Statistical Laboratory

established 1933

Annual Report
July 1, 1991 to June 30, 1992

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IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Contents

THE STATISTICAL LABORATORY
Iowa State University
1991-92 Annual Report

Personnel

Noel A. C. Cressie remained on faculty improvement leave through December 1991 to conduct research on spatial statistics. He spent the fall semester in the Department of Statistics at Stanford University.

Carl Roberts, on faculty improvement leave from August 28, 1991, to August 1, 1992, spent the academic year as a visiting professor in the Anthropology Department at the University of Leiden in the Netherlands.

Mark S. Kaiser, Peter Sherman, and F. Jay Breidt joined the statistical center as assistant professors August 21, 1991.

Mark Kaiser holds a joint appointment in the Department of Statistics (College of Liberal Arts and Sciences) and the statistics department of the Iowa Agriculture and Home Economics Experiment Station. He received a Ph.D. degree in statistics at the University of Missouri-Columbia in 1990 and has worked for the U.S. Fish and Wildlife Service as a mathematical statistician at the National Fisheries Contaminant Research Center in Columbia since 1984. He taught at the University of Missouri-Columbia as visiting assistant professor in the Department of Statistics in 1990-91. He has also served as a statistical consultant to the Missouri Department of Conservation and the USDA Statistical Reporting Service. He has major professional interests in mathematical statistics, biometrics, community ecology, and limnology. His research interests center on "the development of statistical methods, particularly as those methods may be applied in the areas of ecology, biology, and fisheries and wildlife."

F. Jay Breidt has research interests in time series and general methods. His position as assistant professor in the Department of Statistics will also involve some work with the Survey Section of the Statistical Laboratory. Therefore he will add survey sampling as another area of research interest. He received a Ph.D. degree in statistics at Colorado State University in 1991.

Peter J. Sherman received a Ph.D. degree in mechanical engineering at the University of Wisconsin-Madison in 1984 and was an assistant professor of mechanical engineering at Purdue University from then on. At ISU he has a joint appointment in the Department of Statistics and the Department of Aerospace Engineering and Engineering Mechanics. His research interests focus on estimation theory, random processes, and dynamical systems.

J. Peter Jones was a visiting professor in statistics for the 1991-92 academic year while on sabbatical leave from the Department of Chemical Engineering, University of Sherbrooke, Quebec, Canada. Jones first joined the University of Sherbrooke in 1972 and received his doctorate in chemical engineering at Massachusetts Institute of Technology in 1974. In 1989 he completed four years as vice dean for research and graduate studies, Faculty of Applied Sciences. His particular interests at ISU centered on learning new ways in which statistical thinking can be applied in engineering. A skiing accident prevented him from spending as much time here as planned in the spring.

Sarah Nusser returned to the campus as assistant professor in the Statistical Laboratory, Department of Statistics, and statistics department of the Iowa Agriculture and Home Economics Experiment Station, effective May 4, 1992. She is assuming administrative responsibilities as professor-in-charge of the Survey Section. Nusser received her M.S. and Ph.D. degrees in statistics here in 1987 and 1990. She has been working for the Procter & Gamble Company, Cincinnati, Ohio, for 19 months as statistician.

Franz Hering was a visiting professor in January and February 1992, on leave from his position as head of the Department of Statistics, Universität Dortmund, in Germany. He had previously visited here in 1987 to help establish the current exchange program between the ISU and Dortmund statistics departments.

Paul Kvam, who had been at the University of California, Davis, completed a two-month summer 1991 assignment as postdoctoral research associate on H. A. David's Army Research Office contractual project. He then joined Sandia Corporation, Albuquerque, New Mexico.

Caryn Thompson was a visiting scholar for the month of February 1992 in the area of spatial statistics. She is completing a doctorate in statistics at Oregon State University and came here to discuss research topics with Noel Cressie.

Yael Pozin was a visiting scholar for three weeks in April and May, to interact with our experiment station agricultural statistics consulting group and with the Survey Section. She is a statistician with the Ministry of Agriculture, Extension Service, Tel-Aviv, Israel.

Nhora Martinez R., assistant professor, Facultad de Medicina Veterinaria y de Zootecnia, Universidad Nacional de Colombia, was a visiting scholar in May and June. She consulted with Alicia Carriquiry and Mark Kaiser on mixed linear models and hierarchical models and investigated the possibility of applying a model in Colombia for genetic evaluation of dairy cattle.

Kathy Shelley, specialist in the Statistical Computing Section of the Statistical Laboratory, and Mack C. Shelley II, professor of statistics and political science, won second place in the 1991 Zenith Masters of Innovation competition, Liberal Arts and Sciences category. The award was given for developing a software system, combining data entry graphics and sta-

tistical modeling, for projecting presidential delegate counts for primaries and caucuses. The award consists of $4,000 to the winners and a matching amount for their departments, both to be applied to purchase of Zenith equipment at an educational rate.

Oscar Kempthorne received further honors when he went to Harrisburg, Pennsylvania, to give a lecture in the Distinguished Statisticians Lecture Series at Pennsylvania State University. The mayor of Harrisburg issued a proclamation declaring that October 8, 1991, was Dr. Oscar Kempthorne Day. The lieutenant governor of the Commonwealth of Pennsylvania sent official greetings through a proclamation in which he joined in welcoming Kempthorne as a noted statistician and statistical geneticist. His proclamation read in part "Educators like Professor Kempthorne play a vital role in fashioning the leaders of tomorrow. They touch the lives of thousands of our young people and are instrumental in providing them with the necessary skills to become a viable part of our workforce. Throughout his personal life and professional career, Professor Kempthorne has consistently maintained the highest standards along with an exemplary commitment to education."

William Q. Meeker, Jr., received a 1991-92 Teaching Excellence Award at Iowa State in December. The faculty award includes a $1,000 stipend, funded by a special appropriation from the State Legislature to recognize outstanding teaching.

In the spring, W. Robert Stephenson received an ISU Foundation Award for Mid-Career Achievement in Teaching. This $1,000 award is given to tenured faculty at Iowa State University to recognize outstanding performance in teaching.

In 1991 Jerome Sacks, for the third consecutive year, received a USDA-ARS Certificate of Merit and a cash award for superior performance.

At the Alumni Association-ISU annual Honors and Awards Convocation, June 6, 1992, Roy Hickman, professor of statistics and professor-in-charge of the Survey Section of the Statistical Laboratory, received a Faculty Citation in recognition of long, outstanding, and inspiring service.

Looking toward next year: the untimely death of Vincent A. Sposito in February 1992 (see p. 48) and the retirement of C. P. Cox in May 1990 leave the department shorthanded. A search will be conducted to fill these two positions.

John Stufken has been promoted to associate professor, with tenure, effective August 21, 1992. Mervyn Marasinghe began a faculty improvement leave in June and will be working at the School of Statistics, University of Minnesota, through December, to collaborate and conduct research on data analysis and graphical methods.

Statistical Laboratory Staff—Fiscal Year 1991-92 under the administrative direction of:

Martin C. Jischke, Ph.D.—president

Patricia B. Swan, Ph.D.—vice provost for research and advanced studies; dean of the Graduate College; interim provost

John Dobson, Ph.D.—interim vice provost for research and advanced studies; interim dean of the Graduate College

David C. Glenn-Lewin, Ph.D.—interim dean, College of Liberal Arts and Sciences; interim director, Liberal Arts and Sciences Research Institute

David G. Topel, Ph.D.—dean, College of Agriculture; director, Iowa Agriculture and Home Economics Experiment Station

Dean L. Isaacson, 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

Theodore B. Bailey

C. Philip Cox, professor emeritus

David F. Cox

Noel A. C. Cressie

Herbert A. David, Distinguished Professor in Liberal Arts and Sciences

Herbert T. David, joint appointment with Department of Industrial and Manufacturing Systems Engineering

Wayne A. Fuller, Distinguished Professor in Liberal Arts and Sciences; faculty status also in Department of Economics

Richard A. Groeneveld

David A. Harville

Franz Hering, visiting professor

Roy D. Hickman, professor emeritus

Paul N. Hinz, faculty status also in Department of Forestry

Donald K. Hotchkiss, professor emeritus

David V. Huntsberger, professor emeritus

Dean L. Isaacson

J. Peter Jones, visiting professor

Oscar Kempthorne, emeritus Distinguished Professor in Liberal Arts and Sciences

William J. Kennedy

Kenneth J. Koehler

William Q. Meeker, Jr.

Edward Pollak, joint appointment with Department of Genetics

Jerome M. Sacks, USDA collaborator

Mack C. Shelley II, joint appointment with Department of Political Science

Vincent A. Sposito, joint appointment with Computation Center

Robert F. Strahan, joint appointment with Department of Psychology

Norman V. Strand, professor emeritus
Stephen B. Vardeman, joint appointment with Department of Industrial and Manufacturing Systems Engineering
H. Samuel Wieand, Mayo Clinic collaborator
Leroy Wolins, professor emeritus

Associate Professors

Yasuo Amemiya
Frederick O. Lorenz, joint appointment with Department of Sociology
Mervyn G. Marasinghe
Carl W. Roberts, joint appointment with Department of Sociology
W. Robert Stephenson
Shashikala Sukhatme

Assistant Professors

Harold D. Baker
F. Jay Breidt
Alicia Carriquiry, joint appointment with Center for Agricultural and Rural Development
Mark Kaiser
Sarah Nusser
Derrick Rollins, joint appointment with Department of Chemical Engineering
Peter Sherman, joint appointment with Department of Aerospace Engineering and Engineering Mechanics
John Stufken

Temporary Assistant Professor

Soumendra N. Lahiri

Temporary Instructor

Daniel Mundfrom (summer 1991)

Resident Collaborator

Dean Thompson, USDA Soil Conservation Service

Visiting Research Scholar

Nhora Martinez R.
Yael Pozin
Caryn Thompson

Postdoctoral Research Associate

Paul Kvam
Frederick M. Medak

Graduate Assistants

The status of graduate students often changes. Students holding appointments as graduate teaching or research assistants in statistics for part or all of the year are listed here. Cooperative internships are listed on p. 43.

Baiching Anthony An
Jeffrey Andersen
Lori Becker
Todd Borchert
Marek Brabec
Sherry L. Bushaw
Abderrahmane Chakak
    (Fulbright scholar)

Marie Coffin
Alice Cramer
Joseph H. R. Croos
Rohit S. Deo
Kevin W. Dodd
Christoph Edel
    (DAAD scholar)
Jun-ichiro Fukuchi
Heidi Geheb
Mary L. Gessner
David W. Hall
    (Eli Lilly scholar)
Peter Hanson
    (Shell scholar)
William H. Harter, Jr.
Jeffrey Helterbrand
Molly Isbell
    (Shell scholar)
Philip W. Iversen
Stephanie B. Johnson
Rachel Kintzinger
    (Corning scholar)
Thomas Kirchoff
Scott Klabacha
Chinh Kreisberg
Mark Kreisberg
Reiner Kurzhals
    (DAAD scholar)
Jae Hyung Lee
Kye-Don Lee
Ding-Hwa Lei
Klaus Lemke
Charles F. Lerch
    (Corning scholar)
Yang Li
Brian Lindstrom

Chih-Yao Liu
Thomas Loughin
Todd Manke
Steven Mattics
    (Corning scholar)
Elizabeth McMichael
Anita Hinkeldey McVey
Richard C. Meyer
Peter Morse
Hamid Reza Navvab Pour
Christopher Novak
Eric Novak
Savas Papadopoulos
Daniel J. Parks
Elizabeth Paterno
Jean Pelkey
Sara Peterson
    (Corning scholar)
Daniel L. Rose
    (Dow scholar)
Todd Sanger
    (Shell fellow)
Michelle Sawyer
Laura Schillmoeller
Juergen Schroeder
    (DAAD scholar)
Donald E. Smith
    (Eli Lilly scholar)
Michael H. Smith
Margot Tollefson
Daniel Walczak
Hui Wang
Ouhong Wang
Ibrahim Yansaneh
Alan Zimmermann
    (Shell fellow)

Supported Graduate Students

Abdoulaye Adam—USAID-Niger and U.S. Department of Agriculture
Mahmood Ahmad—USAID-Pakistan
Aminul Akbar—MUCIA-USAID-Indonesia
Christine Ashman—College of Business, ISU
Gregorio Atuncar—Federal University of Minas Gerais/CAPES
Victor P. Brescia—Center for Agricultural and Rural Development, ISU
Brad J. Bushman—Department of Psychology, ISU
Bassirou Chitou—ATLAS/AFGRAD
Gerri M. Dunnigan—Center for Nondestructive Evaluation, ISU
Ann Dyer—Engineering Research Institute, ISU
Birol Emir—Government of Turkey
Gilenio Fernandes—EMBRAPA/EPABA, Brazil
Christian Garrigoux—Center for Nondestructive Evaluation, ISU
Michael Hartfield—Dortmund University
Hui-Lin Hu—College of Veterinary Medicine, ISU
Alejandro Islas-Camargo—CONACYT
Cheryl A. Johnson—ISU Enrollment Service
Ihsan Karabulut—Gazi University, Turkey
Georgene Kelly—Iowa Quality Coalition
Seoung-Gon Ko—Abbott Laboratories

Fen-Hui Lin—Department of Industrial and Manufacturing Systems Engineering, ISU

Chi-hsien Joseph Lu—Center for Nondestructive Evaluation, ISU

David G. McDonald—National Center for Atmospheric Research, Boulder, Colorado

Carlos Moreno G.—USAID/FES

Timothy C. U. Ogamba—Graduate College

Bryan Olin (IBM fellow)—Center for Nondestructive Evaluation, ISU

Gerald F. Parise—Department of Economics, ISU

Beta Putranto—MUCIA-AID-Indonesia

Abdul Wajid Rana—USAID-Pakistan

Sellem Remadi—U.S. Department of Agriculture

Shonda Roelfs—Graduate College and College of Liberal Arts and Sciences, ISU

Leroy Rushing—Graduate College, ISU

Ann C. Russey—College of Family and Consumer Sciences, ISU

Muhamad Sabran—Soil Tilth Laboratory, ISU

David Siev—U.S. Department of Agriculture

Kai-One Sriplung—Center for Agricultural and Rural Development, ISU

Hiroshi Takahashi—Department of Animal Science, ISU

Dilek Tali—Central Bank of the Republic of Turkey

Anand Vidyashankar—Department of Mathematics, ISU

Michael Wallendorf—Department of Entomology, ISU

Paul Wenz—College of Veterinary Medicine, ISU

Christopher Wikle (U.S. Department of Energy fellow, Shell scholar)—Department of Geological and Atmospheric Sciences, ISU

Steven Wilmarth—Maytag Company

Lie-Ling Wu—College of Veterinary Medicine, ISU

Ilker Yalçin—Hacettepe University, Turkey

Jincheol Yoo—Korean Army

Seongmo Yoo—Ames Laboratory

Yunn-Hwu Yu—ISU Agricultural Extension

Self-Supporting Graduate Students

Peter Anderson	Jae-Hyung Lee
Yudiantri Asdi	Man-Keung Lee
Mark F. Bryan	Shu-Hua Lee
Chun-Fu Chen	Young Jae Li
Kehang Chen	Kuo-Chin Lin
Hyen-Hyee Cho	Yi-Te Lin
Jihwan Cho	Hetao Liu
Li-Fang Chuang	Dennis Livengood
B. Keith Cranford	Abdolhassan Lotfizadeh
Michael Cummings	Chueck-Wah Stella Luk
Qiong Dong	Dze-Hwei Lyan
Ashraf Farouk El-Houbi	Chuan-Chuan Ma
Marjorie A. Green	Sang-Heon Oh
Shawkat Hassan	Margarita Paterno
Khalifa M. A. Hassanain	Jianying Ding Peng
Hui-Yi Huang	John T. Reese
Mu-Yeh Huang	Chungyeol Shin
Je Yeong Jeong	Kui-Jang Wang
Hyum-Hee Joo	Sun-An Wang
Yu-Ling Kao	Yan Xiao-zhe
Dae-Lyong Kim	Namkyu Yu
Sahmyeong Kim	

Professional and Scientific Staff

Dianne G. Anderson, research associate, Survey Section

Richard Dorsch, programming consultant, Survey Section

Mary Genalo, survey projects coordinator, Survey Section

Masoud Kazemi, research associate, Survey Section

Edith Landin, administrative assistant

Marie Loughin, research associate, Survey Section

Bud Meador, supervisor, Statistical Data Processing Services

Deborah Reed-Margetan, programmer-analyst, Survey Section

Janet L. Schultz, programmer, Survey Section

Kathleen Shelley, supervisor, Statistical Numerical Analysis Services

Melissa J. Swanson, programmer, Survey Section

Harvey Terpstra, data systems manager, Survey Section

Douglas L. Tschopp, programmer, Survey Section

Jauvanta Walker, information specialist

General Office Staff

Rose Ann Anderson, secretary

Norma Elwick, secretary

Janice Franklin, account specialist

Brenda Hewitt, clerk typist

Jeanette La Grange, clerk typist

Denise Riker, secretary

Sharon Shepard, clerk typist

Darlene Wicks, clerk typist, Statistical Computing Section

Survey Section Staff

Glenda Ashley, key entry operator

Kathryn Bottorff, field interviewer

Jean Carey, field interviewer

Carolyn A. Cockayne, clerk, beginning November 11, 1991

Kathryn Goodwin, field interviewer

Vimlesh Gupta, key entry operator

Nancy Heathman, account clerk

Marlys Huff, field interviewer

Marcia Luze, field interviewer

Helen Nelson, secretary

Kathie Reinertson, data technician

Jasmine Seagrave, data technician

Judy Shafer, clerk typist

Susan E. Verkade, data technician

Karon White, key entry operator

Consulting and Cooperative Research

Statistical consulting and research services are provided to other parts of the university and to local, state, and federal agencies as time and funds permit. Some of this work is supported by contracts and grants.

## ▨ Agriculture and Home Economics Experiment Station

The Iowa Agriculture and Home Economics Experiment Station supports collaborative research and statistical consulting services for many staff members and graduate students in the biological, agricultural, and health sciences. The core statistical staff in these areas consists of T. B. Bailey, D. F. Cox, Paul Hinz, Mark Kaiser, and Kenneth J. Koehler, who were assisted this year by graduate students Tom Loughin, Anita McVey, Marek Brabec, Paul Wenz, Lie-ling Wu, and Molly Isbell.

Ted Bailey collaborated with ISU researchers studying the effects of field drainage problems on crop yields and trafficable conditions for planting and harvesting corn. A factorial treatment design was used to estimate the magnitudes of the effects of two flooding treatments (at the soil surface and 15 cm below soil surface) and four stress levels (duration of flooding); the treatments were incorporated into a randomized complete block design. Results of the study indicate that practical subirrigation methods could result in improved yields for poorly drained soils.

On another project, Bailey assisted plant breeders in the analysis, interpretation, and presentation of the results of research on breeding for improved seed production in Tall Fescue germplasm. The large experiment contained more than 25 entries, including synthetics, polycross progenies of third-cycle selection, and several cultivars.

Ken Koehler developed a model for the effect of temperature on hatch times and viability of bean leaf beetle eggs. He continued to work on the study of changes in the immune system of cows during pregnancy and immediately after calving. This research may eventually provide information for breeding cows to reduce high infection rates that occur near calving time. Koehler also provided assistance to several animal ecologists on studies of reproduction and growth rates, habitat selection, and survival.

Mark Kaiser began a collaborative effort with two limnologists at Iowa State and the University of Missouri to investigate the effect of different sampling
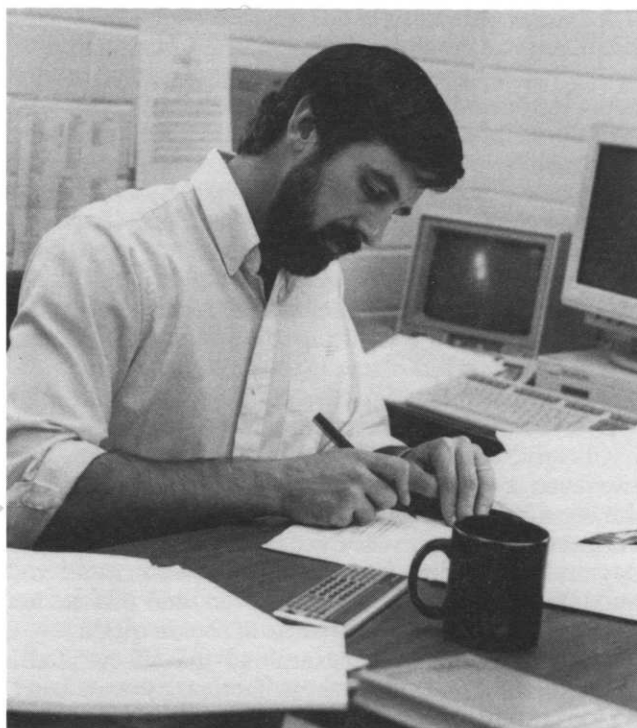
Mark Kaiser, a new member of the experiment station's statistical consulting group, is also involved in collaborative research in limnology.

regimens on the statistical behavior of seasonal mean values of water chemistry variables. Currently, the limnologists are involved in daily sampling of several lakes in Iowa and Missouri. Subsequent to laboratory analysis of their samples, the temporal behavior of individual measurements will be investigated. If a reasonable model can be identified, it will be used in a simulation study of the impact of different sampling strategies on the properties of seasonal mean values. This information will be used in the design of sampling plans to implement the EPA Clean Lakes program in Iowa and Missouri.

With assistance from Klaus Lemke, Kaiser began work on the analysis of data from field trials to assess the effectiveness of several bioremediation treatments for polyaromatic hydrocarbon (PAH) contaminated soils. These data are from the Iowa Department of Natural Resources, and the analysis is being conducted in conjunction with a member of that agency. The problem involves modeling observed levels of soil temperature, pH, and moisture over time, their relation to bacterial counts in the soil, and the ultimate response of interest—the level of observed PAH contamination. The particular study of concern was conducted to determine if PAH degradation in contaminated soil can be enhanced through the addition of nutrients and chemical treatments under field conditions.

Tom Loughin, Anita McVey, Beth McMichael, Paul Wenz, Heidi Gehab, and Paul Hinz traveled to the Woodruff farm near Ames to see the field plots of an experiment on the effect of pesticides on corn. The treatments were a factorial combination of five herbicides and five insecticides. The trip was hosted by

John Hinz (no relation) and Eric Franzenberg from the ISU Department of Agronomy. The hosts also stopped at the nearby Curtiss farm to show the spray equipment they use for this type of experiment.

Mark Kaiser consulted with visiting scholar Nhora Martinez R. on the application of hierarchical models in toxicology. She was able to take back to Colombia a working copy of an algorithm for maximum likelihood estimation of a beta-binomial model.

The kinds of problems faced in the course of routine statistical consulting for the experiment station are illustrated below.

An experiment was designed to determine how type of cookie sheet affects tenderness, moisture, quality, height, and color of cookies. Four pan types and two oven types were studied. The order of baking during a day was considered an important source of variation. The design involved two latin squares where day and order were controlled. The results, analyzed by Molly Isbell, illustrated pan, oven, and interaction effects on the several measures of cookie quality.

Another experiment examined the effects of the factorial combination of three factors, type of bowl, type of mixing, and presence of cream of tartar, on quality of angel cake. Two replications in a completely randomized design indicated that only the main effect of cream of tartar had any influence on any measure of quality.

Advice was given on the design of an experiment to test various combinations of fertilizer and mulching materials on the survival of common beetle pest in Iowa agriculture. The purpose was to see how to keep beetle numbers low without use of pesticides, if possible, in a project supported by the Leopold Center for Sustainable Agriculture. Problems concerning the combining of many experiments on the efficient and effective use of nitrogen in producing Iowa's corn crop were also considered. The goal is to minimize nitrogen inputs to maximize profit and reduce ground water contamination.

Advice was also given on the design and analysis of work to isolate the active fractions of a known plant growth stimulant by means of chromatography, with the ultimate goal of understanding the physiology of the stimulation achieved. Other consulting dealt with the design and interpretation of data on the effects of Ponderosa pine needle ingestion on the reproductive processes of late-gestation beef cows, and with investigations into the nature of intra-litter variability in pig weights in the presence of competition for food.

Anita McVey and Marek Brabec analyzed data from a study of the amount and type of bacteria contamination that occurs at different stages of pork processing.

Lie-ling Wu analyzed data from an experiment to evaluate alternative methods of freezing swine sperm. The sperm were placed in straws of six shapes and frozen at two temperatures. The success of freezing treatments was evaluated by determining the percent of normal sperm after thawing, and the number of sperm attached to eggs in gilts that were artificially inseminated with the sperm.

▨ Statistical Computing Section

The Statistical Computing Section provides statistical computer programming and data processing support for research projects conducted both on and off campus. Its members develop software for special applications, design and install databases for general use, maintain general-purpose software systems, and consult on problems related to scientific applications of digital computers. Teaching and research activities for the section in 1991-92 were led by William J. Kennedy, Mervyn Marasinghe, and Vincent A. Sposito, until his untimely death.

Implementation of Project Vincent™ continued. Named for John Vincent Atanasoff, this is a five-year project establishing a campus-wide network of hardware services and system software based on the design of Project Athena at the Massachusetts Institute of Technology. The ISU network features a 100 megabits-per-second fiber distributed data interface as the backbone, with individual nodes located at campus buildings providing 10 megabits-per-second ethernet services.

Mervyn Marasinghe installed on Project Vincent™ the *Current Index to Statistics* Cumulative Data Base 1978-1990 (1991 version), which the department has purchased from the Institute of Mathematical Statistics. Software programs for searching the database for records containing user-selected key words were also made available to users in the department. Dan Walczak, guided by Marasinghe, installed XGOBI, a graphics package for X-windows, on the Project Vincent™ workstation system.

The Statistical Computing Section's 1991 Project Vincent™ request for additional equipment was granted by the university administration. Five new DEC 3100 workstations are now available, in addition to the DEC 5000 and two DEC 2100s which were previously acquired. The new equipment gives each section member ready access to network facilities. This access is rapidly changing the ways in which
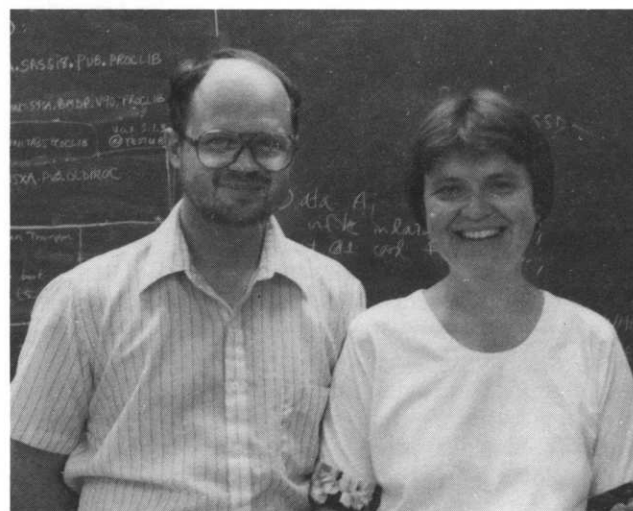
Kathy and Mack Shelley are joint recipients of a Zenith Masters of Innovation award for software they have developed to project presidential delegate counts.

services are provided by section personnel, with electronic communications replacing more and more of the traditional face-to-face consulting.

For the purposes of consulting and provision of programming support, the Statistical Computing Section is organized into two groups, supervised by Kathy Shelley and Bud Meador. The four research assistants in Shelley's group this year were Dean Lei, Dan Parks, Don Smith, and Heidi Geheb. Some of the activities, both on- and off-campus, of this group during the year are described below.

Off-campus client consulting work involved a variety of projects including quality control, cost analysis, statistical graphics, and database management. Three major projects were developed for the director of the State Forest Nursery. Don Smith developed a graphics system relating tree nutrient soil content to the percent of plantable trees. Dan Parks produced a data entry and reporting system to track state-funded fire equipment given to fire stations in Iowa. Parks and Kathy Shelley finished work on the nursery's quality control project for tree grading by species.

Satisfying a need for a user-friendly interface, Dan Parks developed a window-driven star graph procedure for Colgate-Palmolive, Inc. Shelley worked with Ken Koehler in developing a database and appropriate graphics for the Ruan Trucking Company (see p. 10).

Medical statistics played a larger role in the section's activities this year via a liaison with the Iowa Heart Institute at Mercy Hospital. Dean Lei worked intensively to convert a spreadsheet database to a relational database for balloon (PTA) arterial surgery patients. His design now serves as a prototype for other ongoing studies at the Heart Institute.

