estimators of the first-order seasonal autoregressive parameter and of associated predictors is presented. This study demonstrates that approximating the null distributions of the regression "t-statistics" by the Student's t-distribution is not appropriate for the ordinary least squares estimator in small samples. The empirical distribution of the "t-statistic" for the modified estimators was much closer to the tabled distribution. Generally speaking, the predictors constructed from the modified estimator performed better than the least squares predictor.

Examples of seasonal autoregressive processes for which the above results are applicable are presented.

Mee, Robert Wayne. Analysis of ordered categorical responses, assuming an underlying continuous variable. Ph.D. thesis, Iowa State University Library, August 1981.

Procedures are discussed for the analysis of ordered categorical responses. These procedures are analogous to linear model procedures for a continuous response variable. They are based on the assumption that the observed categorical responses are determined by an underlying continuous variable that satisfies a linear model. Previously, estimation procedures have been developed only for the case where the model for the assumed underlying variable is a fixed-effects linear model.

Results are obtained for the case where the linear model for the underlying continuous variable includes random as well as fixed effects. It is generally not possible to evaluate the likelihood function of the observed categorical responses. Procedures that approximate maximum likelihood procedures are developed for estimating fixed effects and variance components. The prediction of random effects is also considered. For the fixed-effects case, conditions are given which ensure the asymptotic normality of the maximum likelihood estimator, and approximate confidence intervals are derived for the probability of a response belonging to a given category.

Mowers, Ronald Paul. Effects of rotations and nitrogen fertilization on corn yields at the Northwest Iowa (Galva-Primghar) Research Center. Ph.D. thesis, Iowa State University Library, August 1981.

A crop rotation and nitrogen (N) fertilization experiment was begun in 1957 at the Northwest Iowa (Galva-Primghar) Research Center near Sutherland, Iowa. The experiment was designed to compare crop rotations and to determine the response of corn to nitrogen fertilization in the various crop rotations. Sixteen years of corn yield data from the experiment are summarized and analyzed in this study.

The experiment was a split-plot with rotations as whole-plot treatments and N fertilization as subplot treatments. The crop rotations were: corn-oats-meadow-meadow (COMM), corn-corn-oats-meadow (CCOM), sorghum-corn-oats-meadow (SgCOM), corn-soybeans (CSb), continuous corn harvested for grain only (C), and continuous corn with the stover and grain removed (C_s). In rotations including meadow, corn was fertilized with 0, 20, 40, and 80 lb. N/acre. In other rotations, the rates were 0, 40, 80, and 120 lb. N/acre. Treatments of 0, 50, 100, and 150 lb. potassium (K)/acre were applied to C_s plots during the last five years of the experiment.

Because of the split-plot design and because the experiment was conducted over time, yields for different treatment combinations were correlated. The corn yield data were transformed to produce nearly uncorrelated errors with homogeneous variance, before estimating functions for the response of corn yields to N and K fertilizer.

The C_s grain yields for 1974-1978 were fitted to a grafted polynomial function of K. The response to K was much greater at higher levels of N fertilization.

Functions for the response of corn yield to N fertilizer in the various rotations were proposed and estimated. The preferred function for the response of corn to N fertilizer was an exponential (Mitscherlich) equation which included terms for a time trend in the yield of continuous corn. The analysis showed that the maximum yield obtained under continuous corn was less than the maximum yield obtained in rotations containing legumes.

Niknian, Minoo. Contributions to the problem of goodness-of-fit. Ph.D. thesis, Iowa State University Library, May 1982.

This dissertation consists of two parts. The first part pertains to residual goodness-of-fit analysis. The second part pertains to the possibility of bringing an asymptotic multi-decision point of view to goodness-of-fit analysis.

Goodness-of-fit testing based on the correlated (OLS) residuals for the standard linear regression model are investigated. A modification of the U-statistic is given, and appropriate quantiles are discussed. Three new statistics for testing normality are introduced.

Goodness-of-fit is also studied through orthogonally transformed residuals. Test size and power are studied for a new vector of transformed residuals (r*), as well as for Theil's BLUS residuals, and comparisons are made with the result obtained for the OLS residuals.

In the second part, the sense in which bivariate large deviations are pertinent to the three-decision view of goodness-of-fit is explored. Various approaches are discussed for computing or approximating the large deviation rates for the classification errors involved.

Noorbaloochi, Siamak. Characterizing a prior distribution through its Bayes estimator. Ph.D. thesis, Iowa State University Library, May 1982.

Let X be a continuous real-valued random variable with a family of possible distributions indexed by the real parameter $\theta \epsilon \Theta$. For the triplet (δ,γ,π), let δ denote a real-valued function over the sample space, γ a real-valued function over the parameter space Θ, and π a non-negative real-valued function over Θ. We are interested in determining when, for a given δ and γ, one can find a unique prior π, such that δ is the Bayes estimator of γ against π, for squared error loss. By imposing different sets of conditions on the form of γ and δ, positive answers to the questions are obtained. The implications of these results in the study of the admissibility of an estimator are noticed, and other applications are discussed.

A second area considered is the relationship between the Bayesness of an estimator and the unbiased property of an estimator. When the loss function is squared error, a dual relationship between the two is noticed. This suggests a general definition of unbiasedness for an arbitrary loss function which generalizes the notion of unbiasedness due to Lehmann. Some consequences of this general definition are noted.

Ramos, Juan Enrique. Estimating the probabilities of misclassification in discriminant analysis. Ph.D. thesis, Iowa State University Library, May 1982.

An observation assumed to have come from one of two populations, Π_1 and Π_2, is to be classified by the John's classification statistic Z. The unconditional probabilities of misclassification depend on the population parameters. When the parameters are unknown, these probabilities are also unknown and must be estimated from samples taken from the two populations.

Several estimators for the unconditional probabilities of misclassification are considered. Some estimators are based on the assumption that the populations are normally distributed; other estimators do not require any distributional assumptions.

