STATISTICAL LABORATORY

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annual report

July 1, 1983 to June 30, 1984
IOWA STATE UNIVERSITY, AMES

Contents

THE STATISTICAL LABORATORY
Iowa State University
1983-84 Annual Report

The 51st Year

The afterglow of the 50th anniversary celebration persisted in the Statistical Laboratory through much of this past year, climaxing in the publication of the conference proceedings in June (see pp. 19-20). However, other events also occurred, as this annual report indicates. Perhaps most noteworthy is the change in leadership of the ISU statistical center which comes at the close of the 1983-84 year.

Herbert A. David is returning to teaching and research duties after 12 years as director of the Statistical Laboratory, head of the Department of Statistics, and head of the Statistics Department of the Iowa Agriculture and Home Economics Experiment Station. David came to Iowa State in 1972 to succeed T. A. Bancroft, first head of the Department of Statistics and second director of the Stat Lab. After receiving his Ph.D. at University College London in 1953, he had served on the staffs of C.S.I.R.O. in Sydney, Australia, Melbourne University, Virginia Polytechnic Institute, and most recently, the University of North Carolina. He had also been editor of *Biometrics* from 1967 to 1972. At Iowa State, David has maintained continuity of purpose and program for the statistical center and expanded them in directions that were natural and needed by the university. Under his leadership, ISU continues to be one of the leading institutions in the nation in both size and strength in statistics. At the same time a broadly based program of research and service, through teaching and consultation, has been maintained and enlarged. David's own research efforts in the areas of order statistics, paired comparisons and cyclic designs, and the theory of competing risks — as well as his service to the profession of statistics — are widely recognized, as indicated by awards and honors conferred on him by societies and organizations outside the university. In further recognition, he was named Distinguished Professor of Sciences and Humanities here in 1980 and elected as president of the Biometric Society for 1982 and 1983.

An appreciation dinner was held for H. A. David and his wife, Vera, on May 31. On that occasion, President W. Robert Parks expressed his appreciation of the international nature of the statistical community at Iowa State — faculty, students, their families, and visiting scholars — and the truly international role the statistical center has provided under David's leadership. Oscar Kempthorne presented a parchment scroll on behalf of the staff. Herbert David is remaining at Iowa State and will concentrate on teaching and on research in order statistics and related areas, with continued support from the U.S. Army Research Office.

Vice president George C. Christensen and William H. Kelly, dean of Sciences and Humanities, converse with honoree H. A. David. President W. Robert Parks addresses the gathering, to be followed by Oscar Kempthorne as presenter. Then Evelyn Fuller, Kempthorne, David, and Wayne Fuller examine the scroll presented at the appreciation dinner. The text reads: "The faculty and staff of the Department of Statistics and Statistical Laboratory hereby express our appreciation and gratitude to Herbert A. David, and his wife, Vera, for exemplary service from 1972 to 1984. As Head and Director, Dr. David has been a fine leader, an excellent administrator, an esteemed colleague, and a scholar of world renown. We of the Department and Laboratory look forward to many more years of association with Herbert and Vera."

Reception, banquet, and presentation

Dean L. Isaacson has been appointed acting director and acting head beginning July 1, 1984. Also the university administration agreed to try to find, during the next year or two, the necessary funds to allow a search for a permanent director and head. Isaacson came to Iowa State in 1968 after completing M.S. and Ph.D. degrees at the University of Minnesota in mathematics. As a probabilist, he has held a joint appointment in the departments of Mathematics and Statistics. His research has been in the area of Markov processes and he is senior author of a book on *Markov Chains: Theory and Applications* (John Wiley & Sons, 1976). For many years Isaacson has served as adviser to incoming graduate students in statistics, a role in which he will continue. In 1979-80 he was honored as Outstanding Teacher in the College of Sciences and Humanities.

Personnel

New additions to the faculty, previously announced, were Noel A. C. Cressie as full professor, filling a vacancy left by Malay Ghosh, and Mark Reiser as adjunct assistant professor in the Survey Section, beginning in August 1983. Oscar Kempthorne spent the academic year on faculty improvement leave at Virginia Polytechnic Institute and State University, as visiting distinguished professor in the Department of Statistics. During that period he studied foundations of statistics, theory of ancillaries, linear models, and design of experiments, with some writing in these areas.

As announced previously, Byron Jones came here as visiting assistant professor for the 1983-84 academic year. After teaching at the University of Texas-Austin during summer school 1984, he will return to his position as lecturer in statistics, University of Kent at Canterbury, England.

Emmanuel Yashchin, visiting assistant professor from Technion, Haifa, Israel, completed research in July under a grant from the U.S. Army Research Office, then went to IBM's Thomas J. Watson Research Center, Yorktown Heights, New York, as IBM Fellow for a year.

Yasuyuki Toyooka is currently engaged in contractual research for the U.S. Bureau of the Census under a half-time appointment as visiting associate professor beginning October 21, 1983. He received the degree of Doctor of Engineering in mathematical statistics at Keio University, Japan, and has been a research associate in the Department of Applied Mathematics, Faculty of Engineering Science, at Osaka University.

Jayanta K. Ghosh arrived June 1 for a two-month term as visiting professor. He is doing research supported by the U.S. Army Research Office and is also giving a special short course on the jackknife, the bootstrap, and related techniques. Ghosh is on leave from his position as professor in the Division of

J. K. Ghosh

Theoretical Statistics and Mathematics, Indian Statistical Institute, Calcutta.

J. Jeffery Goebel resigned at the end of February to accept a position in Washington, D.C., as statistician in the Resources Inventory Division, U.S. Soil Conservation Service. He is now working with SCS people in using and understanding statistical concepts and data; he is also establishing procedures for inventorying and forecasting various natural resources, such as snow quantities and how they affect irrigation, flooding, etc.

After a three-month stay, visiting scholar Wyman Nyquist returned in September to the Purdue University Department of Agronomy, where he is a professor of statistics and quantitative genetics and the Agricultural Experiment Station statistician.

Two visiting scholars from the People's Republic of China began one- to two-year periods of study in the Statistical Laboratory. Since January, Renkuan Guo has studied statistical forecasting methods and other management techniques. In China he taught applied statistics in the Managerial Engineering Department, Dalian Institute of Technology. Shiguang Zhu arrived June 1 to engage in research in mathematical genetics and statistics, working with Edward Pollak and faculty in genetics. He is on leave from his position as lecturer in mathematics, Department of Meteorology, Beijing Agricultural University.

At the end of June visiting scholar Ping Fang returned to Nanjing, People's Republic of China, after a 28-month stay. He had been studying quantitative genetics, experimental design, and statistical methods in order to teach relevant courses at the Nanjing Agricultural College.

Short-term visitors included Tiberiu Postelnicu, director of the Division of Modelling and Stochastic Processes, Centre of Mathematical Statistics, Bucharest, Romania, and professor at the United Nations-Romania Demographic Centre. Also Prem Narain, director, Indian Agricultural Statistics Research Institute, New Delhi, discussed areas of cooperation between the institute and the Stat Lab. The institute has been recognized as a center for advanced studies in the United Nations Development Program.

At the combined annual statistical meetings in Toronto in August, William Q. Meeker, Jr., was elected a Fellow of the American Statistical Association. He was cited "for significantly advancing the theory and practice of accelerated life testing, and for dedicated services to the profession as an educator and editor."

Herbert A. David received the 1983 Wilks Award for Outstanding Contributions to Statistical Methodologies in Army Research, Development, and Testing. This award, established in 1981, commemorates the late Professor Samuel S. Wilks of Princeton University and is administered by the Army Mathematics Steering Committee. The award plaque and a check were presented at the 29th annual Army Design of Experiments Conference held at the Uniformed Services University of the Health Sciences, Bethesda, Maryland, on October 19-21.

John Highland, research assistant in the Survey Group, retired on November 30 but has continued to work part-time as a private soils consultant, mainly on soil damage cases that end up in court. Avonelle Hefflefinger was awarded a certificate in December recognizing 20 years of meritorious service to the Statistical Laboratory. Harvey Terpstra was promoted to data systems manager in February. At the annual Honors and Awards Convocation during Alumni Days, June 9, Margaret Krzysiak Fowler was honored as recipient of the Wallace E. Barron All-University Senior Award. While working in the Survey Section she has also been progressing in an undergraduate program in business administration-marketing.

Looking toward next year: Carl W. Roberts becomes assistant professor of sociology and statistics July 1, 1984, filling a vacancy left by Robert Johnson. In the Department of Statistics he will teach courses on statistical methods for research workers and on statistics in the social sciences. He will also do statistical consulting with students and faculty in sociology and related social sciences and teach research methodology courses offered by Sociology. Roberts received degrees of M.A. in sociology, M.S. in applied mathematics and statistics, and Ph.D. in sociology from the State University of New York at Stony Brook. He was a Fulbright Scholar and a Luftbrueckendank Foundation Fellow in Germany. Most recently he has been a research associate with the SUNY Research Foundation, working as statistical consultant and data analyst on projects at the Health Sciences Center, Department of Psychiatry and Behavioral Science.

Statistical Laboratory Staff — Fiscal Year 1983-84 under the administrative direction of:

W. Robert Parks, Ph.D. — president of the university

Daniel J. Zaffarano, Ph.D. — vice president for research; dean of the Graduate College

William H. Kelly, Ph.D. — dean, College of Sciences and Humanities; director, Sciences and Humanities Research Institute

Lee R. Kolmer, Ph.D. — dean, College of Agriculture; director, Iowa Agriculture and Home Economics Experiment Station

Herbert A. David, Ph.D. — director, Statistical Laboratory; head, Department of Statistics; head, Statistics Department, Iowa Agriculture and Home Economics Experiment Station

Professors

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

Associate Professors

Kenneth J. Koehler
Jerome M. Sacks, USDA collaborator
Mack C. Shelley II, joint appointment with Department of Political Science
Shashikala Sukhatme
Yasuyuki Toyooka, visiting
Stephen B. Vardeman

Adjunct Associate Professor

Thomas Bubolz

Assistant Professors

Yasuo Amemiya
Harold D. Baker
J. Jeffery Goebel
Ronaldo Iachan
Byron Jones, visiting
Frederick O. Lorenz, joint appointment with Department of Sociology and Anthropology
Mervyn Marasinghe
W. Robert Stephenson
Emmanuel Yashchin, visiting

Adjunct Assistant Professor

Mark R. Reiser

Visiting Scholars

Chang Dorea, also visiting associate professor in Department of Electrical Engineering
Ping Fang
Renkuan Guo
Wyman E. Nyquist (*)
Shiguang Zhu

Resident Collaborator

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

Research Assistant

John Highland, Survey Section

Predoctoral Research Associate

Terrance P. Callanan

Graduate Assistants

The status of graduate students often changes. Students holding appointments as graduate teaching or research assistants for part or all of the year are listed here.

Blake Abdella
Kevin Anderson (*,**)
Babu G. Baradwaj
Craig A. Beam
Tammy Bondioli
Thomas A. Borders
Mark F. Bryan
David L. Cassell

Stephen Fu-Chung Chang
Tin Chiu Chua (*)
Carolyn Connor
John R. Cook
Lee Ann Crowder
Stephen V. Crowder
Bruce Diiro
Ping Fang
Charles M. Farmer
Carol A. Francisco
Fah Fatt Gan
Gloriana Giacobello
Mark Gunderson
In Hye Ha
Rachel Harter (*)

Patrick Homblé
Shih-Jian Hsu
Shun-Chuen Huang
Frederick Hulting
Hsien-Ming Hung (*)
David Jacobson
Karen Jensen
Daniel Jeske
John Marcus Jobe
Jason Jones
Byung Chun Kim
Ronald D. King

Kevin Kramer
Carl Moun-Shen Lee
Jyh-Shiun Lin
Tsung-Hua Lin
Sharon K. Loubert
Douglas E. McCoy
Paul McGovern (*)
Sallie Keller McNulty (*)

Cindy Lynn Martin
David Martinich (*)
Edina Miazaki (**)
Stephen M. Miller
Grecia F. Morel
Jorge Morel
Neerchal K. Nagaraj
Nuwan Nanayakkara
Julia Oñate
George Ostrouchov
Gilda Pareja (*)
Jerome Paulissen
Michael P. Rogers
Saad Eldin M. Saad Eldin
Daniel J. Schnell

Steven J. Schuelka
David L. Silvis
John C. Thompson
Miriam Tirol
Margot Tollefson
Jan van Schaik
Steven P. Vilendrer
Hugh Voigt
Annette Wagner
Franklin Winters
Danny A. Wolfgram
Dale L. Zimmerman

Supported Graduate Students

Bahtiar Abbas — International Agricultural Development Service (Rockefeller Foundation)
Yasmin Abdulaziz — Malaysian Government
Edi Abdurachman — USAID, Indonesia
Mohamed Ab-Ghaffar — Malaysian Embassy
Kevin Anderson — Department of Mathematics, ISU
Robert J. Arnold — Engineering Research Institute, ISU
Thomas Bicek — Department of Mathematics, ISU
Thomas A. Borders — Department of Mathematics, ISU
Da Yang — Beijing Agricultural University, China
Mamadou L. Diedhiou — Michigan State University (USAID, Senegal) (**)
Donna Hensen — Department of Mathematics, ISU
Ricardo Heymans — Universidad de Oriente, Cumaná, Venezuela (*)
Mohammed Khan — Food and Agriculture Organization, United Nations

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*summer 1983
**summer 1984

Arunee Kumlung — Chulalongkorn University, Thailand (*)
Youngjo Lee — Engineering Research Institute (*)
Anthony Lui — Computation Center, ISU
Mark McNulty — Department of Economics (*)
David Martinich — Department of Mathematics, ISU
Abdelghani Mehailia — Algerian Government
Edina Miazaki — Universidade Federal de São Carlos, Brazil
Gilda Pareja — Hoyt Memorial Research Assistantship, ISU
Byung Sul Park — Korean Army
Ademir Petenate — Universidade de Campinas, São Paulo, Brazil (*)
Juan Esteban Ramírez C. — Universidad Tecnica del Estado, Santiago, Chile
Cleve Redmond — Computation Center, ISU
Saad Eldin M. Saad Eldin — University of Gezira, Sudan
Margaret Scott — Department of Mathematics, ISU
Hon Richard Tachia — University of Jos, Nigeria (*)
Sergio Torreblanca — Consejo Nacional de Ciencia y Technologia, Mexico
Michael Tveite — Engineering Research Institute, ISU (*)
Kanlaya Vanichbuncha — Chulalongkorn University, Thailand (*)
Tilaka Vijithakumara — Department of Mathematics, ISU
Biyoung Yoon — Korean Army
Francisco Zamudio S. — Consejo Nacional de Ciencia y Technologia, Mexico (*)

Self-Supporting Graduate Students

Rosmawati Abdul-Halim
Seong-San Chae
Min-Shih Chang
Keng-tang Chien
Eiichiro Funo
Margarita Guerrero
In Hye Ha
Chihho Hsieh
Ching-Chang Hwang
Shawn Jacobson
Yoou-Jen Kang
Byung Hwee Kim
Lawrence Kinyon
Mong-Hong Lee
Paul McGovern
Reda Mazloum
Grecia F. Morel
David D. Pohl
Di-ou Ray
Yan-Ling Tsay
Michael Tveite
Steven Vilendrer
Jeffrey R. Wilson
Peh-Jen Jenny Wu
Jin-ying Yu
Rahmat Zakaria

Undergraduate Teaching Assistant

Kathleen Taylor

Professional and Scientific Staff

Tin-Chiu Chua, research associate, Survey Section (**)
Richard Dorsch, research associate, Survey Section
Mary Genalo, research associate, Survey Section
Avonelle Hefflefinger, administrative assistant
Kuo-Ying Hung, research associate, Survey Section, through October
Ye-Fu Lee, research associate, Survey Section
Bud Meador, supervisor, Statistical Data Processing Services
Deborah Reed-Margetan, programmer-analyst, beginning April 9
Kathleen Shelley, data analyst, Statistical Data Processing Services
Harvey Terpstra, data systems manager, Survey Section
Jauvanta Walker, information specialist

General Office Staff

Rose Ann Anderson, secretary, beginning May 5
Norma Elwick, secretary
Lynn Hogan, secretary from August 8 until May 18
Julie Honeick, secretary — Experimental Design Genetic Statistics Section
Donna Nelson, secretary
Marylou Nelson, secretary until July 11
Janice Peters, account specialist
Rita Riis, secretary
Denise Riker, secretary, beginning June 11
Jo Roberts, secretary until April 12
Sharon Shepard, secretary
Darlene Wicks, secretary — Statistical Numerical Analysis and Data Processing Section

Survey Section Staff

Dianne Anderson, clerk
Glenda Ashley, key entry operator
Kathryn Bottorff, field interviewer
Dorothy Bousfield, field interviewer
Julie Ann Cummings, statistical data processor through July
Dorothy Edwards, clerk
Margaret Fowler, statistical data processor, until June 8
Vimlesh Gupta, key entry operator
Esther Harmison, clerk (survey supervisor)
Avis Linden, field interviewer
Marcia Luz, field interviewer
Sylvia McNulty, account clerk
Helen Nelson, secretary
Donna Omundson, clerk
Mary Rathbone, field interviewer
Kathie Reinertson, clerk
Susan Ridnour, clerk
Jasmine Seagrave, clerk
Lisa Sharp, clerk
Jeanne Sorenson, statistical data processor
Marilyn Sporrer, clerk, until January 13
Jane Stowe, clerk typist
Miriam Troyer, field interviewer
Sue Verkade, clerk
Marian Wallace, clerk
Elaine J. Widmann, key entry operator until May 15

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Consulting and Cooperative Research

The Statistical Laboratory has a strong tradition of service and collaborative effort in developing and applying statistical methodology to support research investigations throughout the university. Some of the joint appointments held by Stat Lab faculty reflect this concern, but our involvement in statistical consulting goes far beyond such arrangements. From the early days of George W. Snedecor's interest in proper use of statistics in agricultural and biological research to the present, there has been a rewarding two-way flow of information between statisticians and applied research investigators at Iowa State and in federal and state agencies, which has led to joint publications, new insights, and real-life examples to strengthen the teaching and training of future statisticians and research workers.

Agriculture and Home Economics Experiment Station

The statistics department of the Iowa Agriculture and Home Economics Experiment Station at Iowa State University provides extensive consulting and research support to station research workers. This association stimulates research in applied statistical methodology, as the Current Research section of the Annual Report shows, as well as research in cooperating subject matter fields. Graduate students in the statistical consulting group work under the supervision of D. F. Cox, Paul Hinz, Ted Bailey, and Donald Hotchkiss. Support for one assistantship in statistics is provided by the College of Veterinary Medicine.

In the lifetime work of the late W. G. Cochran, the influence of the period he spent consulting with agricultural scientists is evident. Much of what he did fifty years ago at Rothamsted remains at the center of what we do today in consulting with the scientists at the Agriculture and Home Economics Experiment Station. The basic approach to the design and analysis of experiments remains the same even though the machinery used for computing is totally different. We are continually concerned with how this machinery can be used best to enhance the understanding of the physical and biological forces of interest to agricultural science.

An example from a recent consulting problem illustrates all of that, as well as how this section of the statistics department of the experiment station functions. One of the consultants was working with a group in food sciences. A large factorial treatment design had been carried out, using a split plot structure in a manner that was typical of the early work in Rothamsted. Everything was practically routine except that the scale used for the response had almost none of the properties usually assumed appropriate for a regular analysis of variance and its associated test statistics. Furthermore, the standard power transformations did not appear to be useful. During informal discussions of the situation with a consultant in the social sciences, the suggestion was to rank the data and normalize the ranks in order to obtain a more reasonable scale. Only a few years ago such a suggestion would have been received but not always tried, as it would have required a tedious task of looking up values in tables of normal scores. Today such data manipulations are trivial and routine, and such suggestions can be tried in minutes from the terminals in our section.

Some examples of the many jobs that flowed through the group during the last year are listed here. Dale Zimmerman worked with mammalogists in animal ecology, devising indices that measure the vegetational preferences of South American guanacos. Carl Lee and Jorge Morel analyzed several different studies from the major research efforts carried out here on the European corn borer, which included, for example, the comparison of two methods of breeding for borer resistance in a synthetic cultivar of maize. Mark Bryan worked with food scientists concerned with the effects of various grinding techniques on the quality of spices. Terry Callanan consulted with several researchers from the College of Veterinary Medicine, where problems involve such concerns as lung disease in pigs and the development of diagnostic tests for use by practicing veterinarians. Dan Jeske handled data analyses for research workers in physiology and assisted workers in agronomy with problems involving nonlinear response functions.

A statistical consulting project led to a research paper that was presented at the International Muskie Symposium in LaCrosse, Wisconsin in April. Paul Hinz was co-author of this paper, along with Mike Dombeck and Bruce Menzel, both of the Department of Animal Ecology. The people attending the conference included northwoods guides in wool shirts and jeans, fishermen, conservation commission employees, and university biologists and fisheries specialists. The very broad program featured such things as casting contests, lure displays, reports of case studies on stocking and other management practices, and reports of experiments and highly technical genetic studies. It was a refreshing mix of people and interests. There was general agreement among the fisheries professionals that they had never seen technical sessions so well attended.

Theodore Bailey advised on statistical aspects of a project involving field experiments conducted to evaluate the performance of warm season grasses, grown primarily in the Great Plains, for use as forage grasses in the Midwest. The studies also investigated the effects of nitrogen fertilizer and row spacing on seed yield and selected yield components. Blocking was used to remove the effects of soil variability. The field studies have been completed, and analyses of the data are being carried out to evaluate treatment effects.

Bailey also consulted with crop production researchers relative to two experiments investigating

radical redesign of the database so that historical data can be stored on a microcomputer.

New releases of SPSSX and BMDP were installed on the NAS/6 computer. A new release of MINITAB, designed primarily for interactive operation, was installed on the VAX computing system.

Work was completed on a study of relationships between social mobility and participants in formal marriage contracts in 17th century France. Steve Chang, with Schnell's assistance, provided programming assistance on the project. One especially interesting result was that participants in the ceremonies came from many different guilds or crafts. The common element was that they held similar ranks in their respective occupations. It had been hypothesized that such groups would be formed strictly along occupational lines.