On-campus consulting work included helping clients produce and preview color Postscript files on the Unix workstations so that they could send those files to the university 35mm camera for color slides. Heidi Geheb worked on three projects for the Department of Human Development and Family Studies, dealing with Iowa foster care caseloads, the homeless, and child abuse in Iowa. These studies are ongoing and provide information to the State Legislature for human resource funding. Dan Parks worked with Mack Shelley on a project for the ISU Vice President of Enrollment Services to help produce a model for predicting student decisions on enrollment based on student financial aid and demographics. Mack Shelley also worked with this section on analyzing different teaching methods for a popular undergraduate course in the Department of Speech Communication.

University-wide service now includes support for the statistical software packages on the Unix workstations. The Statistical Computing Section is working closely with the ISU Computation Center by acting as on-line (olc) consultants for statistical software available on the network servers. Currently the commercial packages include S-Plus, SAS*, and SPSS.

The graduate students in the section supervised by Bud Meador were Sherry Bushaw, Phil Iversen, Klaus Lemke, and Dan Walczak. All students in the section did yeomen's work in assisting people trying to handle their own data analyses. No longer can this be described as walk-in traffic, since many of the data analysis and programming problems are presented as electronic mail messages.

Dan Walczak worked on an interesting and somewhat atypical project last fall. The Computation Center asked for help in analyzing end-user response times for Project Vincent workstations. The utility of Walczak's work was to help Project Vincent administrative personnel decide how to most efficiently assign public and/or restricted access files to the various components (file servers) of the network. Ideally, the placement would assure "prompt" response times to all users. Walczak worked with Henry Van Cleef, a senior programmer with the Digital Equipment Corporation, to collect response time data on three types of workstations—the DEC 2100, DEC 3100, and DEC 5000. A C-language program was used to observe a pair of variates for each communication between two workstations. A communication is analogous to placing a long distance telephone call through one or more switchboards (file servers). The first response time measured was the time between placing the call and the time of the first ring at the destination. The second variate was the time between placing the call and the time when a reply to the initial message was received. Several data sets were collected for the situation where one workstation was the caller on a round-robin basis to each of the other workstations. Walczak used the SAS*/GRAPH 6.07 software and the Project Vincent facility to present results from the response-time diagnostic study. For each caller, a separate analysis was made for each of the three types of workstations called.

Two projects were initiated with the Iowa Department of Natural Resources (IDNR). A research worker in the IDNR presented data to ". . . demonstrate integrated biological and chemical treatment strategies for effective remediation of former manufactured gas plant sites." Soil measurement data were collected under EPA standards, and polynuclear aromatic hydrocarbons (PAHs) were assayed by chromatography at the Institute of Gas Technology. A statistical analysis of the data was made by Bud Meador, Klaus Lemke, and Mark Kaiser. The concentrations of PAHs found were used to study the bioremediation of carcinogenic soil contaminants under different treatments. The preliminary analysis included the graphical display of multiple time-series, using S-Plus.

A second project with the DNR involved establishing a dBASE database for the State Forestry Services. Klaus Lemke worked on this project. By law, timber buyers who operate for various companies must be bonded with the DNR in order to conduct business in Iowa. One objective is to maintain an active list of companies who have filed for bond approval of their respective buyers. This will greatly facilitate verifying that potential buyers are bonded and can legally represent themselves and/or their companies. The system will be used to notify companies about upcoming bondage renewal dates.

Phil Iversen spent much of his time on the DNR's State Forest Nursery project; his activities included the following. Work continued on the Tree Orders Management System as new hardware arrived for the Local Area Network. The network now supports data

access, reports, and billing for multiple users. The system features an EPSON-DFX 5000 high-speed printer that can handle plain paper and label stock without reloading forms, a tape backup system for the network server, and an uninterruptable power supply. Seven workstations are connected to the network, providing access to database, word processing, graphics, and data analysis software. Printing can be directed to one of four printers, including a laser printer and the high-speed EPSON. A color graphics printer is also available. Iversen cooperated closely with programmers from the Iowa Department of Natural Resources while setting up the new equipment, and attended training sessions for the Novell operating system in Des Moines.

Iversen also worked on an ongoing project with the ISU College of Veterinary Medicine—a study of the pseudorabies virus in pigs. Data are being collected in Carroll County, Iowa, through surveys of farmers and clinical tests for the virus. Three rounds of testing are planned, with the first round completed and the second in progress. The data are transferred to Project Vincent and are being analyzed in SAS*. The goals of the project are to determine which factors are associated with the virus and to identify procedures that will reduce the rate of incidence.

Sherry Bushaw joined the section in mid-year. One of her first projects was for an off-campus client, a marriage counselor, who needed an analysis of six compatibility measures. Bushaw used SAS* to compute the contrasts of interest as requested by the client. Bushaw has also taken control of the recurring Iowa Crop Processes responsibilities, working with Dan Walczak to effect an orderly transfer of duties.

Toward the end of the year, Dan Walczak worked, as required, to help the Department of Statistics faculty and graduate students use the Project Vincent™ facilities. This function was previously handled by Heidi Geheb.

Survey Section

The Survey Section of the Statistical Laboratory provides consultation and direct operational assistance to research workers in sample design and the planning and execution of sample surveys and censuses. Section staff engage in all areas pertaining to the operational conduct of surveys. Professional staff members also conduct research and teach courses in the areas of sampling, survey design, and statistical methods. Roy Hickman, following his formal retirement as administrative director of the section in May 1991, continued to provide leadership on a temporary basis until Sarah Nusser assumed this administrative role on May 4, 1992.

This year the Survey Section has again provided survey research expertise to on-campus researchers, as well as investigators from outside the university. Section staff completed work on several multi-staged studies.

A study funded by the National Institute for Mental Health was conducted for professors in the ISU Department of Human Development and Family Studies. The research focused on the impact of the Persian Gulf crisis on families of deployed Army National Guard and Reserve members. Section staff assisted with the development of methodology and questionnaires and completed all data collection, data coding, and entry. The first stage of the study, involving telephone interviews with 251 "at-home" caretakers of the children, was completed last year, and interviews with 232 couples were conducted this past fall after deployed military personnel had returned from duty.

The fourth stage of a study of the attitudes of farm operators toward sustainable agriculture practices was completed. This final component of the study involved personal interviews with 115 farmers who had been part of a larger telephone sample interviewed two years ago. Farm operators also completed a mail questionnaire and participated in soil and weed testing on their farms. This research effort, funded by the Northwest Area Foundation, was conducted for sociologists and agronomists at Iowa State. Similar research is being conducted in North Dakota, Minnesota, and Montana. Section staff conducted the personal interviews and coded and entered the Iowa data.

A study involving both telephone and personal interviews with community members promoting the establishment of multicommunity development organizations in rural communities was conducted for a sociologist interested in how these organizations function and their effectiveness in revitalizing rural communities. Telephone interviews were conducted with board members and early proponents of organizations in eight Iowa communities. A snowball sampling scheme was used to identify community leaders. Personal interviews were then conducted with selected leaders. Section personnel assisted with the study design and questionnaire development, trained the field staff, conducted the telephone interviews, and completed data collection by personal interviews.

A project sponsored by the Institute for Agricultural Medicine and Occupational Health at the University of Iowa had as its objective the evaluation of the assessment methods of Iowa farmers' exposure to pesticides. The study also assessed proxy information in relation to self reports of exposure. A total of 250 farm operators or proxy respondents were interviewed. Section staff were responsible for all data collection and assisted with study methodology and questionnaire construction.

Two other farm-related studies were completed this year. The first involved collecting data by mail from managers of farm cooperatives. This project, sponsored by the Leopold Center for Sustainable Agriculture and the Iowa Institute for Cooperatives, was designed to evaluate future strategies for farm cooperatives in supplying agricultural services, such as integrated crop management, and to assess the cooperatives' views of sustainable agricultural farming methods. Staff in the Survey Section assisted with questionnaire design and administration of the study, including coding and entering the data. The second project was part of a federal initiative that seeks to reduce injury and disease among agricultural workers. Section staff collaborated with research scientists from the Social and Behavioral Research Center for

Rural Health at ISU. Section involvement included sample design and selection, questionnaire construction, screening of rural households to identify farm operators, and completion of 521 telephone interviews concerning farm safety practices.

Section staff were involved in three follow-up studies during the year. In a 1988 national study, persons who had income-generating businesses located in their homes or who were employed at home were located and interviewed by telephone. The focus of the research was to assess the effect of these activities on the family and the management of the household. This year, a telephone interview was conducted by section staff with 82 percent of the original sample. The focus of the follow-up study is to identify changes that may have occurred in the status of the business or employment since 1988.

The third wave of a project concerning household money management was carried out in Marshalltown, Iowa. Respondents had originally been identified in 1982 by area sampling and were reinterviewed in 1987. Sixty percent of the original sample were interviewed during this third wave; section staff assisted with questionnaire revision and pretesting and conducted interviews with all respondents.

A sample of Iowa couples of varying ages was initially interviewed in 1979 regarding dietary habits, family relationships, and equity in household responsibilities. This year, 162 of the original couples were located and screened for eligibility, and personal interviews are now being conducted with 125 of these couples. An additional sample of 60 couples who currently have young children has been selected for study. The research is directed by professors in the departments of Food Science and Nutrition and Sociology; section personnel are responsible for all phases of data collection and processing.

Survey Section staff assisted a sociologist in studying the views of black Iowans regarding unemployment, racism, and other problems blacks may face in the state. The staff drew the sample, assisted with questionnaire development, and trained interviewers provided by the investigator.

Two health-related research studies focusing on children are underway. A study of the epidemiology of cleft lip and/or cleft palate is in the third of four years of data collection. Parents of approximately 300 cases and 300 controls are being interviewed by section staff by telephone regarding health and genetic histories. The first year of a three-year case/control project to study the epidemiology of specific language impairment in five-year-olds was initiated. Children in classes selected from Iowa schools will be screened for impairments, and a diagnostic test will be administered. The biological mothers of approximately 950 children will be interviewed by section staff over the course of the study concerning health and genetic histories, the pregnancy, the child's early development, and reading and language skills.

Consulting assistance was provided to a number of faculty and administrators. One project asked recent alumni of the graduate program of the Department of Agronomy for an appraisal of their education

at Iowa State. For the ISU Faculty Senate, an assessment of the faculty's concerns and recommendations regarding the research, teaching, and administration of the university was conducted. Assistance was also given to staff members of the Program for Women in Science and Engineering in an effort to assess the effectiveness of the program and formulate a plan for the future.

Consulting assistance on methodology and questionnaire design was provided to university staff conducting a survey of Supervisory and Confidential employees on campus, to an area hospital assessing nurses' and therapists' views of instituting computers in the workplace, to another area hospital conducting a study of preventive health care for rural Iowans, and to an Ames area committee conducting a needs assessment of physically disabled residents of the county.

Statistical assistance in preparing research proposals was given to a researcher from the Mayo Clinic interested in investigating women's health issues, to a researcher from the ISU Department of Physical Education interested in studying rural women's health issues and access to health care, and to a researcher in the ISU Department of Public Safety interested in investigating several aspects of public safety. Discussions were held with researchers from the University of Northern Iowa on a joint project to investigate drug usage by high school students, and with personnel from the Iowa Department of Employment Services interested in conducting a survey of wages paid to workers in various occupations in Iowa.

Assistance in designing questionnaires was provided to a researcher in horticulture studying pesticide usage on golf courses, to personnel from the ISU Physical Plant conducting a facilities and management survey, to an investigator from the Parks Library surveying other land-grant universities regarding their electronic data bases, to the Iowa Methodist Medical Center studying uses of computers in charting, to the University Committee on Women investigating sex equity at Iowa State University, and to a departmental executive officer surveying other departments about their computer facilities and other budgetary matters.

Consultative assistance in designing samples was given to personnel in the ISU Student Health Center surveying international students on health matters, to an architecture student surveying Ames households regarding usage of public spaces, and to a library staff member surveying members of a library professional association. In addition to consultation on design, samples were selected for researchers in several fields—a student in professional studies surveying ISU students about their satisfaction with their education here, personnel from Women in Science studying ISU female students, personnel from the College of Education surveying Iowa teachers and administrators, a faculty member from the Department of Sociology studying black residents of Des Moines regarding their attitudes toward their local black leaders, a multidepartmental group doing a study of Iowa couples (some of whom had been part of a nutrition study carried out in 1979), and an on-campus group making a diversity needs assessment.

Preliminary discussions of sampling strategies were carried out with researchers from the Department of Forestry for a sample of farmers in the Bear Creek watershed, with a group from Economics interested in surveying users of recreational facilities at Storm Lake, and with an individual from the Soil Tilth Laboratory contemplating a study of farmers using no-till cultivation strategies.

◼ Industry and Engineering Sciences

The Statistical Laboratory, the Engineering Research Institute, and joint faculty appointments with three departments in the College of Engineering support statistical consultation with engineering and physical science faculty and graduate students. During the past year Herbert T. David, Stephen B. Vardeman, and Ann Dyer consulted on two biomedical engineering projects, one aimed at assessing knee surgery, the other for discriminating between several wheelchair dynamics models. Five other projects called for cluster analysis, response surface methods, factorial design, and covariance analysis. Dyer's assistantship was supported by the Engineering Research Institute.

Consulting with industry is provided by individual faculty members and graduate students. Contacts with Iowa industries are often made through the Iowa Quality Coalition, on whose board of directors Dean Isaacson continued to serve. The coalition supported one statistics graduate student, Georgene Kelly, at Iowa State University (see below).

Industrial Consulting

William Q. Meeker, Jr., continued to serve as a consultant to the AT&T Bell Laboratories Quality Technology Center, Holmdel, New Jersey, during summers 1991 and 1992.

Kenneth Koehler and Kathy Shelley have helped the Ruan Transportation Corporation to develop databases, models, and appropriate graphics for costs associated with truck maintenance. This work will better enable the company to evaluate the relative performance of various types of trucks and engines and to plan for labor needs at maintenance centers.

Steve Vardeman answered an inquiry from a reliability engineer from Frigidaire Corporation in Webster City, Iowa, and provided him with formulas for numerical approximation of χ^2 distribution quantiles.

Georgene Kelly, representing the Iowa Quality Coalition, provided training and consultation to Furnas Electric in Osceola, Iowa, which had a problem of detecting variation in a molding process.

A subsidiary of Unisys Corporation that processes Medicaid and Medicare claims received feedback regarding data currently being collected, as well as advice on data that should be collected as the company moves through a quality transformation process.

J. Peter Jones was external technical advisor to several industrial groups. He advised Zenon Ltd. on the conduct of an experimental study using nanofiltration membranes for drinking water treatment. He advised Akam Enterprises on the development of an aerobic filter for the pulp and paper industry. He is technical consultant to Bitumar Ltd., which is developing a new technique for including waste tires in asphalt. He has been responsible for conduct at Teknika of a study of the treatment of scrubber effluent from an incinerator for the Montreal, Quebec, sewage works.

Derrick Rollins consulted with Dow Chemical's Applied Statistics and Consulting Group, Midland, Michigan, in July 1991 on linear regression, process control, and statistical process control. He also consulted with Shell Development Company, Houston, Texas, in May 1992 on gross error detection.

W. Robert Stephenson consulted with Glacier Vandervell, Inc., Atlantic, Iowa, on a problem in experimental design. Georgene Kelly, on behalf of the Iowa Quality Coalition, continued consultations with Glacier begun last year by Christine Whitney Helterbrand.

◼ Social Sciences and Humanities

Mack Shelley provided research assistance to faculty and students in many departments on campus. The topics addressed included the relationship between sexual abuse and suicide; strategies for coping with the consequences of divorce; family financial difficulties; relationships between adult children and their elderly parents in Malaysia; career success among teachers as a function of their involvement in extracurricular activities; citizen satisfaction surveys conducted by the City of Ames; the impact of health and social support on the institutionalization of older persons; intergenerational determinants of violent behavior among children; time use and the proliferation of home industry; effectiveness of three competing methods for teaching an introductory course in speech communication; a national survey of university support for international education; application of learning style inventory measures to workers and managers in the Bahamian hospitality industry; child sexual abuse in Iowa; and a multivariate time series analysis of bank interest rates.

Also addressed were a comparison of the academic performance of transfer and nontransfer undergraduate majors in the Department of Community and Regional Planning; a national survey of the correlates of academic success among industrial education graduate students; a survey of wildlife-oriented farm management practices in Iowa; a survey of special education teachers' satisfaction with their professional training and employment circumstances; experimental observations on preferences for perfume fragrances; a structural-equations analysis of data from a survey of parental stress and children's competence; the use of reliability methods in evaluating Iowa Youth Poll data dealing with locus of control; a survey of farmers and extension officers in Swaziland regarding dissemination of knowledge about farming practices; and experimental data on the effects of starching, laundry methods, and fabric types on contamination of clothing. One consultee, Alyce Holland, from Professional Studies in Education, received a summer 1991 Research Excellence Award for her dissertation work.

Mack Shelley advised administrative staff on the design and analysis of a survey inquiring why nonreturning students left the university and on the analysis of institutional data pertaining to monetary inducements for attracting high-caliber out-of-state undergraduate students to the university.

Frederick Lorenz's consulting efforts during the past year have focused on methodological issues in modeling family data. These efforts arose from his participation as co-principal investigator and statistical consultant on research projects administered through ISU's Center for Family Research on Rural Mental Health. Lorenz also worked with faculty in the departments of Sociology and Psychology in designing studies, preparing proposals, and conducting analyses.

The Department of Statistics has arrangements with both the College of Business Administration and the College of Family and Consumer Sciences to provide them with statistical support. Each of these colleges supports a statistics graduate student. Lorenz and other faculty provide guidance and advice to the students—Chris Ashman (BA) and Ann Russey (FCS)—as questions arise.

Robert Strahan assisted students and faculty from a number of departments in the behavioral sciences and education. Among studies were an investigation of computer-teaching techniques, a survey of computer needs in Taiwan, research into the desirability of certain aspects of toys for children, and a study of the relation between depressive mood and music therapy. Other areas in which assistance was given were counseling procedures, personality scale construction, drug effects on rats' sexual behavior, and intelligence testing.

■ Other Consulting/Cooperation

External consulting projects included a study of ethnic discrimination in jury selection for a federal court case in the Southern District of Iowa. This study, conducted for the Des Moines law firm of Babich, Bennett, and Nickersen, resulted in expert witness testimony by Mack Shelley before the federal court. Another project involved working with Iowa Methodist Medical Center, in Des Moines, on the analysis of data from a study on the prevention of skin breakdown among hospitalized patients. Shelley also advised a Drake University School of Nursing graduate student and Iowa Methodist Medical Center on the analysis of data pertaining to the relationship between chronic obstructive pulmonary disease and serum cholesterol.

Alicia Carriquiry went to the Republics of Ukraine and Latvia in September 1991 as part of a research delegation from the ISU Center for Agricultural and Rural Development (CARD). The purpose of the trip was to investigate possible collaborative projects to carry out with Soviet colleagues. Carriquiry conferred with staff in the Ukrainian Institute of Economics and Agro-Industrial Production, in Kiev, and the Latvian Institute of Economics, in Riga. (Also see p. 20.)

Noel Cressie consulted with researchers at Texas Instruments, the University of New Hampshire, and Arizona State University on spatial experimental design of integrated circuit manufacturing, modeling and predicting climate changes from ice core samples, and spatial prediction of snow water equivalents in the U.S., respectively.

He also consulted with researchers in the Ames Laboratory, the Center for Agricultural and Rural Development, and the Department of Animal Ecology at Iowa State University on geostatistical problems. This work included spatial sampling designs for nuclear waste site characterization and restoration; spatial characterization of water and soil contamination in Erath County, Texas; analysis of recovery locations of banded ducks; and a study of habitat characteristics of neotropical migrant birds breeding in floodplain forests of the upper Mississippi River.

Herbert T. David and Stephen Vardeman collaborated with J. Marcus Jobe (Miami University, Ohio) in performing consulting services for an environmental company. Lower limits of detection, critical values, and error terms were derived for identified analytes from inorganic, isotopic, bioassay, and organic environmental analyses. Corresponding estimates (point and interval) for lower limits of detection were also formulated.

Samuel Wieand continues to have overall responsibility for the statistical conduct of roughly 100 clinical trials as director of the Cancer Center Statistics at Mayo Clinic and group statistician for the North Central Cancer Treatment Group.

Statistical guidance and improved statistical methodology are provided to research staff of the Agricultural Research Service, USDA, under a five-year contractual agreement between the USDA-ARS and the Department of Statistics. Resident collaborator Jerome Sacks leads this project and supervised research assistants Sellem Remadi and William Harter during 1991-92. Much of the work relates to investigations at the National Animal Disease Center (NADC). As agricultural statistician, Sacks consulted and made site visits with USDA research staff in Iowa, Minnesota, and Missouri.

Kenneth Koehler and Kathy Shelley continued to collaborate with the Iowa Heart Center, Des Moines, Iowa, on several heart and angioplasty studies. This work involved establishing data files and analyzing data. The center sought help for studies of factors related to successful treatment of coronary diseases. Shelley developed programs for establishing appropriate databases. Koehler participated in the development of two clinical trials and developed a classification model for detecting patients with a particular rare coronary disorder.

C. Philip Cox consulted with scientists at the National Veterinary Services Laboratories on statistical procedures for the analysis of enzyme immunological assay data. The objective was to obtain a reliable decision on whether or not an 'unknown' preparation was at least as strong as the reference preparation. Existing analytical procedures were reviewed, procedural modifications were suggested, and aspects requiring further research were identified.

Current Research

Research projects supported by outside grants or contracts are listed first in this section. Some of these projects reflect a continuing series of contractual agreements between sections within the Statistical Laboratory and federal or state agencies. Individual research is also summarized. Within the university, research funds are provided by the budgets of the Statistical Laboratory, the Iowa Agriculture and Home Economics Experiment Station (AHEES), the College of Liberal Arts and Sciences (LAS), and the Engineering Research Institute.

▪ Survey Section

National Resource Inventories and Soils Data Bases

The Survey Section continued cooperative research with the Soil Conservation Service (SCS), U.S. Department of Agriculture, through Project 2739 of the Iowa Agriculture and Home Economics Experiment Station. Directed in the past by Roy D. Hickman, this joint activity has been an important part of the work of the Statistical Laboratory since 1956. Dean Thompson serves as resident SCS collaborator on this project.

The SCS conducts a National Resources Inventory (NRI) of the country's soil and water-related resources every five years. During the past year, Survey Section activities were primarily directed toward the 1992 NRI. The 1992 inventory is designed to estimate changes in resource conditions during the last five years. The national sample is a sample of approximately 300,000 primary sampling units (PSUs). Most of the PSUs were observed in the 1982 NRI. Stratification of the sample recognizes the geographic boundaries of county, Major Land Resource Area, and Water Resource Council Hydrologic Unit.

Two types of data are associated with the 1992 National Resources Inventory. County base data provide total acreages for each county in the United States for categories such as land area, water area, federal land, roads, and railroads. Data collected on PSUs include information on soil characteristics, land use, and soil erosion. State SCS staff are recording 1992 data values and verifying and updating data collected in 1982 and 1987. The 1992 NRI data are being collected primarily by remote sensing via aerial photography with a minimum of on-site field visits.

For each state, Survey Section staff prepared computer files containing 1982 and 1987 data values. These files will be used in the NRI Information System Data Entry Software, which will allow SCS staff to enter the 1992 data, as well as verify 1982 and 1987 data. Hard-copy data worksheets were produced for PSUs in several hundred counties to assist SCS staff with their data collection efforts. After data entry is completed by states, all 1992 data will be transmitted to ISU for processing, estimation, and analysis.

Wayne Fuller, Jay Breidt, and Jeff Goebel, SCS national statistician, designed a 1992 NRI sample for Alaska. This will be the first time that Alaska has been included in an NRI.

Several subsamples of PSUs were selected for more intensive data collection in 1992. A national subsample of PSUs containing cropland in 1987 was selected for a study of conservation tillage systems. Four states were included in a sample to be used in studying field and farm windbreaks. States with significant areas of rangeland are collecting data on range condition and the types of woody species. A special sample was also designed to more precisely estimate change in urban areas within the U.S.

Survey Section staff hosted two meetings with SCS national and state personnel. The purpose of these meetings was to develop (1) instructions for use by states in collecting NRI data, and (2) data editing and compatibility check procedures. Section staff initiated design and development of computer software to be used in data editing.

A study designed to estimate the loss of wetlands in the U.S. during the period 1987 to 1991 was completed, and results were forwarded to the Secretary of Agriculture. Data were collected on a subsample of approximately 7,800 PSUs identified as containing wetland during the 1987 NRI. Estimates of acreages in wetlands in 1991 and the change in wetlands acreages from 1987 to 1991 were calculated. Variance estimates were also included in the report.

The SCS is cooperating with the Economic Research Service (ERS), USDA, in the second year of a study to assess the economic and environmental impact of government policies aimed at reducing agricultural sources of ground water contamination. Study areas in Georgia, Idaho, Illinois, Iowa, and North Carolina were selected for completion in 1992-1993. Survey Section staff designed and selected samples of PSUs used in the 1992 NRI. These PSUs will be used to identify a sample of about 1,000 farm operators within each study area. Operators will be interviewed regarding their farming practices and chemical use, and the ERS will investigate economic models that interrelate farming activities, ground water quality, soil properties, and farm operators' decision-making processes.

Richard Dorsch is in charge of NRI data processing activities, assisted by Marie Loughin, Kathie Reinertson, Melissa Swanson, and Sue Verkade. Wayne Fuller directs the work on sample design and estimation, assisted by Harold Baker and Jay Breidt. Other staff members working on inventory projects during the year were Joseph Croos, Ouhong Wang, Savas Papadopoulos, and Margot Tollefson.

Soils

Another important part of the SCS cooperative work is the storage, maintenance, and continuing development of the national soil interpretations data-

bases. These databases are stored on the Iowa State University mainframe computer as part of the SCS cooperative soil survey program for the United States. Harvey Terpstra directs this work, assisted by Deborah Reed-Margetan, Jan Seagrave, Douglas Tschopp, Janet Schultz, Masoud Kazemi, and Todd Borchert. The data entry staff of Glenda Ashley, Vimlesh Gupta, and Karon White also contribute greatly to the data processing effort.

With the addition of 1,000 new records, the soil series interpretations database, which consists of basic soil property and interpretation information for all soil series in the nation, now contains over 34,000 records. The soil map unit database, which consists of information for each map unit in SCS soil surveys, now contains over 3,000 survey areas made up of 270,000 map units. The official soil series description database, which contains a textual description of each soil series in the nation, now contains approximately 15,000 soil descriptions. The soil series classification database contains the official soil classification for over 16,000 soil series.

One of the primary uses of these data has been to produce computer printed tables that are published in SCS soil survey reports. Downloading portions of the databases to state SCS offices is also an ongoing effort. States in turn download to SCS county offices, where the information becomes part of an automated system for providing detailed soils information to farmers, planners, and other users. Other current major uses of the data include annual creation of a national list of hydric soils, generation of water quality ratings for pesticide leaching and pesticide surface runoff potential, and evaluation of soil attributes to aid in determining eligibility of applicants for the Conservation Reserve Program. Nationally, the soils databases are used to help meet the requirements of congressional farm legislation and are distributed to researchers in government, university, and private sectors.

System development undertaken this year includes projects to devise a model to generate soil ratings for plant growth, to produce waste management soil ratings, to generate interpretation ratings for map unit specific data, and to compare map unit specific soils data against the national soil interpretation database for consistency. Program modules that have become part of the SCS state and county computer software system were also developed as part of this cooperative work.

Measurement and Sampling Error

Joint research in measurement error models, time series, and survey design is supported by the U.S. Bureau of the Census and, through AES Project 2699, by the Iowa Agriculture and Home Economics Experiment Station. The bureau's support for the 1991-1992 year came through Joint Statistical Agreements J.S.A. 91-1 and J.S.A. 91-21. Wayne Fuller is principal investigator. Other personnel working on the project include Jay Breidt, Abdoulaye Adam, Joseph Croos, Rohit Deo, Todd Sanger, Hui Wang, and Ibrahim Yansaneh.
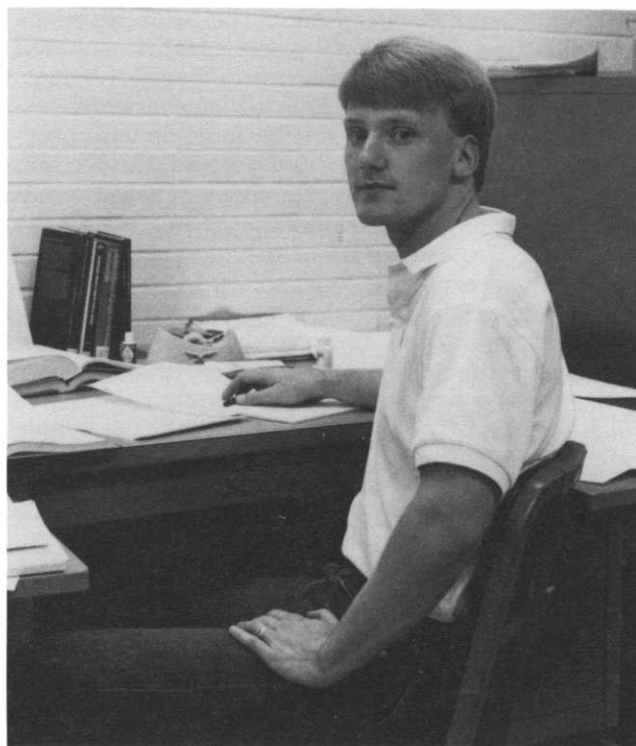
F. Jay Breidt is working in the Survey Section on joint research projects with the Bureau of the Census and SCS.