Expressions for the asymptotic bias and asymptotic mean square error of each one of the estimators based on the normal distribution are obtained. These expressions are then used to compare the performances of the estimators.

The uniformly minimum variance unbiased (UMVU) estimator of the expected value of Lachenbruch's leaving-one-out estimator is obtained. The expected value of this UMVU estimator is used to obtain an exact expression for the unconditional probability of misclassification when the Z classification statistic is used.

Sastrosoewignjo, Soetarto. Aspects of bivariate cdf iteration. Ph.D. thesis, Iowa State University Library, August 1981.

This thesis deals with bivariate cdf iteration $\{ F_n (\cdot , \cdot) \}$ of the form

$$F_n(x,y) = \lambda^{(n)} (G(x),H(y),F(x,y))$$

$$= \lambda (G_{n-1}(x),H_{n-1}(y), F_{n-1}(x,y)),$$

where

$$G_n(x) \equiv \phi_1^{(n)} G(x) \text{ and } H_n(y) \equiv \phi_2^{(n)} H(y),$$

the marginals of $F_n(x,y)$, are two (univariate) cdf iterations. A natural example of this model is given by the bivariate extension of the SSZSTPGPI of Thomas and David (1967) and Thomas (1967). Weak con-

vergence of F_n and conditions for asymptotic independence and dependence are studied for this problem. A second problem dealt with is the identification of conditions for asymptotic independence and dependence for extremes of essentially bounded bivariate r.v.'s.

In both cases, i.e., (maximin and minimax) bivariate cdf iteration and the extreme value case, the upper Fréchet bound (UFB) plays a dominant role in establishing asymptotic dependence. In the former case, the UFB provides essentially the only instance of dependence, while, in the latter case, mixtures involving the UFB provide such instances. In the former case, asymptotic independence holds, essentially, unless the UFB is achieved at a certain critical point, while, in the latter case, asymptotic independence is established for the case $F(x,y) \leq G(x)H(y)$ at (x,y) near a certain critical point.

Skarpness, Bradley Owen. Optimality conditions and dual formulations for programming problems over cone domains. Ph.D. thesis, Iowa State University Library, August 1981.

Let P be an open set in E^n, and C be an arbitrary cone in E^n. Let F and g be functions from P to E^1 and E^n, respectively. Consider the following minimization problem: *Problem P,* find an $x^0 \in E^n$, if it exists, such that

$$F(x^0) = \min_{x \in X} F(x),\ x^0 \in X$$

where

$$X = \{x : x \in P \subset E^n,\ g(x) \in C \subset E^m\}$$

and F is differentiable at x^0.

Associated with the minimization problem is a *modified Kuhn-Tucker stationary point problem* over cone domains. Find an $x^0 \in P \subset E^n$ and $u^0 \in -C^* \subset E^n$, where C^* is the polar cone of C, such that

$$\nabla' F(x^0) + u^{0'} \nabla g(x^0) = 0$$

$$u^{0'} g(x^0) = 0,\ g(x^0) \in C.$$

Necessary and sufficient optimality conditions are established between Problem P and the modified Kuhn-Tucker stationary point problem for a certain class of nonlinear programming problems over arbitrary cone domains. These results are used to prove a modified Farkas Lemma over degenerate and nondegenerate cone domains, which uses only a "partial" linear duality theorem.

A quadratic programming problem is considered. Its dual problem is constructed in a natural way over degenerate and nondegenerate cone domains, and quadratic duality is established between the two problems. The necessary and sufficient optimality conditions are subsequently used to generate dual problems from linear fractional problems over cone domains. These dual problems differ in structure from the classical formulations.

Department of Statistics

This year marked Iowa State University's first experience with the semester system. The list below of course offerings includes the second summer session for 1981 based on the old quarter system, and the full summer session for 1982 based on the semester system. Credit hours indicated for summer courses are expressed in terms of the system prevailing at the time of offering.

Coursework in the Department of Statistics can lead to a B.S., M.S., or Ph.D. degree with major in statistics through the College of Sciences and Humanities or the Graduate College. A specialized biometry curriculum, administered by the Department of Statistics, leads to a B.S. degree conferred by the College of Agriculture. In the fall, approximately 95 graduate majors and 42 undergraduate majors were enrolled; the latter included 6 in biometry.

A student may receive a degree jointly with another department. The most common undergraduate co-major was computer science. Undergraduate statistics and biometry majors are prepared through a combination of theory and applied methods courses for employment in industry or government or for pursuit of graduate studies.

Graduate students may specialize in experimental design, linear models, general methods, general theory, probability, statistical computing, survey sampling, or one of several areas of application. An M.S. candidate may choose either a thesis or a nonthesis option. The latter requires four additional credits, including a "creative component" of at least two credits of individual work. Operations research is offered cooperatively with the Department of Industrial Engineering.

The striking feature of undergraduate enrollment over the past 10 years has been the marked increase in the number of students in Stat. 127/227, Introduction to Business Statistics, which parallels the growth in numbers of majors in the School of Business Administration.

All of the introductory courses play an important role in teacher training, since graduate teaching assistants are prepared to handle laboratory and recitation aspects, and most of the lectures. Several outstanding undergraduate students in statistics were also given opportunities to assist with the teaching program.

Off-campus statistics workshops were offered by D. F. Cox in Cherokee and Spencer, Iowa, for students enrolled in the popular new Master of Agriculture program. The workshops consist of five three-hour sessions and carry one semester credit.

An experimental course, Statistics 513X, on response surface methodology was presented for the second time by David Harville. The course, which fills a clear need, will now become a regular alternate-year offering.