The Statistical Data Processing group is composed of two full-time employees, Kathy Shelley and Bud Meador, and five graduate students: Dania Clark-Lempers, Lee Ann Crowder, Fred Hulting, Byung C. Kim, and Fah Fatt Gan. Clark-Lempers and Hulting are the newest members of the group. Clark-Lempers has a further distinction of being its only research assistant not supported fully by the department — funding instead is furnished by the Graduate College.

An attribute of each individual in the group is versatility, both with respect to the variety of projects (work assignments) and the variety of computer hardware and software tools employed in discharging tasks to complete work assignments. Shelley demonstrated this property in working with faculty, students, and people outside the university community on a variety of projects, and in so doing she made use of every computer facility available to the section.

The group functioned as a unit in much the same manner as in previous years. Noteworthy changes are further involvement in using an IBM PC as a work station and further use of computer software identified as text editors and word processors. This involvement came about naturally from the increased efficiency and reduced difficulty level in using those tools for many of the operational steps in data analysis. An even more natural happening occurred many times where data were recorded in a portable or desk-top computer, and data communication and data editing operations were required to make the date amenable for analysis.

Byung C. Kim and Fred Hulting designed and wrote a communications program to link together an IBM PC microcomputer with an IBM PC-XT and an 8-bit Z80 microprocessor. The work was done for EMCOM, Inc., a major vendor of real-time monitors for leased-line telecommunication networks. Kevin Kramer provided programming support for the statistical display of message components used in transmission protocols. Frequency analyses allow a slowly degrading condition to be detected before a serious communication breakdown occurs.

The presence of the desk-top computer is further noted in that two major programming and software

projects were developed to use the IBM PC as a primary tool. One application area is providing general support in developing a Communication Network Performance System; Kim and Hulting worked with Tom Bubolz to develop this system. The second application involves support to crop experiment workers, to assist in planning an experiment, planting the crop, and collecting data at various times during the season, and in data communications, editing, analysis, etc. Fah Fatt Gan devoted a considerable effort to this project, as well as to other personal computer applications.

The success of the group in finding a niche for the IBM PCs is attributable in part to the knowledge and skills acquired in an in-house short course on the assembly language and design characteristics of specific hardware components of IBM PC computers. The course was taught by William J. Kennedy.

Lee Ann Crowder played a key role in providing data processing support to the College of Veterinary Medicine. Also she and Fred Hulting worked on a large project from the Department of Economics, identified as the Retirement Cohort Study. Crowder made use of the IBM PC to solve part of the computational problem. However, most of the computer work was done on the university's AS/6 mainframe computer.

Dania Clark-Lempers provided the primary support for a sociology project known as the Retirement History Study. Project requirements included drawing a sample from data tapes and setting up a SPSS data base. Model building techniques were used for data analysis.

Bud Meador attended the Ninth Annual Conference of the SAS Users Group International, held in Hollywood Beach, Florida, March 17-21.

V. A. Sposito assisted various members of the Departments of Economics, Industrial Engineering, and Forestry in formulating certain linear programming models during the year. Most of these models were solved by using resident software packages. A sequential unconstrained minimization procedure was developed on the AS/6 and used to solve a nonlinear minimization problem for an industrial engineering student.

During the year Crowder assisted Sposito in developing a linear programming package on the IBM Personal Computer. Present research is being directed toward developing a primal-dual procedure; this procedure will be available on the section's personal computer in the near future.

Survey Section

The Survey Section is completing work on two studies for researchers in the Department of Economics. The first project is the latest in a series of farmland ownership studies that have been conducted during the past 35 years. The study seeks to identify characteristics of owners of agricultural land in Iowa

Survey Section faculty discuss projects with visiting lecturer V. P. Godambe. L to R: new member Mark Reiser, Jeffery Goebel, Wayne A. Fuller, Roy Hickman, Godambe, and Ronaldo Iachan.

and to learn how land is acquired, held, and transferred. The Survey Section edited, coded, and began analyzing data from telephone interviews it conducted, during spring and summer 1983, on statewide samples of shareholders of Iowa farm corporations and land owners not associated with incorporated farms. The sampling design and selection and interviewing procedures were described in the 1982-83 Annual Report of the Statistical Laboratory.

County road use by rural residents is the topic of the second study. The Survey Section completed personal interviews with approximately 682 farmers and 508 nonfarm rural residents associated with land segments 10 miles square in three Iowa counties. The section was also responsible for validating, editing, and coding the data. Analysis is being conducted by the Department of Economics.

Work continues on three case-control studies of cancer incidence in Iowa. The projects are being done in collaboration with the University of Iowa Department of Preventive Medicine and the National Cancer Institute. In connection with these studies, Mary Genalo presented a lecture to epidemiologists at the University of Iowa on procedures and problems of data collection emphasizing inquiries of a sensitive nature.

One of the case-control projects is a four-year epidemiologic study designed to provide better understanding of the established relationship between leukemia and non-Hodgkins lymphomas (NHL) and rural residency, by searching for associations between those diseases and specific elements of agricultural practice. Researchers at the University of Iowa selected all cases and the proxy respondents for controls to match deceased cases. The Survey Section selected the controls for the live cases and completed interviews with 1,215 subjects. The section also performed the initial data edit and validated 10 percent of the completed interviews.

A second study is identical to the leukemia-NHL project but involves 200 cases diagnosed with multiple myeloma. Interviewing on this project will continue for one year.

The third health project involves an investigation into the factors contributing to male breast cancer. The project is being coordinated by the Fred Hutchinson Cancer Research Center in Seattle. Over a three-year period, 25 cases and 38 controls will be interviewed. The Survey Section assisted with questionnaire design, will conduct personal interviews with all cases and controls, will conduct initial data edit, and will validate 10 percent of completed interviews.

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

Assistance with questionnaire design, sampling, coding, and analysis was given to a researcher in the Iowa State University Department of Community and Regional Planning, who was assessing the transportation needs and problems of inner-city residents in Charlotte, North Carolina.

A sample to be used for random-digit dialing was drawn for a researcher in the College of Medicine at the University of Iowa. The sample was used for a study of the health care needs of Iowa children.

Assistance of various kinds was given to researchers and students from different departments on campus. For example, advice was given to a researcher in textiles and clothing on a regional sampling plan for a study concerning pesticide residue on the clothing of pesticide applicators. A student in the Department of Family Environment was given guidance in selecting a sample of married students for a study of money management skills. A sampling plan was devised to enable researchers in the Library to estimate the level of usage of various library services, and an undergraduate honors student studying the residence halls food service system was aided in selecting a sample of students living in the residence halls. Help in questionnaire construction was given to a researcher in the Department of Food and Nutrition studying breast feeding practices in South Africa, to a researcher in the extension department obtaining opinions from home builders about solar heating, to a researcher examining the housing needs of black residents in Detroit, and to a representative of the Graduate Student Senate studying departmental practices with regard to graduate student stipends.

A sample of approximately 9,000 names was selected for an Iowa State University agronomic research group, to be used in a biennial mail survey concerned with the varieties of corn being planted in Iowa. An area sample was selected from every county in Iowa. Farm and ranch directories were used to compile a list of names associated with the area segments. A similar sample selected two years ago was updated, using newer editions of the directories; each sample is retained in the study for one more mailing after its initial use.

Engineering Research Institute

Consulting on the following projects, on the part of H. T. David, Stephen B. Vardeman, and Robert Arnold, was made possible through the support of the Engineering Research Institute, in the form of an assistantship for Arnold.

A civil engineering project dealing with aluminum weldment data, and a related project on the determination of strength curves, involved optimum allocation in regression, calibration, inverse regression, and a challenge to the conventional wisdom that the more appropriate "independent" variable is the one with the better replicability. Another civil engineering study called for designing a filtration experiment, while a further study involved the application of kriging methodology and certain of its adaptations to the modeling of ground water diffusion.

Kriging methods were also invoked in graduating ground water levels in connection with an agronomy study. A diffusion model was encountered, as well, in consulting with chemical engineering staff on the design and analysis of an experiment to compare the rates of diffusion of certain drugs in muscle and other tissues. A further chemical engineering study concerned the evaluation of flotation methods for the purification of coal.

A Bayes methodology for locating vibrating fuel rods was considered in connection with a project in nuclear engineering. Two other nuclear engineering studies called for estimation of the reliability and availability of power plant sub-systems, and the cluster analysis of potsherds by site and elemental composition.

A geologist sought help in the application of nonparametric measures of correlation to the study of oil field mineral core samples; a chemist sought direction in the response surface formulation of a synthesis process.

An agricultural engineer consulted on the analysis of soil run-off data; another discussed the design of a soil compactification experiment and its subsequent multivariate ANOVA analysis. An agronomist consulted on the application of components of variance in laboratory analyses of the chemical make-up of soils.

Staff from the Department of Engineering Science and Mechanics and from the Department of Materials Science and Engineering consulted, respectively, on the estimation of parameters in stress models with correlated residuals, and the determination of measurement error. An industrial engineer and a civil engineer sought direction and references in the area of model building, the former with particular emphasis on the nonlinear regression options available in SAS.

Social Sciences

Mack C. Shelley II worked with faculty and students in the departments of Political Science, Family Environment, Journalism and Mass Communication, Psychology, Community and Regional Planning, and Hotel, Restaurant, and Institution Management. Special projects included a housing discrimination lawsuit through the Iowa Department of Justice (settled out of court) and assessment of pedagogical methods used in an extension short course for local Iowa government officials. Other topics included energy consumption in a hospital kitchen, local Iowa government officials' training programs, content analysis of photographs in the *Des Moines Register,* a questionnaire on industrial development in Iowa, and students' receptiveness to computer-assisted instruction.

Robert Strahan consulted with graduate students and faculty in the departments of Psychology, Child Development, Industrial Education and Technology; Hotel, Restaurant, and Institution Management; Physical Education, Speech Communication, and Secondary Education. Among the projects involving consultation were the construction of a Spanish version of the Wechsler Intelligence Scale for Children, a study of the relation between creativity and intelligence, investigation of the factors that predispose college students to seek psychological counseling, comparison of different techniques for stopping smoking, a survey of college students' attitudes towards cheating, investigation of the physiological basis of copulatory behavior in the rat, and examination of the personality characteristics of amateur trapeze performers ("flyers").

Frederick Lorenz currently serves as statistical consultant to approximately 40 graduate students, mostly in the social science disciplines. In addition, he has worked as statistical consultant on several research projects executed by faculty in the social sciences and related disciplines. One in sociology concerns assessment of the relationship between individual self-esteem and perceptions of equity in marriage. Lorenz evaluated a causal model of the relationship as suggested by previous literature. With a colleague in sociology he executed a longitudinal panel analysis of the relationship between financial well-being and perceptions of health among unmarried people of retirement age. Finally, he is directing the analysis of two data sets generated by the university's Intensive English and Orientation Program concerning the responses of college professors to written errors made by non-native speakers.

Leroy Wolins is assisting a faculty member in the Department of Physical Education with a questionnaire being developed for the purpose of understanding better the nature of eating disorders. According to diagnostic categories offered by psychiatrists, a constellation of symptoms is associated with each category. Preliminary results of factor analysis on normal populations (cheer leaders) and comparisons of groups identified as belonging to one or the other of these categories suggest that self-report measures derived from the factor analysis do not support the psychiatric categories. Each symptom may or may not occur for an individual independently of other symptoms, and a

profile of symptoms derived from self reports may be informative to therapists.

Wolins spent four days evaluating research proposals on smoking prevention and cessation for the National Institutes of Health. Except for three methodologists, the 30 evaluators were subject matter experts. The experience proved gratifying as the methodologists were able to communicate with the subject matter experts about chronic methodological failures in this area of research. The two most common failures were analyzing individual results when groups (e.g., classrooms) were randomly assigned and treated, and assigning too few observational units to the control groups when data from those groups were cheaper to obtain than from treated groups.

Other Consulting

C. Philip Cox consulted with a graduate student in entomology on the design of experiments to compare 96 hour-LC50 estimates of two insecticide preparations using minnows in aquaria. He also consulted on statistical procedures used in enzyme kinetic experiments in chemical engineering.

Three correlated soil constituent variates observed at several depths in a pedological investigation were examined by Cox towards distinguishing between a model positing continuous change in the loess/siltstone ratio and one positing siltstone base, mixture, and loess in more discrete layers. A linear discriminant function analysis had been adduced to favor the latter model. The constituent variables were, however, found to be so highly correlated with the depth variate that the depths alone necessarily predetermined the outcome that shallow samples would be classified as loess and deep ones as siltstone. Good polynomial fits to the data were obtained for the alternative continuous model, but the number of depths sampled in one pedon was too few to permit a reliable decision choice between the two models.

Methods of analyzing spatial variation of soil water infiltration were developed by Noel Cressie with a faculty member in agronomy. Similar analyses were undertaken, for an agricultural engineering project, on matric potential of soil water.

Ronaldo Iachan consulted with the head of the Brazilian National School of Statistical Sciences (Escola Nacional de Ciencias Estatísticas), Rio de Janeiro, December 20-21 on a new M.S. program in statistics. The program was reviewed, and curriculum changes were suggested. A similar contact was made with the chair of the Department of Statistics, Universidade Nacional de Brasilia in Rio de Janeiro, January 4-5, for review of the university's reinvigorated M.S. program in statistics and a new cooperative agreement with the Embrapa (Empresa Brasileira de Pesquisa Agropecuária), the national agricultural research organ.

Current Research

This section summarizes individual research and research supported by grants or sponsored by contracts. Funds are made available through the budgets of the Statistical Laboratory, the Iowa Agriculture and Home Economics Experiment Station (AES), the Engineering Research Institute and the Sciences and Humanities Research Institute within the university, and several government contracts and grants. Papers arising from the work are in part listed in the section on Professional Activities.

AES Project 890

Byron Jones considered several theoretical problems in the area of experimental design. The first one involved using bricks to build block designs. A method was formulated for constructing incomplete block designs in which uncorrelated estimates of contrasts of interest have variances in a specified ratio. The designs are built up by using sets of blocks called bricks. Many of the constructed designs have blocks of different sizes. Choices between competing designs are made by choosing the one that maximizes the weighted sum of the effective replications. A large table of bricks has been derived and is available from the author. Examples are given to illustrate the method.

Consideration was also given to the search for optimal block designs when it can be assumed that the block parameters in the usual linear model are a random sample from a population with mean zero and variance σ_b^2. The optimality criterion which is minimized is the weighted sum of the variances of a set of treatment contrasts of interest. Using results due to D. A. Harville and R. Kackar, an approximation to the true variance of a treatment contrast was obtained. Estimating a treatment contrast involves using an estimate of the ratio, γ, of (i) the block variance and (ii) the usual error variance, and this complicates the calculation of the exact variance of a contrast.

Using this approximation and assuming γ is estimated by restricted maximum likelihood, Jones has derived an algorithm to search for optimal designs. This algorithm is a modification of an earlier one described by Jones and J. A. Eccleston. Examples illustrating the use of the algorithm were developed.

Some previously published optimal crossover designs were shown by Jones to be optimal only if a particular covariance structure for the data is assumed. A criterion of the D-optimal type was used and contrasts of the direct, residual, and cumulative treatment effects were considered. To illustrate the non-uniqueness of optimal crossover designs a different, but more plausible, covariance structure has been used.

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AES Project 2155

Cooperative research with the U.S. Soil Conservation Service (SCS) was carried on by the Survey Section through Project 2155 of the Iowa Agriculture and Home Economics Experiment Station. A major goal was achieved with the completion of the editing and updating of the 1982 National Resources Inventory data base and the release of the data tapes. The National Resources Inventory is a national survey of land use and cover, wind and water erosion, characteristics of soils, conservation needs, prime farmlands availability, wetlands, and other natural resources. Preliminary estimates of land use, soil erosion, conservation needs, potential for new cropland, and other related characteristics were computed and submitted to state and national SCS personnel for review. Appropriate corrections were made, and final national, state, and multi-county estimates are now being computed. Computer software is being developed to present tabular summaries of the data. The release of the data culminated a multi-year effort headed by Roy Hickman and Jeff Goebel. Also contributing were Wayne Fuller, Richard Dorsch, Mark Reiser, Harold Baker, Art Kuhl, Ye-Fu Lee, Kuo-Ying Hung, Jeanne Sorenson, Blake Abdella, and Tammy Bondioli.

Work continues on merging the soil information collected for the 1982 NRI with the soil series interpretation data base also maintained by the Survey Section.

Data collection and editing have begun for individual county inventories and other special studies related to the 1982 NRI. Another study concerns problems of measuring land urbanization. Quality evaluation of resource inventories is ongoing.

Storage, retrieval, and analysis of the interpretations data of soil series in the United States continues as part of the SCS cooperative work. This data base now has over 23,000 records comprised of 170 million bytes of information. The rate of updating this dynamic data set remained high, as over 12,000 records were updated again this year. The large number of updated records can be attributed to computerized editing done to check the compatibility between the soil interpretations data and the 1982 NRI. Numerous missing or incorrect data entries were discovered and corrected because of this editing. The resulting soil interpretations data are much more complete and accurate. Work has also continued on the Map Unit Use File (MUUF). This file will eventually contain a record for each map unit in every published soil survey in the country. MUUF data are directly linked to the interpretations data file to provide soil interpretations at the map unit level. Progress was made in an ongoing effort to edit the data, and new tabular printouts were developed. SCS state offices continue to have immediate access to the soil interpretations and MUUF data from remote processing stations. Deborah Reed-Margetan joined the staff in April as a programmer for this project. Harvey Terpstra directs the development of the data system.

Survey Section members made several visits to Washington, D.C. and regional centers to confer with U.S. Soil Conservation Service staff on various aspects of the joint cooperative agreement for national resources inventory studies. Jeffery Goebel went to Washington in July to discuss initial release of preliminary 1982 National Resources Inventory data. Goebel and Mark Reiser helped conduct sessions in November on the use and analysis of the data by SCS area technical officials. Roy Hickman visited Washington November 27-28 to confer regarding the joint cooperative agreement. Harvey Terpstra went to Fort Worth, Texas, August 1-4 to work with SCS personnel in developing a procedure for including the 1981 Smithsonian national list of scientific plant names in the soils data base. Goebel and Reiser met with state and national officials of the Soil Conservation Service in Denver, Colorado, December 19-20 to discuss a quality evaluation procedure for the 1982 National Resources Inventory. On February 14-15 they took part in resource inventory work sessions in Lincoln, Nebraska. Also in February Terpstra went to Lanham, Maryland, to attend a Soil Conservation Service Soil Database Workshop. In April Reiser took part in a planning session in Fort Worth, Texas, for a remote sensing pilot project.

In March 1984, Jeff Goebel left his position with the Survey Section to work as a statistician for the Soil Conservation Service, U.S. Department of Agriculture. Goebel has been a major contributor to the AES Project 2155, and he will continue to work closely with Survey Section personnel on cooperative research with the Soil Conservation Service.

Small Area Estimation

Cooperative research with the Statistical Reporting Service, United States Department of Agriculture, continued under the direction of Wayne A. Fuller. Graduate assistants Carol Francisco, Sharon Loubert, Rachel Harter, and Hsien-Ming Hung worked on the project. Previously initiated work on methods of combining satellite information with information collected in the June Enumerative Survey continued. The large sample properties of some small area estimates using satellite information were derived.

The Statistical Reporting Service conducts objective yield surveys of corn, cotton, soybeans, and wheat in states that are major producers of these field crops. While field sampling procedures for each crop differ in terms of plot sizes and vegetative and fruit measurement techniques, the surveys rely on the same basic four-stage survey design. Subsampling within fields and within primary sampling units, complicates the construction of consistent estimators of variance. Estimators of state average crop yield and estimators of the variance of the estimators currently used by the Statistical Reporting Service were evaluated. Alternative estimators of the variance of estimated yield were examined.

AES Project 2383

The U.S. Bureau of the Census and the Iowa Agriculture and Home Economics Experiment Station supported joint research in measurement error models, time series, and survey design. Support from the Bureau of the Census was through Joint Statistical Agreements J.S.A. 82-6 and J.S.A. 84-2. Wayne Fuller is principal investigator. Other personnel working on the project include Yasuo Amemiya, Yasuyuki Toyooka, Tin Chiu Chua, Nancy Hasabelnaby, Stephen Miller, Neerchal Nagaraj, Edina Miazaki, and Daniel Schnell.

One of the research activities on this project was a study of the effect of the response error on reported employment status and reported changes in employment status. A model for the response error was formulated in which certain parameters were hypothesized to remain constant over time. The parameters were estimated using data from the Current Population Survey for the period 1976-1980 and for 1982. The data were consistent with the hypothesis that the specified parameters were constant during 1976-1980, but it is possible that the parameters for 1982 are different. The response error decreases the estimated percentages of persons changing classes from one month to the next. There is a corresponding increase in the estimated number of persons staying in the same employment category. Tin Chiu Chua spent two weeks in July 1983 in Washington, D.C., working with Bureau of the Census personnel to create a data file from the Current Population Survey of 1982 for use in the research on gross change.

A review of work on estimation and prediction for nonstationary autoregressive processes was prepared. Fuller presented some of this material at the United States-Japan Joint Seminar on Statistical Time Series Analysis in Tokyo on May 21.

Toyooka considered various risk decompositions of the generalized least squares estimator with estimated covariance parameters (GLSE). The optimality of the GLSE was characterized in linear and nonlinear models with a general covariance structure of a finite parametric time series type. Toyooka also used asymptotic theory to obtain the second-order risk expansion of the GLSE and the maximum likelihood estimator in a regression with a linear process error. Toyooka examined estimation procedures for the indirect observation problem of finite parametric time series models, a problem closely related to the construction of estimators in rotation sampling.

Fuller, Amemiya, and Schnell investigated estimation for the nonlinear measurement error model. The model assumes that underlying true values satisfy a nonlinear implicit functional relationship, and that observations are measured with error. The approximate bias in the maximum likelihood estimator due to the nonlinearity of the relationship was derived and a bias-adjusted estimator was proposed. The superiority of the bias-adjusted estimator relative to the maximum likelihood estimator was demonstrated by numerical and theoretical results.

