# Statistical Laboratory

**established 1933**

## Annual Report

July 1, 1993 to June 30, 1994

$$\sigma^2 \quad \mu$$
$$\Omega \quad \chi^2$$
$$\Sigma \quad \beta$$

# IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

# Contents

**THE STATISTICAL LABORATORY**
**Iowa State University**
**1993-94 Annual Report**

## Personnel

Dianne Cook joined the faculty in August as assistant professor in the Statistical Laboratory and the Department of Statistics. She holds M.S. and Ph.D. degrees from Rutgers University and has research interests in dynamic graphics, exploratory data analysis, multivariate methods, and statistical computing. She most recently held a research fellowship with Bell Communications Research.

Shashikala Sukhatme was a visiting professor at Case Western Reserve University in the Department of Epidemiology and Biostatistics during summer and fall of 1993. In summer she taught a course on sampling; in fall she engaged in research in biostatistics. David Harville took partial leave during the year to work on a book on matrices.

On faculty development leave, Soumendra Lahiri visited Australian National University, Canberra, Australia, from January 16 to June 2, 1994, to work with Prof. Peter Hall, Centre for Mathematics and Its Applications.

John Stufken visited the University of Illinois at Chicago during the spring semester. He continued his collaboration with statistics faculty and students there, taught a course, and worked on a book on orthogonal arrays.

Yoshiko Isogawa joined the Department of Statistics as visiting associate professor for a year, beginning August 22, 1993. She is on leave from her position as associate professor, Department of Management Science, Kobe University of Commerce, Kobe, Japan. Isogawa received degrees of Master of Engineering and Doctor of Engineering at Osaka University in 1980 and 1985 and first joined Kobe University in 1982. She has been working mainly with Professors Fuller, Amemiya, and Nusser in research on measurement error models.

Phil Iversen returned as temporary assistant professor for spring semester 1994 and the summer term. Since completing his Ph.D. in statistics at Iowa State, he had been a senior research associate and half-time lecturer in the University of Newcastle Department of Statistics, in Australia, for a year. During that time he also worked with the Newstat Statistical and Quality Consultants, the university department's external consulting company.

Sastry Pantula, professor of statistics at North Carolina State University, returned as visiting research scholar to work with Wayne Fuller on time series research July 5-30. Visiting scholar Do-Seok Chang left in December, after a year's stay, to return to his position at Dongduck Women's University, Seoul, Korea. Chang is associate professor and chair of the Department of Statistics and Computer Science there.

Mack Shelley served as vice chair of the Department of Political Science at Iowa State during the year.

Wayne Fuller received the 1994 Margaret Ellen White Graduate Faculty Award at Iowa State University on May 4. This $1,500 award recognizes superior performance by a member of the graduate faculty who serves as a mentor and enriches the student-professor relationship through support and attention to detail, enabling students to finish their work in a timely and scholarly manner. Fuller has served as major professor for 26 M.S. and 57 Ph.D. degree candidates.

Fuller has also been selected as a fellow of the Econometric Society and was cited for his publications as follows: "He is the sole author of two major books in time-series and measurement error models. He has published more than 65 papers in 21 journals, plus 20 other refereed publications. He has made numerous contributions in the estimation of linear and nonlinear models, with heteroscedastic errors, correlated errors and nonlinear restrictions on parameters. His papers on distributed lag models are classics. He has made outstandidng contributions in the estimation of errors-in-variables models, which are of great importance in econometrics. His seminal papers on time-series models with unit roots have been extensively cited."

Derrick Rollins, Sr., received the ISU Foundation Award for Early Achievement in Teaching for 1994. Recognition and a $1,000 award were given at the Spring Convocation on May 4. Rollins was cited as having "established himself as a prominent researcher in the new field of probabilistic chemical engineering, and as one of the best teachers at Iowa State University. He has been an innovator in creating new courses that combine statistics and chemical engineering sciences, especially in process control technology."

Soumendra Lahiri was chosen to be the recipient of the ISU Foundation Award for Early Achievement in Research/Scholarship for 1994. Recognition and a $1,000 award were given at the Spring Convocation. Lahiri was cited for having made, in the past five years, "major contributions to the development of an asymptotic theory for 'robust' estimators. The importance of his work has been acknowledged with invitations to speak at three national and two international conferences. He has received National Science Foundation funding since 1991 and was invited to work with top researchers at the Australian National University and Stanford University during 1994."

Toni Genalo received a Regents Award for Staff Excellence on May 4. She is survey projects manager in the Statistical Laboratory Survey Section.

Stephen Vardeman was chosen to receive the American Society for Engineering Education's 1994 Meriam/Wiley Distinguished Author Award. He was selected for his textbook *Statistics for Engineering*

1

*Problem Solving.* Presentation of a certificate and a $2,000 honorarium took place at the ASEE Annual Conference banquet, June 29, 1994, in Edmonton, Alberta, Canada. The biennial award recognizes excellence in the authorship of first-edition engineering books, published within a two-year period, that contribute to the advancement of technical and professional competence at the undergraduate or graduate level.

Frederick O. Lorenz was initiated into the Sigma Xi national honorary research society.

A retirement coffee was held in honor of Helen Nelson on May 6, her last day on the job. Nelson retired after 17 years in the Department of Statistics and the Statistical Laboratory, where she served as the main secretary for the Survey Section. In addition to providing support for the faculty, staff, and students in the Survey Group, she is remembered fondly by many former students and visitors for the help she provided as they settled into their new environment, and for her continued friendship over the years. Nelson is now traveling between Iowa and Montana or Arizona as seasons and family needs dictate.

Looking toward next year: Hal S. Stern will join the faculty in July as associate professor with tenure. He completed M.S. and Ph.D. degrees in statistics at Stanford in 1985 and 1987, respectively, and then joined the Department of Statistics, Harvard University, becoming an associate professor in 1991. Stern has research interests in Bayesian data analysis, paired comparisons and ranking, and statistics in sports.

Frederick Lorenz has been promoted to full professor of sociology and statistics. Soumendra Lahiri has been awarded tenure and promotion to associate professor. He will be visiting the Department of Statistics, Stanford University, California, for fall semester 1994.

## Statistical Laboratory Staff--Fiscal Year 1993-94 under the administrative direction of :

Martin C. Jischke, Ph.D.--president
John J. Kozak, Ph.D.--provost
Patricia B. Swan, Ph.D.--vice provost for research and advanced studies; dean of the Graduate College
Elizabeth Hofmann, Ph.D.--dean, College of Liberal Arts and Sciences; 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
Yasuo Amemiya
Krishna B. Athreya, joint appointment with Department of Mathematics
Theodore B. Bailey
C. Philip Cox, professor emeritus
David F. Cox, University Professor
Noel A. C. Cressie, Distinguished Professor in Liberal Arts and Sciences
Herbert A. David, Distinguished Professor in Liberal Arts and Sciences
Herbert T. David, University Professor, 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
Roy D. Hickman, professor emeritus



Two statistics alumni received Citation of Merit Awards from the College of Liberal Arts and Sciences on June 11, during Alumni Days. Carol Francisco (Ph.D. 8/87) has been with Syntex Laboratories, Palo Alto, California, since 1986 and was promoted to head of the Biostatistics Department there in 1993. She has been cited for her effort in market-support and new drug application clinical trials and as a mentor for her research team and a role model for working women. Emil Jebe received B.S. and M.S. degrees at Iowa State and returned for 10 years as associate professor of statistics after completing a doctorate elsewhere. In 1959 he began a distinguished career at the Willow Run Laboratories (now Environmental Research Institute of Michigan), at the University of Michigan; since being named statistician emeritus in 1979 he has remained actively concerned with his field.

Paul N. Hinz, faculty status also in Department of Forestry
Donald K. Hotchkiss, professor emeritus
David V. Huntsberger, professor emeritus
Dean L. Isaacson
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
Mack C. Shelley II, joint appointment with Department of Political Science
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 SystemsEngineering
H. Samuel Wieand, Mayo Clinic collaborator
Leroy Wolins, professor emeritus

## Associate Professors
Yoshiko Isogawa, visiting
Frederick O. Lorenz, joint appointment with Department of Sociology
Mervyn G. Marasinghe
Carl W. Roberts, joint appointment with Department of Sociology
Peter Sherman, joint appointment with Department of Aerospace Engineering and Engineering Mechanics
W. Robert Stephenson
John Stufken
Shaskikala Sukhatme

## Assistant Professors
Harold D. Baker
F. Jay Breidt
Alicia Carriquiry, joint appointment with Center for Agricultural and Rural Development
Dianne Cook
Mark Kaiser
Soumendra N. Lahiri
Sarah Nusser
Derrick Rollins, joint appointment with Department of Chemical Engineering

## Temporary Assistant Professor
Philip W. Iversen

## Resident Collaborator
Dean Thompson, USDA Soil Conservation Service
Herb Wilson, USDA Soil Conservation Service

## Visiting Research Scholar
Do-Seok Chang

## 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. 00.

Pamela Abbitt
Jeremy Aldworth
Gregg Althen
Anthony Baiching An
Peter Anderson
Gregorio Atúncar
Barbara Dombroski Barnet
Lee Barton
Shawn Bates
Rebecca Benner
Carter Ann Blakeley (Shell scholar)
G. Gordon Brown
Dana Bruden
Aidan Cardella
Jianlin Cheng
Bradley Davidson
Rohit Deo
Mark Dietrich Fryer scholar)
Ansgar Dressler
Thomas M. Dubinin (Shell scholar)
Gerri M. Dunnigan (Shell fellow)
Michael Eraas
Jun-ichiro Fukuchi
Angelita Nason Garth
Matthew Gerdis
Juan Jose Goyeneche (Fulbright/LASPAU scholar)
Peter Hanson
Jeffrey Helterbrand
Kari Ann Henry (Shell scholar)
Nan-Jung Hsu (Vera David fellow)
Hsin-Cheng Huang (Holly and Beth
Amy Rath Johanson
Shin-Soo Kang
Sara Kind

Thomas Kirchoff
Scott Klabacha
Seoung-Gon Ko
Chiang-Sheng Lee
Ding-Hwa Dean Lei
Beth Lencowski
Kelli Leonard
Michael L. Lieber (Dow scholar)
Win-Chin Lin
Chih-Yao Craig Liu
Thomas Loughin
Maritza Melèndez-Cuero
Peter Morse
Sol T. Mumey
Bryan Olin (IBM fellow)
Savas Papadopoulos
Daniel J. Parks
Francis Jave Pascual
Jean Pelkey
Mark Peters
Abdul Wajid Rana
Daniel Rose
Anindya Roy
Stephanie Johnson Schaller
Christopher Scheib
Angela Schneider
Tae-Sung Shin
Richard Sullivan
Catherine Sunde (Corning scholar)
Andrine Swensen
Jürgen Symanzik
Ling-Ling Claire Tsao
Edith Van Valkenberg
Jennifer Walker
Hui Wang
Ouhong Wang
Lisa Wicklund
Jeffrey Wieland
Zugeng Zheng

## Supported Graduate Students
Yudiantri Asdi--Government of Indonesia
Bassirou Chitou--USAID-ATLAS/AFGRAD
Sriram Devanathan--Department of Chemical Engineering, ISU
Kevin Dodd--Center for Agricultural and Rural Development, ISU
Donald J. Dougherty--Center for Continuous Quality Improvement, ISU Research Park
Michael Elling--Iowa Transportation Center
Birol Emir--Government of Turkey
Dennis Field--Iowa Quality Coalition and Department of Industrial and Manufacturing Systems Engineering, ISU
Carolyn Goebel--College of Family and Consumer

3

Sciences, ISU

Hui-Lin Hu--U.S. Department of Agriculture

Mu-Yeh Huang--Engineering Research Institute, ISU

Wynandin Imawan--STAID-IU-Indonesia

Alejandro Islas-Camargo--CONACyT-Mexico

Shuen-Lin Jeng--Center for Nondestructive Evaluation, IPRT, Ames Laboratory, U.S. Department of Energy

Philip G. Jones (Shell fellow)--Center for Agricultural and Rural Development, ISU

Kari Jovaag--Department of Geological and Atmospheric Science, ISU

Matthias Klapper (DAAD scholar)--Dortmund University

Brian Kluge--Admissions Office, ISU

Sock-Cheng Koh--National University of Singapore

Jaehyung Lee--Center for Family Research and Rural Mental Health, ISU

Yang Li--Department of Economics, ISU

Marcia Macedo--CNPq/CAPES and Kellogg Foundation

James Majure--GIS Support and Research Facility, ISU

David McDonald--National Center for Atmospheric Research (in absentia)

Lucky Wes Mokgathle--University of Botswana

Elizabeth Paterno--Department of Economics, ISU

Laknath Peiris (Fulbright scholar)--University of Peradeniya, Sri Lanka

Stephanie Roll (DAAD scholar)--Dortmund University

Leroy Rushing--College of Business, ISU

Pradipta Sarkar--Center for Nondestructive Evaluation, IPRT, Ames Laboratory, U.S. Department of Energy

Steffen Seiffarth (DAAD scholar)--Dortmund University

Chungyeol Shin--Social & Behavioral Research Center for Rural Health, ISU

David Siev--U.S. Department of Agriculture

Hiroshi Takahashi--Global Pig Farms, Inc., Japan

Chi-Hong Tseng--Center for Agricultural and Rural Development, ISU

Elizabeth Uken--Department of Geological and Atmospheric Science, ISU

Delfino Vargas-Chanes--CONACyT-Mexico

Anand Vidyashankar--Department of Mathematics, ISU

Michael Wallendorf--Department of Entomology, ISU

Christopher Wikle--Department of Geological and Atmospheric Science, ISU

Kevin Wright--Center for Agricultural and Rural Development, ISU

Lie-Ling Wu--College of Veterinary Medicine, ISU

Ilker Yalçin--Provost's Office and Department of Sociology, ISU

Jincheol Yoo--Korean Army

Weiye Zhu--U.S. Department of Agriculture

## Self-Supporting Graduate Students

| | |
|---|---|
| Mahmood Ahmad | Marie Coffin |
| Ann Russey Cannon | Joan Qiong Dong |
| Hyen-Hyee Cho | Ashraf El-Houbi |

| | |
|---|---|
| Jason Gunnink | Yoon-Dong Lee |
| Shawkat Hassan | Shyh-Jye Leu |
| Gibog Hong | Chien-Hua Jonathan |
| Shiaau-Er Huarng | Liao |
| Yoon-Sook Jeon | Soheila Naiini |
| Je Yeong Jeong | Sang-Heon Oh |
| Dae-Lyong Kim | Margarita Paterno |
| Sahmyeong Kim | Namkyu Yu |
| Kye-Don Lee | Alan Zimmerman |

## 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 specialist

Anita Hinkeldey McVey, 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, communication 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

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

Sandie Smith, secretary (beginning 4/94)

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 Carol Goebel, Nan-Jung Hsu, Mike Lieber, Tom Loughin, Andrine Swensen, Claire Tsao, Mike Wallendorf, Lie-Ling Wu, and Weiye Zhu.

Ted Bailey consulted with researchers in agronomy on a research project evaluating long-term effects of tillage systems on crop residue cover, corn growth, and grain yield. Three tillage methods, including no-tillage, were compared on continuous corn. The study was unusual because data were collected over a ten-year period. Linear models containing both fixed and random effects were used to estimate the effects of years and tillage systems for a number of traits. The analyses resulted in the important conclusion that, after accounting for plant density differences, no-tillage grain yield increased 0.17 Mg per hectare per year compared to tilled treatments.

Bailey also collaborated with researchers in the Department of Entomology in a study concerned with the mode of inheritance of face fly diapause and its correlation with other developmental traits. Genetic crosses between Minnesota and Iowa face fly strains resulted in six generation types (including parents, $F_1$, $F_2$, backcrosses, and reciprocal crosses) resulting in a total of 14 cross lines. The experiments utilized a randomized complete block experimental design with five replications. Several quantitative traits were measured. The minimum number of genes and heritabilities were estimated for each of the traits. The study also examined the effects of diapause response to photoperiod.

Carol Goebel, Mike Lieber, and Paul Hinz assisted on the design of a study on the biomechanical design of shoes for working women. The study is being undertaken to determine how the distribution of foot pressure on shoe soles changes as heel height increases.

Paul Hinz helped design a study to learn if measurements made on fresh pork loins could be used to predict the quality of Canadian-style bacon produced from those loins. The analysis of the data from the study presented statistical problems in deciding how to use the 60 measurements made on each fresh pork loin to predict 6 finished product characteristics. Because many of the fresh loin measurements were highly correlated, linear combinations of measurements were formed that were relatively uncorrelated, and these were used as independent variables in regression analyses to predict finished product quality.

A pilot study on methods for reducing intestinal disease in pigs used several treatmens in the intestines of live pigs. Nan-Jung Hsu and Mike Wallendorf analyzed counts of bacteria colonies in the intestines and used the results to recommend the numbers of samples and pigs to use in a future experiment.

Lie-Ling Wu analyzed data from the small animal clinic at the College of Veterinary Medicine. Measurements of nitrite, total protein, and IgG (an antibody) were made on blood samples taken from healthy and sick dogs brought to the clinic. A multivariate analysis of variance was used to determine if healthy and sick dogs differed on these measures.

Claire Tsao assisted in the analysis of data from a split plot experiment to study intercropping of wheat and soybeans. The treatments were a factorial combination of three planting dates and seven different intercropping arrangements.

A study from the College of Veterinary Medicine surveyed pig producers in Carroll county, Iowa, on their production practices and determined the incidence of pseudorabies in their herds. Mark Peters and Paul Hinz used the data to determine if the incidence of pseudorabies could be linked to size of herd, pig breed, sanitation practices, source of breeding stock, and other producer characteristics.

Mark Kaiser estimated differences in duodenal immunoglobulin-producing cells among groups of dogs with various forms of gastroenteritis in a clinical study conducted at the ISU College of Veterinary Medicine. Cell counts were modeled using a Gamma-Poisson mixture to account for individual variability among dogs within a group.

Kaiser continued collaborative research with J. R. Jones, School of Natural Resources, University of Missouri, to investigate sampling frequency effects in limnological surveys.

David Harville was a research collaborator on two Iowa experiment station animal breeding projects —one on genetic improvement of dairy cattle using molecular markers and one on genetic enhancement of health and survival in dairy cattle.

Kenneth Koehler applied logistic regression models to data collected by botany researchers to model the effects of controlled changes in water levels on the ability of certain species of wetland plants to emerge

at new locations with suitable water levels. He assisted researchers in animal science in modeling changes in the immune systems of Holstein cows in the weeks before and after calving. He also worked with Tom Loughin and researchers in plant pathology and agronomy on the development and validation of a model for predicting nightly duration of dew periods during the growing season in the Midwest. Accurate estimation of dew duration is an important part in determining potential damage of fungal diseases to fruit and vegetable crops. Models were developed combining classification free methodology with standard linear discriminant analysis.

Andrine Swensen continued work on a project to study the relationship between degree of landscape fragmentation and avian species richness and nest predation in areas along the Mississippi River. Kenneth Koehler consulted with her on aspects of the analysis of data from this three-year study performed by researchers in the animal ecology department.

## ▨ Center for Agricultural and Rural Development

Work by Alicia Carriquiry, Noel Cressie, and James Majure on a national pilot project in Erath County, Texas, on livestock pollution, continued. This project is partially funded through a cooperative agreement with USEPA.

## ▨ 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 1993-94 were led by William J. Kennedy and Mervyn Marasinghe (see pp. 41 and 16).

During the year, section personnel worked on projects that involved a diverse range of subjects, including children's family support services, sports medicine, Iowa farmland ownership patterns, maintenance cost management for truck leasing, the design of a user interface for medical patient tracking, a data entry system for renal arterial surgery, analysis of soybean seed damage related to choice of auger, and the creation of a statistics textbook data diskette.

Support work was also provided for faculty, staff, and students within the Department of Statistics for personal computing hardware needs and software questions mainly relating to the Project Vincent™ Unix environment and personal computer packages. Currently the department houses over 60 workstations. Every faculty member now has a personal computer or workstation on his/her desk to enable the sending and receiving of departmental electronic mail. These machines are maintained by the section.

New 486-level personal computers are being set up for all secretaries, and software is being installed that will enable use of the PCs as X-Window terminals for connection to Project Vincent.

Matt Gerdis and Mervyn Marasinghe installed the PC version of the Current Index to Statistics Extended Database (CIS/ED), 1993 version, on a personal computer located in the Oscar Kempthorne Reading Room. This PC is available to faculty, students, and staff for on-line searches of the database.

Using the dBase language, Shawn Bates created a data entry form to enable researchers in the Child Welfare Research and Training Project to enter over 4,000 cases of children receiving family rehabilitative treatment and support serices. This was done on IBM-compatible personal computers and provided more information than the mainframe computer database at the Iowa Department of Human Services (DHS) in Des Moines. Bates also wrote SAS* programs to translate the dBase data to the ISU mainframe computer to produce tables and graphs that were included in a report submitted to DHS. Their goal is to reduce costs while simultaneously improving the children's home environment by shifting the focus from group home care to the treatment of families in their own homes.

One of the main projects this year was a mandated study initialized by the State Legislature to look at farmland ownership patterns in Iowa. This study will occur every five years. Ann Schultz and Prof. Neil Harl, both of the Department of Economics, worked with Dean Lei and Profs. Jay Breidt and Wayne Fuller in the Department of Statistics to develop a properly weighted sample that could be used to generalize characteristics of farmland ownership in the entire state of Iowa. Lei used the SAS* language to implement the appropriate sample weights used for generalization. Then he worked closely with Schultz to produce tables, which she incorporated into a report that she will present to the Legislature. This was done for data collected by the Survey Section under Toni Genalo's supervision in 1992. Lei also went back to 1982 data and produced appropriate weights for that data so that Schultz could look at trends beginning in 1982.

Pete Anderson joined the Statistical Computing Section this year specifically to work with Tom Bubolz, Center for the Evaluative Clinical Sciences, Dartmouth Medical School. Anderson, Bubolz, and Kathy Shelley are doing design work and implementation on a health care data analysis system that will enable providers and insurers to study variations and outcomes of health care in the United States. The system, running on high-capacity engineering workstations, includes extensive, user-friendly data management capabilities, along with descriptive and inferential statistical analysis and graphics, including line graphs, bar charts, and maps with details at the zip code level. The theory for this data analysis system was developed by Bubolz and his colleagues at Dartmouth.

6

As part of the continuing effort of the Department of Statistics to transfer technology and promote economic development in Iowa, Kenneth Koehler and Kathy Shelley updated and expanded truck maintenance models developed for the Ruan Transportation Company headquartered in Des Moines, Iowa. This project has produced models that have provided the company with accurate predictions of maintenance costs and staffing needs in their Mega Fleet truck leasing operation.

Using an interactive graphics procedure in SAS*, Mark Peters worked with Koehler in graphically identifying outlier data with unreasonable cost or mileage figures. Kathy Shelley wrote a dBase program that reads in current Ruan spreadsheet data, incorporates Koehler's table estimates, and produces cost projections that are translated back into the spreadsheet format. Portable color computers were purchased for Ruan's terminal repair shops throughout the U.S. Lynnann Correy, director of Financial Analysis, provided training to the terminal managers on use of this system. They have saved money and have been able to distribute their repair personnel more efficiently by using this program. Koehler will re-examine his analysis for the 1993 data.

Dean Lei and Kathy Shelley worked with Ken Koehler on projects for the Iowa Heart Center affiliated with Mercy Hospital in Des Moines. One of these projects involved analysis of healthy teenage athletes. The heart center examined the relationship of heart size with levels of physical activity, age, gender, and other physical body characteristics. Lei developed a dBase data entry system for physical attributes of patients who undergo renal arterial surgery. The surgeons are interested in relating surgical success rates to demographic and physical patient traits.

Stephen Vardeman and Lei worked with PWS Publishing to translate textbook data from four different statistical package formats into text files. These files will be included on a diskette that will accompany Vardeman's textbook, *Statistics for Engineering Problem Solving*. Vardeman also worked with section personnel to produce end-of-year graphs for *Technometrics*. These graphs demonstrated the turn-around time for manuscript submission and evaluation.

The impending demise of the mainframe research computer at ISU caused a large increase in section business. First there was a flurry of activity to determine which processes could be easily transferred to either Project Vincent™ or PC equipment. Second, many of the section's clients requested that DOS, Ultrix, or some combination of computing platforms be used for their work.

The most notable conversion requests came from research workers in the Department of Agronomy's corn and soybean projects. For years, plant breeders at ISU have used Fortran-based computer software and OS batch processes controlled through Wylbur. They have decided that this software should be revised for the PC so that Windows/SAS in DOS is the primary programming and processing language. Two Fortran components for conversion were Books and Labels and an analysis of variance program called ABIYO. The Books and Labels component is used in planting, observing, and harvesting a crop. Of course, ABIYO is often used in the analysis of whatever results from the crop. The Books and Labels program is now coded in SAS*. ABIYO is still in Fortran and is used when needed in Windows/SAS.

Graduate students working closely with Bud Meador are Matt Gerdis, Sara Kind, Chiang-Sheng Johnson Lee, Mark Peters, and Jeff Wieland. Gerdis worked primarily on Iowa State Forest Nursery Project applications. Wieland worked on state nursery tasks and on a data collection program for the Department of Entomology. This program runs on an IBM PC-AT to collect data arriving through a National Instruments' PC-DIO-24 board. The board is connected to 16 flight mills that monitor flight characteristics of large moths, such as black cutworm moths. Data are recorded for each mill over a 12- to 16-hour period. The program developed by Wieland represents an upgrade from a previous BASIC program used with a Pet computer.

Sara Kind worked extensively on the various components of the Iowa Corn Yield Report and the associated farmer survey used to determine widely grown varieties. Kind set up a Decwrite procedure in Ultrix to print a wall tag in large easy-to-read type for use in the seed warehouse. This procedure will be used annually. Lee worked on the revision of the plant breeder's software mentioned earlier and prepared to take over Kind's responsibilities for crop reports.

The Statistical Computing Section leases PC/SAS 6.04 and Win/SAS 6.08. Mark Peters handled all aspects of installing and distributing the Windows version of SAS, and most of the distributing of PC/SAS. Peters and Paul Hinz worked with a researcher in veterinary clinical sciences on analysis of data, on the incidence of pseudo-rabies, collected from swine producers over a three year period.

## ▨ Survey Section

The Survey Section of the Statistical Laboratory provides consultation and direct operational assistance to research workers both on- and off-campus 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. Faculty also conduct research and teach courses in the areas of sampling, survey design, and statistical methods. Sarah Nusser serves as administrative director of the section.

