Statistical Laboratory

established 1933

Annual Report

July 1, 1995 to June 30, 1996

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Contents

THE STATISTICAL LABORATORY
Iowa State University
1995-96 Annual Report

Personnel

Effective August 16, 1995, Jean-Didier Opsomer joined the Survey Section as assistant professor; Linda Brant Collins was added to the undergraduate teaching faculty as assistant professor; and Yannis Bilias began a joint appointment as assistant professor in statistics and economics.

Krishna B. Athreya was on faculty improvement leave for the full academic year 1995-96, primarily as a visiting professor at the Jawaharlal Nehru Centre for Advanced Scientific Research, Indian Institute of Science, Bangalore, India. He also visited the Indian Statistical Institute, Bangalore, Calcutta, and Delhi, to do collaborative research on stochastic processes in turbulence, branching Markov processes, Markov chain Monte Carlo, and statistical inference for Markov chains.

Peter Sherman was on faculty improvement leave fall semester to conduct research at the Cooperative Research Centre for Robust and Adaptive Systems, $(CR)^2ASys$, in Adelaide, Australia.

Frederick O. Lorenz spent the fall semester, while on faculty improvement leave, working with colleagues in the Department of Sociology, University of North Carolina-Chapel Hill.

David C. Huang, one of the Directors of Biostatistics at the Upjohn Company, Kalamazoo, Michigan, on a one-year sabbattical, joined the ISU statistical center in August 1995 as a visiting scholar for the academic year. He audited courses, attended seminars and workshops, conducted research and, in the spring semester, taught Stat 401B.

Keith Baggerly was here as a visiting scholar for two separate months during the fall semester (September-October, November-December). He conducted research with Dianne Cook on graphical methods for ranked data, and team taught Stat 328, Applied Business Statistics. Baggerly was a research scientist at Los Alamos National Laboratory and is currently an assistant professor at Rice University. He received his Ph.D. in statistics from Rice University in summer 1994.

Victoria Chen, assistant professor in the School of Industrial and Systems Engineering, Georgia Institute of Technology, came in January as visiting research scholar until June 30, 1996. Her primary purpose was to collaborate with Derrick Rollins on various research projects and to establish a research agenda that will lead to further collaborations. Chen received her bachelor's degree in mathematical sciences at Johns Hopkins University and her master's

and doctorate in operations research at Cornell University. Her research interests concern application of statistical techniques in experimental design and function approximation to high-dimensional continuous-state stochastic dynamic programming, as well as statistical procedures for chemical engineering processes and upper-bound confidence intervals for the range of several means.

Also in January, Rita Nicolau came as visiting research scholar to work with Noel Cressie until May on environmental statistics. She was on leave from the position of research associate at Centro Nacional de Informaçao Geografica, Lisbon, Portugal. In March, Jaap de Gruijter came as visiting research scholar from the Winand Staring Centre, University of Wageningen, the Netherlands, where he is head of the Survey Methods Section. He worked with Noel Cressie until the end of May on spatial sampling. He is a soil scientist by training.

Shomei Tsukibyashi, professor in the Department of Economics, Aichi University, Japan, was here as visiting research scholar March 7-April 13, 1996, primarily to have substantial discussions with H. A. David on order statistics and their concomitants. He also consulted with Yasuo Amemiya on the analysis of covariance.

Ahmed Youssef, who had been here for two years as a visiting research scholar, returned to the Institute of Statistical Studies, Cairo University, Egypt, in April.

Dean Thompson, who has been a USDA Natural Resource Conservation Services collaborator working with the Survey Section of the Statistical Laboratory, became director of the NRCS Natural Resources Inventory and Analysis Institute effective July 1995. He has been joined here by Robert Dayton, agronomist for the institute. Herb Wilson and Tom O'Connor came in late June 1996 to be resident collaborators for NRCS; Wilson had been here previously as a Soil Conservation Service collaborator, leaving in December 1994.

Al Clarke, graduate student in English, was employed on an hourly basis, beginning in June 1996, to prepare a semiannual newsletter for statistics alumni, faculty, staff and students, and special friends of the statistics center. (The first issue was published in July.)

Norman V. Strand, long-time professor emeritus, died on November 19, 1995; see In Memoriam.

David Harville resigned effective December 31, 1995 to take a position as senior statistician with the IBM Thomas J. Watson Research Center, Yorktown Heights, New York.

Bud Meador retired effective March 29, 1996 from the Statistical Computing Section and has moved with his wife, Dorothy, to a new home in Bella Vista, Arkansas. Jan Franklin, account specialist for the statistical center, retired effective May 31, 1996 and has moved to Kansas City, Missouri.

H. A. David, Liberal Arts and Sciences Distinguished Professor, retired at the end of the 1995-1996 academic year but retains an office and is continuing

research here. Robert F. Strahan, professor of psychology and statistics, retired effective June 30, 1996. At the Awards Convocation on May 8, the College of Liberal Arts and Sciences conferred the title of professor emeritus on H. A. David, David Harville, and Robert Strahan.

Oscar Kempthorne, professor emeritus, moved to a new home in Arlington, Maryland, May 4. He has donated much of his professional library to the Department of Statistics.

Alicia Carriquiry was elected as a member of the International Statistical Institute in July 1995, as a representative of Uruguay.

W. Robert Stephenson was elected as a fellow of the American Statistical Association on August 15, 1995, and was cited "for a superb teaching record and outstanding leadership in statistical education; for strong contributions to industrial statistics, quality improvement, and for outreach to industrial groups."
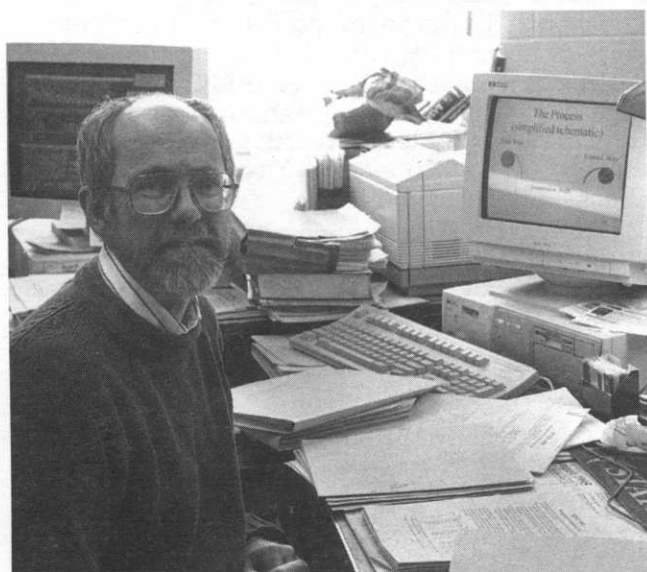
Bob Stephenson was chosen as a fellow of the American Statistical Association at the annual meeting in Orlando, Florida.

Derrick Rollins received special recognition from two Iowa State University groups: as Outstanding Engineering Professor in Chemical Engineering for 1995-96, from the Engineering Student Council, and as Professor of the Year for 1995-96, from Lampos. He was featured as the June Scientist in AEtna's *Calendar of African American History* with the 1996 theme African Americans in Science.

William Q. Meeker was named a Distinguished Professor in Liberal Arts and Sciences at the 1996 Awards Convocation May 9 at Iowa State University. This is the highest academic honor given by ISU. Also Richard Groeneveld was awarded the title of University Professor as a senior faculty member who has had a significant impact on the department and the university in the areas of teaching, research, and professional service.

Meeker was cited for his interest in industrial statistics, which "led to summer jobs at General Electric and Bell Laboratories from 1973 to the present. These regular contacts with industrial statisticians enhanced his research, teaching, mentoring of graduate students, and his ability to use computing technology in all of these endeavors. His research in life testing, time series, survival analysis and reliability has resulted in more than 50 refereed papers and three books. His expertise in reliability led to collaboration with Iowa State's Center for Nondestructive Evaluation, where he is a principal investigator. He also collaborates with the ISU/FAA Center for Aviation Systems Reliability. Since 1975 he has been the professor-in-charge of three undergraduate business statistics courses. He coordinates the courses, mentors the teaching assistants and regularly teaches a section himself. He has been instrumental in bringing computers into all the introductory statistics courses. He received ISU Teaching Excellence Awards in 1989 and 1991."

Groeneveld was cited for his work to strengthen the undergraduate statistics program. "As coordinator of undergraduate studies, Groeneveld has taught and/or coordinated most of the undergraduate statistics courses, setting the standards for these courses. He has mentored hundreds of teaching assistants. Undergraduate statistics majors also have benefited from Groeneveld's work as an administrator, teacher, and adviser. He won an Outstanding Undergraduate Adviser Award in 1981 from the College of Liberal Arts and Sciences. He has authored two textbooks, *An Introduction to Probability and Statistics Using Basic,* and *Introductory Statistical Methods: An Integrated Approach Using Minitab®.* Groeneveld also has maintained an active research program. He has published more than 30 refereed papers and is known as an expert in the area of skewness of distributions."

Four searches were conducted during the year, to fill positions vacated by Harville and David, to fill a new position in environmental statistics, and to replace a position in survey sampling. Three of these searches will be continued in 1996-97.

Looking toward the 1996-97 year: Yuhong Yang will join the faculty as an assistant professor. He has completed the Ph.D. program in the Department of Statistics at Yale University. He will fill an open position for research and teaching, including teaching courses in theory.

Alicia Carriquiry will be on faculty improvement leave from August 16, 1996 to May 15, 1997. She will conduct research on methods to assess the performance of nonlinear filtering algorithms for target tracking, in collaboration with Wolfgang Kliemann and Dragan Mirkovic (Mathematics, ISU), Jay Breidt (Statistics, ISU), and Amarjit Budhiraja (Mathematics, Brown University). She will be a visiting professor in the Department of Statistics, Pontificia Universidad Católica de Chile, in Santiago, Chile, fall 1996, and in the Institute of Statistics and Decision Sciences, Duke University, Durham, North Carolina, in March and April 1997.

W. Robert Stephenson was promoted to full professor and F. Jay Breidt was promoted to associate professor with tenure, with approval by the Board of Regents in April 1996.

Statistical Laboratory Staff--Fiscal Year 1995-96 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 Hoffman, 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, University Professor
David A. Harville, professor emeritus
Roy D. Hickman, professor emeritus
Paul N. Hinz, faculty status also in Department of Forestry
Donald K. Hotchkiss, professor emeritus
David V. Huntsberger, professor emeritus
Dean L. Isaacson
Oscar Kempthorne, emeritus Distinguished Professor in Liberal Arts and Sciences
William J. Kennedy
Kenneth J. Koehler
Frederick O. Lorenz, joint appointment with Department of Sociology
William Q. Meeker, Jr., Distinguished Professor in Liberal Arts and Sciences
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 Systems Engineering

H. Samuel Wieand, University of Pittsburgh collaborator
Leroy Wolins, professor emeritus

Associate Professors
Alicia Carriquiry
Soumendra N. Lahiri
Mervyn G. Marasinghe
Carl W. Roberts, joint appointment with Department of Sociology
Derrick K. Rollins, joint appointment with Department of Chemical Engineering
Peter Sherman, joint appointment with Department of Aerospace Engineering and Engineering Mechanics
W. Robert Stephenson
Hal Stern
John Stufken
Shaskikala Sukhatme

Assistant Professors
Yannis G. Bilias, joint appointment with Department of Economics
F. Jay Breidt
Linda Brant Collins
Dianne Cook
Mark Kaiser
Sarah Nusser
John-Didier Opsomer

Temporary Assistant Professor
Keith Baggerly, visiting
David C. Huang, visiting

Resident Collaborator
Robert Dayton, USDA NRCS, starting November 12, 1995
Tom O'Connor, USDA NRCS, starting June 28, 1996
Dean Thompson--director of NRCS Inventory and Analysis Institute, USDA NRCS
Herb Wilson, USDA NRCS, starting June 24, 1996

Visiting Research Scholar
Victoria C. P. Chen
Jaap De Gruijter
Rita Nicolau
Shomei Tsukibyashi
Ahmed Youssef

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. 47.

Pamela Abbitt (Vera David fellow)	Carter Ann Blakeley
	Marek Brabec
W. Jeremy Aldworth	G. Gordon Brown, Jr.
Anthony Baiching An	Dana Bruden
Barbara Dombroski Barnet	Xiao-Hong Cao
	Ian Carlson
Shawn Bates	Sau-Kum Lydia Chan
Rebecca Benner	Victor Chan (GM scholar)

Cong Chen
Huaichin Chen
Jianlin Cheng
William Christensen
   (Shell scholar)
Lori Cogar (Dow
   scholar)
Rohit Deo
Kevin Dodd (Shell
   fellow)
Thomas Dubinin
Michael Elling
Birol Emir
Michael Eraas
Soledad Fernandez
King-Chong Iris Fung
Karin Funke
John Gabrosek (Shell
   scholar)
Angelita Nason Garth
Juan Jose Goyeneche
   (Fulbright/LASPAU
   scholar and Fryer
   scholar)
Jennifer Hellrung
Kari Ann Henry
Nan-Jung Hsu
Hsin-Cheng Huang
Shiaau-Er Huarng
Shuen-Lin Jeng
Yoon-Sook Jeon
Angela M. Jones
Philip G. Jones
Kari Jovaag
Jae-Kwang Kim
Thomas Kirchoff
Koji Kondo
Shonda Roelfs Kuiper
Sun-hee Kwon
Chiang-Sheng Johnson
   Lee
Jaehyung Lee
Ding-Hwa (Dean) Lei
Lisa Le Tourneau (P&G
   scholar)
Rong Li
Win-Chin Lin
Chih-Yao Craig Liu
Xiao-Hu Liu
Feng Lu

Amy Jo Meyer (GM
   scholar)
Barbara Mock
   (Providian scholar)
Peter Morse
Sol Mumey
Laura Nalbarte-
   Migliaro
Ann Otte Schmidt (Eli
   Lilly scholar)
Savas Papadopoulos
Brandon Paris (Packard
   Foundation fellow)
Francis Pascual
Jean Pelkey
Elizabeth Pierce
Deanne Reber (Shell
   scholar and Vera
   David fellow)
Janelle Rhorer
   (Providian scholar)
Anindya Roy
Abigail Sage
Pradipta Sarkar
Christopher Scheib
Pamela Schmidt
Michael Schuckers (GM
   scholar)
Heidi Shierholz (Shell
   scholar)
Tae-Sung Shin
Haiyan Shu
Heather Smith
   (Shell scholar)
James D. Smith IV
Richard Sullivan
Ling-Ling Claire Tsao
Jennifer Walker
Melanie Wall
Jun-Yuan Wang
Jeffrey Wieland
Christopher Wikle
Kevin Wright
Lie-Ling Wu
Yihong Xiao
Jill Yoder
Zugeng Zheng
Jun Zhu (Shell
   scholar)

Jens Eickhoff (DAAD scholar)--Dortmund University
Allison Florance--College of Veterinary Medicine, ISU
Achim Guttner (DAAD scholar)--Dortmund University
Chad Hart--Department of Economics, ISU
Lun-Xiong He--Department of Electrical and Computer Engineering, ISU, and Ames Laboratory, U.S. Department of Energy
Alejandro Islas-Camargo--CONACyT-Mexico
Lixin Jia--Center for Nondestructive Evaluation, IPRT, Ames Laboratory, U.S. Department of Energy
Sock-Cheng Koh--National University of Singapore
Soon Seng Lau--Department of Electrical and Computer Engineering, ISU
Yoon-Dong Lee--Social and Behavioral Research Center for Rural Health, ISU
Nicholas Lewin--Department of Ecology and Evolutionary Biology, ISU
Huei Grace Liu Ho--National Animal Disease Laboratory
Shiping Liu--National Animal Disease Laboratory
Marcia Macedo--CNPq/CAPES Brazil and Kellogg Foundation
Inna Megretskaia--College of Family and Consumer Sciences, ISU
Bryan Nelson--Research Institute for Studies in Education, ISU
Elizabeth Paterno--Department of Economics, ISU
Laknath Peiris (Fulbright scholar)--University of Peradeniya, Sri Lanka
Kara Riggs Perritt--USDA/NASS
Luiz Peternelli--CNPq/CAPES Brazil and Universidade Federal de Vicosa
Xiao-ming Qi--Department of Forestry, ISU
Melissa Lopez Reyes--Department of Psychology, ISU
Wendelin Schnedler (DAAD scholar)--Dortmund University
Fangqiu Sun--Department of Economics, ISU
Jürgen Symanzik (DAAD scholar)--Dortmund University and Geographic Information Systems Support and Research Facility, ISU
Lars Tschiersch (DAAD scholar)--Dortmund University
Delfino Vargas-Chanes--CONACyT-Mexico
Michael Wallendorf--Department of Entomology, ISU, and USDA
Xue Wang--USPR
Yanrong Wang--Department of Economics, ISU
You Wang--Department of Mathematics, ISU
Jing Zhang--Department of Forestry, ISU
Sanyi Zhao--Department of Electrical and Computer Engineering, ISU

Supported Graduate Students
Kevin Ackley--Department of Sociology and Rural Health Centers, ISU
Abdulelah Al-Nafisa--Kingdom of Saudi Arabia
Hans Martin Axelson--Jan Wallander and Tom Hedelius Foundation for Social Science Research, Sweden
Andim O. Balce--Pamukkale University, Turkey
Kok-Leong Chiang--National University of Singapore
Bassirou Chitou--USAID-ATLAS/AFGRAD
Sriram Devanathan--Department of Chemical Engineering, ISU

Self-Supporting Graduate Students
Pinliang Patrick Chen
Xianfeng Hu
Chin-Liang Hung
Amy Rath Johanson
Kyu-Nam Jung
Dae-Lyong Kim

Beth Lencowski
Song Li
Chien-Hua Jonathan
   Liao
Chiou-Ping Liu
Maritza Melendez

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Andrew Nordine
Kaije Pan
Angela Schneider
Catherine Sunde

Yu-Ping Tien
Yufeng Wang
Ling-Yu Cynthia Yang

Professional and Scientific Staff

Maria Alvarado, systems support specialist, Survey Section, starting August 1, 1995

Dianne G. Anderson, research associate, Survey Section

Richard Dorsch, programming consultant, Survey Section

Masoud Kazemi, research associate, Survey Section

Todd J. Krueger, statistical systems analyst, 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

Andrew Williams, program coordinator (survey projects manager), Survey Section

General Office Staff

Rose Ann Anderson, secretary
Norma Elwick, secretary
Janice Franklin, account specialist until May 31
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
Pubali Banerjee, research assistant, beginning February 9, 1996
Kathryn Bottorff, field interviewer
Jean Carey, field interviewer
Linda Claussen, secretary starting February 16
Carolyn A. Cockayne, clerk
Kathryn Goodwin, field interviewer
Vimlesh Gupta, key entry operator
Nancy Heathman, account specialist
Marlys Huff, field interviewer
Marcia Luze, field interviewer
Kathie Reinertson, data technician
Jasmine Seagrave, data technician
Judy Shafer, clerk typist
Sandie Smith, secretary
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, Kenneth J. Koehler, and Hal Stern, who were assisted this year by graduate students Kari Jovaag, Claire Tsao, Marek Brabec, Nan-Jung Hsu, Grace Liu, Shiping Liu, Haiyan Shu, Kari Henry, Beth Pierce, Huaichin Chen, Yoon-Sook Jeon, and Li-Ling Wu. The College of Veterinary Medicine and the National Animal Disease Laboratory also provide some support for student consulting through the Department of Statistics.

Marek Brabec helped analyze data from a field experiment that was designed to learn how a bacterium is distributed in the soil when it is applied in different dilutions and amounts. The bacterium has been shown to be lethal to some types of grubs that feed on the roots of turf grass. The experiment used a split plot design in which 3 levels of dilution were arranged in a randomized block design and 4 liquid amounts as the split plot factor. Five soil depths and 6 times after application were repeated measures that were analyzed as split split plot factors.

Claire Tsao and Mark Kaiser collaborated with researchers in the Department of Animal Ecology to investigate the effect on growth of turkey polts of two methods for attaching radio transmitters. Growth was measured as change in wing length and body weight for individually marked birds. Tsao applied repeated measures analysis of variance to the growth data to compare the effect of three treatments (control, backpack transmitter, and implanted transmitter). The measurements were taken once every two days for a total of 30 days. She also analyzed the data using a hierarchical regression model with random parameters. The joint posterior density for all parameters in the model was simulated using Gibbs sam-

pling. This was done for each treatment group. Treatment groups will be compared using highest posterior density regions for various quantities.

Li-Ling Wu analyzed data on the relationship between respiratory pressure and volume for pigs. This relationship is being used as a new diagnostic tool for respiratory diseases. The experiment was conducted at the Veterinary Diagnostic Laboratory and used both healthy and sick pigs. The inserted volume of various predetermined pressure levels at both inspiration and expiration stages was analyzed by use of the analysis of variance. The physiological measures of weight and girth were also measured and used as covariates in the analysis.

A completely randomized design was used to evaluate effects of an antibody response of a vaccine on dairy cows. Light transmission was measured on a series of dilutions of a milk sample from each of seven vaccinated and control cows. Shiping Liu used a nonlinear curve to fit data from each cow and to predict dilutions for 25%, 50%, and 75% light transmission. The analysis of variance was used to evaluate the effect of the vaccine on the predicted dilutions.

Grace Liu analyzed data from a study that examined recent isolates of the scrapie agent to see if more than one strain exists in the United States. Mice were inocculated, in a completely randomized design, with suspensions of brain from 15 sheep suspected of having scrapie. Differences among suspension sources were demonstrated for length of incubation but not for number of lesions or prion protein.

Nan-Jung Hsu analyzed data from a completely randomized experiment that was designed to learn if the RTS-151 variant of the virus OAV-6 and the bacterium *P. haemolytica* causes pneumonia in lambs. The treatments were a factorial combination of the presence and absence of the virus and of the bacterium. The analysis showed that the virus causes pneumonia and the severity of the pneumonia increased greatly when the bacterium was combined with the virus.

Kari Henry and Beth Pierce consulted on a weed science project in which weed counts were made at 3 times during the growing season on treatments that were a factorial combination of 3 tillage methods, 2 cropping systems, and 3 weed management systems. A split split plot analysis of variance was recommended with the tillages as the whole plot factor, cropping and weed management systems as split plot factors, and time of measurement as the split split plot factor.

Kari Jovaag and Hiayan Shu consulted on a project that came from the Food Science and Agricultural and Biosystems Engineering departments. The experiment studied how the factors of particle size of ground corn and temperature of manufacture influence the bulk density and expansion of a corn chip type of product. Nonorthogonal contrasts were recommended for the analysis of variance because the treatments did not represent a complete factorial arrangement.

Xianfeng Hu and Paul Hinz analyzed data from a corn/oats/forage rotation experiment that used 3 levels of superphosphate, 2 levels of rock phosphate, and no phosphate as whole plot treatments and presence or absence of a starter fertilizer as a split plot factor. The superphosphate and starter treatments were applied once every 3 years only to the corn crop. The rock phosphate treatments were applied one every 6 years to the corn. Thirty-six years of data were used in the analysis. Yield was 16 bu/a higher for superphosphate than for rock phosphate. Use of starter improved yield by 8 bu/a.

Kenneth Koehler and graduate students Yoon-Sook Jeon and Huaichin Chen helped a faculty member in economics develop classification trees for identifying important factors in the success or failure of farming operations. Koehler and Jeon are also helping him analyze data from a survey of educational interests of agricultural lenders.

Koehler consulted with researchers in animal ecology on modeling the effects of various environmental factors on nest predation rates for ground nesting birds. Logistic regression models were used, and several methods of accounting for within transect correlations among binary responses were investigated. Koehler also consulted with the same researchers on modeling the effects of habitat factors on bird species abundance.

Koehler continues to work with a plant pathology faculty member on developing methods for predicting dew formation and duration of dew periods on plants. He consulted with a researcher in the Veterinary Diagnostics Laboratory on comparing incidence rates of a rare type of cancer in various breeds of dogs.

Hal Stern continues to consult with researchers in animal science. Most of this work is in the area of animal breeding.

▩ 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; supervise maintenance of hardware and software used by faculty, students, and staff in statistics; and consult on problems related to scientific applications of digital computers. Teaching and research activities for the section in 1995-96 were led by William J. Kennedy and Mervyn Marasinghe (see pp. 17).

The section experienced a major loss in March when Bud Meador retired. During his 30 years as supervisor of programming and data processing he maintained a well deserved reputation as a top professional in the computing field. Meador began his career in computing during the birth of the computer industry. His wealth of knowledge and experience in this area was an enormous and irreplaceable asset of the section.

Bud Meador, supervisor of Statistical Data Processing Services, is congratulated at his retirement reception by Ken Koehler, and Wayne Fuller.

The graduate students working with Kathy Shelley during the year included Huaichin Chen, Lori Cogar, Deanne Reber, and Tae-Sung Shin. Major projects included the State Forest Nursery projects, CHIP (Counting Homeless in Iowa), work for Ruan Leasing Inc., the Child Welfare Research Training Project, and EpiSTATION software development funded by ISYS Inc. Departmental computing service work was also provided by Reber, Cogar, and Shin.

Huaichin Chen and Kathy Shelley provided continual support for the State Forest Nursery. Work involved implementing software that allows customers to use VISA or Mastercard to pay for their tree orders. The Tree Order System, programmed in dBase IV, saves the credit card information that is electronically transmitted via modem for credit approval. With this new feature, the nursery has the largest number of credit card customers in the Iowa Department of Natural Resources.

Lori Cogar worked with a faculty member in the ISU Department of Human Development and Family Studies (HDFS) to design a data entry program (CHIP) that enables homeless shelters in Iowa to count and gather information on shelter attendees. This program was written in dBaseIV and is being tested on-site in selected shelters in Iowa. Cogar also produced graphs and sample statistics from a state-collected database. These graphs and statistics were incorporated into a report written by Paula Dail (HDFS) and Mack Shelley, and the results were presented to state officials. The State of Iowa is hoping that CHIP will provide a more accurate count than previous databases have.

Deanne Reber worked with Kenneth Koehler in producing the 1995 maintenance cost database, report, and PC cost estimation software for Ruan Leasing Inc. Reber developed new graphs for the report, which models estimated labor hour and maintenance costs for semi trucks. She also updated the PC software that produces cost and labor hour estimates

for scheduled maintenance of trucks at each repair terminal.

Tae-Sung Shin revised the data entry program for the Child Welfare Research Training Project to include new risk factors for placement of children in foster and group home facilities. This involved redesigning the database and substantial screen revisions. The database was then used in Windows SPSS for report generation. For the State Forest Nursery, Shin also installed new Windows remote control software that will allow us to work directly on the nursery's LAN computers from our section PCs via high speed modems.

Kathy Shelley worked with Pete Anderson (ISYS Inc.) and Tom Bubolz (Dartmouth University Medical School) on EpiSTATION, which is a mouse-driven software application used for data management and analysis of medical claims data. The software currently is in Beta test mode. It is installed and being tested at selected insurance companies, Medicare sites, and state health organizations. The target date for a commercial version of the software is the third quarter of 1996. This is an object-oriented application developed using SAS 6.11 FRAME.

With the rapid increase of World Wide Web usage, a need has been established for PC and Macintosh users to gain access to the Web. Both Deanne Reber and Lori Cogar worked on achieving this goal. Reber installed and tested software that allows users to use a WWW browser from home via the university PPP high speed telephone service. Cogar installed Netscape, a popular WWW browser, on departmental PCs with direct ethernet connections. Reber has also installed Eudora on ethernet-connected PCs, which enables PC users to do electronic mail in the Windows mouse environment. Tae-Sung Shin worked with Mervyn Marasinghe to develop the initial Web page for the ISU Statistical Computing Section. William Kennedy and Darlene Wicks have incorporated the Statistical Laboratory Annual Report on the Web.

Graduate students working with Bud Meador during the year included Chiang-Sheng Johnson Lee and Shiaau-Er Huarng. Lee worked mainly on the Iowa Corn Yield Test Project under direction from Meador and corn breeder Ken Ziegler. Huarng worked on a data analysis project for Dupont, cost estimation for the State Forest Nursery, and tape backups for departmental PCs. Meador continued to supervise installation and billing of Windows SAS for university-wide leasees. Huarng and Reber installed SAS under Meador's direction.

Johnson Lee and Bud Meador worked on completing the transition from mainframe Project Vincent™ PC for the Iowa Corn Yield Test Reports and the Books and Labels program for researchers in the Department of Agronomy. These programs were initially programmed in FORTRAN on a mainframe computer and have been successfully converted to run in Windows SAS on a fast pentium PC with attached laser printer. The amount of program code has been vastly reduced in SAS.