Throughout the academic year 1981-82, Krishna Athreya was in charge of a noncredit Seminar on

Martingales. This was a joint seminar between the Departments of Statistics and Mathematics, attended by a number of faculty members and graduate students from both departments. It began with three lectures by Athreya with a review of background material on probability spaces, random variables, independence, conditioning, and basic definitions of martingales. Dean Isaacson then gave three lectures on the basic system theorems and inequalities for martingales including the optimal sampling theorem and the convergence theorems. Malay Ghosh lectured on the central limit theorem for martingales, developing his material from the recently published book, *Martingale Limit Theory and Its Applications,* by P. Hall and C. C. Heyde. He gave five lectures in all and covered the results of Heyde and Scott, Hall, Macleish, and others.

During the second semester Krishna Athreya started with a lecture on weak convergence on C[0,1], then continued for several weeks with existence of Brownian motion and its properties, Donsker's invariance principle and its generalization to martingales. Sastry Pantula gave two lectures on the application of martingale central limit theorems to stationary processes. Athreya then continued with some more limit theory for stationary processes. All of this material was taken from Hall and Heyde's book. Arnold Faden gave two lectures on Bayesian inference as a martingale process. Athreya lectured for the remaining part of the semester on central limit theory for stationary processes via martingales. There was enthusiastic participation in the seminar from those who attended.

1981-1982 Course Offerings in Statistics

Courses for Undergraduate Students Only

100	Orientation in Statistics and Biometry	R	F	Stephenson
101	Principles of Statistics	4	F,S	Beam Martin Rangachari Stephenson
104	Introduction to Statistics	3	F,S,SS Guerrero Hotchkiss Jeske Jobe	 Johnson Pareja Stephenson Sukhatme
105	Introduction to Statistics	2	F,S Amemiya Cassell D. Jacobson	 Rogers Sukhatme Vardeman
227	Introduction to Business Statistics	4	F,S,SS Arnold Bergeron Isaacson Jobe Kinyon Meeker	 Oñate Pareja Peixoto Shelley Silvis Tveite
228	Applied Business Statistics	3	F,S	Guerrero Meeker
231	Probability and Statistical Inference for Engineers	4	F,S	Cassell Meeden Vardeman
305	Engineering Statistics	3	S	Vardeman
327T	Applied Business Statistics	3	S	Tveite
341	Introduction to Theory of Probability and Statistics	3	F,S	Groeneveld Stephenson Sukhatme
342	Introduction to Theory of Probability and Statistics	3	S	Groeneveld

Courses for Graduate Minors and Undergraduates

401	Statistical Methods for Research Workers	4	F,S,SS Bailey C. P. Cox D. F. Cox Groeneveld Hickman Hotchkiss	 Johnson Lorenz Martin Shelley Strahan
402	Statistical Methods for Research Workers	4q	SSII	Koehler Lorenz
402	Statistical Design and the Analysis of Experiments	3s	S,SS Anderson D. F. Cox & Hinz	 Koehler Marasinghe Wolins
404	Statistics for the Social Sciences	3	F	Lorenz
405	Applied Econometric Statistics	3	S	Hickman
407	Methods of Multivariate Analysis	2	F	Koehler
421	Survey Designs for Research Workers	4q	SSII	Baker
421	Survey Sampling Techniques	3s	S	Iachan
432	Applied Probability Models	3	F	Groeneveld
436	Genetic Statistics for Research Workers	3	F	Bailey
446	Statistical Theory for Research Workers	2	F	Goebel
447	Statistical Theory for Research Workers	3	S,SS	Cassell Ghosh
448	Statistical Theory for Research Workers	3q	SSII	Goebel
451	Applied Time Series	3	S	Meeker
480	Statistical Applications of Digital Computers	3	F	Marasinghe
481	Computer Processing of Statistical Data	3	S	Bubolz & Marasinghe

490	Independent Study	Var.	F,SS	Bubolz Hotchkiss Koehler Meeker

Courses Primarily for Graduate Students, Major or Minor

500	Statistical Methods	4	F	Hinz
501	Multivariate Statistical Methods	3	S	Koehler
511	Theory and Application of Linear Models	3	S	Kempthorne
512	Design of Experiments	3	F	Kempthorne
513X	Response Surface Methodology	3	S	Harville
521	Theory of Sample Surveys I	3	S	Iachan
533	Reliability	3	S	H. T. David & Ghosh
536	Genetic Statistics	2	F	Pollak
537	Genetic Statistics	2	S	Pollak
538	Econometric Statistics	3	F	Fuller
539	Game Theory	3	F	H. T. David
540	Operations Research Methods and Economic Analysis	3	S	Sposito
542	Theory of Probability and Statistics	3	F	Ghosh
543	Theory of Probability and Statistics	3	S	Meeden
544	Bayesian Decision Theory	3	SS	Meeden
545	Stochastic Processes	3q	SSII	Isaacson
579	Introduction to Computer Hardware and Software Systems for Statistical Computing	1	F	Bubolz Kennedy
580	Statistical Computing	3	F	Kennedy
590	Special Topics	Arr		
	A. Theory		SSII,F, S,SS	
			H. A. David H. T. David Fuller Goebel Isaacson	Kempthorne Marasinghe Shelley Sposito Tveite
	B. Methods		SSII,F, S,SS	
			Bailey Bubolz D. F. Cox Goebel Hinz	Hotchkiss Kennedy Koehler Stephenson
	C. Design of Experiments		F,S,SS	D. F. Cox Hotchkiss Kempthorne Strahan
	D. Design of Surveys		SSII,F, S,SS	Goebel Iachan

Courses for Graduate Students, Major or Minor

601	Advanced Statistical Methods	3	F	C. P. Cox
611	Advanced Linear Model Theory	3	F	Harville
642	Measure Theory and Probability	3	S	Athreya
644	Sequential Statistical Decision Theory	3q	SSII	H. T. David
645	Order Statistics	3	F	H. A. David
647	Multivariate Analysis	3	F	Han
651	Time Series	3	S	Fuller & Goebel
680	Advanced Statistical Computing	3	S	Kennedy
699	Research	Var	SSII,F, S,SS	
			Athreya C. P. Cox H. A. David H. T. David Fuller Ghosh Goebel Han Harville Hinz	Isaacson Kempthorne Kennedy Koehler Meeden Meeker Pollak Sposito Strahan Vardeman

Graduate Students

Thirteen Ph.D. degrees, including three for joint majors, and 20 M.S. degrees were earned by students in the department during the fiscal year. Abstracts of Ph.D. dissertations and of one M.S. thesis appear in the Publications section. Nearly all of the master's degrees were conferred on a nonthesis basis. When employment or educational plans are known, a brief account is given for each student. Thirteen master's degree recipients chose to remain at Iowa State to work toward doctorates in statistics. Their names are starred below. Another one began work on a joint major program for the higher degree.