Four health-related studies are being conducted in collaboration with researchers at the University of Iowa. The final year of data collection on a five-year case-control study of craniofacial anomalies was completed. Five hundred eighty mothers were interviewed by telephone regarding their health, pregnancy, and genetic histories in order to study the epidemiology of this birth defect.

A second study of birth defects, funded by the Centers for Disease Control, will examine similar factors when looking at children with specific multiple birth defects. Survey Section staff will conduct interviews by telephone with 300 mothers of children recently diagnosed with these defects.

A collaborative study sponsored by the National Institute on Aging and the National Cancer Institute, to examine co-morbid conditions in older cancer patients, is underway. Survey Section staff will be designing the questionnaire and field forms and conducting the training for the five participating states. The study will continue through 1995, and interviews will be conducted in person with 300 recently diagnosed cancer victims 55 years of age or older.

Work continues on a four-year project related to specific language impairment in five and six year-old children. This year, the third in the study, 540 mothers of cases and controls were interviewed by telephone after University of Iowa staff conducted screening and diagnostic speech and hearing tests with the children. Staff are responsible for interviewing, coding, and processing the data. Work will continue with a final year of interviews in 1994-1995.

A health-related study for the Mayo Clinic's Division of Health Sciences Research is in its second year. Survey Section staff conducted interviews by telephone with 146 women, in two Minnesota counties, regarding the recency of breast exams, pap smears, and mammograms. The study is designed to measure the impact of an intervention program that encourages physicians to institute a cancer screening reminder system with their female patients. The staff has begun working on the third and final year of data collection.

The Survey Section has begun work on a three-stage study of substance abuse treatment needs conducted for the Iowa Consortium for Substance Abuse Prevention and the Iowa Department of Public Health, as part of a national effort directed and funded by the Center for Substance Abuse Treatment. The first stage of the study, a general household telephone survey conducted this year with 940 adult Iowans, was designed to assess the incidence of substance abuse and need for treatment. A second stage of research was funded by the center to examine the effects of the 1993 Iowa flood disaster on mental health and substance use.

The flood study involves two phases. First, a follow-up interview was conducted with telephone respondents who were interviewed on the original study prior to the flooding. Eighty percent of the original sample contacted prior to the flood were interviewed and reported on their mental health, substance use patterns, and treatment needs since the flooding, as well as the effects of the flood on their house, property, and physical health. The second phase of the flood study involved a survey of householders living in ten flood-prone areas of the state. Personal interviews were conducted with 386 residents of flooded areas regarding the same issues.

Survey Section staff designed the sample, developed protocol and forms, conducted interviews, and are processing the data, which will be analyzed by the principal investigator at the University of Northern Iowa.

A number of surveys were conducted for Iowa State University faculty and administrators this past year. The pilot study to compare people who have filed for bankruptcy under Chapter 13 with those who file under Chapter 7 has been completed. The main study, which will be conducted in Maine, Ohio, New Mexico, Iowa, North Carolina, and South Carolina, will look at the decision-making process people go through when choosing how to file for bankruptcy, and the effects of bankruptcy on their lives. The principal investigator, a faculty member in the Department of Human Development and Family Studies, will analyze the data collected from 720 telephone interviews.

For economists examining the level of risk that consumers perceive, when purchasing irradiated meat, 181 telephone interviews were conducted with Story County residents. After the interviews, respondents were invited to particpate in a laboratory experiment regarding the cost of the meat and willingness to consume such products.

A follow-up study of Iowa family farms, originally contacted in 1977, has been proposed. Survey Section staff are working with the principal investigators on design of the project. This year, as an aid to designing the study, a sample consisting of 150 of the original respondents was contacted to determine the proportion of farm owners in the 1977 sample that could be reached and the current status of their farming operation. The study hopes to examine the sustainability of family farms over the past two decades.

The Iowa Energy Center at Iowa State is sponsoring several projects to provide electronic information and instructional software to Iowa schools and libraries. As a part of this effort, Survey Section staff carried out a mail survey with a sample of Iowa schools and public libraries. Five hundred mail questionnaires were returned, processed, and analyzed.

A study of the 150 independent Iowa telephone companies has begun. The sociologist directing the project is exploring telephone company managers' perceptions of the role their firm plays in rural economic development. The Survey Section is conducting telephone interviews and processing the data.

Several studies to measure opinions of faculty, staff, and students were carried out by the Survey Section. A telephone interview of 300 members of the university community was conducted to measure newspaper readership patterns and the influence of advertising on consumerism for the Iowa State Daily newspaper board. Faculty and staff (651) were surveyed by telephone regarding the amount and type of information they receive, and wish to have, regard-

ing their employee benefits package. A mail survey of over 3,000 faculty, staff, and students on campus was conducted to assess the campus climate for diversity, and will be used to direct policies and programs related to diversity issues. Survey Section staff were responsible for sample and questionnaire design, data collection, processing, and simple analysis for all three projects.

Advice on methods of data collection, questionnaire format and design, and coding was given to the following: researchers examining consumers' preference for hair restraints in a university cafeteria; a horticulturist studying business practice and future needs of nursery and landscape centers; a graduate student examining the lack of community involvement in the closing of a neighborhood park in a minority community; a study of the preference for benefits provided to daycare employees; an assessment of the Early Success Program for preschool children in the Ames community schools; a veterinarian examining the spread of pseudorabies in hogs in Iowa farm communities; a faculty member evaluating the use of high-technology classrooms at a number of universities; a study of the role that a technical journal plays in the information process among horticulturists; a study of the role of grandparents as primary caretakers of their grandchildren; and a project investigating the success of study abroad programs at colleges and universities.

Consultation on survey design was given to a representative of Mercy Hospital in Des Moines, Iowa, for a sample of grocery stores; to an economics student on a study of bankruptcy procedures; to a faculty member in the Department of Human Development and Family Studies on a study of the Iowa welfare system; to a faculty member in the Department of Hotel, Restaurant, and Institutional Management on attitudes toward irradiated foods held by food service managers in restaurants, schools, hospitals, and grocery stores; to a faculty member in anthropology on a study of different medical treatments in Mexico; to a forestry student on a sample of sawmills; and to a faculty member in the College of Veterinary Medicine interested in evaluating the quality of the college's consulting program.

### ▨ 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. Consulting with industry is offered by individual faculty members and graduate students.

Herbert T. David, Stephen B. Vardeman, Peter Sherman, and Derrick Rollins provided assistance on engineering research projects during the 1993-94 year. Dennis Field continued industrial statistics consulting as a representative of the Iowa Quality Coalition.

Herbert T. David assisted in research, in the Department of Agricultural and Biosystems Engineering, on modeling baffle-constrained airflow. He also assisted in research, in the Department of Industrial and Manufacturing Systems Engineering, on developing flow shop scheduling algorithms.

Peter Sherman consulted with researchers in mechanical engineering in relation to stochastic representations of measurement data associated with high speed turbomachinery.

Bill Meeker visited the General Electric Research and Development Center, Schenectady, New York, for three days in July 1993. While there he consulted with GE engineers and statisticians on prediction of the number of failures in product populations, the planning of reliability studies, and software development for reliability data analysis.

He has been working with engineers at Ford Motor Company to develop computer software for life data analysis and for the analysis of accelerated life test data. In addition, he is doing research on methods of modeling and analyzing degradation reliability data.

W. Robert Stephenson consulted with Frigidaire Company, in Webster City, Iowa, on a problem involving the reliability of household laundry appliances.

### ▨ Social Sciences and Humanities

Carl Robert's consulting activities include the supervision of quantitative analyses performed in dissertations and theses plus *ad hoc* consulting on research by students and faculty in the social sciences. Recently Roberts has also been consulted by agencies outside the university on methodological topics related to text analysis.

Frederick Lorenz, as part of his work on Western Regional Project W-183, has initiated experiments in surveys with two colleagues in sociology. Each semester, Brent Bruton surveys his introductory sociology students about their attitudes on a variety of topical social issues. Lorenz works with him to introduce variations in response-order and question-order in multiple forms of the questionnaire. With Vernon Ryan, Lorenz has initiated mixed-mode (telephone interviews vs. mail survey) question-order experiments in a rural development study. Responses to telephone interviews with 30 to 35 citizens in each of 30 communities are being compared with parallel data collected from as many as 150 respondents to mail surveys in 100 rural Iowa communities.

Mack Shelley consulted with faculty and students from the departments of Human Development and Family Studies, Professional Studies in Education, Industrial Education and Technology, History, Economics, Psychology, and Political Science, and the programs in Industrial Relations and Neuroscience. He also served as a consultant to the coordinator of orientation and retention programs at ISU; to Iowa Heart, Lung, and Vascular Surgeons, P.C.;

and for the law firm of Taylor, Holiner, & Spicer, P.C., of San Antonio, Texas.

Consulting projects addressed aspects of research design and data analysis, particularly applications of structural equations methods, for surveys and survey data on a wide variety of topics (ranging from personal and home care giving, religion, sexual abuse, community college concerns, job-place training programs and literacy concerns, and leadership training among industrial education graduate programs, to farming practices in Kenya, graduation success rate at ISU, and teacher satisfaction). Advice was also given on an experiment with acoustic emissions in wood drying, data from the Iowa Department of Human Services on child abuse, the use of LISREL models and the use of ordinal logistic regession, and experimental data comparing the incidence of defects in frog embryo brain axons from different chemical treatments.

Special projects included analysis of data on comparative patient surgery survival rates in Iowa and nationally, a survey assessing why "no-show" undergraduate students accepted by Iowa State University failed to matriculate, the analysis of data from a survey of nonreturning undergraduate students at ISU, and statistical analysis for the preparation of arguments in a federal court case alleging racial discrimination against Hispanics in the selection of juries. This latter project involved the presentation of expert witness testimony in federal district court in Bay City, Michigan.

## ▨ Other Consulting/Cooperation

Noel Cressie consulted with researchers in economics at ISU on spatial statistics for Iowa rural economic development policies and on spatial models for sulfur emission cooperation in Europe. He also consulted on a variety of problems presented by researchers at other locations. These dealt with combining ecological assessments, for the National Institute of Statistical Sciences; spatial aspects of crop insurance, for IGF Insurance Company; algorithms for variogram estimation, for SAS Institute; parametric variogram inference in neuroimaging, for the National Institutes of Health; spatial likelihoods for finish parameters of optical surfaces, for Brookhaven National Laboratory; the spatial distribution of marine plankton abundance, for the Observatory of Natural Sciences in France; and spatial dependence of Eastern kingbird abundance across North America, for the Department of Zoology, Brigham Young University.

Mark Kaiser consulted with the U.S. Fish and Wildlife Service in Anchorage, Alaska, on August 12-19, 1993. Noel Cressie consulted on spatial sampling for estimating species abundance, with research statisticians at the Alaska Department of Fish and Game, in Anchorage, in September.

Mark Kaiser completed an analysis of water chemistry data in the Florida Everglades for an environmental consultant in Cary, North Carolina.

Kenneth Koehler served on a state advisory panel for investigating birth defects in Des Moines. He provided advice on the development of computer software and statistical models for analyzing how birth defect rates may vary across different parts of the Des Moines metropolitan area.

H. Samuel Wieand continued to serve as director of the Cancer Center Statistics at Mayo Clinic, Rochester, Minnesota, and as group statistician for the North Central Cancer Treatment Group.
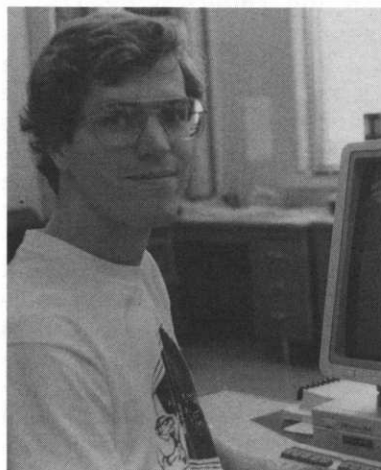


Phil Iversen (Ph.D. 5/93) returned from a year in Australia to take a temporary post as assistant professor for the spring and summer terms.

Philip Iversen began consulting in May 1994 with the Iowa Transportation Center at Iowa State University. The center is an independent evaluator of a study being done by the Kentucky Transportation Center, University of Kentucky, who want to measure the advantages of using a newly-developed weigh station clearance system for truck traffic on U.S. Interstate Highway 75. These "advantages" consist of 16 specific hypotheses to be tested, including whether the new clearance system improves fuel efficiency and delivery times in the trucking industry. Iversen is helping the Iowa Transportation Center design the data collection and data analysis phases of the study. He is also advising on the reporting of results.

Iversen continued several collaborative projects he began in Australia in 1993 with colleagues at the University of Newcastle and with a management consultant with Iona Consultancy in Sydney. These concern the use of factor analysis and logistic regression for analyzing survey data in the field of management; the analysis of data on the extent of pedestrian networks in North American cities and factors influencing their development; an analysis of changes in newspaper coverage of sports in Australia over the last 100 years; and the use of a Markov model and simulation of the manufacturing process in the development of new products.

Wayne Fuller consulted with Doane Marketing Research, Inc., St. Louis, Missouri, in July 1993.

William Q. Meeker met with representatives of Borg-Warner and Ford Motor Company, at the Borg-Warner Test Facilities in Chicago, Illinois, January 4, 1994, to help plan a durability degradation experiment.

10

# 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.

## ▨ National Resource Inventories and Soils Databases

The Survey Section continued cooperative research with the Soil Conservation Service (SCS), U.S. Department of Agriculture. This joint activity is directed by Sarah Nusser. Dean Thompson serves as resident SCS collaborator.

Richard Dorsch is in charge of NRI data processing activities, assisted by Anita McVey, Kathie Reinertson, Melissa Swanson, and Sue Verkade. Wayne Fuller, Jay Breidt, and Harold Baker are responsible for research and operational aspects of sample design and estimation. Other staff members working on inventory projects during the year were Ouhong Wang, Margot Tollefson, Hsin-Cheng Huang, Phil Jones, Rohit Deo, Kelli Leonard, and Savas Papadopoulos.

The SCS conducts a National Resources Inventory (NRI) of the country's soil and water-related resources every five years. During the past year, the Survey Section was heavily involved with the 1992 NRI. The 1992 inventory, together with the 1982 and 1987 inventories, are being used to create a longitudinal database for study of changes in resource conditions during the last ten years.

The national sample for 1992 is a stratified cluster sample of approximately 300,000 primary sampling units (PSUs), with a total of approximately 800,000 points selected within the PSUs. Most of the PSUs were observed in the 1982 NRI, and about one third of the PSUs were observed in the 1987 NRI. Stratification of the sample recognizes the geographic boundaries of counties, Major Land Resource Areas, and Water Resource Council Hydrologic Units.

Two types of data are associated with the 1992 National Resources Inventory. County base data

provide total acreages for each county in the U.S. 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. For the 1992 NRI effort, state SCS staff recorded 1992 data values and verified and updated data collected in 1982 and 1987. The 1992 NRI data were collected primarily by remote sensing via aerial photography with a minimum of on-site field visits.

Much of the last year was devoted to editing the three years of data, merging information from the soils databases with NRI field data, imputing missing data, and constructing weights. Imputation and estimation software was completed based on research conducted by Jay Breidt and Wayne Fuller. Imputation procedures were developed to estimate values for PSUs that were not sampled in 1987 and for PSUs that were not observed prior to 1992. Estimation methods were developed to incorporate acreage information from county base data and from administrative records on Conservation Reserve Program participation.

The final 1992 NRI database and associated soils database were completed in June and sent to Jeff Goebel, SCS national leader for NRI, Washington, D.C. Forty-nine states were included in the final product; results for Alaska will be released later. The 1992 NRI database contains approximately one million 1,000-character records, and requires 2 GB of space.

Work continued on the Area Studies project, based on a cooperative arrangement among SCS, the National Agricultural Statistical Service (NASS), and the Economic Research Service (ERS), USDA. The objective is to assess the economic and environmental impact of government policies aimed at reducing agricultural sources of ground water contamination.

The third year of the study involves a subsample of 1992 NRI PSUs selected by Survey Section staff in study areas in the Mississippi Embayment, the Southern High Plains (Texas and New Mexico), Southern Arizona, and the San Joaquin-Tulane basins in California. The selected PSUs were used to identify a sample of about 1,000 farm operators within each study area. Operators were interviewed by NASS interviewers regarding their farming practices and chemical use. The ERS will investigate the interrelationships of farming activities, ground water quality, soil properties, and farm operators' decision-making processes. The Survey Section estimated weights for the 1993-1994 study year.

## ▨ Soils

Another ongoing part of the SCS cooperative work is the storage and maintenance of, and software development for, the national soil interpretations databases. These databases are stored at Iowa State University on its mainframe computer as an important part of the SCS cooperative soil survey program

for the United States. Harvey Terpstra directs this work, assisted by Douglas Tschopp, Jan Seagrave, Janet Schultz, Deborah Reed-Margetan, and Masoud Kazemi. The data entry staff include Glenda Ashley and Vimlesh Gupta.

Four main databases make up the system of soils data. The soil interpretations database consists of basic soil property and interpretation information for all soil series in the nation. It currently contains over 37,000 records. The soil map unit database consists of information identifying each map unit in SCS soil surveys. It currently contains nearly 275,000 map units from approximately 3,000 survey areas. The official soil series description database contains a textual description of 16,000 soil series. The soil series classification database contains the official soil classification for over 19,000 soil series.

These soils databases are used by the SCS to retrieve and record much of the basic information needed in their soil survey work. A primary use is to provide data for SCS state office computer systems. State offices, in turn, provide data to county SCS office computer systems, where an automated system of providing soils data to SCS clients is being used. Another primary SCS use of these data is the production of tables that are published in SCS soil survey reports. The Statistical Laboratory staff receive numerous requests to furnish data from the soils databases to help answer various soils-related questions. 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. At Iowa State University, researchers at the Soil Tilth Laboratory and at CARD have used the data.

An important new development effort this year was the programming of a remote-user interface for access to the soils databases. Development was done in the ISU Project Vincent environment as part of the USDA Infoshare initiative. Additional functionalities for this system are planned in the coming year. The software package facilitates direct access to the national map unit database by the Extension Service at the University of Minnesota to retrieve a selected set of soil data elements. This data file is then used to help drive a farm financial management software package developed by the Extension Service, which will be distributed to numerous states.

Other system development included continued refinement and testing for the erosion T value program and the soil rating for plant growth program, a new soils interpretation rating program dealing with endangered burrowing animal habitat, near completion of a soils database to match the digitized state general soil maps, and ongoing work on Unix program development for the SCS field office computer system (FOCS). The FOCS software package is designed for use in SCS county offices to provide detailed information and reports to SCS customers and to help in managing various office operations. Survey Section staff are responsible for program development and maintenance for the part of the

system related to the soils database. Numerous maintenance tasks were completed on the existing system of data and software.

This year also saw efforts to identify more research possibilities for this phase of the SCS cooperative work. Cooperative research initiatives in the design of soil survey field work with the Department of Agronomy and in database management and telecommunications with the ISU Computation Center are being investigated.

## 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, the National Agricultural Statistics Service, and, through AES Project 2699, by the Iowa Agriculture and Home Economics Experiment Station. The support from federal agencies was through Cooperative Agreement No. 43-3AEU-3-80088.

Wayne Fuller is principal investigator. Other personnel working on the project include Jay Breidt, Rohit Deo, Anindya Roy, Hsin-Cheng Huang, and Anthony An. Also Sastry Pantula of North Carolina State University visited the Statistical Laboratory and participated in the research on time series.

Anthony An worked on regression estimation procedures as methods of adjusting for nonresponse and for introducing auxiliary information. Two methods of estimation were compared using data from the Survey of Income and Program Participation (SIPP). In the longitudinal portion of SIPP, respondents are interviewed several times. Information from those that responded on the first interview but not on later interviews and information from the Current Population Survey (CPS) are available for use in estimation. In one procedure the sampling weights are adjusted for nonresponse and then the weights are modified by regression procedures based on the CPS. In the second the sample is treated as a two phase sample with known population totals. While the two methods have different theoretical properties, the empirical properties are very similar.

Methods of sampling nonrespondents were studied as possibilities for the Population Census of 2000. A total of four sampling-estimation procedures were compared using data for two district offices in Massachusetts. One procedure was a direct expansion procedure based on a simple random sample of nonrespondents in each block. The remaining three procedures used different auxiliary variables and a cluster sample of blocks. At a ten percent sampling rate, the block sample gave smaller root mean square error for block estimates than the direct-expansion-simple-random-sample procedure. At the 30 percent rate, the direct expansion procedure was generally superior. A report on this work authored by Cary Isaki, Julie Tsay, and Wayne Fuller was presented at the 1994 Census Annual Research Conference.

Limiting properties of the estimated roots for a second order autoregressive process were studied. It

was demonstrated that the sum and the difference of the roots have different rates of convergence if the true process has repeated roots.

Tests for unit roots in time series based on alternative assumptions about the first observation and procedures based on alternative estimators were compared in Monte Carlo studies. Procedures based on unconditional maximum likelihood and on weighted symmetric least squares gave better power for the test of a unit root against the stationary alternative than those based on ordinary least squares. For multivariate unit root processes, the symmetric procedures were generally superior to ordinary least squares procedures, but the superiority was not as great as for the univariate process.

### ▩ Dietary Intake Estimation

One objective of the present five-year cooperative research agreement between the Human Nutrition Information Service (HNIS) of the U.S. Department of Agriculture and the Center for Agricultural and Rural Development (CARD) at Iowa State University is to develop a statistical procedure for estimating usual dietary intake distributions. Statistical Laboratory members working under the cooperative agreement this year are Wayne Fuller, Alicia Carriquiry, Sarah Nusser, Kevin Dodd, Juan José Goyeneche, Kelli Leonard, Zugeng Zheng, Phil Jones, and Hsin-Cheng Huang.

The U.S. Department of Agriculture conducts periodic dietary intake surveys to gain knowledge about the dietary status of the U.S. population or various subpopulations. In most national-scale surveys, no more than three or four days of intake data are available for each individual. Research is being conducted on methods to estimate distributions of usual intakes, which are an individual's long-run average intake of a nutrient.

Several characteristics of daily dietary intake data must be taken into account. Intake data are typically nonnormal; intraindividual variance in intakes tends to be large relative to the between-individual variance; intraindividual variation is heterogeneous; and, if food intake data are collected on consecutive days, intakes are autocorrelated.

Procedures for estimating usual intake distributions and associated parameters such as percentiles have been developed by Survey Section researchers over the past several years. More recently, software has been written for practitioners to apply to dietary components such as nutrients that are consumed on a daily basis.

Beta testing of software is underway by potential users of the package. During the year, simulation studies were initiated to compare the performance of the ISU method and other methods for estimating usual intake distributions.

Researchers have begun to develop methodology for application to dietary components that are not consumed daily, such as specific food items. The approach involves estimating the usual intake distribution for days on which the food is consumed, using a modification of the estimation procedure for nutrient intakes. The distribution of individual probabilities of consuming the food on a given day is estimated using maximum entropy methods. These two distributions can be used to estimate a joint density when consumption day usual intakes are independent of the probability of consumption. The usual intake distribution for all days can then be estimated.

### ▩ Spatial Statistics
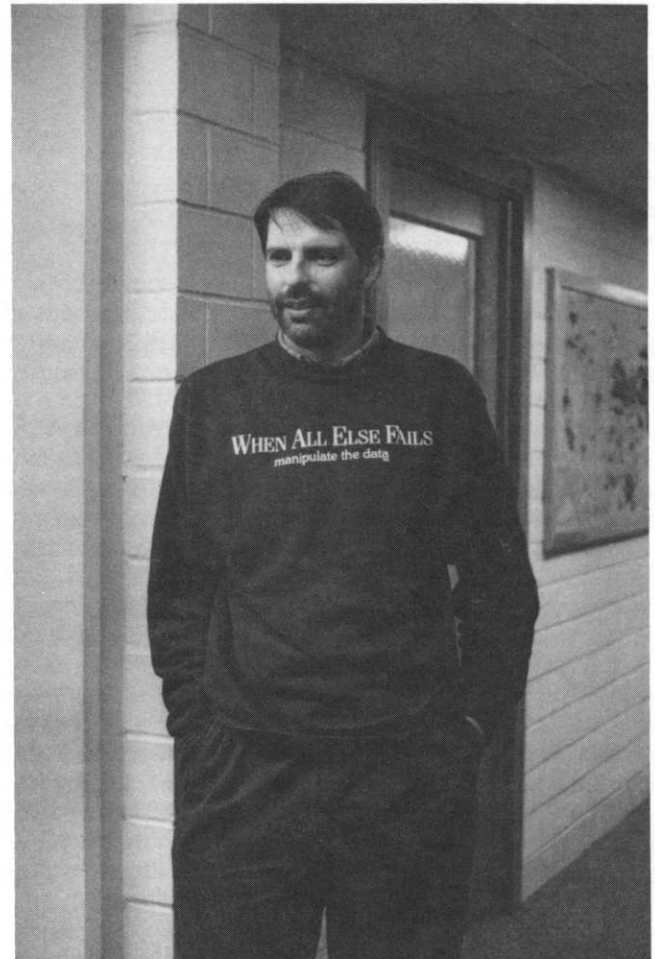


Noel Cressie, the department's most recently named Distinguished Professor of Liberal Arts and Sciences, taught a section of the frontier course, Stat 101, Principles of Statistics, fall semester. He also taught graduate-level courses in Bayesian Decision Theory and Spatial Statistics in 1993-1994. His research program includes work in spatial statistics, with NSF, ONR, and NSA support, and in environmental statistics, for which he will have EPA grant support.

The Office of Naval Research (ONR), the National Science Foundation (NSF), and the National Security Agency are supporting research on spatial statistics. The support from NSF comes jointly from the Probability/Statistics Division and the Geography Division. The ONR support is principally for joint work with Jennifer Davidson, Department of Electrical Engineering and Computer Engineering,

13

on statistical image analysis. Noel Cressie and Davidson co-advised Ph.D. student Jeffrey Helterbrand, who graduated fall 1993. Helterbrand's dissertation concentrated mainly on the problem of boundary identification using Bayesian spatial Markov modeling. Other Markov models, based on partial orders, have been investigated by Cressie and Davidson, and have been shown to generate a versatile family of image texture models.

Noel Cressie continued work with the university's GIS Support and Research Facility, notably its manager James J. Majure. Cressie and Majure completed a final report on spatial prediction of pollution from livestock waste in the streams of the upper North Bosque River (Erath County, Texas). That report was for a project funded by Texas Institute of Applied Environmental Research (Tarleton State University, Stephenville, Texas) and ISU's Center for Agricultural and Rural Development.

In addition, Cressie worked on a variety of other projects involving spatial statistics. Joint research with Steven S. Carroll, Arizona State University, is concerned with the National Weather Service's project on estimation of snow water equivalent. Methods of dealing with multivariate spatial data are under investigation and are of great importance to studies of an environmental nature.