The ISU Computation Center provides backups for Project Vincent user files on public servers but PC

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users are responsible for their own backups. An external portable tape backup drive was purchased with departmental funds and Shiaau-Er Huarng backed up all of the secretary PCs and other faculty PCs. With the rapidly increasing amount of PC software, this will provide an easy way to restore hard disks if a drive crash occurs.
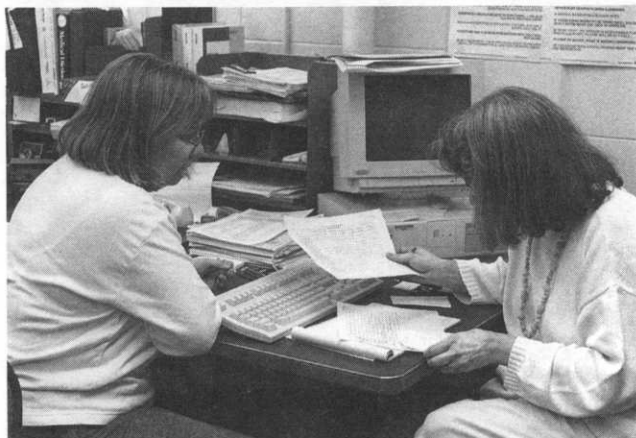
Survey Section

The Survey Section of the Statistical Laboratory provides consultation and direct operational assistance to research workers both on- and off-campus in sample design, 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. Andrew Williams oversees survey projects and staff, with support from Dianne Anderson and Janice Larson.

The Iowa Persian Gulf Research Project, conducted in collaboration with researchers at the University of Iowa, required a major effort throughout the year. Approximately 3,700 veterans who served at the time of the Persian Gulf War were interviewed by telephone to collect information on their physical and mental health, and on the health of children born to the veterans since the war. These hour-long interviews were conducted internationally using the Computer Assisted Telephone Interviewing (CATI) lab in the Survey Section. Five percent of completed interviews received a reliability interview shortly after the main interview. Proxy interviews were also conducted when warranted. The sample consisted of four groups defined by whether or not the veteran was present in the Persian Gulf during the war and whether the veteran was a member of the regular military or of the National Guard or Reserves. Data collection extended from September 1995 to May 1996. Survey Section staff were responsible for conducting the interviews as well as coding and processing the data.

The final year of data collection was completed for the Mayo Clinic's Division of Health Sciences Research. The study was designed to measure the impact of an intervention program that encourages physicians to institute a cancer screening reminder system with their female patients. Survey Section staff conducted interviews by telephone with women in southeastern Minnesota regarding their participation in various kinds of cancer prevention screenings. Staff members were responsible for designing and implementing sample selection procedures, data collection, coding, and processing, and assisting in calculation of estimation weights.

A case-control study of birth defects, funded by the Centers for Disease Control, examined pregnancy and genetic histories of mothers of children born in Iowa with specific multiple birth defects. The Survey Section conducted telephone interviews with

approximately 200 mothers, half of whom had children recently diagnosed with these defects. This survey is part of an ongoing multi-year project, in conjunction with researchers at the University of Iowa. One hundred ten mothers were also interviewed as part of California's birth defects project, sponsored by the California March of Dimes.

Jan Larson (right), the Survey Section's senior interviewing supervisor, discusses the Iowa Persian Gulf Research Project with Allison Tyler, interviewer.

A collaborative study sponsored by the National Institute on Aging and the National Cancer Institute was concluded this past year. This in-person study was designed to examine co-morbid conditions in older cancer patients. Survey Section staff designed the questionnaire and field forms and conducted training for the five participating states. In-person interviews were administered in Iowa with 300 recently diagnosed cancer patients over a two-year period.

Two state government projects were conducted this year. The Survey Section worked with the Iowa Department of Transportation to determine opinions of adult Iowans regarding resource allocation for transportation development options. Survey Section staff designed the sample, helped develop the questionnaire, and conducted telephone interviews with over 1,000 Iowa residents. In addition to the data collection, section staff were responsible for coding and processing the data, and calculating sample weights.

The staff also cooperated with the Iowa Department of Employment Services (DES) to select establishments to particpate in the 1996 survey of Iowa wage rates. The Survey Section was responsible for selecting a stratified sample of firms to obtain wage information for over 400 occupations for substate regions. The DES conducts the mail study and processes the data. In the fall of 1996, the section will conduct a telephone survey with a sample of nonrespondents. Survey Section personnel will then calculate sampling weights and estimate statewide and regional mean wage rates and entry level wages for individual occupations and groups of occupations. The statistical summaries are included in a report produced by the DES.

Several surveys were conducted for Iowa State University faculty and administrators. A pilot study designed to estimate the proportion of U.S. households with at least one member who owns or actively manages a family-owned business was conducted in the summer of 1995. Section staff assisted with questionnaire development and were responsible for sample design. Approximately 1,300 households were contacted and screened using a national white pages list. Section staff analyzed the data in preparation for a larger study of families who own or manage small businesses, to be conducted in 1997. A faculty member of the Department of Human Development and Family Studies organized the study, which was conducted for a multi-university Agricultural Experiment Station research consortium.

Survey Section staff worked with the Committee on University Planning and the Faculty Senate to conduct a faculty attitudes survey. Over 1,100 Iowa State faculty responded to a mail questionnaire designed to assess attitudes toward the quality of education at ISU, satisfaction with academic appointments, and future plans. Section personel were responsible for drawing the sample, designing the survey instrument, data collection, coding, and data processing as well as calculating weights.

A mail questionnaire to gather experiences and perspectives regarding the campus climate was also sent to a sample of students at Iowa State in a project sponsored by the Steering Committee on Diversity. This survey was a follow-up to the 1993 Study of the Campus Climate at Iowa State University. Survey Section staff assisted in the development of the questionnaire and coordinated the data collection, coding, and processing as well as the weight calculation.

A mail questionnaire was designed and sent to all Iowa State University senior administrative officials to determine the incidence of sexual harassment on campus. The section personnel were responsible for instrument design, survey administration, coding, and data processing.

Telephone interviews were conducted with 300 members of the university community to measure newspaper readership patterns and consumer habits for the *Iowa State Daily* newspaper board. This was a follow-up to a similar study conducted two years ago. In addition to assisting with questionnaire design, section staff were responsible for sampling, data collection, coding, and data processing.

A study was designed and conducted by the Survey Section in conjunction with administrators in the President's Office to determine the feasibility of conducting surveys with ISU seniors via e-mail. A sample of ISU students received either a telephone interview or a questionnaire via e-mail. The questions related to the importance of educational goals and satisfaction with educational progress as well as other questions designed to assess potential differences between the two modes of data collection. Survey Section staff were involved in the instrument design and responsible for data collection from the

telephone sample, as well as the data coding, data processing, estimation procedures, and analysis.

Survey Section staff also provided advice and consultation for many members of the university community, including the Office of Institutional Research, the Department of Forestry for a study of tree management in Iowa communities, the College of Family and Consumer Studies for a study of money management techniques, the Student Health Center for a student health project, the College of Design for an investigation of student retention issues, *Inside Iowa State* for a study of newspaper format, the Alumni Association for an International Alumni Survey, the ISU Foundation for an Alumni Contributors Study, the Iowa Supreme Court Select Committee for studies of juveniles in the court system, the Department of Professional Studies for an assessment study of training effectiveness, and the Parks Library for a survey of the tenure process in academic libraries.

▨ Center for Agricultural and Rural Development

Resource and Agricultural Policy Systems (RAPS) is a modeling system developed at the ISU Center for Agricultural and Rural Development (CARD) that can be used to obtain projections of the economic, resource, and environmental effects of agricultural activities at the national and the regional levels. Site-specific resource data from the 1992 National Resources Inventory (NRI) were used to develop many of the models within RAPS, and to design computer simulation experiments. In order to minimize the number of simulations needed to draw inferences at the desired levels of spatial aggregation, Alicia Carriquiry, Jay Breidt, and P. G. Lakshminarayan (CARD) proposed a multiphase stratified sampling approach that uses the 1992 NRI as a basis and further stratifies according to crop and crop rotations. Sampling rates from this sampling scheme can then be combined with the 1992 NRI expansion factors to obtain statistically reliable estimates at the regional, state, and major land resource area (MLRA) levels. A report entitled *RAPS 1996: Agricultural and Environmental Outlook* containing the projections was produced, and can be electronically obtained from the website http://www.ag.iastate.edu/card/RAPS. Jean Opsomer was also a collaborator in this project.

As global positioning systems (GPS) and other high accuracy positioning systems become widely available to farmers, the need for research in areas related to precision farming is pressing. Using signals from U.S. government satellites orbiting the Earth, GPS receivers located on farm machinery give farmers a fix on a specific location in their fields. This, combined with monitors for soil moisture, crop yield, and other measurements of interest, allows farmers to construct maps at very high levels of precision. Information from those maps can then be used by farmers to use inputs in a more efficient

manner and, in general, to better manage their farms. The Center for Agricultural and Rural Development, in collaboration with the Statistical Laboratory, has initiated research on several global issues related to precision farming, including creation and management of GPS-based data bases, combination of GPS data with other data bases such as the NRI, and economic and legal aspects such as ownership, location, cost, and input/output of the information. Alicia Carriquiry and Wayne Fuller, together with Stanley Johnson (CARD) are coauthors of a proposal to develop methods suitable for collecting and analyzing GPS-based data, that is under consideration by the university administration.

How should a farmer decide how much fertilizer to use on a crop? The optimal amount of fertilizer to use on a crop depends on factors such as weather, site characteristics, response of crop to added amounts of nutrients, cost of the fertilizer and its application, and price of output. Using a Bayesian approach and a profit maximizing utility function, Bruce Babcock (CARD), Alicia Carriquiry, and Hal Stern addressed the question of whether soil test information is valuable for a farmer making fertilizer decisions. A conclusion from this study was that farmers uncertain about the amount of nutrients present in the soil at the time of planting can significantly reduce the amount of applied fertilizer (without affecting yields) by conducting one or more soil tests prior to application. However, when farmers have some information about the nutrient content of the soil, the effect of a soil test in reducing fertilizer inputs is not as noticeable.

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.

Engineering Research Institute

Herbert T. David, Peter Sherman, Derrick Rollins, and Stephen Vardeman provided assistance on engineering research projects. For example, Vardeman assisted researchers from civil engineering working on the problem of setting safety factors for measured deflections of existing bridges.

Industrial Consulting

Bill Meeker visited the General Electric Research and Development Center for five days in July 1995. While there he consulted with GE engineers and statisticians on prediction of the number of failures in product populations, statistical methods for rapid product development, analysis of accelerated degradation data, and software for reliability data analysis. In related work, he was involved in helping to plan and analyze the data from an accelerated life test for electronic components to be used in a new generation of communications satellites.

Kenneth Koehler continued to work with Kathy Shelley and Deanne Reber in maintaining a model of truck maintenance costs for the RUAN Transportation Company, Des Moines, Iowa.

Derrick Rollins consulted for the 3M Company plant in Knoxville, Iowa.

Social and Behavioral Sciences and Humanities

Mack Shelley consulted with Iowa State University faculty and students from the departments of Sociology; Statistics; Economics; Human Development and Family Studies; Veterinary Anatomy; Engineering Fundamentls and Multidisciplinary Design; Political Science; Landscape Architecture; Family and Consumer Sciences Education and Studies; Professional Studies in Education; Hotel, Restaurant, and Institution Management; English; Psychology; and Industrial Education and Technology. Shelley also served as a consultant to the Iowa Department of Human Services, the ISU Center for Industrial Research and Service, and the ISU Student Union Board.

Consulting projects undertaken during the year addressed aspects of study design and data analysis, particularly applications of linear models and structural equations methods, to mostly survey data.

Areas of applications included the use of time series methods and structural equation models in a content analysis of government-to-government exchanges; quality assurance sampling procedures required to determine whether providers satisfy agency requirements for service delivery; the use of logistic regression models in a study of meat consumption patterns in Japan; the use of LISREL models in the analysis of survey data on family patterns; the use of factor analysis in a study of Iowa county-level social indicators related to student delinquency; the design and analysis of data from a survey of technology utilization by manufacturing firms in Iowa; a survey of the performance of college preparatory programs for disadvantaged students for a 10-state region; analysis of survey data dealing with compliance with court-ordered child-support payments in Iowa; analysis of data from surveys of attitudes among college students in India and the United States toward marital practices and filial obligation.

A special project led to submission of the study, "An Estimation of the Characteristics and Number of Sheltered Homeless in Iowa," to the Iowa Department of Economic Development, on February 20, 1996. This report is a portion of an ongoing stream of research focused on the causes and consequences of homelessness, and implications of recent trends in homelessness for the study of public policy. This work has been done in part with assistance from Xiaohong Cao.

Another special project, still in progress, resulted in submission of a report to the Iowa Department of Public Health, modeling the effects of design and geographic variables on the likelihood of contamination of rural wells with e. coli, coliform, nitrates, and atrazine. This work is being undertaken with the assistance of Sunhee Kwon.

A third special project, also still underway, involves construction of a survey instrument and analysis of data from a study of Iowa companies' needs for assistance by ISU in their pursuit of international business opportunities. This research is undertaken in collaboration with the International Agriculture Programs office in the College of Agriculture, and is being assisted by Sunhee Kwon. The project is entitled "International Needs Assessment of Iowa Business: The Implication for ISU's 1995-2000 Strategic Plan." Others involved in the project include David Acker, August Ralston, and Steffen Schmidt.

Carl Roberts continued to consult on research in the social sciences, especially on quantitative analyses and on methodological topics related to text analysis. These consulting activities have involved him in scores of research projects pursued by both faculty and graduate students.

As a joint appointment between the departments of Statistics and Sociology, Frederick Lorenz continued to provide faculty and graduate students in the social and behavioral sciences with statistical advice, especially as it relates to the design and analysis of multi-informant panel data.

▓ Other Consulting/Cooperation

Noel Cressie is a member of the Precision Agriculture Issue Team of the ISU College of Agriculture, whose role is to coordinate research at Iowa State in the use of Global Positioning Systems and Geographic Information Systems to improve yield through knowledge of site-specific spatial variability.

Cressie consulted with a professor in the Department of Botany on spatial sampling of riparian buffer strips, and with professors in the Department of Plant Pathology on spatial sampling of street trees in towns in Iowa and Wisconsin.

Kenneth Koehler consulted with a member of the National Animal Disease Laboratory, USDA, about the use of bootstrap methods in assessing the reliability of bacteria phenologies constructed from DNA sequences.

Hal Stern continued his collaboration with researchers at the Center for Transportation Research and Evaluation, Iowa State University, concerning an evaluation of the impact of electronic clearance at truck weigh stations on U.S. Interstate Highway 75. Stern assisted in analyzing the data from two pilot studies, reporting the results to a national advisory committee, and planning a two-year $500,000 evaluation to begin June 1, 1996. This project is part of a national effort to improve commercial vehicle processing.

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), and the College of Liberal Arts and Sciences (LAS). Several other colleges provide research support through graduate assistantships for statistics students; these students consult with researchers within the colleges.

▓ Natural Resources Inventories

The Survey Section continued its research under a cooperative agreement with the National Resources Conservation Service (NRCS), U.S. Department of Agriculture. This work is directed by Sarah Nusser.

Jay Breidt, Wayne Fuller, Nusser, and Jean-Didier Opsomer were responsible for sample design, statistical estimation procedures, and other statistical and survey methods research associated with the project. Richard Dorsch was in charge of data processing and data base management, assisted by Masoud Kazemi, Todd Krueger, Anita McVey, Kathie Reinertson, and Melissa Swanson. Other staff members working on this project during the year were Pubali Banerjee, Hsin-Cheng Huang, Jae-Kwang Kim, Amy Meyer, Junyuan Wang, and Kevin Wright.

The NRCS conducts a National Resources Inventory (NRI) of the country's soil and water-related resources every five years. The 1982, 1987, and 1992 inventories have been used to create a longitudinal database to study changes in resource conditions over the ten-year period. The national sample for 1992 was a stratified cluster sample of approximately 300,000 primary sampling units (PSUs), with approximately 800,000 points selected within 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. Data collected on PSUs included information on soil characteristics, land use, soil erosion, vegetative cover, and ecological variables such as habitat diversity. The 1992 NRI data were collected primarily by remote sensing via aerial photography with a minimum of on-site field visits.

Nusser, Breidt, and Fuller have investigated the general problem of sample design and statistical estimation to support investigations of the dynamics of change in ecological systems, focusing specifically on the use of 1992 NRI data to describe the relationship between temporal patterns in land use and changes in soil loss due to water erosion.

During the past year, several special studies relating to the 1992 NRI were completed. The final edited database was assembled for a subsample of the 1992 NRI, selected to study the condition and trend of rangeland. In addition, tabular summaries were produced for county-reliable data collected by the state of Kansas. Work also continued on edited data collected as part of the 1992 NRI by Alaska and on developing statistical estimation procedures that would enable the Alaska data to be analyzed using procedures similar to those used for the main 1992 NRI database. During the year Jean-Didier Opsomer was in charge of organizing and analyzing the 1992 National Resources Inventory for Alaska.

NRCS has become interested in developing methodology that will allow for more frequent analysis of certain resource conditions. As a result, a 1995 NRI Erosion Update Study was commissioned. A sample of about 3,000 PSUs was selected in early 1995 to study the effects of conservation tillage and other practices on the amount of soil erosion occurring on the nation's croplands, with particular emphasis on land classified as highly erodible. During the past year, data editing for this study was completed. Wayne Fuller, Jay Breidt, and graduate students Kevin Wright and Jae-Kwan Kim constructed regression weights for analysis of the 1995 Erosion Update Study, which were used to calculate estimates of the change in erosion rates from 1992 to 1995. Construction of replicate variance estimates is underway.

As part of the internal organization of NRCS, the National Resources Inventory and Analysis Institute was created and headquartered at the Statistical Laboratory. Dean Thompson (former NRCS collaborator with the Survey Section) serves as director of this institute. Agronomist Robert Dayton is also stationed at ISU. Other institute staff members are in Temple, Texas, and Fort Collins, Colorado. A major part of the institute's mission involves research relating to resource inventory data collection and analysis.

Using data from the 1995 Erosion Update Study, the Survey Section assisted the institute with an analysis of the types of conservation tillage used on certain varieties of cropland. Joint work was also conducted on a pilot project in several states involving an assessment of soil quality, in partnership with the NRICS Soil Quality Institute, also stationed at ISU. Finally, the Survey Section and institute collaborated with the ISU Computation Center to develop a computer-assisted survey information collection system for mobile data gatherers. The system is based on the use of hand-held pen-based computers (Personal Digital Assistants or PDAs) to record
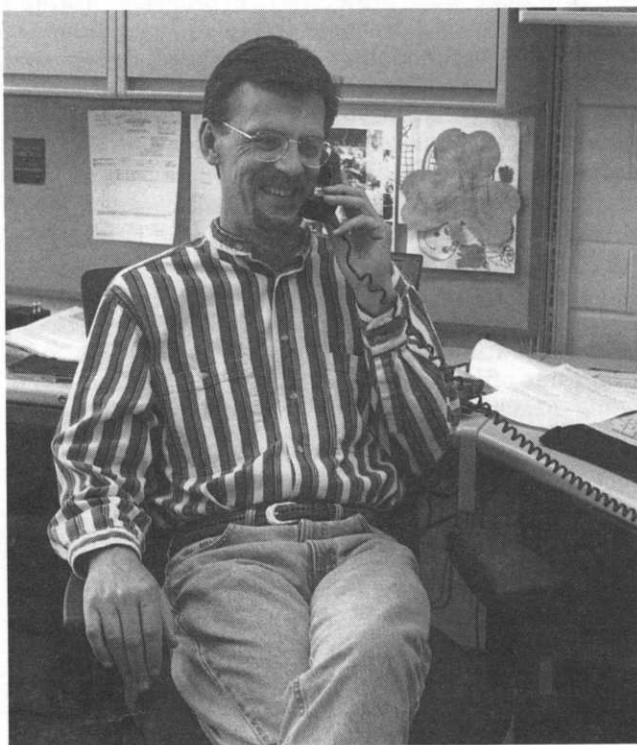
Dean Thompson is director of the Natural Resources Inventory and Analysis Institute established by the National Resources Conservation Service and headquartered at the Statistical Laboratory.

inventory data. The PDAs were field-tested on the Soil Quality Study in May 1996.

Preparation for the national 1997 NRI was also initiated. The national sample for the 1997 NRI will be identical to that of the 1992 NRI. Special studies are being planned to more intensively study selected topics using a subsample of the national sample. The initial survey instrument for the main 1997 NRI was developed along with plans for a central database system.

In May 1996, NRCS commissioned a special 1996 NRI Land Use Study to study the effect of the 1996 Farm Bill and high commodity prices on cropping patterns, land management, and cultural practices. As part of the study, the National Agricultural Statistics Service (NASS) is conducting a personal interview with a subsample of the land operators. A sample of about 4,000 PSUs, including the 3,000 PSUs from the 1995 Erosion Update Study, was selected. About 2,500 points in the selected PSUs were subsampled for operator interviews. F. Jay Breidt and graduate student Hsin-Cheng Huang used NRI data to develop logistic regression models of commodity crop probabilities, which were then used in the selection of the NASS subsample from the 1996 NRI study sample. Survey Section personnel participated in several meetings with NRCS and NASS staff to discuss the specific objectives of the project and the related data collection techniques. NRCS and section staff also collaborated with ISU Computation Center staff and PDA software vendors to develop the data collection screens and communications packages that would be needed to carry out this inventory.

In agricultural economic policy analyses, data such as long-run averages of soil lost to erosion, or chemicals leached to groundwater, are not available due to high costs. However, site-specific computer simulation models, which describe the corresponding physical processes of soil erosion and chemical movement, can be run on a sample of NRI points. Alicia Carriquiry, Breidt, and P. G. Lakshminarayan (CARD) have investigated the use of NRI data in these computer simulation experiments. (Also see p. 9.)

Visiting graduate student H. Martin Axelson, University of Örebro, Sweden, conducted research with Breidt and Carriquiry on agricultural economic policy analyses, in which two-phase regression estimation is used to combine the output of computer simulation experiments with information from the National Resources Inventory to obtain estimates at regional levels (e.g., hydrologic regions, counties, etc.).

▨ Soils Databases

An ongoing part of the NRCS cooperative work is the storage, maintenance, and software development for the national soil survey databases. These databases are stored at Iowa State University as an important part of the NRCS cooperative soil survey program for the United States. Harvey Terpstra directed this work, assisted by Masoud Kazemi, Deborah Reed-Margetan, Janet Schultz, Jan Seagrave, and Douglas Tschopp. The data entry staff included Glenda Ashley and Vimlesh Gupta.

Several main databases make up the system of soils data. The soil interpretations (SIR) database consists of basic soil property and interpretation information for all soil series in the nation. The official soil series description (OSD) database contains a textual description of soil series. The soil series classification (SC) database contains the official soil classification for soil series. The map unit interpretations (MUIR) database contains property and interpretation information for each map unit in NRCS soil surveys.

These soils databases are used by the NRCS to record and retrieve much of the basic information collected in their soil survey work. NRCS uses these databases to provide data for NRCS state and county office computer systems and to produce tables that are published in NRCS soil survey reports. 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 the Center for Agricultural and Rural Development have used the data.

Efforts continued this year on the development of World Wide Web (WWW) access to the NRCS soils data. During the year, access to the MUIR database was compiled, allowing users to download informa-

tion for a selected soil survey area. Work was also begun on enhancing the access to the OSD data by adding a capability to query for soils with selected classification and location attributes. In addition, WWW pages were designed and implemented to provide various information about the NRCS Soils Division (http://www.statlab.iastate.edu/soils/soildiv), including an NRCS manual entitled *Keys to Soil Taxonomy,* which soil scientists and researchers have found very useful when classifying soils.

Work continued throughout the year on transitioning databases from the ISU mainframe computer into a Unix environment. The SC and OSD databases are being moved to a Sun computer located in the ISU Computation Center, with updating and retrieval programs being developed. The MUIR database is already maintained in an Oracle database on Project Vincent™ and will remain in that system. The SIR database will be discontinued from active NRCS use. Investigation into storing the next generation of NRCS soil property and interpretation databases has recently begun.

Another major project this year was the continued development and refinement of a program to calculate the NRCS soil rating for plant growth (SRPG) index. This index is designed for use in comparing the relative productivity of soils nationwide. The index was used in the last USDA Conservation Reserve Program sign-up to help determine eligibility and amount of payment. We anticipate the need for further refinements of this index.

The ongoing tasks of system maintenance, hotline support for NRCS remote users, and data distribution were also part of this year's activities.

▨ Soil Survey Methods

Research to develop statistical methods for soil survey updates was continued in association with NRCS National Soil Survey Center staff in Lincoln, Nebraska, Iowa NRCS, and faculty and students in the departmens of Agronomy and Statistics. At Iowa State, Pam Abbitt, Jay Breidt, Bennie Clark (Agronomy), Tom Fenton (Agronomy), Wayne Fuller, Matt Haubrich, Sarah Nusser, and Zugeng Zheng participated in the project. NRCS staff included Ellis Benham, Louis Beockman, Bennie Clark, Dennis Lytle, and Gary Medlyn.

The National Cooperative Soil Survey, a program in which the NRCS collaborates with a state agency, is responsible for constructing soil maps detailing the location of soil series throughout the U.S. For each county, reports are generated that contain maps plus a description of the characteristics for each soil map unit (SMU) within the county. These maps are periodically updated by NRCS to provide current information on the range of values for particle composition, depth of horizons, and other related attributes. Soil scientists and other natural resource scientists have recently become interested in obtaining more detailed statistical descriptions of the distribution of SMU characteristics and geographically linked data.

A multi-phase sampling plan using Markov chain point selection is being field-tested in a three-year pilot project in Crawford and Woodbury counties as part of the Soil Survey Update for MLRA 107. The phases correspond to increasingly intensive data collection, and are designed to balance the burden of field work against the need for information to make meaningful statistical estimates. Data gathered under this sampling plan will provide improved estimates of central tendency and spread over those used previously with purposive samples. This design will also permit estimation of distributional parameters such as percentiles and will provide higher quality information for researchers who wish to model phenomena using soil properties. Research is being conducted on the properties of the design and estimators for distributional parameters. Pam Abbitt presented a paper at the 1995 Joint Statistical Meetings in Orlando on sample design for this project.

F. Jay Breidt has conducted research on Markov chain designs for sampling of continuous spatial domains as part of this project. These designs include as special cases systematic sampling, balanced systematic sampling, and stratified random sampling with one sampling unit per stratum. Designs are compared on the basis of their anticipated variances under superpopulation models that include both large-scale variation and small-scale variation. These designs were used in the first phase of a soil mapping project currently underway in western Iowa.

A small set of data collected during the 1995 field season was examined to initiate research on estimators for SMU properties. Because of these analyses, several soils in the Marshall series were targeted for data collection during the 1996 field season. Research on design- and model-based estimators is under way.

Work was also initiated to create a computer-assisted survey instrument on hand-held pen-based computers (PDAs). The initial screen designs and choice lists were developed and programmed. A set of edit rules will be assembled and an associated central database will be created in the following year.

▓ 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, the Iowa Agriculture and Home Economics Experiment Station. Federal agencies' support in the 1995-1996 year came 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, Anthony An, Pradipta Sarkar, Jae-Kwang Kim, and Cong Chen.

Research on methods of adjusting for nonresponse continued. Theoretical properties of estimators based on estimated response probabilities were investigated. Possible application of the procedures is to the Survey of Income and Program Participation (SIPP),

a large longitudinal study conducted by the Census Bureau. In SIPP, respondents are interviewed several times. Information from those that responded on the first interview but not on subsequent interviews, and information from the Current Population Survey are available for use in estimation at later stages of the study.

Anindya Roy conducted research on estimation procedures for multivariate time series. Activity concentrated on developing superior estimators for the multivariate autoregressive process under the possibility that the maximum root is near or equal to one. Previous studies have derived the large sample distributions of different estimators under the stationary model, and have shown these distributions to be poor approximations to the finite sample distribution for small or moderately large sample sizes, especially when one root is very close to one. A modification of the least squares estimator for the coefficients of a vector autoregressive process is being developed. The procedure uses properties of the limiting distribution for the unit root case. Preliminary theoretical results on the limiting distribution have been obtained. Monte Carlo results for the bivariate process suggest that the modified estimators have superior performance for models with a root near one.

Pradipta Sarkar worked on the construction of confidence intervals for predictions for time series with unknown error distribution. Stationary processes, near unit root processes, and unit root processes were included in the research. The differences between the empirical distribution function of the error process and the empirical distribution function based on the residuals from the autoregressive process were studied.

One algorithm for computing confidence intervals for predictions assumes that the error distribution can be transformed to normal by some appropriate transformation. In this approach, the underlying transformation, and hence the error distribution, is estimated by a semiparametric distribution estimation procedure based on a sufficiently large but fixed number of residual quantiles. Some of the necessary asymptotics have been developed. Given an estimator of the distribution of the error, a maximum likelihood estimation procedure is used to obtain improved estimators of the parameters. The estimated distribution function can be used to construct confidence intervals for predictions.

The second approach being studied generalizes the idea of recursive residuals and is based on a t-type approximate pivotal. The values of the approximate pivotal are calculated by using only part of the data for each approximate pivotal. The large sample distribution of the approximate pivotal is then estimated from the empirical distribution of these quantities, and the critical values are determined. Confidence intervals for predictions are obtained using these critical values.

