$\Sigma P(A) < \infty?$
$\beta\alpha\Sigma\Omega\Delta=\mu\sigma\rho\theta\epsilon\psi$
$=\mu\sigma\rho\theta\epsilon\psi\delta\gamma\phi\omega\tau$
$\beta\alpha\Sigma\Omega\Delta=\mu\sigma\rho\theta\epsilon\psi$
$=\mu\sigma\rho\theta\epsilon\psi\delta\gamma\phi\omega\tau$
$\lim\int fn\mu\sigma\rho\theta\epsilon\psi$
$\beta\alpha\Sigma\Omega\Delta=\int \lim fn$
$=\mu\sigma\rho\theta\;\;\delta\gamma\phi\omega\tau$
$\beta\alpha\Sigma\Omega\;\;\;\rho\theta\epsilon\psi$
$=\mu\sigma\rho\;\;\;\delta\gamma\phi\omega\tau$
$y(t)=\alpha y(t-1)$
$\beta\alpha\Sigma\Omega\Delta=\mu\sigma\rho\theta\epsilon\psi$
$=\mu\sigma\rho\theta\epsilon\psi\delta\gamma\phi\omega\tau$
$\beta\alpha\Sigma\Omega\Delta=\mu\sigma\rho\theta\epsilon\psi$
$=\mu\sigma\rho\theta\epsilon\psi\delta\gamma\phi\omega\tau$
$C(X)\subset C(Z)\,\theta\epsilon\psi$
$\beta\alpha\Sigma\Omega\Delta=\mu\sigma\rho\theta\epsilon\psi$
$=\mu\sigma\rho\theta\epsilon\psi\delta\gamma\phi\omega\tau$
$\beta\alpha\Sigma\Omega\Delta=\mu\sigma\rho\theta\epsilon\psi$
$=\mu\sigma\rho\theta\epsilon\psi\delta\gamma\phi\omega\tau$
$P(UA) < \Sigma P(A)$
$\beta\alpha\Sigma\Omega\Delta=\mu\sigma\rho\theta\epsilon\psi$
$=\mu\sigma\rho\theta\epsilon\psi\delta\gamma\phi\omega\tau$
$\beta\alpha\Sigma\Omega\Delta=\mu\sigma\rho\theta\epsilon\psi$
$=\mu\sigma\rho\theta\epsilon\psi\delta\gamma\phi\omega\tau$
$Y/X=\Sigma y/\Sigma x\theta\epsilon\psi$
$\beta\alpha\Sigma\Omega\Delta=\mu\sigma\rho\theta\epsilon\psi$
$=\mu\sigma\rho\theta\epsilon\psi\delta\gamma\phi\omega\tau$
$\beta\alpha\Sigma\Omega\Delta=\mu\sigma\rho\theta\epsilon\psi$
$=\mu\sigma\rho\theta\epsilon\psi\delta\gamma\phi\omega\tau$
$y=X\beta y=X\beta y=X\beta$
$\beta\alpha\Sigma\Omega\Delta=\mu\sigma\rho\theta\epsilon\psi$
$=\mu\sigma\rho\theta\epsilon\psi\delta\gamma\phi\omega\tau$
$\beta\alpha\Sigma\Omega\Delta=\mu\sigma\rho\theta\epsilon\psi$
$=\mu\sigma\rho\theta\epsilon\psi\delta\gamma\phi\omega\tau$
$FIT(X\beta)=Py\epsilon\psi$
$\beta\alpha\Sigma\Omega\Delta=\mu\sigma\rho\theta\epsilon\psi$
$=\mu\sigma\rho\theta\epsilon\psi\delta\gamma\phi\omega\tau$
$\beta\alpha\Sigma\Omega\Delta=\mu\sigma\rho\theta\epsilon\psi$
$=\mu\sigma\rho\theta\epsilon\psi\delta\gamma\phi\omega\tau$

50 Years ISU Stat Lab

1933-1983

Statistical Laboratory Annual Report

July 1, 1982 to June 30, 1983   Iowa State University, Ames

Contents

THE STATISTICAL LABORATORY
Iowa State University
1982-83 Annual Report

The Statistical Laboratory 1933-1983

The Statistical Laboratory is the oldest unit of its kind in the United States. Its formation and early history owe much to the vision and pioneering efforts of George W. Snedecor and to the stimulation and support provided by Henry A. Wallace and R. A. Fisher. Throughout its 50 years the Stat Lab has been a leading center for research, consulting, and the training of future statisticians. The early emphasis on agricultural applications, supported also by the ISU Agricultural Experiment Station, has continued. However, the range of activities has been greatly extended and now covers practically all areas of statistics.