Yasuyuki Toyooka, visiting associate professor, is engaged in contractual research for the Bureau of the Census.

Stephen Miller studied the problem of testing hypotheses about the slope in the linear errors-in-variables model. Several test statistics were derived, and their limiting distributions obtained under both the structural and functional models. Monte Carlo results indicated that a likelihood ratio statistic performed best under both models, and it was conjectured that a simpler studentized statistic could be modified to obtain approximately equal power.

A Sampling Design to Survey Offshore Populations

Under AES Project 2596, research on alternative stratification techniques has been the primary objective of a National Marine Fisheries Service grant. Ronaldo Iachan, one of two principal investigators, has looked into possible sampling strategies for redesign of the NMFS shellfish surveys. He consulted with NMFS scientists in Woods Hole, Massachusetts in July on ways of using available auxiliary information to improve the current design and estimation procedures. He also obtained limited data for a pilot test of some proposed methods of forming stratum boundaries. A large-scale investigation is now being carried out by Christopher Gledhill, graduate assistant in animal ecology, employing all data collected in the 1966-1982 offshore surveys of ocean quahogs and surf clams by the NMFS.

Mathematical and Statistical Genetics

Edward Pollak conducted research in mathematical and statistical genetics under Project 2588 of the Iowa Agriculture and Home Economics Experiment Station. He completed an investigation of theory for two sex-linked loci in infinite random-mating age-structured populations. Upper and lower bounds were derived for the long-run rates of approach to zero of the differences of allele frequencies in the two sexes and gametic disequilibria. It was found that these asymptotic rates of decrease are like those for discrete generations if the unit of time is replaced by a number

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that is bounded from below, and well approximated, by the mean age of parents when the population has attained its stable age distribution.

Further research was done on sampling theory for finite monoecious populations that reproduce partially by selfing and partially by random mating. Expressions were derived for the expected proportion of heterozygotes and the between-lines variances in heterozygosity under the assumption that the infinite alleles model holds.

Margaret Scott, working under Pollak's direction, studied a situation in which there are two alleles at one locus that determines the fecundity, or mean number of offspring, of mating pairs. Using the Kuhn-Tucker theory of constrained optimization, she found sets of fecundities for which frequencies of the three genotypes both maximize the mean fecundity and are associated with a stable equilibrium.

Working on a problem posed by Richard Willham, Department of Animal Science, Pollak and Willham developed expressions for the means of two parental populations, the mean of the F_1 generation that results from crossing them, and the mean of the F_2 generation that arises from the random mating of the F_1. It was assumed that two loci, which may be linked, influence the expression of a quantitative character. The results generalize some others that have appeared in the literature.

Order Statistics and Nonparametric Statistics

H. A. David, principal investigator under a grant from the Army Research Office, is making a systematic review of the properties and uses of order statistics in finite sets of non-iid variates. Motivation is provided by k-out-of-n systems consisting of unlike components and by robustness considerations. One of the results obtained can be stated informally as follows. Consider a sample which ideally is randomly drawn for a symmetric unimodal distribution but which in fact may be contaminated by outliers. Then, among all linear functions of the order statistics, the median is the estimator of location most resistant to bias due to extreme outliers.

Also, in conjunction with Michael Rogers, David is continuing research on selection through an associated characteristic. With partial support from the grant, Malay Ghosh, together with other investigators, has completed research on boot-strapping of (a) U-statistics, and (b) the median. Shashikala Sukhatme has published a new approach for obtaining asymptotic properties of Cramér-Smirnov statistics (see p. 27).

Discounted Branching Random Walks

Krishna Athreya worked on discounted branching random walks and long- and short-range dependence, with the support of a grant from the National Science Foundation.

If one associates with each individual in a branching process a random variable (that could denote, for example, his consumption of resources or his contribution or his total income or life length, etc.) and adds this up over all the individuals, then for each generation one has a number of random variables denoting the total for the various lines of descent. Under the assumption that the distribution is scaled by a factor $\rho > 1$ for each generation, the limit distribution of the maximum and the empirical c.d.f. were studied. Also the uniqueness of the solution to the function equation satisfied by the maximum was investigated.

The ideas of Rosenblatt, Maejima, and D. R. Cox on short- and long-range dependence were studied. Also a review of Box's paper on time series was done. These were summarized in a note presented by Athreya, as discussant, in *Statistics: An Appraisal*, the proceedings of the conference to mark the 50th anniversary of the Statistical Laboratory.

Bayesian and Decision Theoretic Statistics

Research in the general area of Bayesian and decision theoretic statistics was done by Glen Meeden. One particular area of interest was admissibility considerations for finite population sampling. This work was supported by a grant from the National Science Foundation.

Spatial Statistics, Robustness, and Random Sets

Preparing and testing data for stationarity is often ignored in spatial statistics and time series. The median polish has been used successfully now by Noel Cressie on mining data and agricultural data. For irregularly spaced sites, a moving nearest neighbor analogue has been used and applied to public health data. The relative variogram is a tool often used in the presence of nonstationarity. An article has been written by Cressie generalizing this notion to a "scaled variogram," and applied to a soil water infiltration problem.

Ongoing work by Cressie on misweighting in the presence of heteroscedasticity has yielded important results for the two-sample problem, which will be extended to the general linear model. Also a model for tumor growth is being developed, based on the stochastic calculus of random set theory.

Sciences and Humanities Research Institute (SHRI)

SHRI funds help to support the research activities of Yasuo Amemiya, Krishna Athreya, Dean Isaacson, Mervyn Marasinghe, and Glen Meeden. Problems have been considered in the areas of multivariate

analysis, stochastic processes, linear models and statistical computing, and Bayesian statistics.

Dean Isaacson continued to do research in the area of Markov chains. In particular, work was done with A. Nakassis and A. Mukherjea on finding the basis of convergent nonhomogeneous Markov chains. Work was also done on ergodic properties of certain continuous-time nonhomogeneous Markov chains.

Isaacson and Glen Meeden considered a problem in Bayesian statistics; results will appear in the *Australian Journal of Statistics*. Richard Groeneveld and Meeden completed an investigation of several measures of skewness. A paper arising from this work has been accepted for publication. Meeden collaborated with Malay Ghosh and Stephen Vardeman on other problems in the area of Bayesian statistics. Part of the work was supported by grants from the National Science Foundation and is reported earlier.

Krishna Athreya worked on (1) renewal theory and (2) mixing for Markov chains and autoregressive series. The number of renewals in a renewal process with iid nonnegative random variables with finite mean has been studied a great deal in the literature. The infinite mean case with a regularly varying tail has also been studied. The present work is devoted to a sharpening of these results and leads to a weak law in the null recurrent case, as well as a central limit theorem.

It is also shown by Athreya that positive recurrent Markov chains are necessarily Strong mixing (a condition of asymptotic independence). This is applied to the case of the first-order nonexplosive autoregressive series with iid errors, where it is shown that under a mild condition on the errors they are Strong mixing. It is further shown that they are uniform mixing if the errors are uniformly bounded, thus implying that the Gaussian error case is not uniform mixing. Some of the results are extended to series with a randomly varying regression coefficient, as well as the case when the errors are not iid but form a positive recurrent Markov chain.

Yasuo Amemiya investigated estimation problems for linear and nonlinear statistical relationships. Research on inference procedures for the linear model with estimated error covariance matrix continued from the last year. The limiting behavior of estimators for the linear model with factor analysis structure was studied under a relatively weak assumption. For the nonlinear functional relationship model, an instrumental variable estimator was proposed, and its large-sample properties were investigated.

Results of research on multiple outlier detection methods in linear regression were presented by Mervyn Marasinghe at the American Statistical Association meetings in Toronto. Some work on non-additivity in two-way classifications was completed. Work by Marasinghe continues on computational algorithms for analysis of variance problems.

Other Research

Relations between the Pearson X^2-statistic and the likelihood ratio statistic G^2, have been examined by C. Philip Cox in the context of 2×2 and binomial goodness-of-fit tests. Circumstances have been defined wherein G^2 necessarily exceeds the X^2-statistic.

Arising out of a chemical engineering consulting problem, research is being carried out by Cox on estimation of the parameters in the Michaelis-Menten equation. Currently used procedures for this parametrically nonlinear situation have assumed constant residual variance, which does not appear valid over relatively small ranges of concentrations. The complex sequence of experimental determinations involved is being reviewed towards obtaining more appropriate assumptions and a consequently more veridical estimation procedure.

In a simple linear regression context, the estimate of the mean response at a specified x-value is the value predicted by the line of best fit at that x-value unless the slope of the line is zero, in which case the mean response is estimated for any x-value as the overall mean of the responses. It was shown by Cox and R. A. Groeneveld that, to ensure that the former estimate has the lower estimated variance over the whole x-range, when single observations are obtained at equally spaced x-values, the coefficient of determination should be at least 0.75 approximately, when a number of (x,y) pairs greater than or equal to ten is used to fit the line.

Chang Dorea obtained the limiting distribution for a certain class of random optimization procedures and is working on construction of confidence intervals for such procedures. Jointly with H. T. David she developed some concepts of asymptotic dependence and investigated their implications in the case of weak convergence of randomly stopped subsequences.

The research activities of Frederick Lorenz have focused on issues concerning complex organizations and interorganizational relations in rural cities. First, data from 167 rural cities and 86 counties in five midwest states were analyzed in order to measure the impact of federal grants on local government capacity to make decisions, mobilize resources, and complete tasks. Second, data from 1,124 New England cities were examined to determine the effects of state bureaucracies and community characteristics on the distribution of Land and Water Conservation Fund grants. Third, data from about 100 Iowa cities were collected and analysis begun in order to study the strategies local governments use to maintain services under conditions of financial strain caused by federal-level fiscal "retrenchment" policies. Finally, an exploratory study of 64 human service organizations in central Iowa was conducted in order to better understand their strategies for surviving when their federal support is reduced or eliminated. A major component of this study is the development of scales of organizational structure and environmental uncertainty.

Professional Activities

H. A. David completed a two-year term as president of the Biometric Society during 1983. In 1984 he is serving as vice president. Oscar Kempthorne began his year as president-elect of the Institute of Mathematical Statistics.

Wayne A. Fuller is a member of the Committee on National Statistics of the National Research Council. He is also a member of the council's Panel on Decennial Census Methodology.

William Q. Meeker, Jr. will serve as a 1984-1986 member of the Advisory Board of the American Statistical Association Section on Physical and Engineering Sciences. Stephen Vardeman has been appointed as a member of the newly formed ASA Ad Hoc Committee on Quality and Productivity.

Kenneth J. Koehler completed his term as secretary of the Iowa chapter, American Statistical Association, and was elected president for the 1984 calendar year. He also was elected as the District 6 Governor for the ASA Council of Chapters. Donald Hotchkiss served as president of the Iowa State chapter of Phi Kappa Phi in 1983-84 and represented the university at the Triennial Conference of Phi Kappa Phi, at the University of Maryland, making a poster presentation of local chapter activities.

Jauvanta Walker, second vice president of the Iowa Poetry Association, also became acting treasurer starting in April.

At the combined statistical meetings in Toronto, Canada, in August 1983, Fuller chaired a session on Semi-nonparametric and Nonparametric Regression: Consumer Demand Applications; he also had organized a session on MEM Regression. Roy Hickman chaired a contributed paper session, Two Topics: Agriculture and Security Pricing. Oscar Kempthorne was chair of the R. A. Fisher Award and Lecture Committee of COPSS and presented the Fisher Award for 1983.

Krishna Athreya served on the organizing committee for, and attended, with Dean Isaacson and two graduate students, the 5th Midwest Probability Colloquium held at Northwestern University on October 21-22. At the invitation of the American Mathematical Society he chaired a session and participated in the AMS-IMS-SIAM Joint Summer Research Conference on Random Matrices and Their Applications, sponsored by the National Science Foundation and held at Bowdoin College June 17-23, 1984.

Glen Meeden chaired an invited session on Multiparameter Estimation at the 1984 spring meeting of the Institute of Mathematical Statistics in Orlando, Florida.

David F. Cox and Leroy Wolins assisted the National Institutes of Health with evaluation of research proposals during the year. For this purpose, Cox visited the Mt. Sinai School of Medicine, New York City, in September, while Wolins went to Bethesda, Maryland, in March (see p. 11). Herbert T. David visited the University of South Carolina in May as an outside evaluator of the statistics program within the Department of Mathematics.

Roy Hickman went to Jakarta, Indonesia, for the period January 27 to February 11, 1984, to consult with officials of the Center for Agro-Economic Research, Government of Indonesia, regarding the National Farm Panel Survey (PATANAS).

Theodore B. Bailey, Jr., attended the Fourth Interregional Corn Quantitative Genetics Symposium, held in St. Louis, Missouri, February 14-16. He served on an American Statistical Association Crops Review Team March 6-8 in Champaign-Urbana, Illinois, under an ASA cooperative agreement with the Environmental Protection Agency for a National Acid Precipitation Assessment Program. The objective of the project is to provide a statistical review of research on the effects of acid deposition.

Noel Cressie consulted with the Geostatistics Group, Division of Mathematics and Statistics, Commonwealth Scientific and Industrial Research Organization, in Melbourne, Australia, May 24-25. Then in Milan, Italy, he presented a three-day course on Spatial Statistics and led a two-day seminar on Bayesian Statistics June 11-15 at the Università Cattolica del Sacro Cuore.

David F. Cox attended a short course on Generalized Linear Models, conducted by P. McCullagh and J. A. Nelder August 13-14 in Toronto just before the combined annual meetings.

Paul N. Hinz went to an International Conference on Renewable Resource Inventories for Monitoring Changes and Trends, held in Corvallis, Oregon August 14-18.

Donald K. Hotchkiss attended the spring meetings of the Biometric Society in Orlando, Florida March 11-14.

Also in March William J. Kennedy attended Computer Science and Statistics: 16th Symposium on the Interface, held in Atlanta, Georgia.

Glen Meeden attended the 27th National Bureau of Economics Research and National Science Foundation Seminar on Bayesian Inference in Econometrics, held in Chicago, Illinois October 28-29, 1983.

W. Robert Stephenson attended the National Science Foundation-Conference Board for Mathematical Sciences Regional Conference on Sequential Nonparametrics: Theory and Applications, held in Iowa City, Iowa July 18-22.

Yasuyuki Toyooka attended the conference, Group Theory in Statistics, sponsored by the U.S. Army Research Office and Ohio State University June 10-12 in Columbus, Ohio.

Stephen Vardeman went to a conference on The Frontiers of Industrial Experimentation—1984 spon-

sored by AT&T Bell Laboratories Quality Assurance Center, New Paltz, New York May 22-24.

Jauvanta Walker attended the biennial convention of the National League of American Pen Women, Washington, D.C., April 6-9 and the North Central Region meeting of Women in Communications, Inc., in St. Paul, Minnesota April 27-29.

Papers Presented, Lectures, and Seminars

At the 1983 joint statistical meetings of the American Statistical Association, the Biometric Society (ENAR and WNAR), the Institute of Mathematical Statistics, and the Statistical Society of Canada in Toronto, Canada:

AMEMIYA, Yasuo, and Wayne A. FULLER: "Estimation for the nonlinear functional relationship";

ATHREYA, K. B.: "Cascades on a Galton-Watson tree";

Hahn, Gerald J., and William Q. MEEKER, Jr.: "Books on statistics for engineers and scientists: A categorized annotated bibliography";

HARVILLE, David A.: "Unbiased quasi-linear prediction in mixed linear models — a Bayes and empirical Bayes perspective";

IACHAN, Ronaldo: "Agreement and differentiation for ordinal data";

KEMPTHORNE, Oscar: discussant, General Methodology Lecture I: Design of Experiments;

KENNEDY, William J.: "A curriculum in statistical computing?"

KOEHLER, Kenneth J.: "Distribution of the likelihood ratio goodness-of-fit statistic for sparse contingency tables";

MARASINGHE, Mervyn G.: "Testing for multiple outliers in simple linear regression";

MEEDEN, Glen, and Stephen VARDEMAN: "Admissible Bayesian credible sets";

MEEKER, William Q., Jr.: "A comparison of accelerated life test plans for Weibull and lognormal distributions"; discussant, *Technometrics* Invited Paper session;

Pantula, Sastry G. (North Carolina State University) and Wayne A. FULLER: "Mean estimation bias in least squares estimation of an autoregressive process";

POLLAK, Edward: "Estimating the effective population size from allele frequency changes";

STEPHENSON, W. Robert: "The rank transform revisited";

WOLINS, Leroy, and Benchalak Phutinart: "Methodology in student evaluation of teachers";

Yeo, W. B. (Korea Development Institute, Seoul, Korea) and H. A. DAVID: "Selection through an associated measurement, with applications to the random effects model."

At the 38th annual meeting of the Soil Conservation Society of America, Hartford, Connecticut August 3:

GOEBEL, J. Jeffery, and Jerry S. Lee: "Using the 1982 National Resources Inventory to address resource issues";

McCracken, Ralph J., Jerry S. Lee, J. Jeffery GOEBEL, and Roy D. HICKMAN: "The 1982 National Resources Inventory."

At the 1984 spring meetings of the Biometric Society (Eastern North American Region), the Institute of Mathematical Statistics, and the American Statistical Association in Orlando, Florida:

CRESSIE, Noel: "Median polish kriging";

HARVILLE, David A., and Alan P. FENECH (now at University of California-Davis): "Confidence intervals for variance ratios in unbalanced mixed linear models";

MEEDEN, Glen D., Stephen B. VARDEMAN, and Malay Ghosh: "Some admissible nonparametric and related finite population sampling estimators."

At the Midwest Sociological Society meetings, Chicago, Illinois April 18-21;

Keith, Patricia, Frederick LORENZ, and William Guerrero: "Relative deprivation, financial strain, and health among the unmarried aged";

Mulford, Charles, Frederick Lorenz, Betty L. Wells, and Patrick J. Caldie: "A reexamination of the Aiken and Hage scales."

At other locations:

AMEMIYA, Yasuo: "Multivariate structural and functional relationship models with estimated error covariance matrix," at the 6th International Symposium on Multivariate Analysis, Pittsburgh, Pennsylvania July 26, 1983.

"Instrumental variable estimation for the nonlinear functional relationship model," at the Open Forum on Functional and Structural Relations and Factor Analysis, University of Dundee, Scotland September 9.

Arnold, Robert: "Network minimization problems; extending Minty's algorithm," at an American Statistical Association Iowa chapter-sponsored session of the 1984 Iowa Mathematics meetings, Waverly, Iowa April 14, 1984.

ATHREYA, Krishna B.: "Cascades on a branching tree," at the 12th International Conference on Stochastic Processes and Their Applications, Cornell University, July 11; also chaired the session on Markov Processes July 12, 1983.

"Regular variation and renewal theory," Mathematics colloquium, Iowa State University, November 22.

"Limit theorems for the number of renewals," at a Regional Conference in Statistics and Probability, sponsored by the Bernoulli Society and the Indian Statistical Institute, December 13, in New Delhi, India.

"Limit theorems for Harris chains," December 17, at the 13th International Conference on Stochastic Processes and Their Applications, held at Banaras Hindu University, Varanasi, India.

"Limit theorems for the number of renewals," at Gauhati University, Assam, India, December 29.

"Recent developments in renewal theory," at North Carolina State University, March 17, 1984.

COX, David F.: "The use of genetic information in planning and analysis of observational studies: 1. Background and terminology; 2. Applications and examples" — two seminars presented in the Department of Medical Statistics and Epidemiology, Mayo Clinic, Rochester, Minnesota January 10 and 11.

"The nature of experimental evidence," Animal Science seminar, University of Minnesota-St. Paul, February 20.

"The role of statistics in animal science," Animal Science seminar, Iowa State University, April 20.

CRESSIE, Noel A.C.: "Towards resistant geostatistics," at the NATO Advanced Studies Institute, Geostat Tahoe 1983, Lake Tahoe, California September 8, 1983.

"When to use relative variograms in geostatistics" and "On the fitting of variogram models" — two seminars for the Department of Applied Earth Sciences, Stanford University, September 19 and 20.

"Spatial statistics," seminar for the Department of Statistics, University of Michigan, February 29, and for the University of Wisconsin at Madison, May 2, 1984.

"Modeling and robust analysis of spatial relationships," seminar for the Department of Agronomy, Iowa State University, April 26.

"Analyzing spatial data," seminar, Department of Statistics, University of Florence, Italy June 8.

"Introduction to Bayesian statistics," seminar, Department of Mathematics, Università Cattolica at Brescia, Italy June 15.

"Spatial data analysis and modeling" and "The scan statistic" — two seminars for the Department of Statistics, University of Padua, Italy June 18 and 19.

"Using the scan statistic to test for uniformity," at the International Colloquium on Goodness of Fit, János Bolyai Mathematical Society, held in Debrecen, Hungary June 25-29.

DAVID, H. A.: "Order statistics in finite sets of non-iid variates," at a meeting on Order Statistics, Quantile Processes, and Extreme Value Theory, March 26, at the Mathematical Research Institute, Oberwolfach, West Germany.

"Selection through an associated characteristic," at the University of Kentucky, April 26.

FULLER, Wayne A.: "A model for multinomial response error" August 26 and "Estimation for the nonlinear functional model" September 9, 1983, at a Workshop and Open Forum, respectively, on Functional and Structural Relationships and Factor Analysis, held at the University of Dundee, Scotland, and sponsored by the United Kingdom Scientific and Research Council and the U.S. Army European Research Office.

"Measurement error models," at Fern University, Hagen, West Germany September 13.

"A model for multinomial response error," by Fuller and **Tin Chiu Chua**, at the International Statistical Institute meetings, Madrid, Spain on September 16.

"The nonlinear functional model," at the University of Wisconsin, Madison, April 6, 1984, sponsored by the Mathematics Research Center.

"Measurement error in regression" and "Nonlinear measurement error models," the Allen T. Craig Memorial Lectures sponsored by the Department of Statistics and Actuarial Science, University of Iowa, April 11 and 12.