Wayne Fuller conducted research on small area estimation, in cooperation with Cary Isaki and Julie Tsay of the Census Bureau. Estimators of variance

for some small area estimators were derived and applied to data collected as part of the 1990 Decennial Census. Methods of constructing estimators of household characteristics given external information on individuals and household information from the census were investigated.

A Monte Carlo study of estimators of the estimated true values for simple linear measurement error models was conducted. The simple procedure that ignores the variance introduced by estimating the parameters was shown to seriously underestimate the variance. Estimators containing the estimation component of the variance produced confidence intervals with coverage probability close to the nominal probabilities.

Dietary Intake Estimation

Work on several aspects of dietary intake estimation continued this year. The research was supported through a cooperative agreement between the Agricultural Research Service of the U.S. Department of Agriculture, the Statistical Laboratory, and the Center for Agricultural and Rural Development at ISU. Participants in this work are Wayne Fuller, Alicia Carriquiry, Sarah Nusser, Todd Krueger, Kevin Dodd, Juan Goyeneche, Soledad Fernandez, Zugeng Zheng, Cong Chen, and Helen Jensen (Center for Agricultural and Rural Development). Patricia Guenther and Phil Kott were active collaborators from the U.S. Department of Agriculture. This long-term project has had as its primary goal the construction of good estimators of the distribution of usual intakes by individuals for dietary components. Usual intake is defined to be the long-run average daily intake by an individual.

Based upon the research of previous years, a production computer program for the estimation of usual intakes was written. Todd Krueger was primarily responsible for preparing the program, written in the C language and operating in an X Windows environment. The program features an easy-to-use graphical interface and produces estimates of the quantiles of usual intake distributions and their standard errors, and diagnostic statistics.

Kevin Dodd conducted extensive Monte Carlo studies to assess the properties of replication variance estimators for the estimated quantiles of usual intakes. Both jackknife and balanced repeated replication methods gave good estimators of variances.

Juan Goyeneche, Alicia Carriquiry, and Wayne Fuller extended the procedures for estimating the usual intake distribution of a single dietary component to the bivariate case. The estimation of a transformation that produces a pair of variables that is nearly bivariate normal requires several additional steps beyond those used for the univariate case. The estimated bivariate distribution was used to estimate the distribution of the ratio of two dietary components. An example of a ratio of interest is the ratio of the usual intake of calories from fat to the usual intake of total calories.

Sarah Nusser and Zugeng Zheng continued research on the estimation of the distribution of usual intakes for foods. The set of observed daily intakes for foods is characterized by the presence of many zeros, and, hence, requires a different estimation approach from that used for nutrients. Different individuals have different probabilities of consuming a particular food. Therefore, the distribution of individual consumption probabilities and the conditional distribution of intakes given that the food is consumed were estimated. Initial work assumed the conditional distribution of intakes to be independent of the probability of consumption. A simulation conducted to examine the performance of methods used when frequency of food intake is unrelated to the consumption day usual intake demonstrated that the procedure worked well under the assumptions. Estimation procedures based on these methods are part of the production program prepared by Krueger. Cong Chen, Carriquiry, and Fuller investigated the relationship between mean consumption on consumption days and the probability of consumption. A model was developed to enable the estimation procedures to be extended to the situation in which mean consumption on consumption days is correlated with the probability of consumption.

Spatial Statistics

Research is supported on two different grants. *Inference for Spatial Stochastic Processes* is a three-year extension of a previous grant from the Office of Naval Research. Noel Cressie is principal investigator working on modeling and detecting clusters in spatial point patterns. Research on local versions of the product density function, joint with Linda Collins, addresses the problem of characterizing points within clusters.

Jennifer Davidson, associate professor in the Department of Electrical Engineering and Computer Engineering, ISU, is co-principal investigator, working with Cressie on the automatic detection of objects from images and on statistical inference for image textures using partially ordered Markov models. Cressie and Davidson prepared a major entry for the *Encyclopedia of Statistical Science (Update)* on Image Processing.

Spatial Statistics Research Applied to Ecological Resource Monitoring Programs is a three-year cooperative agreement funded by the Environmental Protection Agency. Noel Cressie is principal investigator, and Dianne Cook, Mark Kaiser, Soumendra Lahiri, and James Majure (manager of the Geographic Information System Support and Research Facility at Iowa State) are co-principal investigators. Five statistics graduate students are supported on the grant: Jeremy Aldworth, Nan-jung Hsu, Jaehyung Lee, Inna Megretskaia, and Jürgen Symanzik.

Cook, Majure, Megretskaia, and Symanzik are looking at interactive and dynamic graphics for high-dimensional spatial data linked directly to a geographic information system. Cressie, Kaiser, and

Lahiri are looking at statistical inference methods for these statistical summaries. The spatial cumulative distribution function of a given region is one summary that has been considered in detail. Videos displaying the graphics work have been produced with the assistance of the ISU Media Production Unit (see pp. 37 and 40).

Cressie is working on statistical problems in aggregation and disaggregation and, with Aldworth, on the use of geostatistics in sampling from spatially distributed ecological resources. Kaiser is working with Lee on spatial mixture distributions and with Cressie on constructing Markov random fields. Lahiri is working with Hsu, Cressie, and Kaiser on spatial subsampling methods for statistical inference. As an application, the spatial subsampling methodology was used to analyze the forest health monitoring data for the Northeastern region of the U.S. Finite sample properties of the proposed method are currently being investigated through an extensive simulation study.

Noel Cressie and Hal Stern are conducting joint research on spatial epidemiology, in particular, the investigation of putative causes for extremes in disease incidence rates over small areas. Hierarchical Bayes models are being employed with care being taken to construct appropriate spatial prior distributions and relevant loss functions.

Multi-target Tracking

Alicia Carriquiry and Jay Breidt, with Wolfgang Kliemann and Dragan Mirkovic (both in the Department of Mathematics), and Amarjit Budhiraja (Brown University), initiated research on a three-year project on multi-target tracking, with funding from the Office for Naval Research, U.S. Department of Defense.

Multi-target tracking (MTT) is an essential component of military surveillance as well as of air traffic control systems. In an MTT system, the observation data come from sensor measurements reporting information from the coverage region of the sensors. The MTT algorithm then performs basically three steps between successive scans of the sensors: (i) data association: matching observations with the correct target; (ii) filtering: estimating the position of the target; and (iii) prediction: obtaining predicted positions and their prediction regions for the next scan. Today, most MTT systems use linear (or piecewise linear) algorithms for the filtering and prediction steps, combined with a finite state Markov chain technique for the data association problem.

We address the following research questions: (i) how to integrate techniques from nonlinear stochastic systems theory into MTT algorithms, including nonlinear modeling, nonlinear filtering, and prediction, and (ii) how to evaluate the performance of various algorithms, including the (extended) Kalman-Bucy filters and nonlinear algorithms with real time capabilities. Nan-Jung Hsu is a research assistant working on this project.

Nonlinear Mixed Effects Models

Theoretical aspects and applications of nonlinear mixed effects models are being investigated under a three year grant from FONDECYT (Fondo de Ciencia y Tecnologia), Chile, starting in January 1996. Alicia Carriquiry is a co-investigator. The principal investigator, Guido del Pino, and the other co-investigator, Guillermo Marshall, are both in the Department of Statistics, Pontificia Universidad Católica de Chile.

Mercury Contamination in Minnesota Sportfish

Mark Kaiser, Jay Breidt, and Sarah Nusser, assisted by graduate students Dana Bruden, Rong Li, and Heidi Shierholz, completed work on a statistical review of the Minnesota Fish Contaminant Monitoring Program. The project resulted in four reports submitted to the State of Minnesota Department of Natural Resources (MNDNR). Two of these reports propose a probability-based sampling plan for the program in the future, and two concern the analysis of existing data. Major issues in the design of a sampling plan for this program were incorporation of existing data collection efforts by MNDNR under projects other than the monitoring program, and minimizing the number of previously unsampled lakes required for valid statistical estimation of statewide quantities.

Analysis of existing data showed that temporal and spatial patterns did not emerge from the current database (since 1970). The major relations found in existing data were relations between size and mercury concentration in individual fish. Such relations appear to be species and lake specific, and patterns do not emerge from consideration of the state as a whole. A generalized linear model with inverse Gaussian random component and log link is a general form of regression model appropriate for the analysis of data for fish of a single species in a given lake.

Probability Theory and Mathematical Statistics

While on faculty development leave Krishna B. Athreya, in collaboration with R. Narasinha, developed a spatial and temporal point process model for studying turbulence of weather patterns over the Indian subcontinent. He also studied the problem of the vacillating statistician and other random iterations leading to fractal sets. He obtained some results on the relation between conditional and joint distributions. He continued his work on branching Markov processes and large deviation problems.

Research by Soumendra Lahiri on mathematical statistics has been in the areas of resampling methods and spatial statistics (see below). A three-year grant from the National Science Foundation provides support for this work. Block bootstrap methods provide estimators of various population parameters

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under dependence without strong structural assumptions on the underlying process. However, it is not obvious how to obtain a good estimator of the mean squared error (MSE) of the resulting block-bootstrap estimator. In this context, a simple and computationally efficient method, called the Jackknife-After-Bootstrap method, is formulated and consistency of the proposed method is established. In addition to providing an estimator of the MSE, the Jackknife-After-Bootstrap method is noted to have applications in other problems, such as data-based choice of the optimal block length for the block bootstrap method. In other works, properties of a resampling method, called subsampling, have been investigated for spatial data and also for time-series data exhibiting long-range dependence.

Design of Experiments

John Stufken, supported by a grant from the National Science Foundation, continued his research in design of experiments. He considered questions concerning the existence of certain designs, methods of construction for certain designs, and algorithms to find certain designs with desirable properties. Designs that played a role in these considerations were orthogonal arrays, trend-free and nearly trend-free designs of various types, crossover designs, and sampling designs to control the selection probabilities of contiguous units. A major theme of the NSF-supported work was, and will continue to be, making advances in design of experiments more readily available and accessible for applications.

Dynamic Graphics

Dianne Cook conducted research on dynamic graphics methods for analyzing multivariate data. In particular, this focused on user controls for displaying projections of high-dimensional data, and methods applicable to spatial data with multiple measurements made at each spatial location. (See the description of research on spatial statistics on p. 15.)

In addition, Cook is collaborating with the Iowa Center for Emerging Manufacturing Technology on research into using the C2 Virtual Reality environment for exploring multivariate data. Exploratory research is being funded by a National Science Foundation grant.

Statistical Computing

Mervyn Marasinghe is collaborating with Nimal Wickremasinghe, lecturer in the Department of Statistics and Computer Science, University of Colombo, Sri Lanka, on some unresolved problems in the area of analysis of multiway nonreplicated experiments. Wickremasinghe has extended Marasinghe's work on using the multiplicative interaction model for such analyses.

Statistical Methods for Correlated Survival Data

Work by Kenneth Koehler continues on the development of methods of analysis for interval censored time to event data from independent clusters of correlated response times. Applications include analysis of failure times for individual medical procedures when patients are simultaneously treated with more than one procedure, and hatch times for insect eggs.

Modeling Panel Data

Frederick O. Lorenz does 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. During the 1995 fall semester, Lorenz was on a faculty improvement leave to work with a colleague on this project, Prof. Glen H. Elder, Jr., at the University of North Carolina at Chapel Hill. Lorenz also works with Prof. Joseph Hraba (ISU) on an application of the stress-distress model to families in the Czech Republic. Lorenz traveled to Prague in October 1995 to work with Prof. Zdenka Pechacova at the Agricultural University of Prague to finalize plans for the third wave of data collection. Data were collected from over 700 Czech families in January and February, 1994 and 1995, with a 97.5 percent initial response rate and a 95 percent retention rate. The data are currently being analyzed for presentation at professional meetings and for publications.

Precision Farming

Modern agricultural equipment such as combines may be equipped with sensors and global positioning systems (GPS) which together allow a farmer to create a detailed image of the harvest from a particular field. By using a geographic information system (GIS) to overlay this image with layers of information on topography, soil characteristics, seeding rates, chemical applications, and so forth, the farmer hopes to make money-saving decisions. For example, the farmer might vary fertilizer application rates throughout the field, matching chemical inputs to local needs. This is known as "precision farming" or "site-specific crop management." A potential side benefit is reduced environmental impact. F. Jay Breidt is a collaborator with principal investigator Keith Whigham, ISU Department of Agronomy, and others on the project "On-Farm Site-Specific Crop Management for Iowa," funded by the Iowa Soybean Promotion Board.

Reliability and Nondestructive Evaluation

Pradipta Sarkar and Bill Meeker have been working on the NIST funded project "Program for Inte-

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grated Design, NDE, and the Manufacturing Sciences" being conducted by the ISU Center for Nondestructive Evaluation. They have been involved in the use of nondestructive evaluation techniques for process monitoring. In one application, build-up of contaminating material on parts used in a casting process can result in units being produced with an unacceptable level of porosity. Large pores in manufactured parts under stress grow into cracks that would eventually lead to a serious failure. Manufactured units are inspected with a series of X-rays, using 35 different views. The inspection process is expensive and sampling inspection could be used to reduce cost. Sarkar and Meeker developed a process model and used a Bayesian updating scheme to determine appropriate decision criteria and inspection intervals.

Bill Meeker and Shuen-Lin Jeng are members of the Probability of Detection (POD) 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 of the project is to develop and evaluate better ultrasonic inspection methods for finding potentially dangerous "hard alpha" flaws in titanium to be used in components of jet engines. The POD working group is developing better methodology for assessing and predicting probability of detection. The methods being developed use a physical model to predict ultrasonic signal response as a function of parameters of the inspection system, the inspection plan, and physical properties of the material being inspected. This physical model is combined with a statistical model to quantify variabilities that are not captured by the physical model. In the past year, details of the methodology have been implemented in a computer program. As an extension of previous work with flat-bottom hole synthetic flaws, a large experiment was designed and conducted on cylindrical synthetic hard-alpha flaws in titanium. The results of this experiment have been used to quantify the effect that potentially important experimental and flaw factors have on NDE signal strength and to develop an appropriate empirical model for ultrasonic signals and material noise.

Bill Meeker and Luis Escobar (Louisiana State University) continued their collaboration on research problems in the area of reliability data analysis. In one project, they have been developing methods to predict the number of future failures that will occur in a product population, given early information on field failures. In another project (also joint with C. Joseph Lu from National Cheng-Kung University) methods have been developed for the analysis of accelerated degradation data. Accelerated degradation data provide more information in less time and with less reliance on dangerous extrapolation. The major Meeker-Escobar project, however, has been the writing of a text book that has grown out of their consulting work, their research, and the reliability courses that they teach in their respective departments (Stat 533 at ISU). The book will contain a number of important topics that have not appeared in other text books. These include analysis of arbitrarily censored data which often arise in field tracking studies, analysis of degradation data, analysis of system repair data, use of bootstrap likelihood ratio and bootstrap methods for accurate confidence intervals, prediction of future failures, and physics-of-failure concepts for accelerated test models. Meeker and Escobar are also developing a suite of S-Plus functions that will allow analysts to easily use the methods in the book.

▨ Statistical Process Control and Gross Error Detection

Derrick K. Rollins continued as principal investigator on projects funded by the National Science Foundation, the National Aeronautics and Space Administration, and the 3M Corporation. Statistics graduate students working with him during the 1995-1996 year, with support from Rollins' Presidential Faculty Fellows Award and/or project grant funds, include Shonda Roelfs Kuiper, Jean Pelkey, James Smith IV, Kristine Bendixen, Sriram Devanathan, Jun Zhu, Xiaohong Cao, and Yihong Xiao.

Research during the year involved five areas in chemical engineering: industrial data reconciliation and gross error detection, statistical modeling and sensor validation in space life support systems, statistical methods to enhance neural networks, improvement of powder mixture homogeneity, and statistical process control. Master's theses by Angelita Nason-Garth, Maritza Melèndez, and Jennifer Walker (see abstracts on pp. 00 and 00) relate to certain aspects of this research.

Victoria Chen from the Georgia Institute of Technology visited Iowa State from January through June 1996 to work with Derrick Rollins on statistical techniques for chemical engineering processes. In ongoing research, she and Rollins are studying the strengths and weaknesses of applying artificial neural networks (ANNs) to chemical processes.

Visiting scholar Victoria Chen confers with graduate student Jamie Smith. They are involved in collaborative research on statistical techniques for chemical engineering processes undertaken by Derrick Rollins and his group.

In new research, they began collaborations with Cory Finn at the NASA Ames Research Center on statistical and engineering techniques for a closed ecological life support system (CELSS). Finn is project scientist for a laboratory-scale CELSS at NASA Ames, which Chen visited to gain a more complete understanding of the CELSS process. In addition to gross error detection techniques developed by Rollins and his group, Chen is considering methods in statistical process control, change-point analysis, time series, and sequential analysis for the CELSS project. Chen's collaborations with Rollins include several of the students in his group. In particular, she is working with James Smith on the comparison of statistical versus ANN methods for modeling the human thermoregulatory system, and with Jun Zhu on statistical model discrimination for ANNs.

During her visit, Chen also continued her own research on statistical modeling for stochastic dynamic programs and for automatic guided vehicles in a fixed path system.

▨ Drowsy Driver Identification

Ongoing research by Peter Sherman focused on the statistical analysis of a wealth of on-road data collected by research personnel of Rockwell International (RI). Main results of the analysis were (i) driver drowsiness prediction algorithms obtained from simulator driving environments have very limited utility to the on-road environment associated with the RI study, and (ii) a correlation analysis among the algorithm regression variables revealed some strong dependencies, which could contribute to the poor performance of the algorithm. Graduate students Michael Schuckers and Michael Elling were supported by this project, which was funded jointly by the Midwest Transportation Center and Rockwell International.

▨ Periodic Random Process Research

This research by Peter Sherman is concerned with statistics associated with time series model parameters for wide sense stationary processes having mixed spectrum. A major accomplishment in 1996 was a large sample distribution for not only the model parameters but also the corresponding spectral density estimator. A second accomplishment was a large sample distribution for the LS estimator of the frequency of a sinusoid in white (or colored) noise. Of particular importance was the discovery that both bias and variance are minimized when the tone frequency is located at 1/2 of the Nyquist frequency.

This project receives support from a three-year grant from the Division of Statistical Signal Processing, Air Forces Office of Scientific Research; in the 1995-96 year it provided funding for one student in electrical engineering who is pursuing a concurrent degree in statistics.

▨ Other Research

Support for the work below was largely funded by the Statistical Laboratory, the College of Liberal Arts and Sciences, and/or the Agriculture and Home Economics Experiment Station at Iowa State University.

Theory and Methods

H. A. David and Jason Gunnink have written a paper on the paired t-test under artificial pairing. Together with H. N. Nagaraja, Ohio State University, David has prepared a comprehensive article on concomitants of order statistics for Volume 15 (on Order Statistics) of the *Handbook of Statistics*. David has also collaborated with N. Balakrishnan, McMaster University, on the variance of trimmed means. Jointly with Peter Armitage, Oxford University, David has edited *Advances in Biometry,* a volume marking the 50th anniversary of the International Biometric Society.

Noel Cressie and Peter Morgan, Department of Economics, State University of New York-Buffalo, continued their investigations of the variable-sample-size-sequential probability ratio test (VPRT). They have compared the cost efficiencies of the VPRT and other commonly used sequential procedures. They have also prepared an entry for the *Encyclopedia of Statistical Science (Update)* on Variable-Sample-Size-Sequential Probability Ratio Test (VPRT).

Richard Groeneveld reviewed the historical development of measures of skewness going back to the early work of Francis Galton and G. Udny Yule. An article based on this work will appear in the *Encyclopedia of Statistical Sciences,* Update Volume 2.

Yasuo Amemiya conducted research in multivariate analysis. The case of nonlinear factor analysis was investigated as a statistical method for analyzing social and behavioral data. For structural equation analysis with nonlinear measurement models, a two-step model fitting procedure was proposed and studied. With Sock-cheng Koh, for a heteroscedastic factor model with error variances depending on factor scores, a graphical diagnostic procedure and a model fitting algorithm were developed. The problem of multiple nonlinear functional relationships was considered with Jean Pelkey in the context of engineering applications. Inference procedures for the true values adjusted for the nonlinearity bias were proposed for the data reconciliation problem. Three test procedures for the relationships were compared for the problem of leak detection. With Elizabeth Paterno, estimation of random effect models with errors-in-variables was investigated.

F. Jay Breidt continued research on stochastic volatility models, including analyzing a threshold autoregressive variation of the model with graduate student Carter Blakeley, establishing extreme value behavior in joint research with Richard Davis of Colorado State University, and investigating regime-switching alternatives with graduate student Pamela

Schmidt. With graduate student Nan-Jung Hsu, Breidt is exploring methods of estimation for hierarchical long memory time series, including long memory versions of stochastic volatility.

Jean-Didier Opsomer's current research involves extensions of nonparametric regression theory into several areas. He studied the asymptotic behavior and conditions for the existence of estimators for bivariate additive models fitted by local polynomial regression (Preprint 95-27) and proposed a fully automated bandwidth selection algorithm (Preprint 95-32) for that situation. He also analyzed the bandwidth selection problem for local polynomial regression when the observations are correlated (Preprint 95-42), both in the univariate and bivariate cases.

Alicia Carriquiry and Jay Breidt conducted research on methods for estimating genetic trend. In animal selection experiments, objectives include estimation of the unobservable genetic change realized during the experimental period, and forecasting change into the future. Data available to practitioners include phenotypic records for animals in the population, pedigree information, and information on covariates such as breed, gender, and time of birth of those animals. A time series model imbedded in the traditional mixed effects model was proposed for representing data from selection experiments. A Bayesian method for parameter estimation and forecasting was developed, where marginal posterior distributions of interest are obtained using Markov chain Monte Carlo procedures. The method can also be used to analyze longitudinal data. Soledad Fernández is a research assistant working on this project.

Mathematical and Statistical Genetics

Project 3201 of the Iowa Agriculture and Home Economics Experiment Station supports research by Edward Pollak on mathematical and statistical genetics. In the 1995-1996 academic year he developed a general method for obtaining expressions for the effective population size of a finite diploid population. The approach is to use a branching process approximation to calculate the amount of variance in the frequency of a neutral allele that is expected to be generated in the long run if there is originally a single copy of this allele in the population. If there is random mating, or N permanent couples, with probabilities and 1 - respectively that reproduction is by the mating of full-sibs and by random mating, this method yields results for both autosomal and sex-linked loci.

Working under the supervision of Edward Pollak, Laknath Peiris did research on the prediction of progress from selection when both nuclear and cytoplasmic genes influence a quantitative character. In an earlier joint work of Pollak and K. Frey and W. Beavis of the Department of Agronomy, expressions had been given for covariances between relatives for such a quantitative character. Unfortunately, the experimental designs discussed in that paper did not allow for the estimation of all the genetic variance components needed to predict the performance of offspring from the mean of the parents. Peiris has found ways that these estimates can be obtained.

Engineering Statistics

While on faculty improvement leave, Peter Sherman engaged in research on random processes at the Australian Defence Science & Technology Organization, Adelaide, Australia, during the summer and fall 1995, and at the Korea Advanced Institute of Science & Technology, Science Town, Teajon, Korea, in November 1995.

Social Science Applications

Carl Roberts' main activity during the 1995-96 year has been assembling a collection of articles on text analysis for inclusion in an edited volume scheduled for publication in January 1997. He has been completing some additional writing on text analysis.

Roel Popping (University of Groningen, the Netherlands) and Roberts continued their research on the post-1989 East Central European press. Their primary focus is on changes in professionalism during the transition to democracy.

Mack Shelley currently is pursuing research applications of statistical methods, primarily structural equation models and time series techniques, to studies of the patterns of intergenerational interaction between adult children and their parents, policy implications of the well-being of the oldest-old (aged 85 and over), the causes and consequences of homelessness in Iowa, legislative elections, the effect of cultural attitude dimensions and religion on American politics, environmental contamination, and the consequences of age and gender as predictors of injury severity in vehicular collisions. A book on contemporary issues in United States public policy is under preparation. A book chapter on applications of multivariate statistical methods for dichotomous dependent variables is forthcoming. Shelley is co-editor of a forthcoming symposium on The Politics of Policy, in the *Policy Studies Journal.*

Shelley is also principal investigator of a survey to evaluate program performance for the Mid-America Association of Educational Opportunity Program Personnel, for a 10-state region. He is co-principal investigator (with Clete Mercier, of the Department of Civil and Construction Engineering, and Joyce Mercier, of the Department of Human Development and Family Studies) on the study, "A Investigation of Injury Trauma Among Older Vehicular Accident Victims," sponsored by the Iowa State University Gerontology Program, and co-principal investigator (with Janis Stone, of the Department of Textiles and Clothing, and others) for the project "Playground Tires: Are They Safe?," to determine contamination levels on used tractor tires that might be recycled for playground equipment.

Sara Kind, for her creative component, working under Robert Strahan, investigated the multidimensionality of the Marlowe-Crowne Social Desirability Scale.

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Professional Activities

Offices and Committee Work

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

Alicia Carriquiry began a two-year term as a member of the Executive Committee of the American Statistical Association Biometric Section (Proceedings editor), and was president-elect of the ASA Iowa Chapter for 1995-1996. Stephen Vardeman continued to serve on the ASA Nominations and Publications Committees. Carriquiry was also appointed to the Regional Advisory Board of the Eastern North American Region of the International Biometric Society for a period of three years.

Dean Isaacson chaired the ASA Committee of Institutional Members and Academic Chairs at the 1995 joint statistical meetings in Orlando, Florida. This group has been renamed Academic Program Representatives. H. A. David is continuing as an ex officio member of the Committee on ASA Archives and Historical Materials.

Isaacson is serving on the Conference Planning Committee for the Statistics Partnerships among Academe, Industry, and Government (SPAIG). The conference is scheduled to be held in May 1997.

Wayne Fuller is a member of the ASA 1996 Strategic Planning Committee and attended a meeting in Alexandria, Virginia, May 10-11. He chaired meetings of the Advisory Committee on Statistical Methods of Statistics Canada, in Ottawa, Canada, on October 30-31, 1995, and April 22-23, 1996.

Fuller participated in an American Agricultural Economics Association Data Task Force on Economics and Environmental Data Needs that met in Minneapolis, Minnesota, on July 9-11, 1995; at Berkeley, California, on September 14-15; and in San Francisco, California, on January 7-8, 1996. He attended the meeting of the Advisory Committee to the U.S. Census Bureau on the Survey of Income and Program Participation (SIPP) on September 22, 1995, and an American Statistical Association meeting on the Technical Aspects of the SIPP in Washington, D.C., September 26.

Frederick O. Lorenz served as a member of the development committee for the Rural Sociological Society.

Noel Cressie attended an advisory committee meeting of the Geophysical Statistics Project, National Center for Atmospheric Research, in Boulder, Colorado, on February 5, 1996, and returned to the project for a two-week visit on June 7-22. He also served as a member of the Science Advisory Board for the Second International Symposium on Spatial Accuracy Assessment in National Resources and Environmental Sciences, held in Fort Collins, Colorado, May 21-25.

Wayne Fuller continued to serve on the Council of the International Statistical Institute.

H. A. David Conference

At the conference held in his honor, H. A. David receives congratulations after presentation of the Festschrift. Shown are his wife, Ruth, and Carl Roberts.

Sir David R. Cox presents the keynote address.

The Department of Statistics at Iowa State University sponsored and hosted a Conference in Honor of Herbert A. David's 70th Birthday, held on November 17-18, 1995. The conference was supported by the university, Shell Oil, General Motors, and alumni and friends. A Festschrift written in honor of H. A. David was released at the conference.

The organizing committee consisted of Dean Isaacson (ISU), D. F. Morrison (University of Pennsylvania), H. N. Nagaraja (Ohio State University), and P. K. Sen (University of North Carolina, Chapel Hill). The program included a keynote lecture by Sir David R. Cox, six other invited addresses, and a number of contributed papers. More details are given on pp. 44-45.

▨ Short Courses, Workshops, and Paper Sessions

Kenneth J. Koehler participated in the Advanced Placement Statistics Workshop sponsored by the College Board and the American Statistical Association, in San Antonio, Texas, July 9-16, 1995.

Krishna B. Athreya chaired a session at the conference Branching Processes, Markov Chains, and Large Deviations, on the occasion of Peter Ney's 65th birthday celebrations at the University of Wisconsin-Madison July 13-15, 1995. He also chaired the opening session of the Second Oberwolfach Conference on Branching Processes, held December 17-24, 1995, in Oberwolfach, Germany.

At the joint statistical meetings in Orlando, Florida, August 13-17, Alicia Carriquiry chaired a contributed papers session on Time Series and Regression Model Selection. Dianne Cook chaired the contributed papers session on Nonparametric Methods. Stephen B. Vardeman organized and chaired the *Technometrics* invited paper session on Nondestructive Evaluation and Statistics, and hosted the *Technometrics* banquet. William Kennedy chaired the *Journal of Computational and Graphical Statistics* invited paper session. Roundtable luncheons on Interactive Graphics with XGobi and on New Directions for JCGS were hosted by Cook and Kennedy, respectively. Cook is program chair-elect for the ASA Statistical Graphics Section for the 1997 joint meetings.