Jay Breidt studied a frequency domain method of estimating the variance of seasonally adjusted time series. The procedure is based upon the classical decomposition of a time series into trend, seasonal, and irregular components. The estimation procedure recognizes the presence of sampling error in the time series. While smoothness assumptions are required, the procedure, based upon the spectral density of the time series, is largely free of model assumptions. Alternative versions of the estimation procedure have been investigated using Monte Carlo methods.

Research was conducted on the estimation of the measurement error regression model with heterogeneous error variances. The procedure studied used estimated generalized least squares to estimate the mean vector and covariance matrix of the unobserved true values. The parameters of the regression line were then constructed as functions of the estimated mean vector and covariance matrix of the true values. The theoretical properties of the procedure were developed and Monte Carlo studies conducted.

Research was conducted on robust estimation for the structural measurement error model with equation error. It was assumed that the error covariance matrix is known. A robust estimator of the slope parameter was constructed to downweight the effect of an "outlier" observation on the usual estimator. The approach is based on the assumption that the observations are bivariate normal. Two robust regression lines were fitted by constructing the weighted regression of one variable on the other. The weights are a smooth function of squared standardized deviations. The estimated scale parameter, used in standardizing the deviation, was chosen such that it is uncorrelated with the deviation. Then robust estimators of the

population error mean square of the two regressions were constructed as a weighted average of the squared residuals from the robust regression lines.

The weights for the squared errors were constructed through another smooth function with properties similar to those of the deviation weight function except that the weights for the mean squared errors decay to zero at a faster rate than the weights for the deviations. The estimators of the parameters of the measurement error line were shown to be consistent and asymptotically normal, under certain regularity conditions. In a Monte Carlo study of the estimators, the robust estimator displayed good efficiency relative to the usual estimator for normal samples and was much superior to the usual estimator when the sample contained an outlier.

A portion of the research with the Census Bureau was jointly sponsored by the U.S. Bureau of Labor Statistics. Estimation procedures appropriate for the Current Population Survey were investigated under this sponsorship. Data on labor force characteristics for the period 1980-1990 and a detailed data set from the 1987 Current Population Survey were analyzed.

The covariance structure of the sampling error was estimated and used to compare alternative estimation and sampling procedures. The priorities one assigns to alternative objectives, such as estimation of current level, estimation of month-to-month change, and estimation of year-to-year change, heavily influence the choice of the rotation sampling procedure. Estimators currently in use have been designed to produce good estimates of current unemployed and of change in unemployed. Hence little improvement is possible in these estimation procedures. However, the research shows that considerable improvement in estimates of number employed is possible.

Dietary Intake Estimation

Alicia Carriquiry and Wayne Fuller continued their investigations on methods of estimating usual intake distributions for selected dietary components. Dietary survey data are often used to assess the nutritional status of populations. In the 1986 National Academy of Sciences report, the fundamental importance of both the usual intake and requirement distribution for dietary assessment was highlighted. Iowa State staff have developed a procedure for estimating usual intake distributions that takes into account characteristics of intake survey data and provides improved estimates of the prevalence of a dietary deficiency in the population. The method requires that more than one day of intake data be available for at least some individuals in the sample, since it accounts for the presence of within-individual variability of intakes. Observed individual intakes are mapped into normal space via a semiparametric procedure, and individual usual intakes in normal space are estimated based on a measurement error model. The distribution of usual intakes in the original scale is then estimated by applying standard statistical procedures to the normal distribution of the predicted individual intakes.

Work is currently underway to develop estimators of the standard error for selected percentiles of the estimated usual intake distributions. These estimators take into account the complex survey design used for collecting the dietary data. Further, work on simulations has been initiated, in order to compare the proposed methodology with other methodologies available, with respect to ability to accurately predict the population prevalence of a dietary deficiency.

Others working on the project are Kevin Dodd, Anthony An, and David Hall. This research was supported by a research agreement between the Center for Agricultural and Rural Development (CARD) at Iowa State University and the USDA Human Nutrition Information Service. The cooperative agreement was extended in 1991, for an additional five-year period.

■ Statistical Computing Section

Mervyn Marasinghe's current research involves the use of expert systems technology and modern programming environments, to develop software that represents various strategies for solving statistical and data analysis problems.

Marasinghe has installed the **XLISP-STAT** system obtained from the University of Minnesota on Project Vincent™. This system, described in a recent Wiley publication, is a new statistical programming environment based on the Lisp language. Graphics workstations like the DS5000 workstation, available on Project Vincent™, are appropriate for exploiting the capabilities of such systems.

An NSF-funded project for undergraduate instruction, supplemented by student computer fee funds from ISU, has enabled the Department of Statistics to
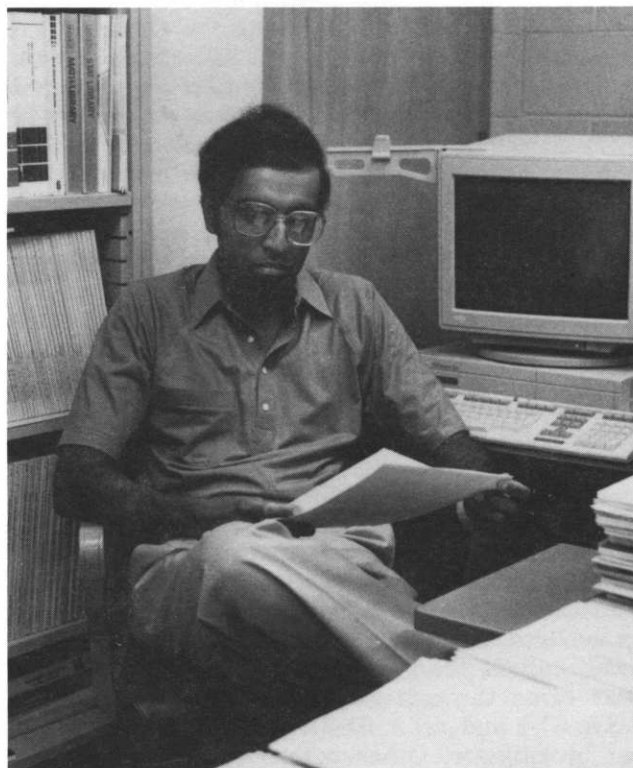
Mervyn Marasinghe's interests in statistical computing are directed toward applications involving statistical graphics and such modern programming environments as XLISP-STAT.

acquire 23 DS5000/25 workstations. As co-principal investigators of this project, William Meeker and Mervyn Marasinghe are coordinating development of a large number of software modules for statistics instruction, to be used on those workstations.

William J. Kennedy and Morgan Wang continued research in self-validating computations for probabilities and percentiles in univariate distributions. New algorithms for the central and noncentral chi-squared and F distributions were developed. Mary Gessner succeeded in porting existing self-validating computing support software from the personal computer to the ULTRIX™-based workstations. This was a difficult translation due to the very different characteristics of the microprocessors used in these machines. Preliminary investigation of the potential for parallel implementations was made, and the results were sufficiently encouraging to motivate more work in this area.

Wayne Fuller, William J. Kennedy, and graduate student Ouhong Wang began work on an extension of PC CARP that will handle auxiliary variables. The ULTRIX™ workstation version of the software will receive this extension. Implementation for personal computers will be done later.

▨ AHEES: Agricultural Statistics

Some of the collaborative research conducted by members of the statistics department of the Iowa Agriculture and Home Economics Experiment Station (AHEES) has already been described under the Survey Section (pp. 12-14). Other projects are described below.

Frontier Estimation and Efficiency Analysis

Research on frontier production function estimation and efficiency of the agricultural sector in the Ukraine was initiated by Alicia Carriquiry jointly with Aziz Bouzaher and Helen Jensen, Department of Economics. This work is funded in part through a grant from the National Council on Soviet and East European Research.

Mathematical and Statistical Genetics

Project 2588 of the Iowa Agriculture and Home Economics Experiment Station supports research by Edward Pollak on mathematical and statistical genetics. In the 1991-92 academic year he and Muhamad Sabran wrote a joint paper on fixation probabilities under partial selfing in a finite population if heterozygotes with an allele A are exactly intermediate in viability in comparison with homozygotes that have two copies of A or no copies. In the special case in which selfed and nonselfed progeny of an individual have independent Poisson distributions, they found their approximation to the fixation probability to be independent of the probability of selfing.

Muhamad Sabran, working under the direction of E. Pollak, has obtained approximations to probabilities of survival of gamete types in a large population, reproducing partly by selfing, if there are two loci affecting a character in a diploid population or if there is selection at one locus in a tetraploid.

Pollak also began research on deterministic theory for effects of selection in a large population that reproduces partly by mating of full-sibs and partly by random mating.

Statistical Modeling

Mark S. Kaiser is pursuing model development for waterbird abundance data on the Stikine Delta National Wildlife Refuge. This study is funded by the Fish and Wildlife Research Center, U.S. Fish and Wildlife Service, Anchorage, Alaska.

Statistical Prediction

Research work by Alicia Carriquiry on approximate inference for posterior moments is underway, in collaboration with Wolfgang Kliemann, Department of Mathematics. The initial funding for this project was obtained from the Iowa Agriculture and Home Economics Experiment Station Spring '91 Competition.

Kenneth Koehler and Tom Loughin are developing models to predict the onset and dry off of dew from hourly weather data. This research is supported by a university research grant (a one-year Carver grant for the 1992 calendar year) and involves working with data collected by a plant pathologist and a meteorologist. Data from an observational study were analyzed to predict when wetness could be favorable for fungus growth on tomatoes and to indicate when spraying of a fungicide might be warranted.

▨ Spatial Statistics

Research on spatial statistics by Noel Cressie continued at Stanford University fall semester, during his faculty improvement leave, with support from a National Science Foundation grant. Jeffrey Helterbrand worked at Stanford on the project from August through December. Renewed support for this research has come from the National Science Foundation and the National Security Agency.

At Iowa State, asymptotic distribution theory for restricted maximum likelihood (REML) estimators has been established by Cressie and Soumendra Lahiri. Work is now in progress to formulate suitable sufficient conditions for the asymptotic normality of REML estimators in certain spatial regression models.

An initiative was started by Noel Cressie with the GIS Support and Research Facility to develop spatial statistical modules for a geographical information system (GIS). This work will be supported partially by the National Science Foundation and the Center for Agricultural and Rural Development (CARD).

Research on census undercount by Noel Cressie was completed with an analysis of U.S. undercount by spatial regression and REML estimation.

▨ Sampling Strategies for DOE Waste Site Mapping

H. T. David and graduate student Seongmo Yoo continued work on developing spatial sampling strategies for DOE waste site mapping. The intent is to systematically prescribe which, and how many, sites

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are to be tested. The research is supported by the Ames Laboratory, under contract with the U.S. Department of Energy.

Mixed-Effects Linear Models

Mixed-effects linear statistical models are widely used as a basis for statistical inference and prediction. The traditional mixed-model methodology, which is primarily frequentist in nature, is deficient in several important respects. In principle, this methodology could be improved by making more extensive use of Bayesian ideas. In practice, the application of the Bayesian approach to mixed-effects linear models is—aside from relatively simple special cases—often dismissed as computationally unfeasible.

David Harville is the principal investigator for a National Security Agency grant project whose primary objective is to devise computationally tractable ways of achieving the potential of the Bayesian approach to mixed-model inference and prediction. The basic approach is to use results on conventional mixed-model methodology and results on the asymptotic expansion of the poly-t distribution in combination with the Gibbs sampler, the Laplace approximation, and other recent developments on the numerical evaluation of expected values. The end product of this research is to be a methodology that not only is more acceptable to Bayesians, but also—for suitably chosen values of the parameters of the prior distribution—has superior frequentist properties.

Order Statistics and Nonparametric Statistics

H. A. David, principal investigator under a U.S. Army Research Office contract, has continued research with H. N. Nagaraja, Ohio State University, on a statistic of interest in the selection of the best of n objects. Kye-Don Lee, research assistant, is investigating various measures of performance of individuals for whom two or more associated measurements are available.

Probability Theory and Mathematical Statistics

Krishna Athreya and Ananda B. Weerasinghe (Department of Mathematics) continued research on bootstrapping asymptotics, stochastic differential equations and optimal control, and nonparametric estimation for diffusion processes. They obtained some ergotic theorems for transient one-dimensional diffusions. They also continued their study of continuous time games. Athreya studied nonparametric estimation of Markov chains. Weerasinghe studied problems of the stochastic harmonic oscillator.

Krishna Athreya spent four weeks, March 1-28, 1992, in research at the Mathematical Sciences Research Institute, Berkeley, California. During his stay at this institute, he worked on problems of bootstrap theory, estimation theory, and large deviations for branching processes.

A National Science Foundation grant to Soumendra Lahiri, beginning August 1991, is supporting research on resampling methods and asymptotic expansions under weak dependence. During the year, Edgeworth expansions for normalized and studentized multivariate M-estimators were proved under minimal conditions, using the technique of Götze (1987, *Journal of Multivariate Analysis*) for U-statistics. Furthermore, a Berry-Esseen type theorem was established for studentized M-estimators under very weak moment conditions.

Lahiri also investigated asymptotic behavior of the moving block bootstrap (MBB) method for the sample mean of heavy-tailed random variables. For some appropriate choice of the block size, it was shown that the MBB works, provided the resample size m grows slower than the sample size n (i.e., m = o(n) as n → ∞). For the natural choice m = n, the MBB approximation fails as in the iid case.

Mathematical Modeling of Dendritic Growth

Research on mathematical modeling of dendritic growth by Alicia Carriquiry, working with Wolfgang Kliemann, Department of Mathematics, and Etsuro Uemura, Department of Veterinary Anatomy, continued with support from a grant from the National Institutes of Health.

Statistical Methods for Survival Data

A grant from the National Cancer Institute supports the development of statistical methods for analyzing survival time and life event history times from data that contain correlated responses. Kenneth J. Koehler is principal investigator for the three-year grant project. Two approaches are being developed: a parametric approach that provides maximum likelihood estimates and a resampling approach that does not require complete specification of a joint likelihood.

At Mayo Clinic, Samuel Wieand has been investigating statistical methods for analyzing data from repeated tests used to predict recurrence of cancer.

Double Sampling Plans

Vincent Shu of Abbott Laboratories, H. T. David, and graduate student Seoung-Gon Ko continued work on developing double sampling plans for use in clinical trials. These are a class of optimal double sampling plans that have both frequentist and Bayesian interpretations. Ko's assistantship is being funded by Abbott Laboratories.

Reliability and Nondestructive Evaluation

Yasuo Amemiya and Herbert T. David, along with Gerri Dunnigan, continued to work on a project under the NSF-supported Industry/University Cooperative Research Program of the ISU Center for Nondestructive Evaluation. For the project, which concerns refinery pipe systems monitoring, some theoretical study of possible inspection schemes based on mixed effect and extreme value analyses was conducted. A proposed mixed-model analysis would model, as fixed effects,

degradation factors that are traceable at specific locations, and, as random effects, degradation factors for which only system-wide evidence is available. The Center for Nondestructive Evaluation has supported Dunnigan's assistantship.

William Q. Meeker, Jr., coordinates the statistics staff's part of the National Institute of Standards and Technology (NIST) Program for Integrated Design, Nondestructive Evaluation (NDE), and Manufacturing Sciences. Meeker, Yasuo Amemiya, and graduate students Christian Garrigoux, Mark Kreisberg, Joseph Lu, and Bryan Olin have been working on this program.

Amemiya and Kreisberg developed statistical data analysis methods for detecting flaws based on C-scan ultrasonic nondestructive measurements in fabricated metal parts. Lu and Meeker have been doing research on the analysis of crack growth data. They have developed a general method of using such data to estimate a distribution of time to first crossing of a threshold for an arbitrary crack-growth model. In related work they have done a detailed numerical comparison to assess the tradeoff between the use of degradation data (such as crack growth data) and the more traditional time-to-failure data when used to estimate a time-to-failure distribution. Garrigoux and Meeker have been involved in the development of reliability models and in-service inspection schedules for nondestructive evaluation of critical components in large systems (e.g., airplanes). Olin and Meeker have been investigating methods of assessing measurement capability of NDE systems.

▦ Other Research

Funds from the College of Liberal Arts and Sciences helped support research in summer 1991 by Krishna Athreya, Derrick Rollins, John Stufken, and Shashikala Sukhatme.

Funds for partial support for basic and collaborative research in summer 1992 were provided by the Statistical Laboratory and the Agriculture and Home Economics Experiment Station to seven B-base faculty: Mack Shelley, W. Robert Stephenson, John Stufken, Shashikala Sukhatme, Steve Vardeman, Ed Pollak, and David Cox. Similar funds from LAS and/ or Engineering provided summer research support to Derrick Rollins, and Peter Sherman.

Mark Kaiser received a summer research award from the Liberal Arts and Sciences Research Institute to pursue an investigation on overdispersed generalized linear models. This work resulted in the production of a computer program for estimation and assessment of standard forms of regular and overdispersed generalized linear models using modified Gauss-Newton and quasi-likelihood estimation. A goodness of fit diagnostic was developed using specification of relations among lower moments from scaled forms of natural exponential families. Investigation of the properties of this diagnostic continues.

Other work included the development of a useful model for analysis of quantal response data from field toxicity tests. Such data result from toxicity tests in which both the number and concentrations of potential contaminants change on a daily basis in a standard short-term toxicity testing situation. The model has been applied by Kaiser to the analysis of irrigation drainwater toxicity near the Stillwater National Wildlife Refuge in Nevada and toxicity of water in tributaries of Chesapeake Bay to larval striped bass.

John Stufken's research efforts have focused on topics related to orthogonal arrays. These include existence questions of symmetrical and asymmetrical orthogonal arrays, methods of construction for asymmetrical orthogonal arrays, and methods of construction for pairwise orthogonal F-squares. Other research efforts include, jointly with Kui-Jang Wang, a study to determine fractions of the 2^n level combinations of a factorial experiment that provide the same information, under a specified criterion, as a given fraction, but without inclusion of certain undesirable (e.g., expensive or toxic) level combinations.

Yasuo Amemiya conducted research on topics in multivariate analysis. Inference procedures for the fixed and random parameters in multivariate mixed-effect repeated measure analysis were studied, with special attention to analysis of random coefficient structure.

Amemiya and a graduate student, Sellem Remadi, have developed a general result in the limiting distribution of the roots of a certain determinantal equation with differential convergence rates. Also, various issues involved in multivariate components of variance problems were investigated. Amemiya and his student Birol Emir studied the convergence, parameter space restriction, and model selection problems in the structural equation model fitting.

Krishna Athreya continued his study of Harris Markov chains with application to Gibbs sampling.

Shashikala Sukhatme continued research on nonparametric receiver operating characteristic (ROC) analysis. ROC curves were used first by engineers in "signal detection" and then by psychologists for comparison of experiments. During the last ten years in clinical experiments, analysis of data using ROC curves has become very popular as they are useful for comparing diagnostic tests based on information obtained from a variety of imaging systems. Hence, ROC analysis of data has become an active area of research. Sukhatme is investigating ways of making ROC curves more effective in diagnostic medicine and signal detection. She has shown how usual area index can be adjusted for bias due to random sample sizes. She also has shown how stratification can be used for improving inferences from ROC studies. Her research continues in this area and in investigation of methods of improving reliability of ROC analysis.

C. Philip Cox considered the problem of estimating the individual group means, assumed to be normally distributed, in a completely randomized, Model II, single classification experiment. As in the BLUP procedure, each estimator is a weighted combination of the sample mean of the individual group and an estimate of the overall mean, the weights being dependent on the ratio of the within- to the between-group variances. As an alternative to the assumption that this ratio is known, it was shown that maximum

likelihood estimators of the two variances can be obtained from data 'indigenous' to one experiment for any number of groups with equal numbers of replicate observations, and for at least two groups with unequal numbers of replications. From numerical examples it was also apparent that weights calculated from the usual variance component estimates in the ANOVA can lead to estimators for the individual group means close to those obtained by the maximum likelihood procedure. Another new procedure whereby estimators of the group means can be obtained using probability plot methods has also been proposed as meriting further research.

Cox also continued research on material originally presented as a departmental seminar in 1974. It was then pointed out that the conventional row + column + treatment additive linear model commonly used for the analysis of latin square experiments could be incompletely veridical when applied to the results of field experiments. The deficiency arises because row $\times$ column, warp or interaction, components are excluded from the structural part of the conventional model.

As an alternative, a polynomial representation of the background effects was proposed wherein the individual parameters were obtained by a stepwise multiple regression procedure. When the two analyses were compared on the latin square example in the widely used text by Snedecor and Cochran, strikingly different inferences were obtained: the analysis based on the standard model revealed no significant treatment effects; that based on the alternative model not only demonstrated significant treatment effects but also that these effects were consonant with those to be expected in an experiment well planned to investigate the optimum spacings in cultivation of millet.

Kenneth J. Koehler is co-principal investigator on a project to estimate the duration of wetness periods in the upper Midwest from standard meteorological parameters. This research is supported by a university research grant.

Richard Groeneveld and Barry C. Arnold (University of California at Riverside) investigated skewness orderings based on natural skewness functions and analogous kurtosis orderings.

Derrick Rollins continued research on data reconciliation and gross error detection. An unrestricted grant from Shell Development Company is partially funding this work.

W. Robert Stephenson during June 1992 engaged in research in the general area of industrial statistics and quality control. Specifically, work continued with a colleague at the University of Newcastle, Australia, on graphical analysis of unreplicated factorial experiments. Work by Stephenson with graduate student Jeff Andersen on nontraditional applications of control charts involved hospital length of stay data and the Box-Cox transformation. A third endeavor focused on the application of methods of Total Quality Management to improving statistics education. Some of the ideas will be implemented in Stat 101, fall 1992.

J. Peter Jones continued to supervise research work at the University of Sherbrooke while on sabbatical leave. One project involved the use of ozone to control color in textile mill effluents. The effect of the type of dye and operational parameters was examined using factorial design techniques. Another project investigated the ability of various laboratory tests to predict performance of full-scale dehydration equipment, specifically a belt press.

At Iowa State, he participated in the research group directed by Richard Dague, Department of Civil and Construction Engineering, on the use of anaerobic treatment processes for industrial and municipal wastewater.

Frederick Lorenz continues to serve as director of statistical services and data management in the ISU Center for Family Research in Rural Mental Health. He also continues to work with colleagues Rand Conger, Ron Simons, and Les Whitbeck on longitudinal studies of 450 rural Iowa families and 200 single parent families. Much of this work is supported by grants from the National Institutes of Mental Health and the National Institute on Drug Abuse.

During the year, at the University of Leiden in the Netherlands, Carl Roberts did some writing on how linguistic ambiguities shape the structure of conversations. Other research projects included a review of recent "relational" approaches to doing content analysis, a description of various loglinear models for estimating occupational mobility, and analyses of trends in U.S. religious affiliation from 1964 to 1986 (with André Nauta) and in Americans' attitudes toward women and blacks from 1970 to 1988 (with Ya-Chun Wang).

At ISU, Mack Shelley is engaged in research on injury severity in vehicular accidents, leadership and voter choice in presidential elections, structural changes in research universities, roll call voting behavior among members of the United States Congress, patterns of interaction between adult children and their elderly parents, interstate human migration, state and federal drug policy, and citizens' voting in U.S. Senate elections.

Peter Sherman received a small grant from the College of Engineering for research on automotive driver impairment. He also worked with a colleague in aeronautical engineering on development of a parameter to characterize roughness of a random surface.

Robert Strahan continued research on driving behavior, aided by a grant from the Midwest Transportation Center. This research is intended to provide a battery of tests predictive of driving competence in the elderly. Potential components of the battery are psychological questionnaires, cognitive tasks, and biographical data. The criterion measure is driving skill on an enclosed course at ISU. Members of the research team are from statistics, psychology, engineering, and family environment.

Strahan continued research on measures of consistency in vocational interest inventories. Modifications were proposed to deal with tied data, prevalent in this area, and assessment of the degree of tied data was undertaken. Other research dealt with measures of magnitude of effect (effect strength), particularly with Robert Rosenthal's and Donald Rubin's binomial effect size display (BESD).

Professional Activities

Wayne Fuller continued as vice president of the American Statistical Association (ASA) and attended meetings of the board of directors on August 16-17 in Atlanta, Georgia, on October 16 and 23 in Washington, D.C., and on April 10-11 in Washington, D.C. He is a member of the budget committee and the planning committee of the board. He attended meetings of the program committee of the International Statistical Institute in Cairo, Egypt, during September.

W. Robert Stephenson continued as chair of the ASA Section on Statistical Education. He organized and moderated the first ASA student College Bowl held during the Winter Conference in Louisville, Kentucky, in January 3-5, 1992. He served on the ASA Committee to Review *Stats* for 1991-92 and was appointed to the ASA Advisory Committee on Continuing Education. Stephenson also served as a member of the advisory committee for an NSF-sponsored Activity-Based Statistics Project.

In 1991 H. A. David was chair of the Committee on ASA Archives and Historical Materials. He is now an ex officio member of the committee. Herbert T. David is on the Advisory Board on the ASA/NSF/NIST Fellowship Program for 1991-1993 and attended a board meeting in Alexandria, Virginia, February 24, 1992.

As section chair through December, Stephen B. Vardeman chaired executive committee and/or general business meetings of the ASA Section on Physical and Engineering Sciences during the 1991 joint statistical meetings and the Annual Fall Technical Conference of the ASQC and ASA. He became an ex officio member of the ASA *Technometrics* Management Committee starting in January 1992.

William Q. Meeker, Jr., is chair of the *Technometrics* Management Committee for 1991-1993. He completed his term as president of the Iowa chapter of the American Statistical Association in August 1991.

Noel Cressie continued to serve as a member of the ASA Review Committee for the EPA's Ecological Monitoring and Assessment Program; the committee met on November 4-6, 1991, in San Francisco. He is a member of the Committee on Fellows for the Statistical Graphics Section of ASA for 1990-1993. In 1991 he became a member of the Publications Committee and the Committee on Symposia and Conferences for the ASA Section for Statistics and the Environment.

W. Robert Stephenson was vice president/president-elect of the Iowa chapter of the American Statistical Association for 1991-92; Richard Groeneveld was Council of Chapters representative.

Wayne Fuller attended meetings of the Statistics Canada Advisory Committee on Statistical Methods on October 28-29 and April 27-28 as chair, in Ottawa, Ontario, Canada.

J. Peter Jones served as regional director of the Canadian Association of Water Pollution Research and Control and as treasurer of the Estrie regional chapter, Canadian Society of Chemical Engineering.

Mack Shelley continued to serve as the Iowa State University Official Representative to the Inter-University Consortium for Political and Social Research.

Kenneth Koehler was appointed to the newly formed Scientific Review Panel on infant mortality organized by the Iowa Department of Public Health. This panel will advise the Iowa Department of Public Health on methods to improve the infant mortality data base and the development and assessment of strategies to reduce infant mortality.

William Q. Meeker chaired the 1991 Gordon Conference on Statistics in Chemistry and Chemical Engineering, held July 28-August 2 in New Hampton, New Hampshire.

Mack Shelley chaired a panel on Cohesion and Cleavage: Party, Ideology, and Policy in Congress, at the annual meeting of the American Political Science Association in August in Washington, D.C.

Noel Cressie was co-organizer and co-editor of the Spatial Statistics Section of the First International Conference/Workshop on Integrating GIS and Environmental Modeling, held in Boulder, Colorado, in September 1991.

J. Peter Jones was awarded the John S. Bates Prize from the Canadian Pulp and Paper Association on January 30, 1992, at its annual meeting. The award was given for a study entitled "The Biocarbon Process as a Treatment Alternative for the Kruger Newspaper Mill."