"Use of general linear models in complex surveys" May 3, Ottawa, Canada, at the Symposium on Analysis of Survey Data, Issues, and Methods — sponsored by Statistics Canada and the Laboratory for Research in Probability and Statistics of Carleton University and Ottawa University.

"Nonstationary autoregressive time series," at the United States-Japan Joint Seminar on Statistical Time Series Analysis, Tokyo, Japan May 21.

"Nonlinear measurement error models," at the University of Tokyo, May 25.

Guerrero, Margarita: "Bayes, Buehler, and Buehler-Bayes confidence bounds," at an American Statistical Association Iowa chapter-sponsored session of the 1984 Iowa Mathematics meetings, Waverly, Iowa April 14.

HARVILLE, David A.: "Mixed-model procedures for analyzing ordered categorical data," Animal Breeding seminar, Iowa State University, October 13, 1983.

"A mixed-model procedure for analyzing ordered categorical data," at the North Central-103 Regional Swine Breeding Conference, Ames, Iowa June 21, 1984.

HICKMAN, Roy D.: "Measurement error in sample surveys," at the Center for Agro-Economic Research, Ministry of Agriculture, Bogar, Indonesia February 9.

HINZ, Paul N.: "Ecological factors affecting natural muskellunge reproduction," by Michael P. Dombeck, Bruce W. Menzel, and Hinz, at the 113th annual meeting of the American Fisheries Society, Milwaukee, Wisconsin August 18, 1983.

"Ecological factors influencing muskellunge-northern pike interaction in Midwestern lakes," by Dombeck, Menzel, and Hinz, at the International Muskie Symposium, LaCrosse, Wisconsin April 5, 1984.

IACHAN, Ronaldo: "Sampling in space and time," at the National Marine Fisheries Service, Woods Hole, Massachusetts July 21, 1983.

JONES, Byron: "Exchange and interchange procedures to search for optimal designs," seminar at Ohio State University February 29 and at Purdue University, March 1, 1984.

"Searching for optimal designs when block effects are fixed or random," seminar at the University of Illinois at Chicago April 6 and at Indiana University, April 9.

KEMPTHORNE, Oscar: "A potpourri of statistical and philosophical ideas," Statistics seminar, Virginia Polytechnic Institute and State University, December 6, 1983.

"Selection theory and theory of quantitative genetics," Genetics seminar, ibid., January 24, 1984.

"The role of statistics in animal science," joint Animal Science, Dairy Science, and Statistics seminar, ibid., February 26.

"Science, statistics, and philosophy," Science Studies Center seminar, ibid., May 3.

"Origins of statistical ideas," Mu Sigma Rho Lecture, ibid., May 7.

LORENZ, Frederick O.: "New perspectives on selected regional councils in the North Central Region," at the Rural Sociological Society meetings in Lexington, Kentucky August 19, 1983.

" 'New privatism' and fiscally stressed small cities," by Gary Mattson and Lorenz, at the Upper Midwest Regional American Planning Association Conference, Chicago, Illinois October 1.

"Error relativity: Faculty response to ESL written errors," by Roberta Vann, Daisy Meyer, and Lorenz, at the Midwest Regional TESOL (Teachers of English to Speakers of Other Languages) Conference, Minneapolis, Minnesota October 21.

"Error gravity: Faculty response to ESL errors in written discourse," by Vann, Meyer, and Lorenz, at the International TESOL Conference, Houston, Texas March 10, 1984.

McNulty, Sallie Keller: "Exact generalized inverses and solution to linear least squares problems using multiple modulus residue arithmetic," at Kansas State University, July 21, 1983.

MARASINGHE, Mervyn: "On testing for main effects in the multiplicative interaction model," at Kansas State University, May 4, 1984.

MEEDEN, Glen: "Bayes and admissible set estimation," by Meeden and **Stephen VARDEMAN,** at the 28th meeting of the National Bureau of Economic Research-National Science Foundation Seminar on Bayesian Inference, Madison, Wisconsin May 4.

MEEKER, William Q.: "Statistical aspects of practical accelerated life tests," at the GTE Laboratories' first annual symposium, Statistics at GTE, in Waltham, Massachusetts October 28, 1983.

"Limited failure population life tests: Application to integrated circuit reliability," Mathematics seminar, at the Thomas J. Watson Research Center, IBM Corporation, Yorktown Heights, New York May 15, 1984.

SACKS, Jerome: "Computer aided classification of viruses based on their gel-plate 'fingerprint' patterns," USDA-NADC seminar at the National Animal Disease Center, Ames, Iowa November 7, 1983.

STRAHAN, Robert F.: "Are men more androgynous than women?" and "On assessing whether two scales measure the same construct," at the annual convention of the American Psychological Association, Anaheim, California August 26 and 28, respectively.

TOYOOKA, Yasuyuki: "Exact and second-order asymptotic theory in GLS estimation with estimated covariance parameters," seminar at the University of Pittsburgh, June 13, 1984.

VARDEMAN, Stephen B.: "Average run lengths for CUSUM schemes when observations are exponentially distributed," by Vardeman and **Di-ou Ray,** June 6 in Columbia, Missouri at an International Conference on Reliability and Quality Control, sponsored by the U.S. Air Force Office of Scientific Research, National Science Foundation, U.S. Army Research Office, and the University of Missouri-Columbia. (See also entries under Meeden.)

L to R: Kenneth and Sue Koehler, Richard Dorsch, W. Robert Stephenson, David A. Harville, and Theodore B. Bailey, Jr., at the Stat Lab appreciation dinner for H. A. David and his wife.

Publications and Dissertation Abstracts

This section contains abstracts of books and journal articles published by staff and graduate students, as well as summaries of doctoral dissertations completed here in statistics during the 1983-84 year. When research was conducted at Iowa State but the author has by publication time accepted a new position his or her current location is listed in parentheses. Some of the publications are included in the Statistical Laboratory's Reprint Series (SLRS). These are indicated by an asterisk (*), and copies are available on request.

Principal editorial positions of faculty members are as follows:

In his position as editor-elect of *The American Statistician,* William J. Kennedy began handling all new submissions on January 1, 1984. He will be the editor for issues published in 1985-87. Wayne Fuller, Glen Meeden, V. A. Sposito, and Stephen Vardeman are associate editors of *The American Statistician.* Fuller is also associate editor of the *Journal of Business and Economic Statistics.*

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

David A. Harville continued to serve as an associate editor of the *Journal of the American Statistical Association* Theory and Methods Section; Glen Meeden, as an associate editor of its Book Review Section.

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

Oscar Kempthorne is a member of the executive committee for the *Journal of Statistical Planning and Inference.* He is also on the editorial advisory board of the *Journal of Statistical Computation and Simulation.*

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

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

50th Anniversary Conference Proceedings

DAVID H. A., and **H. T. DAVID,** editors. *Statistics: An Appraisal* — Proceedings of a Conference Marking the 50th Anniversary of the Statistical Laboratory, Iowa State University, Ames, Iowa, June 13-15, 1983. Iowa State University Press (Ames) 1984. x + 664 pp.

This volume contains nearly all the invited papers, together with formal discussion, presented at the above conference. Abstracts of 48 contributed papers are also given. The book is arranged in 11 sections, as follows.

I. *Historical Setting.* H. A. David, T. A. Bancroft, Oscar Kempthorne. II. *George W. Snedecor Lecture.* D. R. Cox. III. *Experimental Design.* Walter T. Federer, Damaraju Raghavarao, Peter W. M. John. Discussion: V. L. Anderson. IV. *Data Analysis.* A. S. C. Ehrenberg, John W. Tukey. V. *Interpolation and Estimation.* Grace Wahba, A. G. Journel, C. R. Henderson. Discussion: David A. Harville. VI. *Models and Multivariate Applications.* E. C. Pielou, R. Gnanadesikan and J. R. Kettenring. Discussion: J. L. Folks. VII. *Linear Models and Categorical Data Analysis.* C. Radhakrishna Rao, R. L. Anderson and L. A. Nelson, Stephen E. Fienberg. VIII. *Statistical Inference.* E. L. Lehmann, David V. Hinkley, Dennis V. Lindley. Discussion: Robert J. Buehler. IX. *Time Series and Stochastic Processes.* George E. P. Box, M. Rosenblatt. Discussion: K. B. Athreya. X. *Survey Sampling.* Morris H. Hansen, Tore Dalenius, and B. J. Tepping; J. N. K. Rao; Wayne A. Fuller. Discussion: R. J. Jessen. XI. *Statistical Computing.* Ronald A. Thisted, Thomas J. Boardman. Discussion: W. J. Kennedy.

Titles of the papers were provided in the conference program reproduced in full in last year's annual report. Appraisals of many of the subareas of statistics are given, comprising a statement of their condition within the discipline in 1983. Besides reviewing and assessing major developments in their areas of specialization, contributors have discussed trends, future needs, and challenges. Historical and philosophical overviews of the Statistical Laboratory, its role in the university, and influences on modern statistical ideas are also presented. Abstracts and titles given below reflect Statistical Laboratory faculty participation in the invited sessions.

*BANCROFT, T. A. (assisted by Margaret G. Kirwin). Highlights of some expansion years of the Iowa State Statistical Laboratory (statistical center), 1947-72. In *Statistics: An Appraisal,* pp. 19-30. SLRS 589.

It is pointed out that the 50th Anniversary of the Iowa State Statistical Laboratory is actually also the celebration of the 50th anniversary of the beginning of a complete statistical center at Iowa State. While the Department of Statistics was established in 1947, faculty with part-time salaries on the Statistical Laboratory budget and the remainder on teaching departments' budgets, primarily Mathematics and Economics, performed and/or coordinated the beginning stages of the various functions of a complete university center: statistical consulting and cooperative research service, statistical computing service, research and teaching in statistics as a research methodology and as a separate discipline. Highlights of growth and expansion in the Statistical Laboratory (statistical center) for the period 1947-1950 with Ray Jessen as acting director and head and for the period 1950-1972 with the author as the second "permanent" director and first "permanent" head are given. Consideration is given to expansion in: housing space, faculty

and staff, research, teaching, graduate and undergraduate students, computing service, and off-campus activities for both periods.

*DAVID, H. A. The Iowa State Statistical Laboratory: Antecedents and early years, 1914-47. In *Statistics: An Appraisal,* pp. 3-18. SLRS 588.

The Iowa State Statistical Laboratory developed out of the efforts of George W. Snedecor, with the stimulation of Henry A. Wallace and R. A. Fisher. Pivotal events were Snedecor's arrival at Iowa State in 1913, Wallace's ten Saturday afternoon lectures in 1924, the formation of a Mathematics Statistical Service in 1927 under the direction of Snedecor and A. E. Brandt, and Fisher's first visit in 1931. The Laboratory was founded in 1933 with Snedecor as director. In 1937 Snedecor published his famous *Statistical Methods.* A cooperative agreement with the U.S. Department of Agriculture in 1938 made possible a sharp increase in size. In 1939 W. G. Cochran joined the staff and a Ph.D. program was initiated. The Master Sample of Agriculture was begun in 1943, a major project which further consolidated the Laboratory's standing as a leading statistical center.

FULLER, Wayne A. The Master Sample of Agriculture. In *Statistics: An Appraisal,* pp. 583-598.

The joint project of the U.S. Department of Agriculture, the U.S. Bureau of the Census, and the Statistical Laboratory, in which a national area sample of agriculture was developed, is described. The basis for the Master Sample project, the nature of the sample, and the impact of the project on survey sampling are discussed.

*KEMPTHORNE, Oscar. Revisiting the past and anticipating the future. In *Statistics: An Appraisal,* pp. 31-52. SLRS 591.

In this essay, discussion is given of the ubiquitous need for and increasing use of statistical ideas in the overall human endeavor. Some ideas about the origin and nature of the Iowa State effort in statistics are given. A few appraisal remarks about this effort are given. The essay concludes with general discussion of the present state and ideas on the future of the discipline.

ATHREYA, K. B. Discussion of papers by Box and Rosenblatt [on Time Series and Stochastic Processes]. In *Statistics: An Appraisal,* pp. 521-524.

HARVILLE, D. A. Discussion of papers by Wahba, Journel, and Henderson [on Interpolation and Estimation]. In *Statistics: An Appraisal,* pp. 281-286.

KENNEDY, W. J. Discussion of papers by Thisted and Boardman [on Statistical Computing]. In *Statistics: An Appraisal,* pp. 639-641.

Festschrift in Honor of Oscar Kempthorne

Experimental Design, Statistical Models, and Genetic Statistics — Essays in Honor of Oscar Kempthorne was published by Marcel Dekker, Inc., New York in February 1984 as Volume 50 in its series Statistics: Textbooks and Monographs. A Festschrift to honor Kempthorne on the occasion of his 65th birthday, the monograph is edited by Klaus Hinkelmann, head of the Department of Statistics, Virginia Polytechnic Institute and State University, who received his Ph.D. at Iowa State in 1963. [During the birthday celebration held for Kempthorne at VPI, while he was on faculty improvement leave, a commemorative scroll was presented on behalf of the Statistical Laboratory.] The 410-page book presents articles by four members of the Stat Lab, mentioned below, and 17 other papers by friends and former students and colleagues.

BANCROFT, T. A. Chapter 1: The years 1950-1972. Pp. 3-7.

DAVID, H. A. Chapter 2: The years 1972-1984. Pp. 9-13.

These two chapters, comprising Part I: Contributions to Iowa State University and Beyond, sketch Kempthorne's activities and the recognition they have received during the periods specified. The authors discuss his leadership in experimental design and analysis and genetic statistics, meanwhile appreciating personal qualities and his intellectual concern with some of the big issues of statistical inference.

Parts II-IV of the book contain papers by Kempthorne's former students and colleagues N. R. Bohidar, R. N. Curnow, Ted H. Emigh, Walter T. Federer, J. Leroy Folks, K. Ruben Gabriel, F. G. Giesbrecht, Dewey L. Harris, William G. Hill, Klaus Hinkelmann, Basilio A. Rojas, C. Z. Roux, Justus F. Seely, and Robin Thompson. Also included are two papers by present colleagues David A. Harville and Edward Pollak (see abstracts on pp. 24 and 26).

SHELLEY, Mack C., II. *The Permanent Majority: The Conservative Coalition in the U.S. Congress.* The University of Alabama Press. xvi + 201 pp. 1983.

The book examines the impact of an alliance of Republicans and conservative (mostly southern) Democrats on policy formation within Congress. Seven issue areas are discussed — government management, civil liberties, social welfare, international involvement, agricultural assistance, internal congressional affairs, and inter-branch relations with other government units. Historical data, mostly from 1933 to 1980, reveal the relationship of the conservative coalition to congressional partisanship, national ideological divisions, presidential policy programs, constituency pressures, and congressional committees. The cohesiveness, success, and rate of appearance of this voting bloc are examined over time, with applications of the Box-Jenkins method, as well as other appropriate techniques.

Published Research

*AMEMIYA, Yasuo, and **Wayne A. FULLER.** Estimation for the multivariate errors-in-variables model with estimated error covariance matrix. *The Annals of Statistics* 12:2 (1984) 497-509. SLRS 592.

The errors-in-variables model in which the unobserved true values satisfy multiple linear restrictions is considered. Under the assumptions that the unobservable true values are normally distributed and that an estimator of the covariance matrix of the measurement error is available, the maximum likelihood estimators are derived. The limiting properties of the estimators are obtained for a wide range of assumptions, including the assumption of fixed true values.
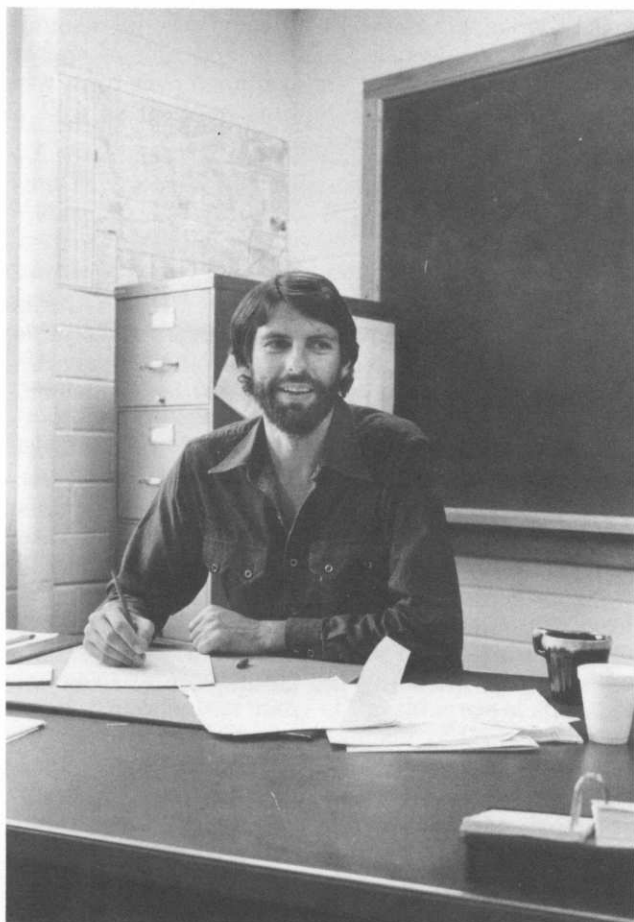
*Ganse, Robert A., **Yasuo AMEMIYA,** and **Wayne A. FULLER.** Prediction when both variables are subject to error, with application to earthquake magnitudes. *Journal of the American Statistical Association* 78:384 (1983) 761-765. SLRS 584.

The structural relation between the amplitude of earthquake surface waves and the amplitude of earthquake body waves is estimated. The structural relation is used to construct an equation to predict surface waves from recorded body waves in a second population of earthquakes.

*BANCROFT, T. A., and Chien-Pai Han. A note on pooling variances. *Journal of the American Statistical Association* 78:384 (1983) 981-983. SLRS 583.

The estimation of variance in the normal distribution by statistical inference based on conditional specification is studied. When two samples are available for estimating variance but it is not certain whether they come from the same population, the experimenter usually uses a test to resolve the uncertainty. When the test is not significant, the samples are pooled to obtain a pooled estimator; otherwise, the individual sample variance is used. The bias and mean squared error of such a preliminary test estimator are studied. It is shown that the preliminary test estimator has a smaller mean squared error than the usual unbiased estimator when the level of significance for the preliminary test is appropriately chosen.

CRESSIE, Noel. Towards resistant geostatistics. In *Geostatistics for Natural Resources Characterization,* Part 1, pp. 21-44 — Proceedings of the NATO Advanced Study Institute on Geostatistics for Natural Resources Characterization, held at South

Noel Cressie is working on spatial statistics, robustness, random sets, and general theory.

This work discusses how Student's *t*-tests might still be validly applied to medical data that may violate the usual statistical assumptions. Here the one sample *t*-test, which includes as a special case the paired comparisons *t*-test, is treated in detail. Practical "rules-of-thumb" are given, along with their applications to various examples, so that readers will easily be able to use them on their own data sets.

Hawkins, Douglas M., and **Noel CRESSIE.** Robust kriging — A proposal. *Mathematical Geology* 16:1 (1984) 3-18.

Geological data frequently have a heavy-tailed normal-in-the-middle distribution, which gives rise to grade distributions that appear to be normal except for the occurrence of a few outliers. This same situation applies to log-transformed data to which lognormal kriging is to be applied. For such data, linear kriging is nonrobust in that (1) kriged estimates tend to infinity as the outliers do, and (2) it is also not minimum mean squared error. The more general nonlinear method of disjunctive kriging is even more nonrobust, computationally more laborious, and in the end need not produce better practical answers. We propose a robust kriging method for such nearly normal data based on linear kriging of an editing of the data. It is little more laborious than conventional linear kriging and, used in conjunction with a robust estimator of the variogram, provides good protection against the effects of data outliers. The method is also applicable to time series analysis.

Lake Tahoe, California September 6-17, 1983. G. Verly, M. David, A. G. Journel, and A. Marechal, editors. D. Reidel Publishing Company (Dordrecht, Holland). 1984.

Implicit in many of the geostatistical techniques developed, is faith that the data are Gaussian (normal) or can be conveniently transformed to Gaussianity. A mining engineer knows, however, that contamination is present all too often. This paper makes an exploratory analysis of spatial data, graphing and summarizing in a way that is resistant to that contamination. The ultimate goal is variogram estimation and kriging, and the data analytic techniques used reflect this. The pocket plot is a new way of looking at contributions of small regions of points to variogram estimation. The gridded data are thought of as a higher way table and analyzed by median polish. The residual table is shown to contain useful information on the spatial relationships between data. Coal ash measurements in Pennsylvania are analyzed from this resistant point of view.

CRESSIE, N. A. C., L. J. Sheffield, and H. J. Whitford. Use of the one sample *t*-test in the real world. *Journal of Chronic Diseases* 37:2 (1984) 107-114.

Keightley, D. D., R. J. Fisher, and **N. A. C. CRESSIE.** Properties and interpretation of the Woolf and Scatchard plots in analysing data from steroid receptor assays. *Journal of Steroid Biochemistry* 19:4 (1983) 1407-1412.

The Woolf plot has been shown to have superior statistical properties compared with the Scatchard plot in analyzing data from steroid receptor assays. This paper examines the properties of the Woolf plot, with a view to aiding its interpretation and improving its familiarity.

The Woolf plot contains the same information as the Scatchard plot, and deviations from linearity of the plot due to positive cooperativity, second binding sites, or nonspecific binding are readily identifiable, and are described. It is emphasized, however, that the range of incubating concentrations should be chosen to give an even spread of data points on the plot.

There is shown to be a relatively stable error distribution along the Woolf plot, and the implications of this for analysis of the data points are discussed. This error distribution is associated with consistently better fitting of a straight line to the data points when they are presented on the Woolf, as opposed to the Scatchard, scale. This has further implications in the definition of receptor positivity, and in determining the reliability of a receptor assay result.

Interpretation of the Woolf plot is easy, with the receptor site concentration being obtained from the slope of the plot, and the dissociation constant from the intersection of the extrapolated line with the abscissa. Familiarity with the plot should lead to its wider use.