A one and one-half day short course on Variance Estimation in Complex Surveys was presented for the International Association of Survey Statisticians on August 20-21, 1995, by Wayne Fuller, Kirk Wolter (NORC), and F. Jay Breidt in Beijing, China.

Frederick Lorenz chaired two sessions, one on health and another on changing rural families, at the 1995 Rural Sociological Society meetings in Washington, D.C.

Peter Sherman was part of a committee to organize a U.S./Australia signal processing workshop, tentatively scheduled for August 1996. The workshop theme is development and application of advanced signal processing for industry and defense applications.

Bill Meeker gave a short course on Statistical Methods for Reliability Data, jointly with L. A. Escobar (Louisiana State University), at Morschach, Switzerland, September 13-15, 1995, under sponsorship of the Swiss Statistical Association.

Alicia Carriquiry was a member of the program committees for the Third World Meeting of the International Society for Bayesian Analysis and Congreso Iberoamericano de Estadistica, both held in Oaxaca, Mexico, September 1995. She was also on the organizing committee for the VI Latin American Congress on Probability and Mathematical Statistics (CLAPEM) held in Viña del Mar, Chile, November 21-24, 1995.

Alicia Carriquiry was on the organizing committee, and Wayne Fuller, on the scientific committee, for the XIV EIPES (Winter School in Probability and Statistics) organized by CIENES and the P. U. Catolica de Chile and held concurrently with the Bernoulli Society's VI CLAPEM (Congreso Latino-Americano de Probabilidad y Estadística Matemática) in Viña del Mar, Chile, November 20-24.

Carriquiry (ISU) and Servet Martinez (Department of Mathematical Engineering, Universidad de Chile) were principal investigators for a grant project funded by the National Science Foundation, Division of International Programs, for a six-month period in 1995-96. The purpose of the project was to partially support a workshop, New Directions in Stochastic Processes, held on November 21-24, in Viña del Mar, Chile.

Alicia Carriquiry was invited to present results from nutrition research work to the National Academy of Sciences Food and Nutrition Board in November 1995.

Krishna Athreya gave a set of four lectures at the Statistics-Mathematics Division, Indian Statistical Institute, Bangalore, India, in November and a set of three talks on branching processes at the Department of Mathematics, Indian Institute of Science, Bangalore, in January 1996. In March-April 1996 he held the Jawaharlal Nehru chair at the University of Hyderabad and gave a set of three lectures on his research and a set of eight lectures on probability theory to the graduate students at the Department of Mathematics there.

Dianne Cook gave a workshop on Graphical Methods for Multivariate Data to atmospheric scientists in San Francisco, California, in February. She also gave a workshop on Information Visualization: Graphical Tools for Statisticians, to Environmental Protection Agency personnel, at Research Triangle Park, North Carolina, and George Mason University, Fairfax, Virginia, on April 24-25.

Alicia Carriquiry, Robert Hogg (University of Iowa), and Anne Cannon (Cornell College) organized the joint spring meetings of the Iowa Chapters of the American Statistical Association and the Mathematics Association of America, held in Mount Vernon, Iowa, April 26-27.

Soumendra Lahiri organized an invited paper session, Empirical Likelihoods and Resampling Methods, for the 1996 IMS annual meeting in Chicago 4-8 August 1996.

Noel Cressie presented a two-day short course, on Spatial Statistics for Environmental Modeling, to the Biostatistical Society of Finland, in Jyvaskyla, Finland, May 13-15.

Jointly with Gerald J. Hahn (GE Corporate Research and Development), Bill Meeker presented Statistical Intervals, a short course sponsored by the Cleveland chapter of the American Statistical Association, in Cleveland, Ohio, May 21, 1996. He presented, jointly with L. A. Escobar, Statistical Methods for Accelerated Testing, a short course sponsored by Centro de Investicion en Matematicas (CIMAT), at Guanajuato, Mexico, June 3-6.

Yasuo Amemiya presented a 10-lecture short course, Statistical Analysis with Errors in Variables, at the Department of Statistics, Tunghai University, Taichung, Taiwan, on May 27-31, 1996.

Derrick Rollins presented a short course on Probability and Statistical Inference for Chemical Engineering Faculty and Graduate Students, on June 11-14 at Iowa State University.

Alicia Carriquiry gave a short course on Bayesian Approaches to Linear Models in June for the International Statistics Symposium: Bayesian Statistics, held in Santa Marta, Colombia.

▨ Editorial Activities

William Kennedy continues as editor of the *Journal of Computational and Graphical Statistics*.

Stephen Vardeman was *Technometrics* editor until the end of 1995, with Sharon Shepard serving as editorial assistant. W. Robert Stephenson continues as an associate editor.

Yasuo Amemiya continues as associate editor of the *Journal of Business and Economic Statistics* and *Statistics & Probability Letters*.

K. B. Athreya continues to be an associate editor of *Statistics & Probability Letters* and of the *Journal of Statistical Planning and Inference*.

Alicia Carriquiry continues as an associate editor of *Revista Colombiana de Estadística*.

Dianne Cook continued as associate editor for graphical and computational articles, expanded to include multivariate analysis articles, for the *Journal of Educational and Behavioral Statistics,* and assumed duties as associate editor of the *Journal of Statistical Software,* a new electronic journal (http://www.stat.ucla.edu/journals/jss/).

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

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

Fred Lorenz served as an associate editor of *Rural Sociology* through December 1995.

Bill Meeker is an associate editor of the *International Statistical Review*.

Sarah Nusser is publications officer, Biometrics Section, American Statistical Association, for calendar years 1995 and 1996.

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

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

W. Robert Stephenson continued on the editorial boards for the *Journal of Statistics Education* and *STATS: The Magazine for Students of Statistics*.

Hal Stern continued to serve as a senior associate editor of *Chance* magazine, published by the American Statistical Association.

John Stufken continued as an associate editor of *Communications in Statistics* and of the *Journal of Statistical Planning and Inference.*

▨ Other Activities

In September 1995, Hal Stern visited Trinity College, Dublin, Ireland, to serve as an external examiner for a Ph.D. thesis written in the Department of Statistics at Trinity.

Wayne Fuller and Michael Perlman (University of Washington) acted as interviewers for the videotaping of Prof. T. W. Anderson for the American Statistical Association's Distinguished Statistician video series, in Hartford, Connecticut, October 3, 1995.

W. Robert Stephenson reviewed proposals submitted to the National Science Foundation's Instrumentation and Laboratory Improvement Program, in Arlington, Virginia, January 31-February 3.

Linda Brant Collins participated as a judge, in Winona, Minnesota, April 12-13, 1996, in the annual Undergraduate Data Analysis Contest sponsored by the American Statistical Association.

Derrick Rollins is chair of the African American Studies interdepartmental undergraduate program at ISU. He also was faculty adviser for the student organization Campus Crusade for Christ at ISU during the year.

Mervyn Marasinghe accepted a visiting senior lecturer appointment in the Department of Statistics and Computer Science, University of Colombo, Sri Lanka, for the period June 7-July 26, 1996. He taught a summer course to fourth-year undergraduates in statistics and engaged in collaborative research (see p. 17).

▨ Papers Presented, Lectures, and Seminars

At the 1995 joint statistical meetings of the American Statistical Association, the Biometric Society (ENAR and WNAR), and the Institute of Mathematical Statistics, Orlando, Florida, August 13-17:

Abbitt, Pamela J., and Sarah M. NUSSER: "Sampling and analysis approaches for soil survey updates";

AMEMIYA, Yasuo: "Fitting nonlinear measurement models to scale scores";

An, Anthony B., and Wayne A. FULLER: "Regression adjustments for nonresponse";

BREIDT, F. Jay: "Markov chain designs for one-per-stratum spatial sampling";

BREIDT, F. Jay, Alicia L. CARRIQUIRY, and Wayne A. FULLER: "Improved quasi-maximum likelihood for stochastic volatility";

Buja, Andreas, and Dianne COOK: "Through the windshield in n-dimensions";

CARRIQUIRY, Alicia L., and Wayne A. FULLER: "Estimation of day-to-day correlations for ratios of nutrients";

Coffin, Marie (Clemson University), and Shashikala SUKHATME: "Nonparametric estimation of the partial area index of a receiver operating characteristic curve";

CRESSIE, Noel, and Hal S. STERN: "Inference for extremes in epidemiology";

Deo, Rohit, and Wayne A. FULLER: "A test for multivariate roots";

Escobar, Luis A., and William Q. MEEKER, Jr.: "Statistical prediction based on censored life data";

FULLER, Wayne: one of 5 panelists (J. Michael Brick, Marjorie Dauphin, Fuller, James M. Lepkowski, and Babu Shah) for panel on "P.C. software for sampling errors from complex surveys";

Nan-Jung Hsu, Hsin-Cheng Huang, Anindya Roy, Pradipta Sarkar, and Kevin Wright: "Choose the right school: Some investigation about the quality of education, tuition and faculty salary structure";

KOEHLER, Kenneth J., and Shin-Soo Kang: "Modification of the Greenwood formula for correlated response times";

NUSSER, Sarah M.: discussant, invited papers session on Sampling Issues in Regional Monitoring Programs;

Olin, Bryan D. (Procter & Gamble Company), and William Q. MEEKER, Jr.: "Applications of statistical methods in nondestructive evaluation";

Papadopoulos, Savas, and Yasuo AMEMIYA: "On factor analysis of longitudinal data";

SHELLEY, Mack C. II, and Joyce McDonough Mercier: "Interaction of adult children with their parents: Health, proximity, and siblings";

Shin, Chungyeol, and Yasuo AMEMIYA: "Estimation of the covariance matrix in the general multivariate mixed effect model";

STEPHENSON, W. Robert: "Statistics at a distance" (selected as the best contributed paper in the Section on Statistical Education at the 1995 ASA meetings);

STERN, Hal S.: "Who's hot and who's not: Runs of success and failure in sports";

Stuetzle, Werner, Andreas Buja, Dianne COOK, and Sally Morton: "Computer graphics in statistics: The first 30 years";

Ver Hoef, Jay M. (Alaskan Department of Fish & Game), and Noel CRESSIE: "Modeling hidden Markov chains using empirical Bayes methods";

Youssef, Ahmed H., Alicia L. CARRIQUIRY, Ghazal A. Ghazal, and Stanley R. Johnson: "Seemingly unrelated unrestricted regression equations";

At the Rural Sociological Society meetings held in Washington, D.C., August 17-20, 1995:

LORENZ, Frederick O., and V. D. Ryan: "Mixing modes in small towns: Mail/telephone experiments in community development projects";

LORENZ, Frederick O., R. L. Simons, C. Johnson, and K. A. S. Wickrama: "Trajectories of life stress and health in single and married women."

At the annual meeting of the American Sociological Association held in Washington, D.C., August 19-23, 1995:

Hraba, J., Frederick O. LORENZ, G. Lee, and Z. Pechacova: "Gender stratification and health in the Czech Republic";

LORENZ, Frederick O., J. Hraba, and Z. Pechacova: "Economic conditions, spousal interactions, and psychological distress of Czech husbands and wives";

ROBERTS, Carl W.: "The politics of secularization: On religious products and the political contexts that enhance their appeal";

ROBERTS, Carl W., and Roel Popping: "On the universe of text-related questions about which statistical inferences may be drawn."

At the 50th Session of the International Statistical Institute, Beijing, People's Republic of China, August 21-29, 1995:

BREIDT, F. J., A. L. CARRIQUIRY, and W. A. FULLER: "A comparison of estimation procedures for stochastic volatility models";

CARRIQUIRY, A. L., and W. Kliemann: "Exploring stationary surfaces for Markov chain Monte Carlo methods";

FULLER, W. A., and R. Deo: "Tests for unit roots in vector time series."

At the 48th Annual Scientific Meeting of the Gerontological Society of America, held in Los Angeles, California, November 15-19, 1995:

Mercier, J. M., M. C. SHELLEY II, and E. A. Powers: "Religious commitment and social relationships: Their relative contributions to self-esteem of Catholic sisters in later life";

Mercier, C. M., M. C. SHELLEY II, J. M. Mercier, and G. H. Adkins: "Age as a predictor of injury severity in broad-side and angle vehicular collisions."

At the Bernoulli Society's VI CLAPEM (Congreso Latino-Americano de Probabilidad y Estadística Matemática) (Sixth Latin-American Congress of Probability and Mathematical Statistics, in Viña del Mar, Chile) held in Valparaíso, Chile, November 20-24, 1995:

BREIDT, F. Jay: "A threshold autoregressive stochastic volatility model";

BREIDT, F. Jay, Nuno Crato, and Pedro J. F. de Lima: "On distinguishing long memory from regime switching in volatilities";

BREIDT, F. Jay, Alicia L. CARRIQUIRY, and Wayne A. FULLER: "Alternative estimation procedures for stochastic volatility";

COOK, Dianne, and Andreas Buja: "Data through the windshield in p-dimensions";

Deo, Rohit, and Wayne A. FULLER: "A test for cointegration";

FULLER, Wayne A.: "Estimation in the presence of measurement error."

At the joint spring meetings of the Iowa Chapters of the American Statistical Association, and the Mathematics Association of America in Mt. Vernon, Iowa, April 26-27, 1996:

Abbitt, Pamela J.: "Sampling approaches for soil survey updates";

Axelson, H. Martin, F. Jay BREIDT, and Alicia L. CARRIQUIRY: "Two-phase regression estimation for policy analysis using computer simulation experiments";

Bruden, Dana L., and Mark S. KAISER: "Effects of aggregation in bivariate correlation";

COOK, Dianne: "Through the windshield in p-dimensions";

Dodd, Kevin W., Alicia L. CARRIQUIRY, and Wayne A. FULLER: "Replicate weighting methods for quantile variance estimation";

Haubrich, Matthew, and Matthew Schwab: "An interactive method for ranking cities";

Hsu, Nan-Jung, and F. Jay BREIDT: "Bayesian approach to long-memory stochastic volatility models";

Huang, Hsin-Cheng, and Noel A. C. CRESSIE: "A spatio-temporal Kalman filter";

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

Roy, Anindya, and Wayne A. FULLER: "Estimator for the first order vector autoregressive process";

Sarkar, Pradipta, and William Q. MEEKER: "Bayesian on-line abrupt change detection algorithms with process monitoring applications";

Shierholz, Heidi: "Sampling approaches for Minnesota fish contamination and ecology studies";

STERN, Hal S.: "Who's hot and who's not?--Runs of success and failure in sports."

At the 96th American Society for Microbiology General Meeting, held in New Orleans, Louisiana, May 19-23, 1996:

Ho, K-L. G., A. L. Pometto III, P. N. HINZ, A. Demirci, and J. S. Dickson: "Ingredients selection for plastic composite supports (PCS) discs for L (+)-lactic acid biofilm fermentation";

Ho, K-L. G., A. L. Pometto III, P. N. HINZ, and A. Demirci: "Micronutrients leaching and end product accumulation in plastic composite supports (PCS) discs for L(+)-lactic acid (LA) biofilm fermentation";

Ho, K-L. G., A. L. Pometto III, and P. N. HINZ: "Optimization of L(+)-lactic acid production by ring/disc plastic composite supports (PCS) through repeated batch biofilm fermentation."

At the Corn Utilization Conference VII, St. Louis, Missouri, June 3-8, 1996:

Ho, K-L. G., A. L. Pometto III, P. N. HINZ, J. S. Dickson, and A. Demirci: "Selection of agricultural materials for plastic composite supports used in L(+)-lactic acid biofilm fermentation";

Ho, K-L. G., A. L. Pometto III, P. N. HINZ, and A. Demirci: "Complex nutrients leaching and lactic acid accumulation in plastic composite supports for L(+)-lactic acid biofilm fermentation";

Ho, K-L. G., A. L. Pometto III, and P. N. HINZ: "Enhancement of L(+)-lactic acid production by plastic composite supports through repeated batch biofilm fermentation."

At the 3rd International Conference on Precision Agriculture, Minneapolis, Minnesota, June 23-26:

Mallarino, A. P., P. N. HINZ, and E. S. Oyarzabal: "Multivariate analysis as a tool for interpreting relationships between site variables and crop yields";

Oyarzabal, E. S., A. P. Mallarino, and P. N. HINZ: "Using precision farming technologies for improving applied on-farm research."

At other locations:

AMEMIYA, Yasuo: "Multivariate data analysis using nonlinear intent variable modeling," seminar at the Department of Statistics, Kansas State University, March 14, 1996.

"Exploring and modeling multivariate data using factor analysis," seminar at the Department of Mathematics, National Central University, Chungli, Taiwan, May 23.

"Nonlinear latent variable modeling of multivariate data," seminar at the Institute of Statistical Science, Academia Sinica, Taipei, Taiwan, May 24.

ATHREYA, Krishna B., and Hye-Jeong Kang: "Laws of large numbers for branching Markov processes," at the joint annual meeting of the Statistics Society of Canada and the Institute of

Mathematical Statistics, Montreal, Quebec, Canada, on July 11, 1995.

"Branching according to St. Peter," at the conference Branching Processes, Markov Chains, and Large Deviations, on the occasion of Peter Ney's 65th birthday, at the University of Wisconsin-Madison, July 13.

"A martingale approach to change of measures," colloquium at the School of Mathematics, T.I.F.R. Centre, Indian Institute of Science, Bangalore, India, September 13.

"Change of measures for Markov chains and an application to Markov chains," a Platinum Jubilee lecture at the 83rd annual session of the Indian Science Congress at Punjabi University, Patiala, India, held January 3-8, 1996.

"Large deviation for branching Markov processes," colloquium talk at the Indian Statistical Institute, New Delhi, January 8.

"Markov chain Monte Carlo methods," colloquium talk at the Department of Automation and Computer Science, Indian Institute of Science, Bangalore, February 13.

"Branching Markov processes" and "Markov chain Monte Carlo methods," at the Statistics-Mathematics Division, Indian Statistical Institute, Calcutta, April 2.

"Bootstrapping--a tool for inference" and "Markov chain Monte Carlo methods," at the Central University, Tezpur, Assam, India, April 5.

"Change of measures for Markov chains," invited lecture to the Indian Mathematical Society, Hyderabad, April 10.

"The vacillating mathematician--a stochastic version," to the National Board of Higher Mathematics Enrichment Program, Indian Statistical Institute, Bangalore, June 19.

BILIAS, Yannis G.: "A sequential analysis of Pennsylvania`reemployment bonus' experiment," at the 5th annual meeting of the Midwest Econometrics Group, St. Louis, Missouri, in October 1995; also at the North American summer meetings of the Econometric Society, Iowa City, Iowa, in June 1996.

BREIDT, F. J.: "Statistical issues in multitarget tracking," by Breidt and A. L. CARRIQUIRY, at the Tracker Workshop, NRaD, U.S. Navy, San Diego, California, February 7, 1996.

CARRIQUIRY, A. L.: "Métodos de estimación en problemas de volatilidad estocástica," by Carriquiry and F. J. BREIDT, at II Congreso Iberoamericano de Estadistica, Oaxaca, Mexico, September 24, 1995.

"Change-point problems in agriculture: The case of response to fertilizer," by Carriquiry and Hal STERN, at the Third World Meeting of the International Society for Bayesian Analysis, Oaxaca, Mexico, September 26, 1995.

"Assessing the dietary status of populations," seminar, Department of Biostatistics, University of Minnesota, Minneapolis, October 17, 1995.

"Assessing the proportion of the population at dietary risk: A brief commentary," seminar, National Academy of Sciences, Institute of Medicine, Washington, D.C., December 12, 1995.

"Transformation of dietary intake records into estimates of population intakes," at the meetings of the Federation of American Societies of Experimental Biology, Washington, D.C., April 17, 1996.

"A Bayesian hierarchical approach to change-point problems," by Carriquiry and Hal STERN, invited talk at the German Cancer Research Institute, Heidelberg, Germany, June 17, 1996.

CHEN, Victoria: "Important considerations in dynamic predictive modeling using artificial neural networks and other empirical

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modeling methods," by A. J. Biechler, Chen, Kelly McGlynn, and **Derrick ROLLINS**, at the 23rd annual National NOBCCHE Conference, Detroit, Michigan, April 1996.

COOK, Dianne: Discussant for "Graphics for assessing the adequacy of regression models," by Dennis Cook, at the American Society for Quality Control Fall Technical Conference, St. Louis, Missouri, October 20, 1995.

CRESSIE, Noel: "Spatial CDF estimation and visualization" and "Change of support and the modifiable areal unit problem," seminars at the National Health and Environmental Effects Research Laboratory, Environmental Protection Agency, Corvallis, Oregon, July 27 and 28, 1995.

"Spatial statistical modeling of environmental data," seminar, Colloquium of the Interdisciplinary Consortium for Statistical Applications, Indiana University, October 25; also Geophysical Statistical Project Seminar at the National Center for Atmospheric Research, Boulder, Colorado, October 26.

"Partially ordered Markov models (POMMs) as spatial statistical models," at the Workshop on Spatial Statistics, Image Analysis and Stochastic Geometry, Centre for Mathematics and Computer Science, Amsterdam, the Netherlands, November 10.

"Non-point source pollution of surface waters over a watershed," by Cressie and **James J. Majure,** at the Statistics in Public Resources, Utilities, and in Care of the Environment (SPRUCE) III Conference held in association with the International Statistical Institute, Merida, Mexico, December 11.

"GIS, spatial statistical graphics, and forest health," by Cressie, **James J. Majure, Dianne COOK,** and Jürgen Symanzik, at the Third International Conference/Workshop on Integrating GIS and Environmental Modeling, Santa Fe, New Mexico, January 22, 1996; also at the Workshop on Data Reliability for Environmental Impact Assessment: Statistical Issues, Modelling, and Policy, Edinburgh, Scotland, March 21.

"Partially ordered Markov models (POMMs) as spatial statistical models," seminar, Department of Computer Science, Iowa State University, April 25, 1996; also seminar, Department of Statistics, University of Chicago, May 20.
"Statistical modeling of environmental data in space and time," at the Second International Symposium on Spatial Accuracy Assessment in Natural Resources and Environmental Sciences, in Fort Collins, Colorado, May 22.

"Clustering in spatial point patterns," by Cressie and **Linda COLLINS,** at the Office of Naval Research Workshop on Minefields and Planar Point Processes, Naval Surface Warfare Center, Dahlgren, Virginia, May 23.

"Spatial analysis and inference for extremes in disease incidence rates," seminar at the Division of Cancer Prevention and Control, National Cancer Institute, Bethesda, Maryland, June 5.

"Change of support and the modifiable areal unit problem" and "Spatial sampling," seminars for the Geophysical Statistical Project, National Center for Atmospheric Research, Boulder, Colorado, June 13 and June 20, respectively.

DAVID, H. A.: "The paired t-test under artificial pairing," seminar, Centre for Applied Statistics, University of Waikato, Hamilton, New Zealand, August 28, 1995.

"First (?) occurrence of common terms in mathematical statistics," at the A. C. Aitken Centenary Conference, University of Otago, Dunedin, New Zealand, August 30, 1995; also at the Department of Statistics, University of Georgia, May 17, 1996.

"The paired t-test under artificial pairing," as the 4th Bradley Lecture, Department of Statistics, University of Georgia, May 17, 1996, and as a presentation to the East Midlands Group of the Royal Statistical Society, Leicester, U.K., June 27.

FULLER, Wayne A.: "Estimation for longitudinal surveys," seminar, U.S. Bureau of the Census, Washington, D.C., May 15.

"Estimation for longitudinal surveys," at the Symposium on Recent Developments in Sampling Methods, New York University, New York City, May 17.

GROENEVELD, Richard A.: "Outcomes assessment in the B.S. statistics program at Iowa State University," at the annual meetings of the Mathematical Association of America in Orlando, Florida, January 12, 1996.

HARVILLE, David: "Use of the Gibbs sampler to invert large, sparse, positive definite matrices," at the Fourth International Workshop on Matrix Methods for Statistics, Montreal, Canada, held July 15-16, 1995.

HINZ, Paul N.: "Applying statistics, some examples," seminar, Department of Mathematics, Gustavus Adolphus College, October 17, 1995.

"Interpreting relationships between soil and plant variables for site specific management," by A. P. Mallarino, Hinz, and E. S. Oyarzabal, at the American Society of Agronomy annual meetings, held in St. Louis, Missouri, October 29-November 3.

"Data presentation in plant sciences journals," guest lecture in the course Hort 529, Department of Horticulture, Iowa State University, February 13, 1996.

"Statistics and its importance in research," seminar for the Agricultural Engineering Graduate Student Organization, Iowa State University, February 29.

HUANG, David C.: "Analysis of repeated measurements of data, by Huang and M. M. Cooper, at Upjohn Company, Kalamazoo, Michigan, May 2, 1996.

KAISER, Mark: "Joint mixing distributions for random parameter models," by Kaiser and **Noel CRESSIE,** at the International Workshop on Statistical Mixture Modelling, in Aussois, France, September 18, 1995.

"Regression mixed over the unit interval," seminar at the Department of Statistics and Actuarial Science, University of Iowa, in October.

"Estimating the relation between environmental gradients and animal abundance," at the 16th annual Midwest Conference on Population Biology, held in Ames, Iowa, November 4-5.

"Estimation of ecologically stable relations using regression mixed over the unit interval," at the 6th International Conference on Environmetrics, held in Bangi, Selangor, Malaysia, in December, and sponsored by the Universiti Kebangsaan, the International Environmetrics Society, and the Malaysian Institute of Statistics.

"Approaches to statistical data analysis in botany," seminar, Department of Botany, Iowa State University, February 23, 1996.

KOEHLER, Kenneth J.: "Analyzing proportions with linear and generalized linear models: A comparison," at the Conference on Applied Statistics in Agriculture, held at Kansas State University, Manhattan, Kansas, April 28-30, 1996.

"Methods for analyzing correlated binary response data: applications to ecological studies," at the Conference on Inference and Applications, held at the University of Minnesota, Minneapolis, Minnesota, June 21-22.

LAHIRI, Soumendra N.: "On the optimal choice of block-size for the moving block bootstrap method," at the 58th Institute of Mathematical Statistics annual meeting with the Statistical Society of Canada, in Montreal, Canada, held July 9-13, 1995.

"Prediction of spatial CDFs and prediction bands based on a subsampling method," seminar, Department of Statistics, Pennsylvania State University, April 19, 1996.

MEEKER, William Q.: "Statistical tools for the rapid development and evaluation of high-reliability products," by Meeker and Michael Hamada, at the General Electric Corporate Research and Development Center, Schenectady, New York, July 24, 1995.

"Accelerated degradation tests: Modeling and analysis," by Meeker, L. A. Escobar, and C. J. Lu, at the General Electric Corporate Research and Development Center, Schenectady, New York, July 25, and at Lockheed-Martin Electronics Park, Syracuse, New York, July 27.

"Methodology for estimating nondestructive evaluation capability," by Meeker, R. B. Thompson, C-P Chiou, and S-L Jeng, at the 1995 Quantitative Nondestructive Evaluation Conference, Seattle, Washington, August 3, 1995.

"Applications of statistical methods to nondestructive evaluation," by **Bryan D. Olin** and Meeker, seminar at the Department of Statistics, University of Missouri, October 4, 1995.

"Development of a methodology for assessing Probability of Detecting Hend-Alpha Flaws in Titanium," at the FAA Engine Rotor Life Workshop, Atlantic City, New Jersey, November 8-9, 1995; also presented at the Engine Titanium Consortium Open Forum, San Francisco, California, May 9, 1996.

"Statistical tools for the rapid development and evaluation of high reliability products," at the Iowa Conference on Rapid Product Development sponsored by the Iowa Technology Transfer Council, Des Moines, Iowa, March 7.

"Assessing the effect of in-service inspections on the reliability of degrading components," at the American Society of Nondestructive Testing Conference, Norfolk, Virginia, March 20.

"Basic concepts of reliability and quality control in product development," at a workshop on substitute heart valves, National Institutes of Health, Washington, D.C., April 30.
"Accelerated degradation tests: Modeling and analysis," at the Joint Research Conference on Quality, Industry, and Technology, at the National Institute of Standards and Technology, Gaithersburg, Maryland, May 29, 1996.

NUSSER, Sarah M.: "Statistical methods for soils survey updates," seminar, National Soil Survey Center, Lincoln, Nebraska, February 20, 1996.

"Methods for using aggregated natural resource data as covariates," by Nusser, W. R. Clark, and D. L. Burden, at ENAR '96: The Value of Statistics and Statistical Reasoning in Society, a joint meeting of the International Biometric Society (ENAR), the Institute of Mathematical Statistics, and sections of the American Statistical Association, Richmond, Virginia, March 18, 1996.

"Indicators of central tendency for food composition databases," seminar at the USDA Human Nutrition Research Center, Riverdale, Maryland, April 1; also workshop panelist.

"Design and estimation for investigating the dynamics of natural resources," by Nusser, **F. Jay BREIDT,** and **Wayne A. FULLER,** at the Ecological Resource Monitoring: Change and Trend Detection Workshop, Laurel, Maryland, May 2.