M.S. Recipients

Adnan Bin Ahmad (Fall 1981, under J. Jeffery Goebel) is teaching and consulting at the Kajian Sains Computa, Institute Technology Mara, in Shah Alam, Selangor, Malaysia.

Noorani Ahmad (Summer 1981, under Kenneth J. Koehler) returned to Baling, Kedah, Malaysia.

George James Bloor (Spring 1982, under Paul N. Hinz) is working as a consulting statistician with Hewlett-Packard Corporation, Rockaway, New Jersey.

***Terrance Patrick Callanan** (Fall 1981, under Edward Pollak).

***David Lee Cassell** (Fall 1981, under Dean Isaacson).

***Stephen Fu-Chung Chang** (Fall 1981, under William J. Kennedy).

Jeanne Anita Devin (Fall 1981, under J. Jeffery Goebel) has been working as biostatistician at the Vicks Research Center, Richardson-Vicks, Inc., Shelton, Connecticut.

***Fah Fatt Gan** (Spring 1982, under Kenneth J. Koehler).

***Rachel Margaret Harter** (Summer 1981, under J. Jeffery Goebel).

Lee Ann Josvanger (Spring 1982, under Vincent A. Sposito) is working toward a Ph.D. in statistics and industrial engineering at Iowa State.

Cynthia Marie Keune (Spring 1982, under Paul N. Hinz) moved to San Diego, California, with her new husband, Steven Richardson, then accepted a position as statistician for the Marine Resources Committee on contractual research. The committee is overseeing a project to evaluate the long-term impact of the San Onofre Nuclear Generator.

***Byung Chun Kim** (Spring 1982, under Oscar Kempthorne).

***Youngjo Lee** (Fall 1981, under Oscar Kempthorne).

***Cindy Lynn Martin** (Fall 1981, under Glen Meeden).

***Reda Ibrahim Mazloum** (Summer 1981, under Glen Meeden).

***George Ostrouchov** (Fall 1981, under W. Q. Meeker, Jr.).

***Michael Philip Rogers** (Spring 1982, under H. A. David).

Pamela Claudine Stangl (Fall 1981, under W. Robert Stephenson) has been teaching in the Mathematics Department, University of Wisconsin-LaCrosse, as an instructor.

***Michael David Tveite** (Fall 1981, under Vincent A. Sposito).

***Jan William van Schaik** (Fall 1981, under Kenneth J. Koehler).

Ph.D. Recipients

David King Blough (Spring 1982, under Glen Meeden) has accepted a position as assistant professor in the Department of Statistics, Ohio State University.

Promod Kumar Chandhok (Spring 1982, under Chien-Pai Han) has an appointment as temporary assistant professor, Department of Accounting, Finance and Quantitative Methods, Ohio University.

Luis Alberto Escobar R. (Fall 1981, under William Q. Meeker, Jr.) is involved in teaching, statistical consulting, and research as assistant professor in the Department of Experimental Statistics, Louisiana State University, Baton Rouge.

Michael Don Hale (Spring 1982, under H. T. David) continues as senior statistician in the Experimental Design Group, Nuclear Operations, Monsanto Research Corporation, The Mound Facility, Miamisburg, Ohio.

Chung Man Fred Ho (Summer 1981, in statistics and industrial engineering, under William J. Kennedy) joined DMR Corporation, Palo Alto, California to do statistical computing and consulting.

Edward Henry Lee (Fall 1981, under Wayne A. Fuller) is an assistant professor, Department of Mathematical Sciences, Montana State University.

Robert Wayne Mee (Summer 1981, under David A. Harville) is a visiting assistant professor in the Department of Statistics, Southern Methodist University.

Ronald Paul Mowers (Summer 1981, in agronomy (soil management) and statistics, under Wayne A. Fuller and Lloyd Dumenil) has been teaching and consulting with plant science researchers in agronomy and horticulture, as assistant professor, Department of Experimental Statistics, Louisiana State University.

Minoo Niknian (Spring 1982, under H. T. David and Kenneth J. Koehler) is teaching in the Department of Statistics, Al-Fateh University, Tripoli, Libya, as an assistant professor.

Siamak Noorbaloochi (Spring 1982, under Glen Meeden) returned to Tehran, Iran.

Juan Enrique Ramos (Spring 1982, under Chien-Pai Han) is working for the Centro de Investigación en Elimentación y Desarrollo, Hermosillo, Sonora, Mexico, as statistician.

Soetarto Sastrosoewignjo (Summer 1981, under H. T. David) is an assistant professor of statistics, Syiah Kuala University, Darussalam, Banda Aceh, Indonesia.

Bradley Owen Skarpness (Summer 1981, in statistics and industrial engineering, under Vincent A. Sposito and Keith L. McRoberts) is teaching as an assistant professor in the Department of Statistics, Virginia Polytechnic Institute & State University.