DAVID, H. A. Gini's mean difference. In *Encyclopedia of Statistical Sciences,* Vol. 3: *Faa di Bruno's Formula — Hypothesis Testing,* pp. 436-437. Samuel Kotz and Norman L. Johnson, editors-in-chief. John Wiley & Sons, Inc. (New York). 1983.

DOREA, C. C. Y. A semigroup characterization of the multiparameter Wiener process. *Semigroup Forum* 26:3-4 (1983) 287-293.

It is well known that the infinitesimal operator $Af = \frac{1}{2} f''$ characterizes the Wiener process $\{W(t), t \geq 0\}$. In this paper we show that the family of operators $A_{C_1 \ldots C_k} \pi f_j = \frac{1}{2} \{\Sigma_j \lambda_{q-1} (C_j) \pi_{i \neq j} f_i f''_j\}$ plays the same role for the q-parameter Wiener process.

FULLER, Wayne A. Comments on "Multiperiod forecast error variances of inflation estimated from ARCH models" by Robert F. Engle and Dennis F. Kraft. Pp. 303-305 in *Applied Time Series Analysis of Economic Data* — Proceedings of the Conference on Applied Time Series Analysis of Economic Data, October 13-15, 1981, Arlington, Virginia, cosponsored by the American Statistical Association; Bureau of the Census, U.S. Department of Commerce; and National Bureau of Economic Research. Economic Research Report ER-5, U.S. Bureau of the Census. 1983.

An alternative representation of the ARCH model of Engle and Kraft is presented. Conditions for stationarity of the model are developed.

Dahm, P. Frederick, Bryan E. Melton, and **Wayne A. FULLER.** Generalized least squares estimation of a genotypic covariance matrix. *Biometrics* 39:3 (1983) 587-597.

A generalized least squares approach is used to estimate the genotypic covariance matrix of weaning weight, feed consumption, average daily gain, and retail product for beef cattle. In this procedure, the elements of "within-sires" and "among-sires" sample covariance matrices are the observations. A satisfactory fit to these data is obtained with a model in which two genotypic factors are present. The model can be used to determine economic values for traits considered in breeding programs.

*Dickey, D. A., D. P. Hasza, and **W. A. FULLER.** Testing for unit roots in seasonal time series. *Journal of the American Statistical Association* 79:386 (1984) 355-367. SLRS 596.

Regression estimators of coefficients in seasonal autoregressive models are described. The percentiles of the distributions for time series that have unit roots at the seasonal lag are computed by Monte Carlo integration for finite samples, and by analytic techniques and Monte Carlo integration for the limit case. The tabled distributions may be used to test the hypothesis that a time series has a seasonal unit root.

GHOSH, Malay (Iowa State University and University of Florida), Jiunn Tzon Hwang, and Kam-Wah Tsui. Construction of improved estimators in multiparameter estimation for continuous exponential families. *Journal of Multivariate Analysis* 14:2 (1984) 212-220.

A unified theory of simultaneous estimation of parameters for the continuous exponential family is presented. Estimators are constructed that improve on the standard ones (the maximum likelihood, UMVUE, or best invariant estimator). These improved estimators shift the standard ones towards possibly non-zero points or data based points.

GHOSH, Malay and **Richard Auer** (Loyola College, Baltimore, Maryland). Simultaneous estimation of parameters in exponential families. *Annals of the Institute of Statistical Mathematics* (Tokyo) 35:3 (1983) Part A, 379-387.

The paper considers estimation of the natural parameter vector or the mean vector from independent distributions each belonging to the one-parameter discrete or absolutely continuous exponential family. The usual estimators (maximum likelihood, minimum variance unbiased or best invariant) are improved simultaneously under various weighted squared error losses.

GHOSH, Malay and **Nader Ebrahimi** (University of Missouri). Shock models leading to multivariate NBU and NBUE distributions. In *Contributions to Statistics: Essays in Honour of Norman L. Johnson,* pp. 175-184. P. K. Sen, editor. North-Holland Publishing Company (Amsterdam). 1983.

The paper shows how shock models can give rise to several classes of multivariate New Better than Used (NBU) and New Better than Used in Expectation (NBUE) distributions.

*GHOSH, Malay** and **Glen MEEDEN.** Estimation of the variance in finite population sampling. *Sankhyā* B 45:3 (1983) 362-375. SLRS 594.

In simple random sampling without replacement, the usual unbiased estimator of the population variance is shown to be inadmissible under squared error loss. An admissible estimator is constructed following the line of argument of Meeden and Ghosh [*Annals of*

Statistics 11 (1983) 296-305 and *Proceedings of the Golden Jubilee Conference* of the Indian Statistical Institute (1984) in press].

*GROENEVELD, Richard A., and Barry C. Arnold. Limit laws in the best of 2n − 1 Bernoulli trials. *Naval Research Logistics Quarterly* 31:2 (1984) 275-281. SLRS 590.

A series of independent Bernoulli trials is considered in which either an outcome of type A or one of type B occurs at each trial. The series terminates when n outcomes of one type have occurred. Two observable random variables of interest are the total number of outcomes in the series and the number of outcomes of the "losing kind." Two methods of approximation of the expectations of these random variables for large n are obtained and compared. The limiting distribution of the number of outcomes of the "losing kind" is considered when a beta distribution is assigned to p, the probability of an outcome of type A.

HARVILLE, David A. A generalized version of Albert's Theorem, with applications to the mixed linear model. Chapter 14 in *Experimental Design, Statistical Models, and Genetic Statistics — Essays in Honor of Oscar Kempthorne,* edited by Klaus Hinkelmann, pp. 231-238. Marcel Dekker, Inc. (New York). 1984.

If $\underline{x}$ is a multivariate normal random vector with mean vector μ and covariance matrix Σ and if $A_1,...,A_k$ are nonrandom nonnull symmetric matrices such that $A = A_1 + ... + A_k$ is idempotent, then sufficient conditions for $x'A_1x, ..., x'A_kx$ to be distributed independently as noncentral chi-square variates are that $A^2_i = A_i$ and $A\Sigma A_i = \gamma_i A_i$ for some nonzero scalar γ_i $(i = 1,...,k)$. If Σ is nonsingular, these conditions are also necessary. These results form a generalization of Albert's [1976, *The Annals of Statistics* 4, 775-778] Theorem and can be derived as a corollary to a generalization of Cochran's [1934, *Proceedings of the Cambridge Philosophical Society* 30, 178-191] Theorem. They can be useful in answering distributional questions that arise with mixed linear models.

*HARVILLE, David A., and Robert W. Mee (University of South Alabama). A mixed-model procedure for analyzing ordered categorical data. *Biometrics* 40:2 (1984) 393-408. SLRS 597.

A mixed-model procedure is developed for predicting the value of an ordered categorical response from knowledge of various predictor variables. This procedure resembles Henderson's [*Biometrics* 31 (1975) 423-447] best linear unbiased procedure for predicting the value of a quantitative response. The approach is based on a mixed-model version of the threshold model, in which it is assumed that the observed category is determined by the value of an underlying unobservable continuous response that follows a mixed linear model. The results are illustrated by applying them to the problem of predicting the degree of difficulty experienced by a dairy cow in the birth of her calf.

HINZ, P., and K. K. Ching. Performance of progenies of single trees in a provenance plantation. *Silvae Genetica* 31:5-6 (1982) 149-150.

Single Douglas-fir trees in a provenance plantation were crossed with different pollen sources in 1966 and 1968. Sources and seed trees significantly affected height of progeny. Low correlation of provenance heights of 1966 and 1968 crosses is believed due to experimental error and to use of different trees in each year's crosses.

*HINZ, Paul N., and Gary B. Pitman. Analyzing data on insect response to pheromones: From a field study of the western pine beetle. *Iowa State Journal of Research* 58:2 (1983) 195-206. SLRS 580.

Journal Paper No. J-10759 of the Iowa Agriculture and Home Economics Experiment Station, Project 101, and Paper 1422 of the Forest Research Laboratory, Oregon State University.

Formulations used in field studies of pheromones can be composed of more than one compound. Data from such experiments are used to deduce the effects of the individual compounds. It is difficult, however, to estimate these effects when the experimental error is large in relation to the size of the effects. In such cases, the statistical methodology of linear models and analysis of variance can be used to estimate average effects of individual compounds and their interactions with each other. The methodology is illustrated on previously unpublished data from a study on western pine beetles (*Dendroctonus brevicomis* LeConte). The analysis confirms the role of verbenone as an interruptive or inhibitor pheromone produced by male beetles and suggests that it may not be the only such pheromone. Suggestions are made for the planning of future experiments of this type.

Bergman, M. K., J. J. Tollefson, and **P. N. HINZ.** Spatial dispersion of corn rootworm larvae (Coleoptera: Chrysomelidae) in Iowa cornfields. *Environmental Entomology* 12:5 (1983) 1443-1446.

Journal Paper No. J-9843 of the Iowa Agriculture and Home Economics Experiment Station, Projects No. 2250 and 2280.

Selected central Iowa cornfields were sampled for corn rootworm larvae in 1978 and 1979, using core and cube sample units and a three-stage, stratified random sampling design. Dispersion patterns were examined by field for each year with the variance-to-mean ratio. Spatial dispersion across fields was estimated from the 1979 sample counts by using s^2/m and Taylor's power law. Most populations of corn rootworm larvae exhibited aggregated dispersion patterns. A discussion of possible reasons for aggregation is presented.

Adams, Donald R., and **Donald K. HOTCHKISS.** The canine nasal mucosa. *Zentralblatt für Veterinarmedizin. Reihe C. Anatomia, Histologia, Embryologia* 12 (1983) 109-125.

Tissues of the nasal mucosa were utilized from 20 dogs for histochemistry, quantitative measurements, and scanning electron microscopy. Attention was given to the type of epithelium, organization of submucosal tissues, distribution of vascular structures, and glandular organization. These features are characterized and compared statistically regarding the respiratory and immune functions of the nasal mucosa.

*IACHAN, Ronaldo.** Nonsampling errors in surveys — A review. *Communications in Statistics — Part A: Theory and Methods* 12:19 (1983) 2273-2287. SLRS 576.

Response errors have become extremely important in increasingly complex surveys, and a review of the ever expanding literature on the subject was judged necessary. The emphasis here is on models for response and nonresponse errors, the most recent ones incorporating the concept of response probabilities.

*IACHAN, Ronaldo.** Asymptotic theory of systematic sampling. *The Annals of Statistics* 11:3 (1983) 959-969. SLRS 577.

The main purpose of this paper is the development of an asymptotic theory of systematic sampling from a stochastic population. The superpopulation model assumed is that the population arises from a second-order stationary process. A comparison among the multiple random start systematic sampling schemes is made in terms of the limiting expected variance of the sample mean. Asymptotic normality of the systematic sampling mean is obtained, both unconditionally and conditionally on the given population. Finally, the asymptotic behavior of confidence intervals based on two distinct variance estimators is studied.

IACHAN, Ronaldo. A measure of agreement for use with the Holland classification system. *Journal of Vocational Behavior* 24:2 (1984) 133-141.

A measure of agreement for partially ordered data is suggested that makes use of the k categories with the highest ranks, the ranks of the remaining categories being disregarded. The proposed measure is applied to the Self-Directed Search in order to evaluate its agreement with occupational preference. Other forms of agreement in the Holland classification system can also be assessed by the proposed measure. Examples are congruence and husband-wife and counselor-client agreement.

IACHAN, Ronaldo. A family of differentiation indices. *Psychometrika* 49:2 (1984) 217-222.

A general class of differentiation indices is introduced for profiles of scores. Their ordinal properties and an application to Holland's classification system are examined. Comparison with other suggested indices is performed both theoretically and empirically.

Bishop, Simon H., and **Byron JONES.** A review of higher-order crossover designs. *Journal of Applied Statistics* 11:1 (1984) 29-50.

The literature concerning crossover trials is reviewed, with particular attention being paid to the design aspect of such trials. Methods of analyzing crossover trials are quite diverse and so are only discussed briefly. A selected bibliography of over 80 publications is included.

Gupta, S. C., and **B. JONES.** Equi-replicate balanced block designs with unequal block sizes. *Biometrika* 70:2 (1983) 433-440.

Methods are given for the construction of equi-replicate balanced block designs with unequal block sizes, using group divisible designs. Balanced designs in which treatments are replicated 25 times or less are tabulated. The plans of these designs can be readily obtained by using existing published sources. Some of the designs given are even smaller than those in balanced incomplete blocks.

Josvanger, Lee Ann, and **V. A. SPOSITO.** L_1 norm estimates using a descent approach. *Computer Science and Statistics: Proceedings of the Fifteenth Symposium on the Interface* (1983) 352-355.

Estimates of the parameters in the simple linear model, $y = \alpha + \beta x + e$ under the criterion of minimizing the sum of absolute deviations, L_1, are usually computed by appealing to linear programming computational techniques. In this paper, a computational procedure using a descent approach is presented; this approach is shown to be equivalent to the problem of finding the weighted median with respect to a specified set of a_i's.

A Monte Carlo study is given comparing this descent approach with the "best" known linear programming based procedures; it is shown that L_1 estimates can be obtained in nearly one-half the time using the descent approach.

KEMPTHORNE, Oscar. Evaluation of current population genetics theory. *American Zoologist* 23:1 (1983) 111-121.

The aim of the paper is to give a partial evaluation or critique of the state of population genetics theory. A decent theory must include the following components: the development of concepts of fitness that have

demonstrated epistemic correlations, life tables, mating, fecundity, finite (even if large) niche size, and, of course, Mendelism and mutation. It must in the end also include varying environment and competition between species. The extent to which the desiderata are met is discussed. The big lacunae in the whole theory appear to be in the inadequate treatment of fitness and the ignoring of niche capacity. Some theorems that are given as fundamental must be questioned and even discarded. Integration of ideas of simple Mendelism, quantitative genetic variation, and ecology is the big task ahead. It is critical that more complete theory be developed.

Lin, C. Charles (BMDP Statistical Software, Los Angeles, California), and **W. J. KENNEDY.** Computer generated test problems for L_p estimates in linear models. *Journal of Statistical Computation and Simulation* 17:3 (1983) 219-222.

Two methods are given that allow the user to produce test data having known solution to the L_p ($p > 1$) estimation problem for the full rank linear model. The methods are easily programmed for digital computers.

Mattson, Gary, and **Frederick LORENZ.** LWCF distribution patterns in New England: An analysis of who benefits. *Municipal Management* 6:1 (1983) 5-11.

A critical issue in any intergovernmental program is who decides how and where grant money is distributed. Part of the answer depends on the organization of the bureaucracy responsible for allocating funds. Using data on the distribution of Land and Water Conservation Fund (LWCF) grants to communities in six New England states between 1965 and 1976, the authors found that states with centralized bureaucracies distributed grants to a greater proportion of cities than did states with decentralized bureaucracies. One implication is that decentralized bureaucracies may be more responsive only to larger, more powerful communities.

Schafer, Robert B., Patricia M. Keith, and **Frederick O. LORENZ.** Equity/inequity and the self-concept: An interactionist analysis. *Social Psychology Quarterly* 47:1 (1984) 42-49.

In this paper the authors examined the relationship between individual self-esteem and perceived marital equity. Using data from a random sample of 329 married couples and a causal model based on path analysis, the findings supported the prediction of a relationship between perceived equity in the marital relationship and marriage partner's self-concept. Much of the effect of perceived equity on self-concept was mediated by the partners' perceptions of their spouses' appraisal of them.

MEEKER, William Q., Jr. Discussion [of a review paper by J. F. Lawless: "Statistical Methods in Reliability"]. *Technometrics* 25:4 (1983) 316-320.

In his paper, Lawless discusses the development of statistical methods in reliability during *Technometrics'* first 25 years. This discussion of Lawless's paper highlights some applications, gives some ideas for bringing statistical methods for life data analysis to practice, and adds to Lawless's list of areas requiring additional development of theory and practice.

*MEEKER, William Q., Jr. A comparison of accelerated life test plans for Weibull and lognormal distributions and type I censoring. *Technometrics* 26:2 (1984) 157-171. SLRS 587.

Previous work on planning accelerated life test plans for the Weibull and lognormal distributions has concentrated on optimum test plans that minimize the variance of some specified estimator. However, those test plans use tests at only two levels of stress and thus have serious practical limitations. This paper compares optimum test plans and some compromise test plans with respect to additional criteria, including (1) the ability to detect departures from the assumed stress-life relationship and (2) robustness to departures from the assumptions used in determining the plans. The comparisons are based on the large sample properties of maximum likelihood estimators, and the test plans are compared over a range of practical testing situations. The comparisons suggest some general rules for planning accelerated life tests.

*Noorbaloochi, Siamak (Jundi Shapur University, Iran), and **Glen MEEDEN.** Unbiasedness as the dual of being Bayes. *Journal of the American Statistical Association* 78:383 (1983) 619-623. SLRS 578.

In this note we define the notion of unbiasedness for a decision function for an arbitrary loss function. This is a generalization of Lehmann's (1951) definition [*Annals of Mathematical Statistics* 22:587-592]. We show that this notion of unbiasedness is a dual to the notion of being Bayes; that is, if the role of the random variable and the parameter is interchanged, then unbiasedness is equivalent to being Bayes, and vice versa. Some consequences of that fact are discussed.

*POLLAK, Edward. The Ewens sampling formula in a population that varies in size. Chapter 21 in *Experimental Design, Statistical Models, and Genetic Statistics — Essays in Honor of Oscar Kempthorne,* edited by Klaus Hinkelmann, pp. 385-400. Marcel Dekker, Inc. (New York). 1984. SLRS 586.

Journal Paper No. J-10990 of the Iowa Agriculture and Home Economics Experiment Station, Project 2588.

The celebrated sampling formula of W. J. Ewens [*Theoretical Population Biology* 3 (1972) 87-112] is

very important in assessing whether observed configurations of allele frequencies in random samples from a population are consistent with the neutrality of the alleles. No proof of it seems to have appeared in the literature for the case where the population size N_t at time t is not a fixed number N.

In this paper it is assumed that the sequence $\{N_t; t = 0, 1,...\}$ is generated by a finite irreducible Markov chain, which may possibly be periodic, and that offspring are produced in accordance with the Wright-Fisher model. The mutation rate of any allele at a locus is taken to be u.

The method of proof that is used is a formal presentation of one that has been sketched by Ewens [in his book *Mathematical Population Genetics* (1979)], and also by O. Kempthorne [*Proceedings of the 5th Berkeley Symposium on Mathematical Statistics and Probability* 4 (1967) 333-343], who considered the special case in which u is equal to 0. The outcome is that the Ewens sampling formula is found to hold if the fixed N is replaced by N_e, which is the reciprocal of the asymptotic average, over possible population sizes, of the reciprocals of these sizes.

REISER, Mark. An item response model for the estimation of demographic effects. *Journal of Educational Statistics* 8:3 (1983) 165-186.

Item sampling procedures employed in many assessment studies are designed so that each respondent answers a small number of items in each of a large number of skill areas. If the item population contains several items designed to measure an underlying variable such as computation skill, it may be desirable to fit an item response model to the data. In studies that employ multiple matrix sampling there are not enough answers from each individual to employ such a model. To circumvent this problem, a model is formulated on the assumption that individual level variability appears as independent error within the cells of the cross classification of manifest demographic variables such as sex and race. This model is successfully fitted to a scale of items, involving addition of fractions, from the National Assessment Study.

*Roux, C. Z. (Animal and Dairy Science Research Institute, Irene, Republic of South Africa). Replacing parents by meritorious offspring: Maximizing within-family selection gains by the use of order statistics. *Biometrics* 39:2 (1983) 479-483. SLRS 579.

The assumption of a symmetric underlying distribution is used to calculate the probability that the most extreme offspring is inferior to the midparental breeding value, with suitable adjustment being made for possible sex differences. Under the assumption of a normal underlying distribution, the maximum conceptual selection progress for within-family selection is calculated, with the truncation points on the distribution of the offspring order statistics determining the geometric distribution that describes the speed of replacement of parents by offspring. The realizable selection progress is calculated by the use of the distribution of the deviation of the nth order statistic from the sample mean.

Van Der Maaten, M. J., M. J. F. Schmerr, J. M. Miller, and **J. M. SACKS.** Levamisole does not affect the virological and serological responses of bovine leukemia virus-infected cattle and sheep. *Canadian Journal of Comparative Medicine* 47 (1983) 474-479.

Levamisole, a compound that has been used widely as an anthelmintic in man and domestic animals, has also been found to be an immunomodulator. It was, thus, of interest to determine whether treatment with levamisole would affect bovine leukemia virus infections in cattle and sheep or the results of serological and virological tests routinely used to identify infected animals. Studies of cattle and sheep given either the recommended anthelmintic dose of levamisole or repeated larger doses of the drug failed to provide evidence of significant changes in antibody titer or virus replication. It is, therefore, concluded that levamisole neither potentiated nor repressed bovine leukemia virus replication or the associated immunological responses.

Graether, John M., Gilbert W. Harris, James A. Davison, Russell H. Watt, Russell R. Widner, and **Vincent SPOSITO.** A comparison of the effects of phacoemulsification and nucleus expression on endothelial cell density. *American Intra-Ocular Implant Society Journal* 9:4 (1983) 420-423.

A group of patients undergoing cataract extraction with posterior chamber lens implantation was studied to evaluate the effects of various techniques on preoperative and postoperative cell density.

STRAHAN, Robert F. Radical statistics supports radical behaviorism — and almost everything else. *Educational Researcher* 12:5 (1983) 31.

A response is made to the claim by Brophy that "rebehavioristic social science" uses statistics whereas his championed behavioral analysis does not. The response is that, explicitly or implicitly, both necessarily employ statistical inference.

*SUKHATME, Shashikala. Asymptotic properties of Cramér-Smirnov statistics — A new approach. *Journal of Multivariate Analysis* 13:4 (1983) 539-549. SLRS 585.