POLLAK, Edward: "Survival probabilities for mutant alleles in tetraploids and two locus allele combinations in diploids," at the 1995 annual meeting of the Society of Systematic Biologists, the Society for the Study of Evolution, and the American Society of Naturalists, at McGill University, Montreal, Canada, July 12.
ROBERTS, Carl W.: "The politics of secularization," seminar, Department of Sociology, Iowa State University, September 11, 1995.

"Network approaches in text analysis," by Roel Popping and Roberts, at the Deutsche Gesellschaft für Klassifikation meeting, Freiburg, Germany, in March 1996.

ROLLINS, Derrick: "To whom much is given, much is required," keynote speech at the ISU Fall 1995 Academic Recognition Banquet, October 11, 1995.

"No more excuses--*carpe diem* (seize the moment)," keynote speach at the annual Alpha Phi Alpha inaugural Black and Gold Ball, Iowa State University, December 1.

"Engineering with passion, purpose, and principles," keynote speech at the Engineer's Week Banquet at Iowa State University, September 18, 1995, and for the 25th anniversary of the Minority Engineering Program, Kansas State University, April 20, 1996.

"Selecting among polynomial, intrinsically linear, and nonlinear regression models: Inference, assessment, and discrimination," by Rollins and S. Pounds, at the annual meeting of the American Society for Engineering Education, June 26, 1996.

SHELLEY, Mack C.: "Quality of the adult child/aging parent relationship: A structural equations approach," by Joyce M. Mercier and Shelley, at the annual meeting of the Midwest Sociological Society, held in Chicago, Illinois, April 3-6, 1996.

SHERMAN, Peter J.: "A convergence-based approach for decomposition of mixed spectrum," seminar, Australian Defence Science & Technology Organization, Adelaide, Australia, November 10, 1995.

"Advanced spectral techniques for analysis of rotating machinery," seminar, Center for Noise & Vibration Control, Korea Advanced Science & Technology Institute, Science Town, Taejon, Korea, November 22.

STEPHENSON, W. R.: "Iowa State University Department of Statistics partnership with General Motors for graduate education," at the Industry/Academe Collaboration Project meeting, San Luis Obispo, California, July 11, 1995.

"Iowa State University: Graduate program in statistics" and "Statistics and health care," invited presentations to members of the statistics group at Baxter HealthCare, Round Lake, Illinois, September 6-9.

STERN, Hal: "Finite mixtures of linear regression models," seminar, Department of Statistics, Trinity College, Dublin, Ireland, September 1, 1995; seminar, Medical Research Council Biostatistics Unit, Institute of Public Health, Cambridge, United Kingdom, September 4.

"Bayesian analysis of a mixed linear model using Gibbs sampling," Animal Breeding and Genetics seminar, Iowa State University, December 1.

"Inference for extremes in epidemiology," seminar, Department of Statistics, Rice University, March 25, 1996; seminar, Department of Statistical Science, Southern Methodist University, March 26.

SUKHATME, Shashikala: "ROC analysis--some problems and new methods," seminar, Biostatistics Department, Medical College of Wisconsin, Milwaukee, Wisconsin, October 24, 1995.

"ROC analysis: An outsider's perspective," at the workshop on ROC Analysis, Department of Radiology, University of Iowa, November 2.

"Receiver Operating Characteristic studies and measurement errors," seminar, Graduate School of Public Health, Department of Biostatistics, University of Pittsburgh, June 19, 1996.

Wikle, Christopher K., and Noel CRESSIE: "Spatio-temporal prediction in the atmospheric sciences using the Kalman filter

with spatial noise," at the 13th Conference on Probability and Statistics in the Atmospheric Sciences, held in San Francisco, California, February 21-23, 1996.

▨ Other Meetings

Noel Cressie participated in the National Research Council Conference on Statistical Challenges and Possible Approaches in the Analysis of Massive Data Sets, Washington, D.C., July 6-9, 1995.

David Harville attended the Summer Research Conference on Linear and Nonlinear Conjugate-Gradient Related Methods, held in Seattle, Washington, July 9-13, sponsored by the American Mathematical Society, the Institute of Mathematical Statistics, and the Society of Industrial and Applied Mathematics.

W. Robert Stephenson participated in an Academe/Industry Collaboration Project sponsored by the National Science Foundation and held in San Luis Obispo, California, July 8-13.

Paul Hinz attended the joint meeting of the NCR-170 and USSEE committees in Fort Collins, Colorado, July 13-14.

Bill Kennedy, Huaichin Chen, Xianfeng Hu, and Rong Li attended the joint statistical meetings in Orlando, Florida, in August.

Hal Stern attended meetings of the advisory board of the Advantage I-75 project with a group from the Center for Transportation Research and Evaluation at Iowa State University. Meetings were held in Cincinnati, Ohio, in August 1995 and June 1996, and in Atlanta, Georgia, in October 1995.

Edith Landin, secretary of the Ames chapter, attended the Northwest District Conference of Professional Secretaries International (PSI) and a seminar on Embracing Diversity, in Salt Lake City, Utah, September 22-24. She also attended the Iowa Division meeting of PSI in Ames June 7-9, 1996.

Dianne Cook attended the Visualization '95 Conference sponsored by the Institute of Electrical and Electronic Engineers and the Association for Computing Machinery, in Atlanta, Georgia, November 1-3.

Maria Alvarado attended the CASES Training Workshop in Berkeley, California, on November 13-17, 1995.

Andy Williams attended the National Study of Business Start-Ups initial design team meeting, sponsored by Babson College Center for Entrepreneurial Studies, in Chicago, Illinois, November 18.

Kenneth Koehler attended the Seattle Symposium in Biostatistics: Survival Analysis, held in Seattle, Washington, November 18-21.

Frederick O. Lorenz participated in the annual meeting of W-183, in Tucson, Arizona, January 24-27, 1996.

Douglas Tschopp attended a National Resources Conservation Service NASIS Training Workshop in Lincoln, Nebraska, February 5-9.

Masoud Kazemi attended three Oracle short courses in Redwood Shores, California, February 8-9, 12-13, and 14-16.

William Q. Meeker attended the Engine Titanium Consortium POD meetings in West Palm Beach, Florida, February 15-16 and in Evendale, Ohio, June 20-21.

F. Jay Breidt attended the Statistical Issues for Ecological and Natural Resource Monitoring Programs Workshop in Crystal City, Virginia, on March 14-16, 1996.

Alicia Carriquiry attended the Survey Resources Day organized by the Agricultural Research Service, Washington, D.C., March 14-16, and the spring meeting of the Biometric Society (ENAR) in Richmond, Virginia, March 17-19.

Noel Cressie attended a workshop, Statistical Issues for Ecological and Natural Resource Monitoring Programs in the United States, sponsored by the American Statistical Association, in Washington, D.C., March 14-15.

Kenneth Koehler and Dean Isaacson participated in the Faculty Conference on Graduate Education at Iowa State University, held on March 22-23, in Grinnell, Iowa.

Deborah Reed-Margetan atttended an Informix Software Training Session, Developing Applications Using INFORMIX-ESQL/C, in Downers Grove, Illinois, April 10-12. Janet Schulz attended Informix Software Training Sessions, Structured Query Language on April 9-10, and Forms and Reports Using INFORMIX-SQL on April 11-12, in Atlanta, Georgia.

Noel Cressie attended the Stat Expo Conference, Paris, France, April 10-12.

Jauvanta Walker attended the 38th Biennial Convention of the National League of American Pen Women, Washington, D.C., April 12-15 as a voting delegate; she is president of the Des Moines branch.

David Cox, Paul Hinz, Kenneth Koehler, Ted Bailey, Kari Jovaag, Tom Kirchoff, Marek Brabec, and David Huang attended the Applied Statistics Conference at Kansas State University on April 29-30.

Andy Williams attended the American Association for Public Opinion Research Conference, in Salt Lake City, Utah, May 15-19; Jan Larson and Williams attended the International Field Directors & Technologies Conference there on May 19-22.

On June 23-26, 1996, Paul Hinz attended the Biometric Society (WNAR)/IMS regional meetings at Pullman, Washington, including the short course Extending the Linear Mixed Effects Model (Dealing with an Imperfect World).

PUBLICATIONS

In the Statistical Laboratory preprint series, 30 titles (#95-15 to 95-44) were added during the last half of 1995 and 16 more (#96-1 to 96-16) in the first half of 1996. 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 1996.

▨ Books

Armitage, Peter, and **Herbert A. DAVID,** editors. *Advances in Biometry: 50 Years of the International Biometric Society.* New York: John Wiley and Sons, Inc. 1996. xiv + 474 pp.

This volume features 21 papers on topics of major importance to biometricians. Progress over the last 50 years is reviewed, often with a look ahead. Following a short historical section, subject areas covered by leading contributors include: the teaching of biometry, experimental design, linear models, categorical data analysis, Bayes procedures, computer-intensive methods, multivariate analysis, survival analysis, statistical computing, statistical ecology, statistics for agriculture and forestry, statistical genetics, statistics in epidemiology, longitudinal studies, spatial analysis, image analysis, clinical trials, and statistics in toxicology. Each paper contains an extensive set of references.

FULLER, Wayne A. *Introduction to Statistical Time Series,* 2nd edition. New York: John Wiley and Sons, Inc. 1996. 698 pp.

The second edition contains new material on nonstationary models, nonlinear estimation multivariate models, state space representations, and model identification. Topics retained from the first edition include moving average and autoregressive processes, spectral analysis, parameter estimation, regression models, and unit root processes.

Simons, R. L. (in collaboration with R. D. Conger, G. H. Elder, Jr., **F. O. LORENZ,** and L. B. Whitbeck. *Understanding Differences Between Divorced and Intact Families: Stress, Interaction, and Child Outcomes.* Thousand Oaks, California: Sage Publications. 1996.

Bardes, Barbara A., **Mack C. SHELLEY II,** and Steffen W. Schmidt. *American Government and Politics Today: The Essentials, 1996-1997 Edi-*

tion. St Paul: West. 1996. xxxviii + 622 pp. + G-14 + I-22.

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 1994 elections in the United States, as well as "logging on" segments providing students with instructions about how to access internet/World Wide Web sites for research and information-gathering purposes. 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.

Gelman, A., J. B. Carlin, **H. S. STERN,** and D. B. Rubin. *Bayesian Data Analysis.* London: Chapman and Hall. 1995. 526 pp.

This book provides a comprehensive treatment of the statistical analysis of data from a Bayesian perspective. Modern computational tools are emphasized, and inferences are typically obtained using computer simulations. The principles of Bayesian analysis are described with an emphasis on practical rather than theoretical issues, and illustrated using actual data. A variety of models are considered, including linear regression, hierarchical (random effects) models, robust models, generalized linear models, and mixture models. The text includes thorough discussions of methods for checking Bayesian models and the role of the design of data collection in influencing Bayesian statistical analysis.

▨ Published Research

ATHREYA, Krishna B. Branching stochastic processes. Pp. 49-56 in *Probability Models and Statistics, a J. Medhi Festschrift.* New Delhi: New Age International Publishers Limited. 1996.

Branching stochastic processes are mathematical models for populations that undergo both growth and geographical migration. When the motion is a positive recurrent Markov chain, the empirical distribution of the geographical spread of the population converges to the stationary distribution of the Markov chain. When the motion is null recurrent or transient but has a limit under appropriate location and scale change, the same holds for the geographical spread. Large deviation probabilities of these decay geometrically fast.

ATHREYA, Krishna B., Hani Doss, and Jayaram Sethuraman. On the convergence of the Markov chain simulation method. *The Annals of Statistics* 24:1 (1996) 69-100.

The Markov chain simulation method has been successfully used in many problems, including some

that arise in Bayesian statistics. A self-contained proof of the convergence of the method for general state species under verifiable conditions is given.

ATHREYA, K. B., and J. Fukuchi (Hiroshima University). Bootstrapping extremes of i.i.d. random variables. Pp. 23-29 in *Extreme Value Theory and Applications--Proceedings of the Conference on Extreme Value Theory and Applications, Vol. 3, Gaithersburg, Maryland, May 1993,* edited by Janos Galambos, James Lechner, and Emil Simiu; Charles Hagwood, technical editor. NIST Special Publication 866. 1994.

Let $X_1, X_2, \ldots$ be i.i.d. random variables with common distribution function F. Define $X_{n:n} \equiv \max(X_1, X_2, \ldots X_n)$. Assume that there exist $a_n > 0$, $b_n \in \mathbf{R}$, $n \geq 1$ such that $G_n(x) \equiv P\{a_n(X_{n:n} - b_n) \leq x\}$ converges to one of Gnedenko's extreme value distributions. In this paper the problem of estimating $G_n(x)$ by the bootstrap technique is considered. We define different bootstrap distributions for different types of domain of attraction that F belongs to. It is shown that both when a_n and b_n are known and when a_n and b_n are estimated from the data the bootstrap distribution is weakly consistent if $m=o(n)$ and it is strongly consistent if $m=o(n/(\log n))$. These results are applied to the problem of obtaining confidence intervals for the upper end point of the support of F.

Devrajani, B. T., R. S. Kanwar, and **T. B. BAILEY**. Effect of soil salt concentration on the transport of salts to ground water in a layered soil--a laboratory study. *Agricultural Engineering Journal* 4:1&2 (1995) 1-16.

A laboratory study was conducted to understand the mechanics of salt transport in large disturbed soil columns. Nine PVC columns measuring 20-cm in diameter and 115-cm long were filled with sandy loam soil sieved through 3.175-mm mesh to form seven layers of different bulk densities (1.47, 1.50, 1.52, 1.52, 1.53, 1.53, and 1.52 g/cm³). The top six soil layers in columns were of 15-cm in thickness and the bottom soil layer was 10-cm thick. Experiments were conducted by using three salt concentrations of 0, 3,200, and 6,400 ppm in soil columns that were achieved by mixing NaCl and $CaCl_2$ salts (1:1 ratio by weight) in soil layers and repacking the columns with salt mixed soil in layers. Leaching of salts was created by maintaining a constant ponding of fresh water on the top of the columns. The leachate was collected from the bottom of the columns every 24 hours for a period of 31 days. The results of this study indicate that after 31 days of constant leaching with fresh water, salts from upper layer columns could be flushed to lower column layers to create upper layers suitable for plant growth. These results could be used to reclaim salt affected soils with similar soil properties.

BREIDT, F. Jay, and Alicia L. CARRIQUIRY. Improved quasi-maximum likelihood estimation for stochastic volatility models. Pp. 228-247 in *Modelling and Prediction: Honoring Seymour Geisser,* edited by Jack C. Lee, Wesley O. Johnson, and Arnold Zellner. New York: Springer-Verlag. 1996.

Jacquier, Polson, and Rossi (1994, *Journal of Business and Economic Statistics*) have proposed a Bayesian hierarchical model and Markov chain Monte Carlo methodology for parameter estimation and smoothing in a stochastic volatility model, where the logarithm of the conditional variance follows an autoregressive process. In sampling experiments, their estimators perform particularly well relative to a quasi-maximum likelihood approach, in which the nonlinear stochastic volatility model is linearized via a logarithmic transformation and the resulting linear state-space model is treated as Gaussian. In this paper, we explore a simple modification to the treatment of inlier observations that reduces the excess kurtosis in the distribution of the observation disturbances and improves the performance of the quasi-maximum likelihood procedure. The method we propose can be carried out with commercial software.

Cannon, Ann R. (Cornell College), and **William Q. MEEKER.** Statistical tests for signals in categorical temporal data. *Biometrical Journal* 38:1 (1996) 39-59.

This paper describes methods for using categorical temporal data to detect differences in behavior between a treated group and a control group. The first-level output from the data is typically a set of many different correlated test statistics comparing the two groups. In previous work, a decision was made by counting the number of significant individual tests and calibrating with bootstrap simulation. This article goes further, suggesting two possible alternative statistics: the sum of the squared individual test statistics and a Wald-like combination of the individual test statistics. All three overall comparison statistics are defined and a method for computing critical values from simulated distributions using a bootstrap method is given. The use of all three methods is then demonstrated on each of three data sets. Finally, a simulated power study reveals that the Wald-like statistic is much better than the other two, leading to the suggestion of its use in place of the other two statistics.

CARRIQUIRY, A. L., W. A. FULLER, J. J. Goyeneche, and H. H. Jensen. Estimated correlations among days for the combined 1989-91 CSFII. *Dietary Assessment Research Series Report 4.* CARD Publications 95-SR 77. Ames, Iowa: Iowa State University. 1995.

CARRIQUIRY, A. L., W. A. FULLER, J. J. Goyeneche, and **K. W. Dodd.** Estimation of the usual intake distributions of ratios of dietary components. *Dietary Assessment Research Series Report 5.* CARD Publications 95-SR 79. Ames, Iowa: Iowa State University. 1995.

Chakak, Abderrahmane (University Abdelmalek Essaadi, Morocco), and **Kenneth J. KOEHLER.** A strategy for constructing multivariate distributions. *Communications in Statistics--Simulation and Computation* 24:3 (1995) 537-550.

Given a random vector $(X_1,...,X_p)$ for which the univariate and bivariate marginal distributions belong to some specified families of distributions, we present a procedure for constructing families of multivariate distributions with the specified univariate and bivariate margins. Some general properties of the resulting families of multivariate distributions are reviewed. This procedure is illustrated by generalizing the bivariate Plackett (1965) and Clayton (1978) distributions to three dimensions. A general algorithm for simulating random observations from these families of multivariate distributions is presented.

Coffin, Marie (Clemson University), and **Shashikala SUKHATME.** A parametric approach to measurement errors in Receiver Operating Characteristic studies. Pp. 71-75 in *Lifetime Data Models in Reliability and Survival Analysis,* edited by N. P. Jewell, *et al..* Boston: Kluwar Academic Publishers. 1996.

The total or partial area under the Receiver Operating Characteristic (ROC) curve can be estimated for data from any parametric family. If the variables are measured with error, the resulting area estimates will be biased downward. Bias-corrected estimators are found for normal and exponential models, and simulation studies demonstrate that the bias-corrected estimators have MSE comparable to the uncorrected estimators.

COOK, Dianne, Andreas Buja, Javier Cabrera, and Catherine Hurley. Grand tour and projection pursuit. *Journal of Computational and Graphical Statistics* 4:3 (1995) 155-172.

The grand tour and projection pursuit are two methods for exploring multivariate data. We show how to combine them into a dynamic graphical tool for exploratory data analysis, called a projection pursuit guided tour. This tool assists in clustering data when clusters are oddly shaped and in finding general low-dimensional structure in high-dimensional, and in particular, sparse data. An example shows that the method, which is projection-based, can be quite powerful in situations that may cause grief for methods based on kernel smoothing. The projection pursuit guided tour is also useful for comparing and developing projection pursuit indexes and illustrating some types of asymptotic results.

Buja, Andreas, Dianne COOK, and Deborah F. Swayne. Interactive high-dimensional data visualization. *Journal of Computational and Graphical Statistics* 5:1 (1996) 78-99.

We propose a rudimentary taxonomy of interactive data visualization based on a triad of data analytic tasks: finding Gestalt, posing queries, and making comparisons. These tasks are supported by three classes of interactive view manipulations: focusing, linking, and arranging views. This discussion extends earlier work on the principles of focusing and linking and sets them on a firmer base. Next, we give a high-level introduction to a particular system for multivariate data visualization--XGobi. This introduction is not comprehensive but emphasizes XGobi tools that are examples of focusing, linking, and arranging views; namely, high-dimensional projections, linked scatterplot brushing, and matrices of conditional plots. Finally, in a series of case studies in data visualization, we show the powers and limitations of particular focusing, linking, and arranging tools. The discussion is dominated by high-dimensional projections that form an extremely well-developed part of XGobi. Of particular interest are the illustration of asymptotic normality of high-dimensional projections (a theorem of Diaconis and Freedman), the use of high-dimensional cubes for visualizing factorial experiments, and a method for interactively generating matrices of conditional plots with high-dimensional projections. Although there is a unifying theme to this article, each section--in particular, the case studies--can be read separately.

Morton, S., D. COOK, W. Stuetzle, and A. Buja. *Computer Graphics in Statistics: The Last 30 Years in Brief.* ASA Statistical Graphics Video Lending Library (contact: dfs@bellcore.com). 1995.

CRESSIE, Noel. Bayesian smoothing of rates in small geographic areas. *Journal of Regional Science* 35:4 (1995) 659-673.

An enormous amount of socio-economic and public-health data comes as rates (e.g., unemployment, per capita income, mortality rates, census underground) reported in small geographic areas. The U.S. Census Bureau regularly publishes data series at the county level, although the county is often a small area chosen for administrative convenience rather than by design. The reported rates can be regarded as a noisy representation of the true geographic distribution of rates over the small areas. This article presents a Bayesian statistical method of smoothing raw rates. In order to illustrate the important features of the method, a data set on undercoverage in the 1980 U.S. Census is used.

CRESSIE, Noel. Change of support and the modifiable areal unit problem. *Geographical Systems* 3 (1996) 159-180.

Geostatistics, which is concerned with inference on spatial processes over a continuous spatial domain, has long recognized the importance of a spatial variable's level of aggregation. For example, in mining exploration, core samples that are each just a few cubic feet in volume are used to predict the average ore grade of mining units that are thousands of cubic feet in volume. The same principle applies to restoration of environmentally damaged regions,

where restoration-unit volumes are typically much larger than sampling-unit volumes. Failure to take into account this change of spatial support can result in severely biased predictions. Similarly, the modifiable areal unit problem is concerned with the influence of the level of aggregation on relationships between two (or more) spatial variables. The geostatistical approach to change of support has only been developed in the univariate setting. This paper shows how a similar approach in a bivariate setting can be used to tackle the modifiable areal unit problem.

CRESSIE, Noel. PIC: Power divergence information criterion. Pp. 3-14 (Chapter 1) in *Statistical Theory and Applications: Papers in Honor of Herbert A. David,* edited by H. N. Nagaraja, Pranab K. Sen, and Donald F. Morrison. New York: Springer-Verlag New York, Inc. 1996.

In this article, the power divergence statistics are adapted to a family of information criteria that includes Akaike's information criterion as a special case. The principal application here is to problems involving counts and proportions, although the power-divergence information criterion (PIC) can be used in all those situations where one finds other information criteria being used, such as in the problem of model selection.

CRESSIE, Noel, and **Michael N. Hartfield** (Wyatt Cafeterias). Conditionally specified Gaussian models for spatial statistical analysis of field trials. *Journal of Agricultural, Biological, and Environmental Statistics* 1:1 (1996) 60-77.

Spatial dependence in data from one- and two-dimensional field trials has been recognized since the mid 1930s. Although originally employed in an agricultural context, the general purpose of field trials is to compare the effects of a number of treatments applied to a collection of proximate experimental units. For example, in the manufacture of integrated-circuit chips from silicon ingots, the experimental units may be contiguous wafer slices from the same ingot or regions of the same wafer. An iterated version of Papadakis' nearest-neighbor method for estimating treatment effects is shown to yield maximum likelihood estimates when the spatial dependence is a conditionally specified Gaussian model. Models of both the mean and the covariance in two-dimensional space are featured in this article.

CRESSIE, Noel, and **Soumendra Nath LAHIRI.** Asymptotics for REML estimation of spatial covariance parameters. *Journal of Statistical Planning and Inference* 50 (1996) 327-341.

In agricultural field trials, restricted maximum likelihood (REML) estimation of the spatial covariance parameters is often preferred to maximum likelihood. Although it has either been conjectured or assumed that REML estimators are asymptotically

Gausiian, conditions under which such asymptotic results hold are clearly needed. This article gives checkable conditions for spatial regression when sampling locations are either on a rectangular grid or are irregularly spaced but satisfy certain growth conditions.

Carroll, Steven S., and **Noel CRESSIE.** A comparison of geostatistical methodologies used to estimate snow water equivalent. *Water Resources Bulletin* 32:2 (1996) 267-278.

The need to monitor and forecast water resources accurately, particularly in the western United States, is becoming increasingly critical as the demand for water continues to escalate. Consequently, the National Weather Service (NWS) has developed a geostatistical model that is used to obtain areal estimates of snow water equivalent (the total water content in all phases of snow-pack), a major source of water in the West. The areal snow water equivalent estimates are used to update the hydrologic simulation models maintained by the NWS and designed to produce extended streamflow forecasts for river systems throughout the United States. An alternative geostatistical technique has been proposed to estimate snow water equivalent. In this research, we describe the two methodologies and compare the accuracy of the estimates produced by each technique. We illustrate their application and compare their estimation accuracy using snow data collected in the North Fork Clearwater River basin in Idaho.

DAVID, H. A. On recurrence relations for order statistics. *Statistics & Probability Letters* 24 (1995) 133-138.

The main purpose of this paper is to provide a unified approach to the treatment of linear recurrence relations for single or pairs of order statistics. Suppose such a relation has been proved in the simplest case when $X_1,...,X_n$ are independent variates having an arbitrary absolutely continuous distribution. It is pointed out that the same relation continues to hold when the X's are exchangeable, whether continuous or not. As has recently become well known, further generalizations are possible when the X's have any joint distribution.

Artiles-León, Noel, **Herbert T. DAVID,** and Howard D. Meeks. Statistical optimal design of control charts with supplementary stopping rules. *IIE Transactions* 28 (1996) 225-236.

This paper deals with the statistical design of control charts and describes a methodology to identify control schemes with action and warning limits that, for a fixed in-control average run length (ARL), minimize the ARL at a given out-of-control situation as measured by a shift in the process mean. This methodology allows the design of control charts with improved ARL performance for moderate shifts without degrading the in-control ARL as typically hap-

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pens when run rules are applied to a conventional control chart. These optimal control schemes significantly reduce the out-of-control average run length compared with nonoptimal schemes.

DAVID, H. T. Herbert Aron David. Pp. 313-326 (Chapter 25) in *Statistical Theory and Applications: Papers in Honor of Herbert A. David,* edited by H. N. Nagaraja, Pranab K. Sen, and Donald F. Morrison. New York: Springer Verlag New York, Inc. 1996.

Here we attempt an overview of H. A. David's impact on statistics and society. H. A. David is the author of more than 100 publications, with over 1400 citations in the *Science Citation Index* over the past 40 years. His two major books, *Order Statistics* and *The Method of Paired Comparisons,* both in two editions, unified and organized widely dispersed subject matter not previously available under one cover. This he was able to do with *both* the researcher and the student in mind. Both books have been translated into Russian. There have been 850 citations over the past 40 years to *Order Statistics* and *The Method of Paired Comparisons* in the *Science Citation Index.*

Former students, colleagues, and friends testify to a life of "integrity, honesty, and humanity" extending to activism on behalf of civil rights and academic freedom and against the Viet Nam war.

GROENEVELD, Richard A. The relative efficiency of several statistics measuring skewness. Pp. 43-53 (Chapter 5) in *Statistical Theory and Applications: Papers in Honor of Herbert A. David,* edited by H. N. Nagaraja, Pranab K. Sen, and Donald F. Morrison. New York: Springer Verlag New York, Inc. 1996.

Several statistics measuring skewness are compared, including the classical standardized third central sample moment. For distributions with finite support, two new functionals measuring skewness are introduced and are shown to have suitable properties as skewness measures. The natural sample estimates of these functions are compared for several families of skewed distributions with finite support. The new measures are shown to outperform the sample standardized third central moment in certain cases. For distributions with infinite support, the classical statistic is compared with two sample estimators suggested by recently proposed skewness measures. For distributions close to normality, but slightly skewed, the classical coefficient is shown to be more sensitive than these estimators. For long-tailed distributions close to symmetry, but slightly skewed, one of the new estimators is shown to outperform the classical estimator.

Helterbrand, Jeffrey D. (Lilly Research Laboratories), Jennifer L. Davidson, and **Noel CRESSIE.** Optimal closed boundary identification in gray-scale imagery. *Journal of Mathematical Imaging and Vision* 5 (1995) 179-205.

Identification of closed boundary contours is an important problem in image analysis because boundaries delineate the structural components, or objects, present in a scene. Most filter-based edge-detection methods do not have a mechanism to identify a group of edge sites that defines a complete closed object boundary. In this paper, we construct a suitable parameter space of one-pixel-wide closed boundaries for gray-scale images that reduces the complexity of the boundary identification problem. An algorithm based on stochastic processes and Bayesian methods is presented to identify an optimal boundary from this space. By defining a prior probability model and appropriately specifying transition probability functions on the space, a Markov chain Monte Carlo algorithm is constructed that theoretically converges to a statistically optimal closed boundary estimate. Moreover, this approach ensures that implementation via computer will result in a final boundary estimate that has the necessary property of closure which previous stochastic approaches have been unable to achieve.

Keiser, J. R., R. E. Mullen, and **P. N. HINZ.** Effects of Ca^{2+}- and Mg^{2+}-enriched germination media on germination and sugar leakage of Ca-deficient soybean seed. *Canadian Journal of Plant Science* 75:2 (1995) 343-346.