A proposal for a three-year grant from the U.S. Environmental Protection Agency has been submitted to develop spatial statistical methods for its Environmental Monitoring and Assessment Program, with Noel Cressie as principal investigator, and Dianne Cook, Mark Kaiser, Soumendra Lahiri, and James Majure as co-investigators. The grant project, which was funded, will begin August 1, 1994, and will support four graduate students.

When a natural resource (e.g., oil reserves, trees in a forest, etc.) is sampled increasingly from a bounded region, leading to what is known as infill sampling, conventional limit theorems fail to describe the asymptotic behavior of standard statistical procedures. Research by Lahiri is underway investigating the issue of consistent estimation of parameters of a spatial process under infill sampling.

## ▨ Statistical Modeling

Mark Kaiser, in cooperation with David Siev of the USDA Veterinary Biologics Field Office in Ames, Iowa, worked on the estimation of relative potency from nonparallel curves in immunoassay studies. Models developed combine the substantive theory of depressed response due to competing antigens with the estimation of nonlinear parameters in link functions of generalized linear models.

## ▨ Probability Theory and Mathematical Statistics

Krishna Athreya's research in probability theory during the 1993-1994 year was in the areas of large deviation for multitype branching processes, entropy maximization problems, and hitting times for branching Markov processes. With his student A. Vidyashankar, he established the geometric decay of the probability that in multitype supercritical branching process the empirical distribution deviates from the deterministic limit by a large amount. This has relevance for estimation of the Malthusian parameter as well as the growth of And/Or evaluations in computer science algorithms.

On entropy maximization, it was shown that every probability distribution is the unique maximizer of relative entropy in an appropriate class. This leads to a new characterization of the Poisson distribution as the maximizer of entropy in a class of distributions subject to two constraints on EX and ElogX!. In joint work with Vidyashankar and A. Weerasinghe, Athreya showed that for a branching Brownian motion the tail of the hitting times of levels has exponential decay.

Research on mathematical statistics focused on bootstrapping sample extremes of i.i.d. r.v. and inference for Markov chains. J. Fukuchi has shown in his doctoral dissertation that the bootstrap is consistent if the resample size m is small compared to the sample size n. He has extended this to dependent sequences such as stationary processes and applied his results to the problem of obtaining confidence intervals for the endpoints of a c.d.f. Gregorio Atuncar studied kernel estimation of the density of the stationary distribution of a Harris recurrent Markov chain via the technique of regeneration. He established consistency and asymptotic normality of the kernel estimators.

Soumendra Lahiri used his faculty improvement leave to conduct research and collaborate with Peter Hall at the Centre for Mathematics and Its Applications, Australian National University (ANU), Canberra, Australia, during the spring semester 1994. Lahiri's visit was partly supported by a grant from ANU. He worked with Hall on a research project on nonparametric curve estimation.

Lahiri continued research on resampling methods with the support of a National Science Foundation grant. Currently he is engaged in joint research on the bootstrap method for long range dependent data with Professors Hall and Bing-Yi Jing of ANU.

## ▨ Statistical Prediction

Alicia Carriquiry continued research on approximate inference for posterior moments, in collaboration with Wolfgang Kliemann, Department of Mathematics.

## ▨ Statistical Methods for Correlated Survival Data

Kenneth Koehler continued to work with Tom Loughin on the development of bootstrap methods for

proportional hazards models. For the usual case of independent response times, simulation studies show that a semiparametric bootstrap provides more accurate estimates of covariance matrices and confidence intervals with more accurate coverage probabilities than large sample methods based on the Cox partial likelihood. For multivariate cases with groups of correlated response times, bootstrap resampling of generalized residuals provides a method of analysis that does not require a complete specification of a joint likelihood function, and it is more accurate than existing methods based on robust sandwich estimators. Bootstrap methods were applied to analyze how temperature affected bean leaf beetle hatch times in a controlled entomology experiment.

## ▨ Modeling Panel Data

Frederick Lorenz continues to do research on modeling multiple wave, multiple informant family data through the Iowa State University Center for Family Research in Rural Mental Health. He also does research for the center on the effects of stressful life events on psychological distress and physical health. He is co-investigator with four colleagues in sociology on two projects supported by grants from the National Institute of Mental Health (NIMH), a five-year grant for research on critical transitions in rural families at risk, and a three-year grant to continue study of rural family resilience to economic stress.

With support from a three-year NIMH grant, Lorenz is working with co-principal investigator Joseph Hraba, Department of Sociology, on an application of the stress-distress model to families in the Czech Republic. Lorenz traveled to Prague in September 1993 to work with Prof. Zdenka Pechacova at the Agricultural University of Prague and with the Czech Census Bureau, to finalize plans for the first wave of data collection. Data were collected from over 700 Czech families in January and February 1994, with a 97.5 percent response rate. In June, Pechacova came to Iowa State to review the results of the first wave of data collection and to make plans for the second wave, to be collected in early 1995.

## ▨ Reliability and Nondestructive Evaluation

William Q. Meeker went to Louisiana State University for a week in January 1994 and ten days in June to work on several research projects with Luis Escobar. A book on reliability data analysis is in progress.

Meeker and Pradipta Sarkar have been working on the NIST-funded project, "Program for Integrated Design, NDE, and the Manufacturing Sciences," being conducted by the ISU Center for Nondestructive Evaluation. In their research, Meeker and Sarkar are exploring the use of Bayesian decision analysis methods for making decisions on when to do in-service inspections and when to replace components that are subject to wearout failure.

Bill Meeker and Shuen-Lin Jeng are members of the Probability of Detection Working Group of the FAA-sponsored Engine Titanium Consortium project. The project is being coordinated by scientists at the ISU/FAA Center for Aviation Systems Reliability. This project has team members from General Electric, Pratt & Whitney, Allied Signal, and Iowa State University. The goal is to develop and evaluate better ultrasonic inspection methods for finding potentially dangerous flaws in titanium to be used in components of jet engines.

Meeker and Jeng, along with other team members, are working to develop a methodology to estimate and predict probability of detection as a function of various factors affecting the measurement system, objects being inspected, and type of flaw. The methodology will be based on physical models of ultrasonic scattering, the results of a series of designed experiments on simulated flaws in titanium specimens, and field data on a limited number of real flaws that have been discovered.

## ▨ Statistical Process Control and Gross Error Detection

Derrick Rollins' research interests concern statistical process control, data reconciliation/gross error detection, on-line process control, artificial neural networks, stochastic modeling of powder mixtures, and mathematical modeling of grain dryers.

Rollins is principal investigator on two new grant-supported projects. Research on statistical gross error detection for dynamic processes is supported by the National Science Foundation. The National Aeronautics and Space Administration is funding research on statistical sensor validation in life support systems. Working with Rollins are statistics graduate students Angelita Nason Garth and James Stallman-Smith.

A grant from the 3M Corporation is supporting research on improving powder mixture homogeneity by Rollins and statistics graduate student Jennifer Walker. Another 3M grant is supporting an interdisciplinary project on statistical methods to enhance artificial neural networks; Rollins is working with a faculty member in mechanical engineering. A grant from the Grain Processing Corporation provides for research on adaptive control for improved drying in grain processing.

## ▨ Drowsy Driver Identification

Peter Sherman continued work on development of an automotive driver impairment identification system, with support from Ford Motor Company and the ISU College of Liberal Arts and Sciences. Rockwell Collins provided funding to help support research on automotive lane tracking. Mike Elling is working on Markov chains and summary statistics for steering wheel data.

# ▩ Other Research

## Theory and Methods

Yasuo Amemiya conducted research in several areas of multivariate analysis. Data analysis and model fitting methods were developed for exploring nonlinear structures in multivariate data. Theoretical and numerical investigation of such methods was conducted. This new area called nonlinear factor analysis is important for applications and will be a focus of further research. The asymptotic robustness of the normality based procedures for the structural equation modeling was studied for multi-population or repeated measure cases. It was shown that the simple method based on the normality and independence can be useful for nonnormal and dependent multi-sample data.

Financial variables such as stock returns often exhibit variances that change over time. One approach that has been suggested to model the serial autocorrelation in the variances is denoted stochastic volatility. In this approach, time-dependent variables are random variables generated by an underlying stochastic process such as an autoregressive process. Goals are usually two-fold: to estimate the parameters in the model, and to obtain smoothed estimates of the time-dependent variances. Estimation in stochastic volatility models is not simple, because the likelihood function cannot be expressed in closed form. A solution to the problem consists in transforming the nonlinear stochastic volatility model into a linear state-space model, and then applying the usual Kalman recursions for estimation. This method is known as quasi-maximum likelihood estimation.

Alicia Carriquiry and Jay Breidt initiated research on methods to improve the performance of the usual quasi-maximum likelihood estimator. They are investigating whether certain robustified transformations that are applied to the observations improve the behavior of the quasi-maximum likelihood estimator both in terms of bias and root mean squared error.

With the cooperation of Edward Pollak, research was carried out by C. Philip Cox on the problem of choosing between the two specifications $\pi_{ij}$, $\sum_{j=1}^{k} \pi_{ij} = 1$, i = A,B, of known multinomial probabilities on the basis of sample values $x_j$, the observed counts in the j = 1,...,k classes, with $\sum_{j=1}^{k} x_j = N$. The particular question examined was "How large should N be to achieve reliable differentiation?" It was shown how to find N such that the probability of misclassification does not exceed a prescribable value. The method was applied to data from a genetic study on soybean breeding.

H. A. David has continued extending his list of terms commonly used in mathematical statistics. In this he has been aided by many correspondents.

David has also worked on recurrence relations for order statistics.

Richard Groeneveld has been working with Barry C. Arnold, University of California at Riverside, on finding an appropriate skewness functional of a distribution with respect to the mode.

John Stufken continued research on various topics in design of experiments. These include existence, construction, and application of orthogonal arrays; blocking in mixture experiments; study of a new class of incomplete block designs that are, in a specified sense, almost balanced; and study of optimal block designs for comparing test treatments with a standard treatment.

Shashikala Sukhatme and Marie Coffin continued investigating problems due to measurement errors in data used for Receiver Operating Characteristics Studies in reliability and survival analysis. They are studying parametric, as well as nonparametric, methods.

## Dynamic Graphics

Dianne Cook continued research, begun for her doctorate, on dynamic graphical methods for high-dimensional problems, in particular, grand tour and projection pursuit. Most recently she has focused on correlation tour as it pertains to multiple regression, viewing of likelihood functions, and analysis of spatial data.

## Statistical Computing

Mervyn Marasinghe expanded his research activities to include optimization algorithms and diagnostics in nonlinear regression. His interests in these topics include acceleration of the EM algorithm and quantifying the effects of curvature on influence and leverage measures.

Marasinghe and Philip Iversen continued research on dynamic graphics methods for experimental design. Attention focused on several new interactive graphical methods for displaying properties of experimental designs.

## Biostatistics and Agronometry

Some of the collaborative research conducted by members of the statistics department of the Iowa Agriculture and Home Economics Experiment Station (AHEES) has been described on pp. 11-13. Other research is described below.

Project 3201 of the Iowa Agriculture and Home Economics Experiment Station supports research by Edward Pollak on mathematical and statistical genetics. In the 1993-1994 academic year he continued to study effects of selection for viability on the change in the frequency of a favorable allele if there is reproduction partly by random mating and partly by a regular system of inbreeding. Under the assumptions that there are two alleles with no dominance and that the inbreeding is not by selfing, it turns out that the frequency of the favorable allele changes in

16

two steps within a generation. The first, which also occurs with complete random mating, is due to probabilities of survival to adulthood that differ among the genotypes. The second occurs because mates are more likely to share a favorable allele than if there is complete random mating, and this induces a positive correlation between the frequencies of the favorable alleles in the mates. This is a partial generalization of a result in the previous report, which applies to partial full sib mating and any level of dominance in viability.

Pollak also derived an expression for the inbreeding effective population size for a finite population of tetraploids that reproduce partly by selfing and partly by random mating. This expression allows for any probability of double reduction.

With support from a grant from the State of Minnesota and in cooperation with Jim Weiner of the U.S. National Biological Survey, Mark Kaiser, Sarah Nusser, and Jay Breidt began work on a statistical review of the State of Minnesota Fish Contaminant Monitoring Program. Graduate students Dana Bruden, Rong Li, and Heidi Shierholz are assisting on the project. The focus of the work is to explore existing data for spatial and temporal trends in mercury contamination in fish and to design a statistical sampling plan for the future.

### Engineering Statistics

Peter Sherman was engaged in research at the Australian Defence, Science and Technology Organization, Adelaide, Australia, July 21-August 13, 1993. He continued his collaboration with researchers at Australian National University and the Australian defence agency (DSTO) on quasi-periodic random processes. Sherman and Ph.D. student Chris Wikle are continuing to investigate stochastic models for climate data.

Mu-Yeh Huang has been working with Stephen Vardeman and Professor McBeth of the Department of Industrial and Manufacturing Systems Engineering on problems of optimal developmental testing for one shot systems. This research was motivated by questions raised at a 1992 National Research Council sponsored Workshop on Statistical Issues in Defense Analysis and Testing attended by Vardeman.

### Social Science Applications

Carl Roberts is currently editing a collection of papers from the 1994 Workshop on Inferential Text Analysis, hosted by Carnegie-Mellon University.

Mack Shelley currently is pursuing research applications of time series and structural equations models, focused on the impact of religion on public opinion and voting behavior; patterns of intergenerational interaction between adult children and their parents; and legislative elections. Other research activities include topics in educational policy and transportation policy.

Besides grant-funded research mentioned earlier, Frederick Lorenz has worked with statistics and sociology faculty on experiments in surveys.

## Professional Activities

W. Robert Stephenson held several positions in the American Statistical Association within the year. He was chair of the ASA Advisory Committee on Continuing Education and publications chair for the ASA Section on Quality and Productivity through December 1993. He continues as a member of both committees. He is one of the representatives to the ASA Council of Sections from the Section on Statistical Education and is a member of advisory committees for two National Science Foundation projects dealing with statistics education.

Wayne Fuller chaired a meeting of the Advisory Committee on Statistical Methods for Statistics Canada, in Ottawa, Canada, October 25-26. He attended a meeting of the ASA Board of Directors in Washington, D.C., December 2-4, 1993.

Noel Cressie served on the Publications Committee and the Committee on Symposia and Conferences for the ASA Section for Statistics and the Environment. In April 1994 he resigned as a member of the ASA Review Committee for the Environmental Protection Agency's Ecological Monitoring and Assessment Program (EMAP).

H. A. David is continuing as an ex officio member of the Committee on ASA Archives and Historical Materials. Herbert T. David continued to serve on the ASA/NSF/NIST Fellowship Review Board.

Krishna Athreya served as chair of the COPSS Presidents' Award Committee for 1994.

W. Robert Stephenson is completing his second term as national president of Mu Sigma Rho, statistics honor society. H. A. David served as president of the ISU chapter of Sigma Xi until April 1994.

Mack Shelley served as vice president of the Iowa State University chapter of the American Association of University Professors.

Edith Landon became president of the Iowa Division of PSI (Professional Secretaries International) in December 1993; she had been president-elect since June 1993.

Paul Hinz was local arrangements and program chair for the NCR-170 (Research Advances in Agricultural Statistics) meetings held in Ames on July 15-16, 1993.

William Q. Meeker, Jr., presented a series of lectures on "Statistical methods and survival analysis for reliability" at the Winter School in Probability and Statistics, Universite Catolicia de Chile, Santiago, Chile, July 19-30.

Stephen Vardeman attended and chaired a session at the Gordon Research Conference on Statistics

in Chemistry and Chemical Engineering, held in New Hampton, New Hampshire, in late July.

David Harville attended the first world meeting of the International Society for Bayesian Analysis, held in San Francisco, California, preceding the 1993 joint statistical meetings in August. He also attended a workshop, The Publishing Process: What to Expect, sponsored by ASA during the joint meetings.

Stephen Vardeman was one of five panelists for the NSF-sponsored Special Presentation: Writing Workshop for Young Researchers, on August 8 at the joint statistical meetings in San Francisco. Wayne Fuller chaired an invited paper session, Methodology and Applications of Small Area Estimation, on August 9. Vardeman was chair/organizer of the *Technometrics* Invited Papers session August 10. Noel Cressie was organizer of the invited paper session, Statistics for Spatial Data, and discussion leader on Spatial Environmental Statistics at the Section on Statistics & the Environment Round-table Luncheon, August 11, while Ted Bailey chaired the presentation of the George W. Snedecor Award. Cressie was awarded a Distinguished Achievement Medal by the ASA Statistics and the Environment Section.

Wayne Fuller presented a short course, Variance Estimation for Complex Surveys, in Padua, Italy, August 23-24.

Carl Roberts, working with Kathleen Carley, Carnegie-Mellon University, organized the Workshop on Inferential Text Analysis, sponsored by Carnegie-Mellon and held in Pittsburgh, Pennsylvania, August 27-28, 1993.

Noel Cressie was a member of the Scientific Committee for the International Workshop on Statistics of Spatial Processes, held in Bari, Italy, in September 1993.

William Q. Meeker presented a short course on Statistical Intervals in conjunction with the Fall Technical Conference sponsored by the American Society for Quality Control and the American Statistical Association, held in Rochester, New York, on October 13.

Alicia Carriquiry was a visiting associate professor in the Department of Statistics at the Pontifical Catholic University of Chile, Santiago, Chile, August 14-October 1 and October 18-November 12. She taught an undergraduate mathematics course on Statistical Inference and an undergraduate engineering course on Inference and Decision Theory. During this time she also gave two short courses for the Organization of American States/CIENES: Topics in Regression Analysis, in September, for the Interamerican Course in Statistics; and Sampling Techniques and PC CARP, for a Sampling Techniques and Applications course, in October. She returned to Chile November 20 to collaborate with colleagues at the Pontifical Catholic University for approximately three more weeks and also visited Montevideo, Uruguay, to collaborate with colleagues in December 15-19.

As a participant in the Quantitative Literacy Program for Secondary Educators in Iowa, Sarah



Alicia Carriquiry poses with a statue of Lenin in the Institute of Agrarian Economics, Kiev, Ukraine, during a visit arising from her statistical consulting work with the ISU Center for Agricultural and Rural Development. Her first trip, in 1991, was as part of an ISU mission to institute a cooperative agreement between CARD and the institute to do research on agricultural policy for Ukraine. She returned on June 30-July 9, 1993, to design a survey to collect input use data on state and collective farms. Other professional activities this year have taken her to Chile, Brazil, Uruguay, and Mexico.

Nusser visited schools in Creston and Stanton, Iowa, November 11-12, 1993.

Wayne A. Fuller was a member of a Bureau of Labor Statistics panel that met on December 17 in Washington, D.C., to discuss the new method of data collection in the Current Population Survey. He also met with staff of the bureau on January 23-24, 1994, in Washington.

W. Robert Stephenson moderated the first round of the second Statistics College Bowl competition, held January 7, 1994, in Atlanta, Georgia, during the American Statistical Association Winter Conference. Eight teams entered the competion, and the Iowa State team won. The winners were Kevin Dodd, Anthony An, Rohit Deo, Savas Papadopolous, and Matt Gerdis. The team won a $25 dinner certificate, and each member received a copy of MINITAB, two statistics books, and an ASA t-shirt.

Stephenson was chair of the evaluation team conducting an external review of the undergraduate program in statistics at California Polytechnic Institute at San Luis Obispo, March 2-6. He participated in followup sessions at middle schools and high schools in west central Iowa for the Quantitative Literacy Project. He also spoke to a group of middle/high school teachers who participated in the QL Project at Hoover high School in Des Moines on March 19.

Krishna Athreya and Peter Jagers were co-chairs of a program on Branching Processes as part of the year 1993-94 devoted to Emerging Applications of Probability Theory at the Institute of Mathematics

and Its Applications. The program was held in Minneapolis, Minnesota, from April 1 to June 20, 1994. It included a week-long international workshop on classical and modern branching processes. The proceedings will be edited by Athreya and Jagers and published for the IMA by Springer-Verlag.

Alicia Carriquiry went to Santiago, Chile, May 5-14, 1994, to be present in the dissertation defense of two Chilean students she had supervised. Maria P. Casanova's M.Sc. thesis is entitled "A Lagrange multiplier approach to hypothesis testing in time series with time-dependent variances." Lorena Correa's B.S. thesis is entitled "Classical and Bayesian approaches to estimating the signal to noise ratio in the local level model."

Frederick Lorenz went to Washington, D.C., to review USDA rural development competitive proposals on May 16-18.

Toni Genalo served as an organizer and program co-chair for the International Field Directors and Field Technologies Conference, held in Boston, Massachusetts, May 15-18, 1994 for professionals directing survey operations.

David F. Cox attended a Workshop for Analysis of Data from Target Animal Safety Studies, held in Rockville, Maryland, May 25-29.

William Q. Meeker organized and chaired a session on reliability improvement at the Spring Research Conference of the Institute of Mathematical Statistics/American Statistical Association Section on Physical & Engineering Sciences, held in Chapel Hill, North Carolina, June 11-15.

Dianne Cook presented a tutorial, Data Analysis Using Interactive Dynamic Graphics: An Introduction to XGobi, on June 15 in Research Triangle Park, North Carolina, preceding Interface '94--the 26th Symposium on the Interface: Computing Science and Statistics. She was an invited participant in the Workshop on New Directions in Curve Estimation, held on June 29-July 2, 1994, at the Centre for Mathematics and Its Applications, Australian National University, Canberra, Australia. This activity was funded by the National Science Foundation.

Soumendra Lahiri attended Interface '94, in Research Triangle Park, North Carolina, June 15-18, 1994, then attended workshops on Sequential Analysis and on Probability Theory, presented in Chapel Hill on June 18-19 and 19-21.

## ▨ Editorial Activities

The American Statistical Association Board of Directors in September 1993 approved the appointment of William Kennedy as the editor of the *Journal of Computational and Graphical Statistics* for the term 1995-97. The year 1994 will be a transition year from the current editor to Kennedy.

Stephen Vardeman is editor of *Technometrics*, with Sharon Shepard as editorial assistant.

Yasuo Amemiya's appointment as associate editor of *The American Statistician* was formally completed at the end of December 1993. Kenneth Koehler

is serving as an associate editor, beginning in June 1993.

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

Alicia Carriquiry has been an associate editor of *Revista Colombiana de Estadística* (Bogotá, Colombia) since June 1993.

Noel Cressie is an associate editor of the *Journal of Statistical Planning and Inference* and an editorial board member of *Chemometrics and Intelligent Laboratory Systems.*

Kenneth J. Koehler is an associate editor of *The American Statistician.*

Frederick O. Lorenz is an associate editor of *Rural Sociology.*

William Q. Meeker continued as co-editor of *Selected Tables in Mathematical Statistics* and chair of the IMS Standing Committee on Selected Tables in Mathematical Statistics; W. Robert Stephenson is a member of the committee.

Meeker continued to serve on the ASA Journals Management Committee and as chair of the *Technometrics* management committee; Stephen Vardeman is an ex officio member of the latter.

Edward Pollak continued to serve on the editorial board of *Mathematical Biosciences.*

W. Robert Stephenson continued as an associate editor of *Technometrics* and served on the editorial boards for the *Journal of Statistics Education* and *STATS: The Magazine for Students of Statistics.*

Mack Shelley is co-editor of the *Policy Studies Journal.*

Peter Sherman is guest editor for a special issue of *Mechanical Systems & Signal Processing,* on signal processing for rotating machinery.

John Stufken is an associate editor of *Communications in Statistics,* serving since January 1994.

## ▨ Papers Presented, Lectures, and Seminars

**At the Society of Photo-Optical Instrumentation Engineers' 1993 International Symposium on Optical Applied Science and Engineering, San Diego, California, July 13:**

Davidson, Jennifer L., and **Noel CRESSIE:** "Markov pyramid models in image analysis;"

**Helterbrand, Jeffrey D.,** and **Noel CRESSIE:** "Stochastic recognition of closed object boundaries in images."

**At the annual meetings of the Rural Sociological Society, Orlando, Florida, August 7-10:**

**LORENZ, Frederick O.,** and D. Hoyt: "A question of order effect: Even-handedness and the evaluation of self and spouse behavior";

**LORENZ, Frederick O.,** M. Isbell, and R. L. Simons: "Family structure, psychological distress, and physical health: The mediating effects of stressors and support";

Saltiel, John, and **Frederick O. LORENZ:** "A question of order effect: Multiple specific items vs. overall community quality of life."

**At the 1993 joint statistical meetings of the American**

Statistical Association, the Biometric Society (ENAR and WNAR), and the Institute of Mathematical Statistics, San Francisco, California, August 8-12:

AMEMIYA, Yasuo: "On nonlinear factor analysis";

ATHREYA, K. B., and A. Vidyashankar: "Large deviation results for supercritical age-dependent branching"; or "Large deviations for supercritical age-dependent branching processes";

BAILEY, Ted B.: "The statistician as a collaborator with researchers in agriculture";

BREIDT, F. Jay, and Wayne A. FULLER: "Regression weighting for multiphase Forest Service samples";

CRESSIE, Noel: "Spatial environmental statistics," at the Roundtable Luncheon, Section on Statistics and the Environment;

CRESSIE, Noel: "Comment on 'An approach to spatial-temporal modeling of meteorological fields,' by Mark S. Handcock and James R. Wallis," as invited discussant;

CRESSIE, Noel, and James J. Majure: "Spatio-temporal statistical modeling of livestock waste in surface waters"--poster paper;

Davidson, Jennifer L., and Noel CRESSIE: "Spatial models for image analysis";

Escobar, Luis A., and William Q. MEEKER, Jr.: "The asymptotic covariance matrix for maximum likelihood estimators with models based on location-scale distributions involving censoring, truncation, and explanatory variables";

HARVILLE, David A., and Hiroshi Takahashi: "Computation of restricted maximum likelihood estimates of variance components";

HINZ, Paul N.: "Interpreting significance levels";

Iversen, Philip W. (University of Newcastle), and Mervyn G. MARASINGHE: "Dynamic graphics for experimental design";

KAISER, Mark S.: "Underdispersed binary trials in toxicity tests";

KENNEDY, William J., Ouhong Wang, and Wayne A. FULLER: "Recent developments in PC Carp";

Loughin, Thomas M., and Kenneth J. KOEHLER: "A bootstrap approach to multivariate survival data with explanatory variables";

MEEKER, William Q., Jr.: discussant, for ASA Special Invited Lecture: "Statistics education fin de siecle," by David S. Moore;

Mercier, Cletus R., Geneva H. Adkins, Mack C. SHELLEY II, and Joyce M. Mercier: "Age as a predictor of injury severity in broad-side and angle vehicular collisions";

NUSSER, Sarah M.: "Estimating usual intake distributions in the presence of many zero intakes";

Olin, Bryan D.: "Design of mixture experiments in the presence of blocking variables and time trends";

POLLAK, Edward: "Some effects of selection when there is partial full sib mating";

Sanger, Todd M. (Eli Lilly & Co.), and Wayne A. FULLER: "Estimated generalized least squares with unequal rates";

STEPHENSON, W. Robert: "Significant effects or outlying observations? A case study";

SUKHATME, Shashikala, and C. H. Lin (Ming Chuan College,

Taiwan): "Exact powers of the Wilcoxon test and the logrank test under random censoring";

Symanzik, Jürgen: "Three-dimensional statistical graphics based on interactively animated anaglyphs";

Ver Hoef, Jay M. (Alaska Department of Fish & Game), and Noel CRESSIE: "Bayesian estimation of average patch size in one-dimensional transects";

Vidyashankar, A.: "Branching random walk in a random environment";

Wang, Morgan C. (University of Central Florida): "Self-validating computation for the distribution of the sample correlation coefficient";

Yalçin, Ilker, and Yasuo AMEMIYA: "Fitting of a general nonlinear factor analysis model";

At the annual American Institute of Chemical Engineers Conference, held in St. Louis, Missouri, November 9-11, 1993:

ROLLINS, D. K., D. L. Faust, and D. L. Jabas: "Statistical evaluation of techniques to determine segregation in powder mixes";

ROLLINS, D. K., Y. Cheng, and J. F. Davis: "Gross error detection under various conditions when variances-covariances are unknown."