Let $Y_1, ..., Y_n$ be independent identically distributed random variables with distribution function $F(x,\underline{\theta})$, $\underline{\theta} = (\underline{\theta}'_1,\underline{\theta}'_2)$, where $\underline{\theta}_i$ (i = 1,2) is a vector of p_i components, $p = p_1 + p_2$ and for $\forall \underline{\theta} \in I$, an open interval in $\mathscr{R}^p$, $F(x,\underline{\theta})$ is continuous. In the present paper

the author shows that the asymptotic distribution of a modified Cramér-Smirnov statistic under $H_n: \theta_1 = \theta_{10} + n^{-1/2}\gamma$, θ_2 unspecified, where γ is a given vector independent of n, is the distribution of a sum of weighted noncentral χ_1^2 variables whose weights are eigenvalues of a covariance function of a Gaussian process and noncentrality parameters are Fourier coefficients of the mean function of the Gaussian process. Further, the author exploits the special form of the covariance function by using perturbation theory to obtain the noncentrality parameters and the weights. The technique is applicable to other goodness-of-fit statistics such as U^2 [G. S. Watson, *Biometrika* 48 (1961), 109-114].

TOYOOKA, Y. Second-order structure of mean squared error of GLSE adjusted by estimated residuals in a location model with autoregressive error. *Mathematica Japonica* 28:2 (1983) 163-171.

For the location model with autoregressive error, the structure of the risk of the two-step generalized least squares estimator (GLSE) is considered and discussed up to $O(1/n^2)$. It is shown that the use of estimated residuals does not incur information loss up to $O(1/n^2)$.

Pedigo, L. P., and **J. W. van Schaik.** Time-sequential sampling: A new use of the sequential probability ratio test for pest management decisions. *Bulletin of the Entomological Society of America* 30:1 (1984) 32-36.

A method was developed to use the sequential probability ratio test of Wald (sequential sampling) in a time-oriented sense rather than in a spatial sense. The method allows a grower or scout to decide if a population is of an endemic or outbreak type on the basis of mathematical dispersion and differential growth rates of the types. Formulas and calculations are presented for data from negative-binomial, Poisson, and binomial distributions. An example of time-sequential sampling is presented for immigrant green cloverworm adults on soybean. The use and position of time-sequential sampling in the green cloverworm pest management subsystem is indicated.

VARDEMAN, Stephen and **Glen MEEDEN.** Admissible estimators in finite population sampling employing various types of prior information. *Journal of Statistical Planning and Inference* 7:4 (1983) 329-341.

We consider some estimators of the total and variance of a finite population from Bayesian and pseudo-Bayesian perspectives. Recently, Meeden and Ghosh have provided quite simple but powerful tools for proving admissibility of estimators and estimator-design pairs in finite population sampling problems. We consider what these techniques yield in the way of admissibility results for the estimators discussed.

VARDEMAN, Stephen, and **Glen MEEDEN.** Admissible estimators of the population total using trimming and Winsorization. *Statistics & Probability Letters* 1:6 (1983) 317-321.

In this article we provide admissibility and uniform admissibility results for estimators of the total of a finite population that employ trimming or Winsorization. These follow from application of recent Meeden-Ghosh techniques.

*VARDEMAN, Stephen, and **Glen MEEDEN.** Calibration, sufficiency, and domination considerations for Bayesian probability assessors. *Journal of the American Statistical Association* 78:384 (1983) 808-816. SLRS 582.

Various aspects of the problem of evaluating the performance of probability appraisers were considered in a 1982 paper by DeGroot and Fienberg [in *Statistical Decision Theory and Related Topics,* Vol. 1, edited by J. O. Berger and S. S. Gupta]. After briefly reviewing their notions of calibration and sufficiency we introduce related ideas of "semi-calibration" and "domination" and consider their relationship to the earlier concepts. We then turn to the investigation of some simple Bayesian mechanisms for making probability assessments and study how choices of the probability structures involved in these affect statements that can be made concerning the calibration, semi-calibration, sufficiency and domination properties of such assessment schemes. Finally, several results concerning the comparison of finite dichotomous experiments, relevant to the present work, are collected in an appendix.

VARDEMAN, Stephen, and **Glen MEEDEN.** Admissible estimators for the total of a stratified population that employ prior information. *The Annals of Statistics* 12:2 (1984) 675-684.

We consider the problem of estimation of the total of a stratified finite population. For two levels of prior knowledge about the stratification, we provide Bayes and pseudo-Bayes estimators that make use of that prior knowledge in sensible ways. We then note that admissibility results can be established for these estimators using the Meeden-Ghosh techniques and indicate some possible natural extensions of the present work.

Galejs, Irma, Damaris Pease, and **Leroy WOLINS.** Personal reaction scale for college and noncollege adults: Its development and factorial validity. *Educational and Psychological Measurement* 44:2 (1984) 383-393.

The Personal Reaction Scale (PRS) was developed as a paper-and-pencil test for college and noncollege adults to measure their locus of control perceptions. The 79-item PRS was administered to women college

students (n = 150), their mothers (n = 105) and fathers (n = 88), and parents of 20 preschool-age children. Responses of the 382 subjects were factor analyzed to yield six factors: fate, social self, personal self, self-determination, luck, and powerlessness. Reliability estimates, based on use of the usual Spearman-Brown formula, were computed for each factor for total variance (range = .39 to .84) and for unique variance (range = .34 to .75). The low intercorrelations among factors (range = .36 to -.32) offer support for uniqueness of each factor, and suggest that the locus of control construct is not a single concept but rather multidimensional in nature. Furthermore, even though relationships were evident between the responses of parents and children, it seems that the locus of control construct is either related to age or correlated with developmental processes experienced during the individual's life span. Additional research is required to verify the different emphases of persons' perceptions of control over events.

Stockdale, Dahlia, Irma Galejs, and **Leroy WOLINS.** Cooperative-competitive preferences and behavioral correlates as a function of sex and age of school-age children. *Psychological Reports* 53:3 (1983) 739-750.

Journal Paper No. 272 of the Home Economics Research Institute, College of Home Economics, Iowa State University, Project 148.

The objectives of the study were to: (1) develop a two-factor self-report preference measure of cooperation and competition; (2) explore the relationships between cooperative and competitive preferences, locus of control, social competence (parent rating), and school behaviors (teacher rating); (3) investigate sex and grade differences on the dependent measures. Factor analysis was employed on an 85-item inventory, administered to 120 children, resulting in the two expected factors plus two other factors. Another sample of 246 fourth-, fifth-, and sixth-grade children, their parents, and teachers was obtained. Correlational analysis indicated that children's cooperative-competitive preferences were not related to behaviors rated by teachers or parents; however, children's externality was related to competitive preferences and maladaptive behaviors at school. Analyses of variance showed girls indicated significantly more cooperative preferences than boys, and girls remained uniformly cooperative over the three grade levels while males declined in cooperative preferences. Findings supported traditional sex differences as in the literature.

*Yeo, W. B. (Korea Development Institute, Seoul, Korea), and **H. A. DAVID.** Selection through an associated characteristic, with applications to the random effects model. *Journal of the American Statistical Association* 79:385 (1984) 399-405. SLRS 593.

The problem of choosing the best k objects out of n is considered when, instead of measurements y_i (i = 1, ..., n) of primary interest, only associated measurements x_i are readily obtainable. Large measurements are regarded as desirable. It is assumed that the n pairs (x_i, y_i) are a random sample from a continuous population. A general expression is developed for the probability π that the s objects with the largest X-values include the k objects (k $\leq$ s) with the largest Y-values. When X and Y are bivariate normal with correlation ρ, a table of π is presented for n $\leq$ 15; this table gives immediately the smallest s for which $\pi \geq$ P*, where P* is preassigned. Several applications are treated, especially one to the random effects model for n varieties with r replications. It is shown how reasonable values of r may be found to provide a reduction in the number of varieties from n to s, such that the chosen s contain the k best varieties with at least probability P*. A method conditional on the observed values of the X's is also developed.

Book Reviews, Etcetera

BUBOLZ, Thomas A. *BMDP Statistical Software 1981,* by W. J. Dixon (ed.). Berkeley CA: University of California Press, 1981. x + 726 pp. $17.50. Reviewed in *Journal of the American Statistical Association* 79:386 (1984) 477-478.

DAVID, H. A. Foreword to *The Chronological Annotated Bibliography of Order Statistics. Volume I: Pre-1950,* by H. Leon Harter, pp. iii-iv. American Sciences Press, Inc. (Columbus). 1983.

DAVID, H. T. *Statistical Theory and Inference in Research,* by T. A. Bancroft and Chien-Pai Han. New York: Marcel Dekker, 1981. xiv + 372 pp. $34.50. Reviewed in *Journal of the American Statistical Association* 79:386 (1984) 470.

SHELLEY, Mack. *Content Analysis: An Introduction to Its Methodology,* by Klaus Krippendorff. Beverly Hills, California: Sage Publications, 1980. 191 pp. $15.00. Reviewed in *Journal of the American Statistical Association* 79:385 (1984) 240.

STEPHENSON, W. Robert, and **Oscar KEMPTHORNE.** *An Introduction to Contemporary Statistics,* by Lambert H. Koopmans. Boston: Duxbury Press, 1981. xx + 599 pp. $20.95. Reviewed in *Journal of the American Statistical Association* 79:385 (1984) 228-229.

STRAHAN, Robert F. *Single-Case Research Designs: Methods for Clinical and Applied Settings,* by Alan E. Kazdin. New York: Oxford University Press. 1982. Pp. xiii + 368. $25.50 and $14.95 (paperback). Reviewed in *Educational and Psychological Measurement* 44:2 (1984) 540-542.

Thesis Abstracts

Chua, Tin Chiu. Response errors in repeated surveys with duplicated observations. Ph.D. thesis, Iowa State University Library. July 1983.

The analysis of response error models for categorical data that form an $r \times r$ contingency table is considered. Individuals are placed in the row and column classes on the basis of two interviews. It is assumed that the errors in the row and in the column classifications are independent. It is also assumed that the error in the classification of an individual depends only on the individual's true class. A parametric model for the probability that an individual belonging to the ith class is classified in the jth class is proposed.

Reinterview on one of the dimensions is conducted in order to estimate the classification probabilities. Two kinds of reinterview procedures are performed by the U.S. Bureau of the Census in the Current Population Survey. In the first kind, the reinterviewers are not given the original responses. In the second kind, the original responses are given to the reinterviewers and a reconciliation is made after the responses are collected in the reinterview. The Gauss-Newton procedure for the nonlinear model is used to estimate the parameters of the classification model from data collected in the three interviews.

The determination of the optimal number of replicates to observe for the estimation of the simple errors-in-variables model is considered. It is assumed that the cost of obtaining an observation is the same for every unit. For a fixed total cost, the optimal ratio of the number of units with duplicated observations to the total number of units is obtained by minimizing the variance of the estimator of the slope in the simple linear errors-in-variables regression model. Extension of replicated designs to three observations per unit is considered under the condition that all the units in the sample are observed twice. Tables of optimal designs are constructed for some specific values of the parameters of the model. The optimal design for the case where the observed values are dichotomous is also considered.

Harter, Rachel Margaret. Small area estimation using nested-error models. Ph.D. thesis, Iowa State University Library. December 1983.

A prediction approach to small area estimation is presented. The procedure uses survey and auxiliary data and is based on the assumption of a nested-error model. The mean squared error and the mean squared conditional bias of the predictor are given. Under the nested-error model, the best linear unbiased predictor of the small area mean has the form of a James-Stein estimator.

Estimators for the variance components of the nested-error model are suggested. A generalized least squares procedure is given for constructing estimators of the variance components given prior estimators of the components. The asymptotic distribution of the estimated generalized least squares estimator of the fixed effects is presented and the approximate mean squared error of the predictor is derived.

The Statistical Reporting Service of the U.S. Department of Agriculture (USDA) collects data on hectares of crops in the June Enumerative Survey. Auxiliary data from LANDSAT satellites is available for the same areas. The prediction procedure for the homogeneous nested-error model is illustrated by using the USDA and LANDSAT data to predict corn and soybean hectares for 12 Iowa counties. The prediction procedure for the heterogeneous nested-error model is illustrated by estimating the percentage of urban acres in five Alabama counties.

Hung, Hsien-Ming. Use of transformed LANDSAT data in regression estimation of crop acreages. Ph.D. thesis, Iowa State University Library. December 1983.

This study investigates the use of function of a vector $\underline{X}$ as auxiliary variables in the regression estimation of the population mean with survey data. Functions of the vector $\underline{X}$ are estimated by estimating the unknown parameters of the transformation. Under certain assumptions, the error in the estimated parameters is order $n^{-1/2}$, where n is the sample size. The effect of estimating the auxiliary variables is investigated under the assumption that the finite population is a random sample of an infinite population. Asymptotic properties of regression estimators of the finite population mean constructed with estimated auxiliary variables are developed.

The U.S. Department of Agriculture (USDA) uses satellite (LANDSAT) data to improve crop acreage estimates. LANDSAT data consist of a vector $\underline{X}$ of four radiation values in four wavelength bands of the electromagnetic spectrum. Based on these data, the USDA has developed a classification function for use as an auxiliary variable. In this study, other transformations of LANDSAT data are considered. The estimated posterior probability that a point with a satellite value of $\underline{X}$ is from crop j is developed as one auxiliary variable. Based on the estimated probability, a "classification rule" is constructed as another auxiliary variable.

Data collected in northern Missouri by USDA are used in the study of alternative auxiliary variables. Two regressions are computed to evaluate the auxiliary variables. The first regression uses the individual pixels as observations, where a pixel is the unit of observation for the satellite data. In the second regression, both the dependent variable and the independent variable are constructed by summing pixel values over all the pixels in a segment, where the segment is the primary sampling unit in the survey. The estimated posterior probability transformation performs considerably better than the classification functions in the pixel regressions, but the posterior probability is only marginally superior to the classification function in the segment regressions.

An estimator of the variance of the regression estimator based on an estimated auxiliary variable can be constructed using asymptotic theory. A form of the jackknife estimator of variance is compared with the estimator based on asymptotic theory. For a sample of 45 segments, it is estimated that the estimator based on the asymptotic formula underestimates the variance by 10 to 20 percent.

Lee, Youngjo. Estimation of multivariate normal mean and its application to mixed linear models. Ph.D. thesis, Iowa State University Library, December 1983.

Let $\underline{X} = (x_1, x_2, ..., x_p)'$ be a multivariate normal random variable with mean vector, $\underline{\theta}$, in a space $\oplus$, and variance matrix I. From Strawderman's class of estimators [*Annals of Mathematical Statistics* 42 (1971) 385-388], we derive a minimax admissible estimator for $\underline{\theta}$. It has a relatively simple form when p is greater than or equal to five. We also extend Stein's technique [*Proceedings of the Prague Symposium on Asymptotic Statistics* (1973) 345-387] to evaluate unbiased estimators of risks for discontinuous estimators. Then we show the exact risks of a preliminary test estimator and of compromised or mixture estimators. We develop estimators that shrink towards some subspace of $\oplus$ and show the relationship between shrinkage functionals and variance component estimators in balanced mixed linear models. We also investigate the asymptotic behavior of shrinkage estimators. By choosing an appropriate subspace, we show that our estimator and ridge regression estimators achieve stability of prediction in a particular data example.

Lewis, Jerry Wayne. Some effects of subdivision of finite populations on genetic diversity measures. Ph.D. thesis, Iowa State University Library, December 1983.

Random genetic drift and mutation in subdivided populations are considered in terms of the infinite-alleles Wright-Fisher model. Moments of the multi-dimensional frequency spectrum of order n correspond to probabilities of identity for n genes drawn from specified subpopulations. Recursions are developed for moments of arbitrary order.

Several authors have studied the second moments of frequency spectrums for certain population structures. They point out that these second moments can be used to approximate expectations, under the neutrality hypothesis, of some common measures of genetic identity and distance. In the present work, fourth moments and related probabilities are used to approximate variances of these measures. Specific examples are given for two demes, the island model, and the circular stepping stone model.

It stands to reason that the effects of subdivision should vanish if there are large rates of migration among the demes. An analytic proof of this result has recently been given by T. Nagylaki [*Journal of Mathematical Biology* 9 (1980) 101-114]. This result is confirmed, and the effects of smaller migration rates are studied for certain population structures. Even when the population as a whole is not effectively panmictic, the individual subpopulations are, although their effective sizes may be considerably larger than their actual sizes. Moreover, it seems that the distribution of genes in k of the P subpopulations is similar to that of a population with exactly k subpopulations, where the deme sizes and migration rates are so chosen as to give the same second moments of the frequency spectrum as those from the original population.

Since the distribution of genes can be approximated in this fashion, variances of the genetic identity or distance between two demes of an arbitrary subdivided population can be approximated using a two deme model with appropriate effective migration, mutation, and size parameters. Similarly, when the appropriate effective parameters can be found, covariances of distance can be approximated via a four deme model.

Lin, Cherng-Tarng (Tony). Waiting times for target detection models. Ph.D. thesis, Iowa State University Library, July 1983.

A modification of the traditional traveling salesman problem is made to relate to the development of optimal search strategies. The modification involves inserting "capture" probabilities at the "cities" to be visited, and adapts the traditional dynamic programming algorithms to this added stochastic feature. A countably infinite version of this stochastic modification also is formulated, for which typical ingredients of infinite dynamic programs are explored. These include: the convergence of the optimal value function, Bellman's functional equation, and the construction of optimal (in this case only conditionally optimal) strategies.

Visual search is a process involving certain deterministic, as well as random, components. This idea is incorporated into a second search model for which the expected value, variance, and distribution of search time are computed, and also approximated numerically. A certain accelerated Monte Carlo method is discussed in connection with the numerical approximation of the distribution of search time.

McNulty, Sallie Ann Keller. Exact generalized inverses and solution to linear least squares problems using multiple modulus residue arithmetic. Ph.D. thesis, Iowa State University Library, July 1983.

The floating point number system on the computer does not accurately model the real number system; consequently, the condition of data and error due to rounding must be considered. A multiple modulus number system, however, is capable of exactly modeling the rational number system. Therefore, with only the assumption that the problem has rational entries,

an exact solution can be sought. Methods are developed that use multiple modulus residue arithmetic to compute exact reflexive and exact Moore-Penrose inverses for an artitrary n × s matrix. The methods are then applied to find exact solutions to linear least squares problems.

An important distinction between working over the field of rational numbers and working over a Galois field generated by the integers (0, 1, 2, ..., p - 1), for prime number p, is made. This enables us to develop the multiple modulus theory necessary to find exact generalized inverses. Exact generalized inverses have been previously computed using single modulus arithmetic; however, the single modulus solution is unsatisfactory from an applied point of view because the size of the modulus necessary to complete the problem is usually too large to fit in a standard computer fixed-point word. Algorithms are developed and implemented that compute these exact generalized inverses and exact solutions to the linear least squares problems.

Petenate, Ademir José. Optimal allocation and other aspects of kriging on a line. Ph.D. thesis, Iowa State University Library, July 1983.

Kriging is a technique that has been used to interpolate a set of observed data points $\{(x_i, z(x_i)); x_i \in DcR^p, i = 1, ..., n\}$. The basic assumption is that the function $z(x)$ is a realization of a stochastic process $\{Z(x); x \in R^p\}$. The relation between kriging and BLUP is shown.

We restrict our attention to covariance stationary stochastic processes, and we discuss the optimal allocation of the points $x_1, ..., x_n$ when $p = 1$ and $D = [0,1]$.

L-spline is another technique that is used for interpolation purposes. Although not always stated explicitly, there is a stochastic process that underlies an L-spline of interpolation such that kriging and L-spline give the same interpolating function. The efficiency of the linear and cubic spline, with regard to kriging, is evaluated for some covariance models that have been used in the geological area. The multiquadric method of interpolation is also compared with kriging.

Zamudio S., Francisco José. Estimation of Poisson parameters: Maximum likelihood, Bayes, empirical Bayes or a compromise? Ph.D. thesis, Iowa State University Library, July 1983.

Maximum likelihood, Bayes, and empirical Bayes estimators are considered for the simultaneous estimation of the means for p independent Poisson random variables $X_1, X_2, ..., X_p$. Let θ_i denote the mean of X_i for each $i = 1, 2, ..., p$. For an estimator $\underset{\sim}{a} = (a_1, a_2, ..., a_p)$ of the vector of means $\underset{\sim}{\theta} = (\theta_1, \theta_2, ..., \theta_p)$, loss functions of the form

$$L(\underset{\sim}{\theta}, \underset{\sim}{a}) = \Sigma_{i=1}^p \theta_i^{-m_i} (\theta_i - a_i)^2$$

are considered, where $\underset{\sim}{m} = (m_1, m_2, ..., m_p)$ is a vector of known nonnegative integers. The maximum likelihood estimator $\underset{\sim}{X} = (X_1, X_2, ..., X_p)$ is admissible when $p = 1$, but it is not admissible for larger values of p. The values of p for which the maximum likelihood estimator is admissible depend on $\underset{\sim}{m}$.

A Bayes estimator for the vector of means is developed using a conjugate prior distribution. A compromise between the Bayes and maximum likelihood estimators is constructed, following the limited translation rule developed by Efron and Morris for normal distributions. The corresponding empirical Bayes estimator is also considered, and a compromise between this estimator and the maximum likelihood estimator is constructed.