M.S. Candidates

Abdul-Aziz, Yasmin
Abdurachman, Edi
Ab-Ghaffar, Mohamed
Ahmad, Adnan Bin
Ahmad, Noorani
Beam, Carl A.
Bergeron, Geoffrey
Black, Victoria
Bloor, George
Brandon, Dennis
Calcano-Collazo, Jose
Cheung, Sze Wai
Crowder, Stephen V.
Devin, Jeanne
Filos, Victor
Gazaui, Mirna J.
Hines, Merlon
Hukportie, Komlan A.
Jacobson, David
Jacobson, Shawn D.
Jeske, Daniel
Keune, Cynthia
Kim, Byung Hwee
Kim, Chiho
Kramer, Kevin
Kumlung, Arunee
Loubert, Sharon K.
Lui, Anthony
Mischke, Thomas
Morel, Grecia F.
Morel, Jorge
Oñate, Julia
Paulissen, Jerome
Pohl, David D.
Raudsep, John
Ray, Di-Ou
Rohlk, Kendra
Saadun, Shaharuddin
Schnell, Daniel J.
Schroeder, Debra
Silva, Fernando
Silvis, David K.
Stangl, Pamela
Tachia, Hon R.
Torreblanca, Sergio
Tsouko, Stavroula
Vanichbuncha, Kanlaya
Vijithakumara, Tilaka
Wickremasinghe, W. N.
Yu, Jin-Ying

Non-degree Student

Lappi, Juha

Ph.D. Candidates

Amemiya, Yasuo
Anderson, Kevin
Arnold, Robert J.
Auer, Richard
Blough, David K.
Callanan, Terrance
Cassell, David L.
Chandhok, Promod

Chang, Stephen Fu-Chung
Chapline, Janella
Christenson, Peter
Chua, Tin-Chiu
Escobar, Luis
Fahrenholtz, Steven
Farmer, Charles M.
Francisco, Carol Ann
Gan, Fah Fatt
Guerrero, Margarita
Hale, Michael D.
Ho, Chung Man Fred
(joint statistics-industrial engineering)
Hung, Hsien-Ming
Ihnen, Leigh
Jobe, John Marcus
Josvanger, Lee Ann
Keller, Sallie
Kim, Byung Chun
Kinyon, Lawrence
(joint economics-statistics)
Lee, Edward Henry
Lee, Moun-Shen Carl
Lee, Youngjo
Lewis, Jerry
Lin, Char-Lung Charles
Lin, Cherng-Tarng
(joint industrial engineering-statistics)
McGovern, Paul
(joint psychology-statistics)
McNulty, Mark
Martin, Cindy Lynn
Mazloum, Reda
Mee, Robert
Miazaki, Edina
Mowers, Ronald P.
(joint agronomy-statistics)
Niknian, Minoo
Nkansah, Paul T.
(joint statistics-industrial engineering)
Noorbaloochi, Siamak
Ostrouchov, George
Pantula, G. Sastry
Pareja, Gilda
Park, Byung Sul
Peixoto, Julio
Petenate, Ademir J.
Ponder, Wendell
Ramos, Juan Enrique
Rangachari, Lakshmi
Razmpour, Ahmad
Rogers, Michael
Saad Eldin, Saad Eldin M.
Sastrosoewignjo, Soetarto
Shih, Tai-Tao
Skarpness, Bradley
Slamet
(joint industrial engineering-statistics)
Tveite, Michael
van Schaik, Jan
Wilson, Jeffrey R.
Yeo, Woon Bang
Zamudio, Francisco J.

Lakshmi Rangachari received an International Award from the Iowa State University Faculty Women's Club. Youngjo Lee and Edina Miazaki were initiated into Phi Kappa Phi.

Snedecor and Bancroft Awards

Yasuo Amemiya, Yokohama, Japan, was chosen as 1982 recipient of the George W. Snedecor Statistics Award, given each year 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. It was established in 1954 to honor George Snedecor, internationally recognized pioneer in applied statistics, who was founder and first director of the Statistical Laboratory.

As a graduate research assistant, Amemiya has worked in the Survey Section since September 1978, mainly on contractual research on measurement error models for the U.S. Bureau of the Census. He has also taught an introductory statistics course. As noted on p. 1, he will be remaining at Iowa State.

Luz Maria DeAlba-Guerra, a mathematics graduate major from Mexico City, Mexico, was named as winner of the 1982 T. A. Bancroft Statistics Award. She was selected on the basis of outstanding performance as a doctoral candidate minoring in statistics. The award consists of a cash prize and a subscription to a statistically-oriented journal of the awardee's choice. It honors T. A. Bancroft, professor emeritus and former director and head of the Statistical Laboratory and Department of Statistics.

DeAlba-Guerra received two B.S. degrees from the Universidad Nacional Autonoma de Mexico and a master's degree in mathematics at Iowa State. She had held a teaching assistantship in the Mathematics Department since September 1979.

Both awards were presented on February 3 at the regular Statistical Laboratory seminar.

Mu Sigma Rho

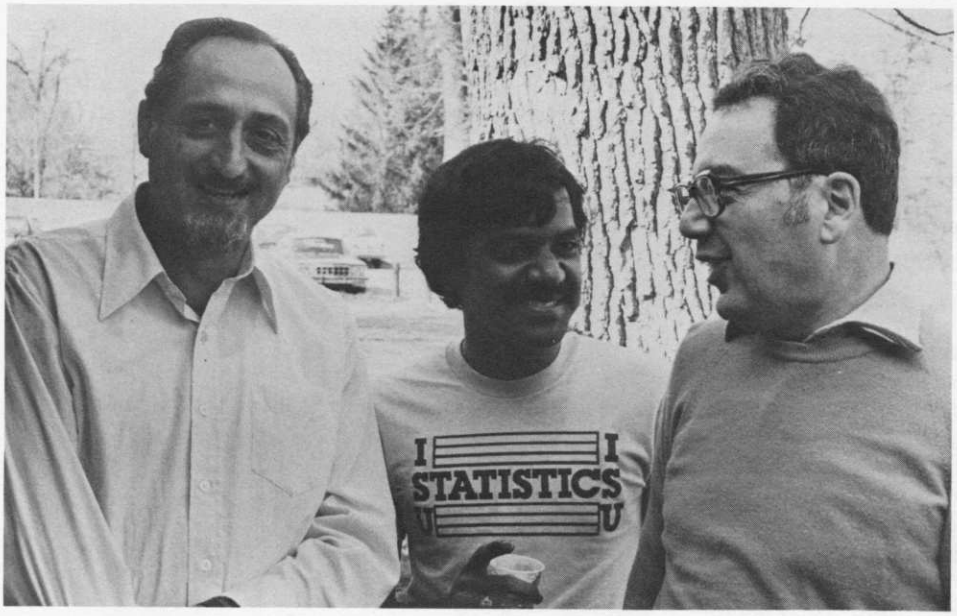
Stephen E. Fienberg.