Inadequate seed Ca concentrations are associated with reduced seed quality of soybean [*Glycine max* (L.) Merr.]. Standard germination and sugar leakage tests were conducted to determine the effect of seed Ca content and exogenous Ca^{2+} or Mg^{2+} on seed quality and seed leakage. Soybean seeds containing different Ca levels were germinated in rolled towels that had been soaked in distilled water, 0.01 M $Ca(NO_3)_2$, or 0.01 M $Mg(NO_3)_2$. Sugar leakage was measured by soaking seed containing 1.10, 1.72 or 2.36 mg g^{-1} Ca in distilled water, 0.01 M $Ca(NO_3)_2$ or polyethylene glycol (PEG). As seed Ca content decreased from 2.36 to 1.10 mg g^{-1}, germination in distilled water decreased from 87 to 56%. Addition of either $Ca(NO_3)_2$ or $Mg(NO_3)_2$ to the medium resulted in increased germination of low-Ca seed, but $Ca(NO_3)_2$ was more effective in improving germination of low-Ca seed than $Mg(NO_3)_2$.

Huang, Hsin-Cheng, and **Noel CRESSIE.** Spatio-temporal prediction of snow water equivalent using the Kalman filter. *Computational Statistics & Data Analysis* 22 (1996) 159-175.

Consider a spatio-temporal stochastic process $\{Z(s;t): s \in D; t = 1,2,...\}$ and suppose it is of interest to predict $\{Z(s;t_0): s \in D\}$ at some fixed time point t_0. Purely spatial methods use data $Z(s_1;t_0),...,Z(s_n;t_0)$ to construct a spatial predictor (e.g., kriging). But, when data $\{Z(s_i;t): i = 1,...,n; t = 1,2,...,t_0\}$ are available, it is advantageous to treat the problem as one of spatio-temporal prediction. The U.S. National

Weather Service now uses current snow water equivalent (SWE) data and a purely spatial model to predict SWE at sites where no observations are available. To improve SWE predictions, we introduce a spatiotemporal model that incorporates the SWE data from the past, resulting in a Kalman-filter prediction algorithm. A simple procedure for estimating the parameters in the model is developed and an example is presented for the Animas River basin in southwest Colorado.

KAISER, Mark S., and Susan E. Finger. A model for field toxicity tests. *Environmetrics* 7 (1996) 215-229.

Toxicity tests conducted under field conditions present an interesting challenge for statistical modeling. In contrast to laboratory tests, the concentrations of potential toxicants are not held constant over the test. In addition, the number and identity of toxicants that belong in a model as explanatory factors are not known and must be determined through a model selection process.

We present one model to deal with these needs. This model takes the record of mortalities to form a multinomial distribution in which parameters are modeled as products of conditional daily survival probabilities. These conditional probabilities are in turn modeled as logistic functions of the explanatory factors. The model incorporates lagged values of the explanatory factors to deal with changes in the pattern of mortalities over time. The issue of model selection and assessment is approached through the use of generalized information criteria and power divergence goodness of fit tests. These model selection criteria are applied in a cross-validation scheme designed to assess the ability of a model to both fit data used in estimation and predict data deleted from the estimation data set. The example presented demonstrates the need for inclusion of lagged values of the explanatory factors and suggests that penalized likelihood criteria may not provide adequate protection against overparameterized models in model selection.

Jergens, Albert E., Frances M. Moore, **Mark S. KAISER,** Joseph S. Haynes, and Joann M. Kinyon. Morphometric evaluation of immunoglobulin A-containing and immunoglobulin G-containing cells and T cells in duodenal mucosa from healthy dogs and dogs with inflammatory bowel disease or nonspecific gastroenteritis. *The American Journal of Veterinary Research* 57:5 (1996) 697-704.

The quantity of IgA- and IgG-containing and T cells in the villi of duodenal mucosa was examined in healthy dogs, and in dogs with either inflammatory bowel disease or nonspecific gastroenteritis. Cell counts in individual dogs were modeled with Poisson probability mass functions. To deal with over-dispersion, a gamma mixing distribution was assigned to Poisson parameters for dogs within each group. Groups of dogs were compared using likelihood ratio tests for common mixing distributions among groups. It was found that mixing distributions may be J-shaped for immunoglobulin-producing cells (IgA and IgG), and that significant differences in the abundance of cells existed among groups of dogs for all cell types examined.

KOEHLER, Kenneth J., and **James T. Symanowski** (Lilly Research Laboratories). Constructing multivariate distributions with specific marginal distributions. *Journal of Multivariate Analysis* 55 (1995) 261-282.

A method is presented for constructing multivariate distributions with any specific set of univariate marginal distributions. This construction provides a rich class of distributions for modeling multivariate data as well as a basis for easily simulating correlated observations. The joint cdf and joint density function are expressed as explicit functions of the cdf's and density functions for the univariate marginal distributions. An application to multivariate survival analysis is briefly considered.

Zeiss, M. R., **K. J. KOEHLER,** and L. P. Pedigo. Degree-day re-quirements for development of the bean leaf beetle (Coleoptera: Chrysomelidae) under two rearing regimes. *Journal of Economic Entomology* 89:1 (1996) 111-118.

Bean leaf beetles, *Cerotoma trifurcata* (Forster), were reared from egg to adult at temperatures from 18 to 32°C. When larvae fed on cotyledons, *C. trifurcata* required 491 ± 8.1 DD (>11.58°C) to complete development from egg to adult. The relationship between developmental rate and temperature was significantly different when larvae fed on soybean roots, where *C. trifurcata* required 646 ± 17.4 DD (>7.61°C) to complete development. Degree-day requirements under each rearing regime were not significantly different from requirements of field populations, as estimated from seven years of field data. Bootstrap methods for limited failure population models were used to obtain standard errors and make inferences.

LAHIRI, Soumendra Nath. On Edgeworth expansions and the moving block bootstrap for studentized M-estimators in multiple linear regression models. *Journal of Multivariate Analysis* 56:1 (1996) 42-59.

This paper considers the multiple linear regression model $Y_i = x_i' + \epsilon_i$, $i = 1,...,n$, where x_i's are known $p \times 1$ vectors, β is a $p \times 1$ vector of parameters, and $\epsilon_1, \epsilon_2,...$ are stationary, strongly mixing random variables. Let β_n denote an M-estimator of β corresponding to some score function ψ. Under some conditions on ψ, x_i's and ϵ_i's, a two-term Edgeworth expansion for Studentized multivariate M-estimator is proved. Furthermore, it is shown that the moving block bootstrap is second-order correct for some suitable bootstrap analog of Studentized β_n.

LAHIRI, S. N. On the asymptotic behaviour of the moving block bootstrap for normalized sums of heavy-tail random variables. *The Annals of Statistics* 23:4 (1995) 1331-1349.

This paper studies the performance of the moving block bootstrap procedure for normalized sums of dependent random variables. Suppose that $X_1, X_2, \ldots$ are stationary ρ-mixing random variables with $\sum \rho(2^i) < \infty$. Let $T_n = (X_1 + \ldots X_n - b_n)/a_n$, for some suitable constants a_n and b_n, and let $T^*_{m,n}$ denote the moving block bootstrap version of T_n based on a bootstrap sample of size m. Under certain regularity conditions, it is shown that, for X_n's lying in the domain of partial attraction of certain infinitely divisible distributions, the conditional distribution $\hat{H}_{m,n}$ of $T^*_{m,n}$ provides a valid approximation to the distribution of T_n along every weakly convergent subsequence, provided $m = o(n)$ as $n \to \infty$. On the other hand, for the usual choice of the resample size $m = n$, $\hat{H}_{m,n}(x)$ is shown to converge to a nondegenerate random limit as given by Athreya (1987) when T_n has a stable limit of order α, $1 < \alpha < 2$.

Hall, Peter, **Soumendra Nath LAHIRI,** and Jörg Polzehl. On bandwidth choice in nonparametric regression with both short- and long-range dependent errors. *The Annals of Statistics* 23:6 (1995) 1921-1936.

We analyze methods based on the block bootstrap and leave-out cross-validation, for choosing the bandwidth in nonparametric regression when errors have an almost arbitrarily long range of dependence. A novel analytical device for modeling the dependence structure of errors is introduced. This allows a concise theoretical description of the way in which the range of dependence affects optimal bandwidth choice. It is shown that, provided block length or leave-out number, respectively, are chosen appropriately, both techniques produce first-order optimal bandwidths. Nevertheless, the block bootstrap has far better empirical properties, particularly under long-range dependence.

Hall, Peter, **Soumendra Nath LAHIRI,** and Young K. Truong. On bandwidth choice for density estimation with dependent data. *The Annals of Statistics* 23:6 (1995) 2241-2263.

We address the empirical bandwidth choice problem in cases where the range of dependence may be virtually arbitrarily long. Assuming that the observed data derive from an unknown function of a Gaussian process, it is argued that, unlike more traditional contexts of statistical inference, in density estimation there is no clear role for the classical distinction between short- and long-range dependence. Indeed, the "boundaries" that separate different modes of behavior for optimal bandwidths and mean squared errors are determined more by kernel order than by traditional notions of strength of dependence, for example, by whether or not the sum of the covariances converges. We provide surprising evidence that, even for some strongly dependent data sequences, the asymptotically optimal bandwidth for independent data is a good choice. A plug-in empirical bandwidth selector based on this observation is suggested. We determine the properties of this choice for a wide range of different strengths of dependence. Properties of cross-validation are also addressed.

LORENZ, Frederick O., and B. T. Bruton. Experiments in surveys: Linking mass class questionnaires to introductory research methods. *Teaching Sociology* 24:2 (1996) 264-271.

In spring and fall, 1993 and 1994, we incorporated experiments into questionnaires administered to introductory sociology students. The results were presented to undergraduate methods classes to illustrate the effects of question order, response category order, and response choices on patterns of responses. The article includes student evaluations of the presentations.

LORENZ, Frederick O., R. D. Conger, R. L. Simons, and L. B. Whitbeck. The effects of unequal variances and covariances on simultaneous inference: The case of hostility and marital quality. *The Journal of Marriage and the Family* 57 (November 1995) 1049-1064.

In family research, models with reciprocal effects are viewed as realistic but difficult to estimate. This paper shows that reciprocal effects in two-wave, two-variable models are determined by three distinct pairs of factors--cross-lagged covariances, stability covariances, and reliabilities. Using models with husbands' hostility and wives' marital quality, we demonstrate that stability and reliability are two distinct and sometimes conflicting statistical mechanisms linking theoretical arguments to empirical results. Failure to distinguish between these mechanisms may lead to inadvertently drawing conclusions inconsistent with the characteristics of the data.

LORENZ, Frederick O., and D. T. Dillman. Four papers on order effects in surveys: Introduction. *Rural Sociology* 60:4 (1995) 639-640.

This article introduces a series of articles on experiments in surveys by discussing the research agenda of Western Regional Project W-183 and by placing the articles in the larger context of research on questionnaire design.

LORENZ, Frederick O., J. Hraba, and R. Conger. Economic change and change in well-being in the Czech Republic, with comparison to married women in the United States. *Czech Sociological Review* 4:1 (1996) 43-62.

This article uses panel data to examine the effects of economic change on change in individual well-

being during a time of rapid social change in the Czech Republic. Respondents who were forced to make economic adjustments that reduced their standard of living also reported increases in health problems and depressive symptoms. Compared with a sample of U.S. women, Czech women reported significantly stronger paths linking education to changes in health conditions, but weaker paths linking actual economic adjustments to changes in health.

LORENZ, Frederick O., J. Saltiel, and D. Hoyt. Question order and fair play: Evidence of even-handedness in rural surveys. *Rural Sociology* 60:4 (1995) 641-653.

The norm of even-handedness is known to occur in face-to-face interviews under when respondents are asked pairs of complementary or competing opinion questions. This article extends the norm to telephone interviews and to questions about recall of behavior. Data are from a Montana Farm and Ranch Poll and an Iowa Health Survey.

LORENZ, Frederick O., R. L. Simons, and W. Chao. Family structure and mother's depression. Pp. 65-77 in *Understanding Differences between Divorced and Intact Families: Stress, Interaction, and Child Outcomes,* by R. L. Simons (in collaboration with R. D. Conger, G. H. Elder, Jr., F. O. Lorenz, and L. B. Whitbeck). Thousand Oaks, California: Sage Publications. 1996.

In this chapter (Chapter 4) we demonstrate that nearly all of the effect of family structure (married vs. divorced) on increased depressive affect in divorced women is mediated through increased economic pressure, increased work stress, and increased negative life events. These findings controlled for histories of antisocial behavior.

Dillman, D. A., T. L. Brown, J. E. Carlson, E. H. Carpenter, **Frederick O. LORENZ,** R. Mason, J. Saltiel, and R. L. Sangster. Effect of category order on answers in mail and telephone surveys. *Rural Sociology* 60:4 (1995) 674-687.

Past research suggests that mail surveys encourage primacy effects whereas telephone surveys encourage recency effects. This paper summarizes results from 82 new experiments conducted in 12 separate surveys in seven states. The conclusion is that the prevalence of primacy and recency effects has been overestimated by past research and a new theoretical approach that takes into account multiple causation is needed for examining these effects.

Ge, X., R. D. Conger, **Frederick O. LORENZ,** M. Shanahan, and G. H. Elder, Jr. Mutual influences in parent and adolescent psychological distress. *Developmental Psychology* 9:3 (1995) 280-293.

Using three waves of data from the Iowa Youth and Families Study, this paper examined the effects of fathers' and mothers' depressive symptoms on their sons and daughters. The strongest and most consistent pattern was the effects of fathers' depressive symptoms on their daughters' depressive symptoms during the daughters' high school years.

Simons, R. L., C. Johnson, and **Frederick O. LORENZ.** Family structure differences in stress and behavioral predispositions. Pp. 45-64 in *Understanding Differences Between Divorced and Intact Families: Stress, Interaction, and Child Outcomes,* by R. L. Simons (in collaboration with R. D. Conger, G. H. Elder, jr., F. O. Lorenz, and L. B. Whitbeck). Thousand Oaks, California: Sage Publications. 1996.

This chapter compared married and recently divorced mothers on selected economic and social support indicators. As Chapter 3 in the monogram, it set the stage for subsequent chapters that dealt in more detail with the consequences of divorce for mothers who are living in rural areas with their adolescent children.

Wickrama, K. A. S., R. D. Conger, and **Frederick O. LORENZ.** Role identity, role satisfaction, and perceived physical health. *Social Psychology Quarterly* 58:4 (1995) 270-283.

Using two waves of data for 310 husbands and wives living in the rural midwest, the findings support the hypotheses that greater work satisfaction affects husbands' perceived health while satisfaction with parenting positively affects wives' perceived health. The findings underscore the usefulness of identity theory for explaining gender differences in the relationship between different role experiences and perceived physical well-being.

Wickrama, K. A. S., R. D. Conger, and **Frederick O. LORENZ.** Work, marriage, life style, and changes in men's physical health. *Journal of Behavioral Medicine* 18 (1995) 97-111.

Using three waves of data for 320 men living in the rural midwest, this study tested a model that proposed independent effects of work conditions and marital experiences on changes in physical health. Both control over work and positive marital interactions reduced the probability of risky health behaviors (e.g., smoking, drinking, etc.). The findings document the importance of specific work and marital processes for maintaining good physical health.

Loughin, Thomas M. (Kansas State University), and **Kenneth J. KOEHLER.** A semiparametric bootstrap for proportional hazards models. Pp. 207-211 in *Lifetime Data: Models in Reliability and Survival Analysis,* edited by N. P. Jewell et al. Dordrecht, the Netherlands: Kluwer Academic Publishers. 1996.

We present a bootstrap resampling plan for the Cox partial likelihood estimator for proportional haz-

ards models with nonrandom explanatory variables. Instead of resampling observed times, the proposed plan resamples from the Uniform $(0,1)$ distribution of probability integral transformations of conditional failure times. Adaptations to a variety of censoring schemes are discussed. A simulation study provides comparisons with standard partial likelihood estimation procedures and resampling plans that assume random explanatory variables.

Lu, C. Joseph (National Cheng-Kung University, Taiwan), **William Q. MEEKER,** and Luis A. Escobar. A comparison of degradation and failure-time analysis methods for estimating a time-to-failure distribution. *Statistica Sinica* 6 (1996) 531-546.

Degradation analysis can be used to assess reliability when few or even no failures are expected in a life test. In this paper, we use a simple but useful degradation model to compare degradation analysis and traditional failure-time analysis in terms of asymptotic efficiency. The comparisons consider a range of practical testing situations and provide insight into the trade-offs between these two methods of estimating the quantiles of the time-to-failure distribution. We investigate the effect that the number of inspections, the amount of measurement error, and the quantile of interest have on the asymptotic variances of the quantile estimators. Although measurement error can induce some loss of precision in degradation analysis, our comparisons show that, except in extreme cases, degradation analysis provides more precision than traditional failure-time analysis.

Majure, J. J., D. COOK, N. CRESSIE, M. KAISER, S. LAHIRI, and **J. Symanzik.** *Spatial CDF Estimation and Visualization with Applications to Forest Health Monitoring.* ASA Statistical Graphics Video Lending Library (contact: dfs@bellcore.com). 1995.

Majure, J. J., D. COOK, J. Symanzik, and I. **Megretskaia.** *An Interactive Environment for the Graphical Analysis of Spatial Data.* ASA Statistical Graphics Video Lending Library (contact: dfs@bellcore.com). 1996.

MEEKER, William Q., R. Bruce Thompson, Chien-Ping Chiou, Shuen-Lin Jeng, and William T. Tucker. Methodology for estimating nondestructive evaluation capability. Pp. 1983-1991 in *Review of Progress in Quantitative Nondestructive Evaluation,* edited by D. O. Thompson and D. E. Chimenti. New York: Plenum Press. 1996.

This paper outlines a proposed methodology for using combinations of physical modeling of an inspection process along with laboratory and production data to estimate Nondestructive Evaluation (NDE) capability. The physical/statistical prediction model will be used to predict Probability of Detection (POD),

Probability of False Alarm (PFA), and Receiver Operating Characteristic (ROC) function curves. These output functions are used to quantify the NDE capability. The particular focus of this work is on the use of ultrasonic methods for detecting hard-alpha and other subsurface flaws in titanium using gated peak detection. This is a uniquely challenging problem since the inspection must detect very complex subsurface flaws with significant "material" noise. However, the underlying framework of the methodology should be general enough to apply to other NDE methods.

Escobar, Luis A., and William Q. MEEKER, Jr. Planning accelerated life tests with two or more factors. *Technometrics* 37:4 (1995) 411-427.

Accelerated life testing is a widely used tool for assessing the reliability of product components and materials. Most of the available literature on accelerated life testing deals with tests that use one accelerating factor and no other explanatory variables. Frequently, however, there is need to use more than one accelerating or other experimental factor. In this article we describe methods and guidelines for planning two-factor accelerated life test experiments for models in which there is no interaction between the factors. Although our discussion and examples focus on two-factor experiments, the extension to multifactor experiments is straightforward.

Moore, David S., George W. Cobb, Joan Garfield, and William Q. MEEKER. Statistics education fin de siècle. *The American Statistician* 49:3 (1995) 250-260.

Higher education faces an environment of financial constraints, changing customer demands, and loss of public confidence. Technological advances may at last bring widespread change to college teaching. The movement for education reform also urges widespread change. What will be the state of statistics teaching at the university level at the end of the century? This article attempts to imagine plausible futures as stimuli to discussion. It takes the form of provocations by the first author with responses from the others on three themes: the impact of technology, the reform of teaching, and challenges to the internal culture of higher education.

NUSSER, S. M., W. A. FULLER, and Patricia M. Guenther. Estimating usual dietary intake distributions adjusting for measurement error and nonnormality in 24-hour food intake data. *Dietary Assessment Research Series Report 6.* CARD Publications 95-SR 80. 1995.

Olin, Bryan D. (Procter & Gamble), and **William Q. MEEKER.** Applications of statistical methods to nondestructive evaluation. *Technometrics.* 38:2 (1996) 95-112.

Nondestructive evaluation (NDE) techniques are used widely in many manufacturing and operational

areas of industry. NDE is a highly statistical science that has developed rapidly over the past decade with relatively little input from individuals with formal training in statistics. This review article describes some of the many methods and applications of NDE, including eddy-current methods for detecting fatigue in jet-engine turbine disks, ultrasonic methods for detecting flaws in forged titanium, and radiographic methods for detecting out-of-control conditions in a casting process. We also outline the important potential for increased use of modern methods of statistics to improve the practice of nondestructive evaluation. Areas of statistics important in NDE include data analysis and signal processing, decision theory, screening and calibration, the assessment of measurement capability, and the use of designed experiments for improvement of measurement/detection processes.

Olin, Bryan D. (Procter & Gamble), and **William Q. MEEKER.** Reply [to discussion]. *Technometrics.* 38:2 (1996) 128-130.

OPSOMER, J.-D., J. Agras, A. Carpi, and G. Rodrigues. An application of locally weighted regression to airborne mercury deposition around an incinerator site. *Environmetrics* 6 (1995) 205-221.

Nonparametric regression by local polynomials is reviewed and used to model the accumulation of mercury in vegetation around a solid waste incinerator. The regression surface exhibits a clear pattern related to the presence of a point source, and the effect is shown to be significant at the 10 percent level.

ROLLINS, Derrick K., Yisun Cheng, and **Victoria C. P. CHEN.** Detection of equipment faults in automatically controlled processes. *AIChE Journal* 42:6 (1996) 1642-1647.

Based on the UBET, a new strategy for identifying faulty equipment for dynamic chemical processes under automatic control is presented. The strategy is designed to distinguish between measurement biases, controller biases, and process leaks. For illustration purposes, application is given to a level control process under pseudo-steady state. This approach was inspired by the work of Rollins and Devanathan to identify biased measurements under dynamic conditions. Advantages of this method are that it is not computationally intensive, can accurately detect and specifically identify the type of fault, and can accurately determine the time when the fault occurs.

ROLLINS, Derrick K., Yisun Cheng, and **Sriram Devanathan.** Intelligent selection of hypothesis tests to enhance gross error identification. *Computers & Chemical Engineering Journal* 20:5 (1996) 517-530.

The objective of this study was to evaluate the ability of a new technique to identify systematic measurement errors (i.e., biases) in process variables. This technique obtains high identification accuracy and computational speed by efficiently selecting a small subset of statistical hypothesis tests from a very large set using new selection criteria developed in this work. In this article the proposed technique is also evaluated and compared to a well known method in a fairly extensive Monte Carlo simulation study. The proposed technique was found to be computationally faster and, as the variances of measurement errors decreased, significantly more accurate in identifying systematic errors.

ROLLINS, Derrick K., James F. Davis, and **Jennifer Walker.** Application of multiresponse estimation to a wetted wall column model. *AIChE Journal* 41:10 (1995) 2327-2332.

ROLLINS, Derrick K., Donna L. Faust, and Duane L. Jabas. A superior approach to indices in determining mixture segregation. *Powder Technology* 84 (1995) 277-282.

In the forties, the index approach to measure segregation for powder mixtures was introduced. Since that time, several researchers have introduced new indices in an effort to improve this approach continually for the determination of mixture segregation. However, there are two major drawbacks of all current indices that make them unattractive as measures of segregation. First, these indices can vary for reasons other than segregation. The second drawback is the inability to determine if the calculated values of these indices are significant while controlling the probability of making incorrect conclusions. In this article a measure of segregation is proposed that is not subject to these limitations. In addition, a theoretical evaluation is given of current indices and the proposed approach. The conclusions of this evaluation are illustrated and confirmed by a Monte Carlo simulation study.

SHERMAN, P. J., R. Dudley, and M. Suarez. The stochastic structure of downstream pressure from an axial compressor--II. An investigation of blade-to-blade variability. *Mechanical Systems and Signal Processing* 10:4 (1996) 423-437.

This work investigates the use of statistical and time-frequency analysis of the downstream pressure signature to characterise blade-to-blade variability of both average and residual pressure associated with a single row 36 blade axial compressor. Analysis of the average pressure signatures suggests that the blade mean pressure signatures are not identical at a 90 percent significance level. Analysis of the residual signatures, obtained by removing the average signatures, reveals that the wake region contains approximately four times as much power as the core flow region. Time-frequency analysis shows that the strong harmonic content that persists in the residual process is temporally concentrated in the wake flow region, but that the blade-to-blade variability of this

narrowband structure is sufficient to be almost eliminated upon averaging of individual blade spectra.

SHERMAN, Peter J., and Lang B. White. Improved periodic spectral analysis with application to diesel vibration data. *Journal of the Acoustical Society of America* 98:6 (1995) 3285-3301.

The purpose of this work is to begin the development of a comprehensive time/frequency spectral analysis approach that can be applied to complex signals associated with real world systems, such as rotating machinery. In this work, a periodic-time/frequency characterization procedure is introduced in the context of vibration analysis associated with a diesel engine operating at nominally constant speed. This application highlights a number of difficulties, such as the need for accurate period estimation, accommodation of noninteger periods in relation to digital processing, and identification and separtion of tonal components from the signature in order to arrive at a more parsimonious characterization. A theorem relating to the limiting influence of these difficulties is presented. The difficulties are addressed using advanced signal processing tools, such as a recently developed tone identification procedure and extended Kalman filtering, which to the authors' knowledge have not been considered to date in such a setting. Results include a simple correction algorithm for noninteger periods, excellent separation of tonal components whose frequencies are slowly varying, and subsequently a modest improvement in the spectral characterization of the remainder of the process. These results have some significance in relation to diesel engine vibration, since they unambiguously identify tonal vibration components, in addition to a random structure that appears to include random excitation of resonances.

Lyon, Donald E., Daniel J. Maguire, **Peter J. SHERMAN,** and Dan G. Patterson. A remote method for simultaneous measurement of corneal thickness and curvature at a single point. *Biomedical Instrumentation & Technology* 29:5 (1995) 425-433.

Advances in refractive surgery have been limited by the measurement technology for determining corneal thickness and curvature. A measurement technique is needed that can provide a detailed corneal thickness and curvature model without contacting the cornea or obstructing the view of the surgeon or surgical equipment. The authors present preliminary results of a method to remotely measure the thickness and curvature of the human cornea at a single point. The method combines ray tracing and interferometry to estimate thickness and curvature in two orthogonal planes in an area less than 100 m in diameter. This technique has been successfully used to provide very accurate estimates of several thin-shelled test objects. Based upon these results, recommendations are given for further improvement of the technique and extension to a multipoint cornea-modeling system.

Van Zante, D., R. L. Feddersen, M. Suarez, and **P. J. SHERMAN.** The stochastic structure of downstream pressure from an axial compressor--I. A periodic time-frequency spectral description. *Mechanical Systems and Signal Processing* 10:4 (1996) 413-422.

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.

Shierholz, Heidi. Statlinguistic analysis of adjectives and adverbs. Featured Project Department of *STATS,* no. 15 (1996) 25-27.

STERN, H. S., D. Arcus, J. Kagan, D. B. Rubin, and N. Snidman. Using mixture models in temperament research. *International Journal of Behavioral Development* 18:3 (1995) 407-423.

Temperamental characteristics can be conceptualized as continuous dimensions or qualitative categories. The continuous versus categorical question concerns the underlying temperamental characteristics and not the measured variables, which can be recorded in either continuous or categorical forms. This paper argues for a categorical conceptualization of temperamental characteristics and applies a finite mixture model appropriate to this view to two sets of longitudinal observations of infants and young children. This statistical approach provides a good description of the observed predictive relation between behavioral profiles of children at 4 months and the degree of behavioral signs of fear at 14 months.

STERN, H. S. Who's Number 1 in college football? ... And how might we decide? *Chance* 8:3 (1995) 7-14.

College football is perhaps the only major team sport that does not decide a unique champion via competition each year. College football teams are rated during the season by two polls, one a survey of journalists and one a survey of coaches. In the 1994 season, both groups preferred undefeated Nebraska

to undefeated Penn State in their final polls, but there was substantial debate among experts and fans about whether this was the correct decision. In both 1990 and 1991 the two polls disagreed. What can the field of statistics say about choosing the number one team? In this paper, ratings based on the familiar statistical idea of least squares are explored.

Rubin, Donald B., **Hal S. STERN,** and Vasja Vehovar. Handling "don't know" survey responses: The case of the Slovenian plebiscite. *Journal of the American Statistical Association* 90:431 (1995) 822-828.

The Slovenian Public Opinion (SPO) survey of November/December 1990 was carried out in advance of a crucial plebiscite on Slovenian independence. Since the plebiscite counted as "YES votes" only those voters who attended and voted for independence (nonvoters counted as "NO voters"), "Don't Know" survey responses can be thought of as missing data--the true intention of the voter is unknown but must be either YES or NO. An analysis of the survey data under the missing-at-random assumption for the missing responses provides remarkably accurate estimates of the eventual plebiscite outcome, substantially better than ad hoc methods and a nonignorable model that allows nonresponse to depend on the intended vote.

STRAHAN, R. F., and A. E. Kelly. Showing clients what their profiles mean. *Journal of Counseling and Development* 72 (1994) 329-331.

Hedayat, A., **John STUFKEN,** and W. G. Zhang. Contingently and virtually balanced incomplete block designs. *Statistica Sinica* 5:2 (1995) 575-591.