Peter Sherman chaired a session on Experimental Methods in Modal Analysis at the 10th International Modal Analysis Conference, San Diego, California, February 5, 1992.

At the joint spring meetings of the Biometric Society (ENAR), Institute of Mathematical Statistics, and the American Statistical Association, held in Cincinnati, Ohio, on March 22-25, Noel Cressie organized and chaired the IMS invited paper session on Inference for Spatial Processes.

David Harville visited SAS Institute Inc., Cary, North Carolina, from July 15-19, 1991, and presented a sequence of ten lectures entitled "Mixed-model methodology."

Samuel Wieand taught a one-week course entitled "Analysis of clinical trials" as part of the International Graduate Summer Session in Epidemiology at the University of Michigan, on July 26-30. On April 16-17, 1992, he visited Cleveland Clinic, Cleveland, Ohio, as part of the clinic's Meet the Professor program.

Carl Roberts gave seminars/workshops on content analysis at universities in Leiden (February 19), Budapest (March 6), Tel Aviv (April 26), and Groningen (June 11, 1992).

Yasuo Amemiya attended the Workshop on Multivariate Analysis of General Populations, held in Guangzhou, China, on March 20-21 and sponsored by the Institute of Mathematical Statistics and Zhongshan University. W. Robert Stephenson attended

a workshop on the formation of a new journal on statistical education, held in Raleigh, North Carolina, May 28-30.

Alicia Carriquiry met with Uruguayan officials and staff of IDB and USAID, in Washington, D.C., March 16-19, on behalf of ISU's Center for Agricultural and Rural Development. She was invited by the Secretary of Agriculture of Uruguay to be part of a roundtable of experts, on June 4, 1992, to discuss a new law related to liberalization of trade of genetic material in Uruguay. Between May 25 and June 25, she provided technical support to the Association of Dairy Producers, a cooperative in Montevideo, Uruguay, on issues related to genetic improvement of livestock.

Derrick Rollins lectured in Moscow, Russia, by invitation of the Academy of World Civilization on May 28-29 .

W. Robert Stephenson participated in a National Science Foundation Workshop on Introductory Statistics Instruction, held in Washington, D.C., June 28-30.

◾ Editorial Activities

Stephen Vardeman, an associate editor of *Technometrics,* became editor-elect beginning on January 1, 1992, and attended an editor's meeting for ASA journal editors in Alexandria, Virginia, February 22.

Yasuo Amemiya continues as associate editor of *The American Statistician.*

Krishna Athreya is an associate editor of *Statistics & Probability Letters.*

Wayne Fuller continues as associate editor of *Survey Methodology.*

Edward Pollak is an associate editor of *Biometrics* and continues to serve on the editorial board of *Mathematical Biosciences.*

Noel Cressie interviewed Oscar Kempthorne in a one-hour videotape, "Oscar Kempthorne: From Observation to Inference," for the ASA Committee for the Filming of Distinguished Statisticians.

Cressie is on the editorial board of *Chemometrics and Intelligent Laboratory Systems.* He became associate editor of the *Journal of Statistical Planning and Inference* January 1, 1992.

William J. Kennedy completed his term on the international editorial board of *Communications in Statistics—Simulation and Computation* and as co-editor of its Algorithms section.

William Q. Meeker, Jr., is continuing on the editorial board of *Selected Tables in Mathematical Statistics* and is a co-editor of that publication; W. Robert Stephenson is also a member of the editorial board.

Mack Shelley became a member of the board of editors for the *Policy Studies Journal* for 1992-1994.

◾ Papers Presented, Lectures, and Seminars

At the Workshop on Total Least Squares: Concepts, Algorithms, Applications, Katholieke Universiteit Leuven, Heverlee, Belgium, August 12-15, 1991:

AMEMIYA, Yasuo: "Parameter estimation in nonlinear errors-in-variables problems";

FULLER, Wayne A.: "Properties of estimators for the errors-in-variables model."

At the 1991 joint statistical meetings of the American Statistical Association, the Biometric Society (ENAR and WNAR), and the Institute of Mathematical Statistics, Atlanta, Georgia, August 18-22:

AMEMIYA, Yasuo: "On the test of rank in multivariate components of variance";

ATHREYA, K. B.: "On measures of degeneracy";

CRESSIE, Noel A. C.: Discussant, session on Analysis of Spatial Point Patterns;

CRESSIE, Noel A. C., and Jennifer L. Davidson: "Statistical image algebra";

Croos, Joseph, and Wayne A. FULLER: "Robust estimation in measurement error models";

DuBois, Dawn, Robert Gibberd, Craig Shaw, and W. Robert STEPHENSON: "Control charts for hospital length of stay data";

Arnold, Barry C., Robert J. Beaver, and Richard A. GROENEVELD: "The nontruncated marginal of a truncated bivariate normal distribution";

KOEHLER, Kenneth J.: "Analyses of insect egg hatch and larva development times";

LAHIRI, Soumendra N.: "Rates of bootstrap approximation for the mean of lattice variables";

Lin, C. H. (Ming Chuan College, Taipei), and Shashikala SUKHATME: "Two-sample UMP and LMP rank tests with truncated populations";

Liu, Jingyu, and H. A. DAVID: "Comparing two groups of ranked objects by matching pairs";

MEEKER, William Q., Jr.: "Statistical models for accelerated life test data based on reliability kinetics" in the Accelerated Testing short course;

NUSSER, Sarah M., Alicia CARRIQUIRY, and Wayne A. FULLER: "A nonparametric transformation to normality: Application to dietary data";

Sanger, Todd M., and Wayne A. FULLER: "Estimation of the measurement error model with unequal error variances";

SHELLEY, Mack C. II, and Kathleen D. SHELLEY: "Presidential elections and campaign money: Statistical and graphical evidence";

STUFKEN, John: "Comparing test treatments with a control";

Symanowski, James T. (Lilly Research Laboratories), and Kenneth J. KOEHLER: "A bivariate logistic regression model for ordered categorical responses";

Vander Wiel, Scott A. (AT&T Bell Laboratories): "Optimal discrete adjustments for short production runs";

VARDEMAN, Stephen B.: "Teaching statistics to undergraduate engineers";

Wang, Kui-Jang, and John STUFKEN: "Fractional factorial designs with equal information matrices";

Wang, Morgan C., and William J. KENNEDY: "Self-validating computations of probabilities and percentiles for central and noncentral chi-square distributions."

At the 1991 Midwest SAS Users Group Conference in Schaumburg, Illinois, September 29-October 1:

MEADOR, Bud J.: "Installing PC/SAS—one on one";

SHELLEY, Kathy, and Mack SHELLEY: "Designing data analysis systems by integrating PC/SAS, Windows 3.0, and Toolbook."

At the 1992 ASA Winter Conference, Statistics and Education, in Louisville, Kentucky, January 3-5:

MUNDFROM, Daniel J. (University of Arkansas-Little Rock), Mack C. SHELLEY II, and William G. Miller: "Perceptions of course difficulty";

STEPHENSON, W. Robert: discussant for contributed papers session, Alternative Approaches to Teaching Statistics; also panelist for a panel discussion, Training of Graduate Teaching Assistants.

At the spring meeting of the Institute of Mathematical Statistics, four sections of the American Statistical Association, and the Biometric Society (ENAR), Cincinnati, Ohio, March 22-25, 1992:

CRESSIE, Noel, and Frederick M. Medak: "Hierarchical testing of parametric models: Beyond the loglikelihood-ratio statistic";

KOEHLER, Kenneth J.: "Survival analysis for correlated responses";

LAHIRI, Soumendra N.: "On the asymptotic normality of REML estimators with application(s) to spatial regression";

SUKHATME, Shashikala, and Madhuri S. Mulekar: "Comparison of rank tests for randomly censored data."

At the Midwest Sociological Society annual meeting, in Kansas City, Missouri, in April:

Kinney, William J., William F. Woodman, and Mack C. SHELLEY: "Economic development funding and the land-grant university: The changing nature of university personnel and their research";

Mercier, Cletus R., Julie B. Rimkus, Mack C. SHELLEY II, and Joyce M. Mercier: "Age as a predictor of injury severity in broadside and angle vehicular collisions."

At the Fourth Annual Kansas State University Conference on Applied Statistics in Agriculture, Manhattan, Kansas, April 26-28, 1992:

COX, C. Philip, and Jeff B. Meeker: "A simple alternative to the regular statistical model for the analysis of field experiments with latin square designs";

SACKS, J. M., R. C. Cutlip, and H. D. Lehmkuhl: "Prevalence rate analysis based on herdmate records in a large nonrandom survey of ovine progressive pneumonia."

At the Seventh International Conference on Multivariate Analysis, held in University Park, Pennsylvania, May 5-9:

AMEMIYA, Yasuo: "Random parameter analysis for multivariate linear models";

CRESSIE, Noel: "Multivariate spatial prediction."

At other locations:

AMEMIYA, Yasuo: "On multivariate mixed model analysis," at the International Symposium on Multivariate Analysis and its Applications, in Hong Kong, March 18, 1992.

"Random parameter analysis for multivariate linear models," at the 7th International Conference on Multivariate Analysis, University Park, Pennsylvania, May 6.

ATHREYA, Krishna B.: "Continuous time games," at an international conference, 50 Years after Doeblin—Developments in the Theory of Markov Chains, Markov Processes, and Sums of Random Variables, Blaubeuren, Germany, November 3, 1991.

"Large deviations in branching processes," at the Department of Mathematics, University of Mainz, Mainz, Germany, November 7; at the Department of Mathematics, University of Singapore, December 17; also at the Indian Statistical Institute, Bangalore, India, January 6, 1992, and at the Indian Statistical Institute, Calcutta, January 20.

BAILEY, Theodore B.: "Culture media influences on induction of tomato anther callus," by William L. Summers, Juan Jaramillo, and Bailey, at the Tomato Breeders Round Table, San Diego, California, March 1991.

"An evaluation of hemostatic parameters following use of hypertonic saline combined with colloids for resuscitation of hypovolemia," by A. E. Jergens and Bailey, University of Iowa College of Medicine Research Days XVI, April 1991.

"Inflammatory bowel disease in the dog and cat: Histological and endoscopic observations," by A. E. Jergens and Bailey, at the National Pathology Meetings, Orlando, Florida, held on December 8-13, 1991.

CARRIQUIRY, Alicia: "Why BLUP is good," by Terry Speed and Carriquiry, at the X Winter School on Probability and Statistics, Santiago, Chile, July 31, 1991.

"Classical and Bayesian approaches to variance component estimation," invited lecture at the I Capricornio Congress on Probability and Statistics, Catholic University of the North, Antofagasta, Chile, August 8, 1991.

"Statistical aspects of the genetic evaluation of livestock," at the Forum on Livestock Improvement in Uruguay in Face of MERCOSUR, sponsored by the National Institute of Agricultural Research, Montevideo, Uruguay, August 23.

"Approximate inference for posterior means in mixed linear models," seminar, Department of Statistics, Universidad Nacional Autonoma de Mexico, Mexico City, February 20, 1992.

"Estimation of usual intake distributions," by Carriquiry, H. H. Jensen, W. A. FULLER, and P. Guenther, at the annual meeting of the Federation of American Societies of Experimental Biology (FASEB), Anaheim, California, April 20.

CRESSIE, Noel A. C.: "Statistical image algebra: A Bayesian approach," by J. L. Davidson and Cressie, at the SPIE (Society of Photo-Optical Instrumentation Engineers) 1991 International Symposium on Optical Applied Science and Engineering, San Diego, California, July 23, 1991.

"Spatial statistical analysis of ecological data: From observation to inference," at the First International Conference/Workshop on Integrating GIS and Environmental Modeling, Boulder, Colorado, September 17; also member of panel discussion on What is the Role of Statistics in Environmental Modeling?

"Spatial design and analysis of experiments," seminar, Department of Statistics, Oregon State University, October 7.

"Regional mapping of incidence rates," at the joint meeting of the San Francisco Bay Area Chapter of the American Statistical Association and the Stanford Workshop in Biostatistics, Stanford, California, October 17.

"Spatial design and analysis of experiments," by Cressie and Martín O. Grondona, at the 35th Annual Fall Technical Conference, Lexington, Kentucky, October 25, 1991, co-sponsored by the Chemical and Process Industries, the Statistics Divisions of the American Society for Quality Control, and the ASA Section on Physical and Engineering Sciences.

"Spatial model based smoothing of regional data," at the 1991 Regenstrief Conference on Methods for Comparing Patterns of Care, held in Turkey Run State Park, Indiana, October 28.

"Nonstationary spatial prediction," seminar, at the Naval Research Laboratory, Monterey, California, November 15.

"Hierarchical testing of parametric models: Beyond the loglikelihood-ratio statistic," Berkeley/Stanford Statistics Seminar, University of California, Berkeley, December 3; also an invited paper by the same title at the Wilks Conference, Princeton, New Jersey, January 27, 1992.

"Regional mapping of incidence rates," seminars at Rand Corporation, Santa Monica, California, December 19; at Los Alamos National Laboratory, Los Alamos, New Mexico, January 3, 1992; at AT&T Bell Laboratories, Murray Hill, New Jersey, January 29; at Battelle Pacific Northwest Laboratories, Richland, Washington, April 14; and at the National Institute of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, Maryland, May 18.

"Spatial statistical analysis of environmental and ecological data," seminar at Sandia National Laboratories, Albuquerque, New Mexico, January 2.

Discussant, with Jennifer L. Davidson, of Mathematical Morphology at Department of Defense Tri-Service Workshop on Stochastic Methods in Image Analysis, Washington, D.C., May 21.

DAVID, H. A.: "Comparing two groups of ranked objects by matching pairs," by David and **Jingyu Liu**, at the AMS-IMS-SIAM Joint Summer Research Conference in the Mathematical Sciences, on Stochastic Inequalities, held July 6-11, 1991, in Seattle, Washington.

"Concomitants of order statistics: Review and recent developments," seminar, Department of Statistics, Kansas State University, October 31.

"Concomitants of order statistics: Theory and applications," seminar, Department of Statistics, Dortmund University, Germany, November 12.

FULLER, Wayne A.: "Multinomial response error and labor flows," seminar, Department of Social Statistics, University of Southampton, England, July 4, 1991.

"Measurement error models with unequal error variances," July 17 at the International Workshop on Statistical Modeling and Latent Variables held in Trento, Italy, and sponsored by the Institute of Statistics and Operations Research and the Department of Social Policy at the University of Trento.

"Regression for samples with imputed values," at a meeting of the International Statistical Institute, Cairo, Egypt, September 10.

"Estimation and testing for unit root models," at the annual meeting of the Financial Management Association, Chicago, Illinois, October 10.

"Estimation for multivariant unit root autoregressive processes," seminar for the Department of Statistics, North Carolina State University, April 3, 1992.

"Design of a National Resource Inventory," by J. Jeffery Goebel and Fuller, at the IMS-WNAR Western Regional Conference, Corvallis, Oregon, June 15.

GENALO, Mary "Toni": "Requests for and participation in surveys among Iowa farm operators," by Genalo and **Roy D. HICKMAN,** at the Survey Field Directors Conference, St. Petersburg Beach, Florida, May 20.

HARVILLE, David A.: "Mean squared error of estimation or prediction under a general linear model," joint seminar, Department of Statistics, Carnegie Mellon University, and Department of Mathematics and Statistics, University of Pittsburgh, March 6, 1992.

HINZ, Paul N.: "Graduate study in statistics at Iowa State," lecture at Luther College, December 6, 1991.

ISAACSON, Dean: "What do mathematicians do when they grow up?" given at the annual meeting of Kappa Mu Epsilon, Wartburg College, March 21, 1992.

"The role of mathematics and statistics in the 'real world'," by David Glenn-Lewin, Michael Smiley, and Isaacson, for Math Week Activities, Iowa State University, May 1.

Iversen, Philip W.: "Visualizing experimental designs with LISP-STAT," by Iversen and **Mervyn G. MARASINGHE,** at the 24th Symposium on the Interface: Computing Science and Statistics, College Station, Texas, March 19, 1992.

JONES, J. Peter: "The use of ozone for decolorizing textile wastewater," by J. Carrière, Jones, and A. D. Broadbent, at the International Ozone Association Pan American Conference, held September 15-18, 1991, in Toronto, Ontario, Canada.

"Removal of toxicity and some nonconventional pollutants by a dual power multicellular lagoon system," by Jones and A. Kantardjieff, at the 64th Annual Conference of the Water Pollution Control Federation, held October 7-10, in Toronto.

"The numerical model of dewatering in a rotary press," by A. Poulin and Jones, at the National Meeting of the American Filtration Society, held October 20-23 in Atlanta, Georgia.

"A new technique for evaluating the dewatering potential of sewage sludge," by F. Poulin, Jones, and A. Poulin, at the 27th Canadian Symposium on Water Pollution Research, February 12, 1992, in Burlington, Ontario, Canada.

"Usefulness of sludge dehydration tests," by F. Poulin, Jones, and A. Poulin, at the American Filtration Society 1992 annual meeting, held in Chicago, Illinois, May 11-13.

KAISER, Mark: "Modeling the effect of metal contamination and water chemistry on larval striped bass survival," at a meeting of the Emergency Striped Bass Fund Coordination Committee, U.S. Fish and Wildlife Service and National Marine Fisheries Service, Norfolk, Virginia, February 5, 1992.

"A model for field toxicity tests," seminar, Department of Animal Ecology, Iowa State University, February 21.

KEMPTHORNE, Oscar: "A life of statistics: Success and failure," the Fourth Annual Distinguished Statisticians Lecture Series, sponsored by the Department of Mathematical Sciences, Pennsylvania State University, and the Harrisburg Chapter of the American Statistical Association, October 8, 1991, in Harrisburg, Pennsylvania.

KOEHLER, Kenneth J.: "Some methods for analyzing life event data with correlated responses," seminar, Department of Preventive Medicine and Environmental Health, invited by the Biostatistics Student Association, University of Iowa, March 16, 1992.

LAHIRI, Soumendra Nath: "Edgeworth expansion for sums of weakly dependent random vectors," invited supplementary lecture at the NSF-CBMS Conference on Higher Order Asymptotics with Applications to Statistical Inference, August 9, 1991, in Chapel Hill, North Carolina.

LORENZ, Frederick O.: "Marital and social network support as moderators of the impact of economic strain upon parenting," by R. L. Simons, R. D. Conger, Lorenz, L. B. Whitbeck, and G. H. Elder, at the annual meeting of the International Society for the Study of Behavioral Development, Minneapolis, Minnesota, July 3, 1991.

"Doing worse and feeling worse: The psychological consequences of economic hardship," by Lorenz, Ruth Montague, and R. D. Conger; also "Problems in modeling longitudinal family data," by Lorenz, both at the Rural Sociological Society meetings in Columbus, Ohio, on August 19.

"The effects of stability and reliability in modeling panel data," at the annual meetings of the National Council on Family Relations, November 20, in Denver, Colorado.

LOUGHIN, Marie: "Weight construction for the 1987-88 Nationwide Food Consumption Survey," by Loughin, **Harold BAKER,** and **Wayne A. FULLER,** at the annual meeting of the American Agricultural Economics Association, held in Manhattan, Kansas, August 6-7, 1991.

MEEKER, William Q.: "An accelerated life test model based on reliability kinetics," by Meeker and Michael LuValle, at the National Institute of Statistical Sciences (NISS) First Workshop: Statistical Strategies for Accelerating and Improving the Design of Products and Processes, held in Research Triangle, North Carolina, November 3.

"An accelerated life test model based on reliability kinetics" and "Influence analysis with censored regression data," seminars for the Department of Information and Decision Sciences, Arizona State University, November 6 and 7, respectively; the first talk also as a seminar at the National Institute of Standards and Technology (NIST), Gaithersberg, Maryland, November 15, and the Department of Mathematics, Winona State University, January 17, 1992, and as a talk for the Red River Valley chapter of the American Statistical Association in Fargo, North Dakota, February 19.

"Some business and industrial applications of statistics," seminar for the Department of Mathematics, Moorhead State University, February 19.

"Statistical inference for industrial applications: Another look," at the Deming Seminar for Statisticians, New York City, March 16, 1992, and at the conference Making Statistics More Effective in Business Schools, in Knoxville, Tennessee, June 26.

MUNDFROM, Daniel (University of Arkansas-Little Rock): "An application of course difficulty estimates to the prediction of academic achievement," by Mundfrom, William G. Miller, and **Mack C. SHELLEY II,** at the annual meeting of the American Educational Research Association, April 1992.

ROBERTS, Carl W.: "Content analysis," didactic seminar at the American Sociological Association meeting, Cincinnati, Ohio, August 24, 1991.

"When ideologies no longer make sense," at a conference on recent changes in Eastern Europe, Kulturelle und politische Orientierungen im Europa der Zukunft, June 25, 1992, in Munich, Germany.

ROLLINS, Derrick: "Problem solving in the chemical process industry," seminar, at Dow Chemical Company, Midland, Michigan, July 18, 1991.

"Gross error detection that yields unbiased estimates and confidence intervals for process variables," by Rollins and **Shonda Roelfs**—poster paper at the 1991 Gordon Research Conference on Statistics in Chemistry and Chemical Engineering, New Hampton, New Hampshire, July 31.

"Unbiased estimation of process variables when gross errors exist and constraints are bilinear," by Rollins and **Shonda Roelfs,** at the annual meeting of the American Institute of Chemical Engineers, Los Angeles, California, November 19.

"Maintaining accuracy in data reconciliation when gross errors are present," seminar, at Shell Development Company, Houston, Texas, May 12, 1992.

"Racism," seminar for undergraduate engineering students, at Moscow Bauman State Technical University and Moscow Mendeleev Institute, Moscow, Russia, May 28 and 29, respectively.

"Chemical engineering problem solving in the 'real world'," seminar for the Department of Chemical Engineering, Moscow Mendeleev Institute, May 29.

SACKS, Jerome: "The response of potato tubers to simulated handling," by P. Orr, M. Glynn, and Sacks, at the 1992 Summer Meeting sponsored by the American Society of Agricultural Engineers, held in Charlotte, North Carolina, June 21-24, 1992.

"Single dilution titration based on subjective scores," by Sacks, **S. Remadi,** C. Bolin, and J. R. Thurston, at the Great Lakes Symposium on Experimental Design, Kalamazoo, Michigan, held on June 24-26.

"Comparisons of blood values in gnotobiotic and conventional swine and calves," by E. D. Dennis, P. J. Matthews, and Sacks, at the Gnotobiotic Association meeting held in Madison, Wisconsin, on June 25-26.

SHELLEY, Mack C. II: "Contamination of cotton denim with Terbufos," by Janis Stone, Patricia Higby, Shelley, and H. Michael Starr, at the Nordic Coordination Group on Protective Clothing as a Technical Preventive Measure (NOKOBETEF) IV, 1992 Conference on Quality and Usage of Protective Clothing, Kittila, Finland, February 1992.

"Conservative policy success in the United States Congress: A longitudinal analysis of alternative measures," presented at the Midwest Political Science Association annual meeting, Chicago, Illinois, April.

SHERMAN, P. J.: "Random processes from rotating machinery," at a Workshop on Nonstationary Random Processes and Their Applications, held in Hampton, Virginia, August 1-2, 1991.

"A convergence approach for identifying harmonic signals," two lectures in the Stochastic Processes Seminar Series, Department of Mathematics, Iowa State University, November 14 and 21.

"Harmonic signals in unknown noise," seminar, Department of Electrical Engineering and Computer Engineering, Iowa State University, January 31, 1992.

"Hankel matrix range and null space methods for harmonic retrieval in unknown colored noise," by Sherman and D. E. Lyon, at the 1992 American Control Conference, held in Chicago, Illinois, June 24-26.

STEPHENSON, W. Robert: "Experimental design: A tool for process and product improvement," at a meeting of the Central Iowa Section, American Society for Quality Control, October 8, 1991, in Ankeny, Iowa.

STRAHAN, ROBERT F.: "Generalizing the binomial effect size display," at the annual meeting of the American Psychological Association, San Francisco, California, August 18, 1991.

STUFKEN, John: "Sampling designs useful for solid waste sampling," by A. S. Hedayat and Stufken, at the 1991 Conference on Solid Waste Research and Technology, held in Oak Brook, Illinois, October 15-16.

SUKHATME, Shashikala: "A simple method of finding powers of two-sample rank tests and its applications," seminar, Department of Mathematics Colloquium series, University of New Orleans, October 28.

"Two-sample rank tests with truncated populations," Department of Mathematics and Statistics, Bowling Green State University, November 25.

"On the choice of precedence tests," Department of Mathematical Sciences colloquium at the University of Akron, March 12, 1992.

"Stratification in nonparametric ROC studies," at Case-Western University, at the spring meeting of the Cleveland Decision Analysis Group, May 19, and as a special seminar, Department of Epidemiology and Biostatistics, May 22.

TERPSTRA, Harvey: "An overview of soil survey database activities at Iowa State University," at a regional U.S. Soil Conservation Service Soil Survey Database Workshop, Nashville, Tennessee, April 29.

VARDEMAN, Stephen B.: Discussant for the invited paper "Algorithmic Statistical Process Control and Continuous Improvement," July 30, 1991, during the Gordon Research Conference on Statistics in Chemistry and Chemical Engineering, in New Hampton, New Hampshire.

"The truth about inspection and 'All or None'," seminar, Department of Decision Sciences, Miami University, Ohio, April 24, 1992.

Ver Hoef, Jay M.: "Spatial design of ecological experiments," by Ver Hoef and **Noel A. C. CRESSIE,** at the annual meeting of the Ecological Society of America, San Antonio, Texas, August 6, 1991.

▓ Other Meetings

Edith Landin attended the annual convention of Professional Secretaries International in Dallas, Texas, July 19-25, 1991, as delegate for the Ames chapter.

Harold Baker and Marie Loughin attended the annual meeting of the American Agricultural Economics Association, in Manhattan, Kansas, August 5-7.

In addition to the faculty and graduate students mentioned earlier, Dean Isaacson, William J. Kennedy, Philip Iversen, Kui-Jang Wang, and Alan Zimmermann attended the annual joint statistical meetings in Atlanta, Georgia, in August. Soumendra Lahiri also attended the IMS/NSF Writing Workshop for Young Researchers, held in Atlanta.

Jauvanta Walker, secretary and art chair for the Iowa State Association, National League of American Pen Women, Inc., helped organize and conduct the annual state meeting in Des Moines September 21.

Wayne Fuller attended a meeting sponsored by the Committee on National Statistics September 25, in Washington, D.C., and the 1991 NBER/NSF Time Series Seminar September 28 at the University of Pittsburgh.

Dean L. Isaacson attended the Steven Orey Memorial Symposium, sponsored by the National Science Foundation, at the University of Minnesota, October 4.

Kathy Shelley attended technical sessions at the National Educom Conference in San Diego, California, October 16-19, and demonstrated, in the Zenith Data Systems booth, software she and Mack Shelley developed.

Soumendra Lahiri and Krishna Athreya attended the Thirteenth Midwest Conference on Probability, at Northwestern University October 18-19.

David Cox attended the winter meetings of the American Statistical Association in Louisville, Kentucky, January 2-5, on statistics in education.

Kathy Shelley attended the 24th Symposium on the Interface: Computing Science and Statistics, on March 18-21, 1992, at College Station, Texas.

W. Robert Stephenson, Richard Groeneveld, and David Harville attended the Iowa chapter meeting of the American Statistical Association and a statistics colloquium at the University of Iowa on April 16.

Stephenson attended a two-day seminar, "Quality, Speed, Customer Involvement, and the New Look of Organizations," presented by the Tom Peters' Group in Des Moines, Iowa, on April 20-21.

Ted Bailey participated in the North Central Regional Technical Committee—21 (Quantitative Genetics) meeting at Clemson University April 24.

David Cox, Paul Hinz, Mark Brabec, Molly Isbell, Thomas Loughin, Anita McVey, and Lie-ling Wu attended the Fourth Annual Conference on Applied Statistics in Agriculture at Kansas State University April 27-28. (Papers presented by C. Philip Cox and Jerome Sacks have been mentioned earlier.) On April 29, Jerome Sacks attended the USDA Biometricians annual meeting in Manhattan, Kansas.

Peter Sherman attended an Advanced Automotive Technologies Conference sponsored by the National Institute of Standards and Testing, in Gaithersburg, Maryland, May 4-5.

Dianne Anderson attended the Survey Field Directors Conference, St. Petersburg Beach, Florida, May 19-22.

F. Jay Breidt attended the International Workshop on Seasonal Adjustment Methods and Diagnostics, held by the Bureau of the Census in Washington, D.C., June 2-3.

Paul Hinz went to the IMS-WNAR Western Regional Meeting and an associated short course on Longitudinal Data and Time Series, held in Corvallis, Oregon, June 14-17.