A lecture entitled "A statistician goes to court" was presented by Stephen E. Fienberg, professor of statistics and social science, Carnegie-Mellon University, at the annual banquet and spring initiation of the local chapter of Mu Sigma Rho.

Four undergraduates, seven graduate students, and seven faculty members were initiated as new members. Carolyn Connor and Sallie Keller were joint recipients of the Mu Sigma Rho Award for academic excellence and service to the organization and the department.

Mu Sigma Rho, in conjunction with the Iowa STAT-ers, departments of Statistics, Political Science, and Sociology, the Graduate College and the University Committee on Lectures, sponsored Fienberg's visit. During his stay Fienberg presented three additional lectures, one to each of the co-sponsoring departments.

Officers for the 1982-83 academic year are: Rachel Harter, president; Terrance Callanan, vice president; David Cassell, secretary-treasurer. Roy Hickman continues as faculty adviser.



H. T. David, Sastry Pantula, and H. A. David (l. to r.) at the spring breakfast. Sastry wears one of the new T-shirts designed and sold by the Iowa STAT-ers.

Iowa STAT-ers

The purposes of the Iowa STAT-ers graduate student club are to encourage professional growth in statistics, to promote statistics on campus, and to provide opportunities for fellowship among graduate students.

Club projects and activities include the student seminar series, information packets for new students, a notebook of recent master's degree topics to help students choose a major professor, and the traditional pizza parties. This year the club helped sponsor the lecture series given by Dr. Stephen E. Fienberg of Carnegie-Mellon University. Also, the STAT-ers sold statistics T-shirts and showed a series of free summer films for students and their families.

The officers and committee members of the Iowa STAT-ers were: Steve Fahrenholtz, president; Julio Peixoto, vice president; Mike Rogers, secretary; David Cassell, treasurer; Yasuo Amemiya, faculty meeting representative; Tin-Chiu Chua and Mohammed Saad Eldin, faculty committee representatives; George Ostrouchov, seminar committee; David Blough, speaker committee; Bob Arnold, Cindy Martin, and Sastry Pantula, social committee; Jan van Schaik and David Cassell, graduate student senators. Kenneth J. Koehler served as adviser to the Iowa STAT-ers.

Undergraduates

Statistics majors were the recipients of a number of honors and awards during this year. Carolyn P. Connor and Linda J. Nollen were initiated into Phi Kappa Phi Honor Society during ceremonies on March 23, 1982, in the Memorial Union. Carl E. Fritz and Beth A. Huegli became members of the statistics honorary, Mu Sigma Rho, at the annual banquet on the same date. Beth Huegli also received a Laura Vernon Scholarship award during ceremonies at Veishea on May 8. During Veishea Carolyn Connor was tapped for membership in Cardinal Key, the activities honorary, which selects members on the basis of leadership, service to Iowa State University, scholarship, and character.

At the Scholarship Recognition Dinners held May 2 and 3 three statistics majors were honored. At this annual event the upper two percent of students by class in each of the colleges and the high scholarship graduating senior in each individual major are recognized. Kwok-Lai Bonnie Ng, a statistics freshman, and Beth Huegli, a statistics junior, were in the top two percent of their classes in Sciences and Humanities. Carolyn Connor was honored as the highest scholarship graduating senior in statistics.

Richard A. Groeneveld, Donald K. Hotchkiss, Frederick Lorenz, William Q. Meeker, W. Robert Stephenson, and Shashikala B. Sukhatme served as undergraduate advisers during the year. The following 19 students received the B.S. degree in the period July 1, 1981, to June 30, 1982.

J. Robert Bartos (joint with computer science)
Amy Chen (honors program)
Carolyn Patricia Connor, with distinction
Clifton Dennis Exley
Robert James Heinzen
Charles Russell Helt (joint with industrial administration)
Komlan A. Hukportie
Scott Eric Iverson
Yi-Nan Jung (SS 1981)
Kevin R. Kramer (joint with economics)
Stephanie A. Leonard (biometry)
Tet Feei Liew (joint with computer science)
Linda Louise Lohmann
Linda Joy Nollen, with distinction
Ruth Tambrey Paeth
Randall Jay Parmer (joint with economics), with distinction
Douglas Lee Tschopp

William Oliver Valent (SS 1981)
Judi Marie Vogelgesang (joint with computer science)

Carolyn Connor, Komlan A. Hukportie, and Kevin Kramer are continuing at Iowa State as graduate students in statistics. Amy Chen plans graduate study in biostatistics at the University of Washington, Seattle, in the fall, after spending the summer working at Mayo Clinic, Rochester, Minnesota, as data analyst in the Medical Research Statistics Division. Robert (Rocky) Bartos joined the Shell Oil Company Information Center in Houston, Texas, as a data processing analyst. Yi-Nan Jung took some advanced work in statistics at Iowa State, then moved to Wellesley, Massachusetts, with her husband, Tim Wah Luk. Linda Nollen Wooster will work as an applied costing analyst with the Union Pacific Railroad in Omaha, Nebraska. Ruth Paeth is working in data processing with the Iowa Commerce Commission in Des Moines, and William Valent, in sales for Xerox Corporation, West Des Moines, Iowa. Judi Vogelgesang will accept a position in computing.