At the 49th Session of the International Statistical Institute, Florence, Italy, August 31-September 2:

FULLER, W. A.: "Estimators for log-tailed distributions";

Yansaneh, I. S., and W. A. FULLER: Least squares estimation for repeated surveys."

At the 26th International Symposium on Automotive Technology and Automation, in Aachen, Germany, September 13-17, 1993:

SHERMAN, P. J., and K. Brase: "Real-time image-based lane tracking";

SHERMAN, P. J., J. H. Song, C. R. Mercier, J. R. Mercier, R. F. STRAHAN, and M. W. O'Boyle: "Characterization of elderly drivers using lane tracking information."

At the 12th International Conference on Modal Analysis, in Honolulu, Hawaii, January 31-February 3, 1994:

VanZante, D., R. L. Feddersen, M. Suarez, and P. J. SHERMAN: "The stochastic structure of downstream pressure from an axial compressor";

McConnell, K. G., P. J. SHERMAN, and P. S. Varato: "Pseudo-random excitation is more cost effective than random excitation";

SHERMAN, Peter J., and Lang B. White: "Period variability of a diesel automotive engine at nominally constant speed."

At the Sixth Annual Kansas State University Conference on Applied Statistics in Agriculture, April 24-26, 1994:

COX, C. P., and Edward POLLAK: "On choosing between two trinomial simple hypotheses--with genetics examples";

KOEHLER, K. J.: "Analysis of temperature effects on bean leaf beetle egg hatch times";

Loughin, T. M., D. F. COX, P. N. HINZ, W. T. Schapaugh, Jr., and L. Kilgore-Norquest: "Experimental error in agronomic field trials";

**Swenson, A. R.:** "Using capture-recapture methodology to estimate the number of bird species"--poster paper.

**At the Institute of Mathematical Statistics-Bernoulli Society Conference in Chapel Hill, North Carolina, June 19-25:**

**ATHREYA, K. B.,** and **G. Atuncar:** "Estimation of stationary distribution for a Harris recurrent Markov chain--consistency and asymptotic normality";

**ATHREYA, K. B.,** and **A. Vidyashankar:** "Large deviations for multitype branching processes";

**Fukuchi, J.:** "Bootstrapping extremes: dependent case";

**LAHIRI, Soumendra Nath:** "On Edgeworth expansion and moving block bootstrap for studentized M-estimators in multiple linear regression models."
**At other locations:**

**AMEMIYA, Yasuo:** "On the analysis of longitudinal data using a random parameter nonlinear regression model," at the 1993 European meeting of the Psychometric Society, Barcelona, Spain, July 27, 1993.

**ANDERSON, Dianne:** panelist, panel on Developing an Arsenal of Tools for Evaluating Interviewer Training, at the International Field Directors and Field Technologies Conference, Boston, Massachusetts, May 17, 1994.

**ATHREYA, Krishna B.:** "Entropy maximization," colloquium at the T.I.F.R. Centre, Bangalore, India, January 10, 1994; also Mathematics Colloquium, Iowa State University, March 29.

"Inference for heavy-tailed distribution," at the Indian Statistical Institute, Bangalore, India, January 11.

**BAILEY, Theodore B.:** "Effects of salts on saturated hydraulic conductivity of sandy loam soil" and "Transport of $NO_3$-N and Atrazine through long disturbed columns," both by B. T. Devrajani, R. S. Kanwar, S. W. Melvin, and Bailey, at the Mid-Central Conference of the American Society of Agricultural Engineers, held in St. Joseph, Missouri, April 9-10, 1993.

"Data displays in the analysis of data," at the Iowa SAS User's Group Meeting, Ames, Iowa, May 20, 1993.

**CARRIQUIRY, Alicia:** "Estimation of usual intake distributions," seminar, Department of Statistics, Pontifical Catholic University of Chile, Santiago, Chile, October 6, 1993.

"Classical and Bayesian approaches to components of variance models," invited talk at the Semana de la Estadistica, Catholic University of Valparaiso, Valparaiso, Chile, October 7, 1993.

"Stochastic volatility models," seminar, Department of Mathematics, Pontifical Catholic University of Chile, Santiago, November 9.

"Bayesian estimation of signal to noise ratios," at the National Science Foundation Conference on Bayesian Hierarchical Models, Rio de Janeiro, Brazil, held on December 2-5.

"Production efficiency and agricultural reform in Ukraine," by P. G. Lakshminarayan, Stanley Johnson, Aziz Bouzaher, Carriquiry, Helen Jensen, and Peter Sabluk, at the annual meeting of the Allied Social Science Associations, Boston, Massachusetts, January 3, 1994.

"Stochastic volatility models for futures returns," seminar, Finance Department, Iowa State University, March 4, 1994.

"Estimating usual intake distributions," seminar, U.S. Department of Agriculture, Human Nutrition Information Service, Hyattsville, Maryland, April 22.

"Economic-environmental models: Applications in agriculture," seminar, Department of Natural Resources, Autonomous University of Chihuahua, Chihuahua, Mexico, May 16.

"Dietary assessment: A comparison of different procedures," seminar, Food and Drug Administration, Center for Food Safety and Applied Nutrition, Washington, D.C., June 14.

**COOK, Dianne:** "Exploring multidimensional data with the grand tour and projection pursuit," seminar, Department of Statistics, Duke University, September 24; seminar, Department of Mathematics, Statistics, and Computer Science, Dalhousie University, Halifax, Nova Scotia, Canada, December 7; and seminar, School of Statistics, University of Minnesota-Minneapolis, April 14, 1994.

"Exploring multivariate relations in high energy particle physics data using the grand tour and projection pursuit," seminar, Department of Physics, Iowa State University, November 17, 1993.

**COX, David F.:** "Effects of pH, mixing bowl material, and beater type on angel cake," by D. R. McComber, T. Laning, and Cox, at the Institute of Food Technologists annual meeting, held in Chicago, Illinois, July 10-14, 1993.

**CRESSIE, Noel:** "Constrained spatial prediction," seminar, Department of Statistics, Oregon State University, July 22.

"Spatial environmental statistics," "Constrained spatial prediction," "Spatial mapping of rates," and "Elements of Bayesian statistics," four invited talks at the 1993 annual meeting of the Alaska Chapter of the American Statistical Association, Fairbanks, Alaska, September 7-8.

"Comment on combining ecological assessments," as invited discussant at the National Institute of Statistical Sciences Workshop on Statistical Methods for Combining Environmental Information, held in Chapel Hill, North Carolina, September 28.

"Texture analysis using partially ordered Markov models," by Jennifer L. Davidson and Cressie, at the Navy Mine Countermeasures Image Analysis Workshop, Panama City, Florida, November 12.

"Spatio-temporal statistical modeling of livestock waste in streams," by Cressie and **James J. Majure**, at GISDATA, European Science Foundation Scientific Programme (inaugural specialist meeting on GIS and spatial analysis), Amsterdam, Netherlands, December 3.

"Bayesian considerations for spatial prediction," at the International Symposium on Exploration of Informational Aspects of Bayesian Statistics (co-sponsored by the Institute of Statistical Mathematics), Fujiyoshida, Japan, December 19.

"Spatial prediction from a Bayesian perspective," Department of Mathematics and Statistics, University of Nebraska-Lincoln, April 7, 1994.

"Spatial stochastic processes with image algebra," at the Office of Naval Research Grantee Meeting on Vision and Optical Information Processing, Washington, D.C., April 26.

**DAVID, H. A.:** "First (?) occurrence of terms in mathematical statistics," at the 49th session of the International Statistical Institute, Florence, Italy, September 2, 1993.

"The statistician's progress," to the Iowa State University chapter of Sigma Xi, April 21, 1994.

"First (?) occurrence of common terms in mathematical statistics," at a Festkolloquium, University of Dortmund, Germany, May 24.

"On recurrence relations for order statistics," at a joint meeting of German statistical societies, Dortmund, Germany, May 25.

**FULLER, Wayne A.:** "Design and estimation for samples of census nonresponse," by C. T. Isaki, J. H. Tsay, and Fuller, at the 1994 Census Annual Research Conference, Washington, D.C., March 22.

**GENALO, Toni:** "Interviewers' and respondents' perceptions on a questionnaire with sensitive issues," at the International Field Directors and Field Technologies Conference, Boston, Massachusetts, May 17, 1994; also discussion leader for session, Do Respondents Have Opinions and Are They Accurate?.

**HARVILLE, David A.:** "Mixed-model methodology: frequentist and Bayesian perspectives," seminar, School of Statistics, University of Minnesota, March 3, 1994.

**HINZ, Paul N.:** "Graduate study in statistics" and "Difficulties in interpreting simple linear regression," lectures at Luther College, December 3, 1993.

**ISAACSON, Dean L.:** "The M.S. in statistics for General Motors employees," at six General Motors sites, March 16-18, 1994.

**Iversen, Philip W.** (University of Newcastle): "Dynamic graphics for experimental design," at the annual meeting of the International Association for Statistical Computing, STATCOMP '93, in Wollongong, New South Wales, Australia, September 28, 1993.

**KOEHLER, K. J.:** "A semiparametric bootstrap for proportional hazards models," at the International Research Conference on Lifetime Data Models in Reliability and Survival Analysis, held in Boston, Massachusetts, June 14-17, 1994.

**LAHIRI, Soumendra Nath:** "Asymptotic expansions for normalized sums of weakly dependent random vectors," colloquium at the Centre for Mathematics and Its Applications, Australian National University, Canberra, Australia, January 27, 1994.

"On asymptotic properties of the block bootstrap under weak and strong dependence," colloquium, Department of Mathematics, Queensland University of Technology, Brisbane, Australia, May 10.

**LORENZ, Frederick O.:** panel discussion participant, Rural Health Interest group, at the Rural Sociological Society meeting held August 7-10, 1993, Orlando, Florida.

**MEEKER, William Q.:** "A degradation model for planning in-service nondestructive tests to control the hazard function of system-critical components," at the Conference on Industrial Statistics and Quality Improvement, sponsored by Oakland University, ASA-Quality and Productivity Section, Quality Sciences Inc., and Ford Motor Company, in Rochester, Michigan, August 20, 1993.

"Planning accelerated life tests with two or more experimental factors," seminar, Department of Mathematics, Northern Illinois University, October 1.

"Accelerated life test methodology," at the SEMATECH Statistical Methods Symposium, Austin, Texas, February 2, 1994.

"A comparison of degradation and failure-time analysis methods of estimating a time-to-failure distribution;" also panel discussant for a special session on Challenges on Research Directions for Statistics in Industry and Technology, at the Spring Research Conference of the Institute of Mathematical Statistics/American Statistical Association Section on Physical & Engineering Sciences, Chapel Hill, North Carolina, June 12.

**NUSSER, Sarah:** "Estimating usual intake distributions from food record and recall data," at the annual meeting of the American Public Health Association, San Francisco, California, October 25, 1993; also as a seminar for the Department of Food Science and Human Nutrition, Iowa State University, October 20, the Human Nutrition Information Service, USDA, Hyattsville, Maryland, November 16, and the Division of Biostatistics, University of Iowa, January 24, 1994.

**Olin, Bryan D.:** "Applications of statistical experimental design to nondestructive evaluation," by Olin and **William Q. MEEKER,** at the Review of Progress in Quantitative Nondestructive Evaluation, Bowdoin College, August 3, 1993.

**ROBERTS, Carl W.:** "Linguistic content analysis" and "A theoretical map for selecting among text analysis methods," at the Workshop on Inferential Text Analysis, Pittsburgh, Pennsylvania, on August 27 and 28, 1993, respectively.

"The politics of secularization," at a conference on Modernisierung und Säkularisierung in Europa, at the University of Munich, Germany, November 18.

"Content analysis," lecture for JLMC 502, Department of Journalism and Mass Communications, Iowa State University, March 9, 1994.

"The content analysis of texts," seminar, Department of Journalism, University of Texas-Austin, March 22.

"Linguistic content analysis," seminar, Department of Statistics, Texas A&M University, March 24.

**ROLLINS, D. K.:** "Statistical evaluation of mixing," at the 3M Compounding Mixing & Extrusion Conference, held in St. Paul, Minnesota, October 11-15, 1993.

**ROLLINS, D. K.:** commentator for Session I, Issues on Process Monitoring, at the Foundations of Computer-aided Process Operations Meeting held in Crested Butte, Colorado, July 18-23, 1993.

**SHELLEY, Kathleen:** "Graphs which almost knock your socks off: Using visualization principles to convey the message," at the Midwest SAS Users Group meeting in Indianapolis, Indiana, September 14.

**SHELLEY, Mack C. II:** "Consistency or change in issue dimensions of the cultural war," by Shelley and Steven G. Koven, at the annual meeting of the American Political Science Association, Washington, D.C., September 2, 1993.

"Attitude formation, religion, and the mass public: Choice and change in the cultural dimensions of American politics," by Shelley and Steven G. Koven, at the annual meeting of the Midwest Political Science Association, Chicago, April 16, 1994.

**SHERMAN, Peter:** "On period uncertainty in periodic random processes," invited talk to the Australia Defence Science and Technology Organization, Adelaide, Australia, August 3, 1993.

"Period uncertainty in periodic spectral analysis of processes associated with periodic phenomena," seminar, Department of Electrical Engineering and Computer Engineering, Iowa State University, September 28.

"The influence of period uncertainty in nominally periodic processes," invited talk, Department of Information and Computer Sciences, University of Hawaii, February 1, 1994.

"Period uncertainty in periodic spectral analysis of processes associated with periodic phenomena," by Lang B. White and Sherman, at the IEEE International Conference on Acoustics, Speech and Signal Processing, held in Adelaide, SA, Australia, April 19-22, 1994.

**STEPHENSON, W. Robert:** "Total quality management (TQM) and instruction," at the Total Quality Management University Challenge Symposium, Dallas, Texas, held August 15-17, 1993.

"Engineering/industrial resarch: The interaction between engineers, mathematicians, and statisticians," by Stephenson and Robert R. Bittle, Mathematics Colloquium, Iowa State University, November 30.

**STUFKEN, John:** "Orthogonal arrays: Selected results and some open problems," seminar, Department of Statistics and Actuarial Science, University of Waterloo, Canada, December 2.

"Orthogonal arrays: Some selected problems," seminar, Division of Statistics, Northern Illinois University, April 28, 1994.

**SUKHATME, Shashikala:** "Receiver operating characteristic curves with random number of cases"; also "Stratification in nonparametric receiver operating characteristic studies," by Sukhatme and C. A. Beam, at the 14th meeting of the International Society for Clinical Biostatistics, Cambridge, England, held September 21-24, 1993.

"Small sample properties of two-sample rank tests with truncated populations," seminar, Department of Statistics and Computational Mathematics, University of Liverpool, September 27.

"Application of stratification in nonparametric ROC studies," seminar, Department of Social Statistics, University of Southampton, Southampton, England, September 29.

"Some problems in nonparametric receiver operating characteristic studies," at the Statistics and Probability Symposium, held at Kent State University, September 30-October 2.

"Statistical inference: Chi square tests for contingency tables," seminar and workshop, Department of Pediatric Emergency, Case Western Reserve University, October 8.
"Stratification in nonparametric ROC studies," seminar, Department of Mathematics and Statistics, Oakland University, October 12, and seminar, Department of Biostatistics, University of Michigan, Ann Arbor, October 14; also Biostatistics Series seminar, Department of Statistics, Ohio State University, October 21.

"Two-sample rank tests with truncated populations," seminar, Department of Statistics, McMaster University, Hamilton, Ontario, Canada, November 10.

"Applications of stratification in receiver operating characteristic studies," Department of Mathematical Sciences Colloquium, University of Akron, December 2.

"Some problems in receiver operating characteristic studies," seminar, Department of Biostatistics, Cleveland Clinic Foundation, Cleveland, Ohio, December 20.

"A parametric approach to measurement errors in Receiver Operating Characteristic curves," at the International Research Conference on Lifetime Data Models in Reliability and Survival Analysis, Boston, Massachusetts, held June 14-17.

**Takahashi, Hiroshi:** "Computations for REML estimation of variance components," Animal Breeding and Genetics Seminar, Iowa State University, October 12, 1993.

**Wang, Morgan C.** (University of Central Florida), and **William J. KENNEDY:** Interval analysis and self-validating computation of non-central F probabilities and percentiles, at Interface '94, 26th Symposium on the Interface: Computing Science and Statistics--Computationally Intensive Statistical Methods, Research Triangle Park, North Carolina, June 17.

## ▨ Other Meetings

Edith Landon attended the convention of Professional Secretaries International, Calgary, Canada, July 25-29, as alternate delegate of the Iowa Division.

In addition to faculty and students mentioned earlier, Stephen Vardeman, Ding Hwa Lei, and Ouhong Wang attended the Joint Statistical Meetings in San Francisco, California, in August.

Dean Isaacson and, as indicated above, W. R. Stephenson participated in the Total Quality Management University Challenge Symposium sponsored by Texas Instruments, Dallas, Texas, August 15-17.

W. Robert Stephenson attended a Total Quality Forum at Iowa State University October 5 and the ASQC 48th Midwest Conference in Des Moines, Iowa, October 19.

Frederick Lorenz attended a meeting at Michigan State University October 26-28 at the Institute for Children, Youth, and Families regarding proposed collaborative research on children in poverty in rural areas, and met with computer staff at the Institute for Social Research, Ann Arbor, Michigan, October 28-29 period.

Derrick K. Rollins, Maritza Melendez, Angelita Nason, and Jennifer Walker attended the 1993 annual meeting of the American Institute of Chemical Engineers, in St. Louis, Missouri, November 9-11.

Anthony An, Rohit Deo, Kevin Dodd, Matt Gerdis, Savas Papadopoulus, and Jean Pelkey attended the American Statistical Association 1994 Winter Conference in Atlanta, Georgia, in January.

Frederick Lorenz attended the annual meeting of the Western Regional Project #183, Experiments in Surveys, in Tucson, Arizona, January 27-30, 1994.

Edward Pollak participated in the Workshop on Mathematical Population Genetics held by the Institute for Mathematics and Its Applications, University of Minnesota, January 24-28, 1994.

William Q. Meeker attended a meeting of the Engine Titanium Consortium, ISU/FAA Center for Aviation Systems Reliability, held at the Pratt-Whitney facilities, West Palm Beach, Florida, March 2-3.

Besides the seven faculty and graduate students presenting papers at the Sixth Annual Kansas State University Conference on Applied Statistics in Agriculture, six other graduate students attended on April 24-26: Carol Goebel, Nan-Jung Hsu, Michael Lieber, L. Claire Tsao, Michael Wallendorf, and Lie-Ling Wu.

Sarah Nusser and, as indicated above, Toni Genalo and Dianne Anderson attended the International Field Directors and Field Technologies Conference, Boston, Massachusetts, held on May 15-18.

Mark Kaiser participated in the Summer Research Conference on Markov Chain Monte Carlo Methods sponsored by the American Mathematical Society, at Mt. Holyoke College, South Hadley, Massachusetts, June 26-30.

In the Statistical Laboratory preprint series, 34 titles (#93-5 to 93-38) were added during the last half of 1993 and 16 more (#94-1 to 94-16) in the first half of 1994. 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 1994.

### ▨ Books

**CRESSIE, Noel.** *Statistics for Spatial Data,* revised edition. New York: John Wiley & Sons. 1993. xx + 900 pp.

This book, introduced in 1991, 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. In the revised edition, a number of typographical errors have been corrected, and the section on Markov chain Monte Carlo methods has been updated.

Hinkelmann, Klaus, and **Oscar KEMPTHORNE.** *Design and Analysis of Experiments, Vol. 1: Introduction to Experimental Design.* New York: John Wiley & Sons, Inc. 1994. xvi + 495 pp.

Volume I is a general introduction to the subject laying the foundations for the development of various aspects of experimental design. It is intended as a textbook for a one-semester course for first-year graduate students who have already taken a fairly rigorous course on statistical methods. It represents a considerable rewriting of the book *Design and Analysis of Experiments* by Kempthorne that was published in 1952.

Students in statistics tend to have had little experience or required knowledge in philosophy of science. Hinkelmann and Kempthorne take the point of view that everything begins from observation and that there are two types of science--descriptive science, consisting of observing the real world and writing down what was seen, and the development of theory. The basic problem of science, in general, is that we cannot manufacture or obtain nearly identical small systems. A long introductory chapter on the processes of science discusses the authors' perception of observation, theory, and science, the role of experiments, the role of data analysis, and the introduction of the ideas of probability as related to relative frequency in a defined population of repetitions.

Chapter 2 discusses the nature of experimentation and the principles of experimental design, considering three components: treatment design, error control design, and the sampling and observation design. This leads to discussion of evaluation of the importance of possible sources of variation through the statistical analysis of variance and appropriate use of replication, randomization, and local control or blocking.

Chapter 3 gives a broad survey of experimental designs and leads into linear model theory. The authors give some basic theory of equations and discuss generalized inverses and the Moore-Penrose inverse. Balanced classificator structures and the possibilities of nested factors, crossed factors, and confounded factors are dealt with. Chapter 4 ends with a basic discussion of what one is do with the analysis of covariance model. The authors consider the role of the stochastic linear model and discuss distribution theory.

Chapter 5 on randomization distinguishes between observational and interventional studies and then focuses on the latter. The use of historical controls, Fisher's famous lady tasting tea experiment, a simple triangular experiment, and the general idea of a randomization test are discussed.

Beginning with Chapter 6, Hinkelmann and Kempthorne develop from first principles various error-control designs. Thus Chapter 6 explains the nature, philosophy, and properties of the completely randomized design, obtains a derived linear model, with an associated analysis of variance, and discusses the randomization test, subsampling, and transformations.

The seven remaining chapters deal with comparisons of treatments; the use of supplementary information; randomized block designs and the general notion of incomplete block designs; Latin square-type designs; factorial experiments; response surface designs; and split-plot designs.

The book contains exercises in each chapter, with limited guidance on the use of available statistical software. It closes with a long list of references and a list of additional readings from the writings of Kempthorne for interested students.

Conger, R. D., and G. H. Elder, Jr. (in collaboration with **Frederick O. LORENZ,** Ronald L. Simons, and Les B. Whitbeck). *Families in Troubled Times: Adapting to Change in Rural America.* Hillsdale, New Jersey: Aldine. 303 pp.

Four chapters (2, 5, 6, and 7) are reviewed in the next section of the Annual Report (see Lorenz).

Bardes, Barbara A., **Mack C. SHELLEY II,** and Steffen W. Schmidt. *American Government and*

*Politics Today: The Essentials,* 1994-95 edition. St. Paul: West Publishing Company. 1994. xxxvi + 548 pp.

This is the latest edition of a widely used introductory textbook in political science. The current edition features extensive coverage of opinion polling and voting behavior associated with the 1992 national elections in the United States. Major supplements include a software package applying statistical procedures and display graphics to data sets keyed to the subject matter of each chapter, a companion reader, and an appendix on conducting research in political science.

**VARDEMAN, Stephen B.** *Statistics for Engineering Problem Solving.* PWS Foundations in Engineering Series. Boston: PWS Publishing Company. 1994. xii + 712 + A99 pp.

This nonstandard beginning engineering statistics textbook presents most of the elementary and intermediate statistical methods currently used by practicing engineers. Without assuming any prior experience with statistical methods, the text covers such important topics as practical issues in engineering data collection, least squares curve and surface fitting, factorial analyses, Shewhart control charts, prediction and tolerance intervals, $2^p$ factorial and $2^{p-q}$ fractional factorial experimental designs and analysis, response surface methods, mixture studies, and simple ideas of variance component estimation. The development of scientific thought processes and efficient data collection and its interpretation in the context of real engineering problems are emphasized, while mathematical theory and formalism are deemphasized. The book's discussions and essentially all of its numerous exercises are based on real engineering data and/or scenarios, and MINITAB output is provided in many of the examples. The final chapter consists of a case study of a highly successful industrial project integrating many of the methods introduced in the book. A 375-page solutions manual providing complete solutions to the book's exercises was prepared by Chuck Lerch, and is available to instructors from the publisher.

## ▨ Published Research

**AMEMIYA, Yasuo.** Instrumental variable estimation for nonlinear factor analysis. Pp. 113-129 in *Multivariate Analysis: Future Directions 2,* edited by C. M. Cuadras and C. R. Rao. Amsterdam: Elsevier Science Publishers. 1993.

A general nonlinear model for factor analysis is proposed and discussed. Issues associated with the use of the model are discussed, including the identification problem. A single-equation model fitting procedure based on instrumental variable approach is introduced. The procedure includes an adjustment designed to reduce the bias due to the nonlinearity of

the model. Theoretical results based on the small-error asymptotics are presented in support of the procedure and the bias adjustment. An illustrative example is also given.

**ATHREYA, K. B.** Iterates of maps: random and deterministic. *Journal of the Indian Academy of Sciences* 1041 (1994) 63-67.

For deterministic and random maps iterates are shown to converge to fixed points. Rates of convergence to there are discussed.

**ATHREYA, Krishna.** Rates of decay of the survival probability of a mutant gene: multitype case. *Journal of Mathematical Biology* 32 (1993) 45-53.

For a multitype branching process that is slightly supercritical, approximations for the survival probability in terms of the maximal eigenvalue of the mean matrix and a generalized variance are developed. These answer a conjecture of Ewens.