To mark the occasion of the 50th anniversary of the Stat Lab a major international conference was held in Ames, June 13-15, 1983. In accordance with the conference theme *Statistics: An Appraisal,* leading statisticians were invited to review and evaluate developments over the past 50 years in many important areas of statistics and also to indicate future trends and needs. The enthusiastic response to our invitations and the high standard of papers presented were the best kind of tribute to the esteem with which the Stat Lab is regarded. We believe that the aim of the conference was achieved admirably by the program of invited sessions, as will be even clearer from the full versions of the papers to appear in the conference proceedings volume. The reader is also referred to this Iowa State University Press publication for a number of historical articles and for abstracts of the contributed papers read. Details of the conference program and photos of some of the participants are given elsewhere in this report.

Of course, the conference was also a celebration, and we were delighted to see so many alumni and friends in Ames. The continued strength of the Stat Lab depends in many ways on the support of its alumni. We wish to record our grateful appreciation for the generous response of alumni and friends to our appeal for funds that were crucially needed to supplement grants and gifts from the National Science Foundation, the Army Research Office, the Office of Naval Research, Pioneer Hi-Bred International, Inc., and the ISU Graduate College. Judging by comments received, the conference was greatly enjoyed by all in attendance. Such a success is possible only through the energetic and devoted efforts of numerous individuals, both inside and outside the Stat Lab, to whom we express our warm thanks.

How do we see ourselves at age 50? We try to be good at many things: research in theoretical and applied statistics; teaching at all levels, including a heavy load of service teaching; providing an extensive consulting service for faculty and students; working on off-campus projects for local, state, and

H. A. David, director and head, welcomes participants and guests at the 50th anniversary conference banquet.

especially federal agencies. This range of activities is paralleled in very few other statistical centers. We believe that the breadth of our approach is highly desirable, both academically and in filling the needs for statistics and statisticians.

The Stat Lab and Department of Statistics have grown to a faculty of 36, seven of whom hold joint appointments. Currently there are about 100 graduate students, and we are consistently at or near the top in the number of Ph.D. and other degrees awarded annually by statistics departments in the U.S. The high quality of our graduate program has been confirmed by the recent peer evaluation of research-doctorate programs in the U.S. published by the National Academy Press. This assessment placed us in approximately fifth position among 64 statistics/biostatistics programs. A pleasing statistic of another kind was provided at the Toronto statistical meetings: Of 36 newly-elected ASA fellows, one is on our faculty and four received their Ph.D.'s here.

Our efforts must never cease to improve what we have accomplished so far. Achieving this, indeed just staying put, requires not only the devoted energy of the statistics faculty but also the continued enlightened support of the university administration. Recently H. A. David announced his decision to return to teaching and research effective June 30, 1984, when he will have served for 12 years as director and head. Readers are invited to suggest names of possible replacements to Dean Isaacson, Chair, Search Committee [102 Snedecor Hall, Iowa State University, Ames, Iowa 50011, or phone (515) 294-3440].

The Statistical Laboratory, in spite of current economic stringencies and other uncertainties, is looking forward with confidence to its next 50 years.

Personnel

Malay Ghosh resigned in August to join the Department of Statistics, University of Florida, but continued to supervise graduate research underway here. He returned for the month of June to work on an Army Research Office grant project.

Jerome Sacks succeeded Gordon Booth as resident collaborator, Biometrical Services, U.S. Department of Agriculture. In October he was granted faculty status as an associate professor of statistics. Sacks received a B.S. degree in biology at the University of Pittsburgh, M.S. and Ph.D. degrees in statistics and genetics, respectively, at the University of Minnesota. He served as senior research statistician with the Israel Agricultural Research Organization, Volcani Research Center, for ten years.

A new addition to the faculty, previously announced, was assistant professor Yasuo Amemiya, in the area of multivariate analysis. Richard A. Groeneveld and David Harville took faculty improvement leaves for the 1982-83 academic year, serving as visiting professors in the Department of Statistics, Wharton School, University of Pennsylvania, and the Department of Mathematics, University of Texas at Austin, respectively.