William Q. Meeker and W. Robert Stephenson attended the National Science Foundation Conference on Statistics Education held in Washington, D.C., June 28-30.

Toni Genalo, survey projects coordinator, makes sourdough French toast with hot syrup for the spring breakfast.

Publications

In the Statistical Laboratory preprint series, 19 titles (#91-19 to 91-37) were added during the last half of 1991 and 11 more (#92-1 to 92-11) in the first half of 1992. Copies of the most recent set of abstracts are available on request. Any preprint may be requested by number directly from the author. A new set of preprint abstracts will be released in fall 1992.

In the listing of published work that follows, the names of authors from the ISU statistics center are in boldface type—all caps for faculty and staff and lower case letters for graduate students. When a publication is presenting work done wholly or in part at ISU but the author identified in boldface type is no longer here, present location is shown in parentheses.

Books

CRESSIE, Noel. *Statistics for Spatial Data.* New York: John Wiley & Sons. September 1991. xxii + 900 pp.

This book offers a wide but comprehensive coverage of the analysis of spatial data through statistical models. It delineates the three most vigorous areas of growth—geostatistical data, lattice data, and point patterns. The subject is presented through a blend of theory and applications. An extensive list of references, many from outside of statistics, is included.

Hahn, Gerald J., and **William Q. MEEKER, Jr.** *Statistical Intervals: A Guide for Practitioners.* New York: John Wiley & Sons. August 1991. xvii + 392 pp.

Frequently analysts need to draw conclusions about the real world from scanty sample data, and to quantify the "margin of error" associated with their inferences. Confidence intervals, prediction intervals, and tolerance intervals provide the mechanism for doing this. Thus, such intervals can be used to quantify uncertainty in data. Elementary statistics courses provide information on the construction of a few well-known confidence intervals, such as for a normal distribution mean and variance and for a binomial proportion. However, other statistical intervals frequently required in practice—such as a confidence interval on the probability of meeting a threshold value and a prediction interval on a future observation—are rarely discussed. As a result, analysts sometimes use the incorrect interval in applications.

This book provides an exposition of the application of the wide range of statistical intervals that can be used to answer various important practical questions that motivate statistical studies. Both distribution-free and distribution-dependent intervals are covered. The book includes detailed discussion of underlying assumptions, emphasis on choosing the appropriate interval, and detailed treatment of sample size requirements. The book contains easy-to-use figures and tables that make it easy to compute intervals for data and to determine the sample size that will be needed to achieve a specified degree of precision. Case studies illustrate practical considerations.

Bardes, Barbara A., **Mack C. SHELLEY II,** and Steffen W. Schmidt. *American Government and Politics Today: The Essentials,* 1992-93 edition. St. Paul: West Publishing Company. 1992. xxxi + 561 pp.

This is the fourth edition of the essentials version of an introductory textbook in national political institutions and processes. Extensive use is made of public opinion data, and students are advised how to interpret popular poll results in the light of sampling procedures and other considerations. Results of the 1988 and 1990 national elections are emphasized throughout the book.

Gene Sellers, **Stephen B. VARDEMAN,** and Del Hackert. *A First Course in Statistics,* 3rd edition. 1991. New York: Harper-Collins Publishers. xxi + 831 pp.

This elementary statistics textbook is a complete revision of the 1982 text *Elementary Statistics* by Sellers and Vardeman.

Published Research

Anderson, T. W., and **Yasuo AMEMIYA.** Testing dimensionality in the multivariate analysis of variance. *Statistics & Probability Letters* 12:6 (1991) 445-463.

In the multivariate one-way classification with fixed or random effects, the between-group effects may be restricted to a lower dimensional space. The problem of testing the dimension of the effect space is treated. For the balanced random effect model, the asymptotic null distribution of the likelihood ratio statistic is discussed; the asymptotic distribution is not chi-squared. For the unbalanced fixed or random effect model, we suggest the use of a test statistic of the same form. The test statistic is shown to have the same asymptotic null distribution as that for the balanced random effect model. The result is extended to the fixed or random effect models with covariates. The use of the test is illustrated in an example from animal breeding. Some optimality properties of the tests and open problems are discussed as well.

ATHREYA, K. B. On a maximum sequence in a critical multitype branching process. *The Annals of Probability* 20:2 (1992) 746-752.

Let $\{Z_n\}$ be a p type positively regular nonsingular critical branching process with mean matrix M. If v is a right eigenvector of M for the eigenvalue 1 and $Y_n = Z_n \cdot v$, and if $M_n = \max_{0 \le j \le n} Y_j$, then it is shown that under second moments $(\log n)^{-1} E_i M_n \to i \cdot v$, where E_i denotes starting with $Z_0 = i$ and $\cdot$ denotes inner product. This is an extension of the result for the single typecase obtained by Athreya in 1988.

ATHREYA, K. B., and **C. D. Fuh** (Academia Sinica, Taipei). Bootstrapping Markov chains. Pp. 49-64 in *Exploring the Bootstrap,* edited by R. LePage and L. Billard. New York: John Wiley & Sons, Inc. 1992.

This paper gives a survey of recent results on bootstrapping Markov chains. The results include those of (i) Prakasa Rao and Kulperger on finite state irreducible chains, (ii) Athreya and Fuh on countable state space positive recurrent irreducible aperiodic chains, (iii) Dutta and McCormick on the second-order accuracy in the finite state space case. Some open problems are also indicated.

ATHREYA, Krishna. Rates of decay of the survival probability of a mutant gene. *Journal of Mathematical Biology* 30:6 (1992) 576-582.

For a slightly supercritical branching process, the survival probability $1 - \nu$ is approximated by $2(m-1)\sigma^{-2}$ where m and σ are the mean and standard deviation of the offspring distribution. This paper provides a simple set of sufficient conditions for the validity of this result.

Fox, S. R., L. A. Johnson, C. R. Hurburgh, Jr., C. Dorsey-Redding, and **T. B. BAILEY.** Relations of grain proximate composition and physical properties to wet-milling characteristics of maize. *Cereal Chemistry* 69:2 (1992) 191-197.

Journal Paper J-1433 of the Iowa Agriculture and Home Economics Experiment Station, Projects 0178 and 2339.

Twenty-seven maize hybrids were selected from entries in the 1987 Iowa Corn Yield Trials. Shelled maize samples for these hybrids were then subsampled and studied to determine the relations of proximate compositions and physical properties to laboratory wet-milling characteristics. Multiple regression analyses and three-factor correlations were examined. No single trait accounted for more than 40% of the variation (r^2) in starch yield or more than 60% of the variation in protein content of the recovered starch. The best models for predicting starch yields included grain protein content and any of the following: test weight, absolute density, kernel hardness (Stenvert sample height), or water absorptivity (index or initial rate). Protein content in starch was found to be a function of grain protein and oil contents.

Lee, Byungtae, Anthony L. Pometto III, Alfred Fratzke, and **Theodore B. BAILEY, Jr.** Biodegradation of degradable plastic polyethylene by *Phanerochaete* and *Streptomyces* species. *Applied and Environmental Microbiology* 57:3 (1991) 678-685.

Journal Paper J-14183 of the Iowa Agriculture and Home Economics Experiment Station, Projects 178 and 2889.

The ability of lignin-degrading microorganisms to attack degradable plastics was investigated in pure shake flask culture studies. Weight loss and changes in tensile strength, percent elongation, and polyethylene molecular weight distribution were used to evaluate biodegradability after chemical degradation was initiated by heat pretreatment or UV irradiation pretreatment of the plastic film. Six heat pretreatment durations and three irradiation pretreatment durations were used in the experimental design with three *Streptomyces* species treatments and one *Phanerochaete* fungal treatment and an uninoculated control for each treatment.

A unique feature of the design was the inclusion of pure culture systems as controls. These controls permitted a distinction between chemical and biological degradation. The research demonstrated that lignin-degrading microorganisms can degrade specific components of degradable plastics.

Beam, Craig A. (Duke University Medical Center), and **H. Samuel WIEAND.** A statistical method for the comparison of a discrete diagnostic test with several continuous diagnostic tests. *Biometrics* 47:3 (1991) 907-919.

In this paper we study a statistic that is suitable for comparing a discrete diagnostic marker to one or more continuous diagnostic markers. Test procedures and confidence intervals are based on asymptotic normality. The statistic is applicable for correlated data in which all the markers are obtained for each subject. The statistic was studied for use in comparing two markers for rectal bleeding. Examples for this application and two more general applications are presented.

BREIDT, F. Jay, Duane C. Boes, Joel I. Wagner, and Mark D. Flora. Antidegradation water quality criteria for the Delaware River: A distribution-free statistical approach. *Water Resources Bulletin* 27:5 (1991) 849-858.

Existing water quality for the Middle Delaware Scenic and Recreational River is significantly better than is required by current standards, leaving a potential for degradation. A method is presented for deriving candidate antidegradation water quality criteria for this segment of the Delaware River using statistical analysis of historic (ambient) water quality data.

CARRIQUIRY, A. L., W. P. Ireland, W. H. Kliemann, and E. Uemura. Statistical evaluation of dendritic growth models. *Bulletin of Mathematical Biology* 53:4 (1991) 579-589.

A mathematical model that predicts the quantitative branching pattern of dendritic tree was evaluated, using the apical and basal dendrites of rat hippocampal neurons. The Wald statistic for χ^2-test was developed for the branching pattern of dendritic trees and for the distribution of the maximal order of the tree. Using this statistic, we obtained a reasonable fit of the mathematical model for the dendritic data. The model's predictability of branching pattern was greatly enhanced by replacing the assumption "splitting of branches for all dendritic orders is stochastically independent," with a new assumption "branches are more likely to split in areas where there is already a high density of branches." The modified model delivered an excellent fit for dendrites of hippocampal neurons from young rats (30-34 days postpartum).

Bouzaher, Aziz, and **Alicia L. CARRIQUIRY.** Multiproduct dry milling yields prediction when products are not independent. *Applied Statistics in Agriculture*—Proceedings of the 1991 Kansas State University Conference on Applied Statistics in Agriculture. 1992. Pp. 102-117.

CRESSIE, N. Small-area prediction of undercount using the general linear model. Pp. 93-105 in *Proceedings of Statistics Canada 90 Symposium—Measurement and Improvement of Data Quality.* Ottawa: Statistics Canada. 1991.

CRESSIE, N. Comment on "Should we have adjusted the Census of 1980?" by D. A. Freedman and W. C. Navidi. *Survey Methodology* 18:1 (1992) 32-34.

CRESSIE, Noel. Modeling growth with random sets. Pp. 31-45 in *Spatial Statistics and Imaging* (Proceedings of the 1988 AMS-IMS-SIAM Joint Summer Research Conference), edited by A. Possolo. Hayward, California: Institute of Mathematical Statistics. 1991.

CRESSIE, Noel. Smoothing regional maps using empirical Bayes predictors. *Geographical Analysis* 24:1 (1992) 75-95.

Maps are one of the geographer's basic tools. Suppose the data to be mapped are values of a variable that are known only by region. From the point of view of pure data summary, a map of the regions coded or colored according to the values of the variable is a very effective way of presenting both the data and the regional geography. However, it is tempting to use such a map for other purposes, such as cluster detection and comparison with previous time periods. This article concentrates on the important case where the variable mapped is a rate. Since such rates have a nonconstant base, one is faced with a statistical comparison of regional data whose variances may be highly different.

CRESSIE, Noel. REML estimation in empirical Bayes smoothing of census undercount. *Survey Methodology* 18:1 (1992) 75-94.

One way to assess the undercount at subnational levels (e.g., the state level) is to obtain sample data from a post-enumeration survey, and then smooth those data based on a linear model of explanatory variables. The relative importance of sampling-error variances to corresponding model-error variances determines the amount of smoothing. Maximum likelihood estimation can lead to oversmoothing, thus making the assessment of undercount over-reliant on the linear model. Restricted maximum likelihood (REML) estimators do not suffer from this drawback. Empirical Bayes prediction of undercount based on REML is presented in this article, and is compared to maximum likelihood and a method of moments by both simulation and example.

CRESSIE, Noel, and **Martín O. Grondona** (Instituto Nacional de Tecnologia Agropecuaria, Buenos Aires, Argentina). A comparison of variogram estimation with covariogram estimation. Chapter 15 (pp. 191-208) in *The Art of Statistical Science,* edited by K. V. Mardia. Chichester, England: John Wiley & Sons Ltd. 1992.

Consider the class of intrinsically stationary spatial processes, which contains the class of second-order stationary processes. A measure of spatial independence in the larger class is the variogram, from which optimal linear spatial predictors can be constructed. For processes that are second-order stationary, these optimal linear predictors can also be expressed in terms of the covariogram. Traditionally, time-series forecasting has used the covariogram, but use of the variogram allows more general processes to be considered. These measures of spatial dependence are often unknown and have to be estimated from the data. In this article, we show that estimation of the variogram has important advantages over estimation of the covariogram.

CRESSIE, Noel, and Frederick L. Hulting. A spatial statistical analysis of tumor growth. *Journal of the American Statistical Association* 87:418 (1992) 272-283.

Growth models commonly are developed for a one-dimensional summary (e.g., number of cells, volume). At the supracellular level, however, ignoring tumor shape leads to oversimplification of the growth mechanism. This article presents a growth model that uses shape information at a previous time to describe the tumor at the present time. An analysis is given of three successive two-dimensional images of cell islands, which are obtained from *in vitro* growth of human breast cancer cells.

CRESSIE, Noel, and Dale L. Zimmerman. On the stability of the geostatistical method. *Mathematical Geology* 24:1 (1992) 45-59.

A thorough geostatistical analysis of spatial data, observed at given spatial locations, includes explor-

atory data analysis, spatial-model building, diagnosing the model fit, and inference on unknown model parameters or unobserved values (at known locations). Using results from mathematical analysis, exact and asymptotic distribution theory, and simulation studies, we argue that, when used sensibly, the geostatistical method is reassuringly stable.

Ruppert, David, **Noel CRESSIE,** and Raymond J. Carroll. Response to "Generalized linear models for enzyme-kinetic data" by J. A. Nelder. *Biometrics* 47:4 (1991) 1610-1615.

Zimmerman, Dale L., and **Noel CRESSIE.** Mean squared prediction error in the spatial linear model with estimated covariance parameters. *Annals of the Institute of Statistical Mathematics* 44:1 (1992) 27-43.

The problem considered is that of predicting the value of a linear functional of a random field when the parameter vector $\underset{\sim}{\theta}$ of the covariance function (or generalized covariance function) is unknown. The customary predictor when $\underset{\sim}{\theta}$ is unknown, which we call the EBLUP, is obtained by substituting an estimator $\underset{\sim}{\hat{\theta}}$ for $\underset{\sim}{\theta}$ in the expression for the BLUP's mean squared prediction error (MSPE); we call this the EMSPE. In this article, the appropriateness of the EMSPE as an estimator of the EBLUP's MSPE is examined, and alternative estimators are suggested for use when the EMSPE is inappropriate. Several illustrative examples show that the performance of the EMSPE depends on the strength of spatial correlation; the EMSPE is at its best when the spatial correlation is strong.

DAVID, H. A.: Some properties of order statistics filters. *Circuits, Systems, and Signal Processing,* Special Issue, 11:1 (1992) 109-114.

Let X_1, X_2,... be a stationary sequence of random variables with $\Pr\{X_t \leq x\} = F(x)$, t = 1, 2,.... Also let $X_{i:n}^{(t)}$, i = 1,...,n, denote the ith order statistic (OS) in the moving sample $(X_{t-N},...,X_{t+N})$ of odd size n = 2N + 1. Then $Y_t = \Sigma \, a_i X_{i:n}^{(t)}$ with $\Sigma \, a_i = 1$ is an order-statistics filter. In practice $a_i \geq 0$, i = 1,...,n. For t > N, the sequence $\{Y_t\}$ is also stationary. If X_1, X_2,... are independent, the autocorrelation function $\rho(r) = corr(Y_t, Y_{t+r})$ is zero for r > n − 1 and for r ≤ n − 1 can be evaluated directly in terms of the means, variances, and covariances of the OS in random samples of size n + r from F(x).

In special cases several authors have observed that the spectral density function $f(\omega)$ of $\{Y_t\}$ is initially decreasing for $\omega > 0$. This result is made more precise and shown to hold generally under white noise. The effect of outliers (impulses) is also discussed.

DAVID, H. A. Introduction to Frederick Mosteller (1946) "On some useful 'inefficient' statistics." *Annals of Mathematical Statistics* 17, 377-408. Pp. 203-220 in *Breakthroughs in Statistics,* Vol. 2, edited by S. Kotz and N. L. Johnson. New York: Springer Verlag. 1992.

DAVID, H. T., and **Shawki A. Salem** (Princeton Biostatistics Group). Three shrinkage constructions for Pitman-closeness in the one-dimensional location case. *Communications in Statistics— Theory and Methods* 20:11 (1991) 3605-3627.

Let θ be the location parameter of a location family, and let X be a single observation from a member of that family. Write $T(X) \triangleright T'(X)$ when the statistic T(X) is closer in the Pitman sense to θ than T' is. This paper exhibits (1) for each of a large class of univariate location families, a set S of statistics T(X) with $T(X) \triangleright X$; (2) for each of the same class, a "Pitman-transitive" set S* (i.e., such that, for T, T', T" $\in$ S*, $T \triangleright T'$ and $T' \triangleright T''$ imply $T \triangleright T''$) in one-to-one correspondence with the closed unit interval, and (3) for the univariate Laplace location family with unit scale parameter, a "Pitman-intransitive" triple (T,T',T") of members of S.

Jobe, J. Marcus, and **H. T. DAVID:** Buehler confidence bounds for a reliability-maintainability measure. *Technometrics* 34:2 (1992) 214-222.

This article presents an upper confidence bound for a measure of reliability/maintainability of a series system in which component repair is assumed to restore the system to its original status. Under exponentiality of component-repair time and survival time distributions, the measure M is the ratio of expected system-repair time to expected system-survival time. Moreover, under this exponentiality assumption, the bound is uniformly minimum among all bounds of specified level that are nondecreasing functions of the maximum-likelihood estimator of M. As a matter of practical interest, the measure M has been incorporated into Military Standard MIL-STD-470B and is an official statistic of the Air Force Reliability Maintainability Information System.

FULLER, W. A. Regression estimation in the presence of measurement error. Pp. 617-635 in *Measurement Errors in Surveys,* edited by P. P. Biemer et al. New York: John Wiley & Sons, Inc. 1991.

Methods of incorporating knowledge about the measurement error process into estimators of regression coefficients are given. The basic theory for regression models with error in the independent variables and the extension of the basic theory to complex surveys is reviewed. Models with heterogeneous error variances are discussed, and the effect of estimating the response error variances of the independent variables on the estimators is evaluated. It is demonstrated that, for analytic surveys, use of one fourth of the resources for response variance estimation can often be justified. Methods of estimation appropriate for designs in which repeated measures are available for part of the responses are presented.

FULLER, Wayne A. Small area estimation as a measurement error problem. Pp. 333-359 in *Eco-*

nomic Models, Estimation, and Socioeconomic Systems: Essays in Honor of Karl A. Fox, edited by Tej K. Kaul and Jati K. Sengupta. Amsterdam: North Holland 1991.

The small area estimation problem considered contains three components: (a) a probability sample that can be used to construct direct estimates for some of the small areas, (b) auxiliary information present for all small areas, and (c) a model, which specifies the relationship among the forms of information and permits construction of estimators for the small areas. We present a model and estimation procedure for small area estimation in which the true values for the small areas can be treated as fixed. Estimators are constructed for the small areas that are unbiased for each small area under the fixed model. The model can be modified to treat the small area means as a random sample from a super population. The fixed and random specifications enable identification of the sources of error in alternative small area estimators.

Nagaraj, Neerchal K., and **Wayne A. FULLER.** Estimation of the parameters of linear time series models subject to nonlinear restrictions. *The Annals of Statistics* 19:3 (1991) 1143-1154.

Least squares estimators of the parameters of a linear time series model, where the parameters are constrained by a set of nonlinear restrictions, are studied. The model may contain lags of the dependent variable as regressors and the sums of squares of the explanatory variables may grow at different rates as the sample size increases. The estimation procedures can be applied to a regression model with an error process that satisfies either a stationary or a nonstationary autoregression.

Gan, F. F. (National University of Singapore), and **K. J. KOEHLER.** A goodness-of-fit test based on P-P probability plots. *Journal of Quality Technology* 24:2 (1992) 96-102.

A quantitative measure of linearity of a P-P probability plot is the square of the correlation coefficient of points on the plot. This statistic aids in the assessment of goodness of fit of a hypothesized distribution. A computer program is presented for computing the p value of this statistic when testing the goodness of fit of a normal, a Gumbel, or an exponential distribution. The program can also construct a normal, a Gumbel, or an exponential P-P probability plot.

Stafford, K., M. Winter, K. A. Duncan, and **M. A. GENALO.** Studying at-home income generation: Issues and methods. *Life Styles: the Journal of Family and Economic Issues* 13:2 (1992) 139-158.

Methods used to locate and study 899 home-based workers and their households in nine states are described in detail, with emphasis on the rationale behind the decisions about the definition of home-

based work, sampling, the development of the interview schedule, data collection procedures, and data preparation. More than 10 percent of all households in the nine states included someone who was engaged in home-based work; 7 percent of the households had a member who had been engaged in the activity for more than one year and who spent at least 312 hours annually in the activity. The respondents had a mean age of 42.5 years, and had completed a mean of 13.8 years of education. More than half lived in communities of 2500 or over, and had lived there for more than 10 years. More than 40 percent of the sample consisted of individuals who were married and had children living in the home. The average household income in 1988 was just over $42,000.

GROENEVELD, Richard A. Sharp inequalities for skewness measures. *The Statistician* 40:4 (1991) 387-392.

Several functionals measuring skewness of a random variable are considered. Bounds are found for a number of these measures, and conditions under which these bounds hold as equalities shed light on the idea of skewness. In particular, for μ, m, and σ representing the expectation, median, and standard deviation of X, the functional $(\mu - m)/\sigma$ is shown to be an inappropriate skewness measure for highly J-shaped distributions. The functional $(\mu - m)/E|X - m|$ is, however, an appropriate skewness measure.

Grondona, Martín O. (Instituto Nacional de Tecnologia Agropecuaria, Buenos Aires, Argentina), and **Noel CRESSIE.** Using spatial considerations in the analysis of experiments. *Technometrics* 33:4 (1991) 381-392.

Classical experimental design is based on the three concepts of randomization, blocking, and replication. Randomization endeavors to neutralize the effects of (spatial) correlation and yields valid tests for the hypothesis of equal treatment effects. More recently, attempts have been made to use the spatial location of treatments to improve the efficiencies of estimators of treatment contrasts. In this article, we show that a simple, flexible spatial-modeling approach to the analysis of industrial experiments (e.g., wafer fabrication) can yield more efficient estimators of the treatment contrasts than the classical approach.

HARVILLE, David A. Comment on "Interpreting blocks and random factors," by M. L. Samuels, G. Casella, and G. P. McCabe. *Journal of the American Statistical Association* 86:415 (1991) 812-815.

Fenech, Alan P., and **David A. HARVILLE.** Exact confidence sets for variance components in unbalanced mixed linear models. *The Annals of Statistics* 19:4 (1991) 1771-1785.

A general procedure is presented for obtaining an exact confidence set for the variance components in a mixed linear model. It uses, as pivotal quantities, quadratic forms that are distributed independently as

chi-squared variables. These quadratic forms are constructed with reference to spaces that are orthogonal with respect to the covariance matrix of the observation vector, which is a function of the variance components. For balanced models, these pivotal quantities simplify to multiples of the sums of squares used in the ANOVA method. An exact confidence set for the vector of ratios of the effect variances to the error variance is also presented, based on the same collection of quadratic forms.

HINZ, Paul N., and **John P. Lagus** (3M Company). Evaluation of four covariate types used for adjustment of spatial variability. *Applied Statistics in Agriculture*—Proceedings of the 1991 Kansas State University Conference on Applied Statistics in Agriculture. 1992. Pp. 118-126.

Four types of covariates are used to account for spatial variability in data from a field experiment for evaluating 620 soybean varieties for iron chlorosis. The covariates are calculated as the average of 4 and of 14 neighboring residuals and of 4 and of 14 neighboring observations. The residual mean square from the analysis of covariance was smaller when residuals were used in the calculation of the covariates than when observations were used. Moreover, use of 14 neighbors resulted in smaller residual mean squares than did use of 4 neighbors. Expected values for the covariate regression coefficients were derived based on an errors-in-variables model.

Hulting, Frederick L. (Alcoa Laboratories), and **David A. HARVILLE.** Some Bayesian and non-Bayesian procedures for the analysis of comparative experiments and for small-area estimation: computational aspects, frequentist properties, and relationships. *Journal of the American Statistical Association* 86:415 (1991) 557-568.

The estimation of a treatment contrast from experimental data and the estimation of a small-area mean are special cases of the prediction of the realization of a linear combination of fixed and random effects in a possibly unbalanced two-part mixed linear model. In this article, a Bayesian approach to point and interval prediction is presented, and its computational requirements are examined. Differences between the Bayesian approach and the traditional (classical) approach are discussed in general terms, and also in terms of two examples. Some deficiencies in the classical approach are pointed out, and the Bayesian approach is considered from a frequentist perspective.

Araneda, L., **J. P. JONES,** A. Kantardjieff, and R. Zaloum. Le procédé biocarbone comme alternative de traitement secondaire pour l'usine de papier journal Kruger Inc., Bromptonville (The biocarbon process—an alternative secondary treatment process for Kruger Inc. newsprint mill in Bromptonville). *Pulp Paper Canada* 93:3 (1992) T64-68.

Wastewaters from the Kruger Bromptonville mill were used for test dealing with performance limitation analysis of biological filtration carried out under controlled flow conditions. Results indicated that the aerated biological filter efficiency in reducing conventional parameters is similar to that of traditional methods despite much lower residence times. Biological tests on rainbow trout, daphnia, algae, and photoluminescent bacteria showed an absence of toxicity of treated effluents. An analysis of results obtained is presented.

Carrière, J., **J. P. JONES,** and A. D. Broadbent. The use of ozone for decolorizing textile wastewater. *Proceedings of the International Ozone Association, PAC.* 1991. Pp. 297-307.

An investigation was performed into the effect of pH, temperature, and initial concentration on the decolorization reactions using ozone. Two synthetic textile wastewaters were examined corresponding to two commonly used dyestuffs in the carpet industry.

Carrière, J., **J. P. JONES,** and A. D. Broadbent. Décoloration des eaux usées par ozonation (Decolorization of wastewater by ozonation). *Canadian Textile Journal* 109:4 (1992) 26-30.

One of the major problems that the textile industry will have to solve in the near future is the decolorization of its effluents. Ozonation is a solution. It was found that, with ozonation, very high levels of decolorization can be reached and that the resulting wastewaters are disinfected to almost 100%. More research is needed on the interaction of organic compounds with the dyes during ozonation to reduce as much as possible the costs related to decolorization and to optimize the ozonation process for decolorizing industrial wastewaters.

Polan, P., and **J. P. JONES.** Problématique des métaux lourds et des organismes pathogènes dans les boues de station d'épuration municipale (Heavy metals and pathogens in sludge from municipal wastewaters treatment plants). *Sciences et Techniques de l'eau* 25:1 (1992) 11-16.

Among the various options for eliminating wastewaters treatment sludge, composting is the most attractive based on the environmental impacts. This paper discusses the options for attenuating the effects of heavy metals and pathogenic microorganisms.

KEMPTHORNE, O. Intervention experiments, randomization and inference. Pp. 13-31 in *Current Issues in Statistical Inference: Essays in Honor of D. Basu,* edited by Malay Ghosh and Pramod K. Pathak. Institute of Mathematical Statistics Lecture Notes-Monograph Series, Volume 17. 1992.

This essay gives a discussion of processes of design and analysis of a study of the effect of two or more interventions or treatments on a set of experimental material (e.g., an agricultural area, or a set of mice, or a human). The problems of design, which includes, critically, the plan by which treatments are conjoined to experimental units, and of analysis are discussed. The author suggests that everything be based on randomization, both design and analysis by randomization tests and inversion thereof. The problem that usual conventional randomization gives bad plans is discussed, and a suggestion is made to overcome it. Parametric models are not used, so defects in conventional parametric inference do not arise. The matter of subjectivity and objectivity is discussed.

KOEHLER, Kenneth J., and **James T. Symanowski** (Lilly Research Laboratories). Applications to ordered categorical data. Chapter 18 (pp. 495-552) in *Handbook of the Logistic Distribution,* edited by N. Balakrishnan. New York: Marcel-Dekker. 1991.