**Al-yahya, S. A., C. J. Bern, M. K. Misra, and T. B. BAILEY.** Carbon dioxide evolution of fungicide-treated high-moisture corn. *Transactions of the American Society of Agricultural Engineers* 36:5 (1993) 1417-1422.

Two corn hybrids, one resistant (FR35 × FR20), the other susceptible (DF20 × DF12) to storage fungi, were harvested and hand-shelled at 22% moisture, wet basis, and stored at this moisture in aerated 1-kg bin units. Four Rovral fungicide treatments plus an untreated control were tested using carbon dioxide evolution as the index of grain-deterioration rate. Equations of carbon dioxide weight versus time were fitted. The resistant corn hybrid manifested a lower deterioration rate than the susceptible hybrid did. Samples treated with fungicide showed a reduction in grain-deterioration rate compared with untreated samples.

**Mansky, L. M., D. P. Durand, T. B. BAILEY, and J. H. Hill.** Variation of cell-free translation profiles among pathogenic strains of soybean mosaic virus. *Journal of Phytopathology* 137:4 (1993) 293-300.

Cell-free translation products from isolates representing soybean mosaic virus (SMV) strains G1 to G7 and G7a, along with several other SMV isolates, were analyzed. SMV RNAs were translated in both rabbit reticulocyte lysates and wheat germ extracts, yielding approximately 20 translation products for each strain from each translation system. Comparison of translation profiles (using principal component analysis of the data matrix indicating the presence or absence of proteins) allowed for the formation of distinctive groups from each cell-free translation system. Groupings formed by analysis of products from rabbit reticulocyte lysates correlated with patho-

genicity; groupings formed by analysis of products from wheat germ extracts had no apparent biological significance.

Swan, J. B., R. L. Higgs, **T. B. BAILEY**, N. C. Wollenhaupt, W. H. Paulson, and A. E. Peterson. Surface residue and in-row treatment effects on long term no-tillage continuous corn. *Agronomy Journal* 86:4 (1994) 711-718.

The objectives of this research were to determine the effects of surface crop residue and planter attachments on six corn traits. Effects of the treatments were compared over a six year period (1984 through 1990). The field layout of the experiment was a split-plot design with a randomized complete block arrangement of the whole-plot factor (residue treatment). Separate statistical analyses were conducted for each year. A combined analysis over years was also completed to determine average treatment effects and to assess whether these effects were consistent over time. It was found that seasonal effects, presumably due to weather conditions, accounted for more than ninety percent of the variability in grain yield. An important conclusion of the research was that average yields with normal residue (i.e., the control) were 0.44 Mg ha$^{-1}$ greater than those in plots where residue was removed.

**CARRIQUIRY, Alicia L.**, Helen H. Jensen, **W. A. FULLER**, and P. Guenther. Methods for estimating usual intake distributions. *The American Journal of Clinical Nutrition* 59:1 (1994) 305 (supplement).

Mansur, L. M., **A. L. CARRIQUIRY**, and A. P. Rao-Arelli. Generation mean analysis of resistance to Race 3 of soybean cyst nematode. *Crop Science* 33:6 (1993) 1249-1253.

The soybean cyst nematode (SCN) is a serious pest of soybean. We investigated the mode of inheritance for resistance to Race 3 of SCN by weighted least squares regression analysis of generation means for genetic models having additive and dominance param-eters. Six generation means in three of the crosses, and four in one, were used to estimate mean genetic effects. Data were transformed for analysis because they were not normally distributed. Results indicated that an additive genetic model was sufficient to explain most of the genetic variation for resistance to Race 3 in each cross. Analysis of the pooled data from all crosses, however, indicated the presence of dominance effects as well. Estimates for broad sense heritabilities on single plant basis ranged from 0.48 to 0.81. This indicates that breeders should be able to select genotypes with an intermediate level of resistance.

**COOK, Dianne**, Andreas Buja, and Javier Cabrera. Projection pursuit indexes based on orthogonal function expansions. *Journal of Computational and Graphical Statistics* 2:3 (1993) 225-250.

Projection pursuit describes a procedure for searching high-dimensional data for "interesting" low-dimensional projections via the optimization of a criterion function called the projection pursuit index. By empirically examining the optimization process for several projection pursuit indexes, we observed differences in the types of structure that maximized each index. We were especially curious about differences between two indexes based on expansions in terms of orthogonal polynomials, the Legendre index, and the Hermite index. Being fast to compute, these indexes are ideally suited for dynamic graphics implementations.

Both Legendre and Hermite indexes are weighted $L^2$-distances between the density of the projected data and a standard normal density. A general form for this type of index is introduced that encompasses both indexes. The form clarifies the effects of the weight function on the index's sensitivity to differences from normality, highlighting some conceptual problems with the Legendre and Hermite indexes. A new index, called the Natural Hermite index, which alleviates some of these problems, is introduced.

A polynomial expansion of the data density reduces the form of the index to a sum of squares of the coefficients used in the expansion. This drew our attention to examining these coefficients as indexes in their own right. We found that the first two coefficients, and the lowest-order indexes produced by them, are the most useful ones for practical data exploration because they respond to structure that can be analytically identified, and because they have "long-sighted" vision that enables them to "see" large structure from a distance. Complementing this low-order behavior, the higher-order indexes are "short-sighted." They are able to see intricate structure, but only when they are close to it.

We also show some practical use of projection pursuit using the polynomial indexes, including a discovery of previously unseen structure in a set of telephone usage data, and two cautionary examples that illustrate that structure found is not always meaningful.

DeBey, M. C., D. W. Trampel, J. L. Richard, D. S. Bundy, L. J. Hoffman, V. M. Meyer, and **D. F. COX.** Effect of building ventilation design on environment and performance of turkeys. *American Journal for Veterinary Research* 55:2 (1994) 216-220.

Air quality in turkey buildings is a factor in turkey performance, so the effectiveness of natural ventilation systems is of concern. The objective of the study reported here was to determine which type of natural ventilation system, curtain or sliding door, provided better air quality in commercial turkey confinement houses. Differences in air quality between summer and winter were measured. In addition, the effect of building ventilation type on performance of turkeys was monitored. Environmental variables assessed in 10 buildings, five of each ventilation design, included airspeed; temperature; rela-

tive humidity; gases; particle number, size, and mass per cubic meter of air; and colonies of bacteria, yeasts, and other fungi per cubic meter of air. Also colonies of yeasts and other fungi were quantitated in feed and litter. The resulting data were analyzed by analysis of variance, and correlation coefficients were calculated to measure linear relationships among the environmental and performance variables.

McComber, Diane R., Harry T. Horner, Mark A. Chamberlin, and **David F. COX.** Potato cultivar differences associated with mealiness. *Journal of Agricultural Food Chemistry* 42:11 (1994) 2433-2439.

Russet Burbank, Norchip, Pontiac, and LaSoda potato cultivars were examined for the parameters mealy and waxy. Russet Burbank was judged dry, hard and particulate, typifying mealiness. Using phase contrast microscopy and scanning electron microscopy, raw mealy cells were determined to be larger and more irregularly shaped than cells from waxy cultivars. Mealy cooked cells were engorged with gelatinized starch, cell walls were more polarized, and cell shapes were better retained after mashing, when compared to waxy cells. NMR-TZ bound water readings from Russet Burbank and Pontiac samples did not differ from each other. Starch granule sizes and shapes varied by cultivar.

Thielen, Tanya F., Diane R. McComber, and **D. F. COX.** Effect of alternative sweeteners on egg-thickened mixtures. *Journal of the American Dietetic Association* 93:7 (1993) 814-815.

The purpose of this study was to determine the effects of substituting alternative sweeteners for sucrose in baked custards. Six alternative recipes were compared with a control in a completely randomized design with five replications of each of the seven recipes. Resulting data on crust appearance and tenderness, gel consistency, sweetness, bitterness, and acceptibility by a taste panel were evaluated by analysis of variance for significant differences.

**CRESSIE, Noel.** Comment on "An approach to statistical spatial-temporal modeling of meteorological fields," by Mark S. Handcock and James R. Wallis. *Journal of the American Statistical Association* 89:426 (1994) 379-382.

**CRESSIE, Noel.** Geostatistics: A tool for environmental modelers. Pp. 414-421 in *Environmental Modeling with GIS,* edited by M. F. Goodchild, B. O. Parks, and L. T. Steyaert. Oxford: Oxford University Press. September 1993.

Models of the environment are ideally both extensive and dynamic, thus allowing reliable spatio-temporal predictions. Since formally, at least, the time component can be thought of as a fourth dimension, most of this paper is about spatial prediction. In practice, the different qualitative nature of the time

dimension necessitates care in modeling the spatio-temporal dependence. Geostatistics is the area of spatial statistics that is concerned mostly with prediction of unknown values at given locations (or of aggregations over given regions). Typically, the prediction is based on univariate and bivariate distributions of the spatial variable under consideration. These distributions, or appropriate moments of them, are estimated from an initial analysis of the data.

**CRESSIE, Noel.** Spatial chemostatistics. Pp. 131-146 (Chapter 6) in *Environmental Statistics, Assessment and Forecasting,* edited by C. Richard Cothern and N. Phillip Ross. Boca Raton, Florida: Lewis Publishers. 1994.

Chemostatistics is concerned with statistics for measured chemical data. Sometimes knowledge of where such data come from can be very useful in predicting values of a process at locations where no data were taken. Examples include resource evaluation, atmospheric-deposition monitoring, and hazardous waste site characterizations. Results from chemical assays give a highly multivariate picture of the underlying process. However, the picture is incomplete because of sparseness of the samples in space, censoring due to limits of detection, measurement error, and so forth. This chapter discusses these issues.

**CRESSIE, Noel.** Spatial prediction in a multivariate setting. Pp. 99-107 (Chapter 4) in *Multivariate Environmental Statistics,* edited by G. P. Patil and C. R. Rao. New York: North Holland. 1993.

Hazardous waste site characterization and remediation problems are typically multivariate and spatial in nature. However, much of the associated literature in design, data analysis, modeling, and prediction is decidedly univariate. A multivariate approach to the problem of spatial prediction is presented. It is apparent that there is currently a dearth of valid multivariate spatial models, which is holding back the development of practical tools for multivariate geostatistical analyses.

**CRESSIE, Noel, Jonathan Biele** (Universidade de Campinas, Brazil), and Peter B. Morgan. Sample-size-optimal sequential testing. *Journal of Statistical Planning and Inference* 39:2 (1994) 305-327.

Sequential sampling schemes have traditionally used ad hoc rules for sample size. The variable-sample-size sequential probability ratio test (VPRT), developed by Cressie and Morgan (*Proceedings of the 4th Purdue Symposium on Decision Theory and Related Topics,* IV Vol. 2, New York: Springer (1988), 107-118), generalizes the classical one-at-a-time and group-sequential procedures to an optimal procedure that maximizes the expected net gain of sampling, conditional on the accumulated observations on the

stochastic process. In this paper, we apply the VPRT to the problem of sequential testing of a Gaussian mean.

**CRESSIE, Noel,** and **Jeffrey D. Helterbrand.** Multivariate spatial statistical models. *Geographical Systems* 1:2 (1994) 179-188.

One of the strengths of a geographic information system (GIS) is its capability to handle multiple layers of information through common georeferencing. Thus, statistical methods that are both multivariate and spatial should, along with the GIS, be an integral part of the "analysis engine" that interfaces between multivariate spatial data and multivariate spatial models. Any analysis of (multivariate spatial) data has its roots in a more or less vaguely specified statistical model. This paper brings together several well-known multivariate spatial statistical models and asks what data analytic tools they engender.

**CRESSIE, Noel,** and **Mark S. KAISER.** Comment on "Small area estimation: An appraisal," by M. Ghosh and J. N. K. Rao. *Statistical Science* 9:1 (1994) 76-80.

**CRESSIE, Noel,** and Peter B. Morgan. The VPRT: A sequential testing procedure dominating the SPRT. *Econometric Theory* 9:3 (1993) 431-450.

Under more general assumptions than those usually made in the sequential analysis literature, a variable-sample-size-sequential probability ratio test (VPRT) of two simple hypotheses is found that maximizes the expected net gain over all sequential decision procedures. In contrast, Wald and Wolfowitz (1948) developed the sequential probability ratio test (SPRT) to minimize expected sample size, but their assumptions on the parameters of the decision problem were restrictive. In this article we show that the expected net-gain-maximizing VPRT also minimizes the expected (with respect to both data and prior) total sampling cost and that, under slightly more general conditions than those imposed by Wald and Wolfowitz, it reduces to the one-observation-at-a-time sequential probability ratio test (SPRT). The ways in which the size and power of the VPRT depend upon the parameters of the decision problem are also examined.

**CRESSIE, Noel,** and Jay M. Ver Hoef. Spatial statistical analysis of environmental and ecological data. Pp. 404-413 in *Environmental Modeling with GIS,* edited by M. F. Goodchild, B. O. Parks, and L. T. Steyaert. Oxford: Oxford University Press. 1993.

In this paper we present an overview of spatial statistical methods applied to the sampling, description, modeling, and prediction of environmental phenomena. This problem is inherently difficult because often there is just one experimental unit: the earth! Geographic Information Systems (GISs) are powerful tools whose potential for implementing spatial statistical methodology has yet to be properly realized. Considering the high cost of monitoring the environment, substantial resources could be saved by recognizing the spatial dependence in environmental and ecological data, fitting spatial models, and then using the most precise inferences. We believe that future generations of GISs should have a (spatial) statistical inference capability as a primary feature.

Davidson, J. L., and **N. A. C. CRESSIE.** Markov pyramid models in image analysis. Pp. 179-190 in *Image Algebra and Morphological Image Processing IV,* edited by E. R. Dougherty, P. D. Gader, and J. C. Serra. Bellingham, Washington: Society of Photo-Optical Instrumentation Engineers (SPIE) Proceedings, Vol. 2030. 1993.

The use of statistical pattern recognition techniques in image processing has led to simplifying assumptions on the statistical interdependence of the pixel values of an image, which allow theoretical analysis and/or computational implementation to be achieved. However, these results are very limiting in representing models for data, and do not allow for analysis of arbitrary spatial dependencies in the data. One model for two-dimensional data on a lattice array is the *Markov mesh* model, which allows a computationally attractive implementation of statistical procedures involving joint and conditional probabilities. In this paper, we generalize this model to what we call the *Markov pyramid* model, using the concept of partial ordering.

**DAVID, H. A.** A note on order statistics for dependent variates. *The American Statistician* 47:3 (1993) 198-199.

Sathe and Dixit (1990) showed that a basic recurrence relation for cdf's of order statistics can be modified to hold under any dependence structure of the original variates. A greatly shortened proof is given in this note.

Nagaraja, H. N., and **H. A. DAVID.** Distribution of the maximum of concomitants of selected order statistics. *The Annals of Statistics* 22:1 (1994) 478-494.

For a random sample of size $n$ from an absolutely continuous bivariate population (X,Y), let $X_{i:n}$ denote the $i^{th}$ order statistic of the X sample values. The Y-value associated with $X_{i:n}$ is denoted by $Y_{[i:n]}$ and is called the concomitant of the $i^{th}$ order statistic. For $1 \leq k \leq n$, let $V_{k:n} = \max(Y_{[n-k+1:n]},...,Y_{[n:n]})$. In this paper, we discuss the finite-sample and the asymptotic distributions of $V_{k:n}$ as $n \to \infty$, when k is held fixed and when $k = [np]$, $0 < p < 1$. In both cases we obtain simple sufficient conditions and determine the associated norming constants. We apply our results to some interesting situations, including the bivariate normal population and the simple linear regression model.

**DAVID, H. T.,** and **Seongmo Yoo.** Where next? Adaptive measurement site selection for area remediation. Pp. 361-372 in *Environmental Statistics, Assessment, and Forecasting,* edited by C. Richard Cothern and N. Phillip Ross. Boca Raton, Florida: Lewis Publishers, Inc. 1994.

We consider efficient adaptive toxic site characterization. The methodology calls for spatial interpolation, adaptive measurement site selection, and a stop-decision rule. Site selection is based in part on selecting next a measurement site that, together with a certain subset of sites selected so far, yields a contamination map near the current map.

**DAVID, H. T.,** and **Seongmo Yoo.** The best of both worlds: Integrating statistical and deterministic approaches to area remediation. Pp. 1418-1425 in *Proceedings of the Fourth Annual International Conference on High-Level Radioactive Waste Management,* held in April 1993, Las Vegas, Nevada. 1993.

We seek a complete framework for adaptive area characterization for purposes of remediation, incorporating both statistical and deterministic features. This adds the dimension of statistical assessment to the previous paper (see above).

Siha, Samia, and **H. T. DAVID.** A Finch-Foster duality between 'pull' and 'push' production systems. *Journal of the Operational Research Society* 45:2 (1994) 179-186.

This paper views 'push' and 'pull' production systems as mutually dual in a sense originally proposed by Finch and Foster. Four measures of production effectiveness are analyzed for both systems in the light of this duality, using continuous-time Markov process modeling. Two of the four measures are found to be identical for the two systems, while the other two are found to be complementary in a sense explained in the body of the paper.

**FULLER, Wayne A.** Masking procedures for microdata disclosure limitation. *Journal of Official Statistics* 9:2 (1993) 383-406.

Masking methods in which error is added to the elements of a data set prior to data release are described. The nature of confidentiality protection provided by these methods, the costs of such procedures to data providers, and the costs of the procedures to data users are investigated.

Pantula, Sastry G., and **Wayne A. FULLER.** The large sample distribution of the roots of the second order autoregressive polynomial. *Biometrika* 80:4 (1993) 919-923.

The roots of the characteristic polynomial of an autoregressive process are sometimes of interest. In this paper, we show that the estimated roots of a second order autoregressive polynomial have different asymptotic distributions depending upon whether the true roots are equal or unequal.

Arnold, Barry C., Robert J. Beaver, **Richard A. GROENEVELD,** and **William Q. MEEKER.** The nontruncated marginal of a truncated bivariate normal distribution. *Psychometrika* 58:3 (1993) 471-488.

Inference is considered for the marginal distribution of X, when (X,Y) has a truncated bivariate normal distribution. The Y variable is truncated, but only the X values are observed. The relationship of this distribution to Azzalini's "skew-normal" distribution is obtained. Method of moments and maximum likelihood estimation are compared for the three-parameter Azza-lini distribution. Samples that are uninformative about the skewness of this distribution may occur, even for large n. Profile likelihood methods are employed to describe the uncertainty involved in parameter estimation. A sample of 87 Otis test scores is shown to be well-described by this model.

**Grondona, Martín O.** (Instituto National de Tecnologia Agropecuaria (INTA), Argentina), and **Noel CRESSIE.** Efficiency of block designs under stationary second-order autoregressive errors. *Sankyhā, A* 55:Pt. 2 (1993) 267-284.

This article presents sufficient conditions for the universal optimality of block designs when observations within blocks follow a second-order autoregressive (AR(2)) process. The optimal design is then compared to first-order nearest-neighbor (NN) balanced complete block designs, which are much easier to construct. In terms of the $A$-optimality and $D$-optimality criteria, first-order NN balanced designs are shown to be very efficient. Furthermore, they are more efficient (in terms of average variance of treatment differences) than randomized complete block designs. Finally, the robustness of first-order NN balanced complete block designs, against a misspecified AR(1) error model, is assessed.

**HARVILLE, David A.,** and Michael H. Smith. The home-court advantage: How large is it, and does it vary from team to team? *The American Statistician* 48:1 (1994) 22-28.

College basketball fans often speculate on the extent and nature of the home-court advantage. In this article, it is shown how questions about the size of the home-court advantage and about team-to-team differences in the home-court advantage can be addressed by fitting three different linear models to the outcomes of college basketball games. This approach was applied to data from the 1991-1992 college basketball season. The advantage of playing at home (in relation to playing on a neutral court) was estimated to be $4.68 \pm 0.28$ points. The effect of team-to-team differences in the home-court advantage was found to be relatively small.

**Hasabelnaby, Nancy A.** (King Saud University, Saudi Arabia), and **Wayne A. FULLER** Measurement error models with unequal error variances. Pp. 151-162 in *Statistical Modelling and Latent Variables*--Proceedings of the International Workshop on Statistical Modelling and Latent Variables, Trento, Italy, 15-17 July 1991, edited by K. Haagen, D. Bartholomew, and M. Deistler. Amsterdam: Elsevier Science Publishers. 1993.

The use of weights in the estimation of the parameters of the measurement error model with heterogeneous error variances is investigated. Estimation of an appropriate set of weights is discussed, and weights that are functions of the unknown true values are considered. The limiting distribution of the properly standardized estimator constructed with fixed weights is normal under weak conditions. The limiting distribution of the weighted estimator constructed with estimated weights is normal when the limit is taken as the sample size gets large and the error variances become small.

A Monte Carlo study using data similar to that collected in a farm survey is presented. The large sample approximation to the distribution of the pivotal for the weighted estimator seems adequate in samples of size 50, but samples of size 200 are needed for the "t-statistic" of the unweighted estimator to behave as a random variable with a Student's t-distribution.

Weighting reduces the mean square error of the estimated slope and improves the t-approximation to the pivotal, relative to the unweighted procedure.

**Helterbrand, Jeffrey D.,** and **Noel A. C. CRESSIE.** Stochastic recognition of closed object boundaries in images. Pp. 240-251 in *Image Algebra and Morphological Image Processing IV*, edited by E. R. Dougherty, P. D. Gader, and J. C. Serra. Society of Photo-Optical Instrumentation Engineers (SPIE) Proceedings, Vol. 2030. 1993.

Engineering-based edge detection techniques generally use local intensity information to identify whether a pixel location is part of a boundary. Boundaries are presumed present where sharp transitions in the observed intensities occur. Unfortunately, these approaches are sensitive to error and hidden partial boundaries, which hinders the determination of closed object boundaries. In this research, a method to obtain statistically optimal closed object boundaries is presented.

**Helterbrand, Jeffrey D.,** and **Noel CRESSIE.** Universal cokriging under intrinsic coregionalization. *Mathematical Geology* 26:2 (1994) 205-226.

Under the intrinsic coregionalization model, if both primary and secondary measurements are available at all sample locations, the conventional geostatistical wisdom is that cokriging provides exactly the same solution as univariate kriging on the primary process alone. However, recent examples have been given where nonzero secondary cokriging weights have occurred under this spatial dependence structure. This note identifies the conditions under which secondary information is useful under the assumption of intrinsic coregionalization. An illustration is given using a data set of plutonium and americium concentrations collected from a region of the Nevada Test Site.

**Hameed, Abdul, Linda M. Pollak,** and **Paul N. HINZ.** Evaluation of Cateto maize accessions for grain yield and physical grain quality traits. *Crop Science* 34:1 (1994) 265-269.

Because many exotic corn (*Zea mays* L.) races have different evolutionary histories from those of U.S. races, they may possess unique, favorable alleles for physical grain quality traits. This paper reports on the effectiveness of using exotic inbreds from Uruguay, Argentina, South Africa, and Taiwan (representing 'Cateto'-type, intermediate, and non-Cateto races) to inprove physical grain quality of U.S., Corn Belt hybrids. A randomized complete block design was used to evaluate testcrosses ($F_1$s), their $F_2$ and backcross (to the Corn Belt inbreds) generations, and four checks grown at two locations in Iowa and at one location in Missouri.

**Hameed, Abdul, Linda M. Pollak,** and **Paul N. HINZ.** Evaluation of Cateto maize accessions for grain yield and other agronomic traits in temperate and tropical environments. *Crop Science* 34:1 (1994) 270-275.

The temperate maize (*Zea mays* L.) race Cateto may have potential for improving grain quality in temperate breeding programs. Temperate germplasm may also be useful in tropical breeding programs for improving yield, agronomic traits, and grain quality. This paper reports on the yield potential of Cateto race accession testcrossed with two Corn Belt inbreds for grain yield and other agronomic traits in both temperate and tropical environments. Testcrosses ($F_1$s), their $F_2$ and backcross generations, and four checks were evaluated in 1989 through 1991 at locations in Iowa, Missouri, Florida, and Zimbabwe.

**Norton, Don C.,** and **P. N. HINZ.** Morphometric variation and biogeography of *Ogma menzeli* and *Criconema sphagni*. *Journal of Nematology* 24:3 (1992) 399-403.

Morphometrics of *Ogma menzeli* from woodlands in the Adirondack Mountains of New York State and in Iowa were compared. Specimens from the Adirondacks were significantly greater in mean total body length, stylet length, the b, R, and RV values, body width, and esophagus length than specimens from Iowa. Relative to elevation in the Adirondacks, *Criconema sphagni* morphometric measurements differed significantly for the RV value (negative) and V

value (positive), while *O. menzeli* measurements differed significantly for the RV value (positive).

Wilson, Doyle E., Huilian Zhang, Gene H. Rouse, Mercedes M. Izquierdo, David A. Duello, and **Paul N. HINZ.** Using real-time ultrasound to predict intramuscular fat in the *Logissimus Dorsi* of live beef animals: A progress report. Pp. 29-31 in *1993 Beef and Sheep Research Report,* AS-622. Ames, Iowa: Iowa State University. 1993.

Ultrasound images from 139 yearling bulls and 134 yearling steers were used to derive gray-scale statistics and Fourier transform parameters for each animal. These were used in factor analysis and multiple regression analysis to develop models for predicting the percent fat in the ribeye muscle of the live animals.

Zeifman, A. I., and **Dean ISAACSON.** On strong ergodicity for nonhomogeneous continuous-time Markov chains. *Stochastic Processes and Their Applications* 50:2 (1994) 263-273.

A nonhomogeneous continuous-time Markov chain, X(t), is defined using intensity matrices Q(t). When the chain is perturbed so that the new chain, Y(t), has intensity matrices $\tilde{Q}(t)$, the ergodicity relationships between X(t) and Y(t) are studied. In particular perturbations of the form $\| Q(t) - \tilde{Q}(t) \| \to 0$ and $\int_0^\infty Q(t) - \tilde{Q}(t) \, dt < \infty$ are investigated.

**Iversen, Philip W.,** and **Mervyn G. MARASINGHE.** Visualizing experimental designs with LISP-STAT. *Computing Science and Statistics: Proceedings of the 24th Symposium on the Interface* 24 (1992) 121-125.

The structure diagram described by Taylor and Hilton (*The American Statistician*, 1981) provides a visual display of the relationships between factors for balanced complete experimental designs. Using the idea of factor sets one can obtain the model and the ANOVA table, including expected mean squares, from the structure diagram. This procedure has been implemented in LISP-STAT using a software representation of the experimental design.

Rugimbana, Robert, and **Philip IVERSEN.** Perceived attributes of ATMs and their marketing implications. *The International Journal of Bank Marketing* 12:2 (1994) 30-35.