We introduce two classes of designs, Contingently Balanced Incomplete Block (C-BIB) designs and Virtually Balanced Incomplete Block (V-BIB) designs, that may be considered if a Balanced Incomplete Block (BIB) design does not exist or is not known. C-BIB and V-BIB designs are constructed from Unfinished Balanced Incomplete Block (U-BIB) designs, which are obtained from a sequential search algorithm. Some V-BIB designs are shown to be highly efficient under A-, D-, and E-optimality criteria.

SUKHATME, Shashikala, and C. H. Lin (Ming Chuan Col-lege). Exact powers of the Wilcoxon test and the logrank test under random censoring. *Journal of Statistical Planning and Inference* 48 (1995) 291-301.

The modifications of the Wilcoxon test and the logrank test are often used when the observations are randomly censored. However, performance of these frequently used tests is not clearly understood when the sample sizes are small and the data are randomly censored. We compute the exact powers of these tests when the distributions of the lifetimes and/or distributions of the censoring times satisfy condition for the Lehmann type alternatives. We find that the powers are comparable.

Symanzik, J., J. J. Majure, and **D. COOK.** *Dynamic Graphics in a GIS: Analyzing and Exploring Multivariate Spatial Data.* ASA Statistical Graphics Video Lending Library (contact: dfs@bellcore.com). 1995.

Wikle, Christopher K., Peter J. SHERMAN, and Tsing-Chang Chen. Identifying periodic components in atmospheric data using a family of minimum variance spectral estimators. *Journal of Climate* 8:10 (1995) 2352-2363.

This work describes the application of a recently developed signal processing technique for identifying periodic components in the presence of unknown colored noise. Specifically, the application of this technique to the identification of strongly periodic components in meteorological time series is examined. The technique is based on the unique convergence properties of the family of minimum variance (MV) spectral estimators. The MV convergence methodology and computational procedures are described and are illustrated with a theoretical example.

The utility of this method to atmospheric signals is demonstrated with a 26-year (1964-1989) time series of 70-mb wind components at Truk Island in the equatorial Pacific. The MV method clearly shows that, although equatorial disturbances with periods of 3-5 days have a strong signal, they do not show a strong periodic component. As expected, MV convergence illustrates that the 70-mb zonal wind series at this location has a significant period component at the frequency of the annual cycle. In addition, the MV technique provides evidence for a strong periodic component at the frequency of the semiannual cycle and at a frequency within the commonly accepted range of the QBO. Although the QBO is clearly not a strictly periodic phenomenon (since its period is known to vary), the available data suggest that it can be modeled as a periodic component of the zonal wind. This is substantiated by a simple three-sinusoid plus autoregressive order 1 noise model of the 70-mb Truk zonal wind. This parsimonious model provides a very good fit to the observed data.

Yoo, Seongmoo (Korea University), and **Herbert T. DAVID.** Three remarks on Pitman domination. *Journal of the Korean Statistical Society* 24:2 (1995) 361-373.

Three remarks are offered, pertaining to classes of estimators Pitman-dominating a given estimator. The first remark concerns incorporating general loss in the construction of such classes. The second remark concerns Pitman domination comparisons amongst the members of such classes. The third remark concerns construction of such a class in the location-scale case.

■ Book Reviews, Etcetera

LORENZ, Frederick O. *American Dreams, Rural Realities: Family Farms in Crisis,* by Peggy F. Barlett. Chapel Hill: University of North Carolina Press. 1993. 305 pp. Reviewed in *Rural Sociology* 61:1 (1996) 178-179.

MEEKER, W. Q. *System Reliability Theory: Models and Statistics Methods,* by Arnljot Höyland and Marvin Rausand. New York: John Wiley and Sons, 1994. Reviewed in *Siam Review* 38:1 (1996) 175-177.

■ Theses

Deo, Rohit Siddheshwar. Tests for unit roots in multivariate autoregressive processes. Ph.D. thesis, Iowa State University Library. August 1995.

A vector autoregressive process of order p and dimension k such that the associated autoregressive operator has r < k unit roots and has other roots larger than one in unit value is studied. We assume that there exists a linear transformation of rank k − r, such that k − r components of the transformed vector are stationary, in which case the process is said to be cointegrated of rank k − r. A test for cointegration similar to the likelihood ratio test but based on alternative estimators of the process parameters is considered. The asymptotic distribution of the test statistic is derived and the performance of the test evaluated via Monte Carlo studies. This test procedure provides a definite improvement in power relative to the likelihood ratio test for cointegration.

The second problem studied is that of parameter estimation for long memory time series. Long memory time series are those whose covariance functions decay hyperbolically to zero. It is shown that if an observed series is the sum of a long memory Gaussian signal and noise, where the noise is an independent identically distributed zero mean sequence, then the parameter estimates obtained by maximizing the Gaussian likelihood are asymptotically normal. In addition, regression models with long memory errors are studied. The ordinary least squares estimators of the regression model parameters with polynomial trends as regressors are shown to be asymptotically normal. A similar result is established for a weighted least squares estimator, which is known to be asymptotically efficient in the case of polynomial trend regressors. The asymptotic distribution of the periodogram of a long memory time series evaluated at a fixed Fourier frequency is also derived. An approximate maximum likelihood estimator is proposed for the parameters of a class of long memory time series and is proved to be asymptotically normally distributed.

Emir, Birol. Nonparametric procedures for comparing the performance of repeated markers used to predict a survival endpoint. Ph.D. thesis, Iowa State University. May 1996.

This work considers methods for evaluating repeated markers to be used as a substitute for a clinical examination or to predict an outcome, in our case progression of breast cancer. We propose a definition of specificity and sensitivity for this setting and describe nonparametric estimators for these parameters. We then derive the theory required to obtain confidence intervals for the specificity and sensitivity of a marker and to define an asymptotically normal statistic for comparing the sensitivities of two markers at a fixed specificity. The theory allows for correlations introduced by the fact that markers may be obtained from the same patient at multiple visits and that both markers being compared may be obtained from the same patient. The work allows for an approach that compliments the frequently used time dependent Cox model which, we believe, will facilitate clinical interpretation of marker data. We also present simulation results for comparing a weighted average of sensitivities across all specificities, instead of being restricted to one specificity.

Garth, Angelita Dawn Nason. Evaluation of existing model discrimination techniques in artificial neural networks. M.S. thesis, Iowa State University Library. December 1995.

In recent years, there has been much publicity about artificial neural networks and their supposed ability to fit to any data set. Due in part to their reputation to do this, neural networks are becoming popular in a wide variety of disciplines. However, one drawback of neural networks in the modeling of data is their tendency to overfit to a data set, i.e., to model not just the underlying structure, but also the random error in the data. This can result in an inappropriate model selection, and can make the model inadequate at prediction.

To deal with this drawback, neural network researchers use existing statistical model discrimination techniques or create new discrimination methods to determine the correct artificial neural network model. However, because one can seldom be confident of what the true model is in real world applications, there is no way of telling whether or not the model discrimination technique is choosing the optimal model for that data. Consequently, there has been little or no testing of the ability of some of these techniques in neural network applications to see how they are really performing.

This study attempts to evaluate certain existing model discrimination techniques. To do this, data were simulated from an actual neural network model with added error. Different combinations of error variances and replications were added to the data, and then the different techniques were evaluated as to how often they were able to choose the true model.

The techniques that were evaluated are as follows. The F test, which is a classical statistical test, was evaluated. In addition, Akaike's Information Criterion, Mallows' C_p, and Schwarz's Bayesian Criterion, techniques used often in model discrimination

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for linear regression models, were tested on neural network models. A method called Data Splitting, which is also used in statistical literature, was evaluated as well. Also, the use of Mean Squared Error for model discrimination was investigated.

Some of the results of this study are as follows. Changing the number of replications of input data or changing the level of experimental error variance had little efect on the different techniques. Only the criteria used in the Data Splitting method were affected significantly. Mean Squared Error overall performed worse than any of the other techniques at choosing the correct model. Mallows' C_p and AIC gave results that were very similar to each other. They both performed well in most cases, but they did not perform as well as the F test with = 0.01 or another Data Splitting criterion called Mean Squared Prediction Error. These latter two performed similar to each other, and they generally performed better than most of the other techniques. Schwarz's Bayesian Criterion was another technique that performed very well. In several cases, it performed quite poorly, but in most situations it performed better than any other technique. Although none of these techniques performed well in all cases, in most situations they did a respectable job at model discrimination.

Lei, Dean Ding-Hwa. The LRT method of constructing a two-sided "variables" acceptance region and its comparison with other methods. Ph.D. thesis, Iowa State University Library. August 1995.

In this dissertation a likelihood ratio test statistic with attractive statistical properties is used as a device to develop a new two-sided variables acceptance sampling method for normally distributed lots. The maximum thickness of an acceptance sampling plan's Operating Characteristic (OC) band is taken as a basis for comparing the acceptance sampling method with three existing methods (a method due to Wallis (1950), one due to Resnikoff based on the UMVUE of p, and another advocated by Hamilton and Lesperance (1995) based on the MLE of p).

To implement and study the various variables acceptance sampling plans, FORTRAN programs have been written that produce acceptance regions for combination of sample size and producer's risk (for a specified proportion defective). After intensive computational effort, the following major conclusions have been reached. For small sample sizes, the UMVUE method is still the best choice currently available. However, an "optimized" LRT method will provide the best sampling plan for large sample sizes (say, n ≥ 30).

In a particular application, OC bands can be produced for variables acceptance sampling plans based on any of these four methods using the FORTRAN programs. With these OC bands in hand, an analyst will be able to assess what is achievable through the use of variables acceptance sampling for various sample sizes, and then choose a sample size and plan with acceptable statistical properties.

Liu, Chih-Yao. Variants of asymptotic extremes. Ph.D. thesis, Iowa State University Library. May 1996.

In this dissertation, we study two variants of asymptotic extremes, with the first exploiting Daniels' "covering circle," and the second exploiting a certain variant of it. The first topic concerns geometric tolerancing, for gauging the quality of either the assembly of two manufactured planar parts, or the conformance of a single such planar part to its jig. Minimax point-to-point discrepancy and the corresponding plate misalignment are studied asymptotically in n, using the notion of random covering circle, in the case of circular normal and circular uniform error. The second topic concerns certain asymptotic distributions related to game values, for k × n two-person zero sum games with i.i.d. payoff random variables, for n tending to infinity with k fixed. In particular, with the payoff distribution normal and k equal to 2, we give the joint asymptotic distribution of the game value and player I's optimal strategy. Lower and upper k × n game values are found to be generally asymptotically independent. Further asymptotic analysis is devoted to the lower value, for certain payoff location family models.

Melèndez, Maritza. Detection of gross errors in real chemical process data. M.S. thesis, Iowa State University Library. December 1995.

In detecting biased measurements of process variables or process leaks, the ability to *control* the probability of correctly detecting their existence (i.e., power) is critical to effective performance. By *control* it is meant to keep the power within a selected range, not just maintain the power above some minimum value. This type of *control* is necessary because too little power can cause significant biases to be undetected, and too much power can cause insignificant biases to be detected.

In real processes, no measured variable is ever without some bias, no matter how small. In statistical GED where hypothesis testing is used to detect biased measurements, power increases as the number of samples, N, increases. If N is too large, many material and energy balances will indicate lack of closure even when biases are relatively small. Thus, in these cases, specific identification of significantly biased variables may be difficult, if not impossible, due to too much test sensitivity. The way to avoid this problem is to use power functions to determine N a priori for specified magnitude of biases and to use no more than N samples in the tests.

In this thesis we demonstrate the problem of too much power using the technique of Rollins and Davis (1993) on data provided by the Shell Company. This technique is chosen because it gives the power functions, uses data to estimate the variance-covariance matrix, and is applicable to pseudo steady state conditions, which appear to be the conditions of the Shell data.

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Reyes, Melissa L. Lopez. Automatization and transfer of alphabet arithmetic, number comparison, and object comparison among intellectually gifted youth, average-ability youth, and college students. Ph.D. thesis, Iowa State University Library. May 1996.

Two experiments were conducted to determine how performance is influenced by intellectual abilities of learners and by similarity between training and transfer stimuli. Participants trained for automatization by repeatedly performing a task on the same stimuli, and then worked on the same task as in training but with novel stimuli.

In Experiment 1, gifted and average-ability youth and college students trained on alphabet arithmetic (A + 4 = E) and worked on transfer equations: commutativity (4 + A = E), reflexivity (E = A + 4), subtraction (E - A = 4), and add-one (A + 5 = F). Response-time data were linearly regressed on digits of equations. A decreasing pattern in slopes would indicate a shift from counting to remembering and was used as evidence for automatization. During training, all groups exhibited parallel shifts from counting to remembering, suggesting that these groups had comparable abilities for automatization. For all groups, slopes for commutativity, reflexivity, and subtraction were comparable to slope for final training block, suggesting that all groups were capable of using memory traces that accumulated during training in order to respond to novelty. For gifted youth and college students, slope for add-one was comparable to slope for final training block; for average-ability youth, slope for add-one was steeper than slope for final training block. Thus, gifted youth and college students utilized available memory traces during transfer to add-one, but average-ability youth did not.

In Experiment 2, gifted youth and college students trained on number and object comparisons (21 < 24; COIN smaller than MOUSE), worked on reversed comparisons (24 > 21; MOUSE larger than COIN), and then worked on new comparisons (less-than and smaller-than comparisons not included in training). Response-time data (RT) of each participant were fitted to the power law: $\mathbf{RT = a + bN^{-c}}$, (N = number of trials). The parameter **c** measured rate of automatization. The two groups had comparable rates of automatization and parallel profiles. With numbers, **c** did not change across different stages. With objects, **c** did not change from training to reversed stage, but increased from reversed to new stage. Thus, increased efficiency in magnitude comparison was evident with objects but not with numbers.

Implications of the current research to intellectual precocity and to the instance theory of automaticity are discussed.

Smith, Patricia A. Evaluation of modeling techniques for nonlinear dynamic processes. M.S. thesis, Iowa State University Library. May 1995.

A new simplistic way of predictive modeling of process variables in nonlinear dynamic processes is introduced. This approach, which is semi-empirical, is demonstrated on a simulated continuous stirred tank reactor. Model development uses a first-order-plus-dead-time structure and *only* two or three input changes for determining the coefficients. This approach is evaluated for a variety of situations that include measured output, unmeasured output, extrapolation beyond the input range, various levels of dead time, various levels of measurement error, large dynamics, and various levels of nonlinear behavior. In the situation of unmeasured output, the proposed approach is very accurate, and in the other cases it is extremely accurate and far superior to linear regression and artificial neural network models.

Walker, Jennifer. Evaluation of segregation in powder mixtures using nonparametric and multivariate analysis. M.S. thesis, Iowa State University Library. December 1995.

This thesis consists of two papers. The main objective of the research is to use computer simulated data to evaluate the ability of several analysis techniques to detect segregation in powder mixtures. The two main areas of research are that of nonnormal measurement errors and the multicomponent mixture. The first study compared the performance of the ANOVA analysis to that of the Kruskal-Wallis test when the distributions of the measurement errors are normal, truncated normal, beta, and truncated two-parameter exponential. It was found that the ANOVA analysis out-performed the Kruskal-Wallis test even though the assumption of normality, which ANOVA is based on, was severely violated. It should be noted that neither method performed exceedingly well, but that the distributions used for the measurement errors were used for their departure from normality, not their accuracy to the true process. The second part of the research examined the multivariate case. The abilities of MANOVA and the multivariate indices to classify the level of mixedness in powder mixtures were compared under the assumption of normality. The results from this test gave many of the same conclusions that were drawn by Rollins et al. (date) for the univariate case. The indices varied more with changes in the level of measurement error than with changes in segregation level. This same trend occurred in the simulations done where correlation exists between species from the same sample. In both the uncorrelated and correlate cases, MANOVA performed similarlly, that is, its performance was unaffected by correlation.

Based on this research, ANOVA and MANOVA are the recommended analysis techniques for the case of determining univariate and multivariate levels of segregation. Even when the data are severely nonnormal, ANOVA outperforms Kruskal-Wallis. MANOVA clearly outperformed the multivariate indices for uncorrelated data and has the added benefit of the ability to analyze correlated data.

Department of Statistics

Results of the 1993 survey of doctoral programs by the National Research Council include high ratings for ISU's chemistry and statistics programs. The faculty in these programs ranked in the top quartile of comparable programs as judged by peers.

Derrick Rollins served as research advisor for a number of undergraduate students in engineering and mathematics during the year and for summer intern students for the Women in Science and Engineering Program (1995 and 1996) and the Agriculture Minority Summer Research Internship Program (1996).

Stephen Vardeman has begun writing a text with Marcus Jobe on *Statistical Quality Assurance Methods for Engineers* under contract with John Wiley & Sons. An undergraduate text in systems and control theory by Peter Sherman is under contract with Addison Wesley. The book will integrate classical concepts with aspects of statistics (e.g., robust models) and signal processing. William Q. Meeker is writing a book with Luis Escobar on *Statistical Methods for Reliability Data* under contract with Wiley (see p. 18 for more details).

■ The H. A. David Conference

A Conference in Honor of ISU Distinguished Professor of Statistics Herbert A. David's 70th Birthday was organized and hosted by the Department of Statistics on November 17-18 at the Best Western Starlite Village Motel and the Holiday Inn Gateway Center, Ames, Iowa.

The conference included both invited talks and contributed papers, as well as presentation of a Festschrift honoring H. A. David (334 + xvii pp.). The final chapter of this volume, edited by H. N. Nagaraja, Pranab K. Sen, and Donald F. Morrison, contains abstracts of invited talks, and anecdotes and words of appreciation by some of the contributors and other professional colleagues. (Also see pp. 32 and 33 of this annual report.) On Saturday evening a celebratory banquet was held. The full list of speakers and topics follows:

On November 17:

Welcome: Dean L. Isaacson, Head, Department of Statistics, and Elizabeth Hoffman, Dean, College of Liberal Arts and Sciences, Iowa State University

Invited Paper Session I: Richard Groeneveld, ISU, chair
"Estimation for samples from skewed distributions," Wayne A. Fuller, ISU;
"Rummaging around records," Barry C. Arnold, University of California-Riverside

Contributed Paper Session I: Stephen B. Vardeman, chair
"Asymptotic aspects of order restricted estimators," Richard Dysktra, University of Iowa
"On some aspects of ranked set sampling in statistical inference," Bimal K. Sinha, University of Maryland-Baltimore County
"Conservative spacings for the Weibull and extreme value distributions," Dale Umbach and M. Masoom Ali, Ball State University
"Symmetric functions of concomitants of selected order statistics," H. N. Nagaraja, Ohio State University

On November 18:

Festschrift Release: H. N. Nagaraja, Ohio State University, chair
"On Herbert A. David," Herbert T. David, ISU
Festschrift Release

Keynote Address: H. N. Nagaraja, chair
"Graphical models and multivariate analysis," Sir David R. Cox, Nuffield College, Oxford

Invited Paper Session II: William J. Kennedy, ISU, chair
"Early history of order statistics," Norman L. Johnson, University of North Carolina
"Paired comparisons: The history of personal identification before DNA," Stephen M. Stigler, University of Chicago

Invited Paper Session III: William Q. Meeker, ISU, chair
"Extreme value theory and Bonferroni-type inequalities," Janos Galambos, Temple University
"Multivariate paired comparisons revisited," Pranab K. Sen, University of North Carolina

Contributed Paper Session II: David A. Harville, ISU, chair
"Order statistics and some of their applications," H. Leon Harter, consultant, Champaign, Illinois

The Friday opening session audience.

"Weak laws of large numbers for large order statistics," Ursula Gather, Dortmund University

"Some inferences of univariate distributions based on generalized order statistics," M. Ahsanullah, Rider University

"On sample spacings from IMRL distributions," S. N. U. A. Kirmani, University of Northern Iowa

"Variants of asymptotic extremes," Craig Liu, ISU

Contributed Paper Session III: Noel A. C. Cressie, ISU, chair

"The mixture approach to assessing the fit of a statistical model," Tamás Rudas, Eötvös University and TÁRKI, Budapest, Hungary

"Competing risks," M. L. Moeschberger, Ohio State University

"The price of an uncertain prize," W. A. Thompson, Jr., University of Missouri-Columbia

"Summarizing DNA evidence when relatives are possible suspects," Thomas R. Belin, David W. Gjertson, and Ming-yi Hu, University of California-Los Angeles

"Factor analysis for unbalanced repeated measures," Savas Papadopoulos, ISU

Banquet Address:

"Banquet talk," Robert V. Hogg, University of Iowa

Dinner companions Ursula Gather, Wayne Fuller, Ron Mowers, Oscar Kempthorne, and Rich Sullivan.

The conference was supported in part by money from the Shell Development Company, General Motors, the Department of Statistics, and alumni and friends.

Remodeling Project

The statistical center's Main Office area on the first floor was remodeled, and a departmental lounge was created in Room 104. Portions of the Survey Section on the second floor were also remodeled. Work included the removal of asbestos, installation of new carpeting, repainting, and replacement of some office furniture with modular units.

1995-96 Course Offerings in Statistics

Noel Cressie offered an experimental course in spring 1996, Stat 505x, Environmental Statistics. The three-credit course involves two hours of lectures and a two-hour lab per week. The lab includes use of GIS. Topics include toxicology, spatial statistics, sampling of ecological resources, epidemiology, and risk analysis. Prerequisites are Stat 401 and Stat 447 (or Stat 341).

Stat 500 and 511, taught by Kenneth J. Koehler and John Stufken, were offered by videotape to students at General Motors. Stat 401 was offered off-

Ken Koehler has been teaching in the second year of the ISU Statistics distance education program. He stands with pictures of GM students from three sites.

campus in the summer of 1996, by Barbara Barnet, to students in the Master of Mathematics Education program.

Course offerings with primary catalog listing in statistics, and instructors for the 1995-96 academic year and the 1996 summer session are listed electronically on our website http://www.iastate.edu/stat/general/annual_report/department.

Graduate Students

Five Ph.D. degrees and 24 M.S. degrees were granted in the Department of Statistics during the fiscal year. All but three of the masters' degrees were conferred on a nonthesis basis, with candidates completing creative components based on independent study. Abstracts of Ph.D. dissertations and master's theses appear on pp. 41-43. An M.S. degree in operations research completed in May 1995 under the departments of Industrial and Manufacturing Systems Engineering and Statistics, but omitted from the last annual report, is mentioned below; an abstract of the thesis is on p. 43.

The Vera David Graduate Fellowship in Statistics was given to Pam Abbitt and Deanne Reber for the 1995-96 year. The award is designated for a woman who has just completed her first year of graduate studies in statistics at Iowa State. Also chosen during the summer 1995 was Juan Goyeneche as the Ph.D. student to receive the Holly and Beth Fryer Scholarship Award for the 1995-96 year. This

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award is given to a student who has just finished Stat 642.

Industrial scholarships and a fellowship were awarded to 14 graduate students with support from Dow Chemical Co., General Motors, Eli Lilly, Shell Development Foundation, Procter & Gamble, and Providian Bancorp (see p. 4).

Teaching Excellence Awards were presented to Michael Eraas and Christopher Scheib in February 1996 and Melanie Wall in May. A Research Excellence Award was presented to Rohit Deo in August 1995. The Department of Statistics presented the Dan Mowrey Consulting Excellence Award to Francis Pascual and Becky Benner, and the Vincent Sposito Statistical Computing Award to Tae-Sung Shin and Kevin Wright, in May 1996.

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

*Pamela Joy Abbitt (Fall 1995; Sarah Nusser).

Shawn M. Bates (Summer 1995; Dianne Cook) joined Fingerhut in Minneapolis, Minnesota.

*Rebecca Jean Benner (Fall 1995; Kenneth Koehler).

Carter Ann Blakeley (Summer 1995; F. Jay Breidt) joined the Office of Information Resources, Washington, DC, as an operations research analyst.

George Gordon Brown, Jr. (Fall 1995; Mark Kaiser) is continuing graduate study toward a Ph.D. in statistics as a research associate at North Carolina State University.

Huaichin Chen (Spring 1996; Kenneth J. Koehler) is employed as a credit analyst by Providian Bancorp, San Francisco, California.

Angelita Dawn Nason Garth (Fall 1995; Derrick K. Rollins) joined Applied Research Consultants, Inc., Manhattan, Kansas.

*Kari Ann Henry (Fall 1995; Mack C. Shelley II and Kenneth Koehler).

Xianfeng Hu (Spring 1996; Paul N. Hinz) completed requirements for a concurrent M.S. degree in economics at Iowa State University and is employed at the Norwest Card Service in Des Moines, Iowa.

*Philip Gerard Jones (Summer 1995; Dianne Cook) accepted a fall 1995 internship with Marion Merrell Dow, Kansas City, Missouri, and returned to ISU in January to continue doctoral studies in statistics.

Sara Beth Kind (Summer 1995; Robert F. Strahan) joined Strategic Advantage, Inc., Minneapolis, Minnesota as a research associate in November 1994.

Beth Marie Lencowski (Summer 1995; Carl Roberts).

Michael Lincoln Lieber (Summer 1995; Max C. Shelley II) joined the Indiana Medical Review Organization, Terre Haute, Indiana, as a statistician in July 1995; currently he is employed at the Cleveland Clinic, Cleveland, Ohio.

Feng Lu (Spring 1996; Paul N. Hinz) is a statistical consultant with Trilogy Consulting Corporation, initially stationed at The Prudential, South Plainfield, New Jersey.

Maritza Melèndez (Fall 1995; Derrick K. Rollins) resides in Dortmund, Germany, with her husband, Tillman Krahnke.

Lucky Les Mokgatlhe (Summer 1995; Kenneth J. Koehler) returned to the University of Botswana as a lecturer.

Wendelin Felix Schnedler (Fall 1995; David A. Harville) returned to the University of Dortmund in Germany for further studies in the Department of Statistics.

Angela Jean Schneider (Fall 1995; Alicia Carriquiry) is a mathematical statistician with the National Agricultural Statistics Services, stationed in Columbus, Ohio.

Heidi Sue Shierholz (Spring 1996; Sarah Nusser) is a mathematical statistician at the U.S. Bureau of Labor Statistics, Washington, D.C.

Patricia A. Smith (Spring 1995, operations research; Howard Meeks and Derrick Rollins) works for Texas Instruments in Dallas, Texas.

Catherine Michelle Sunde (Summer 1995; Hal Stern) accepted a position as manager, Target Marketing Division, AT&T Universal Card Services, Jacksonville, Florida.

Jennifer Jane Walker (Fall 1995; Derrick K. Rollins) is continuing graduate studies in chemical engineering at Iowa State University.

*Melanie Marie Wall (Summer 1995; Yasuo Amemiya).

Lisa Ann Wicklund (Summer 1995; Carl Roberts) joined Frank Magid & Associates, Marion, Iowa, as a senior statistician.

*Zugeng Zheng (Summer 1995; Sarah M. Nusser) is pursuing a co-major Ph.D. degree with the Department of Industrial and Manufacturing Systems Engineering at Iowa State University.

Ph.D. Recipients

Rohit Siddheshwar Deo (Summer 1995; Wayne A. Fuller) is an assistant professor at New York University in the Department of Statistics and Operations Research.

Birol Emir (Spring 1996; H. Samuel Wieand and Shashikala Sukhatme) has been a statistician in the NSABP Biostatistical Center, Pittsburgh, Pennsylvania, since August 1995.

Dean Ding-hua Lei (Summer 1995; Stephen B. Vardeman) is an assistant professor in the Department of General Education, Divine Word College, Epworth, Iowa, teaching statistics and mathematics and directing the Computer Laboratory.

Chih-Yao Craig Liu (Spring 1996; Herbert T. David) is a research associate in the Department of Mathematics and Statistics, McGill University, Montreal, Canada.

Melissa Lucia Lopez Reyes (Spring 1996; psychology and statistics, Veronica J. Dark and Kenneth J. Koehler) is working as a postdoctoral research associate in the Center for Family Research in Rural Mental Health at ISU.