Three juniors in statistics are employed this summer. Carl Fritz and Beth Huegli are data analysts with the Iowa Commerce Commission, Des Moines, Iowa. Carol Griffith is a market research analyst with Ruddick Market Research, Tulsa, Oklahoma.

Statistics Club

The activities of the Statistics Club are aimed at promoting interest among undergraduates in the field of statistics. During the year the club arranges for talks by statisticians, a field trip to the site of an important user of statistics, and social events promoting interaction among students and faculty.

The annual Statistics Club "get acquainted" picnic at Brookside Park started off this year's activities. The picnic provided a good opportunity for statistics and biometry majors to get reacquainted and to meet with undergraduate instructors and advisers.

Daniel Pearl, the quality and process control manager of Corning Glass Works in New York, spoke to the club concerning industrial uses of statistics. Besides presenting examples of where and how statistics are used at Corning Glass, he indicated what sorts of training and courses employers look for when interviewing for statistics-related jobs.

Students who held statistics-related summer jobs talked about their experiences at the November meeting of the club. Kevin Kramer described his job at Upjohn in Kalamazoo, Michigan. Linda Nollen discussed her work as a statistical research assistant at the Iowa Commerce Commission in Des Moines. Rocky Bartos participated in the co-operative education program with the Bureau of the Census in Washington, D.C. for a second period. Amy Chen told the club about her experiences as a data analyst in the Medical Research Statistics Division of the Mayo Clinic in Rochester, Minnesota, where she worked on a special cancer project.

During the spring semester, those undergraduates interested in graduate school had the opportunity to meet with Professor Stephen Fienberg of Carnegie-Mellon University at an informal luncheon. Fienberg spoke about the statistics program at Carnegie-Mellon and about general background requirements of most graduate programs in statistics.

A highlight of this year's activities was the spring field trip to Minneapolis. The club visited both the Federal Reserve Bank and the Pillsbury Company. Besides a tour of Pillsbury's Research and Development Department several members of the staff presented talks on various uses of statistics. Topics included mathematical modeling, factorial and fractional-factorial designs, and response surface methodology.

For the first time the Statistics Club compiled a booklet containing resumés of graduating seniors. Also several members purchased Statistics Club T-shirts.

Carl Fritz was named the recipient of the 1982-83 Statistics Club scholarship. The following were elected officers for 1982-83:

president: Carl Fritz
vice president: Lynette Halley
treasurer: Beth Huegli
secretary: Carol Griffith.

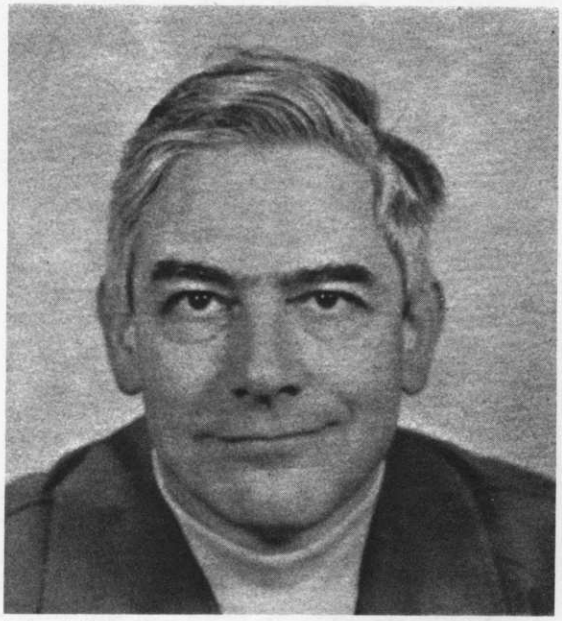
W. Robert Stephenson serves as faculty adviser to the Statistics Club.

B. V. Sukhatme Memorial Lecture

This annual lecture series in survey sampling honors the late Bal Sukhatme, professor of statistics, ISU 1967-1979. Postponed from spring 1981, the second B. V. Sukhatme Lecture was given by Debabrata (Dev) Basu, professor of statistics, Florida State University. Basu was a visiting professor at Iowa State in the summer of 1976. Well known for his fundamental research in statistical inference and survey sampling, he spoke on "Bayesian analysis of categorical survey data." The third Lecture was presented in spring 1982 by Philip J. McCarthy, professor of economic and social statistics in the New York State School of Industrial and Labor Relations, Cornell University. Long a leading figure in survey sampling, McCarthy discussed "Estimated variance for the combined ratio estimate: stratified two-stage samples without replacement."

George Zyskind Memorial Lecture

Peter J. Huber, professor and chairman of the Department of Statistics, Harvard University, presented the seventh George Zyskind Memorial Lecture. His topic was "Minimax aspects of bounded influence regression." Huber is well known for his fundamental research on robust statistics. The lecture series honors the late George Zyskind, statistics professor at ISU from 1959 to 1974.



Peter J. Huber.

Seminars

The program of regular weekly noncredit seminars offered by the Statistical Laboratory and Department of Statistics was planned by a committee comprised of Mervyn Marasinghe, Mack C. Shelley II, and student representative George Ostrouchov. Topics and speakers for this year follow:

Statistical Laboratory Seminars

Summer 1981

July 8 — A review of criteria for making selection decision, Charles R. Henderson, Cornell University

15 — Estimation, prediction, and test of hypotheses in unbalanced mixed models, Charles R. Henderson

August 5 — Computer generation of pseudorandom numbers for the normal, multinomial, and hypergeometric distributions, Fred C. M. Ho

Fall 1981

August 31 — Some case histories of stochastic modeling, C. C. Heyde, Commonwealth Scientific and Industrial Research Organization, Canberra, Australia

September 2 — The Stat Lab today, H. A. David

8 — Statistical information, sufficiency, and adequacy, D. Basu, Florida State University

10 — Statistical information, sufficiency, and adequacy II, D. Basu

16 — Genetic diversity in subdivided populations, Jerry W. Lewis

23 — Some application of statistics in dynamic meteorology, Tsing-Chang (Mike) Chen, ISU Department of Earth Sciences (Meteorology)

30 — Bayesian sample survey theory and randomization, Arnold Faden, ISU Department of Economics

October 7 — Digital computer support available to statisticians: a status report, William J. Kennedy, Jr.