As announced previously, John T. Webster arrived in August to spend the fall semester as visiting professor, on leave from the Department of Statistics at Southern Methodist University. Also Emmanuel Yashchin, visiting assistant professor, arrived for the academic year and the following summer to teach and conduct research in the area of engineering statistics. He received his M.Sc. and D.Sc. degrees at Technion in operations research and statistics and has been a member of the Faculty of Industrial Engineering and Management at Technion, Haifa, Israel. Dan Scott was appointed temporary instructor for the academic year. A mathematics graduate of Iowa State University, he subsequently studied both here and at Stanford University, primarily in the area of operations research.

Sonny Loo arrived in July to spend five months as visiting associate professor, working primarily on concomitants of order statistics and the theory of competing risks. He has now returned to his position as senior lecturer in mathematics at Monash University, Australia. Chang Dorea, associate professor in the Department of Mathematics, University of Brasilia, Brazil, has been spending her sabbatical leave for 1982-83 as visiting scholar in the Statistical Laboratory. In the fall semester she also served as part-time visiting associate professor in the Department of Electrical Engineering.

Wyman E. Nyquist, professor of statistics and quantitative genetics at Purdue University, arrived in June 1983 for about three months, to work on completing a manuscript on statistical genetics and to interact with Statistical Laboratory workers in that area.

Betty Ibrahim, account specialist, and Evelyn Green, longtime Survey Group supervisor, retired during the year; Norma Elwick, Richard Dorsch, and Harvey Terpstra were awarded certificates in December recognizing their years of meritorious service to the Statistical Laboratory. Mary Genalo and Ye-Fu Lee received promotions to research associate.
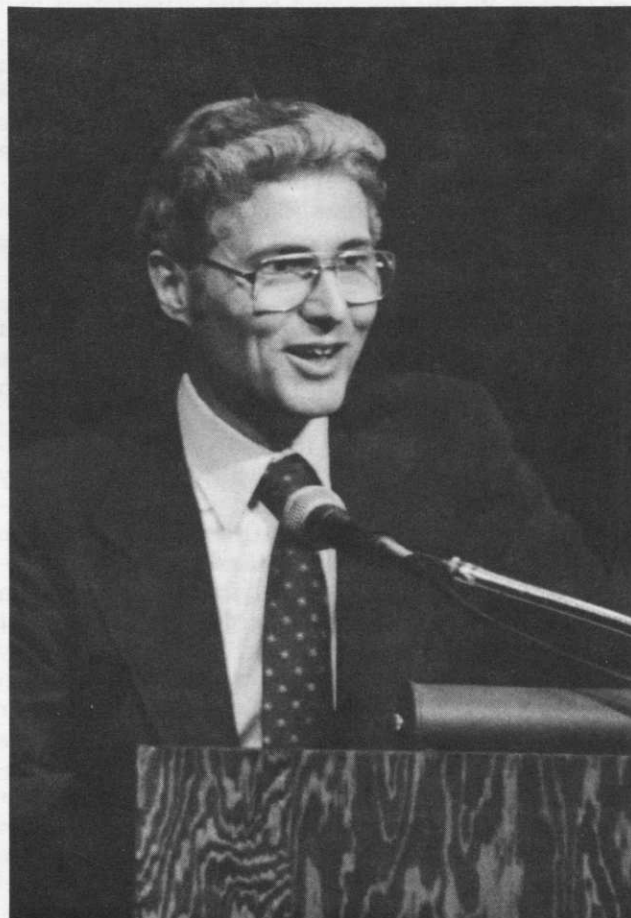
Wayne A. Fuller, newly named as Distinguished Professor in Sciences and Humanities.

Wayne A. Fuller was honored at a meeting of the General Faculty in May as a Distinguished Professor in Sciences and Humanities. He was cited for achieving "worldwide recognition as both an applied and a theoretical statistician." A Fellow of the American Statistical Association and the Institute of Mathematical Statistics, as well as a member of the International Statistical Institute, he has written a major text on time series, and developed a popular computer program manual for analysis of survey data. He is author or co-author of more than 60 articles on time series, econometrics, or survey sampling and has directed more than 30 Ph.D. students. Fuller first joined the Statistical Laboratory and Department of Statistics in 1959.