The Bayes estimator performs well if the true parameter vector $\underset{\sim}{\theta}$ is sufficiently close to the mode of the prior distribution, but performs poorly, with respect to a componentwise risk criterion, for mean values far from the prior mode. On the other hand, the componentwise estimate for θ_i provided by the maximum likelihood estimator, namely X_i, is minimax with constant risk 1. Consequently a combination of the Bayes and maximum likelihood estimators that favors the maximum likelihood estimator when X_i is far from the prior mode provides an estimator that is more robust than the Bayes estimator against misspecification of the prior parameters. Numerical comparisons of the risks of the Bayes estimator, maximum likelihood estimator, and the estimator based on the limited translation compromise are provided. Numerical comparisons are also made for the empirical Bayes estimator. The estimator based on the limited translation compromise performs better for most situations in both a combined and a componentwise sense. The combined estimation of the means is superior to the componentwise estimation when the means are similar.
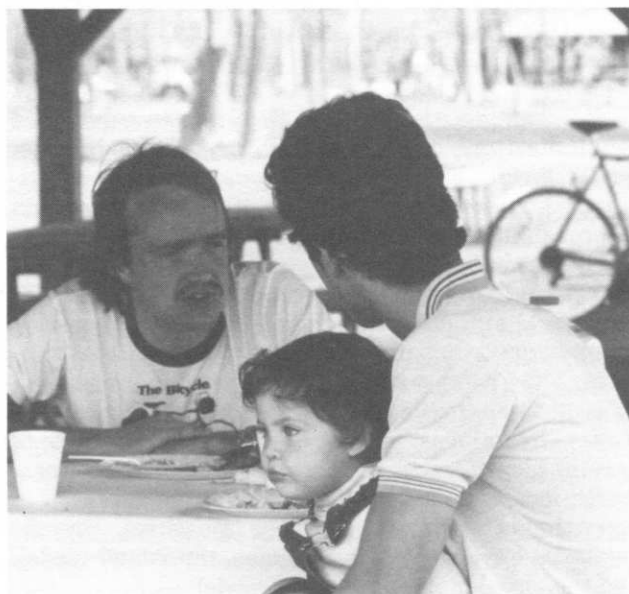
At the traditional spring breakfast in Brookside Park, Jan van Schaik confers with Ronaldo Iachan, while Iachan's daughter, Monica, surveys her surroundings.

Department of Statistics

The Department of Statistics is the teaching arm of the Iowa State University statistical center. Coursework leads to the degrees of Bachelor of Science, Master of Science, or Doctor of Philosophy with major in statistics, through the College of Sciences and Humanities or the Graduate College. A specialized curriculum in biometry, administered by the Department of Statistics, leads to a B.S. degree conferred by the College of Agriculture. In the fall semester, approximately 100 graduate majors and 33 undergraduate majors were enrolled; the latter included five in biometry.

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

Graduate students may specialize in probability, general theory, general methods, linear models, experimental design, survey sampling, statistical computing, operations research, or one of several areas of application. Co-major programs can also be arranged. Students interested in operations research, for example, usually choose to co-major in industrial engineering. More information is given in the brochure, "Iowa State University — Graduate Program in Statistics, July 1984."

The doctoral program is research-oriented and requires completion of a thesis based on independent, creative work. An M.S. candidate may choose either a thesis or a nonthesis option. The latter requires completion of four additional credits, including a "creative component" of at least two credits of individual work.

A new graduate course in spatial statistics, a subject with important applications in geology and ecology, was introduced by Noel Cressie. It covered the areas of continuous spatial variation (geostatistics), lattice models (Markov random fields), and spatial point patterns. It will become a regular offering every two years under Stat. 606.

Departmental courses in quality control and related areas are being expanded and updated under the initiative of Stephen Vardeman. A new course summary developed by C. Philip Cox for Stat. 401 was well received by his students as an alternative to sometimes excessive note taking. Stat. 227, Introduction to Business Statistics, remained the most popular of the undergraduate introductory courses, continuing to show a rise in enrollment. However, because of budget restrictions, 250 students were excluded from 100-level statistics courses in the spring.

Jerome Sacks organized and helped present a four-day short course in SAS for local USDA-ARS personnel in March. There were 58 participants. Stephen Vardeman taught two one-week short courses in June, on statistics for quality and productivity, to M.S.- and Ph.D.-level statisticians and engineers of Hewlett-Packard Corporation in Palo Alto and Santa Rosa, California.

Stat. 401, besides being given on-campus, was offered as an off-campus credit course in Rock Island, Illinois, through the ISU Extension Office of Continuing Education. Mack Shelley flew from Ames weekly between January 25 and May 2 to teach at the Quad Cities Graduate Center, primarily to reach students working toward the degree of Master of Public Administration.

Committee work is always a necessary and important function in a department. Such activity in 1983-84 at the college and university levels involved the following: In the College of Sciences and Humanities, Wayne A. Fuller chairs the Tenure and Promotion Committee; Shelley, the Individual Major Review Board; Leroy Wolins, the Long-range Planning Committee. Donald Hotchkiss is on the Advising Committee and the Committee on Instruction, Ronaldo Iachan the Honors Program Committee, William J. Kennedy the Computer Advisory Committee, Kenneth J. Koehler the Physical Facilities Committee, and Glen Meeden the Faculty Development Comittee. William Q. Meeker, Jr. is a member of the newly constituted Policy Advisory Committee. Theodore Bailey is the college representative in Phi Kappa Phi.

In the Graduate College, Kennedy serves on the Computation Center Advisory Committee, and Meeker on the Business Administrative Sciences Committee. Kevin Kramer was chosen by the Graduate Student Senate to serve, as one of three student members, on the Graduate Council for 1983-84. All-university committee members include Kennedy on the Academic Affairs Computer Advisory Committee and the Committee for Microcomputers. Shelley is the Iowa State University Official Representative to the Inter-University Consortium for Political and Social Research.

Course offerings for the 1983-84 academic year and the 1984 summer session are listed below. The summer session for 1983 was covered in the last annual report.

1983-1984 Course Offerings in Statistics

Courses for Undergraduate Students Only

100	Orientation in Statistics and Biometry	R	F	Stephenson
101	Principles of Statistics	4	F,S	Beam Jeske Martin Stephenson
104	Introduction to Statistics	3	F,S,SS C.P. Cox Hotchkiss C. Lee Oñate	Schnell Sukhatme Wagner Wolfgram
105	Introduction to Statistics	2	F,S Amemiya Iachan Stephenson	Sukhatme Vardeman

227	Introduction to Business Statistics	4	F,S,SS		
			Connor	McCoy	
			Cook	Meeker	
			Crowder	Oñate	
			Jensen	Ostrouchov	
			Jobe	Rogers	
			King	Shelley	
			Kramer	Silvis	
228	Applied Business Statistics	3	F,S	Groeneveld Meeker Silvis	
231	Probability and Statistical Inference for Engineers	4	F,S	Cassell Meeden Vardeman	
305	Engineering Statistics	3	S	Vardeman	
341	Introduction to Theory of Probability and Statistics	3	F,S	Groeneveld Stephenson	
342	Introduction to Theory of Probability and Statistics	3	S	Groeneveld	

Courses for Graduate Minors and Undergraduates

401	Statistical Methods for Research Workers	4	F,S,SS		
			Bailey	Hotchkiss	
			Cook	Lorenz	
			C. P. Cox	Reiser	
			D. F. Cox	Shelley	
			Hickman	Strahan	
402	Statistical Design and the Analysis of Experiments	3	S,SS	D. F. Cox & Hinz Koehler Marasinghe Wolins	
404	Statistics for the Social Sciences	3	F	Lorenz	
405	Applied Econometric Statistics	3	S	Hickman	
407	Methods of Multivariate Analysis	2	F	Koehler	
421	Survey Sampling Techniques	3	S	Iachan	
436	Genetic Statistics for Research Workers	3	F	Bailey	
446	Statistical Theory for Research Workers	2	F	Goebel	
447	Statistical Theory for Research Workers	3	S,SS	Amemiya	
451	Applied Time Series	3	S	Meeker	
480	Statistical Application of Digital Computers	3	F	Marasinghe	
481	Computer Processing of Statistical Data	3	S	Bubolz & Marasinghe	
490	Independent Study	Var.	F,S	Bubolz Stephenson Wolins	

490H	Independent Study — Honors	2	F	Hotchkiss

Courses Primarily for Graduate Students, Major or Minor

500	Statistical Methods	4	F	Hinz
501	Multivariate Statistical Methods	3	S	Koehler
511	Theory and Application of Linear Models	3	S	Harville
512	Design of Experiments	3	F	Jones
521	Theory of Sample Surveys I	3	S	Iachan
533	Reliability	3	S	H. T. David & Meeker
536	Genetic Statistics	2	F	Pollak
537	Genetic Statistics	2	S	Pollak
538	Econometric Statistics	3	F	Fuller
539	Game Theory	3	F	H. T. David
540	Operations Research Methods and Economic Analysis	3	S	Sposito
542	Theory of Probability and Statistics	3	F	Athreya
543	Theory of Probability and Statistics	3	S	Cressie
544	Bayesian Decision Theory	3	SS	Meeden
579	Introduction to Computer Hardware and Software Systems for Statistical Computing	1	F	Kennedy
580	Statistical Computing	3	F	Kennedy

590	Special Topics A. Theory	Arr	F,S,SS		
			Athreya	Pollak	
			H. T. David	Vardeman	
			Fuller		
	B. Methods		F,S,SS		
			Amemiya	Lorenz	
			D. F. Cox	Meeker	
			H. T. David	Shelley	
			Hinz	Stephenson	
			Kennedy	Sukhatme	
			Koehler		
590	Special Topics C. Design of Experiments	Arr	F	Hotchkiss Sacks	
	D. Design of Surveys		S,SS	Amemiya Fuller Iachan	

Yasuo Amemiya has teaching and research interests in the fields of multivariate analysis and regression analysis.

Courses for Graduate Students, Major or Minor

601	Advanced Statistical Methods	3	F	C. P. Cox
611	Advanced Linear Model Theory	3	F	Harville
612	Advanced Design of Experiments	3	S	Jones
642	Measure Theory and Probability	3	S	Isaacson
643	Theory of Estimation and Testing of Hypotheses	3	F	Meeden
645	Order Statistics	3	F	H. A. David
647	Multivariate Analysis	3	F	Amemiya
648	Seminar on Theory of Statistics and Probability (Spatial Statistics)	3	S	Cressie
	(Recent Advances in Asymptotic Theory)	1	SS	Ghosh
651	Time Series	3	S	Fuller
699	Research	Var	F,S,SS	

Athreya	Kennedy
H. A. David	Koehler
H. T. David	Marasinghe
Fuller	Meeden
Harville	Pollak
Iachan	Sposito
Isaacson	Strahan
Kempthorne	Vardeman

Graduate Students

During the fiscal year, nine Ph.D. degrees, including one for a joint major, and 23 M.S. degrees were earned in the Department of Statistics. Abstracts of Ph.D. dissertations appear in the Publications section, pp. 30-32. The masters' degrees were conferred on a nonthesis basis, with candidates each completing a creative component based on independent study. Employment or further educational plans are indicated for the degree recipients insofar as possible. An asterisk identifies students who chose to remain at Iowa State to work toward doctorates in statistics.

M.S. Recipients

Yasmin Abdulaziz (Fall 1983, under S. Sukhatme) returned to Malaysia.

*Edi Abdurachman (Summer 1983, under J. Jeffery Goebel)

Mohamed Isa Ab-Ghaffar (Fall 1983, under Donald K. Hotchkiss) is teaching in the Department of Mathematical Sciences & Computing, Mara Institute of Technology, in Shah Alam, Selangor, Malaysia.

Craig Allen Beam (Summer 1983, under Glen Meeden) joined Trilogy Corporation, a consulting firm, and has been working as consulting statistician at Abbott Laboratories, in Waukegan, Illinois.

Bruce Warren Diiro (Fall 1983, under D. F. Cox) has accepted a position with Rockwell International as industrial statistician, Statistical Process Control, in the Rocky Flats Plant, Golden, Colorado.

David William Jacobson (Fall 1983, under W. Robert Stephenson) is an associate engineer with IBM Corporation, Laboratory Operations Systems, Rochester, Minnesota.

Shawn Dean Jacobson (Fall 1983, under Mack C. Shelley II) is a mathematical statistician in the Office of Employment and Unemployment, U.S. Bureau of Labor Statistics, Washington, D.C.

Kevin R. Kramer (Spring 1984, under Stephen B. Vardeman) is working for 3-M Corporation, Hutchinson, Minnesota, as quality engineer, Magnetic Audio-Visual Products.

Jason Richard Jones (Spring 1984, under William Q. Meeker, Jr.) accepted a position as associate statistician, Loads and Strengths Department, General Motors Proving Grounds, Milford, Michigan.

Arunee Kumlung (Summer 1983, under Glen Meeden) is working toward a Ph.D. in education, specializing in research and evaluation, at Iowa State.

*Sharon Kay Loubert (Fall 1983, under William Q. Meeker, Jr.).

David Edward Martinich (Spring 1984, under William Q. Meeker, Jr.) joined AT&T Laboratories, Holmdel, New Jersey, as statistical consultant.

Jerome Bernard Paulissen (Fall 1983, under Paul N. Hinz) continued graduate studies in forestry at Iowa State.

David Duane Pohl (Spring 1984, under Paul N. Hinz).

*Daniel James Schnell (Fall 1983, under Wayne A. Fuller).

Steven Jay Schuelka (Fall 1983, under Stephen B. Vardeman) is a statistical consultant at the Inland Steel Company, Indiana Harbor Works, in East Chicago, Illinois.

*David Lee William Silvis (Summer 1983, under Kenneth J. Koehler).

Hon Richard Tachia (Summer 1983, under Stephen B. Vardeman) began work toward a doctorate in statistics at Oklahoma State University.

Sergio Torreblanca-Cortes (Fall 1983, under Kenneth J. Koehler) returned to Mexico City, Mexico to teach as professor of statistics and mathematics in the Department of Economics, Universidad Panamericana.

Stavroula Tsoukou (Fall 1983, under Mack C. Shelley II) has continued graduate studies at Iowa State in political science.

Kanlaya Vanichbuncha (Summer 1983, under Ronaldo Iachan) is working on a doctoral program at the University of Georgia.

Hugh Kennedy Voigt (Spring 1984, under William Q. Meeker, Jr.) joined IBM Corporation, Minneapolis, Minnesota, as systems engineer.

Jin-ying Yu (Spring 1984, under Jerome M. Sacks) is a statistician and programmer at IT&T in San Francisco, California.

Ph.D. Recipients

Tin Chiu Chua (Summer 1983, under Wayne A. Fuller) is an assistant professor, Department of Mathematical Sciences, University of South Dakota.

Rachel Margaret Harter (Fall 1983, under Wayne A. Fuller) is working as statistician with A. C. Nielsen Company in Northbrook, Illinois.

Hsien-Ming Hung (Fall 1983, under Wayne A. Fuller) was appointed assistant professor in statistics and mathematics at the University of Minnesota-Morris.

Youngjo Lee (Fall 1983, under Oscar Kempthorne) has been a visiting assistant professor, Department of Statistics, Oregon State University.

Jerry Wayne Lewis (Fall 1983, under Edward Pollak) continues as assistant professor in the Department of Agronomy, Louisiana State University.

Cherng-Tarng (Tony) Lin (Summer 1983 in statistics and engineering valuation, under Herbert T. David and Keith L. McRoberts) is an assistant professor in the Department of Industrial & Systems Engineering, General Motors Institute, Flint, Michigan.

Sallie Ann Keller McNulty (Summer 1983, under William J. Kennedy, Jr.) joined the University of North Carolina at Greensboro as assistant professor in the Department of Mathematical Sciences.

Ademir José Petenate (Summer 1983, under Oscar Kempthorne) returned to Brazil as assistant professor of statistics, Universidade Estadual de Campinas/IMECC.

Francisco José Zamudio S. (Summer 1983, under Malay Ghosh), resumed his position as professor, Departmento de Irragacion, Universidad Autonoma Chapingo, in Mexico.

M.S. Candidates

Abbas, Bahtiar S.
Abdella, Blake
Abdulaziz, Yasmin
Ab-Ghaffar, Mohamed
Baradwaj, Babu G.
Bicek, Thomas
Bondioli, Tammy
Borders, Thomas A.
Bryan, Mark F.
Calcaño-Collazo, José
Chae, Seong-San
Chang Yang, Min-Shih
Chien, Keng-tang
Connor, Carolyn
Cook, John R.
Diedhiou, Mamadou L.
Diiro, Bruce W.
Giacobello, Gloriana
Gunderson, Mark
Ha, In Hye
Hasab-el-Naby, Nancy Eyink
Hensen, Donna C.
Homblé, Patrick
Hsieh, Chihho
Huang, Shun-Chuen
Hulting, Frederick
Hwang, Ching-Chang
Jacobson, David
Jacobson, Shawn D.
Jensen, Karen L.
Jones, Jason R.
Kang, Yoou-Jen
Khan, Mohammad I.
Kim, Byung Hwee
Kramer, Kevin
Kumlung, Arunee
Lee, Mong-Hong
Lin, Jyh-Shiun
Lui, Anthony Yuk-Leung
McCoy, Douglas E.
Martinich, David
Mehailia, Abdelghani
Miller, Stephen M.
Morel, Grecia F.
Paulissen, Jerome
Pohl, David D.
Ray, Di-ou
Redmond, Cleve R.
Schuelka, Steven J.
Scott, Margaret
Tachia, Hon Richard
Thompson, John C.
Tirol, Miriam B.
Tollefson, Margot H.
Torreblanca, Sergio
Tsay, Yan-Ling
Tsokou, Stavroula
Vanichbuncha, Kanlaya
Vijithakumara, Tilaka
Vilendrer, Steven P.
Voigt, Hugh
Wagner, Annette
Winters, Franklin
Wolfgram, Danny A.
Wu, Peh-Jen Jenny
Yu, Jin-ying
Zakaria, Rahmat Syahni

Nondegree Students

Abdul-Halim, Rosmawati
Heymans, Ricardo
Seyed Sadr, S. Mahmoud

Ph.D. Candidates

Abdurachman, Edi
Anderson, Kevin K.
Arnold, Robert J.
Beam, Craig A.
Brozovsky, Paul Victor
Callanan, Terrance P.
Cassell, David L.
Chang, Stephen Fu-Chung
Chua, Tin Chiu
Crowder, Lee Ann
    (joint statistics-industrial engineering)
Crowder, Stephen V.
Da Yang
    (joint statistics-animal science)
Farmer, Charles M.
Francisco, Carol A.
Funo, Eiichiro
Gan, Fah Fatt
Guerrero, Margarita
Harter, Rachel
Hsu, Shih-Jian
Hung, Hsien-Ming
Jeske, Daniel R.
Jobe, John Marcus
Kim, Byung Chun
King, Ronald D.
Kinyon, Lawrence
    (joint economics-statistics)
Lee, Carl Moun-Shen
Lee, Youngjo
Lewis, Jerry W.
Lin, Cherng-Tarng (Tony)
    (joint industrial engineering-statistics)
Lin, Tsung-Hua (Tom)
Loubert, Sharon K.
McGovern, Paul
    (joint psychology-statistics)
McNulty, Mark
    (joint agricultural economics-statistics)
McNulty, Sallie Keller
Martin, Cindy Lynn
Mazloum, Reda
Miazaki, Edina
Morel, Jorge
Nagaraj, Neerchal K.
Nanayakkara, Nuwan
Oñate, Julia
Ostrouchov, George
Pareja, Gilda
Park, Byung Sul
Petenate, Ademir
Ramírez C., Juan Esteban

Rogers, Michael P.   van Schaik, Jan
Saad Eldin, Saad Eldin M.   Wilson, Jeffrey R.
Schnell, Daniel J.   Yoon, Byoung Chang
Silvis, David L.   Zamudio S., Francisco
Tveite, Michael   Zimmerman, Dale L.

The cooperative internship program arranged with Weyerhaeuser Co. continued for another year. Tammy Bondioli spent her fall semester working at Weyerhaeuser's Forest Paper Products center in Hot Springs, Arkansas.

Blake Abdella, Kevin Anderson, Jason Jones, David Martinich, and Neerchal Nagaraj were inducted into Phi Kappa Phi honor society in March.

Gilda Pareja was one of three university students chosen to receive the Elizabeth Hoyt Scholarship, awarded to international students in their final, dissertation-writing year.

Iowa STAT-ers

This last year was viewed as a banner year by Iowa STAT-ers, the statistics graduate student organization. It began with two well-attended social events, a summer picnic at Hickory Grove Park and the traditional fall pizza party, which welcomes new statistics students to Ames. During the semesters that followed, students were privileged to hear seminars by Kenneth Koehler, H. T. David, Noel Cressie, Paul Hinz, David Cassell, Dan Schnell, and Carl Lee. These events were organized by Dan Jeske. An updated 12-page picture directory of faculty, staff, and graduate students was prepared and distributed by Jorge Morel and Lee Ann Crowder, with special assistance from Annie Callanan.

Cindy L. Martin won the coveted STAT-ers Teaching Award, for best undergraduate teacher. Dean Isaacson won the graduate teaching equivalent, the Windex Award. Finally, STAT-ers Secretary of the Year Award went to Julie Honeick.

In June 1984 the Iowa STAT-ers Volunteer Consulting Service metamorphosized into STACON, the Statistical Consulting Service. After experimenting

The spring pizza party is traditionally given by graduate students who successfully passed prelims or final degree exams during the year.

with short-term consulting for a year, the board of directors voted to branch into longer-term consulting.

On the social side, several Movie Nights provided opportunities for STAT-ers to get together. The 1st Annual George Ostrouchov Memorial Bake Off and Social (GOMBOS) also proved to be a success; statistics, family environment, home economics education, chemistry, and computer science students joined forces to create a sumptuous feast.

During the Statistical Laboratory Winter Party, STAT-ers played a key role; they kept the audience spellbound with an original production by Robert Arnold, Noel Cressie, Cindy Martin, Jean Ann Memken, Dan Schnell, and Margot Tollefson. Industrial Light & Magic supplied the special effects.

The final social event, the spring pizza party, was hosted by students who had passed doctoral prelims or masters' examinations during the year. It drew a large crowd of graduate students, faculty, staff, and their families.

Iowa STAT-ers officers and committee members for the year were: Michael Rogers, president; Charles Farmer, vice president-secretary; Dan Jeske, treasurer; Robert Arnold, faculty meeting representative; Terrance Callanan, Cindy Martin, Dan Jeske, Kevin Anderson, Craig Beam, Dan Schnell, and Dale Zimmerman. Kenneth Koehler is faculty adviser.

Snedecor and Bancroft Awards

Daniel Robert Jeske was chosen as recipient of the 1984 George W. Snedecor Statistics Award, given each year to the most outstanding Ph.D. candidate in the Department of Statistics. The award consists of a year's membership in the Institute of Mathematical Statistics and a cash prize. It was established in 1954 to honor George W. Snedecor, internationally recognized pioneer in applied statistics, who was founder and first director of the Statistical Laboratory.