Most retail banking research has explored ATM usage patterns entirely from the viewpoint of consumers' demographics. This research examines ATM usage patterns on the basis of consumers' perceptions of the attributes of this innovation. The study sought to determine the association between consumer ATM usage patterns and their perceptions of ATM attributes by identifying those variables that distinguish users and nonusers. The results based on a survey of 630 retail banking consumers from two

separate Australian banking institutions, a bank and a credit union, suggest that ATM users from both institutions differed quite significantly from nonusers in their perceptions of at least three ATM attributes: convenience, reliability, and suitability. Furthermore the results indicate that most users perceive ATMs as mere cash dispensers. Successful marketing strategies must focus on the most important attributes of ATMs as well as identify different user groups and develop strategies to maximize their patronage.

**Jensen, Karen L.** (Alcoa Technical Center), and **Stephen B. VARDEMAN.** Optimal adjustment in the presence of deterministic process drift and random adjustment error. *Technometrics* 35:4 (1993) 376-389.

A state-space process-control model involving adjustment error and deterministic drift of the process mean is presented. The optimal adjustment policy is developed by dynamic programming. This policy calls for a particular adjustment when a Kalman-filter estimator is outside a deadband defined by upper and lower action limits. The effects of adjustment cost, adjustment variance, and drift rate on the optimal policy are discussed. The optimal adjustment policy is computed for a real machining process, and a simulation study is presented that compares the optimal policy to two sensible suboptimal policies.

Heglund, P. J., J. R. Jones, L. H. Frederickson, and **M. S. KAISER.** Use of boreal forested wetlands by Pacific loons (*Gavia pacifica*) and horned grebes (*Podiceps auritis* L.): Relations with limnological characteristics. *Hydrobiologia* 279/280 (1994) 171-183.

The abundances of Pacific loons and horned grebes on 123 wetlands of the Yukon Flats National Wildlife Refuge in east central Alaska were related to limnological characteristics of those wetlands. Statistical models were developed for both the probability of wetland use by these birds, and the abundance of birds on wetlands that received use.

**KAISER, Mark S.,** Paul L. Speckman, and John R. Jones. Statistical models for limiting nutrient relations in inland waters. *Journal of the American Statistical Association* 89:426 (1994) 410-423.

The ecological theory of limiting factors holds that the observed level of response in a biological process will be governed by the input factor in least supply--the limiting factor. This theory has formed the basis for numerous attempts by aquatic ecologists to describe the relation between the biological productivity of inland waters and the availability of plant nutrients required for algal growth. Regression analysis has been the primary statistical tool used in the development of such relations, yet any statistical

model that represents the limiting effect of some explanatory factor as an expectation contradicts the substantive theory of limiting factors.

Data from limnological studies often exhibit a scatter of points distributed in the shape of a triangle lying beneath an upper boundary. Appropriate models for such data are introduced in this paper to describe the upper boundary or potential limit, the distribution of points falling below the limit, and the degree of random error. An application of the EM algorithm provides marginal maximum likelihood estimates of the parameters in the more complex models considered. Several results are given for the models, including a goodness-of-fit diagnostic and estimation of the large-sample parameter covariance matrix. Application of the models is illustrated by fitting empirical relationships between chlorophyll and the plant nutrient phosphorus in temperate lakes.

**LAHIRI, S. N.** On the moving block bootstrap under long range dependence. *Statistics and Probability Letters* 18 (December 2, 1993) 405-413.

It is shown that, under some conditions, the moving block bootstrap provides valid approximation to the distribution of the normalized sample mean $T_n$ for a class of long-range dependent observations if and only if $T_n$ is asymptotically normal.

**LAHIRI, S. N.** Rates of bootstrap approximation for the mean of lattice variables. *Sankyhā, A* 56:Pt. 1 (1994) 77-89.

It is shown that even for the mean of lattice variables, bootstrap approximation is second order correct in a suitable metric that metrizes the topology of weak convergence on **R**. In addition, almost sure rates of bootstrap approximation for normalized sample means of i.i.d. lattice random variables are established in the cases where the error of approximation is measured in the Lévy metric and in the bounded Lipschitz metric.

**LAHIRI, Soumendra Nath.** On second order correctness of Efron's bootstrap without Cramér-type conditions in linear regression models. *Mathematical Methods of Statistics* 3:2 (1994) 130-148.

Let $\beta_n$ denote an *M*-estimator of the regression parameters in a multiple linear regression model with independent and identically distributed errors. Under certain growth conditions on the design vectors, this paper establishes the second order correctness of Efron's bootstrap for studentized $\beta_n$ even when any nonlatticeness and/or Cramér-type conditions do not hold. The conclusion is in sharp contrast with the known results of Singh (*The Annals of Statistics,* 1981) for the sample mean of independent and identically distributed random variables, where the nonlatticeness of the observations is a necessary condition for the second order optimality of boot-

strap. As a result the superiority of Efron's bootstrap for *M*-estimators in linear regression models is justified for a larger class of error distribution provided the design vectors are chosen appropriately. The main tool used in the proof is a two-term Edgeworth expansion for studentized $\beta_n$, which can be of independent interest.

Koul, H. L., and **S. N. LAHIRI.** On bootstrapping M-estimated residual processes in multiple linear regression models. *Journal of Multivariate Analysis* 49:2 (1994) 255-265.

The main result of the paper is that, under fairly general conditions, Efron's bootstrap procedure provides a valid approximation to the limit distribution of weighted empirical processes based on M-estimated residuals in multiple linear regression models. As an application, bootstrap confidence bands for the error distribution function F are constructed. Furthermore, it is also shown that the bootstrap method can be used to design distribution-free goodness-of-fit tests for F without any recourse to the split-sample estimation of the regression parameters.

**Lin, Chiou-Hua** (Ming Chuan College), and **Shashikala SUKHATME.** Hoeffding type theorem and power comparison of some two-sample rank tests. *Journal of the Indian Statistical Association* 31:1 (1993) 71-83.

We present an extensive study of the small sample powers of the most frequently used rank tests for two-sample location and scale problems. We use a generalized Hoeffding type theorem (Hoeffding 1951) to obtain the distributions of the vector of ranks under a variety of alternatives where the supports of the distributions are not the same and no one of the supports contains the other. Hence the powers of several rank tests such as the Wilcoxon test, the Mood test, the Galton test, the Kolmogorov-Smirnov test, and the Ansari-Bradley test are computed.

**Lin, C. H.** (Ming Chuan College), and **Shashikala SUKHATME.** Two-sample rank tests with truncated populations. *Metrika* 40:pt. 3-4 (1993) 149-172.

Let $X_1,...,X_m$ and $Y_1,...,Y_n$ be two independent samples from continuous distributions F and G respectively. Using a Hoeffding (1951) type theorem, we obtain the distribution of the vector $S = (S_{(1)},...,S_{(n)})$, where $S_{(j)} = \#(X_i's \le Y_{(j)})$ and $Y_{(j)}$ is the $j^{th}$ order statistic of Y sample, under three truncation models: (a) G is a left truncation of F or G is a right truncation of F, (b) F is a right truncation of H and G is a left truncation of H, where H is some continuous distribution function, (c) G is a two-tail truncation of F. Exploiting the relation between S and the vector **R** of the ranks of the order statistics of the Y-sample in the pooled sample, we can obtain exact distributions of many rank tests. We use these to compare powers of the Hajek test (Hajek 1967), the Sidak Vondracek

test (1957), and the Mann-Whitney-Wilcoxon test.

We derive some order relations between the values of the probability-functions under each model. Hence we find that the tests based on $S_{(1)}$ and $S_{(n)}$ are the UMP rank tests for the alternative (a). We also find LMP rank tests under the alternatives (b) and (c).

**LORENZ, Frederick,** and Rand D. Conger. Rural family studies: The case for multiple wave, multiple indicator data. Chapter 7 (pp. 91-112) in *Rural People, Data, and Policy: Information Systems for the 21st Century,* edited by James A. Christenson, R. C. Maurer, and N. L. Strang. Denver, Colorado: Westview Press. 1994.

This chapter is part of an effort by researchers to delineate data needs for policy decisions for rural America. It makes a case for smaller scale, intensive studies that shed light on the mechanisms linking economic conditions to individual outcomes, and outlines the advantages of multiple wave, multiple informant data in modeling rural family processes.

**LORENZ, Frederick O.,** R. D. Conger, and Ruth Montague. Doing worse and feeling worse: The psychological consequences of economic hardship. Chapter 6 (pp. 167-186) in *Families in Troubled Times: Adapting to Change in Rural America,* by R. D. Conger and G. H. Elder, Jr., in collaboration with **F. O. LORENZ,** R. L. Simons, and L. B. Whitbeck. Hillsdale, New Jersey: Aldine. 1994.

Previous studies have linked economic conditions to individual psychological well-being, especially depressive symptoms and demoralization. We extended these findings by testing hypotheses about the effects of economic conditions on the depressive symptoms of rural husbands and wives, and by examining the mediating and moderating (interaction) effects of family and extrafamilial social support. The results indicate family support moderates the relationship between economic conditions and depressive symptoms for lower income families, while extrafamilial support moderates the same relationship for higher income families.

**LORENZ, Frederick O.,** R. D. Conger, R. B. Montague, and K. A. S. Wichrama. Economic conditions, spouse support, and psychological distress of rural husbands and wives. *Rural Sociology* 58:2 (1993) 247-268.

Using three waves of data from the Iowa Youth and Families Project, this paper shows that the relationship between economic pressure and psychological distress operates differently for husbands and wives. For husbands, wives' support buffers the relation between economic pressure and husbands' sense of control over events in their lives, which in turn reduces their depression. For wives, husbands' support both directly reduces their depression and buffers the effects of economic pressure by weakening the relation between sense of control and feelings of depression.

**LORENZ, Frederick O.,** and Jan Melby. Analyzing families' stress and adaptation: Methods of study. Chapter 2 (pp. 21-51) in *Families in Troubled Times: Adapting to Change in Rural America,* by R. D. Conger and G. H. Elder, Jr., in collaboration with **F. O. LORENZ,** R. L. Simons, and L. B. Whitbeck. Hillsdale, New Jersey: Aldine. 1994.

This chapter outlines the methods used to collect and analyze data reported in the remaining chapters of the book. Both questionnaire and observational data were collected from 451 rural Iowa families. Methods of analysis focused on structural equations with latent variables, and emphasized methods of comparing competing models.

Conger, R. D., Xiao-Jia Ge, and **Frederick O. LORENZ. Economic stress and marital relations.** Pp. 187-203 in *Families in Troubled Times: Adapting to Change in Rural America,* by R. D. Conger and G. H. Elder, Jr., in collaboration with **F. O. LORENZ,** R. L. Simons, and L. B. Whitbeck. Hillsdale, New Jersey: Aldine. 1994.

This chapter examines the mechanisms whereby economic conditions affect marital. The results demonstrate a process whereby economic hardship exacerbates husbands' hostile mood (husbands' reports), which in turn creates a pattern of observed hostile interactions between husbands and wives, thus reducing the wives' reports of marital quality.

Ge, X., R. D. Conger, **Frederick O. LORENZ,** and R. L. Simons. Parents' stress and adolescent depressive symptoms: Mediating processes. *Journal of Health and Social Behavior* 35:4 (1993) 28-43.

A study of 451 rural Iowa families examined a mediational model of the relations between (a) stressful life events experienced by parents and (b) adolescent depressed mood. Detailed models were examined for four dyads: fathers-sons; fathers-daughters; mothers-sons; mothers-daughters. Details varied by dyad, but in general the findings indicate that stressful life events increase parents' depressed mood, which disrupts skillful parenting practices. The disrupted parenting practices place adolescents at increased risk for developing depressive symptoms.

Lee, G., J. Hraba, **Frederick O. LORENZ,** and Zdenka Pechacova. Economic reform in the Czech Republic: Economic strain, depression, hostility and the difference gender makes. *Sociological Inquiry* 64:1 (1994) 103-113.

The Czech Republic is changing rapidly and its current economic transformation is a strain on Czech

families. Using log-linear models, this paper examines the connection between economic strain and individual well-being for a sample of 234 respondents in 1990. For Czech women, depression rises more with economic strain than does hostility, whereas men become more hostile than depressed. For women, social support is a buffer between economic strain and hostility, while self-esteem is a buffer between economic strain and depression. For men, both self-esteem and social support exacerbate hostility in the context of economic strain.

Whitbeck, L. B., **Frederick O. LORENZ**, R. L. Simons, and S. Huck. Family origins of personal and social well-being. Pp. 149-164 in *Families in Troubled Times: Adapting to Change in Rural America,* by R. D. Conger and G. H. Elder, Jr., in collaboration with F. Lorenz, R. Simons, and L. Whitbeck. Hillsdale, New Jersey: Aldine. 1994.

This chapter examines the family histories of the Iowa parents and their resourceful or deprivational legacy in managing hard times. Using retrospective reports of early family experiences, we examined the effects of this experience on the quality of adult relations with aging parents and on personal self-confidence and positive interaction styles, qualities that promote healthy social relationships and the potential for coping successfully with stressful times.

Nys, M., P. Darius, and **M. MARASINGHE.** An interactive window-based environment to explore the design of an experiment. Pp. 205-212 in *SoftStat '93: Advances in Statistical Software 4,* edited by F. Faulbaum. Stuttgart and New York: Gustav Fischer. 1994.

The number of statistical packages with features dealing with design is growing, and a number of programs dealing exclusively with design of experiments have been written (see Rasch and Darius (1993) for an overview). Examples of typical design packages are DEXPERT (Lorenzen et al., 1992), DEXTER (Haaland et al., 1990), and CADEMO (Rasch et al., 1992). In this paper we describe a software system that assists the researcher in building and exploring a design.

**Majure, James J.,** and **Noel CRESSIE.** Explore: Exploratory spatial data analysis in ARC/INFO. Pp. 277-281 in *Proceedings of the Thirteenth Annual ESRI USER Conference, Vol. 1.* Redlands, California: Environmental Systems Research Institute. 1993.

This report describes a prototype system for incorporating exploratory spatial data analysis functions within a geographic information system (GIS) environment. GISs have exceptional capabilities to collect, store, manage, and display spatial data. However, most GISs do not have readily available functionality to conduct statistical modeling or exploratory data analysis. Nevertheless, many GISs already contain many of the tools necessary to conduct advanced exploratory spatial data analysis. In this report, we present a dynamic exploratory data analysis system implemented completely within a GIS.

**MEEKER, William Q.,** and Luis A. Escobar. An algorithm to compute the cdf of the product of two normal random variables. *Communications in Statistics* 23:1 (1994) 271-280.

This paper provides a fortran algorithm that can be used to compute the cdf of the product of two normal distribution random variables. We also give references that provide mathemathematical properties, tables, and applications of this distribution.

**Meeter, Carol A.** (3M Center, St. Paul, Minnesota), and **William Q. MEEKER.** Optimum accelerated life tests with a nonconstant scale parameter. *Technometrics* 36:1 (1994) 71-83.

Previous work on planning accelerated life tests has assumed that the scale parameter for a location-scale distribution of log lifetime remains constant over all stress levels. This assumption is, however, inappropriate for many applications, including accelerated tests for metal fatigue and certain electronic components. This article extends the existing maximum likelihood theory for test planning to the nonconstant model and presents test plans for a large range of practical testing situations. The test plans are optimum in that they minimize the asymptotic variance of the maximum likelihood estimator of a specified quantile at the design stress. The development and discussion in the article, as well as the theory given in the appendix, applies to accelerated-life-test models in which the log time-to-failure can be modeled as a location-scale distribution. The test setup assumes simultaneous testing of units with time censoring. We give particular numerical results for the Weibull failure-time distribution.

**Olin, Bryan D.,** and **William Q. MEEKER**. Applications of experimental design in nondestructive evaluation. Pp. 2199-2206 in *Review of Progress in Quantitative Nondestructive Evaluation,* edited by D. O. Thompson and D. E. Chimenti. New York: Plenum Press. 1994.

Nondestructive evaluation (NDE) techniques are used to detect and characterize defects or flaws in physical objects. The methods are also used to measure wear or detect damage to units that are in service. Researchers are developing new NDE methods and improving existing NDE methods. This paper describes the use of statistical experimental design to improve NDE measurement/detection processes. The paper describes the use of both classical methods and Taguchi methods.

**Rathbun, Stephen L.** (University of Georgia), and **Noel CRESSIE.** Asymptotic properties of esti-

mators for the parameters of spatial inhomogeneous Poisson point processes. *Advances in Applied Probability* 26:1 (1994) 122-154.

Consider a spatial point pattern realized from an inhomogeneous Poisson process on a bounded Borel set $A \subset \mathbb{R}^d$, with intensity function $\lambda(\mathbf{s}; \theta)$, where $\theta \ni \Theta \subset \mathbb{R}^k$. In this article, we show that the maximum likelihood estimator $\hat{\theta}_A$ and the Bayes estimator $\check{\theta}_A$ are consistent, asymptotically normal, and asymptotically efficient as the sample region $A \uparrow \mathbb{R}^d$. These results extend asymptotic results of Kutoyants (1984), proved for an inhomogeneous Poisson process on $[0,T] \subset \mathbb{R}$, where $T \to \infty$. They also formalize (and extend to the multiparameter case) results announced by Krickeberg (1982), for the spatial domain $\mathbb{R}^d$. Furthermore, a Cramér-Rao lower bound is found for any estimator $\theta_A^*$ of $\theta$. The asymptotic properties of $\hat{\theta}_A$ and $\check{\theta}_A$ are considered for modulated (Cox (1972)), and linear Poisson processes.

**Remadi, Sellem** (Ecole Superieur d'Horticulture, Chott-Mariem, Tunisia), and **Yasuo AMEMIYA.** Asymptotic properties of the estimators for multivariate components of variance. *Journal of Multivariate Analysis* 49:1 (1994) 110-131.

Estimation of the covariance matrices in the multivariate balanced one-way random effect model is discussed. The rank of the between-group covariance matrix plays a large role in model building as well as in assessing asymptotic properties of the estimated covariance matrices. The restricted (residual) maximum likelihood estimators derived under a rank condition are considered. Asymptotic properties of the estimators are derived for a possibly incorrectly specified rank and under either the number of groups, the number of replicates, or both, tending to infinity. A higher order expansion covering various cases leads to a common approximate inference procedure that can be used in a wide range of practical situations. A simulation study is also presented.

**ROBERTS, Carl W.,** and Roel Popping. Computer-supported content analysis: Some recent developments. *Social Science Computer Review* 11:3 (1993) 283-291.

This paper presents an overview of some recent developments in the clause-based content analysis of linguistic data. It introduces network analysis of evaluative texts, the analysis of cognitive maps, and linguistic content analysis. The focus is on the types of substantive inferences afforded by the three approaches.

Krafsur, E. S., A. L. Rosales, **J. F. Robison-Cox** (Montana State University), and **K. J. KOEHLER.** Bionomics of pyrethroid-resistant and susceptible horn fly populations (Diptera: Muscidae) in Iowa. *Journal of Economic Ento-*

*mology* 86:2 (1993) 246-257.

Census, age-grading techniques, and bioassays were applied to mostly pyrethroid-resistant or mostly susceptible horn fly, *Haematobia irritans* L., populations in 1985-1990, some of which were undergoing disruptive selection for both traits. Bioassays showed that resistant phenotypes declined rapidly on untreated cattle. Age structures, fecundity, body sizes, and reproductive success of horn fly populations varied significantly among herds, but not according to insecticidal treatment. This result suggests that adult male and female survival rates and female reproductive success of resistant and susceptible phenotypes were not greatly different. Life-history traits that were correlated with insecticide-resistant or susceptible phenotypes were thus too small in magnitude to be detected.

**ROLLINS, D. K.,** and J. F. Davis. Gross error detection when variance-covariance matrices are unknown. *AIChE [American Institute of Chemical Engineers] Journal* 39:8 (1993) 1335-1341.

In this paper the unbiased estimation technique (UBET) is extended to situations when the variance-covariance matrix of the measurements, $\Sigma$, is unknown and the sample size, $N$, is large. The latter requirement typically means that the time period to obtain a large sample of measurements for each variable must also be large. Therefore, it may be unreasonable to assume that only measurement variability occurs in process measurements. Process variability arising from physical changes may also need to be considered. Hence, in this paper the UBET not only takes measurement variability into account but also process variability due to nonsteady state conditions while sampling.

**ROLLINS, D. K.,** and **Sriram Devanathan.** Computational issues in gross error detection and data reconciliation. Pp. 437-441 in *Proceedings of 1993 Foundations of Computer-aided Process Operations (FOCAPO) Meeting.* 1993.

**ROLLINS, Derrick K.,** and **Sriram Devanathan**. Unbiased estimation in dynamic data reconciliation. **AIChE Journal** 39:8 (1993) 1330-1334.

A computationally fast technique that improves the accuracy of process variables while satisfying linear process constraints when conditions are dynamic due to changes in steady states is presented. The process variable estimators are unbiased and have known distributions. Thus, confidence intervals for true values of process variables are provided.

The formulation of this technique was motivated by a recursive, dynamic data reconciliation technique that obtains an optimal solution in least squares. It is shown that the estimators of that recursive technique can be very biased and have large standard errors. The two techniques are compared in terms of computational speed and accuracy of estimators. The

proposed technique is shown to be computationally faster, in general, and more accurate when large changes in steady states occur.

Koven, Steven G., and **Mack C. SHELLEY II.** No consensus on fighting the drug war: Differences between state policy elites and the mass public. *International Journal of the Addictions* 28:14 (1993) 1531-1548.

This article explores implications for the implementation of drug policy in the United States, based on the findings from a 1990 survey of state drug policy coordinators in all 50 states and the responses to a national mass public survey. State drug policy elites' perceptions of the relative seriousness of nine different specific drugs are assessed, together with their evaluations of federal drug policy. Significant differences in state elites' attitudes are found for certain regional effects, for the relative degree of state urbanism, and for relative state income levels. These results are compared against the findings from a 1989 CBS News/*New York Times* mass opinion survey measuring citizen perceptions on drug misuse and the efficacy of Bush administration policy initiatives. This comparison reveals a wide disparity between elite and mass attitudes regarding appropriate funding of the drug war, the rating of federal drug policy initiatives, and federal drug policy strategies. Such mass/elite perceptual disparities accentuate the difficulties inherent in pursuing a "drug war" strategy.

Stone, J., P. Higby, **M. SHELLEY,** H. M. Stahr, and J. Huck. Effects of liquid laundry starch on Terbufos residues, thermal insulation, and permeability of cotton work fabrics. Pp. 148-160 in *Consumer Environmental Issues: Safety, Health, Chemicals, and Textiles in the Near Environment,* edited by Barbara M. Reagan, Janice Huck, and Janet Porter; Second International Symposium Proceedings, sponsored by USDA-CSRS and the University of Georgia. Manhattan, Kansas: Kansas State University. 1993.

Clothing helps protect agricultural workers from exposure to pesticides during crop application. Few farmers attribute health effects to pesticide use, but both farmers and commercial applicators seem to be changing their attitudes about protective clothing. The purposes of this study were (1) to determine the effect of commercially available liquid laundry starch and three detergent types on the removal of residues resulting from contamination of three heavyweight denim fabrics with granular terbufos, and (2) to assess the effect of starch on dry (conduction, convection, and radiation) and evaporative heat transfer in two heavyweight twill fabrics.

Through analysis of variance and multiple comparison procedures, the results of the study indicated that (1) liquid Tide was superior to the concentrated powdered detergent for terbufos removal in these experiments with hot water; (2) the use of liquid laundry starch (Sta-Flo) may offer some advantages in terms of pesticide removal for some fabrics, and does not interfere with the removal of terbufos residue; and (3) fabric geometry is a variable that deserves more scrutiny with regard to ease of removing residue from 100-percent cotton fabrics. Thermal insulation and permeability may be altered by starch, but the effect on comfort appears to depend on the fabric system involved.

**SHERMAN, Peter J.,** and Lang B. White. Periodic spectral analysis of diesel vibration data. Pp. 1461-1467 in *Proceedings of the 12th International Conference on Modal Analysis.* 1994.

This work addresses the problem of trying to take advantage of the nominally periodic nature of a diesel engine running at constant speed to obtain a time-varying spectral description of vibration data over the shaft period. It requires addressing a number of issues, most notably period estimation and removal of tonal components whose presence in a time-varying spectrum is redundant and undesirable. Use of a recently designed method to identify sinusoids, in conjunction with an adaptive tracking algorithm, results in significant improvement in simulations, and reasonably good improvement in the case of the diesel vibration data, especially when considering the complexity of the stochastic structure of this data.

Lyon, Donald E., and **Peter J. SHERMAN.** Practical issues concerning the family of multichannel MV spectra for recovery of point spectrum. *IEEE Transactions on Acoustics, Speech and Signal Processing*, ASSP-41:11 (1993) 3177-3181.

This work addresses some of the practical issues associated with the multichannel point spectrum identification of Foias et al. (*Mathematics of Control Systems and Signal Processing,* Vol. 3, 1990). These include a convergence test for detecting signal frequencies and identifying the associated spectral matrices. An in-depth example is presented.

Lyon, D. E., **P. J. SHERMAN,** and A. E. Frazho. The MV spectral convergence applied to random fields. Pp. 799+ in *Signal Processing VI: Theories and Applications,* edited by J. Vandewalle, R. Boite, M. Moonen, and A. Oosterlinck--Proceedings of the 6th European Signal Processing Conference, Brussels, Belgium, August 24-27, 1992. Amsterdam: Elsevier Science Publishers B.V. 1992.

This work addresses the problem of identifying a multichannel harmonic signal field that has been corrupted by an unknown homogeneous noise field. Because recursive spectral-based algorithms such as the Levinson algorithm do not exist in the d-dimensional setting (for $d > 1$), the computational expense associated with multichannel spectral analysis on a d-dimensional field can play a major role in the types of models that can be considered and in the resolution

of the d-dimensional lattice on which it is computed. This is particularly true of a recently developed method of Foias et al. (*Mathematics of Control Systems and Signal Processing*, Vol. 3, 1990). In the random process setting (d = 1) the MV(n) spectra can be computed in a recursive fashion. This work presents a method for utilizing this recursive nature for the d > 1 setting.

McConnell, Kenneth G., **Peter SHERMAN,** and Paulo S. Varato. Pseudo-random excitation is more cost effective than random excitation. Pp. 1-7 in *Proceedings of the 12th International Conference on Modal Analysis.* 1994.

Frequency response functions calculations in vibration tests are strongly influenced by the type of excitation signal used to drive the test specimen. Random signals are frequently used although they present filter leakage problems and require longer test times than pseudorandom signals. Pseudorandom signals are periodic in the time window and do not present filter leakage problems. When measurement noise is not a major concern, pseudorandom excitation signals require only one input output data sample, and hence, the test times decrease significantly when compared to random signals, which often require an average of 100 or more sets of data.