David F. Cox received a Faculty Citation, for long, outstanding, and inspiring service, at the annual awards convocation of the Iowa State University Alumni Association, June 4, 1983. The citation states: "Professor Cox contributes unselfishly in a

patient and constructive manner to the graduate education of innumerable students at the expense of his own personal and professional gain. He is an effective communicator in and out of the classroom, and students seek his advice on design and analysis of their graduate research problems. Dr. Cox willingly consults with hundreds of students in the agricultural and biological sciences on the proper statistical analysis and interpretation of their research data. Since many of these are foreign students, his influence extends beyond the national level. His contributions to the many young persons who have received graduate degrees from Iowa State University will be multiplied many times over and may exceed the more standard measures of success."

Looking toward next year: Robert Johnson has accepted a postdoctoral fellowship on quantitative methods in criminal justice, at the School of Urban and Public Affairs, Carnegie-Mellon University, starting July 1, 1983. Oscar Kempthorne will spend the coming academic year at Virginia Polytechnic Institute and State University as distinguished visiting professor of statistics, on faculty improvement leave from Iowa State. Mack Shelley, Shashikala Sukhatme, and Stephen Vardeman were promoted to associate professor rank; Tom Bubolz will become adjunct associate professor.

There will be new faces. Noel A. C. Cressie, senior lecturer in statistics, Flinders University, Adelaide, South Australia, will replace Malay Ghosh as full professor. Cressie holds a B.Sc. (Honours) degree in mathematics from the University of Western Australia and M.A. and Ph.D. degrees in statistics from Princeton University. He has published widely in both theoretical and applied areas, his special interests including asymptotic theory, spatial statistics, geostatistics, and data analysis.

Mark Reiser will fill a new position as adjunct assistant professor in the Survey Group primarily supported by the Statistical Laboratory's cooperative research agreement with the Soil Conservation Service, USDA. He received his doctorate at the University of Chicago in behavioral research methodology and has been a postdoctoral fellow at Indiana University.

Byron Jones is coming next fall, as visiting assistant professor, from the University of Kent at Canterbury, England, where he completed his doctorate and serves as lecturer in statistics. His special interests are in experimental design and cluster analysis. Jayanta K. Ghosh will be a visiting professor for the summer of 1984, primarily for research on order statistics and nonparametric statistics. He has long been a leading member of the Indian Statistical Institute.

Oscar Kempthorne will become president-elect of the Institute of Mathematical Statistics during the Toronto statistical meetings in August. William J. Kennedy has been appointed editor of *The American Statistician*. He will assume full duties on January 1, 1985.

Statisticial Laboratory Staff—Fiscal Year 1982-83 under the administrative direction of:

W. Robert Parks, Ph.D.—president of the university
Daniel J. Zaffarano, Ph.D.—vice president for research; dean of the Graduate College
Wallace A. Russell, Ph.D.—dean, College of Sciences and Humanities, through November 19
Richard J. VanIten, Ph.D.—acting dean, College of Sciences and Humanities, November 20 to June 30
Lee R. Kolmer, Ph.D.—dean, College of Agriculture; director, Iowa Agriculture and Home Economics Experiment Station
Herbert A. David, Ph.D.—director, Statistical Laboratory; head, Department of Statistics; head, Statistics Department, Iowa Agriculture and Home Economics Experiment Station

Professors

Krishna B. Athreya, joint appointment with Department of Mathematics
T. A. Bancroft, professor emeritus
Theodore B. Bailey, Jr.
C. Philip Cox
David F. Cox
Herbert A. David, Distinguished Professor in Sciences and Humanities
Herbert T. David, joint appointment with Department of Industrial Engineering
Wayne A. Fuller, Distinguished Professor in Sciences and Humanities; faculty status also in Department of Economics
Malay Ghosh, through August 8; visiting, June 1983
Richard Groeneveld
David A. Harville
Roy D. Hickman
Paul Hinz, faculty status also in Department of Forestry
Donald K. Hotchkiss
David V. Huntsberger, professor emeritus
Dean Isaacson, joint appointment with Department of Mathematics
Oscar Kempthorne, Distinguished Professor in Sciences and Humanities
William J. Kennedy
Glen Meeden
William Q. Meeker, Jr.
Edward Pollak, joint appointment with Department of Genetics
Vincent A. Sposito, joint appointment with Computation Center
Robert F. Strahan, joint appointment with Department of Psychology
Norman Strand, professor emeritus
John T. Webster, visiting
Leroy Wolins, joint appointment with Department of Psychology

Associate Professors

Kenneth J. Koehler
Sonny G. Loo, visiting
Jerome M. Sacks, USDA collaborator

Assistant Professors

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

Adjunct Assistant Professor

Thomas Bubolz

Instructor

Dan M. Scott

Visiting Scholars and Scientists

Chang Dorea
Ping Fang
Wyman E. Nyquist

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 regular appointments as graduate assistants during the year are listed here.