Jeske, who comes from Winton, California, received the B.S. degree at Austin Peay State University and an M.S. degree in statistics at Iowa State. He has worked in the statistical consulting program of the Agriculture and Home Economics Experiment Station since September 1980 and has taught introductory statistics.

Jane Ellen Gerloff was named as winner of the 1984 T. A. Bancroft Statistics Award, on the basis of outstanding performance as a doctoral candidate minoring in statistics. Gerloff, a research assistant in the Department of Agronomy from Woodstock, Illinois, is majoring in plant breeding and cytogenetics. She received her B.S. degree at Michigan State University in crop and soil science.

The award honors T. A. Bancroft, professor emeritus and former director and head of the Statistical Laboratory and Department of Statistics. It consists of a cash prize and a subscription to a statistically-oriented journal of the awardee's choice.

Both awards were presented on February 29 at the regular Statistical Laboratory seminar.

B. V. Sukhatme Memorial Lectures

The fourth B. V. Sukhatme Memorial Lecture was presented in October by V. P. Godambe, professor in the Department of Statistics and Actuarial Science, University of Waterloo, Canada. He spoke on "Survey sampling: Modeling, randomization, and robustness." Godambe has made major contributions to survey sampling theory.

Graham Kalton

The fifth lecture in the series that honors the late B. V. Sukhatme, professor of statistics at ISU from 1968 to 1979, was presented in April by Graham Kalton, speaking on "Questioning effects in surveys." Professor of biostatistics and research scientist in the Institute for Social Research, University of Michigan, Ann Arbor, Kalton is active in survey research and in survey practice.

George Zyskind Memorial Lecture

The ninth George Zyskind Memorial Lecture was given in November by Colin L. Mallows, who has been head of the Statistical Models and Methods Research Department, AT&T Bell Laboratories, Murray Hill, New Jersey, since 1969. His topic was "The relevance of robustness." Mallows has made significant contributions to data analysis and other areas of statistics and probability. The Zyskind lecture series honors the late George Zyskind, statistics professor at ISU from 1959 to 1974.

Gerald J. Hahn

Mu Sigma Rho

The local chapter of the Mu Sigma Rho statistics honor society held its annual lecture on April 10, 1984. The invited speaker was Gerald J. Hahn, manager, Statistics Program, Corporate Research and Development, General Electric Company, Schenectady, New York. His talk was entitled "A week in the life of an industrial statistician."

Immediately preceding the lecture was the annual Mu Sigma Rho banquet and spring meeting, which included initiation of 24 new members and Dr. Hahn as an honorary member. New members included eight undergraduates, 12 graduate students, and four faculty members. Elected officers for the 1984-85 academic year were also introduced: Jorge Morel, president; Lee Ann Crowder, vice president; Carol Francisco, secretary-treasurer. Yasuo Amemiya agreed to continue as the chapter's faculty adviser.

Cindy L. Martin, a Ph.D. candidate in statistics, received the 1984 Mu Sigma Rho Award for academic excellence and service to the department.

Undergraduates

Statistics and biometry majors were the recipients of a number of awards during the year. Sarah Arterburn and Eric Grau (biometry) were initiated into the Phi Kappa Phi honor society at the annual banquet on March 8, 1984. Arterburn was also initiated into Phi

Beta Kappa at ceremonies on April 16. Gene Nelson (biometry), Samphone Rasavanh, and Lay-Ying Song were chosen as members of Mu Sigma Rho on April 10. Wendy Iverson was chosen for Lampos, the Sciences and Humanities honorary society, during the fall term. She also received a Laura Vernon Scholarship at ceremonies during Veishea and was initiated into Mortar Board on May 4. At the university Scholarship Recognition Dinner on May 8, Sarah Arterburn was recognized as the high scholarship graduate in statistics.

Ten students received B.S. degrees during the period July 1, 1983 to June 30, 1984 — seven with statistics majors, two with joint majors in statistics and another field, and one in biometry. Where known, the future employment or other plans are indicated below.

Sarah Jane Arterburn (Spring 1984, statistics) is a statician with the General Motors Proving Grounds, Milford, Michigan.

Debra Jean Haglund (Fall 1983, statistics) is a statistical analyst with the American Security Insurance Group, Atlanta, Georgia.

Christine Carol Jensen (Spring 1984, statistics) has accepted a position with Mayo Clinic, Rochester, Minnesota.

Yam Wa Lo (Spring 1984, joint with mathematics) is returning to Hong Kong.

Ibrahim Bin Md-Said (Spring 1984, statistics).

Kamarudzman Mohd-Kasby (Fall 1983, statistics) is a graduate student in applied mathematics at Western Michigan University, Kalamazoo, Michigan.

Gene Orlan Nelson (Spring 1984, biometry).

Cynthia Ann Squire (Spring 1984, joint with biology).

Kathleen Marie Taylor (Spring 1984, statistics) is a statistical analyst with Air Products and Chemicals, Inc., in Allentown, Pennsylvania.

Steven James Wall (Spring 1984, statistics) is a statistical technician with Pioneer Hi-Bred International, Inc., Johnston, Iowa.

Under a cooperative agreement between Weyerhaeuser Co., Hot Springs, Arkansas and the Department of Statistics, Eric Grau spent the spring semester and part of the summer as a trainee with the company.

Continuing service as academic advisers for undergraduate students were Richard Groeneveld, Donald Hotchkiss, William Meeker, W. Robert Stephenson, and Shashikala Sukhatme.

Statistics Club

Through activities, both social and educational, the Statistics Club tries to promote interest among undergraduates in the field of Statistics. Several social events during the year gave old and new members of the club the opportunity to meet with faculty members and to get better acquainted with each other. These events included a pizza party in September, an evening of ice skating in March, and a pizza party in May to thank all those who helped with the Veishea display.

At the first business meeting of the second semester several students who had had summer jobs relating to statistics shared their experiences with other club members. Sarah Arterburn was involved in a summer internship with IBM in Rochester, Minnesota. Besides collaborating on short articles on statistics for a newsletter, she was involved in a project to develop expert programs for statistical analysis. The Iowa State Commerce Commission in Des Moines again hired a statistics major for the summer. Christine Jensen worked on data analysis of the cost of utilities in the state. Kathleen Taylor told the club about her work as a data analyst for Centocor in Malvern, Pennsylvania. Taylor worked on the analysis of data from clinical trials of health maintenance equipment. Discussion followed on how to go about getting a summer job, and possible summer employers were mentioned.

Several members of the club had the opportunity to have lunch with Gerald Hahn of the General Electric Company, when he visited the campus to present the Mu Sigma Rho Lecture. Hahn discussed opportunities in industry for those trained in statistics.

The club traveled north to Austin, Minnesota to visit the George A. Hormel & Co. on April 27. After a brief tour of the corporate offices several people gave
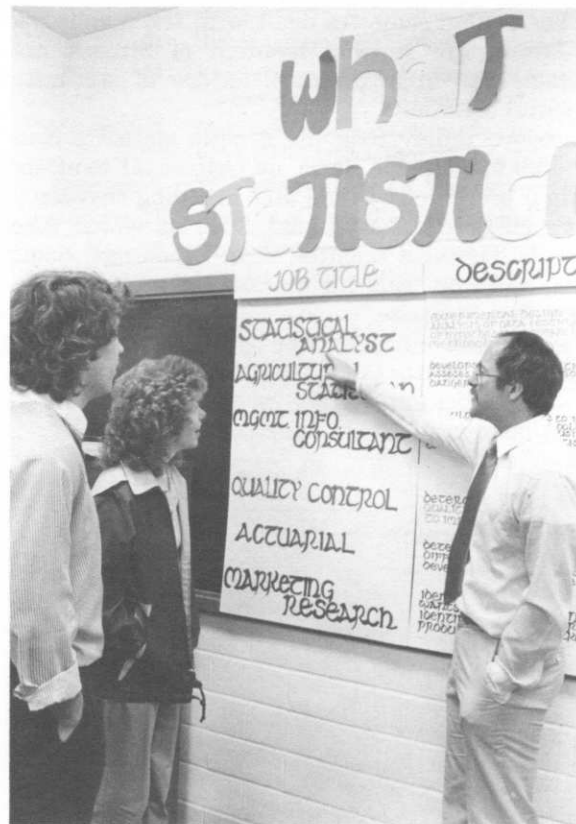
Danny Wolfgram, Christine Jensen, and W. Robert Stephenson discuss career choices during the departmental open house for Veishea, ISU's campuswide spring celebration.

presentations on the use of statistics in operations research, marketing research, and quality and process control. The club wishes to thank Robert Wells, vice president, for arranging for the trip.

This year's Veishea Open House display entitled "Prediction: More than guesswork," explained linear regression. A computer program was used to predict a person's height based on his/her armspan and sex. Visitors also learned what statisticians do and about career opportunities. A certificate from the Veishea Open House Display Committee recognized the club's participation this year.

Holly Hoegh and Jean Wells were chosen to be co-recipients of the 1984-85 Statistics Club Scholarship. The following were elected officers for 1984-85:
  president: Holly Hoegh
  vice president: Wendy Iverson
  treasurer: Jean Wells
  secretary: Jill Redmond.
W. Robert Stephenson serves as faculty adviser to the Statistics Club.

Seminars

Krishna Athreya ran a year-long noncredit seminar on stochastic differential equations with W. Kliemann of the Department of Mathematics, primarily for faculty members in mathematics and statistics. The first semester was devoted to basic ideas of Brownian motion and Ito stochastic integrals and stochastic differential equations in one dimension. The second semester dealt with the martingale formulation, the support theorem of Stroock and Varadhan, and approximate solutions of stochastic differential equations.

Theodore Bailey took his genetic statistics class (Stat. 436) to Johnston, Iowa, on October 11 to attend a seminar presented by the Plant Breeding Division of Pioneer Hi-Bred International, Inc., at which Alex Kahler, USDA-ARS scientist from Brookings, South Dakota, spoke on "Enzyme marker loci and quantitative genetics in maize."

The program of regular weekly noncredit seminars offered by the Statistical Laboratory and the Department of Statistics for the 1983-84 year was planned by Yasuo Amemiya, H. T. David, and H. A. David. Topics and speakers follow.

Statistical Laboratory Seminars

Summer 1983

July 25	Small area estimation using nested-error models and auxiliary data, Rachel Harter
27	Use of transformed LANDSAT data in regression estimation of crop acreages, Hsien-Ming Hung

Fall 1983

August 31	Statistical societies, H. A. David
September 7	Weak convergence under random stopping, Chang C. Y. Dorea, Universidade de Brasilia and Iowa State University
12	Detection of multiple outliers in linear regression, Mervyn Marasinghe
September 21	Bayes and admissible set estimation, Glen Meeden
28	Two-sample nonparametric tests based on subsamples, W. Robert Stephenson
October 5	Exchange and interchange procedures to search for optimal designs, Byron Jones, University of Kent at Canterbury, England, and Iowa State University
11	Robust estimation through estimating equations, V. P. Godambe, University of Waterloo, Ontario, Canada (co-sponsored by the Iowa chapter, American Statistical Association)
17	Response of the statistician in the public interest, Fred C. Leone, American Statistical Association
19	Levels of null persistency for Markov chains, Dean L. Isaacson
26	Robust/resistant analysis of geostatistical data, Noel Cressie
November 2	Inference from stratified samples, Chien-Fu Jeff Wu, University of Wisconsin-Madison
9	Confidence intervals for a variance ratio, or for heritability, in an unbalanced mixed linear model, David A. Harville
16	Nonstandard order statistics, Colin L. Mallows, AT&T Bell Laboratories, Murray Hill, New Jersey
30	Assessing the fit of log-linear models in large, sparse contingency tables, Kenneth J. Koehler
December 7	Large, sparse least squares computations, George Ostrouchov

Spring 1984

January 18	Optimal filtering and detection theory (or an engineer's warped viewpoint on Bayesian estimation and hypothesis testing), R. Grover Brown, Department of Electrical Engineering, Iowa State University
25	Exact and 2nd-order asymptotic theory in GLS estimation with estimated covariance parameters, Yasuyuki Toyooka, Osaka University, Japan, and Iowa State University
February 1	The foundations of probability, Arnold M. Faden, Department of Economics, Iowa State University
8	The role of capital markets in commercial-bank surveillance: An intervention analysis, Mack C. Shelley II
15	Population models — expected stochastic behavior vs. deterministic behavior, Wolfgang Kliemann, Department of Mathematics, Iowa State University
22	Mismatch between occupation and schooling: A prevalence measure, recent trends, and demographic analysis, James W. Shockey, Department of Sociology, Pennsylvania State University (a joint seminar co-sponsored by the Department of Sociology and Anthropology, ISU)
24	The effects of marital history on wages of working women (co-sponsored by the Department of Sociology and Anthropology), Richard R. Peterson, Department of Sociology, Columbia University, and Albert Einstein College of Medicine
29	The Ewens sampling formula in a population that varies in size, Edward Pollak
March 7	Two Gray Code generators, Bud J. Meador
14	Inference with model misspecification in finite population sampling, Lih-Yuan Deng, University of Wisconsin-Madison
21	Goodness of fit chi-square statistics with imputed data, Phyllis A. Gimotty, University of Michigan

Summer 1984

Special Lectures and Seminars

Graduate Student Seminar Series

All Ph.D. students in statistics are required to present a regular departmental seminar based on their thesis work. In addition, the graduate students themselves sponsor a limited series of seminars. Usually these are based on their doctoral research or on master's degree creative components. This year the student series, organized by Terry Callanan and Dan Jeske, varied its programming by inviting some of the statistics faculty to speak. Topics and speakers for the year follow:

Jason Jones, Steven Vilendrer, Frederick Hulting (with his back to the camera), and Kevin Kramer take time out from eating and more active events at the spring breakfast.

Avonelle Hefflefinger was honored at the December open house, for her 20 years of service to the Stat Lab. Professor emeritus David Huntsberger came over to congratulate her and reminisce.

Serendipity

Daniel G. Horvitz was elected to the new position of executive vice president of the Research Triangle Institute in September. He had been vice president for statistical services since 1974. Horvitz received the Ph.D. degree in statistics at Iowa State in 1953.

Alumnus Kenneth Henry was awarded the U.S. Department of Commerce's Silver Medal on October 26 "for his efforts in establishing a comprehensive scientific basis for salmon management in the Pacific Northwest." His contribution aided development of a scientific foundation for international coastal management of Pacific salmon by the United States and Canada. Henry received his M.S. degree in statistics at Iowa State in 1952 and a Ph.D. from the University of Washington College of Fisheries. He has been with the Resource Ecology and Fisheries Management Division, Northwest and Alaska Fisheries Center, National Marine Fisheries Service, since 1969.

Charles R. Henderson, who was visiting professor of statistics here for a brief period in 1981 and is professor emeritus, Department of Animal Science, Cornell University, was honored by Iowa State University during Alumni Days, June 9, as recipient of the Henry A. Wallace Award presented by the College of Agriculture. He received his Ph.D. at ISU in genetics and animal breeding, with a minor in mathematical statistics.

50th Anniversary Conference Note

Price of the conference proceedings, *Statistics: An Appraisal*, has now been set at $31.25, plus $1.44 for shipping within the U.S. Orders or special inquiries should be directed to the Iowa State University Press, 2121 South State Avenue, Ames, IA 50010.

In Memoriam

Fred A. Brandner, 1891-1983

Fred Brandner, who taught a graduate-level theory sequence in mathematical statistics at ISU in the 1930s and early 1940s, died July 28, 1983. He had continued teaching in the Department of Mathematics until 1978. He is survived by his wife Marguerite and son Carl.

Lyndell William Franzen, 1938-1983

Bill Franzen died October 7 at Sloan-Kettering Cancer Institute, New York City; he is survived by his wife. He came to Iowa State in 1956 and completed a B.S. degree in statistics in 1960; he had worked in the Survey Section two summers. After graduation he joined Western Electric, Inc., in Omaha, Nebraska as systems computer analyst in its Operations Research and Data Processing Development Group. At the time of his death Franzen was information systems manager for Western Electric in Morristown, New Jersey.

Horace W. Norton III, 1914-1983

Horace "Todd" Norton came to Iowa State in 1935 after completing a B.S. degree in chemical engineering at the University of Wisconsin. A fellow in mathematics, he obtained his master's degree in 1937 under A. E. Brandt. This was the fourth M.S. degree in statistics granted at Iowa State. R. A. Fisher was a visiting lecturer in statistics here during the 1936 summer session. Norton followed him to England, to University College, London, and finished a doctorate under him in 1940. Subsequently Norton held posts at the University of Chicago, the U.S. Department of

Agriculture, the War Department, the Weather Bureau, and the Atomic Energy Commission.

In 1950 he went to the University of Illinois, where he became professor of statistical design and analysis in the Department of Animal Science. Characterized as "an interesting fellow, a very bright and brilliant fellow," he was widely known across campus through his extensive advising on the design and interpretation of experiments; he was author or co-author of 215 research papers and active in the campus senate, AAUP, and the American Civil Liberties Union. In 1978 Norton received the H. H. Mitchell Award for Excellence in Graduate Teaching and Research. He was a fellow of the American Association for the Advancement of Science. He died in Champaign, Illinois, on November 4, 1983, and is survived by his wife Winifred, sons Karl, David, Paul, and Philip, and a stepson, James Alleman.

Gerhard Tintner, 1907-1983

Gerhard Tintner, former professor of economics, mathematics, and statistics at Iowa State, died on November 12, in Vienna, Austria. He was a major figure in the econometrics movement which, between 1930 and 1960, transformed much of economic theory into a mathematical discipline and applied advanced methods of mathematical statistics to the estimation of economic relationships.

Tintner received his doctorate from the University of Vienna in 1929, then studied at the London School of Economics and, as a Rockefeller fellow, at Harvard, Columbia, the University of Chicago, Stanford, the University of California at Berkeley, the Institut Henri Poincaré in France, and Cambridge University in England. He worked briefly at the Austrian Institute for Trade Cycle Research in Vienna, then was a Cowles Commission research fellow in 1936-37. As a professor at Iowa State from 1937 through 1962, formally associated with the Statistical Laboratory for much of that time, he introduced graduate courses in econometrics and econometric statistics. The second Ph.D. thesis in statistics here, by R. L. Anderson (1941), was written under Tintner's supervision. His text, *Econometrics* (1952), defined the subject matter of the field and helped to shape teaching programs in many countries. While at Iowa State, Tintner also published *The Variate Difference Method, Mathematics & Statistics for Economists,* and *Modern Methods of Mathematical Economics* and published widely in international journals. He held positions as associate editor of *Metroeconomica,* and as associate editor and book review editor of *Econometrica.* In addition he served as consultant to the U.S. Office of Strategic Services and the United Nations and held visiting appointments at Cambridge, the University of Vienna, and the Technical University of Lisbon in Portugal. The quantity of his reading was legendary.

From 1963 to 1972 Tintner served at the University of Pittsburgh briefly, then at the University of Southern California as Distinguished Professor of Economics and Mathematics. From 1973 until his retirement in 1978 he headed the Institute for Econometrics at the Technical University in Vienna and was honorary professor at the University of Vienna.

Tintner was a fellow of the Econometric Society, the Institute of Mathematical Statistics, and the American Statistical Association, and an honorary member of the Austrian Academy of Sciences. The University of Bonn awarded him an honorary doctor's degree in 1970. Survivors include his wife Léontine and son Phillip.

Chandu M. Patel, 1939-1984

Chandubhai Maganbhai Patel, senior biostatistician with Ortho Pharmaceutical Corporation, Raritan, New Jersey, died on February 7. He received B.S. and M.S. degrees in mathematics and statistics, respectively, in 1963 and 1965 at Sardar Patel University in India. After teaching as lecturer in statistics at Rajratna P. T. Patel Science College, he came to Iowa State late in 1966 for further study of statistics. He completed a M.S. degree under Wayne A. Fuller, then continued studies toward a doctorate until August 1970, when he joined Geigy Pharmaceuticals as biostatistician. In 1972 he became senior statistician with Ciba-Geigy and remained there until September 1981, when he joined Ortho Pharmaceutical Corporation. Shortly after coming here for the 50th anniversary conference, Chandu wrote about His years of experience, the papers presented at scientific conferences, and his hope to grow in his field. He is survived by his wife Indira, son Devang, and daughter Monica.

Paul G. Homeyer, 1915-1984

Paul Homeyer, retired senior statistician in the Office of the Vice President, Research Triangle Institute, North Carolina, died on February 20 in the Duke University Medical Center. He came to Ames for graduate study in 1937 and, except for a brief period at Louisiana State University, remained on the Statistical Laboratory staff at ISU until 1958.

Homeyer received a B.S. degree in agriculture in 1934 and an M.S. degree in poultry husbandry and agricultural economics in 1936 at Texas A&M. He stayed there until fall 1937 as statistical technical assistant in the experiment station. He continued studies in economics and statistics at Iowa State and at summer sessions at the University of Chicago and North Carolina State University. For two years, 1939-1941, he was a statistics instructor and USDA collaborator at Louisiana State University; then he returned to the Statistical Laboratory.

Homeyer's interest in the basic ideas of statistics and the application of statistical methods to research problems in the biological and agricultural sciences shaped his activities for the rest of his life. He carried on a massive program of statistical consulting here with faculty and students in agriculture and biology, which resulted in a large number of joint publications.

He also taught basic courses in statistical methods and the design of experiments, and served as technical assistant in statistics for FAO, United Nations, in Israel and Mexico on special assignments. An important early research bulletin, with Mary Clem and Walter T. Federer, discussed punched card and calculating machine methods for analyzing lattice experiments.

In 1958 Homeyer joined former Stat Lab colleagues at General Analysis Corporation, Los Angeles, California. When the group merged with C-E-I-R, Inc., he continued as project director and eventually vice president of Advanced Systems for its Western Region. The last ten years of his professional life, until retirement in 1980, were at the Research Triangle Institute. Homeyer was a Fellow of the American Statistical Association. He is survived by his wife Grace, son Charles, and daughter Jane Homeyer/Jensen. The example he set by his commitment to correct and innovative uses of statistical ideas throughout the full spectrum of scientific investigation will be long remembered by his co-workers and students.

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