A bivariate distribution with logistic marginals is developed. The distribution function has a closed form expression and it is everywhere differentiable. The correlation coefficient can range from $-3\pi^2$ to 1. Two applications to ordered categorical data are considered. The first considers measures of association and changes in the means and variances of the marginal distributions of two-way contingency tables. The second application includes the development of a bivariate logistic regression model.

LAHIRI, S. N. Edgeworth correction by 'Moving Block' bootstrap for stationary and nonstationary data. Pp. 183-214 in *Exploring the Limits of Bootstrap,* edited by Raoul LePage and Lynne Billard. New York: John Wiley & Sons, Inc. 1992.

This paper considers second order properties of the 'moving block' bootstrap procedure, proposed by Künsch (1989: *The Annals of Statistics,* 17, 1217-1241). In the case of sample mean of weakly dependent stationary data, the exact rate of approximation by Künsch's bootstrapped statistic is determined and observed to be worse than the rate of normal approximation. However, a suitable modification in the definition of the bootstrapped statistic removes this deficiency and provides a second order correct approximation. Similar optimality is proved for the studentized sample mean of m-dependent data. Furthermore, the modified version is shown to be "robust" in the cases where the observations are not necessarily stationary.

Liu, Jingyu. Precedence probabilities and their applications. *Communications in Statistics—Theory and Methods* 21:6 (1992) 1667-1682.

In precedence tests, the test powers are given by the probabilities $P(Y_{(i)} > X_{(j)})$ for some i and j, where $X_{(j)}$ and $Y_{(i)}$ are the order statistics of two independent random samples. Such probabilities can also arise in reliability theory. In this paper, we investigate the properties of these probabilities and their applications.

Conger, Rand D., Katherine J. Conger, Glen H. Elder, Jr., **Frederick O. LORENZ,** Ronald L. Simons, and Les B. Whitbeck. A family process model of economic hardship and adjustment of early adolescent boys. *Child Development* 63:3 (1992) 526-541.

Journal Paper J-13888 of the Iowa Agriculture and Home Economics Experiment Station, Project 2931.

This paper proposes a family process model linking economic stress in families to prosocial and problematic adolescent adjustment. Using a sample of 205 seventh grade boys living in intact families in the rural Midwest, we found that objective economic conditions were related to parents' emotional status and behaviors through their perceptions of increased economic pressures such as inability to pay monthly bills. These pressures were associated with depression and demoralization for both parents, which was related to marital conflict and disruptions in skillful parenting. Disrupted parenting mediated the relations between the earlier steps in the stress process and adolescent adjustment.

Conger, R. D., **Frederick O. LORENZ,** G. H. Elder, Jr., J. N. Melby, R. L. Simons, and R. J. Conger. A process model of family economic pressure and early adolescent alcohol use. *Journal of Early Adolescence* 11:4 (1991) 430-449.

This study examines the utility of a process model that links economic pressure and adolescent use of alcohol in a sample of 76 rural Midwest families. The findings suggest that parental hostility directed toward children is associated with adolescent antisocial behavior through a process of social learning that leads to deviant friends and alcohol use. Conflict in the marriage is directly related to adolescent drinking as a possible coping response to family stress and, perhaps, through the disruption of parents' ability to function as effective agents of social control.

Vann, Roberta J., **Frederick O. LORENZ,** and Daisy Meyers. Error gravity: Faulty responses to errors in written discourse of non-native speakers of English. Pp. 181-195 (Chapter 10) in *Assessing Second Language Writing in Academic Contexts,* edited by L. Hamp-Lyons. Norwood, New Jersey: ABLEX. 1991.

Faculty at a Midwest university were randomly assigned to questionnaires that asked them to evaluate compositions with one of three types of errors: verb tense, articles, and spelling. The research extended earlier studies to show that a "hierarchy of errors" exists only in special instances. When asked how acceptable the language was, respondents followed a

traditional hierarchy of errors: spelling errors were most acceptable, followed by article errors. But for other criteria, the posited hierarchy of errors did not show up. The multivariate analysis of variance was based on 215 respondents.

Whitbeck, L. B., R. L. Simons, R. D. Conger, **Frederick O. LORENZ,** S. Huck, and G. H. Elder, Jr. Family economic hardship, parental support, and adolescent self-esteem. *Social Psychology Quarterly* 54:4 (1991) 353-363.

Based on self-reports and observational data from a sample of 451 families of early adolescents, we used structural equation models to examine the effects of parents' reports of family economic hardship on the self-esteem of their adolescent children. We found that family economic hardship affects early adolescents' self-esteem indirectly by decreasing parental support and involvement, but had a very weak direct effect. We conclude that the effects of the family's economic hard times on parents' behaviors toward their adolescent children are more psychologically central to early adolescents than are the direct consequences of the family's economic situation.

MEADOR, Bud J. Installing PC/SAS—one on one. Pp. 295-299 in *Proceedings of MWSUG '91*, edited by LeRoy Bessler. Fox Point, Wisconsin: Midwest SAS Users Group. 1991.

Medak, Frederick, and **Noel CRESSIE.** Confidence regions in ternary diagrams based on the power-divergence statistics. *Mathematical Geology* 23:8 (1991) 1045-1057.

G. S. Watson and H. Nguyen (*Mathematical Geology* 17, 209-213, 1985) and Watson (*ibid.* 19, 347-348, 1987) consider the problem of plotting confidence regions in a ternary diagram, for a trinomial probability vector π, based on Pearson's χ^2. Their results are extended to the power-divergence family of statistics resulting in confidence regions of diverse shapes and sizes. The members of the family with the most accurate coverage probabilities are $\lambda = \frac{2}{3}$ and $\lambda = \frac{1}{2}$.

MEEDEN, Glen (University of Minnesota), and **Stephen VARDEMAN.** A noninformative Bayesian approach to interval estimation in finite population sampling. *Journal of the American Statistical Association* 86:416 (1991) 972-980.

A noninformative Bayesian approach to interval estimation in finite population sampling is discussed. Given the sample, this method introduces the Polya distribution as a pseudo posterior distribution over the unobserved members of the population. In many cases this distribution yields interval estimates similar to those of standard frequentist theory. In addition, it can be used in situations where the standard methods are difficult to apply, for example, in producing an interval estimate for the ratio of two medians. We also consider related point estimation problems and observe that estimators derived from the pseudo posterior often perform better than classical alternatives.

MEEKER, William Q., Jr., Luis A. Escobar, and David A. Hill. Sample sizes for estimating the Weibull hazard function from censored samples. *IEEE Transactions on Reliability* 41:1 (1992) 133-138.
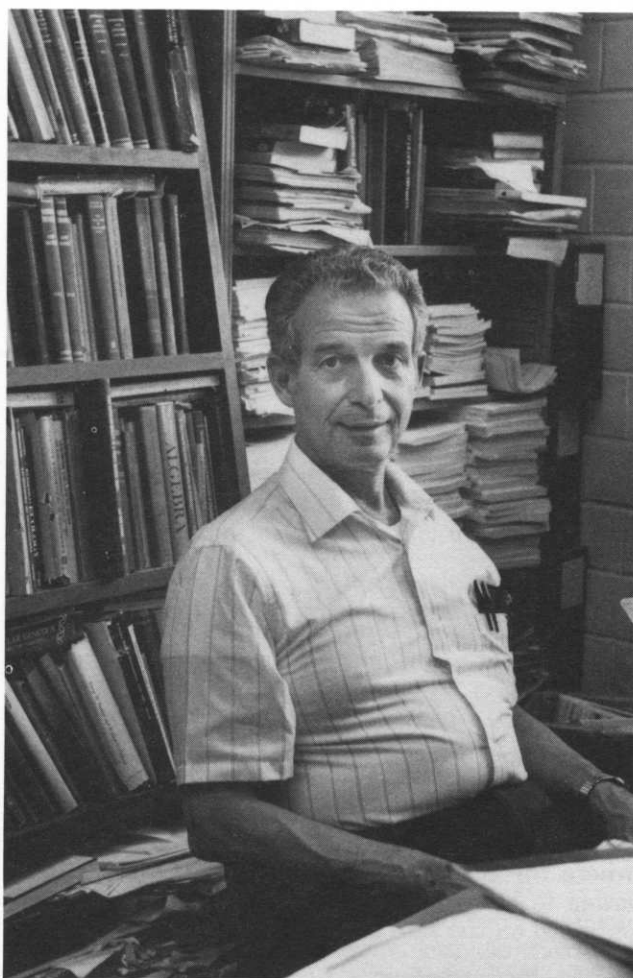
An important part of planning a life test is the specification of the sample size needed to achieve a specified degree of precision from the experiment. The hazard function is frequently used as a decision criterion, especially in replacement decisions. In this paper we show how to choose the sample size needed to estimate a point on the hazard function with a specified degree of precision. We provide an easy-to-use graph that can be used with the Weibull distribution and a life test that will be terminated after a pre-specified amount of time. We describe how to apply the methodology with other time-to-failure distributions and other kinds of life tests.

Escobar, Luis A., and **William Q. MEEKER, Jr.** Assessing influence in regression analysis with censored data. *Biometrics* 48:2 (1992) 507-528.

In this paper we show how to evaluate the effect that perturbations to the model, data, or case weights have on maximum likelihood estimates from censored survival data. The ideas and methods also apply to other nonlinear estimation problems. We review the ideas behind using log-likelihood displacement and local influence methods. We describe new interpretations for some local influence statistics and show how these statistics extend and complement traditional case deletion influence statistics for linear least squares. These statistics identify individual and combinations of cases that have important influence on estimates of parameters and functions of those parameters. We illustrate the methods by reanalyzing the Stanford Heart Transplant data with a parametric regression model.

Kernan, W. J., and **W. Q. MEEKER.** A statistical test to assess changes in spontaneous behavior of rats observed with a computer pattern recognition system. *Journal of Biopharmaceutical Statistics* 2:1 (1992) 115-135.

A computer pattern recognition system, RAPID, has been used to study the spontaneous motor activity of Sprague-Dawley rats. This system produces a large number of measures of the activity of control and experimental groups in any given study. The large number of measures involved presents a problem when one attempts to decide whether the behavioral activity of the exposed group differs from that of the control group. Extensive Monte Carlo studies have been performed in an attempt to develop and validate a simple statistic to be used in such decisions.

confidence intervals for process measurements and leaks. This technique includes α-level (control of type I error) global and component tests with their appropriate power functions. The component tests address the identification of measurement biases and process leaks when multiple biases and leaks exist alone and simultaneously. A general process network algorithm is being developed which combines all these methods for optimal analysis and estimation.

Davis, J. F., P. R. Prasad, J. K. McDowell, J. R. Whiteley, K. Sravana Kumar, **D. K. ROLLINS,** D. R. Myers, and M. S. Gandikota. On-line diagnosis of process and manufacturing operations: The integration of knowledge-based, neural net and conventional numeric approaches. Pp. 589-594 in *Probabilistic Safety Assessment and Management, Volume 1,* edited by George Apostolakis—Proceedings of the 1991 International Conference on Probabilistic Safety Assessment and Management (PSAM). New York: Elsevier Science Publishing Company. 1991.

Cutlip, Randall C., Howard D. Lehmkuhl, **Jerome M. SACKS,** and **Amy L. Weaver.** Seroprevalence of ovine progressive pneumonia virus in the United States as assessed by analyses of voluntarily submitted samples. *American Journal of Veterinary Research* 53:6 (1992) 976-979.

In this study of detection of antibodies against ovine progressive pneumonia (OPP) virus in sheep in the U.S., we found a lower general prevalence of antibodies than was previously reported. Of 16,827 sheep from 29 states in the U.S., 26% were seropositive and 48% of 164 flocks that were tested had 1 or more seropositive sheep. Seropositivity to OPP virus for sheep within special categories and within regions of the U.S. was determined. Seropositivity was variable among regions and among breeds and was not associated with sex, wool class, or place of origin of ancestors. Prevalence increased with age to a plateau of 34% at 4 years.

Orr, P. H., J. R. Sowokinos, D. C. Nelson, M. C. Thoreson, **J. M. SACKS, J. D. Hofer,** and K. G. Janardan. Chipping quality and yield of 'Norchip' potatoes damaged by simulated hail. *Transactions of the American Society of Agricultural Engineers* 34:5 (1991) 2085-2090.

'Norchip' potato plants were subjected to simulated hail damage in a two-factor experimental design. The factors were degree of damage and time of damage in weeks post emergence. Hail was simulated by striking plants with lead spheres tethered to a hand-held rotating shaft. Losses due to simulated hail damage were assessed as quality loss, as measured by pre-harvest sugar concentration and post-harvest chip color, as yield loss, and as specific gravity loss. The experiment was replicated for four years. The results

Ed Pollak continues the development of theory in mathematical and statistical genetics.

POLLAK, Edward. Survival probabilities for some multitype branching processes in genetics. *Journal of Mathematical Biology* 30:6 (1992) 583-596.

Consider a positively regular slightly supercritical branching process with K types. An approximation to the probability of survival of a line descended from a single individual of type i has recently been derived by F. M. Hoppe. If K is large, however, this approximation may not be easy to compute. A further approximation that is easily computable is given. The result is used to estimate probabilities of survival of an allele A that is originally present in one male or one female in a large random mating age-structured population. Both autosomal and sex-linked loci are considered. Another application of the approximation is also discussed.

ROLLINS, D. K., and J. F. Davis. Unbiased estimation of gross errors in process measurements. *AIChE [American Institute of Chemical Engineers] Journal.* 38:4 (1992) 563-572.

In this work a new gross error detection technique is described that provides unbiased estimates and

suggest that, in general, hail damage had little influence on chip color but could reduce yield to 64% of control by causing both reduced tuber weight and lower tuber number. Average specific gravity (an important quality attribute of chip potatoes) also fell from 1.096 to 1.085.

Tatum, Fred M., Philippe G. Detilleux, **Jerome M. SACKS,** and Shirley M. Haling. Construction of Cu-Zn Superoxide dismutase deletion mutants of *Brucella abortus:* Analysis of survival in vitro in epithelial and phagocytic cells and in vivo mice. *Infection and Immunity* 60:7 (1992) 2863-2869.

Cu-Zn superoxide dismutase (SOD) deletion mutants of *Brucella abortus* S2308, a virulent strain, and S19, a vaccine strain, were generated by gene replacement. A deletion plasmid, pBAΔsodkn^r, was constructed and introduced into *B. abortus* by electroporation, and Southern blot analysis confirmed that the antibiotic resistance fragment had replaced Cu-Zn *sod* in kanamycin-resistant colonies. The survival and growth of Cu-Zn SOD mutant strains were compared with, and found similar to, those of the parental strains in HeLa cells and in the mouse macrophagelike cell line J774. The kinetics of infection with these strains were examined in BALB/c mice. Results suggest that the antioxidant enzyme Cu-Zn SOD plays a role in the survival and pathogenicity of *B. abortus* in vivo.

SHELLEY, Kathy, and **Mack C. SHELLEY II.** Designing data analysis systems by integrating PC SAS, Windows 3.0, and Toolbook. Pp. 300-305 in *Proceedings of MWSUG '91,* edited by LeRoy Bessler. Fox Point, Wisconsin: Midwest SAS Users Group. 1991.

Stone, J. F., P. Higby, **M. SHELLEY,** and H. M. Stahr. Contamination of cotton denim with Terbufos. Pp. 203-208 in *Proceedings of the Fourth Scandinavian Symposium on Protective Clothing Against Chemicals and Other Health Hazards (NOKOBETEF IV),* edited by Helena Makinen. Kittila, Finland: Finnish Institute of Occupational Health. 1992.

This article uses a four-way factorial analysis of variance model to estimate the amount of granular terbufos contamination detected, in cotton denim similar to clothing worn by Iowa farm operators, through laboratory analysis employing nine different methods. Significant main effects were found for amount of moisture, immediate versus delayed extraction of the residue, time of exposure, and amount of contamination. Interactions between immediate/delayed extraction and amount of contamination, and between time of exposure and amount of contamination, also were significant.

SHERMAN, P. J. Random processes from rotating machinery. Pp. 211-218 in *Proceedings, Workshop on Nonstationary Random Processes and Their Applications.* World Scientific Publications. 1991.

SHERMAN, P. J., and D. E. Lyon. Hankel matrix range and null space methods for harmonic retrieval in unknown colored noise. Pp. 3006-3011 in *Proceedings of the 1992 American Control Conference.* 1992.

The utility of the Hankel covariance matrix in estimating the frequencies of sinusoids corrupted by unknown colored noise is evaluated. Specifically, we address, in a comparative setting, some range and null space methods, including the use of nominally excessive matrix dimensions, higher order covariance lags, and linear combinations of null space eigenvectors in a root locus setting. Numerical results suggest that while range and null space methods can yield comparable results, the former are more sensitive to retaining low lags. Methods that take greater advantage of theoretical redundancy are also addressed.

Frazho, A. E., and **P. J. SHERMAN.** On the convergence of the minimum variance spectral estimator in nonstationary noise. *IEEE Transactions on Information Theory,* 37:5 (1991) 1457-1459.

A simple proof is presented of the convergence of the minimum variance spectral estimator to the point spectrum, as the order of the covariance matrix goes to infinity. This is done in the multichannel setting where the corrupting unknown noise process is allowed to be nonstationary. Explicit bounds are also obtained on the rate of convergence.

Van Wyk, K. D., J. S. Bolton, and **P. J. SHERMAN.** The use of a single-parameter model to characterize the condition of asphalt surfaces. *Noise Control Engineering Journal* 38:1 (1992) 39-50.

A technique is presented for characterizing the condition of an asphalt surface by use of a single parameter. Comprehensive measurements of grazing incidence sound propagation over two asphalt surfaces, both before and after application of a sealant, are also presented. The measurements have been compared to predictions made using a theory that depends on a single parameter, the effective flow resistivity. It was found that estimates of the effective flow resistivity could be used to distinguish between asphalt surfaces having different surface treatments. The single-parameter theory was also found to reproduce the trends of the measured data; however, the estimates of the effective flow resistivity were seen to vary systematically with the distance and frequency ranges over which the theory and measurements were matched.

Lakshminarayan, P. G., Jay Dee Atwood, Stanley R. Johnson, and **Vince A. SPOSITO.** Compromise solution for economic-environmental decisions in agriculture. *Journal of Environmental Management* 33:1 (1991) 51-64.

Least-cost production versus the environmental on- and off-site erosion damage of agriculture is evaluated in a policy context for a major Corn Belt watershed. Compromise programming, previously utilized in firm-level multicriteria decision-making problems, is applied to a regional agricultural production model with environmental policy goal trade-offs. The crop sector model allocates land, water, labor, capital, and commodity-grown base acres to crop production. Production options include four conservation practices, three tillage methods, and several crop rotations. Crop yield and fertilizer levels are dependent upon erosion. Cropping options selected allow for both wind and water erosion.

A vector of three functions is to be minimized: current production cost, future value of productivity loss, and sediment damage. A vector optimization technique was used to generate the payoff matrix containing efficient but simultaneously unobtainable solutions. Given the ideal but infeasible solution vector, efficient solutions were generated in the compromise subset corresponding to the L_1, L_2, and L_∞ metrics. Trade-off relations were developed using the non-inferior set estimation technique.

Narula, Subhash C., **V. A. SPOSITO,** and James E. Gentle. Comparison of computer programs for simple linear L_1 regression. *Journal of Statistical Computation and Simulation* 39:1+2 (1991) 63-68.

A number of efficient computer codes are available for the simple linear L_1 regression problem. However, a number of these codes can be made more efficient by utilizing the least squares solution. In fact, a couple of available computer programs already do so.

We report the results of a computational study comparing several openly available computer programs for solving the simple linear L_1 regression problem with and without computing and utilizing a least squares solution.

STRAHAN, R. F. Remarks on the binomial effect size display. *American Psychologist* 46:10 (1991) 1083-1084.

Derivation of the binomial effect size display is amplified, and a cautionary note is given regarding use of this measure of magnitude of effect.

STRAHAN, Robert F., and John B. Severinghaus. Dealing with ties in Holland-type consistency measures. *Journal of Vocational Behavior* 40:2 (1992) 260-267.

This article describes adaptations of Strahan's (1987) methods for calculating consistency indexes when ties are obtained in Holland-type codes.

STUFKEN, John. Bayes A-optimal and efficient block designs for comparing test treatments with a standard treatment. *Communications in Statistics—Theory and Methods* 20:12 (1991) 3849-3862.

A sufficient condition for the Bayes A-optimality of block designs when comparing a standard treatment with v test treatments is given by Majumdar (pp. 15-27 in *Optimal Design and Analysis of Experiments,* edited by Y. Dodge, V. V. Fedorov, and H. P. Wynn, North-Holland, 1988). The priors that he considers depend on a constant $\alpha\epsilon[0,\infty)$, with $\alpha = 0$ corresponding to no prior information at all. Large families of optimal and highly efficient designs are only known for the case $\alpha = 0$. It is shown how some of the results for $\alpha = 0$ can be extended to obtain large families of Bayes A-optimal and efficient designs for arbitrary values of α. In addition, these results are useful when considering design robustness against an improper choice of α.

STUFKEN, John. On hierarchical positioning—Letter to the Editor. *The American Statistician* 46:1 (1992) 70-71.

Chevan and Sutherland (*The American Statistician* 45:2 (1991) 90-96) propose a method to assess the relative importance of each of the independent variables in multiple regression problems. This problem is analogous to a problem in cooperative game theory, and their solution corresponds in that context to the well known Shapley value.

STUFKEN, John, and Kwanghun Kim. Optimal group divisible treatment designs for comparing a standard treatment with test treatments. *Utilitas Mathematica* 41 (1992) 211-227.

We consider the problem of comparing a standard treatment with v test treatments in blocks of size k. For k = 2, 3 and v = k,...,6 we provide tables with A-optimal designs in the class of group divisible treatment designs (GDTD's) for any number of blocks not exceeding a specified number. Rules are provided to obtain highly efficient GDTD's for larger values of the number of blocks.

SUKHATME, Shashikala. Powers of two-sample rank tests under Lehmann alternatives. *The American Statistician* 46:3 (1992) 212-214.

This note presents a method of finding the power of a two-sample rank test under the Lehmann alternatives. The method considers expressing a rank statistic in terms of the empirical distribution functions of the samples and uses properties of order statistics. The author finds the students in an introductory course on nonparametric statistics feel more comfortable with this than the elegant approach presented by Lehmann (1953).

Jackman, John, **Stephen VARDEMAN,** and Way Kuo. Stochastic rendering of geometric forms in design for manufacturing. *Journal of Design and Manufacturing* 1 (1991) 57-66.

Fundamentally, discrete parts manufacturing is concerned with the production of geometric forms. Increased attention is being paid to design for manufacturing techniques that reduce costs and increase productivity. We present a method for the rendering of geometric forms based on a probabilistic view of manufacturing processes (i.e., machining processes). Models are developed for drilling, end milling, and turning operations. This technique provides design engineers with an actual rendering of their design so that intelligent design choices can be made before proceeding to the manufacturing phase.

Wang, Morgan, and **W. J. KENNEDY.** A numerical method for accurately approximating multivariate normal probabilities. *Computational Statistics & Data Analysis* 13:2 (1992) 197-210.

A Taylor series expansion of the multivariate normal integral is used to calculate the value of the integral over rectangular regions. Interval analysis and automatic differentiation provide self-validation for calculated probabilities. In examples, the Taylor series approximation gives more accurate results than the algorithm of M. J. Schervish (1984) [*Applied Statistics,* 33:1, 81-94].

Cha, Stephen, and **Samuel WIEAND.** Description of the statistical aspects of a study for advanced colorectal cancer patients. *Statistics in Medicine* 11 (1992) 5-11.

A screening design was used in a trial that compared a standard regimen to five experimental regimens for the treatment of advanced colorectal cancer where the endpoint was survival. The two-stage design permitted the termination of accrual to experimental regimens that failed to show promise at the first stage. It also allowed for termination of accrual to the standard regimen if an experimental regimen appeared to offer a highly significant improvement over the standard regimen. This paper presents a description of the design and the results of the trial.

▓ Book Reviews, Etcetera

CRESSIE, Noel A. C. *Robust Estimation and Testing,* by Robert G. Staudte and Simon J. Sheather. Wiley Series in Probability and Mathematical Statistics: Applied Probability and Statistics. A Wiley-Interscience Publication. John Wiley & Sons, Inc., New York, 1990. xx + 351 pp. $54.95. Reviewed in *Mathematical Reviews* 91 (1991) 3307-3308.

DAVID, Herbert A. Letter from Florence Nightingale placed in ASA archives. *Amstat News,* No. 184 (1992) 2.

GROENEVELD, Richard A. Another comment on Searls and Intarapanich—Letter to the Editor. *The American Statistician* 45:3 (1991) 259.

▓ Theses

Akbar, Aminul. 3-player bargaining. M.S. thesis, Iowa State University Library. December 1991.

Three-player bargaining is treated as the problem of predicting which of two proposed payoff triples will obtain. This is done by reduction to standard two-player theory. Specifically, each player is assumed to anticipate the outcome for himself/herself of the two-player bargaining that would result, were he/she to withdraw to a passive stance. The player with least to lose by so withdrawing is assumed to do so. The resulting two-player conflict determines the operative triple.

Garcia-Santamaria, Cathalina M. Economic choice of a Military Standard 105D sampling plan. M.S. thesis, Iowa State University Library. August 1991.

This thesis considers the selection of a minimum cost sampling scheme from the Military Standard 105D. The proposed cost analysis has the following main characteristics: (1) The analysis is based on the operation of the MIL-STD-105D sampling scheme (including the switching rules) under single sampling. (2) The fraction of defective units or the number of defects per unit θ, varies from lot to lot according to a probability distribution $w(\theta)$. (3) The damage or the revenue of different inspection actions is assumed to be measurable in economic terms. (4) The probabilities of error in inspection are known. When the replacement (of identified defectives) function is also possibly imperfect, these probabilities of error in classification of units are also used in the analysis. (5) The analysis does not assume any particular viewpoint (of the producer or consumer, for example).

A FORTRAN program has been written to compute the average long-term cost of each of the single attributes sampling plans included in MIL-STD-105D for percent defective applications. Figures produced by this program can be used to choose among MIL-STD-105D plans, or to analyze the behavior of the cost function over different values of the lot size, AQL value, and inspection level. An example and recommendations for the use of the program are discussed.

Karabulut, Ihsan. Edgeworth expansion and bootstrap approximation for the distribution of M-estimators of a simple linear regression parameter without Cramèr's condition. M.S. thesis, Iowa State University Library. December 1991.

Edgeworth expansions for the distributions of M-estimators of a simple linear regression parameter are obtained when the error distribution does not satisfy the Cramèr condition. As an application it is shown that certain modifications of the naive bootstrap procedure are second order correct. This is in marked contrast with the results of K. Singh (1981) [*The Annals of Statistics* 6:1187-1195] on the sample mean of i.i.d. lattice random variables.

Lu, Chi-Hsien Joseph. The use of degradation measures in assessing reliability. Ph.D. thesis, Iowa State University Library. May 1992.

With today's high technology, traditional life tests for highly reliable products often result in few or even no failures. This makes it difficult to assess product reliability. For some products, degradation measures taken over time are useful for reliability assessment. By defining product failure in terms of a specified level of degradation, we study the distribution of time to failure for the degradation measures. We develop general statistical methods for using degradation measures to estimate a time-to-failure distribution. These methods employ Monte Carlo simulation to obtain point estimates and confidence intervals for reliability assessment, and these can be used with a much more general and practical class of degradation models.

An important application for degradation analysis, as an alternate approach in assessing reliability, is in problems where few or even no failures are expected in a life test. It is thus of interest to know how degradation analysis compares with failure time analysis.

We make such a comparison, in terms of relative efficiency: the ratio of the asymptotic variances of an estimated p quantile of time-to-failure distribution, by using a simple, but physically reasonable, degradation model. Even for such a simple model, the comparison is impossible to do analytically, and we use numerical evaluation. We also look at how the number of inspections, the amount of measurement error, and the quantile of interest affect the asymptotic variance factor of the estimated percentile. We also describe and illustrate the computational and graphical methods for such a degradation analysis, and present the computer programs developed in the S language. We use fatigue crack growth data and a special case of Paris Law as a degradation path model to illustrate the methods.

Medak, Frederick Martin. Hierarchical testing using the power-divergence family of statistics. Ph.D. thesis, Iowa State University Library. August 1991.

Methodology for discrete multivariate data based on the loglikelihood ratio statistics G^2, and Pearson's statistic X^2, is extended to the power-divergence family of goodness-of-fit statistics indexed by the parameter λ ($-\infty < \lambda < \infty$). This family includes G^2, X^2, the Freeman-Tukey statistic, the modified loglikelihood ratio statistic, and the Neyman-modified chi-squared statistic.