Blake Abdella	José Calcaño-Collazo
Yasuo Amemiya (*)	Terrance P. Callanan (*)
Kevin Anderson (*)	David L. Cassell
Robert J. Arnold	Stephen Fu-Chung Chang
Craig A. Beam	Janella Chapline
Tammy Bondioli	Sze Wai Cheung

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* summer 1982 only

Peter D. Christenson (*)	Grecia F. Morel
Tin-Chiu Chua	Jorgé Morel
Carolyn Connor	Neerchal K. Nagaraj
Stephen V. Crowder	Deborah Nelson
Bruce W. Diiro	Paulette Nicholson
Nancy Eyink	Julia Oñate
Charles M. Farmer	George Ostrouchov
Carol A. Francisco	Sastry G. Pantula (*)
Fah Fatt Gan	Gilda Pareja
Rachel Harter	Jerome Paulissen
Arnold J. Hawley	Julio Peixoto (*)
Patrick Homblé	David D. Pohl
Hsien-Ming Hung	John Raudsep (*)
David Jacobson	Di-Ou Ray
Shawn D. Jacobson	Michael P. Rogers
Daniel Jeske	Daniel J. Schnell
John Marcus Jobe	Debra Schroeder
Jason R. Jones	Steven J. Schuelka
Lee Ann Josvanger	David L. Silvis
Byung Chun Kim	Sergio Torreblanca
Chiho Kim	Yan-Ling Tsay
Lawrence Kinyon (*)	Michael Tveite (*)
Kevin Kramer	Kanlaya Vanichbuncha
Moun-Shen Carl Lee	Jan van Schaik
Youngjo Lee	Hugh Voigt
Sharon K. Loubert	Annette Wagner
Paul McGovern	W. N. Wickremasinghe
Sallie Keller McNulty	Woon Bang Yeo (*)
Cindy Lynn Martin	Jin-ying Yu
Reda Mazloum	Dale Zimmerman
Stephen Miller	

Supported Graduate Students

Yasmin Abdul-Aziz—Malaysian Government
Edi Abdurachman—USAID, Indonesia
Mohamed Ab-Ghaffar—Malaysian Embassy
Kevin Anderson—Department of Mathematics, ISU
Victoria Black—Department of Mathematics, ISU
Steven Fahrenholtz—Engineering Research Institute, ISU (*)
Victor Filos—Iowa Department of Transportation
Margarita Guerrero—Department of Mathematics, ISU
Ricardo Heymans—Universidad de Oriente, Cumaná, Venezuela
Komlan Hukportie—USAID, Togo
Leigh Ihnen—Department of Entomology, ISU
Arunee Kumlung—Chulalongkorn University, Thailand
Youngjo Lee—Engineering Research Institute, ISU
Cherng-Tarng Lin—Department of Freshman Engineering, ISU
Anthony Lui—Computation Center, ISU
Paul McGovern—Graduate College, ISU
Mark McNulty—Department of Economics, ISU
David Martinich—Department of Mathematics, ISU
Abdelghani Mehailia—Algerian Government
Edina Miazaki—Universidade Féderal de São Carlos, Brazil
Paul T. Nkansah—Iowa Department of Transportation (*); University of Minnesota—Morris