14 — What data processes should working statisticians and scientists use? Oscar Kempthorne

21 — Projection pursuit, Peter J. Huber, Harvard University

28 — Estimation of nonstationary autoregressive time series, Wayne A. Fuller

November 4 — Extensions and uses of sure bounds in sampling from finite populations, Richard A. Groeneveld

9 — Estimating the gain of a linear filter from noisy data, Melvin J. Hinich, Virginia Polytechnic Institute and State University

11 — Design and evaluation of a survey of the nation's agricultural resources, J. Jeffery Goebel

18 — Food and entropy, P. V. Sukhatme, Maharashtra Association for the Cultivation of Science, Poona, India

December 2 — Data analysis: description of strong orderings by ordered polychotomies, Lakshmi Rangachari

9 — Finite admissibility and finite population sampling, Malay Ghosh

16 — A study of the effects of measurement error in survey sampling, Promod Kumar Chandhok

Spring 1982

January 13 — Estimating the probabilities of misclassification in discriminant analysis, Juan Enrique Ramos

20 — Measures of location and asymmetry in the plane, David K. Blough

27 — Life tests with units from a "limited-failure population," William Q. Meeker, Jr.

February 3 — Estimating the common location parameter of two exponential distributions, Ahmad Razmpour

5 — An asymptotic multi-decision view of goodness-of-fit, Minoo Niknian

10 — Characterization of the Pareto distribution, Wing-Yue Wong, University of Malaya

17 — Characterization of priors through the Bayes estimator, Siamak Noorbaloochi

22 — Analysis of multivariate linear errors-in-variables model, Yasuo Amemiya

24 — Some multivariate testing problems with additional observations, Sanat K. Sarkar, University of Pittsburgh

March 5 — SAS analyses of split plots with missing data, Dallas E. Johnson, Kansas State University

10 — Some results for the countable general linear model, Dennis Gilliland, Michigan State University

24 — Assessing probability assessors: calibration, refinement, and sufficiency, Stephen E. Fienberg, Carnegie-Mellon University

31 — On a general approach to BIB designs, Yong-Quan Yin, China University of Science and Technology, Peking

April 7 — Network p-median problems: theory and applications, Paul T. Nkansah

21 — Some remarks on best linear unbiased predictions, Alan P. Fenech, University of California at Davis

28 — Probabilistic models for social networks, Robert A. Johnson

May 7 — A storage process and Gnedenko's limit laws for the maximum, Daryl J. Daley, Australian National University, Canberra

Summer 1982

June 2 Estimation of random effects in the balanced one-way ANOVA model, Julio L. Peixoto
7 Statistics in literature, Joseph M. Gani, University of Kentucky
23 Selection through an associated characteristic, Woon Bang Yeo

Special Lectures and Seminars

September 9 2nd annual B. V. Sukhatme Memorial Lecture: Bayesian analysis of categorical survey data, D. Basu, Florida State University
October 20 7th George Zyskind Memorial Lecture: Minimax aspects of bounded influence regression, Peter J. Huber, Harvard University
March 23 Mu Sigma Rho Lecture: A statistician goes to court, Stephen E. Fienberg, Carnegie-Mellon University
26 Quantitative Genetics Seminar: Statistical analysis of genotype-disease association, Klaus Hinkelmann, Virginia Polytechnic Institute and State University
April 16 3rd annual B. V. Sukhatme Memorial Lecture: Estimated variance for the combined ratio estimate: stratified, two-stage samples without replacement, Philip J. McCarthy, Cornell University

Graduate Student Seminar Series

October 9 How to play the slots, Steven Fahrenholtz
October 30 Measures of location in the plane, David K. Blough
April 23 A statistical sampling technique for estimating highway traffic volumes, Paul Nkansah

In Memoriam

Robert J. Cochran, 1941-1981

We were sorry to learn of the death of Robert Jones Cochran in October 1981. He was senior vice president in charge of Trust Department Campaigning, National Bank of Champaign, Champaign, Illinois. Bob had received a B.S. degree in statistics at Iowa State in 1963 and a law degree at the University of Missouri at Columbia in 1969, before pursuing a career in banking finance and accounting. Our sympathies go to his wife and children.

International Conference to Mark the 50th Anniversary of the Statistical Laboratory

Plans for the above conference, to be held in Ames, June 13-15, 1983, are progressing well. The theme of the conference will be an assessment of developments, over the past 50 years, in major areas of both applied and theoretical statistics. Such an appraisal will be coupled with an effort to gauge future trends and needs. The tentative program of invited speakers is as follows:

Historical Setting	C. Eisenhart, H. A. David, T. A. Bancroft
George W. Snedecor Lecture	D. R. Cox
Experimental Design	W. T. Federer, D. Raghavarao, P.W.M. John
Data Analysis	A.S.C. Ehrenberg, J. W. Tukey, M. B. Wilk
Applications I	E. C. Pielou, R. R. Sokal
Applications II	G. Wahba, A. G. Journel, C. R. Henderson
Linear Models and Categorical Data Analysis	C. R. Rao, R. L. Anderson, S. E. Fienberg
Statistical Inference	E. L. Lehmann, D. V. Hinkley, D. V. Lindley
Time Series and Stochastic Processes	G.E.P. Box, M. Rosenblatt
Survey Sampling	M. H. Hansen, J.N.K. Rao, W. A. Fuller
Statistical Computing	G. H. Golub, J. H. Goodnight, R. A. Thisted
Conference Banquet	O. Kempthorne

It is planned to publish a proceedings volume. Further information will be issued in fall 1982.

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