This paper shows the efficiency of pseudorandom over random excitation in experimentally determining a system's FRF once a given baseband is selected. The FRF's frequency resolution is controlled by the f selected and is the same for both excitation methods. The paper shows that once the startup transients have vanished, the pseudorandom test requires only one sample period. Therefore, valuable test time can be saved in order to meet specific test requirements.

VanZante, D., R. L. Feddersen, M. Suarez, and **P. J. SHERMAN.** The stochastic structure of downstream pressure from an axial compressor. Pp. 1468-1474 in *Proceedings of the 12th International Conference on Modal Analysis.* 1994.

This work investigates the potential of recently developed spectral analysis methods for nonstationary periodic random processes for extracting information associated with the downstream pressure signature of a single row 36 blade axial compressor. First, it is shown that the pressure signature is not wide sense stationary when collection and processing are carried out in a way synchronous with the shaft speed, as is usually the case. This suggests that traditional spectrum estimation methods commonly used may lead to ambiguous, if not misleading, results. To accommodate the nonstationarity associated with synchronous data collection, while adhering to the periodic nature of the phenomena, recently developed signal processing tools for spectral analysis of periodic random processes are applied. It is shown that these tools can provide notably more detailed information about the intracycle structure of the pressure signature than can be provided by traditional methods of analysis.

**SUKHATME, S.,** and C. A. Beam. Stratification in nonparametric ROC studies. *Biometrics* 50:1 (1994) 149-163.

In many clinical experiments it is clear that external factors can affect the performance of diagnostic tests as these factors influence the distributions of separator variables. The authors investigate how stratification of cases and/or controls can be used in nonparametric receiver operating characteristic (ROC) studies, and develop statistical methods using stratification. The method can be used to simultaneously assess the ability of a diagnostic marker against several types of controls or cases. This allows a new method for the assessment of diagnostic tests.

**SUKHATME, Shashikala,** and **C. H. Lin** (Ming Chuan College, Taipei, ROC). Distribution of ranks in a two-sample problem with right censored data. *Communications in Statistics--Theory and Methodology* 23:6 (1994) 1753-1769.

We consider different censoring models for a two-sample problem, and find the joint distribution of the rank vector and number of uncensored observations under each censoring model when the distributions of life times and/or distributions of censoring variables satisfy the condition for the Lehmann type of alternatives.

**Vander Wiel, Scott A.** (AT&T Bell Laboratories), and **Stephen B. VARDEMAN.** A discussion of all-or-none inspection policies. **Technometrics** 36:1 (1994) 102-109.

An optimal inspection policy will inspect either every item produced or no item when (a) product characteristics are well modeled as iid and (b) overall inspection cost is a sum of individually and identically determined costs for each of the items encountered. This result is widely known for special cases such as iid Bernoulli product characteristics with single-sample lot acceptance-sampling plans. We show that the result holds true much more generally and over a much wider class of inspection plans, even when independent inspection errors are possible. We examine the assumptions that lead to all-or-none optimality and discuss the practical meaning of all-or-none results to practitioners. Examples are given to demonstrate that both "other" cost structures and "informative" inspections (i.e., lack of independence) can lead to optimal policies that are *not* of the all-or-none type.

Jackman, John, Jyh-Jeng Deng, Hae-Il Ahn, Way Kuo, and **Stephen VARDEMAN.** A compliance measure for the alignment of cylindrical part features. *Transactions of the Institute of Industrial Engineers* 26:1 (1994) 2-10.

Tolerance can be viewed as the allowable range for a dimension in order to satisfy product functionality requirements. Compliance of machined parts to

tolerance specifications is necessary if a manufactured product is to have good fit and desired functional characteristics. We present a method for assessing compliance of several cylindrical part features based on comparing tolerance specifications with actual measurement data. A single measure of compliance is developed based on the alignment of individual part features. A part with multiple holes is used to illustrate the approach.

**Ver Hoef, Jay M.** (Alaska Department of Fish and Game, and **Noel CRESSIE**. Spatial statistics: Analysis of field experiments. Pp. 319-341 (Chapter 14) in *Design and Analysis of Ecological Experiments,* edited by Samuel M. Scheiner and Jessica Gurevitch. London: Chapman & Hall. 1993.

A field experiment has experimental units located in a spatial environment that is usually heterogeneous. Typically, it is observed that observations from the experimental units exhibit spatial autocorrelation. In this chapter we model the spatial autocorrelation (with variograms), making possible a more powerful analysis of the experiment than if classical ANOVA analyses were used.

**Yoo, Seongmo** (Social & Behavioral Research Center for Rural Health, Iowa State University), and **H. T. DAVID**. Shrinkage constructions for Pitman domination. *Sankhyā , Series B*, 56:Pt. 1 (1994) 107-114.

Examples are studied of estimators that dominate, in the sense of Pitman, a minimal sufficient median-unbiased or otherwise natural estimator.

**Yoo, Seongmo**, and Richard Spoth. An alternative method for sample size determination in substance misuse prevention research. *The International Journal of Addictions* 28:11 (1993) 1085-1094.

This article presents a simple alternative to conventional procedures for sample size determination that can be applied to controlled study of substance initiation and similar outcomes.

## ▓ Book Reviews, Etcetera

**CRESSIE, Noel.** Editorial: Limits of detection. *Chemometrics and Intelligent Laboratory Systems.* 22:1 (1994) 161-163.

**MARASINGHE, Mervyn G.** *Evaluation and Control of Measurements,* by John Mandel. New York: Marcel Dekker, 1991. xi + 249 pp. $99.75. Reviewed in *Journal of the American Statistical Association* 89:426 (1994) 720.

**STRAHAN, R. H.** An apple, an orange, and a pear: Three statistics books. *Contemporary Psychology* 38:9 (1993) 909-912.

## ▓ Theses

**Cannon, Ann Christina Russey.** Signal detection using categorical temporal data. Ph.D. thesis, Iowa State University Library. May 1994.

This thesis is divided into two parts. In the first part, the spatial statistic known as the K function is adapted for temporal processes and patterns. The (optimal) K-function estimator is used in a testing procedure to determine whether behavior patterns of exposed rats versus control rats are different. Specifically, the temporal analogue to the K function is given and an approximately optimal estimator is developed. Next, a testing procedure, to determine whether a group of point patterns is generated from complete temporal randomness, is given. Finally, a testing procedure, to compare pairwise two groups of point patterns, is given. The testing procedures are illustrated with rat-behavior data from both a control-control experiment and an exposed-control experiment, where in the latter case a difference in behavior is known to exist.

The second part considers methods of using information from a large number of related test statistics to detect a difference between two groups. We compare three different overall statistics: a count of individual significant tests, the sum of the squared individual test statistics, and a Wald-like combination of the individual test statistics using an estimated covariance matrix. Results of this study show that the Wald-like statistic is often quite better than the other two.

**Coffin, Marie Ann.** Some problems with nonsampling errors in receiver operating characteristic studies. Ph.D. thesis, Iowa State University Library. May 1994.

A Receiver Operating Characteristic (ROC) analysis is appropriate to a situation where a unit may be classified into one of two nonoverlapping groups. The ROC curve is a plot of the false positive probability against the true positive probability. The area under the ROC curve measures the extent to which the variable under consideration can distinguish between the two groups. This thesis considers both the total area and partial area indices.

The estimates of total and partial area are based on the observed data. Thus, when the variable being considered is measured with error, the added variability introduced by the measurement error causes bias in the estimates of total and partial area. The thesis considers the effects of nonsampling errors on the total and partial area indices, and develops bias-corrected estimates of total and partial area. The bias-corrected estimates provide a better measure of the ability of the underlying variable to distinguish between the two groups.

The main focus of this thesis is on nonparametric methods of ROC analysis, but some common parametric models are considered also.

**Helterbrand, Jeffrey Donald.** Spatial dependence models and image analysis. Ph.D. thesis, Iowa State University Library. December 1993.

This dissertation investigates the use of spatial dependence models to solve problems in image analysis and multivariate geostatistics.

In Paper I, a statistical theory, and an algorithm, is presented to identify one-pixel-wide closed object boundaries in gray-scale images. Closed boundary identification is an important problem because boundaries of objects are major features in images. In spite of this, most statistical approaches to image restoration and texture identification place inappropriate stationary model assumptions on the image domain. One way to characterize the structural components present in images is to identify one-pixel-wide closed boundaries that delineate objects. By defining a prior probability model on the space of one-pixel-wide closed boundary configurations and appropriately specifying transition probability functions on this space, a Markov chain Monte Carlo algorithm is constructed that theoretically converges to a statistically optimal closed boundary estimate. Moreover, this approach ensures that any approximation to the statistically optimal boundary estimate will have the necessary property of closure.

In Paper II, a Bayesian statistical theory and algorithm based on image segmentation models is presented to identify objects in gray-scale and colored images. Image segmentation algorithms necessitate *a priori* knowledge of the maximum number of labels to use and estimates of label class parameters. An estimate of these parameters and an initial labeling of the image is obtained using a modified image segmentation algorithm. Then, a Bayesian Markov chain Monte Carlo algorithm is combined with a morphological algorithm to obtain sets of edge pixels that define closed object boundaries.

In Paper III, the properties of multivariate spatial prediction under a special class of multivariate spatial dependence models is analyzed. More specifically, the usefulness of covariate information in cokriging is considered under the assumption of multivariate intrinsic coregionalization. It is found that, under the assumption of intrinsic coregionalization with observations available on all components at each sample location, the large-scale parameter space for uniform unbiasedness determines the allowable values for the covariate cokriging weights. An illustration is given using a data set of plutonium and americium concentrations collected from a region of the Nevada Test Site.

**Loughin, Thomas Michael.** Bootstrap applications in proportional hazards models. Ph.D. thesis, Iowa State University Library. August 1993.

Experiments in which the measured responses are times until events occur are common in a variety of fields. When only one response is measured on each subject, the proportional hazards model of Cox (1972) is often used to assess the effects of one or more explanatory variables on the event times. Two new resampling plans are introduced for bootstrapping estimators from this model when explanatory variables are fixed by design. One method resamples from the Uniform (0,1) distribution of the probability integral transformation corresponding to the conditional failure time distribution, and it is easily adapted to a wide variety of censoring schemes. The other method is an analog to the residual-resampling method for regression introduced by Efron (1979), and it admits random censoring from a class of distributions that includes the Koziol-Green model.

Multivariate extensions of resampling methods are developed for situations where multiple event times are monitored on individual subjects. Marginal models are fit using an independence working model approach. Resampling procedures are then applied to the joint distribution of the multiple responses or residuals to make bias corrections to the parameter estimates, estimate covariance matrices, and construct confidence intervals. Simulation studies indicate that each of the proposed methods provides substantial improvements in mean squared errors over existing techniques for estimation of model parameters. The proposed methods also provide better estimates of standard errors and more reliable confidence intervals for model parameters than existing methods that rely largely on asymptotic approximations. These methods are demonstrated through applications to data sets available in the literature.

**McDonald, David Giles.** Partitioning forecast errors in numerical weather prediction models. Ph.D. thesis, Iowa State University Library. August 1993.

This study presents a statistical technique to partition numerical model forecast mean squared error into model deficiency components and components due to random errors in the initial conditions. In addition to the partitioning technique, this study presents a procedure to evaluate if each component's contribution to the total error, in the presence of the residual (unpartitioned) error, is negligible. The application of the partitioning techniques in an operational environment is discussed briefly.

The partitioning technique and component evaluation procedure were applied to a hierarchy of global spectral models. The hierarchy consisted of a barotropic model, a classic two-layer baroclinic model, an improved two-layer baroclinic model, and a two-layer linear balance model. The models were initialized with a sample of data generated with Monte Carlo techniques; details are presented in an appendix.

The application demonstrated the relative ease in which partitioning and evaluations may be applied to model forecasts. The analyses identified the fore-

cast time at which model differences became nonnegligible, and how this time varied with latitude. The effectiveness of incremental model improvements, represented by the difference between the classical and improved baroclinic models, was also evaluated and discussed.

**Olin, Bryan Douglas.** The design of mixture experiments in the presence of covariates. Ph.D. thesis, Iowa State University Library. December 1993.

Over the past three decades, the design and analysis of mixture experiments has been an active area of research, often driven by industrial applications. However, the construction of block designs for mixture experiments and trend-free orderings of the mixtures are problems that have been largely ignored until recently. These two problems form the principal subjects of this dissertation.

Block designs are constructed using combinatorial structures called symbolic and integral mixture mates of strength t. Certain pairs of Latin squares are a special case of symbolic mixture mates. One flexible method of constructing integral mixture mates of strength t uses the theory of trade-off for m-ary designs. Other methods to construct such block designs, using fractional factorial designs, are also considered. Finally, we formulate algorithms that allocate a given set of mixtures to blocks in such a way that an objective function is maximized.

Trend-free mixture orderings allow uncorrelated estimators of mixture model parameters and deterministic trend parameters to be obtained. Deterministic trends may be induced by time effects or other lurking variables. We study methods to obtain trend-free or nearly trend-free mixture orders.

**Takahashi, Hiroshi.** Computation of restricted maximum likelihood estimates of variance components. Ph.D. thesis, Iowa State University Library. December 1993.

The method preferred by animal breeders for the estimation of variance components is restricted maximum likelihood (REML). Various iterative algorithms have been proposed for computing REML estimates. Five different computational strategies for implementing such an algorithm were compared in terms of flops (floating-point operations). These strategies were based respectively on the LDL' decomposition, the W transformation, the SWEEP method, tridiagonalization and diagonalization of the coefficient matrix of the mixed-model equations.

In most animal breeding applications, the coefficient matrix of the mixed-model equations is extremely sparse and of very large order. The use of sparse-matrix techniques for the numerical evaluation of the log-likelihood function and its first- and second-order partial derivatives was investigated in the case of the simple sire and animal models. Instead of applying these techniques directly to the coefficient matrix of the mixed-model equations to obtain the Cholesky factor, they were used to obtain the Cholesky factor indirectly by carrying out a QR decomposition of an augmented model matrix.

**Zimmermann, Alan George.** Inference about the fixed and random effects in a mixed-effects linear model: An approximate Bayesian approach. Ph.D. thesis, Iowa State University Library. August 1993.

An approximate Bayesian analysis is considered for data that follow a mixed-effects linear model of the form $y = X\beta + Zs + e$, where $X$ and $Z$ are known matrices, $\beta$ is a vector of unknown parameters, and $s$ and $e$ are statistically independent random vectors whose distributions are multivariate normal with null mean vectors and variance-covariance matrices $\sigma_1^2 I$ and $\sigma^2 I$, respectively. It is assumed that *a priori* $\beta$, $\sigma_1^2$, and $\sigma^2$ are statistically independent, that the distribution of $\beta$ is noninformative, and that $1/\sigma_1^2$ and $1/\sigma^2$ have gamma distributions.

The problem considered is that of inferences about a linear combination of the fixed and random effects, based on a normal approximation to the posterior density $p(\beta, s | y)$ of $\beta$ and $s$. Two approaches to the approximation of $p(\beta, s | y)$ are discussed. One is centered at $(\hat{\beta}, \hat{s})$ where $\hat{s}$ is the maximum of $p(s | y)$ and $\hat{\beta}$ is the maximum of $p(\beta | s = \hat{s}, y)$, and the other is centered at the values of $\beta$ and $s$ that maximize $p(\beta, s | y)$.

The possible multimodality of $p(s | y)$ and of $p(\beta, s | y)$ is discussed, and the numerical problem of finding the maxima of $p(s | y)$ or $p(\beta, s | y)$ is investigated. It is shown that by adopting an approach that is similar in spirit and technique to the ridge analysis of a response surface, the numerical problem can be reduced to a one-dimensional problem.

Some extensions to mixed-effects linear models with more than two variance components are considered.



From L to R: H. A. David, Distinguished Professor in Liberal Arts and Sciences, with Herbert T. David, University Professor, and Ruth David, H. A.'s wife, during a departmental open house.

# Department of Statistics

Arrangements have been made with General Motors for Iowa State University to offer a master's degree program in applied statistics to GM employees. Dean Isaacson visited GM headquarters in Warren, Michigan, and six other sites to discuss details. A series of courses, Applied Statistics for Industry I and II, are being prepared by W. Robert Stephenson, with assistance from graduate assistant Gregg Althen and temporary instructor Philip Iversen. The first two courses in the program will be offered in 1994-95 by Stephenson. The courses will be presented on campus and by videotape delay to GM sites.

The work on instructional material associated with the NSF project "Developing modern computing and graphics-based methods for teaching important concepts in undergraduate statistics courses" began in earnest in the fall of 1993. Dianne Cook joined the co-principal investigators William Meeker and Mervyn Marasinghe in this effort. A graduate student, Tae-sung Shin, was hired to help with the software development. The goal was to design instructional tools for illustrating statistical concepts more effectively in the classroom than is possible using just mathematical arguments or static graphical displays.

The development team have so far developed a number of instructional modules that include ones for understanding confidence intervals, examining univariate data plotting methods, exploring power transformations, illustrating the central limit theorem, fitting linear least squares regression, and studying sampling distributions of various statistics.

The software components of these modules use a combination of dynamic graphics techniques, computer simulation, and highly interactive user interfaces to create state-of-the-art instructional material. Students need only execute one command to start a module. All further interaction is through a mouse by using point-and-click or by moving slidebars. Each instructional module is accompanied by a sample 3-to-6 page lesson/instruction/exercise document. Instructors can either use these documents or customize them for their own purpose and class.

The modules' software components have been programmed in the Lisp-Stat language. The source code for the software is available via anonymous ftp from Iowa State University.

The Statistics Reading Room was renamed the Oscar Kempthorne Statistics Reading Room. Announcement was made at the opening Statistical
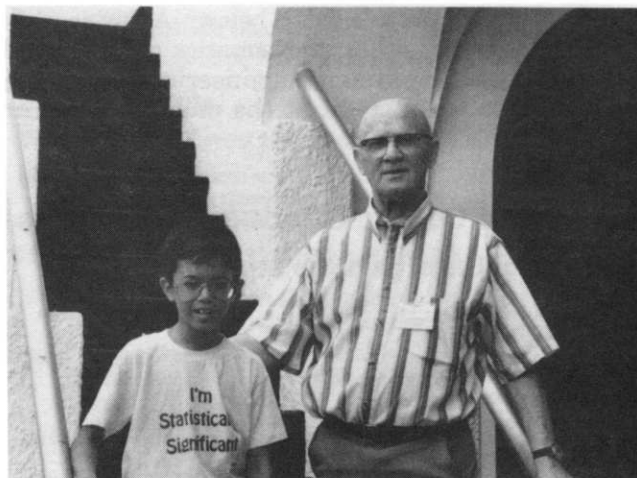


Oscar Kempthorne, emeritus Distinguished Professor of Sciences and Humanities, and David Morel, young son of Jorge Morel, had time together in Turrialba, Costa Rica, during the 2nd meeting of the Biometric Society Central America and Caribbean Network. The network organized a recognition to Kempthorne for the contributions he has made to statistics, with the participation of three Iowa State alumni: Gilda Pareja (M.S. 5/76, Ph.D. 8/84), Winston Richards (M.S. 2/73, Ph.D. 11/80), and Jorge Morel M.S. 12/82, Ph.D. 8/87).

Laboratory seminar fall semester. Kempthorne came to Iowa State as an associate professor in January 1947, six months before the Department of Statistics was established. His achievements on campus led to his being named Distinguished Professor in 1964 and Emeritus Distinguished Professor of Statistics and Emeritus Distinguished Professor in Liberal Arts and Sciences in 1989. He was president of the Biometrics Society (ENAR) in 1961, chair of AAAS Section U in 1981, and president of the Institute of Mathematical Statistics 1984-1986. A testimonial plaque, concerning these and other facts of his continuing career, and a photo-portrait have been installed in Kempthorne's honor.

Peter Sherman, together with Wolfgang Kliemann of the Department of Mathematics, developed an experimental graduate level course Stat/Math 517X, Application of Hilbert Space Techniques to Statistics, which was offered for the first time in the spring 1994 semester. The first half of the course covers some of the mathematics of Hilbert spaces. The second half applies these tools to problems in four areas of statistics: linear models, multivariate analysis, time series modeling, and filtering/prediction theory. Initially, half of the students were from statistics, half from engineering.

Another experimental course, Stat 551X, Time Series Analysis, was approved for offering by Jay Breidt fall 1994.

Don Hotchkiss taught Stat 401, Statistical Methods for Research Workers, at Hoover High School, Des Moines, as part of the ISU Extension Education program in fall 1993. Stat 328, Applied Business Statistics, was taught to 36 Saturday M.B.A. students at Iowa State in the spring semester by Philip Iversen.

Course offerings for the 1993-94 academic year and the 1994 summer session, with primary catalog

41

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.

## ▨ 1993-94 Course Offerings in Statistics

### Courses for Undergraduate Students Only

| | | | | | |
|---|---|---|---|---|---|
| 100 | Orientation in Statististics and Biometry | R | F | | Stephenson |
| 101 | Principles of Statistics | 4 | F,S,SS Barton Cressie Dombroski Dunnigan | Eraas Kirchoff Parks Stephenson | |
| 104 | Introduction to Statistics | 3 | F,S,SS Cook Davidson Henry Kaiser` | Pollak Rose VanValkenburg | |
| 105 | Introduction to Statistics for Engineers | 3 | F,S Isaacson Lahiri | Peloquin | |
| 201 | Applied Regression Analysis for Business | 2 | F Davidson | Hanson | |
| 227 | Introduction to Business Statistics | 5 | F,S,SS Benner Blakeley Brown | Dietrich Klabacha Peloquin | |
| 231 | Probability and Statistical Inference for Engineers | 4 | F,S Morse | Rollins | |
| 305 | Engineering Statistics | 3 | F,S,SS Althen Deo Morse | Pascual Rollins Vardeman | |
| 328 | Applied Business Statistics | 3 | F,S Groeneveld | Meeker | |
| 333 | Probability and Statistics for Electrical and Computer Engineers | 3 | F,S Iversen | Sherman | |
| 341 | Introduction to Theory of Probability and Statistics | 3 | F,S Groeneveld | Sukhatme | |
| 342 | Introduction to Theory of Probability and Statistics | 3 | S | | Groeneveld |

### Courses for Graduate Minors and Undergraduates

| | | | | | |
|---|---|---|---|---|---|
| 401 | Statistical Methods for Research Workers | 4 | F,S,SS Bailey Cook D. Cox Groeneveld Iversen | Kaiser Kennedy Roberts Shelley Stephenson | |
| 402 | Statistical Design and the Analysis of Experiments | 3 | F,S D. Cox/ Hinz Stephenson | Strahan Stufken | |
| 404 | Statistics for the Social Sciences | 3 | F | | Roberts |

| | | | | | |
|---|---|---|---|---|---|
| 407 | Methods of Multivariate Analysis | 2 | F | | Hinz |
| 421 | Survey Sampling Techniques | 3 | S | | Nusser |
| 436 | Genetic Statistics for Research Workers | 3 | S | | Bailey |
| 447 | Statistical Theory for Research Workers | 4 | S,SS Amemiya | | Sukhatme |
| 451 | Applied Time Series | 3 | S | | Meeker |
| 480 | Statistical Applications of Digital Computers | 3 | F | | Marasinghe |
| 481 | Computer Processing of Statistical Data | 3 | S | | Marasinghe |
| 490 | Independent Study | 1 | S | | Meeker |
| 493 | Workshop in Statistics | 1 | F | | D. Cox |

### Courses Primarily for Graduate Students, Major or Minor

| | | | | | |
|---|---|---|---|---|---|
| 500 | Statistictical Methods | 4 | F | | Koehler |
| 501 | Multivariate Statistical Methods | 3 | S | | Koehler |
| 511 | Theory and Application of Linear Models | 3 | S | | Amemiya |
| 512 | Design of Experiments | 3 | F | | Stufken |
| 513 | Response Surface Methodology | 3 | S | | Carriquiry |
| 517x | Application of Hilbert Space | 3 | S | | Sherman/ Kliemann |
| 521 | Theory of Sample Surveys I | 3 | S | | Breidt |
| 533 | Reliability | 3 | S | | H. T. David/ Meeker |
| 536 | Genetic Statistics | 2 | F | | Pollak |
| 537 | Genetic Statistics | 2 | S | | Pollak |
| 538 | Econometric Statistics | 3 | F | | Breidt |
| 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 |
| 590 A | Special Topics: Theory | 5 | S | | Pollak |
| 590 B | Special Topics: Methods | Var | S,SS Meeker | | Stephenson |

| 599 | Creative Component | Var | F,S,SS | | |
|---|---|---|---|---|---|
| | | | Breidt | Koehler | |
| | | | Carriquiry | Lorenz | |
| | | | Cook | Marasinghe | |
| | | | Cressie | Meeker | |
| | | | H. A. David | Nusser | |
| | | | | Pollak | |
| | | | H. T. David | Rollins | |
| | | | | Sherman | |
| | | | Hinz | Stephenson | |
| | | | Kaiser | Strahan | |
| | | | Kennedy | Vardeman | |

## Courses for Graduate Students, Major or Minor

| 606 | Spatial Statistics | 3 | S | Cressie |
|---|---|---|---|---|
| 611 | Advanced Linear Model Theory | 3 | F | Amemiya |
| 642 | Advanced Probability Theory | 3 | S | Athreya |
| 643 | Theory of Estimation and Testing of Hypotheses | 3 | F | Lahiri |
| 645 | Order Statistics | 3 | F | H. A. David |
| 651 | Time Series | 3 | S | Fuller |
| 699 | Research | Var | F,S,SS | |

| | | | Amemiya | Kaiser |
|---|---|---|---|---|
| | | | Athreya | Kennedy |
| | | | Carriquiry | Koehler |
| | | | Cressie | Marasinghe |
| | | | H. A. David | Meeker |
| | | | | Rollins |
| | | | H. T. David | Sherman |
| | | | | Stufken |
| | | | Fuller | Vardeman |
| | | | Harville | Wieand |

## ▨ Graduate Students

Eight Ph.D. degrees (including two for joint majors) and 26 M.S. degrees were granted in the Department of Statistics during the fiscal year. All of the masters' degrees were conferred on a nonthesis basis, with candidates completing creative components based on independent study. Abstracts of Ph.D. dissertations appear on pp. 38-40.

The Vera David Graduate Fellowship in Statistics for 1993-94 was awarded to Nan-Jung Hsu. The Holly and Beth Fryer Scholarship Award went to Hsing-Cheng Huang.