Byung Sul Park—Korean Army
Ademir Petenate—Universidade de Campinas, São Paulo, Brazil
Hilal Putrus—Government of Iraq and University of Baghdad
Juan Esteban Ramírez C.—Universidad Tecnica del Estado, Santiago, Chile
John Raudsep—Department of Mathematics, ISU
Saad Eldin M. Saad Eldin—University of Gezira, Sudan
Shaharuddin B. Saadun—Malaysian Government
Margaret Scott—Department of Mathematics, ISU
Fernando R. Silva—Inter-American Institute for Development of Agricultural Science, Chile (*)
Slamet—Surabaya Institute of Technology Project, Indonesia
Hon Richard Tachia—University of Jos, Nigeria
Miriam B. Tirol—Department of Computer Science, ISU
Sergio Torreblanca—Consejo Nacional de Ciencia y Technologia, Mexico
Stavroula Tsokou—Department of Mathematics, ISU
Michael Tveite—Engineering Research Institute, ISU
Kanlaya Vanichbuncha—Chulalongkorn University, Thailand
Tilaka Vijithakumara—University of Peradeniya, Sri Lanka
W. N. Wickremasinghe—USAID, Sri Lanka
Jeffrey R. Wilson—Trinidad Government
Franklin Winters—Department of Mathematics, ISU; Graduate College (**)
Fouad Younan—University of Baghdad, Iraq
Francisco Zamudio—Consejo Nacional de Ciencia y Technologia, Mexico

Self-Supporting Graduate Students

William D. Adams	Lawrence Kinyon
Richard Auer (*)	Mong-Hong Lee
Geoffrey Bergeron (*)	Jerry Lewis
Dennis L. Brandon	Char-Lung Charles Lin (*)
Min-Shih Chang	Jyh-Shiun Lin
Victor Filos	Grecia F. Morel
Eiichiro Funo	Wendell Ponder
Mirna Janet Gazaui	Lakshmi Rangachari (*)
Arnold J. Hawley	Ahmed Razmpour (*)
Shun-Chuen Huang (**)	S. Mahmoud Seyed
Shawn D. Jacobson	Sadr (**)
Byung Chun Kim	Yan-Ling Tsay
Byung Hwee Kim	

Undergraduate Teaching Assistants

Carl E. Fritz
Beth A. Huegli
Karen Kellenberger

** summer 1983

Professional and Scientific Staff

Richard Dorsch, research associate, Survey Section
Mary Genalo, research associate, Survey Section
Avonelle Hefflefinger, administrative assistant
Kuo-Ying Hung, research associate, Survey Section, beginning in February
Ye-Fu Lee, research associate, Survey Section
Bud Meador, supervisor, Statistical Data Processing Services
Kathleen Shelley, data analyst, Statistical Data Processing Services
Harvey Terpstra, systems analyst, Survey Section
Jauvanta Walker, information specialist

General Office Staff

Frances Bradley, secretary until August
Phyllis Carr, secretary—Experimental Design Genetic Statistics Section
Spring Davidson, secretary, beginning in August
Norma Elwick, secretary
Chris Fry, secretary from September until January
Julie Honeick, secretary beginning in August
Betty Ibrahim, account specialist until August
Judith LaMotte, secretary, through July 23
Pam Mason, secretary beginning in February
Marylou Nelson, secretary
Janice Peters, account specialist
Sharon Shepard, secretary
Darlene Wicks, secretary—Statistical Numerical Analysis and Data Processing Section

Survey Section Staff

Glenda Ashley, key entry operator
Kathryn Bottorff, field interviewer
Dorothy Bousfield, field interviewer
Julie Ann Cummings, statistical data processor
Dorothy Edwards, clerk

Margaret Fowler, statistical data processor
Evelyn Green, clerk (survey supervisor) until April
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
Jeanne Sorenson-Wright, statistical data processor
Marilyn Sporrer, clerk
Jane Stowe, clerk typist
Miriam Troyer, field interviewer
Sue Verkade, clerk
Elaine J. Widmann, key entry operator

# Statistical Laboratory Staff and Graduate Students, May 1983

1 Strahan
2 H. T. David
3 Kempthorne
4 Fuller
5 H. A. David
6 Hickman
7 Iachan
8 Amemiya
9 Chua
10 H. M. Hung
11 K. Y. Hung
12 Ostrouchov
13 van Schaik
14 Sposito
15 C. F. Cox
16 Pollak
17 Bubolz
18 Meeker
19 Kennedy
20 Marasinghe
21 Hotchkiss
22 Miazaki

23 Hefflefinger
24 DeMeuse
25 Hinz
26 Walker
27 D. F. Cox
28 Isaacson
29 Vardeman
30 Meeden
31 M. Shelley
32 Wagner
33 Stephenson
34 S. K. McNulty
35 Wolins
36 Koehler
37 M. McNulty
38 Baker
39 Y. Lee
40 Bailey
41 K. Anderson
42 Arnold
43 Gan
44 Harter