Formulas for confidence regions in a ternary diagram, based on Pearson's X^2, are extended to the power-divergence family. A comparison based on the accuracy of confidence level and the area of confidence region finds the family members $\lambda = \frac{2}{3}$ and $\lambda = \frac{1}{2}$ to be the best performers.

Maximum likelihood methods for testing hierarchical parametric models are extended to the power-divergence family. It is shown that, under Birch's

conditions, an analysis of divergence is possible with the power-divergence family, analogous to the usual partitioning of G^2. Further, an algorithm similar to iterative proportional fitting, for finding cell probability estimates, is given. Similarly, methodology for hierarchically assessing homogeneity in product-multinomial distributions, based on the power-divergence statistics, is developed. It is shown that, under mild assumptions, an analysis of divergence for the power-divergence statistics is possible.

Robison-Cox, James. Order statistics under linear trend. Ph.D. thesis, Iowa State University Library. December 1991.

Order statistics and linear functions of order statistics are frequently used as estimators of location and scale. The moments of order statistics have been tabled for many commonly used distributions under assumptions of independence and identical distribution. Applications of estimators based on the order statistics have spread to situations in which identical distribution cannot be assumed, even though independence is still a sensible assumption. As an example, estimators based on order statistics are used in the field of communications where the median and other functions of order statistics of a moving sample are used to recover a signal contaminated with random noise. In this case, if we assume that the noise has a distribution that is independent over time, then the sample is independent. However, it is not identically distributed, since the means of the observations follow the original signal. The signal could have any shape, but we will consider only the simplest case, that of (locally) linear trend. We want to describe the effect of linear trend on the moments of the order statistics and to follow up on a conjecture (David 1988) that the variances of the median increase with trend for certain types of distributions.

We present computed tables of means, variances, and covariances of the order statistics of normal random variables that are assumed independent with unit variance, having means exhibiting linear trend. Then several uses of these tables are given, one in statistical process control and the other in the evaluation of estimators based on order statistics. Estimators based on order statistics are also evaluated for a model combining linear trend with a large outlier.

The theory involved with ordering in dispersion is discussed using majorization arguments and stochastic ordering.

Tiro, Muhammad Arif. Edgeworth expansion and bootstrap approximation for M-estimators of linear regression parameters with increasing dimensions. Ph.D. thesis, Iowa State University Library. August 1991.

Edgeworth expansions for the standardized, as well as studentized, M-estimators in multiple linear regression models are obtained without assuming normal errors. The number of parameters is allowed to increase with the number of observations. This is an extension of the results of Ringland (1980) to a general

design matrix. Similar results are obtained for linear combinations of least squares estimators complementing the results of Qumsiyeh (1986). Furthermore, it is shown that the bootstrap method is second order correct for the studentized statistics. This improves the results of Bickel and Freedman (1983) and extends the results of Lahiri (1990) to increasing dimension.

Ver Hoef, Jay Michael. Statistical analysis of spatial pattern in ecological data. Ph.D. thesis, Iowa State University Library. August 1991.

A general statistical framework is proposed for unifying definitions of pattern and process in ecology and statistics. This statistical framework allows several pattern techniques used in ecology, namely, nested ANOVA, two-term local variance, and paired quadrat variance, to be compared using the variogram as a function of aggregation.

Another ecological quantity of interest is average patch size in a transect of data. The effects of three factors: (1) the signal-to-noise ratio, (2) the expected sizes of the patches relative to the plot size, and (3) the distribution of patch sizes, are determined for three estimators of average patch size: (1) two-term local variance, (2) a moving two-sample t-test, and (3) a Bayesian approach using simulated annealing. From a simulation experiment, it is determined that the Bayesian approach is best. An example from grassland vegetation is included.

Besides estimation, spatial prediction is important in ecology. For spatial prediction, it has been usual to predict one variable at a time (e.g., kriging or cokriging). It is often desirable to predict the joint spatial abundance of ecological variables. Simultaneous spatial prediction of several variables is developed using covariances and variograms and cross-variograms. Consequently, one obtains the mean-squared-prediction-error matrix, which allows construction of joint multivariate prediction regions.

Wang, Kui-Jang. Contributions to design of experiments. Ph.D. thesis, Iowa State University Library. May 1992.

When a fractional factorial design is used, some runs may be more difficult to implement than others. There may then be a need to use a fractional factorial design that does not contain any undesirable runs. As this should not go at the expense of the information that such a design can provide for the factorial effects of interest, it is important to develop techniques that provide alternative designs with the same information matrix as a given design for the effects of interest. This problem will be addressed for 2-level fractional factorial designs.

One of the methods that is considered is based on a relationship between this problem and the problem of trade-off in block designs. By exploring that relationship, the extensive results on t-trades can be used for construction of the desired factorial designs. This provides also additional incentive for the continued development of the theory of trade-off. We also present two programs to generate fractional factorial designs that are information-equivalent to a given design.

Based on a relationship between fractional factorial designs and balanced incomplete block designs, the ideas in the aforementioned programs are used for a program to generate balanced incomplete block designs with various supports and support sizes, avoiding possible undesirable blocks. Finally, these ideas are used for two programs to generate πPS sampling designs that satisfy requirements on the second-order inclusion probabilities, if any, and that avoid any undesirable samples in their support.

Wang, Morgan Chung-Ching. Numerical methods for self-validating computation of probabilities and percentiles in selected distributions using interval analysis. Ph.D. thesis, Iowa State University Library. August 1991.

Most scientific computations are carried out on computers that employ fixed-precision floating-point number systems. Therefore, the accuracy of the values produced by a scalar algorithm without given associated error estimators still poses a problem in today's software. The self-validating numerical methods that not only produce an answer but also produce a guaranteed error bound would be of interest, especially for the following situations: (1) an essentially true answer is required for an accuracy comparison study among several competing algorithms or an accuracy study of a newly developed algorithm, and (2) the computed result has to satisfy given accuracy requirements because it is to be used in subsequent computations.

In this study, we use four different numerical tools—interval arithmetic, automatic differentiation, continued fractions, and Taylor series expansion—to develop self-validating numerical integration methods. Then we apply these methods to the computations of probabilities and percentiles in selected distributions.

Our software was developed in IBM-compatible personal computers equipped with INTEL 80287 NPX. This software includes a support library and several algorithms that compute the probabilities and percentiles of selected distributions. The support library includes basic rounded interval arithmetic operations and some utility routines, such as interval complete gamma function and interval exponential function. The software is available from the author on request.

Wu, Peitsang. Pricing allocation priority and specification level of products with upper limits on the numbers of shortages. M.S. thesis, Iowa State University Library. May 1992.

The objective of this thesis is to obtain optimum upper limits for the numbers of shortages of heterogeneous products. These limits are optimum in the sense of minimizing the sum of consumer and producer costs. The approach is alternative to prior work, that focused on the prediction of shortages. Computer software was developed, for computing the optimum upper limits as functions of various pricing schemes.

Department of Statistics

The Department of Statistics offers courses leading to the degrees Bachelor of Science, Master of Science, and Doctor of Philosophy with major in statistics. These degrees are conferred by the College of Liberal Arts and Sciences and by the Graduate College. A Master of Science degree in operations research is offered jointly with the Department of Industrial and Manufacturing Systems Engineering.

Undergraduates in statistics may choose double majors if they wish. Co-majors are not frequent at the M.S. level but several Ph.D. students choose co-majors every year in order to add depth in an area of application.

Two changes in admission requirements for the graduate program in statistics will be implemented starting with applications received in summer 1992: General Graduate Record Examination scores, previously recommended, will now be required. TOEFL scores for international students must now be at least 550. Both changes bring us into conformity with the majority of departments at Iowa State University.

M.S. candidates may choose either the thesis or the nonthesis option. The latter requires a written examination and completion of a creative component representing at least two credits of independent work. More information is given in the departmental brochure, "Iowa State University—Graduate Program in Statistics," which is available upon request.

The exchange program with Dortmund University, Dortmund, Germany, brought three statistics graduate students here for the 1991-92 academic year and sent one from Ames to Dortmund. Additional reinforcement came through the visit of Franz Hering, who is in charge of the Dortmund end of the exchange program. Two of this year's DAAD fellows will return next fall to complete M.S. degrees at Iowa State.

The Department of Statistics/Eli Lilly Company Scholarship has been established for an outstanding entering freshman student majoring in statistics. The first award, of $1,000 for the first year of study at ISU, was made to Gregory Kinser of Emerson, Iowa, for 1991-92.

The Department of Statistics has a large service teaching role. For example, four different engineering statistics courses are taught for undergraduate engineering students. Currently the ISU curricula in ceramic engineering, computer engineering, construction engineering, electrical engineering, engineering science, industrial and manufacturing systems engineering, mechanical engineering, and metallurgical engineering include a required statistics course.

Peter Sherman initiated a newsletter in Stat 333, to enhance student motivation and interest in statistical aspects of systems and signals. An optional weekly evening discussion session was also set up to relate course material to areas of current theoretical and applied research in electrical engineering.

Special effort was made during the year to recruit minority students. Dean Isaacson traveled to Houston, Texas, February 7-10, 1992, to recruit students from Texas Southern, Prairie View A&M, and Rice. Similar trips are planned for the future in order to increase the diversity of our graduate student population.

Derrick Rollins was active in ISU's Science Bound Program, attending advisory board meetings, traveling to Des Moines to speak with high school teachers and mentors, and assisting in Saturday programs set up for visitors of our engineering departments. He also assisted the College of Engineering with minority retention plans, took part in the Research Careers for Minority Scholars meetings in October 1991, and advised several students participating in the Women in Science and Engineering Program during summer 1992.

Two statistics faculty, Dean Isaacson and W. Robert Stephenson, took part in formulating a university proposal for curriculum development, research, and implementation of Total Quality Management at ISU. This proposal was submitted in the IBM Total Quality Management Grants Competition.

Course offerings for the 1991-92 academic year and the 1992 summer session, with primary catalog listing in statistics, are listed below. A few courses with primary listing in mathematics or industrial and manufacturing systems engineering may also be taken for statistics credit at the undergraduate or graduate level.

■ 1991-92 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,SS	Cramer	M. Shelley
				Gessner	M. Smith
				Kirchoff	Stephenson
				Lerch	
104	Introduction to Statistics	3	F,S,SS	Bailey	Peterson
				Coffin	Pollak
				D. Cox	Sukhatme
				Kaiser	Wenz
105	Introduction to Statistics for Engineers	2	F,S	Isaacson	C. Novak
				Lahiri	
201	Applied Regression Analysis for Business	2	F	Coffin	Olin
227	Introduction to Business Statistics	5	F,S,SS	Becker	Morse
				Hall	C. Novak
				Lindstrom	E. Novak
				McMichael	Schillmoeller

No.	Title	Cr.	Sem.	Instructor(s)	
231	Probability and Statistical Inference for Engineers	4	F,S	Manke Pelkey	Rollins
305	Engineering Statistics	3	F,S	P. Jones Lerch	Vardeman Zimmerman
328	Applied Business Statistics	3	F,S	Coffin	Meeker
333	Probability and Statistics for Electrical and Computer Engineers	3	F,S	Lahiri	Sherman
341	Introduction to Theory of Probability and Statistics	3	F,S	Groeneveld	Pollak
342	Introduction to Theory of Probability and Statistics	3	S		Groeneveld

Courses for Graduate Minors and Undergraduates

No.	Title	Cr.	Sem.	Instructor(s)	
401	Statistical Methods for Research Workers	4	F,S,SS	Bailey Breidt Carriquiry D. Cox Groeneveld Kaiser	Kennedy Kirchoff M. Shelley Stephenson Strahan
402	Statistical Design and the Analysis of Experiments	3	F,S	Hinz/D. Cox Stephenson	Strahan Stufken
404	Statistics for the Social Sciences	3	F		Lorenz
407	Methods of Multivariate Analysis	2	F		Hinz
421	Survey Sampling Techniques	3	S		Baker
432	Applied Probability Models	3	F		Groeneveld
447	Statistical Theory for Research Workers	4	S,SS		Amemiya
451	Applied Time Series	3	S		Meeker
480	Statistical Application of Digital Computers	3	F		Marasinghe
481	Computer Processing of Statistical Data	3	S		Marasinghe
490	Independent Study	Var	F,S,SS	Meeker Rollins	Stephenson Stufken
493	Workshop in Statistics (off-campus)	1	F		D. Cox

Courses Primarily for Graduate Students, Major or Minor

No.	Title	Cr.	Sem.	Instructor(s)
500	Statistical Methods	4	F	Koehler
501	Multivariate Statistical Methods	3	S	Koehler
511	Theory and Application of Linear Models	3	S	Stufken
512	Design of Experiments	3	F	Stufken
513	Response Surface Methodology	3	S	Harville
521	Theory of Sample Surveys I	3	S	Breidt
533	Reliability	3	S	H. T. David/ Meeker
536	Genetic Statistics I	2	F	Pollak
538	Econometric Statistics	3	F	Amemiya
539	Game Theory	3	F	H. T. David
542	Theory of Probability and Statistics	3	F	Athreya
543	Theory of Probability and Statistics	3	S	H. A. David
544	Bayesian Decision Theory	3	SS	Cressie
579	Introduction to Computer Hardware and Software Systems for Statistical Computing	1	F	Marasinghe/ Kennedy
580	Statistical Computing	3	F	Kennedy
590B	Special Topics: Methods	Var	S,SS	Kaiser / Kennedy
590C	Special Topics: Design of Experiments	2	F	Stufken
599	Creative Component	Var	F,S,SS	Amemiya, Athreya, Carriquiry, D. Cox, H. A. David, Fuller, Groeneveld, Harville, Hinz, Kennedy, Koehler, Lorenz, Marasinghe, Meeker, M. Shelley, Stephenson, Stufken, Vardeman

Courses for Graduate Students, Major or Minor

No.	Title	Cr.	Sem.	Instructor(s)
606	Spatial Statistics	3	S	Cressie
611	Advanced Linear Model Theory	3	F	Harville
642	Advanced Probability Theory	3	S	Weerasinghe (Math.)
643	Theory of Estimation and Testing of Hypotheses	3	F	Lahiri
645	Order Statistics	3	F	H. A. David
647	Multivariate Analysis	3	F	Amemiya
651	Time Series	3	S	Fuller
699	Research	Var	F,S,SS	Amemiya, Athreya, Carriquiry, Cressie, H. A. David, H. T. David, Fuller, Harville, Hinz, Kennedy, Koehler, Lahiri, Marasinghe, Meeker, Pollak, Rollins, Stufken, Sukhatme, Vardeman

Graduate Students

Graduate College Teaching Excellence Awards were given to Brian Lindstrom (summer 1991), Bryan Olin (fall 1991), and Marie Coffin and Laura Schillmoeller (spring 1992).

Outstanding contribution in statistical consulting was recognized through the Dan Mowrey Consulting Excellence Award, presented in May to Tom Loughin and Bill Harter.

Outstanding contribution in statistical computing was recognized by a new award, in memory of Vincent A. Sposito, given in May to Phil Iversen.

The establishment of two new scholarship funds for statistics graduate students was announced in spring 1992. The first recipient of the Vera David Graduate Fellowship in Statistics (in memory of the wife of H. A. David, past director and head here) will be chosen during the summer and presented next fall. This award will be given to a female student who has just completed her first year of graduate studies. Over 30 alumni, faculty, and friends have contributed to the fund for this award. The first award from the Holly and Beth Fryer Scholarship Award Fund will also be given in fall 1992. This fund has been set up by Iowa State's first Ph.D. graduate in statistics, Holly C. Fryer, and his wife. The award will be given to a Ph.D. student who has just completed Stat 642. The new scholarship award funds were both announced at a seminar given by Dr. Fryer on April 22 (see p. 46).

Four statistics graduate students were initiated as members of the Honor Society of Phi Kappa Phi on March 19: An Baiching, Christian Garrigoux, Thomas M. Loughin, and Ouhong Wang.

Seven Ph.D. degrees and 42 M.S. degrees were granted in the Department of Statistics during the fiscal year. These included two M.S. degrees in operations research, administered jointly with the Department of Industrial and Manufacturing Systems Engineering. All but four of the masters' degrees were conferred on a nonthesis basis, with candidates completing creative components based on independent study. Abstracts of Ph.D. dissertations and master's theses appear on pp. 36-38.

Names of graduate degree recipients, with names of major professors, time of graduation, and employment or educational decisions, are given below. An asterisk signifies that the student has chosen to remain at Iowa State to work toward a doctorate in statistics.

M.S. Recipients

Aminul Akbar (operations research, Fall 1991; Herbert T. David and Howard Meeks) returned to the Central Bureau of Statistics, Jakarta, Indonesia.

Abdullah A. M. Al-Shiha (Summer 1991; Soumendra N. Lahiri) is working on a Ph.D. program in statistics at Kansas State University.

Jeffrey William Andersen (Spring 1992; W. Robert Stephenson)

Chun-Fu Chen (Spring 1992; Kenneth J. Koehler) enrolled in the Ph.D. program in biostatistics at UCLA.

Kehang Chen (Summer 1991; Kenneth J. Koehler) is pursuing a Ph.D. in mechanical engineering at Iowa State.

Alice Man-Lai Cheng (Spring 1992; William Q. Meeker, Jr.) accepted a position as statistician (data analyst) with the Joint Commission on Accreditation of Health Care Organizations, Oakbrook Terrace, Illinois.

Jihwan Cho (Spring 1992; John Stufken) will teach in the Korean Air Force Academy, Chung Ju, as a professor and officer in its Department of Statistics, beginning in March 1993.

Li-Fang Chuang (Fall 1991; Alicia Carriquiry) returned to Taipei, Taiwan.

*Kevin Wayne Dodd (Spring 1992; Alicia Carriquiry).

Barbara Ann Dombroski (Summer 1991; William Q. Meeker, Jr.) is a quality assurance engineer at Eastman Kodak, Rochester, New York.

Dawn Michele Dubois (Summer 1991; W. Robert Stephenson) is a biostatistician in the Statistics and Data Analysis Department, Marion Merrell Dow Inc., Kansas City, Missouri.

*Birol Emir (Spring 1992; Yasuo Amemiya).

Cathalina M. Garcia-Santamaria (statistics—quality control, Summer 1991; Stephen B. Vardeman) returned to San Pedro, San Jose, Costa Rica, where she is professor of statistics, Escuela de Estadistica, Universidad de Costa Rica.

*Christian Garrigoux (Summer 1991; William Q. Meeker, Jr.) is continuing studies here toward a doctorate in statistics and industrial education and technology.

Heidi Katrina Geheb (Spring 1992; Paul N. Hinz) joined the Frontier Science and Technology Research Foundation, Brookline, Massachusetts, to work in opportunistic infection Phase I clinical trials for AIDS patients, in association with the Statistical Data Analysis Center at Harvard's School of Public Health and the AIDS Clinical Trials Group.

William Henry Harter, Jr. (Spring 1992; Frederick Lorenz) has joined Marion Merrell Dow Inc., Kansas City, Missouri, as associate statistician.

Sarah Florence Howard (Summer 1991; Jerome Sacks) has a position as senior statistician with G. D. Searle & Co. in Skokie, Illinois.

*Shin-Soo Kang (Summer 1991; Kenneth J. Koehler).

Yu-Ling Kao (Summer 1991; Yasuo Amemiya) returned to Taipei, Taiwan.

Ihsan Karabulut (Fall 1991; Soumendra N. Lahiri) returned to Gazi University, Ankara, Turkey, where he is an instructor in the Department of Statistics.

Georgene Kelly (Spring 1992; Paul N. Hinz), now Georgene Schroeder, joined the School of Public Health, University of Minnesota, as protocol manager, to work on a National Institutes of Health grant project.

Mark Stanton Kreisberg (Summer 1991; Yasuo Amemiya) remained at Iowa State for additional studies in biology and preparation for medical school.

Shu-Hua Lee (Spring 1992; Kenneth J. Koehler) is remaining at Iowa State University to work toward an M.B.A. degree.

Kuo-Chin Lin (Summer 1991; Herbert T. David) is working toward a Ph.D. degree in the Department of Statistics, University of Missouri-Columbia.

Yi-Te Lin (Spring 1992; Kenneth J. Koehler)

Brian Lee Lindstrom (Fall 1991; William Q. Meeker) has joined Eastman Kodak Company, Rochester, New York, as statistician.

Chuan-Chuan Ma (Fall 1991; Paul N. Hinz) returned to Chiayi, Taiwan.

Todd Sterling Manke (Spring 1992; Stephen B. Vardeman) is a statistical process engineer with Corning, Inc., Corning, New York; initially he is working at a ceramics production plant in Erwin, New York.

Elizabeth Jean McMichael (Spring 1992; Mack Shelley II) is engaged in quality control and economic forecasting, as a quality representative with Unisys, Des Moines, Iowa.

Richard Carl Meyer (Spring 1992; Stephen B. Vardeman) is a quality engineer with the 3M Company, Bedford Park, Illinois, serving as statistical consultant, SPC facilitator, and instructor of statistics.

Rochelle Lynette Milbrath (Fall 1991; Paul N. Hinz) is an associate research biostatistician (preclinical trials) with the Bristol-Myers Squibb Company, Syracuse, New York.

Carlos Arturo Moreno Gil (Fall 1991; Kenneth J. Koehler) returned to his position as biometrician in the Sugar Cane Research Center of Colombia (CENICAÑA), Cali, Valle, Colombia.

Eric Leo Novak (Spring 1992; Mervyn Marasinghe) has accepted a position with Doanes, a marketing research agency in St. Louis, Missouri.

Beta Putranto (Summer 1991; Paul N. Hinz) returned to Jakarta, Indonesia, to teach statistics and forestry at Hasanuddin University, Ujung Pandang.

Philip Hugh Ross, now Philip McNealy, (Fall 1991; W. Robert Stephenson) joined Alpha Transmission, Indianapolis, Indiana.

Leroy N. Rushing, Jr. (Fall 1991; William Q. Meeker) is continuing graduate studies in the Department of Biostatistics, University of North Carolina at Chapel Hill.

*Ann Christine Russey (Summer 1991; Frederick O. Lorenz).

Laura Lynn Schillmoeller (Spring 1992; W. Robert Stephenson) is working as project manager in the Statistical Services Department of Conway, Milliken, and Associates, a Chicago, Illinois, market research company.

Michael Henry Smith (Spring 1992; David Harville) has accepted a position as biostatistician with Hofmann-La Roche, Nutley, New Jersey.

*Ouhong Wang (Fall 1991; William J. Kennedy).

Christine Whitney Helterbrand (Summer 1991; Stephen B. Vardeman) accepted a five-month consulting position with the Dow Chemical Company, Western Applied Science & Technology Division, Pittsburg, California in August. In January 1992 she returned to Iowa to join the newly formed Center for Continuous Quality Improvement, Ames, as an associate, to function as a quality management trainer.

Peitsang Wu (operations research, Spring 1992; Kyung Jo Min and Herbert T. David) is continuing studies toward a Ph.D. in industrial engineering at North Carolina State University.

Ph.D. Recipients

Chi-Hsien Joseph Lu (Spring 1992; William Q. Meeker, Jr.) is joining the Department of Statistics, National Cheng-Kung University, Tainan, Taiwan, as associate professor.

Frederick Martin Medak (Summer 1991; Noel A. C. Cressie) became a postdoctoral research associate in the Statistical Laboratory, Iowa State University; on December 30, 1991, he joined BP Research, Warrensville Research Center, Cleveland, Ohio, as senior technical associate.

James F. Robison-Cox (Fall 1991; H. A. David) is an assistant professor in the Department of Mathematical Sciences, Montana State University.

Muhammad Arif Tiro (Summer 1991; Soumendra N. Lahiri) returned to his position as lecturer, Faculty of Mathematical Science, Institut Keguruan & Ilmu Pendidikan (IKIP), Ujung Pandang, Indonesia.

Jay Michael Ver Hoef (Summer 1991; co-majors in ecology and evolutionary biology and statistics; David C. Glenn-Lewin and Noel A. C. Cressie) is a biometrician with the Alaska Department of Fish and Game, Fairbanks, Alaska.

Kui-Jang Wang (Spring 1992; John Stufken) is joining the Department of Mathematics, Tamkang University, Tamsui, Taiwan, as associate professor of statistics.

Morgan Chung-Ching Wang (Summer 1991; William J. Kennedy) is an assistant professor in the Department of Statistics, University of Central Florida.

M.S. Candidates

Mahmood Ahmad	Rachel Kintzinger
Aminul Akbar (operations research)	Thomas Kirchoff
	Scott Klabacha
Abdullah Al-Shiha	Chinh Nguyen Kreisberg
Jeffrey Andersen	Reiner Kurzhals
Peter Anderson	Kye-Don Lee
Yudiantri Asdi	Man-Keung Lee
Christine Ashman	Shu-Hua Lee
Lori Becker	Charles F. Lerch
Todd Borchert	Yang Li
Sherry Bushaw	Young Jae Li
Chun-Fu Chen	Fen-Hui Lin (operations research)
Man-Lai Alice Cheng	Kuo-Chin Lin
Hyen-Hyee Cho	Yi-Te Lin
Jihwan Cho	Brian Lindstrom
Li-Fang Chuang	Dennis Wayne Livengood
Alice Cramer	Stella Chueck-Wah Luk
Michael Cummings	Chuan-Chuan Ma
Jianying Jane Ding Peng	Todd Manke
Kevin W. Dodd	Steven Mattics
Qiong Dong	Elizabeth McMichael
Ann Dyer	Anita Hinkeldey McVey
Christoph Edel	Richard C. Meyer
Ashraf Farouk El-Houbi	Rochelle Milbrath
Birol Emir	Carlos Moreno G.
Gilenio Borges Fernandes	Peter Morse
Cathalina Garcia-Santamaria	Christopher Novak
Heidi Geheb	Eric Novak
Mary L. Gessner	Timothy C. U. Ogamba
Marjorie A. Green	Sang-Heon Oh
David W. Hall	Savas Papadopoulos
Peter Hanson	Gerald Parise
William H. Harter, Jr.	Daniel J. Parks
Michael Hartfield (in absentia)	Elizabeth Paterno
Shawkat Hassan (operations research)	Margarita Paterno
	Sara Peterson
Hui-Lin Hu	Beta Putranto
Hui-Yi Huang	Lisanne Raymos
Molly Isbell	John T. Reese
Je Yeong Jeong	Shonda D. Roelfs
Cheryl A. Johnson	Philip H. Ross (now McNealy)
Stephanie B. Johnson	
Hyum-Hee Joo	Jason Rupe (operations research)
Yu-Ling Kao	
Ihsan Karabulut	Leroy N. Rushing
Georgene Kelly	Michelle Sawyer
Dae-Lyong Kim	Laura Schillmoeller
Sahmyeong Kim	Juergen Schroeder

Chungyeol Shin
David Siev
Donald E. Smith
Michael H. Smith
Dilek Tali
Daniel Walczak
Hui Wang
Paul Wenz
Christine Whitney

Christopher Wikle
Steven Wilmarth
Lie-Ling Wu
Peitsang Wu
   (operations research)
Xiao-zhe Yan
Jincheol Yoo
Namkyu Yu

Ph.D. Candidates

Abdoulaye Adam
Baiching Anthony An
Gregorio Atuncar
Marek Brabec
Victor Brescia
Mark F. Bryan (in absentia)
Brad J. Bushman
Abderahmane Chakak
Kehang Chen
Bassirou Chitou
Marie Coffin
B. Keith Cranford
   (in absentia)
Joseph H. R. Croos
Rohit S. Deo
Geraldine Dunnigan
Jun-ichiro Fukuchi
Christian Garrigoux
   (statistics and industrial
   education and technology)
Jeffrey Helterbrand
Mu-Yeh Huang (statistics and
   industrial engineering)
Alejandro Islas-Camargo
Philip W. Iversen
Shin-Soo Kang
Seoung-Gon Ko
Mark Kreisberg
Jae Hyung Lee
Ding-Hwa Lei
Klaus Lemke (statistics and
   industrial engineering)
Chih-Yao Liu
Jingyu Liu

Abdolhassan Lotfizadeh
Thomas Loughin
Chi-hsien Joseph Lu
David G. McDonald
   (statistics and
   meteorology) (in absentia)
Frederick M. Medak
Hamid Navvabpour
Bryan Olin
Jean Pelkey
Abdul Wajid Rana
Sellem Remadi
James F. Robison-Cox
Daniel L. Rose
Ann C. Russey
Muhamad Sabran
Todd Sanger
Kai-One Sriplung
   (economics and statistics)
Hiroshi Takahashi (animal
   science and statistics)
Muhammad Tiro
Margot Tollefson
Anand Vidyashankar
   (mathematics and
   statistics)
Michael Wallendorf
Kui-Jang Wang
Ouhong Wang
Ilker Yalçin
Ibrahim Yansaneh
Seongmo Yoo
Yunn-Hwu Yu
Alan Zimmermann

Lori Becker completed a one-year cooperative internship with Weyerhaeuser, Federal Way, Washington, in August. An incoming graduate student, Jason Gunnink, began his connection with Iowa State University by taking a statistics cooperative internship with Weyerhaeuser, Hot Springs, Arkansas, January 1992. His term overlaps with that of Peter Morse, who began an internship there in June 1992. Cheryl Johnson and Rachel Kintzinger have summer 1992 positions with Syntex Laboratories, Inc., Palo Alto, California, and Pratt & Whitney, West Palm Beach, Florida, respectively. Juergen Schroeder and Reiner Kurzhals have summer positions with Corning New York in Coburg, Germany, and Kaiserslautern, Germany, respectively. Dan Rose went to Tiberias, Israel, for the summer on a statistics internship with Galtronics.