M.S. Candidates

Kevin Ackley	Michael Elling
Abdulelah Al-Nafisa	Soledad Fernandez
Shawn Bates	Allison Florance
Carter Ann Blakeley	King-Chong Iris Fung
G. Gordon Brown, Jr.	Karin Funke
Dana Bruden	Angelita Nason Garth
Xiao-Hong Cao	Juan Jose Goyeneche
Ian Carlson	Achim Guttner
Sau-Kum Lydia Chan	Lun-Xiong He
Huaichin Chen	Jennifer Heldt Hellrung
Pinliang Patrick Chen	Xianfeng Hu
Kok-Leong Chiang	Chin-Liang Hung
Lori Cogar	Alejandro Islas-Camargo
Thomas Dubinin	Lixin Jia
Jens Eickhoff	Amy Rath Johanson

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Angela M. Jones
Soon Seng Lau
Beth Lencowski
Lisa Le Tourneau
Nicholas Lewin
Rong Li
Song Li
Chien-Hua Jonathan Liao
Chiou-Ping Liu
Shiping Liu
Feng Lu
Marcia Macedo
Inna Megretskaia
Maritza Melendez
Amy Jo Meyer
Barbara Mock
Sol Mumey
Laura Nalbarte-Migliaro
Bryan Nelson
Andrew Nordine
Ann Otte Schmidt
Kaijie Pan
Brandon Paris
Laknath Peiris
Kara Riggs Perritt
Elizabeth Pierce
Xiao-ming Qi
Deanne Reber

Janelle Rhorer
Abigail Sage
Christopher Scheib
Pamela Schmidt
Wendelin Schnedler
Angela Schneider (in absentia)
Heidi Shierholz
Tae-Sung Shin
Haiyan Shu
Heather Smith
James D. Smith IV
Richard Sullivan
Fangqiu Sun
Catherine Sunde
Yu-Ping Tien
Lars Tschiersch
Delfino Vargas-Chanes
Jennifer Walker
Jun-Yuan Wang
Xue Wang
Yanrong Wang
You Wang
Yufeng Wang
Jeffrey Wieland
Yihong Xiao
Ling-Yu Cynthia Yang
Jing Zhang
Sanyi Zhao

M.S. Candidates (General Motors)

Diana M. Baran
Leonard A. Brown
Larry E. Cisney
David M. Hammelef
Brian T. Kenney

Mary E. Kriz
Timothy J. Lang
Richard J. Schumaker
David A. Skoog
Michael R. Wood

Nondegree

Hans Martin Axelson

Ph.D. Candidates

Pamela Abbitt
W. Jeremy Aldworth
Anthony Baiching An (in
  absentia)
Andim Balce
Barbara Dombroski Barnet
Rebecca Benner
Marek Brabec
Victor Chan
Cong Chen
Jianlin Cheng
Bassirou Chitou
William Christensen
Rohit Deo
Sriram Devanathan (chemical
  engineering and statistics)
Kevin Dodd
Birol Emir (in absentia)
Michael Eraas
John Gabrosek
Chad Hart (economics and
  statistics)
Kari Henry
Nan-Jung Hsu
Hsin-Cheng Huang
Shiaau-Er Huarng
Shuen-Lin Jeng
Yoon-Sook Jeon
Philip G. Jones
Kari Jovaag
Kyu-Nam Jung
Dae-Lyong Kim
Jae-Kwang Kim
Thomas Kirchoff
Sock-Cheng Koh

Koji Kondo (economics and
  statistics)
Shonda Roelfs Kuiper
Sun-hee Kwon
Chiang-Sheng Johnson Lee
Jaehyung Lee
Yoon-Dong Lee
Ding-Hwa (Dean) Lei
Win-Chin Lin
Huei Grace Liu Ho
Chih-Yao Craig Liu
Xiao-Hu Liu (statistics and
  aerospace engineering)
Peter Morse
Savas Papadopoulos
Francis Pascual
Elizabeth Paterno (economics
  and statistics)
Jean Pelkey
Luiz Peternelli (statistics and
  plant breeding)
Melissa Lopez Reyes (psy-
  chology and statistics)
Anindya Roy
Pradipta Sarkar
Michael Schuckers
Jürgen Symanzik (computer
  science and statistics)
Ling-Ling Claire Tsao
Melanie Wall
Michael Wallendorf (statistics
  and animal ecology)
Christopher Wikle (statistics
  and meteorology)
Kevin Wright

Lie-Ling Wu (statistics and ecol-
  ogy and evolutionary biology)
Jill Yoder

Zugeng Zheng (statistics and
  industrial engineering)
Jun Zhu

Philip Jones, after completing a summer intern-ship with Providian Bancorp in San Francisco, took an internship for fall 1995 with Marion Merrell Dow, Kansas City, Missouri. Christopher Scheib was a statistical intern with Weyerhaeuser, Hot Springs, Arkansas, starting in January 1996 and has accepted a second six-month internship there. After complet-ing an internship with Ruan Corporation, Dan Parks took a regular position with Ruan Transportation Management Systems, Des Moines, Iowa. Marek Brabec took an internship for summer 1996 with Sequus. Jun Zhu worked as a statistical intern for Mayo Clinic, Rochester, Minnesota, during summer 1996; Elizabeth Paterno was a summer intern in the Poverty and Human Resources Division, Policy Re-search Department of the World Bank, Washington, D.C. Summer internships were also held by Becky Benner at the R. W. Johnson Pharmaceutical Re-search Institute, William Christensen at Abbott Labo-ratories, Barbara Mock at General Motors, and Deanne Reber at Hoechst-Marion-Roussel.

▓ Iowa STAT-ers

The Department of Statistics graduate student organization, Iowa STAT-ers, offers opportunities for athletic, social, and intellectual interaction among members and faculty. Seminars sponsored by the STAT-ers are listed on p. 51.

Officers for the 1995-96 year were Pam Abbitt, president; Kevin Wright, vice president; and Angela Jones, treasurer. Kari Henry and Deanne Reber served on the social committee. Melanie Wall was intramural coordinator. Abbitt served as student representative to the Department of Statistics fac-ulty meetings.

The senators representing the department in the Graduate Student Senate this year were Becky Benner, Nicholas Lewin, and Claire Tsao. Among other things, the GSS worked to develop a plan that would allow graduate assistants to deduct tuition from their paychecks (for a substantial tax savings), but were stymied by the university administration.

The *STAT-er Chatter* and *STAT-er Calendar* took a one-year leave of absence, but other activities proceeded as usual. The Halloween and Winter parties were both well-attended, and intramural sports continued to be a strong tradition for the STAT-ers. STAT-ers were represented by co-rec broomball and football team championships, indi-vidual championships in wrestling and doubles ten-nis, and participation in softball, basketball, volley-ball, walleyball, soccer, indoor soccer, treds football, and sports trivia.

Other social activities included a camping trip, fall picnic, games night, and the weekly FAC. The STAT-ers also continued to be involved in recycling aluminum cans and newspapers.

The principal (and hugely successful) fundraiser for the year was the sale of T-shirts with the Top 10

Reasons to be a Statistician on the back. Sale of the shirts continued through the spring and summer.

The department installed an enclosed bulletin board in the main entryway of Snedecor Hall to feature photographs of the graduate students, faculty, and staff. Several STAT-ers volunteered their time to take and post pictures for this project.

Shell Industrial Seminar

The Shell Lecture in Industrial Statistics was presented by Robert R. Starbuck, assistant vice president, Clinical Biostatistics & Data Management, Clinical Research & Development, Wyeth-Ayerst Research, Philadelphia, Pennsylvania, on October 20. It was entitled "Anxiety over statistics (or vice versa?)" and was the third in a series of annual lectures supported by departmental grants from the Shell Oil Company Foundation. Dr. Starbuck also gave a seminar for the Iowa STAT-ers on the same day, on "The role of the clinical statistician."

Snedecor Lecture

Joan Fisher Box and James Crow, Snedecor lecturers

The sixth George W. Snedecor Lecture was presented on April 22, 1996, by Joan Fisher Box, with additional comments by James F. Crow, Madison, Wisconsin. They spoke on "The Life and Times of R. A. Fisher." The Snedecor Lectures are a series of occasional lectures that recognize George Snedecor's pioneering contributions to the field of statistics and to the Statistical Laboratory.

Box is a daughter of R. A. Fisher and author of a major biography dealing with his life. She holds a B.A. degree in English literature and an M.A. degree in the history of science, both from the University of Wisconsin, Madison. For two years she was employed in the Chemistry Department at Rothamsted Experimental Station, Harpenden. To quote from the dust jacket of her biography, *R. A. Fisher, the Life of a Scientist,* published by John Wiley & Sons in 1978: "She was with him [her father] in the department at Whittingehame Lodge, and went on to be his travelling companion to India and to Australia."

Crow, a geneticist, has received various campus honors at the University of Wisconsin, including a Bascom Professorship in 1965, and later awards for teaching and distinguished service. He is a member of the National Academy of Sciences, the National Academy of Medicine, the American Philosophical Society, the American Academy of Arts and Sciences, and the World Academy of Art and Science.

Snedecor and Bancroft Awards

The George W. Snedecor Award to an outstanding doctoral student in statistics went to Anindya Roy, who received his bachelor's (honours) and master's degrees in statistics at the Indian Statistical Institute, Calcutta. He has held a graduate assistantship here since 1993.

The 1996 T. A. Bancroft Award went to Elizabeth Paterno, who is pursuing a joint Ph.D. in economics and statistics. She received a B.S. degree in statistics, magna cum laude, in 1989 from the University of the Philippines Los Banos and then was an instructor there in the Department of Economics for a year. She has held a graduate assistantship in statistics and/or economics at ISU since 1990, completing an M.S. degree in statistics in 1992.

Both awards were made during the Statistical Laboratory seminar on February 28.

Undergraduate Students

Several undergraduate statistics majors received scholarships or recognitions for 1995-96. The George W. Snedecor Undergraduate Statistics Award of $200 recognizes a statistics major who has demonstrated superior academic achievement and scholarship. Two such awards were given for 1995-96--to Lingcheng Huang and to Charlotte Schulze-Hewett. Schulze-Hewett has a double major in statistics and mathematics. She also was selected to receive the Schillmoeller Family Scholarship in statistics for 1995-96, which carries a $500 award. Both students are seniors. These awards were recognized at the opening Statistical Laboratory seminar on August 28, 1995. Both Vera Boulaevskaia and Huang, statistics majors, were recipients of Barry M. Goldwater Scholarships for 1995-96. Boulaevskaia was also the 1995-96 recipient of the Eastern Iowa American Society for Quality Control Scholarship, which carries an award of $1,000. Daniel P. Ewald, a freshman statistics major, received the Statistics Department/Eli Lilly Company Scholarship of $1,000 for his first year of study at Iowa State.

At the 1996 Scholarship Recognition Dinners on April 8-9, Gary J. Walters, a sophomore major, and Vera Boulaevskaia were recognized as standing in the top two percent of the sophomore and junior classes, respectively, in the College of Liberal Arts and Sciences. Charlotte Schulze-Hewett was recognized as the highest graduating senior for the academic year 1995-96 in both the Departments of Mathematics and Statistics. Ryan J. Lennon, a junior

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statistics major, and Lingcheng Huang were initiated as members of Phi Beta Kappa on April 28, 1996.

In April and June 1996, several statistics students were selected to receive scholarships for the academic year 1996-1997: Gary J. Walters, a sophomore major, will receive the first Max Boehm Scholarship in Statistics. This scholarship covers full instate tuition for the academic year. Walters also was awarded the Schillmoeller Family Scholarship for the 1996-97 academic year. Ryan J. Lennon received the Eastern Iowa American Society for Quality Control Scholarship for 1996-97, his senior year. Vera Boulaevskaia, who is a double degree candidate in statistics and French, received the George W. Snedecor Undergraduate Statistics Award for 1996-1997 on April 29, 1996. She will also hold the Barry M. Goldwater Scholarship for a second year.

Seven students received B.S. degrees in statistics during the period July 1, 1995, to June 30, 1996. 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.

*Matthew Scott Haubrich (Spring 1996; W. Robert Stephenson).

Lingcheng Huang (Spring 1996, with distinction; Richard A. Groeneveld) is a statistical analyst at the Mayo Clinic, Rochester, Minnesota.

Nathan D. Pelzer (Spring 1996, with distinction; Mark S. Kaiser) is employed as a Statistician I with the ICI Seeds Research Department, Slater, Iowa.

Jeremy Aron Petersen (Spring 1996; W. Robert Stephenson).

Sondra Margaret Reis (Summer 1995, honors program, majors in statistics and political science; W. Robert Stephenson) is a communications and development officer at the Dodge Nature Center, West St. Paul, Minnesota.

Charlotte Marie Schulze-Hewett (Spring 1996, honors program, degrees in both mathematics and statistics, with distinction; William Q. Meeker) will be a research assistant with Prof. Derrick Rollins in 1996-97 at Iowa State.

Matthew Robert Schwab (Spring 1996; Richard A. Groeneveld) is a graduate student in statistics at North Carolina State University.

During the summer 1996, a number of undergraduate statistics majors had internships. Vera Boulaevskaia worked as a statistical intern for the Motorola Company in Mount Pleasant, Iowa; Aaron Kaufman worked for John Deere Health Care, Moline, Illinois, as an actuarial intern; Ryan J. Lennon worked as a data analyst in the Biostatistics Department, Mayo Clinic, Rochester, Minnesota. Matthew Haubrich, a Spring 1996 B.S. graduate, worked over the summer with the Survey Section of the Statistical Laboratory in Snedecor Hall, ISU.

Statistics Club

The purpose of the Statistics Club (STAT CLUB) is to promote interest in statistics among undergraduate students at Iowa State University. W. Robert Stephenson serves as advisor to the club.

Matt Haubrich received the STAT CLUB Prize for 1995-96 at the first meeting in the fall in recognition of his contributions to the Statistics Club and his academic achievement. The award of $200 was supported by the club and the Department of Statistics.

Much of the activity of the club this year was directed at the 2nd Annual Undergraduate Data Analysis Contest. The goals of the contest were (a) to bring together students and statistics professionals for the presentation and discussion of the analysis of a preselected data set and (b) to award prizes to the best works. The contest was sponsored by the American Statistical Association. This year's data set consisted of 23 variables recorded for 77 cities in the U.S. whose population in 1990 was 200,000 or more. Although several general suggestions for analysis were given, it was left to the teams to decide upon and carry out an appropriate analysis.

Although many undergraduate majors expressed interest in the data set and the contest, only one team, consisting of Matt Schwab and Matt Haubrich (Matt[2]), submitted the written report of their analysis by the February 1 deadline. The written report was only the first part of the contest. Based on the written reports the top teams were invited to present their analyses orally at Winona State University on April 13, 1996.

Matt[2] did a fine job using multivariate analysis techniques to develop an interactive computer program that allowed individuals to construct a personal list of "best" cities based on each individual's preferences. Their report and presentation earned them third place. They received a plaque, which they have donated to the Department of Statistics, a $500 cash prize, and other prizes. We hope that this will be the first of many award-winning teams from Iowa State at the Undergraduate Data Analysis Contest.

The officers of the club for 1995-96 were Matt Schwab, president; Lingcheng Huang, vice president; Vera Boulaevskaia, treasurer; and Matt Haubrich, secretary.

Seminars

The series of regular weekly seminars offered by the Statistical Laboratory and the Department of Statistics throughout the 1995-96 year was planned by John Stufken and Dianne Cook. Kevin Wright was chair for the Iowa STAT-er seminar series. Speakers were from the Department of Statistics unless identified otherwise.

Statistical Laboratory Seminars

Fall 1995

August 28	[Untitled] Welcome to the Department of Statistics, with a review of the Departmental Strategic Plan of 1995. Dean L. Isaacson
September 11	A link between ArcView 2.0 and XGobi: A tool for dynamic graphical analysis of spatially referenced data. Jürgen Symanzik, Department of Statistics, and James J. Majure, Geographic Information System Support and Research Facility, ISU

September 18   Expectations of products of quadratic forms. Ghazal A. Ghazal, Institute of Statistics, Cairo University

25   Sometimes there is a free (and delicious) lunch.... Xiao-Li Meng, Department of Statistics, University of Chicago

October 2   Empirical likelihood as a goodness of fit measure. Keith Baggerly, Los Alamos National Laboratory

9   (Co-sponsored by the Center for Teaching Excellence) Exploiting technology to revitalize introductory statistics for engineers. Panickos Palettas, Department of Statistics, Virginia Polytechnic Institute and State University

16   Statistics for monitoring total error from target in total quality control of an analytical method. Lawrence Lin, Baxter Healthcare Co., Riverwoods, Illinois

23   Converting tables into plots. Dan Carr, Center for Computational Statistics, George Mason University

30   Compression of morbidity: Trends in hip fracture incidence and survival. Terry Therneau, Section of Biostatistics, Mayo Clinic

November 2   Likelihood and Bayesian asymptotics. Nancy Reid, Department of Statistics, University of Toronto

3   An overview of some recent methods in statistical inference. D. A. S. Fraser, Department of Statistics, University of Toronto

9   Model choice: A minimum posterior predictive loss approach. Alan E. Gelfand, Department of Statistics, University of Connecticut

13   Tuning the prior distribution of regression parameters for model-mixing. James S. Hodges, Division of Biostatistics, School of Public Health, University of Minnesota

14   (Joint Mathematics-Statistics Colloquium) A stochastic venture into quantum mechanics. Gopi Kallianpur, Department of Statistics, University of North Carolina-Chapel Hill

27   Tetraploid and two-locus survival probabilities when there is partial selfing. Edward Pollak

December 4   Accelerated degradation test modeling and analysis. William Q. Meeker

6   Which part of the ordered sample contains the information? Sangun Park, Department of Applied Statistics, Yonsei University, Seoul, South Korea

Spring 1996

January 16   Clustering and spatial point processes: A Bayesian MCMC approach. Vincent Granville, Statistical Laboratory, University of Cambridge, Cambrdige, United Kingdom

22   An application of MARS and orthogonal arrays to high-dimensional continuous-state stochastic dynamic programming. Victoria C. P. Chen, School of Industrial and Systems Engineering, Georgia Institute of Technology

24   (Joint Mathematics-Statistics Colloquium) Quasi stationary distributions: Markov processes and dynamical systems. Servet Martinez, University of Chile, Santiago, Chile

February 12   Weighted semiparametric estimation in regression analysis with missinv covariate data. Suojin Wang, Department of Statistics, Texas A&M University

14   Model selection for density estimation. Yuhong Yang, Department of Statistics, Yale University

15   Analysis of hidden Markov models using Markov chain Monte Carlo. Bruce A. Craig, Department of Statistics, University of Wisconsin-Madison

February 19   The AECM algorithm--a flexible and efficient generalization of EM. David van Dyk, Department of Mathematics, Kalamazoo College

19   Posterior consistency in Gaussian shift experiments. Suman Majumdar, Department of Statistics, Michigan State University

21   On the accuracy and efficiency of empirical likelihood. Nicole Lazar, Department of Statistics, the University of Chicago

22   Conditional quantile by spline approximation. Xuming He, Department of Statistics, University of Illinois at Urbana-Champaign

26   Improved Markov chain Monte Carlo sampling schemes. Richard Levine, Biometrics Unit, Cornell University

28   Modeling the correlation structure of the TOMS ozone data. Dongping Fang, Department of Statistics, the University of Chicago

March 4   Bayesian analysis of multiple event survival data. Sujit K. Ghosh, Department of Statistics, University of Connecticut

18   Smoothing geographical data in the form of rates. Karen Kafadar, Department of Mathematics, University of Colorado

25   Computationally intensive methods in spatial epidemiology. Andrew Lawson, Division of Mathematical Sciences, University of Abertay Dundee, Dundee, UK

29   The influence of aberrant spatial data values on semivariogram modeling. Richard F. Gunst, Department of Statistical Science, Southern Methodist University

April 1   Discriminant adaptive nearest neighbor classification. Trevor Hastie, Statistics Department, Stanford University

4   Nonparametric procedures for comparing the performance of repeated markers used to predict a survival endpoint. Birol Emir

8   Asymptotic statistics of AR spectral estimators for processes containing mixed spectrum. Peter Sherman

15   Marginal distributions and Bayesian model selection in non-normal linear models. Julia Varshavsky, Eli Lilly

18   Random sampling or geostatistical modeling? Jaap J. de Gruijter, DLO Winand Staring Centre for Integrated Land, Soil and Water Research, University of Wageningen, the Netherlands

29   An assessment of Bayesian inference in nonparametric logistic regression. Nandini Raghavan, Department of Statistics, the Ohio State University

May 6   Estimation of antigen-responsive T-cell frequencies in PBMC from human subjects. Terry Speed, Department of Statistics, University of California-Berkeley

9   (Joint Computer Science-Statistics Colloquium) Timed data flow diagrams. Jürgen Symanzik

Summer 1996

May 29   Spatially descriptive, temporally dynamic models for predicting meteorological and climatological processes. Christopher K. Wikle, Department of Statistics and Department of Geological and Atmospheric Sciences, Iowa State University

June 10   Regression estimation for finite population means in the presence of nonresponse. Anthony B. An

24   Dynamic statistical graphics in the CAVE virtual reality environment. Jürgen Symanzik

Special Lectures and Seminars

October 20   Shell Lecture in Industrial Statistics: Anxiety over statistics (or vice versa?). Robert Starbuck, Wyeth-Ayerst Research, West Chester, Pennsylvania

April 22   George W. Snedecor Lecture: The life and times of R. A. Fisher. Joan Fisher Box, Madison, Wisconsin, with additional comments by James F. Crow, Department of Genetics, University of Wisconsin-Madison

22   (Joint Statistics and Animal Breeding Seminar) The high genomic rate of spontaneous mutation. James F. Crow, Department of Genetics, University of Wisconsin-Madison

May 20   (Joint Agronomy, Ames Laboratory, and Statistics Seminar) Comprehensive appraisal of plutonium in soils around Rocky Flats using nonparametric spatial estimation techniques. Iggy Litaor, Department of Civil and Environmental Engineering, University of Colorado-Boulder, and Department of Geology, Tel-Hai Rodman College, Upper Galilee, Israel

Seminars in Environmental/Ecological Statistics

October 2   Change of support and the modifiable areal unit problem. Noel Cressie

23   Graphical ideas and map construction. Dan Carr, Center for Computational Statistics, George Mason University

Iowa STAT-ers Seminar

September 6   Experiences of summer internships. Mike Eraas, Angela Jones, and Pam Schmidt

20   Providian Bancorp. Kelli (Leonard) Peters and Drew Langevin, Providian Corporation

October 4   Sampling approaches for soil survey updates. Pam Abbitt

17   Viral assay and inactivation process validation: Statistical issues. Lawrence Lin, Baxter Healthcare Co., Riverwoods, Illinois

20   The role of the clinical statistician. Robert Starbuck, Wyeth-Ayerst Research, West Chester, Pennsylvania

November 1   Statistics at Merck & Co., Inc. Brian Wiens, Merck Research Laboratories

10   Markov chain Monte Carlo methods for statistical inference. Alan E. Gelfand, Department of Statistics, University of Connecticut

29   A modified minimum Chi-square estimator of food consumption probability distributions. Zugeng Zheng

January 24   Personal experiences of a career in the pharmaceutical industry. David C. Huang, Department of Statistics, ISU, and the Upjohn Company

February 2   A measure from information theory for detecting significant marketplace events. Rachel Harter, National Opinion Research Center

9   Statistics at Pratt and Whitney. Christine Ashman, Pratt and Whitney

March 29   Statistics and Trilogy Consulting Corporation. Greg Jareck, Trilogy Consulting Corporation

April 5   Methods for drawing statistical inferences about population of texts. Carl Roberts

April 10   Maximum likelihood, Bayesian estimation, and animal breeding. Hal Stern

23   Sampling approaches for Minnesota fish contamination and ecology studies. Heidi Shierholz

24   Experiments in surveys: Replications in time and space. Fred Lorenz

IN MEMORIAM

Norman V. Strand (1908-1995)

Norman V(ictor) Strand died on November 19, 1995, at the Bethany Manor Care Center, Story City, Iowa, of complications arising from Alzheimer's disease. He was born in Pierre, South Dakota, on September 26, 1908, and received his bacheler's and master's degrees in 1934 and 1935 at South Dakota State University. From 1936 to 1941 he was director of the WPA economic projects for the Ames and Des Moines area. In 1941 he joined the U.S. Department of Agriculture, initially being stationed in Milwaukee, Wisconsin, and at Purdue University. He served in the U.S. Army during World War II and retired from the Army Reserve in 1968 as a lieutenant colonel.

Strand joined the Statistical Laboratory staff at ISU (then Iowa State College) in 1946. He retired in 1972 and was named emeritus professor. During his period at Iowa State he had also served as an agent of the U.S. Department of Agriculture and had engaged in international projects for the U.S. government in Greece, South Korea, and Thailand.

From 1973 to 1986, Strand and his wife, Mary, lived in Mountain Home, Arkansas. Following her death he returned to Ames. He is survived by three daughters, Anne Thompson of Springfield, Virginia, Martha Fye of Amelia Island, Florida, and Elizabeth Coon of Ames, and ten grandchildren.

Clifford Hildreth (1917-1995)

Clifford Hildreth, a former member of the Statistical Laboratory, died at the age of 77. He had been a professor of statistics at the University of Minnesota for the past 24 years.

He received an A.B. degree at the University of Kansas in 1939 and an M.S. degree in agricultural economics at Iowa State College in 1941. Work for a doctorate was interrupted by military service during World War II, mainly as an air navigator in the U.S. Navy. He became a research associate in the Statistical Laboratory at Iowa State in 1946, completed a Ph.D. in economics in 1947, and was promoted to assistant professor of statistics. He was on leave for the first half of 1948 to join the Cowles Commission for Research in Economics, Chicago, Illlinois, then returned in July as research associate professor in the Statistical Laboratory and associate professor of economics. Hildreth resigned on June 30, 1949 to rejoin the Cowles Commission and the Department of Economics at the University of Chicago. He remained there until 1953, except for spring quarter 1950 when he was a visiting professor of statistics and economics at Iowa State.

Hildreth went to North Carolina State for two years as professor of agricultural economics, before going to Michigan State University and finally to the University of Minnesota. While at Michigan State he served as head of the Department of Economics for a number of years. He also was editor of the *Journal of the American Statistical Association* from 1960 to 1965 and ASA president in 1973. He was a fellow of ASA, IMS, and the Econometric Society. He served as a consultant to the Air Force, the U.S. Treasury Department, and the Tennessee Valley Authority. Since retirement from active duty at Minnesota, Hildreth had lived in Eugene, Oregon.

Margaret Elizabeth Kirwin (1907-1996)

Margaret E. Kirwin died on February 19, 1996, in Ames of respiratory failure. She was born in Superior, Nebraska, on November 1, 1907, graduated from Ames High School in 1925 and attended Iowa State College. She also began working as a clerk and secretary at Iowa State in the Home Economics Department, and then the Chemical Engineering Department. In 1929 Margaret Goosman married Edwin A. Kirwin and moved to Winona, Minnesota, returning to Ames in 1941 following his death. She was employed at Iowa State University for over 35 years, including 31 years in the Statistical Laboratory and Department of Statistics, retiring as administrative assistant in 1977.

Mrs. Kirwin was active in professional, church, and volunteer work. She was a member of St. John's Episcopal Church, a former board member of the ISU Credit Union, a former officer of the National Secretaries Association, and a lifetime member of the ISU Memorial Union. She is survived by two daughters, Shirley Ann Bolce of Ames and Alice Mae King of Newton, Iowa; one son, Milton Charles Kirwin of St. Paul, Minnesota; six grandchildren; and 11 great-grandchildren.

Emil Henry Jebe (1909-1996)

Emil H. Jebe, a former faculty member in statistics at Iowa State, died of cancer at his home in Arkansas on May 18, 1996. A memorial service was held in Iowa in June. He was preceded in death by his first wife, Noma, in 1992; he is survived by his second wife, Florence, 1318 Lela, Rogers, Arkansas.

Jebe was born in Clutier, Iowa, on February 26, 1909. After graduating from high school, he worked on his father's farm until 1934. He received a B.S. degree in economics at Iowa State College in 1938 and an M.S. in agricultural economics in 1941. He was on active duty in the army from May 1941 to October 1946, ending as major, was awarded an Army Commendation Ribbon for service with USAMGIK, Seoul, Korea, for work on food and agricultural statistics in 1945-46, and then continued to serve in the reserves.

Jebe went to North Carolina State College for doctoral studies and work as a Bureau of Agricultural Economics resident collaborator from 1946 through

October 1949, receiving a Ph.D. in experimental statistics from North Carolina State College in 1950. In November 1949 he joined the Statistical Laboratory and Department of Statistics at Iowa State as associate professor, with duties including work as consulting statistician in the statistics department of the Iowa Agricultural Experiment Station. In 1951 he also became a part-time member of the USAF-ISC Operations Analysis standby unit of the Operations Analysis Office in Washington, D.C. He was on leave to serve as visiting associate professor for the 1959 Graduate Summer Session of Statistics in the Health Sciences, held at the University of Michigan under NSF sponsorship. On November 30, 1959 his resignation from Iowa State became effective to allow him to begin a 13-year period as research mathematician in the Operations Research Department, Willow Run Laboratories, University of Michigan. In 1973, when the laboratories separated from the university and became the Environmental Research Institute of Michigan, Jebe continued with the new organization. He formally retired in 1974 but continued to be active in work at ERIM and in professional society activities. In 1994 he moved from Ann Arbor, Michigan, to Traer, Iowa, with winter residence in Rogers, Arkansas.

Emil Jebe was a fellow of the American Statistical Association and of the American Society for Testing and Materials. When he was given the ASTM 1985 Award of Merit, he was cited for "outstanding leadership as chairman of Committee E-11 [on Statistical Methods] and for exceptional technical contributions to the development and review of statistical standards within E-11 development and review of statistical standards within E-11 and to the application of these standards and techniques in other ASTM Committees." He was an energetic and devoted supporter of Iowa State and the Statistical Laboratory/Department of Statistics, returning often to the campus to visit.