45 Sorenson-Wright
46 Sukhatme
47 Y. F. Lee
48 Honeick
49 Dorsch
50 Terpstra
51 Bottorff
52 Seagrave
53 Walsh
54 Pareja
55 Davidson
56 Wilson
57 Petenate
58 Nagaraj
59 Diiro
60 Abdella
61 Eyink
62 Bondioli
63 Tveite
64 Cassell
65 Schuelka
66 Chapline

67 Francisco
68 Pohl
69 Jobe
70 Isvik
71 Beam
72 Mason
73 Ridnour
74 Peters
75 S. McNulty
76 Edwards
77 D. Anderson
78 Genalo
79 Hafner
80 J. Morel
81 Iverson
82 Silvis
83 Loubert
84 Nelson
85 D. Jacobson
86 Schroeder
87 Shepard
88 Black

89 Wicks
90 Miller
91 West
92 Jones
93 Kramer
94 Chang
95 Wallace
96 Martin
97 Fisher
98 Rogers
99 Callanan
100 Farmer
101 Jeske
102 K. Shelley
103 Nervig
104 Ashley
105 Reinertson
106 Schnell
107 Turner
108 Widmann
109 Elwick
110 Nelson
111 Stowe
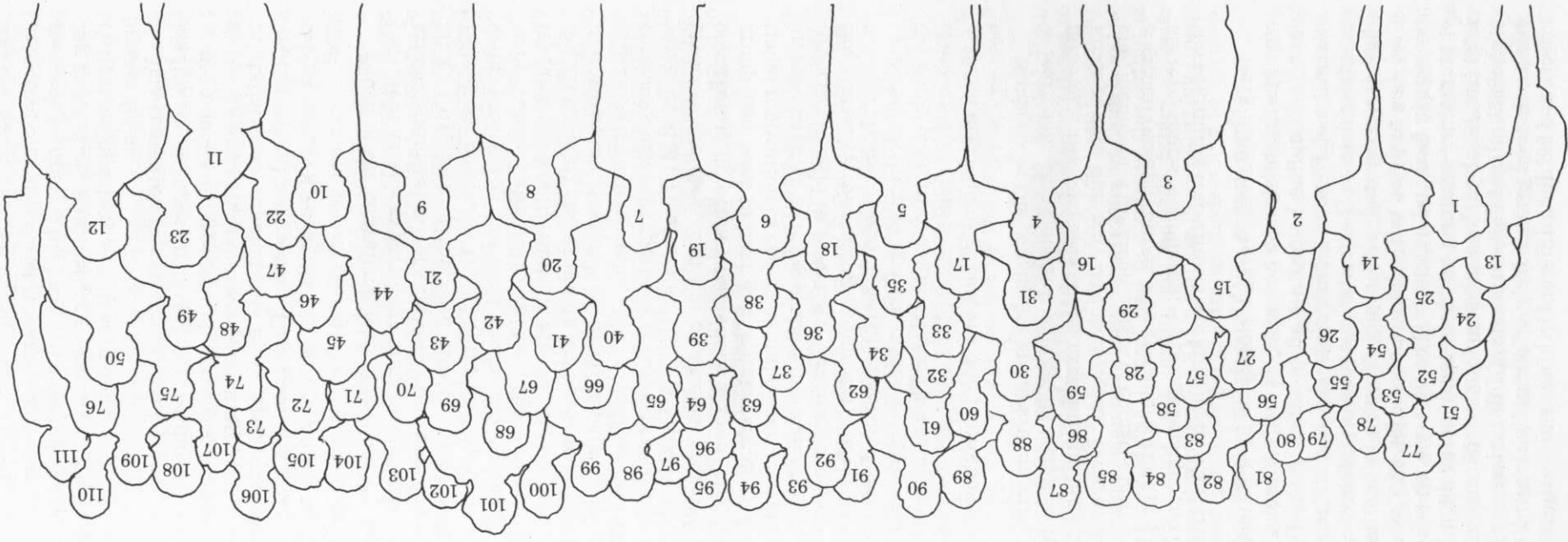
Consulting and Cooperative Research
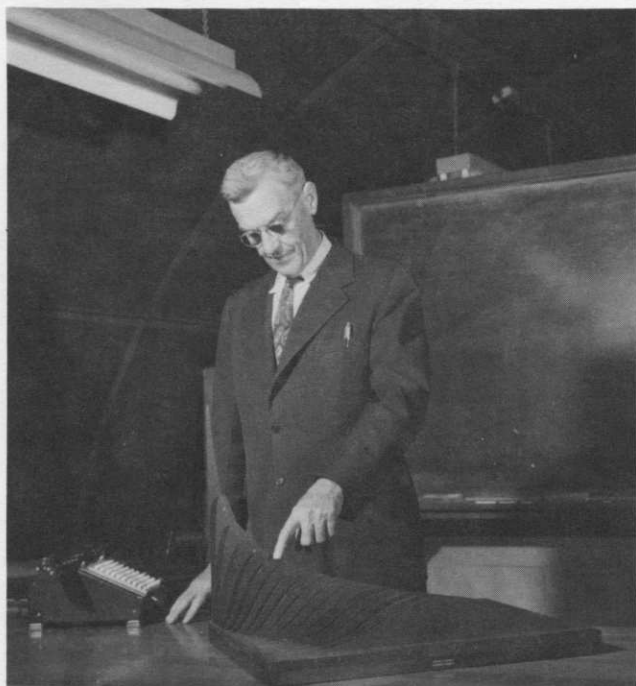
George W. Snedecor, founder and first director of the Statistical Laboratory—teaches in the quonset in 1949.