◼ Iowa STAT-ers

The Iowa STAT-ers, the Department of Statistics graduate student organization, offers opportunities for social and intellectual interaction among members and faculty. This active group of about 50 students has gained recognition from graduate departments at ISU and from other statistics departments for its activities and its high level of participation.

In the 1991-92 year, STAT-er activities included a bi-weekly seminar series, organized by vice presidents Ann Russey and Gerri Dunnigan, in which ISU faculty members, students, or company representatives spoke to graduate students about various topics in the field. See p. 47 for details.

Social activities were arranged by Mike Smith and Bill Harter. These activities included Friday Afternoon Club (FAC—a weekly social gathering), a Fall Tennis Tournament and grill out, a Cultural Party, Halloween Party, Winter Party, and an end-of-the-year Pizza Party.

Another popular STAT-er activity was intramural sports. This year the STAT-ers had teams or individuals participating in such sports as sand volleyball, indoor* and outdoor soccer, basketball, broomball*, pickleball, badminton*, tennis, throwton, flag football, croquet, indoor volleyball, water volleyball, rollerblade poker*, golf, hearts, racquetball, and wallyball.

Fundraisers this year included STAT-er coffee mugs, birthday calendars, T-shirts, and the First Annual STAT-er Cookbook, which will be back next year by popular demand. The cookbook included recipes submitted by graduate students and faculty members.

Officers for the 1991-92 year were Todd Sanger, president; Ann Russey and Gerri Dunnigan, vice presidents; Chris Novak, treasurer; and Todd Borchert, secretary. Baiching An and Hiroshi Takahashi served as international representatives. Todd Sanger was the student representative at statistics faculty meetings. Kenneth J. Koehler was faculty advisor to the student club. Three Iowa STAT-ers served as ISU Graduate Student Senate senators: Todd Sanger, Rohit Deo, and Rick Meyer.

◼ George Zyskind Memorial Lecture

The 16th George Zyskind Memorial Lecture was given by David B. Duncan, professor emeritus, Johns Hopkins University, on October 8. Duncan received his Ph.D. in mathematical statistics at Iowa State in 1947. His 1955 *Biometrics* paper on Multiple Range and Multiple F Tests is the statistical paper with the largest number of citations (8,945) in the *Science Citation Index,* 1945-88. Duncan also gave a Statistical Laboratory seminar on October 9.

◼ B. V. Sukhatme Memorial Lecture

The 9th B. V. Sukhatme Memorial Lecture was presented by Donald B. Rubin on March 17, 1992. He spoke on "A Proposal for Satisfying All Confidentiality Constraints through the Use of Multiply-imputed Micro-data." On the following day he gave a Statistical Laboratory seminar (see p. 46). The Sukhatme lecture series honors the late B. V. Sukhatme, professor of statistics at ISU from 1968 to 1979, well known for his work in survey sampling and nonparametrics.

Rubin came to the Department of Statistics, Harvard University, as professor in 1984, from the

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* sports in which STAT-ers won the championship
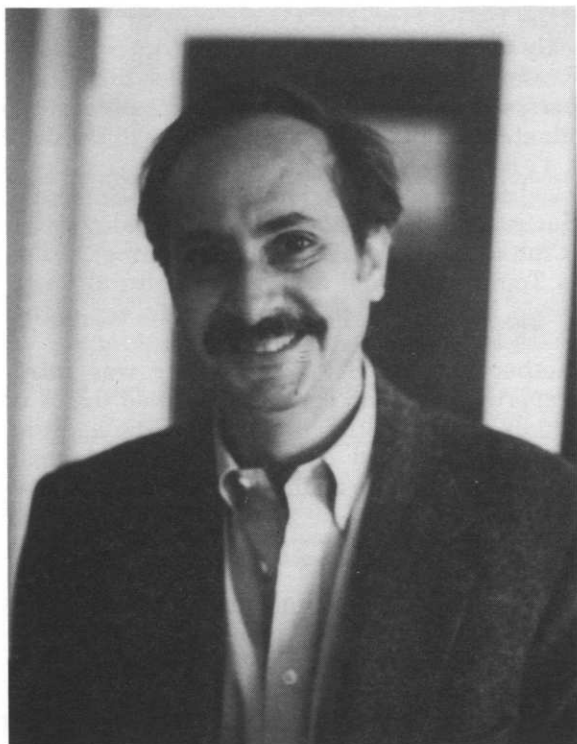
Donald Rubin, Sukhatme lecturer

University of Chicago; he became chair in 1985. Previously he had been with the Educational Testing Service, Princeton, New Jersey. He received his doctorate at Harvard. Rubin is a fellow of the American Statistical Association, Institute of Mathematical Statistics, and American Association for the Advancement of Science, and an elected member of the International Statistical Institute. He is author of two books, *Multiple Imputation for Nonresponse in Surveys* and, with R. J. A. Little, *Statistical Analysis of Missing Data,* as well as co-editor of two other books.

Snedecor and Bancroft Awards

The 1992 George W. Snedecor Award was presented to Todd Sanger as the most outstanding Ph.D. candidate in the Department of Statistics among students completing the doctoral preliminary examination during 1991. The award honors the founder and first director of the Statistical Laboratory. Sanger came here in 1987 and was awarded a three-year National Science Foundation predoctoral fellowship in 1988. He received an M.S. degree in statistics in May 1991 and expects to complete doctoral research under Wayne Fuller in August 1992. He is a past treasurer of Iowa STAT-ers and a past president of the ISU Graduate Student Senate. He has held internships with Dow Chemical Company in the U.S. and in Switzerland.

The T. A. Bancroft award recognizes achievements in statistics by students who completed prelim examinations in the past calendar year and who have a joint major in statistics and another area or a declared minor in statistics. The 1992 award was given to Bevin L. Harris and Hiroshi Takahashi. The award honors Theodore A. Bancroft, director of the Statistical Laboratory and head of the Department of Statistics from 1950 to 1972. Harris has a major in animal breeding and a minor in statistics. Takahashi is co-majoring in statistics and animal breeding.

Hiroshi Takahashi received undergraduate degrees in food technology and animal science, respectively, from Nippon Veterinary and Zootechnical College, Japan, and Iowa State University. He has been an employee of Global Pig Farms, Inc., Japan, since 1985. He completed a master's degree in animal breeding here in 1989 and passed doctoral prelims in statistics in 1991.

Bevin Harris came to Iowa State in January 1990 after completing B.Sc. and M.Sc. degrees at Massey University, Palmerston North, New Zealand. He passed his oral prelim in 1991 and has begun to publish results of his research. This has involved estimating genetic response when selection is for many correlated traits and with overlapping generations. Harris has written a computer program that allows simulation of selection response for 50 years under two-stage selection: pedigree and progeny testing. This program is widely used at ISU and has been requested by other universities and artificial insemination organizations.

Mu Sigma Rho

The 21st annual Mu Sigma Rho lecture was presented by Andrew Solow, research fellow at the Woods Hole Oceanographic Institute in Woods Hole, Massachusetts. His talk, "Statistical Issues in Global Warming," was attended by over 100 people. A skeptic about the severity of global warming, Solow acknowledged the increase in atmospheric concentrations of carbon dioxide and the relationship between carbon dioxide concentrations and global temperature. The real question is how sensitive is the climate system to such concentrations. The quantification of the natural temperature differences of Earth and the large variation in predictive models leave this question open to debate.
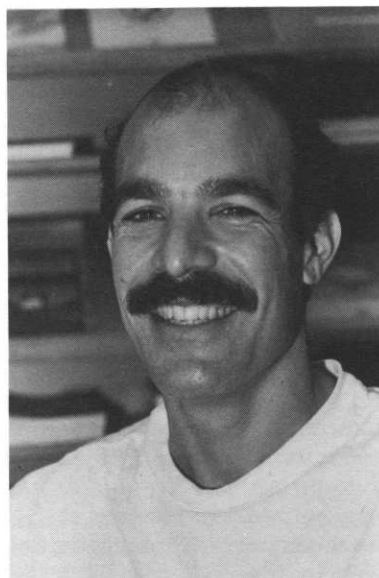
**Mu Sigma Rho lecturer
Andrew Solow**

Solow has published numerous articles in a variety of statistical and scientific journals, including *Mathematical Geology, Biometrics, Journal of Climate,* and *Ecology.* His visit on April 7-8 was co-sponsored by the Iowa STAT-ers, the ISU Department of Statistics, the undergraduate Statistics Club, fourteen other departments, the Institute for Physical Research and Technology, the Leopold Center for Sustainable Agriculture, the Graduate College, and the Committee on Lectures, and the Ames Laboratory of the U.S. Department of Energy.

Prior to the lecture, 10 undergraduates, 16 graduate students, and one faculty member were inducted into Mu Sigma Rho at the annual banquet in the Campanile Room, Memorial Union. Dr. Solow was made an honorary member. Officers for 1991-92 for the Iowa Alpha Chapter were Thomas Loughin, president; Jeffrey Helterbrand, vice president; and Bryan Olin, secretary-treasurer. W. Robert Stephenson served as faculty advisor.

Undergraduate Students

Matt L. Gerdis had an unusual opportunity in his last semester as an undergraduate statistics major, fall 1991. He presented a paper, entitled "Analysis of Data from Two-Level Fractional Factorial Experiments Using XLIPSTAT," at the Second Annual Argonne Symposium for Undergraduates in Science, Engineering, and Mathematics, at the Argonne National Laboratory, in Illinois, on November 8. The paper was the result of a project, in the course Stat 490, on which Gerdis worked during summer 1991 under the direction of Mervyn Marasinghe.

At the annual banquet of the Mu Sigma Rho statistics honorary on April 7, 1992, two undergraduate statistics majors, Shawn M. Bates and Weiye Zhu, were initiated as members. On April 21, at the Scholarship Recognition Dinner, Matt Gerdis was recognized as the highest-ranking graduating senior in statistics during the 1991-92 academic year.

The George W. Snedecor Undergraduate Statistics Award was established in spring 1992 as an annual award. It recognizes the junior or senior statistics major who has demonstrated the highest level of academic achievement and scholarship. A selection committee composed of the coordinator of undergraduate studies in statistics, the advising coordinator for the Department of Statistics, and a third member of the faculty of the department makes the final selection among all juniors and seniors majoring in statistics. The award consists of a certificate and a $200 cash recognition. The 1992 recipient is Weiye Zhu.

Seven students received B.S. degrees in statistics during the period July 1, 1991, to June 30, 1992. Names of the degree recipients follow, with employment or study plans, where definite. An asterisk indicates that the student is continuing in the graduate program in statistics at ISU.

Myung Hyun Baik (Fall 1991) is working for the Commercial Bank of Korea in New York City, New York, in its Loan Department.

George Gordon Brown, Jr. (Fall 1991) is a part-time data analyst in the Department of Zoology and Genetics at ISU and is taking courses in mathematics as a special student.

Susan M. Dyer (Fall 1991) is an actuarial analyst with the Associated Benefits Company, Des Moines, Iowa.

*Matt Lee Gerdis (Fall 1991, with distinction) will continue studies in statistics at ISU on completion of a cooperative internship in Rochester, Minnesota, working on quality control at IBM January-July 1992.

Dana Paul Reeves (Spring 1992)

Kyle Lee Sindlinger (Spring 1992) is working in production for Century Manufacturing Company, Bloomington, Minnesota.

Holly Marie Vancil (Spring 1992) temporarily served as office manager, Ogden Allied Concessions, at Hilton Coliseum, ISU, then accepted a position as statistician I with ICI Seeds (Garst Seed Company), Slater, Iowa.

Jeffrey Eickholt worked at Weyerhaeuser, Hot Springs, Arkansas, August 1991 through fall semester, as a statistics cooperative intern, then returned to ISU. Four undergraduate majors have taken statistical positions for summer 1992: Heather Doane, David L. Ramsey, and Ronald Schewe as data analysts with ICI (Garst Seed Company) in Slater, Iowa; Adam Sharp, with Motorola, Inc., Mount Pleasant, Iowa. The Doane and Schewe positions will continue on a part-time basis in fall 1992.

Statistics Club

The Statistics Club was established to promote interest in the field of statistics among undergraduates. The first meeting of the year was the traditional get-together and pizza feed. This meeting gave students a chance to reacquaint themselves with returning statistics majors and to meet the new members. It also served as a planning meeting for upcoming Statistics Club activities.

The first speaker of the year was Alicia Carriquiry, assistant professor of statistics at Iowa State. She talked about her travels to South America and Central Europe as a statistician for the ISU Center for Agricultural and Rural Development (CARD). In November, the club visited Delavan, Inc., Gas Turbine Products Division, in West Des Moines, Iowa. Delavan makes fuel injection components primarily for jet aircraft engines. In addition to having a plant tour, club members met with a group of engineers who have been learning about statistically designed experiments.

Ed McGuire, U.S. Bureau of the Census, spoke to the club in February about career opportunities with the government in general and the bureau in particular. The last meeting of the year was held at Hickory Park Restaurant, where club members enjoyed sundaes and heard about the advantages of student membership in the American Statistical Association from the club's faculty advisor W. Robert Stephenson.

Statistics Club officers for 1991-92 were David Ramsey, president; Ron Schewe, vice president and department representative to the Liberal Arts and Sciences College Council; Holly Vancil, treasurer; and Tracy McKee, secretary. The 1991-92 Statistics Club prize was shared by David Ramsey and Holly Vancil.

Seminars

The series of regular weekly seminars offered by the Statistical Laboratory and the Department of Statistics throughout the 1991-92 year was planned by John Stufken and Krishna Athreya. Gerri Dunnigan and Ann Russey were co-chairs for the Iowa STAT-er seminar series.

A highlight of the Statistical Laboratory series was the return of Holly C. Fryer to campus. Fryer received the first Ph.D. degree in statistics given at Iowa State, in 1940. His dissertation research, on "An Analysis of Group Differences Arising from a Poisson Distribution of Observations Obtained from Irradiation Experiments," was completed under George W. Snedecor. He has been at Kansas State (College, then University) since September 1940, except for a period of war research at Columbia University in 1944-45.

Fryer's career and achievements at Kansas State in many ways parallel the career of George W. Snedecor at Iowa State. He began as assistant professor in the Department of Mathematics and statistician for the agricultural experiment station, became full professor in 1945, helped organize a Statistical Laboratory in the experiment station and became its director in 1946, then helped organize a new Department of Statistics, becoming its head in 1959. In the period 1967-71 he led the creation of a Department of Statistics and Computer Science. (Computer Science has since then developed into a separate department.) Fryer is now professor emeritus and continues statistical consulting on campus.

In 1992 Holly Clair Fryer and his wife, Beth, returned to campus to share some of his experiences in a Stat Lab seminar and to launch a scholarship award fund for statistics Ph.D. students. In 1940 Fryer received Iowa State's first doctorate in statistics.

Statistical Laboratory Seminars

Summer 1991

July 10	Edgeworth expansion and bootstrap approximation for linear functions of least squares estimators of linear regression parameters with increasing dimensions. Muhammad Arif Tiro
24	Order statistics under linear trend. James Robison-Cox

Fall 1991

August 28	Introductions of new faculty and students; External Review Report. Dean L. Isaacson
September 11	An accelerated life test model based on reliability kinetics. William Q. Meeker
18	Issues of independence in underdispersed binary data. Mark S. Kaiser
October 2	Identifying periodicities in measurement data. Peter Sherman
9	Fully efficient t tests, t intervals, and point estimates for multiple comparisons. David B. Duncan, Johns Hopkins University
16	Obtaining initial parameter estimates for nonlinear systems using multicriteria associative memories. Leigh Testfatsion, Department of Economics and Department of Mathematics, Iowa State University
23	Order statistics filters. H. A. David
30	A semiparametric transformation to normality: An application to dietary intake data. Sarah Nusser, the Procter & Gamble Company
November 8	Using degradation measures to estimate a failure time distribution. C. Joseph Lu

13	Gross error detection in chemical process operations. Derrick Rollins
20	How many modes can a posterior distribution have? Alicia Carriquiry
December 11	Robust estimation in measurement error models. Joseph Croos

Spring 1992

January 22	LISP-STAT: A Lisp-based statistical programming environment. Mervyn Marasinghe and Philip Iversen
31	Analysis of variance in function spaces, with applications. Grace Wahba, Bascomb Professor of Statistics, University of Wisconsin-Madison
February 5	Estimation of the measurement error model with unequal error variances. Todd M. Sanger
12	Large deviations for branching processes. Krishna B. Athreya
17	Selecting the order in antedependence models. Raul Macchiavelli, Department of Statistics, Pennsylvania State University
24	Deconvolution and jump detection by the method of local approximation. Jianming Ye, Department of Statistics, University of Chicago
26	Partially efficiency balanced block designs: Theory and applications. Franz Hering, Department of Statistics, University of Dortmund, Germany
27	Simultaneously modeling the joint and marginal distributions of multivariate categorical response data. Joseph B. Lang, Department of Statistics, University of Florida
March 18	Honest inferences from iterative simulation. Donald B. Rubin, Department of Statistics, Harvard University
27	Statistical problems in genetic linkage and mapping. Terry Speed, Department of Statistics, University of California at Berkeley
April 1	Regional mapping of incidence rates. Noel Cressie
8	Inferring extinction from sighting data. Andrew R. Solow, Woods Hole Oceanographic Institute
22	Faculty and education available to statistics majors at Iowa State 1937-1940. Holly C. Fryer,

Department of Statistics, Kansas State University

27 (joint with Department of Industrial and Manufacturing Systems Engineering) Discrete Pearson distributions. Kimiko Bowman, Oak Ridge National Laboratory

29 (joint with Department of Industrial and Manufacturing Systems Engineering) Transformations and kernel density estimation: a survey. David Ruppert, School of Operations Research and Industrial Engineering, Cornell University

May 5 Seminar on Time Series: Estimation of the parameters for unstable autoregressive models. An Hong-zhi, Institute of Applied Mathematics, Academia Sinica

6 (joint with Department of Economics) Sampling-based Bayesian econometric modelling. John Geweke, Department of Economics, University of Minnesota

Summer 1992

May 21 (joint with Department of Mathematics and Department of Electrical Engineering and Computer Engineering) A fast recursive algorithm for the maximum likelihood estimation of the parameters of a periodic signal. Langford B. White, Electronics Research Laboratory, Defence Science and Technology Organization, Salisbury SA, Australia

22 (joint with Department of Mathematics and Department of Electrical Engineering and Computer Engineering) The use of H_∞ filters for linear demodulation and equalization. Langford B. White, Electronics Research Laboratory, Defence Science and Technology Organization, Salisbury SA, Australia

29 Space-time evolution of magnitude frequency distributions inferred from earthquake catalogs. Y. Ogata, Institute of Statistical Mathematics, Tokyo, Japan

June 3 Random rectangular tessellation models and some problems in archaeology. Margaret Mackisack, School of Mathematics, Queensland University of Technology, Brisbane, Australia

Special Lectures and Seminars

September 25 Joint Economics-Statistics Colloquium—I. W. Arthur Memorial Lecture: A Bayesian perspective on evidence that economic series have unit roots. Charles Whiteman, Department of Economics, University of Iowa

October 8 16th George Zyskind Memorial Lecture: Fully efficient t tests, t intervals, and point estimates for multiple comparisons (the first of two talks on this topic). David B. Duncan (emeritus), Department of Biostatistics, Johns Hopkins University

March 17 B. V. Sukhatme Memorial Lecture: A proposal for satisfying all confidentiality constraints through the use of multiply-imputed micro-data. Donald B. Rubin, Department of Statistics, Harvard University

April 7 Mu Sigma Rho Lecture: Statistical issues in global warming. Andrew Solow, Woods Hole Oceanographic Institute—cosponsored by the Graduate College; Ames Laboratories; Institute for Physical Research & Technology; Leopold Center for Sustainable Agriculture; Iowa STAT-ers; the undergraduate Statistics Club; the departments of Statistics, Agronomy, Animal Ecology, Chemistry, Forestry, Mathematics, Sociology, Zoology, Agricultural Engineering, Botany, Earth Science, Economics, Philosophy, and Physics; and the Committee on Lectures

Iowa STAT-ers Seminars

September 16 Membership in statistical societies: A student's perspective. Todd Sanger and Alan Zimmermann

23 A procedure of variable selection in linear regression models. Baiching An

30 Research assistantships. Christine Ashman, Joe Croos, Paul Wenz, Phil Iversen, and Anita McVey

October 14 The application of statistical tools in quality and productivity advancement at the Dow Chemical Company. Janelle Dombek, Dow Chemical U.S.A.

31 Brown bag lunch with interview and job search tips. Sarah Nusser, Procter and Gamble

November 4 Use of statistics in evaluating leak detection methods for underground storage tanks. Jean Pelkey

11 Statistics and experimentation in agricultural and biological sciences. T. B. Bailey

December 2 Assessing influence in regression analysis with censored data. William Q. Meeker, Jr.

9 A growing experience in statistics for statisticians. Dean V. Neubauer, Corning Inc.

February 3 Statistics at Pratt & Whitney: Where there's never a dull moment. Kim Erland, Pratt & Whitney

10 EMAP: An overview. Caryn Thompson, Department of Statistics, Oregon State University

12 Statistician's role at Universal Foods Corporation. Thomas Hsiang, Universal Foods Corporation

24 Internships. Lori Becker, Todd Manke, and Bryan Olin

March 23 Inference from hypothesis testing: Do we know what we're doing? Mark Kaiser

30 Video: *From Observation to Inference*, a taped interview with Oscar Kempthorne conducted by Noel Cressie.

April 27 Statistics at Eli Lilly & Company. Scott Andersen, Eli Lilly & Company.

May 4 Estimating dietary intake distributions. Kevin Dodd

Photo Credits

The photos of Donald Rubin and Andrew Solow on p. 44 are provided through the courtesy of the guest lecturers. The photo of Vince Sposito on p. 48 was taken by the ISU Photo Service. The remaining photos and the layout design are by Jauvanta Walker.

In Memoriam

Vincent A. Sposito, 1936-1991
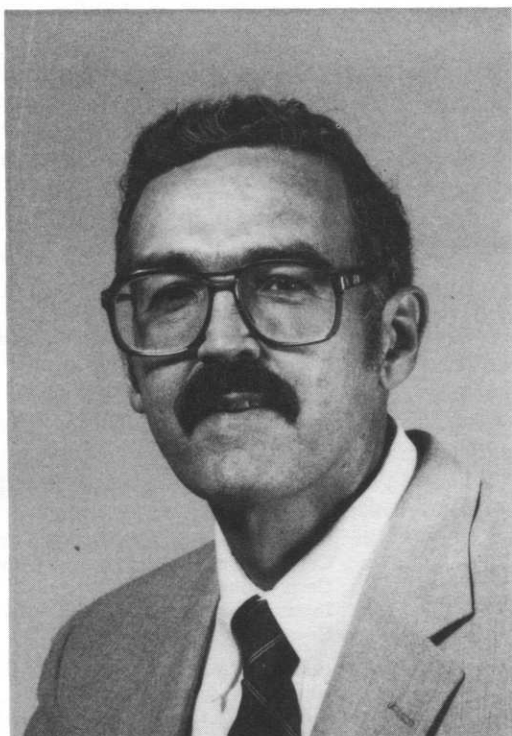
Professor Vincent A. Sposito was born in Pittsburg, California, November 15, 1936. He worked as a lab technician in the Metallurgy Division of Aerojet Corporation in 1958-1964. He received a bachelor's degree in mathematics and statistics (1965) from Sacramento State College and remained there for a year as instructor and as programmer with the Division of Highways, State of California. He then came to Iowa State University as a research associate in the Statistical Laboratory and received a master's degree in statistics (1967) from Iowa State University, and a Ph.D. in statistics (1970) from Iowa State. He was appointed assistant professor in the Department of Statistics in 1970 and was promoted to full professor in 1978. Vince Sposito died on October 16, 1991, after a twenty-year battle with cancer.

Vince's fields of specialization were mathematical programming and statistical computing. He was a member of the Statistical Computing Section of the Statistical Laboratory, the consulting staff of the Center for Agricultural and Rural Development, and the Computation Center. He assisted in the design and development of numerous large mathematical programming models for research projects in a wide variety of application areas on campus. He also en-gaged in consulting activities at the University of Iowa and IMSL, Inc., in Houston, Texas.

He was active in research throughout his career at Iowa State. In addition to numerous research publications in leading scientific journals, he authored two books, *Linear and Nonlinear Programming* (1975) and *Linear Programming with Statistical Applications* (1989), which are regarded as pioneering works in applications of mathematical programming in statistics. Included among the more than three dozen graduate student research projects that he directed are ten completed Ph.D. dissertations. He traveled and presented papers at professional meetings both in the United States and abroad. Dr. Sposito was a member of the American Statistical Association, the Mathematical Programming Society, Sigma Xi, Mu Sigma Rho, and Pi Mu Epsilon, and a fellow of the Royal Statistical Society.

Vince taught courses in mathematical programming and statistical computing at the graduate level. He was a popular instructor who was very patient and sympathetic when dealing with students. He was acutely aware of the impact that his teaching could have and always sought to maximize it.

Professor Sposito will be remembered for his expertise in mathematical programming, his enthusiasm for teaching and research, and his commitment to keeping Iowa State University a top quality academic institution. Colleagues and former students will remember him as a dear friend and an exceptionally caring and courageous man. He is survived by his wife, Marlene, and by his children, Lori and Philip of Ames, Iowa; Carrie of Lakeport, California; and David of Pleasant Hill, California.

Donovan J. Thompson, 1919-1991

Professor Emeritus Donovan Thompson died of an acute myocardial infarction on the golf course in Seattle, Washington, June 25, 1991, after recovering from a stroke the preceding May. He was born in Stoughton, Wisconsin, on January 30, 1919. He received a bachelor's degree in economics and mathematics at St. Olaf College in 1941, then served in the U.S. Marine Corps for nearly five years as aide-de-camp and communication officer with the rank of major. Upon reception of a master's degree in mathematics and statistics at the University of Minnesota in 1947, he joined the Statistical Laboratory at Iowa State as a research fellow and graduate student. He completed his doctorate in 1952 and remained here as an assistant professor of statistics for another year. His dissertation, written under P. C. Tang, dealt with "A theory of sampling finite universes with arbitrary probabilities."

Donovan joined the Department of Biostatistics, School of Public Health, University of Pittsburgh as assistant professor in 1953, was soon promoted, and became full professor in 1958. In 1966 he joined the Department of Preventive Medicine, School of Medicine, University of Washington, as professor of biometry. He became professor of biostatistics when the new School of Public Health and Community Medicine

was created in 1970 and served as acting dean 1971-1973. In 1973 he became chair of the Department of Biostatistics, holding that position until 1982, when he was named professor emeritus.

Thompson was an expert in conducting large-scale clinical trials and worked as consultant and reviewer for the U.S. Public Health Service and the National Institutes of Health. Under a National Academy of Sciences contract with the University of Washington and the Fred Hutchinson Cancer Research Center, he initiated an exchange of Japanese and American students and faculty. He founded the program in epidemiology and biostatistics at the Hutchinson Center and was on the center's board of trustees in 1972-1977. Thompson also served on the planning committee for establishment of the Department of Statistics at Washington. Following his retirement from the university he served as permanent director and chief of research in the Department of Epidemiology and Statistics, Radiation Effects Research Foundation, in Hiroshima, Japan.

Donovan Thompson was a fellow of the American Statistical Association and first president of the Pittsburgh chapter. He served as president of the Biometric Society (WNAR) in 1970-71. He is survived by his wife, Georgia, daughters Michel and Tove, and their families. A colloquium in his honor was presented at the School of Public Health, University of Washington, on December 5, 1991.