In December, a Teaching Excellence Award was presented to Peter Morse and a Research Excellence Award was given to Jeffrey Helterbrand. The Department of Statistics presented the Dan Mowrey Consulting Excellence Award to Andrine Swensen and Lie-Ling Wu, and the Vincent Sposito Statistical Computing Award to Mark Peters in May.

This year 11 graduate students in statistics were initiated into the Iowa Alpha Chapter of Mu Sigma Rho, national statistics honorary.

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 work toward a doctorate in statistics at Iowa State.

### M.S. Recipients

**Yudiantri Asdi** (Spring 1994; Mark Kaiser) returned to Malaysia.

**Marek Brabec** (Summer 1993; Kenneth J. Koehler) returned to Praha (Prague), Czech Republic, to work as a statistician in the Czech Hydrometeorological Institute.

**Hyun Hyee Cho** (Fall 1993; Edward Pollak).

**Bradley Dale Davidson** (Spring 1994; W. Robert Stephenson) accepted a position with AT&T in Basking Ridge, New Jersey.

**Joan Qiong Dong** (Summer 1993; Stephen B. Vardeman) is a statistician in Clinic Statistics, Abbott Laboratories, Houston, Texas.

**David Warren Hall** (Summer 1993; Alicia L. Carriquiry).

**Michael Noel Hartfield** (Summer 1993; Noel A. C. Cressie) joined the Wyatt Company, Dallas, Texas, as actuarial analyst.

**Shawkat Hassan** (Fall 1993; Kenneth J. Koehler) accepted a statistical intern position as data analyst at Weyerhaeuser, Hot Springs, Arkansas.

**Cheryl Ann Johnson** (Summer 1993; W. Robert Stephenson) joined Communications Data Services, Des Moines, Iowa.

**\*Kari Ann Jovaag** (Spring 1994; Paul N. Hinz) is working for a Ph.D. at ISU as a co-major in statistics and in ecology and evolutionary biology.

**Chinh Nguyen Kreisberg** (Summer 1993; W. Robert Stephenson) took a position as temporary instructor in the Department of Statistics, University of South Alabama.

**Kelli Ann Leonard** (Spring 1994; Sarah M. Nusser) took a position with Providian Bancorp (formerly First Deposit National Corporation), San Francisco, California.

**Charles Franklin Lerch** (Summer 1993; William Q. Meeker, Jr.) has taken a position with L. L. Bean in Freeport, Maine.

**Yang Li** (Summer 1993; F. Jay Breidt) is a graduate research assistant in economics working toward a Ph.D. in economics.

**Peter Neville Morse** (Fall 1993; Stephen B. Vardeman) took a temporary position as instructor in the Department of Statistics, Iowa State University, for spring semester 1994, before continuing studies toward a Ph.D. in statistics here in August.

**Soheila Amir-Sadri Naiini** (Spring 1994; H. A. David).

**Sang-Heon Oh** (Summer 1993; John Stufken) is working toward a Ph.D. degree in statistics at Yeoungnam University, Daegu, South Korea.

**Daniel James Parks** (Spring 1994; W. Robert Stephenson) will work as a research associate in statistical computing within the ISU Statistical Laboratory.

**Margarita Carmen S. Paterno** (Spring 1994; William J. Kennedy).

**Stephanie B. Johnson Schaller** (Spring 1994; Sarah M. Nusser) is an information analyst with Blue Cross Blue Shield of Kansas City, Kansas City, Missouri.

**David Siev** (Summer 1993; Mark Kaiser) returned to his position at Veterinary Biologics Field Operations, USDA, Ames, Iowa, where he had been a biologics specialist.

**Enid Suzanne Van Valkenburg** (Spring 1994; Stephen B. Vardeman), now Enid Martinets, accepted a position as quality engineer with Scientific-Atlanta, in Norcross, Georgia.

**Hui Wang** (Summer 1993; Kenneth J. Koehler) joined her husband in North Plainfield, New Jersey, and took a position as statistical analyst at Merrill Lynch in New York.

**\*Christopher Kim Wikle** (Spring 1994; Peter J. Sherman) is continuing studies for a Ph.D. with co-majors in statistics and meteorology.

**Jincheol Yoo** (Summer 1993; Herbert T. David) is a faculty member, recently promoted to captain, in the Department of Mathematics, Korea Military Academy, Seoul, Korea.

**\*Namkyu Yu** (Spring 1994; H. A. David) intends to return to Iowa State in January 1995.

## Ph.D. Recipients

**Ann Christina Russey Cannon** (Spring 1994; William Q. Meeker and Noel A. C. Cressie) joined the Department of Mathematics, Cornell College, beginning September 1, 1993, as instructor and became an assistant professor upon completion of the doctorate.

**Marie Ann Coffin** (Spring 1994; Shashikala Sukhatme) joined the Department of Mathematics, Clemson University, in August 1993 as assistant professor.

**Jeffrey Donald Helterbrand** (Fall 1993; Noel A. C. Cressie) is a senior research scientist in the Statistical and Mathematical Sciences Division, Lilly Research Laboratories, Indianapolis, Indiana.

**Thomas Michael Loughin** (Summer 1993; Kenneth J. Koehler) is an assistant professor in the Department of Statistics, Kansas State University.

**David Giles McDonald** (Summer 1993, meteorology and statistics; Tsing-Chang Chen and Herbert T. David), after temporary assignments teaching astronomy in the Eastern Wyoming University continuing education program, has taken a position at Offutt Air Force Base, Omaha, Nebraska.

**Bryan Douglas Olin** (Fall 1993; John Stufken) is a statistician in the Biometrics and Statistical Sciences group at the Procter and Gamble Company, Cincinnati, Ohio.

**Hiroshi Takahashi** (Fall 1993, statistics and animal breeding; David A. Harville) returned to his position as manager, GP SHIPS, Global Pig Farms, Inc., Hokkitsu, Gumma, Japan.

**Alan George Zimmermann** (Summer 1993; David A. Harville) is a statistician with Lederle Laboratories, Pearl River, New York.

## M.S. Candidates

| | |
|---|---|
| Pamela Abbitt | Dae-Lyong Kim |
| Gregg Althen | Sara Kind Scott Klabacha |
| Peter Anderson | Matthias Klapper |
| Yudiantri Asdi | Brian Kluge |
| Lee Barton | Sock-Cheng Koh |
| Shawn Bates | Kye-Don Lee |
| Rebecca Benner | Beth Lencowski |
| Carter Ann Blakeley | Kelli Leonard |
| G. Gordon Brown, Jr. | Shyh-Jye Leu |
| Dana Bruden | Yang Li |
| Aidan Cardella | Chien-Hua |
| Hyen-Hyee Cho | Jonathan Liao |
| Bradley Davidson | Michael L. Lieber |
| Mark Dietrich | Win-Chin Lin |
| Joan Qiong Dong | Marcia Macedo |
| Donald J. Dougherty | James Majure |
| Ansgar Dressler | Maritza Melendez-Cuero |
| Ashraf El-Houbi | Lucky Wes Mokgathle |
| Michael Elling | Peter Morse |
| Dennis Field | Sol T. Mumey |
| Angelita Nason Garth | Soheila Naiini (in absentia) |
| Matthew Gerdis | Sang-Heon Oh |
| Carolyn Goebel | Daniel J. Parks |
| Juan Jose Goyeneche | Francis Jave Pascual |
| Jason Gunnink | Margarita Paterno |
| Peter Hanson | Laknath Peiris |
| Shawkat Hassan | Mark Peters |
| (operations research) | Stephanie Roll |
| Kari Ann Henry | Daniel Rose |
| Gibog Hong | Stephanie Johnson |
| Nan-Jung Hsu | Schaller |
| Hsin-Cheng Huang | Christopher Scheib |
| Wynandin Imawan | Angela Schneider |
| Yoon-Sook Jeon | Steffen Seiffarth |
| Je Yeong Jeong | Tae-Sung Shin |
| Amy Rath Johanson | David Siev |
| Philip G. Jones | Richard Sullivan |
| Kari Jovaag | Catherine Sunde |

| | |
|---|---|
| Andrine Swensen | Lisa Wicklund |
| Chi-Hong Tseng | Jeffrey Wieland |
| Elizabeth Uken | Christopher Wikle |
| Enid Van Valkenburg | Jincheol Yoo |
| Delfino Vargas-Chanes | Namkyu Yu |
| Jennifer Walker | Weiye Zhu |
| Hui Wang | |

## Ph.D. Candidates

| | |
|---|---|
| Mahmood Ahmad (statistics and industrial education and technology) | Jaehyung Lee |
| | Yoon-Dong Lee |
| | Ding-Hwa Lei |
| Jeremy Aldworth | Chih-Yao Craig Liu |
| Anthony Baiching An | Thomas Loughin |
| Gregorio Atuncar | David G. McDonald |
| Barbara Dombroski Barnet | (statistics and meteorology) |
| Ann Russey Cannon (in absentia) | (in absentia) |
| | Bryan Olin |
| Jianlin Cheng | Savas Papadopoulos |
| Bassirou Chitou | Elizabeth Paterno (economics |
| Marie Coffin (in absentia) | and statistics) |
| Rohit Deo | Jean Pelkey |
| Sriram Devanathan | Abdul Majid Rana |
| (chemical engineering and statistics) | Anindya Roy |
| | Leroy Rushing |
| Kevin Dodd | Pradipta Sarkar |
| Thomas M. Dubinin | Chungyeol Shin |
| Geraldine Dunnigan | Jürgen Symanzik (statistics |
| Birol Emir | and computer science) |
| Michael Eraas | Hiroshi Takahashi (animal |
| Jun-ichiro Fukuchi | science and statistics) |
| Jeffrey Helterbrand | Ling-Ling Claire Tsao |
| Hui-Lin Hu | Anand Vidyashankar |
| Mu-Yeh Huang | (statistics and |
| (statistics and industrial engineering) | mathematics) |
| | Michael Wallendorf |
| Shiaau-Er Huarng | (statistics and animal |
| Alejandro Islas-Camargo | ecology) |
| Shuen-Lin Jeng | Ouhong Wang |
| Shin-Soo Kang | Kevin Wright |
| Sahmyeong Kim | Lie-Ling Wu |
| Thomas Kirchoff | Ilker Yalçin |
| Seoung-Gon Ko | Zugeng Zheng |
| Chiang-Sheng Lee | Alan Zimmermann |

During summer 1993, Andrine Swensen worked at Johnson and Johnson out east as a statistical intern, while Michael Hartfield taught statistics at Drake University as an instructor. Silke Schmidt, Angelita Nason, and Mark Dietrich went to Mayo Clinic, Rochester, Minnesota, as summer cooperative interns. Other internships were mentioned in the last annual report.

Jason Gunnink went to Dortmund University for the academic year on the ISU-Dortmund exchange program in statistics.

Aidan Cardella interned at Weyerhaeuser, Inc., Hot Springs, Arkansas, as a data analyst from July to December 1993, while Shawkat Hassan interned there January 3 to July 15, 1994.

Peter Morse took a statistical internship with General Motors for summer 1994, while Savas Papadopoulos accepted one in the Educational Testing Service, Princeton, New Jersey, for eight weeks starting June 6, 1994. Jean Pelkey was director of Statistical Research & Development at EnviroQuest Technologies Limited, Kansas City, Missouri, during the summer.

## ▓ 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.

Officers for the 1993-94 year were Kevin Dodd, president; Tony An and Jean Pelkey, co-vice presidents; Becky Benner, treasurer; and Mark Peters, secretary. Kelli Leonard and Enid Van Valkenberg served on the social committee; Ilker Yalçin was the club's international representative. Kevin Dodd attended statistics faculty meetings as the student representative. Jay Breidt and Alicia Carriquiry were faculty advisors to the student club.

This year's Reading Group meetings were organized by Matt Gerdis and Andrine Swensen. Gregg Althen served as intramural sports coordinator and designated FAC organizer. Mark Peters edited the *Iowa STAT-er Chatter* newsletter. Becky Benner, Carol Goebel, and Andrine Swensen served on the ISU Graduate Student Senate.

Social events during the year included a Pizza Party, a fall picnic, a hayride, the traditional Howard House Halloween Party, the Winter Party where students and faculty display hidden talents, and sports tournaments. Members of STAT-ers continued to serve as recycling volunteers for Snedecor Hall for a third year, produced a STAT-er birthday calendar, and carried on active sports programs.

## ▓ Snedecor Lecture



John C. Bailar, Snedecor Lecturer

The fifth George W. Snedecor Lecture was presented on March 22, 1994, by John C. Bailar III, who spoke on "Cancer undefeated: statistical lessons for policy makers." He gave a talk on "Slippery science" on March 21 as a regular Statistical Laboratory seminar. The Snedecor Lecture program is a series of occasional lectures that recognize George Snedecor's pioneering contributions to the field of statistics and to the Statistical Laboratory.

Dr. Bailar received his M.D. degree in medicine at Yale and his Ph.D. degree in statistics at American University. He is currently chair of the Department of Epidemiology and Biostatistics, McGill University

Faculty of Medicine, and holds an appointment in the Department of Medicine, Montreal General Hospital. As a 1990-1995 MacArthur Fellow, he serves as scholar in residence at the National Academy of Sciences, Washington, D.C. as part of his duties at McGill.

Bailar is a member of the International Statistical Institute and the Institute of Medicine, a fellow of AAAS, and a past president of the Biometric Society (ENAR).

## ▓ Sukhatme Lecture

The 11th B. V. Sukhatme Memorial Lecture was presented by Ivan P. Fellegi, Chief Statistician of Canada, Statistics Canada, on May 2. He spoke on "Criteria for assessing statistical systems," focusing on national systems.

Fellegi was born in Hungary, received the B.S. degree at the University of Budapest in 1956, emigrated to Canada, and obtained M.S. and Ph.D. degrees at Carleton University. He has made his career at Statistics Canada, since 1985 serving as Chief Statistician of Canada. According to the *Economist* of London, this is the best statistical agency in the world.

Fellegi has published widely on topics in survey sampling. He has been president of the International Statistical Institute, the International Association of Survey Statisticians, and the Statistical Society of Canada. He is a fellow of the American Statistical Association and AAAS, as well as an honorary fellow of the Royal Statistical Society and an honorary member of ISI.

The Sukhatme lecture series honors the late B. V. Sukhatme, who was professor of statistics at Iowa State from 1968 to 1979, specializing in survey sampling.

## ▓ Snedecor and Bancroft Awards

The 1994 George W. Snedecor Award in Statistics for the most outstanding Ph.D. candidate in the Department of Statistics was presented to Jaehyung Lee. Selection was made from those students who had completed the doctoral preliminary examination in 1993. Lee came here in August 1991. He received his M.S. degree in statistics at Seoul National University in 1989, then completed military service and a period of employment in Korea. He became a graduate teaching assistant in spring 1992, then a Fryer scholar and a research assistant in statistics for the ISU Center for Family Research and Rural Mental Health. The award honors the founder and first director of the Statistical Laboratory.

The T. A. Bancroft Award for 1994 was given to Chandraratne Dematawewa, a graduate student in animal breeding with a statistics minor. Students who completed prelims in the 1993 calendar year were eligible. This award honors Theodore A. Bancroft, director of the Statistical Laboratory and head of the Department of Statistics from 1950 to

1972. The award recognizes achievements in statistics by a doctoral student who has a declared minor in statistics or a joint major in statistics and another area.

Dematawewa received a B.S. degree in agriculture, with honors, at the University of Peradeniya, Sri Lanka, in 1985, and a postgraduate diploma in animal breeding at the University of Edinburgh, Scotland, in 1989, then returned to Peradeniya for a year as lecturer in animal breeding. In 1990 he came to Iowa State as a graduate research assistant and completed a master's in animal breeding in 1992. He is currently working with P. Jeffrey Berger on evaluating the cost and risk associated with sire selection in dairy cattle. Dematawewa is a member of Gamma Sigma Delta, Phi Kappa Phi, and Mu Sigma Rho honoraries.

## ▓ Undergraduate Students

Undergraduate statistics majors received a number of awards and recognitions in spring 1994. Jill L. Griffith and Kelly R. Iverson became members of Mu Sigma Rho, the national statistics honorary society. Sandra M. Reis (who has a second major in political science) was elected to Lampos, the College of Liberal Arts and Sciences honorary. Charlotte M. Schultze was inducted into Phi Beta Kappa at the initiation ceremony on April 25. She has a primary major in mathematics and a second major in statistics.

At the 41st annual Scholarship Recognition Dinner, April 11-12, Vera Boulaevskaia, a sophomore statistics major, and Lingcheng Helen Huang, a junior major, were recognized as High Scholastic students, in the top 2 percent in the College of Liberal Arts and Sciences. Sum-Kum Lydia Chan was recognized as the high scholarship graduating senior in statistics. Rebecca Swanson, a junior, will receive a $1,200 scholarship from the American Business Women's Association for the 1994-95 academic year.

Sondra Reis was chosen by the Kappa Alpha Theta Foundation to receive the Melissa Luton Bradford Scholarship of $2,825 for the 1994-95 academic year. This is one of the larger named scholarships for undergraduates given by the national foundation.

Six students received B.S. degrees in statistics during the period July 1, 1993, to June 30, 1994. 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.

**Sau-Kum Lydia Chan** (Spring 1994, with distinction; W. Robert Stephenson).

**Heather Eileen Honeck Doane** (Fall 1993; Richard Groeneveld) is a statistical analyst with the Principal Financial Group, Des Moines, Iowa.

**Nasrudin Md-Rahim** (Fall 1993; W. Robert Stephenson) returned to Malaysia.

**Kelley Jo Mechem** (Spring 1994; W. Robert Stephenson), now Kelley Buchacker, is a statistical analyst with the Principal Financial Group, Des Moines, Iowa.

**\*Bryan E. Nelson** (Spring 1994; William Q. Meeker).

**Ronald Gene Smith** (Spring 1994; W. Robert Stephenson) is temporarily employed as a construction worker at Mary Greeley Medical Center, Ames.

Update on positions taken by recent graduates: We have heard from Dana Reeves (B.S. 5/92 in statistics) that he is now working for Pharmaceutical Prescription Card Services, Inc., in Scottsdale, Arizona, as a statistical analyst.

A number of undergraduate statistics majors worked on- or off-campus during summer 1994. Vera Boulaevskaia was an undergraduate research assistant in the ISU Women in Science and Engineering Program; Lincheng Huang and Richard Shelton worked for the ICI Seeds Research Department in Slater, Iowa, as SAS programmers; Kelly Iverson was an intern for the Allied Group Insurance Company, Des Moines, Iowa; Rebecca Swanson worked as a data analyst in the Department of Agronomy, ISU; Anya Whigham worked with the National Agricultural Statistics Service, USDA, Des Moines, as a junior statistician.

## ▓ Statistics Club

The purpose of the Statistics Club (STAT CLUB) is to promote interest in statistics among undergraduate students at Iowa State University. This year's officers were Kelley Mechem, president; Sondra Reis, vice president; Matt Haubrich, treasurer; and Heather Doane, secretary. Reis was the Department of Statistics representative to the College of Liberal Arts and Sciences Council. W. Robert Stephenson served as faculty advisor to the club.

The year's activities began with a get-together at DaVinci's Pizza, with a really good turnout and many new members in attendance. At the meeting, Kelley Mechem received the STAT CLUB Award for 1993-1994. This $200 award recognizes an undergraduate statistics major who is active in the Statistics Club and who has demonstrated academic achievement.

The first formal meeting was on October 12--a planning meeting for a trip to the Mayo Clinic later in October. Eight undergraduate statistics majors, accompanied by Richard Groeneveld and W. Robert Stephenson, made the long trip to Rochester, Minnesota, to visit the Mayo Clinic on Thursday, October 28. Jeff Larson-Keller (B.S. stat 1987) had made arrangements for this visit both to the Mayo Clinic and its Biostatistics Section. Dr. J. Michael O'Fallon, head of the Biostatistics Section, welcomed the group and told a little about the section. After his presentation, there was an opportunity to hear from ISU graduates currently working in the section. In addition to Jeff Larson-Keller, Steve Wallrichs (B.S. stat 1987), Nancy Houar Fish (B.S. stat 1990), Jeff Eickholt (B.S. stat 1992), and Lori Stephany (stat major 1992) shared some of their experiences at the Mayo Clinic. There was also a presentation by Duane Ilstrup on statistical aspects of the projects he has been involved with during his 20 years at the clinic. The visit finished up with a tour of the clinic itself. The

Department of Statistics helped with funding for the trip and paid for pizza on the way back to Ames.

On March 1, the club met for dessert at Hickory Park and discussed plans for speakers and a short field trip. During the year, the STAT CLUB newsletter kept members informed about internships, scholarship and fellowship opportunities, and awards.

The Statistics Club Award for 1994-95, supported by the club and the Department of Statistics, will be shared by Sondra Reis and Matt Haubrich, who will each receive $150 in recognition of their service to the club and the department and for their academic achievement.

## ▨ Seminars

The series of regular weekly seminars offered by the Statistical Laboratory and the Department of Statistics throughout the 1993-94 year was planned by Soumendra Lahiri and Sarah Nusser. Tony An was chair for the Iowa STAT-er seminar series. Two seminars by Will Gersch, University of Hawaii, and one by Andrew Harvey, London School of Economics, were part of a six-seminar series on Systems and Control Theory sponsored by the departments of Mathematics, Statistics, and Aerospace Engineering and Engineering Mechanics during the period April 26-May 3, 1994.

### Statistical Laboratory Seminars

#### Summer 1993

| | |
|---|---|
| July 2 | Bootstrap applications in proportional hazards models. Tom Loughin |
| 22 | Fixation probability of a favorable gene in a small population under partial selfing. Muhamad Sabran |
| August 3 | (joint with Department of Industrial and Manufacturing Systems Engineering) Quality and productivity improvement: Some case examples. B. K. Pal, Indian Statistical Institute |

#### Fall 1993

| | |
|---|---|
| August 25 | Introduction of new students and faculty and announcement of awards. Dean L. Isaacson |
| September 1 | Modeling animal abundance: An approach based on habitat gradients. Mark S. Kaiser |
| 15 | Linguistic content analysis. Carl W. Roberts |
| 22 | A statistical approach to identifying closed object boundaries in images. Jeffrey D. Helterbrand |
| October 1 | Asymptotics of regression quantiles under long range dependent errors. Kanchan Mukherjee, Department of Mathematics and Statistics, University of Nebraska-Lincoln |
| 6 | Large deviation rates for branching processes. Anand Vidyashankar |
| 13 | First (?) occurrence of terms in mathematical statistics. H. A. David |
| 20 | Multiple outliers--models and methods. Ursula Gather, Department of Statistics, University of Dortmund, Germany |
| 28 | The design of mixture experiments in the presence of blocking variables. Bryan D. Olin, Iowa State University and the Procter and Gamble Company |

| | |
|---|---|
| November 3 | A multicriteria approach to model specification and estimation. Leigh Tesfatsion, Department of Economics and Department of Mathematics, Iowa State University |
| 10 | Spectral analysis for copersistent processes. Andrew McDouglass, Department of Statistics, Rutgers University |
| 17 | Selection procedures for Gibbs-Markov random field texture models. Lynne Seymour, Department of Statistics, University of North Carolina-Chapel Hill and Department of Statistics and Actuarial Science, University of Iowa |
| December 1 | The Statistical Laboratory's Survey Section: Perspectives on the past, present, and future. Sarah Nusser |
| 8 | Multilinear models in spectroscopy. Sue Leurgens, Biostatistics Section, Department of Preventive Medicine, Rush Medical College |
| 15 | Some problems with nonsampling errors in Receiver Operating Characteristics studies. Marie Coffin |

#### Spring 1994

| | |
|---|---|
| January 19 | Stochastic volatility models: Introduction and an application. Alicia Carriquiry |
| 26 | Modeling long memory stochastic volatility. F. Jay Breidt |
| 27 | Model checking for finite mixture models. Hal S. Stern, Department of Statistics, Harvard University |
| 29 | A statistical model for the progress of sports scores. Hal S. Stern, Department of Statistics, Harvard University |
| 31 | Bayesian inference for agricultural variety trials. David Higdon, Department of Statistics, University of Washington |
| February 3 | Estimation and visualization of structure in ranked and lattice data. Keith A. Baggerly, Department of Statistics, Rice University |
| 10 | Bayesian analysis of nonidentigiable models with applications to the coompeting risks problem. Andrew Neath, Department of Statistics, University of California-Davis |
| 28 | Locally lattice sampling designs for isotropic random fields. Michael Stein, Department of Statistics, University of Chicago |
| March 9 | Extremes of shot noise processes with applications to rainfall modeling. Patrick Homble, Department of Statistics, University of Georgia |
| 21 | Slippery science. John Bailar, Department of Epidemiology and Biostatistics, McGill University |
| 30 | Comparing the time-to-threshold and summary statistic methods for analyzing repeated measures. Jeffrey Dawson, Department of Preventive Medicine, University of Iowa |
| April 6 | A theory of image analysis with partially ordered Markov models. Noel Cressie |
| 19 | Gibbs sampler and Bayesian method of moments analyses of simultaneous equation and related models. Arnold Zellner, Department of Economics and Statistics, University of Chicago |
| 21 | Signal detection using categorical temporal data. Ann Russey Cannon, Department of Statistics, ISU, and Department of Mathematics, Cornell College |
| 25 | A probability model for cancer growth. Peter Jagers, Mathematics Department, Chalmers University of Technology, Goteborg, Sweden |
| 25 | Noncooperative international behavior: A spatially autoregressive model of sulfur |

## Summer 1994

## Special Lectures and Seminars

## Iowa STAT-ers Seminar

## Photo Credits

Photos on pp. 2, 18, and 41 are black-and-white versions of pictures provided by Dean Isaacson, Aziz Bouzaher, and alumnus Jorge Morel, respectively. The photo of John C. Bailar III on p. 45 is provided through the courtesy of the guest lecturer. The remaining photos and the layout design are by Jauvanta Walker.
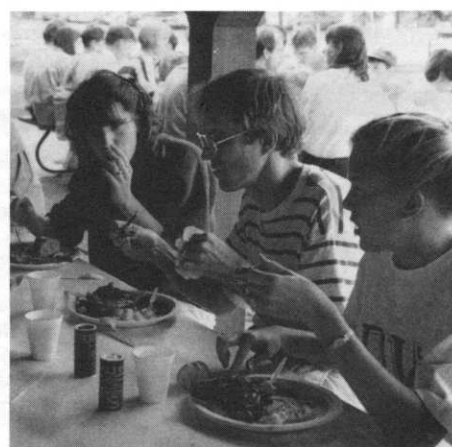




Wayne Fuller and Leroy Wolins oversee Bill Marion's grill work at a fall picnic. Once the plates are filled, serious work begins; here Amy and Tom Kirchoff and Larz, wife of Dan Rose, find that fingers handle it better than forks.