From its earliest days the Statistical Laboratory has been heavily involved in applied service to agricultural and biological fields. As the university's research program has broadened and as new statistical theory and methodology have developed, the laboratory's involvement became broader and more complex. The statistics faculty and graduate students today offer advice on statistical aspects of research throughout the university. For some this is indeed a major interdisciplinary activity, which on occasion leads to joint publications.

Funding for consulting is provided mainly by the Statistical Laboratory and the statistics department of the Agriculture and Home Economics Experiment Station. Some assistantships are supported by the Engineering Research Institute and the College of Veterinary Medicine. Federal, state, and local agencies receive additional help through grants, contracts, and cooperative agreements. Cooperative research has been conducted, for example, with the USDA Soil Conservation Service since the mid-1960s.

Agriculture and Home Economics Experiment Station

The Statistical Laboratory's 50th anniversary marks 50 years of formal association with the Agricultural Experiment Station, starting with the appointment of George W. Snedecor, professor of mathematics, as station statistician. The statistics section, now department, of the experiment station was created in 1935 under Snedecor to provide more extensive consulting and research support to station research workers. This has been a mutually rewarding association, stimulating research in applied statistical methodology as well as in cooperating subject matter fields.

The computer in various guises is continually leading to changes in research procedures and to improvements in research effectiveness. Computer modeling and simulation are particularly important in statistics as supplements to, or even substitutes for, theoretical approaches. The consulting group received two new video display terminals during the year.

Much of the consulting load of the statistics department of the experiment station is carried by graduate assistants working under the supervision of D. F. Cox, Paul Hinz, Ted Bailey, and Donald Hotchkiss. The major thrust of the group's work is to bring the best of the most recent developments in computational and statistical methods to bear on the research work of the Station. Members of the consulting group, staff and graduate students, participated in a workshop November 10-11 on consulting intern programs for statisticians, held in Madison, Wis. Discussions concerned methods of training students for work in statistical consulting. A variety of approaches are used, and the conference provided an opportunity to review what is done at Iowa State. The group also went to hear J. S. Hunter speak on fractional replication in experimental design, in April at an Iowa chapter meeting of the American Statistical Association held in Iowa City. Graduate students in the statistics consulting group were taken to see weather shelter research facilities at the Hinds farm to introduce them to modern research approaches in the study of plant-drought stress. This also provided them with a "classic" example of an apparently well-planned experiment gone awry due to unknown soil heterogeneity.

Students in the consulting group are encouraged to learn something about a science: its technical terminology, the purposes of the experiments, and the kinds of data that may be encountered. Towards this end, members of the Department of Forestry provided a special reading course, when no appropriate graduate level course was offered, to provide background for the beginning consultants working under Paul Hinz.

Terry Callanan worked closely with a student who was establishing a new assay in food technology; Janella Chapline helped a staff member in the Department of Food and Nutrition who had collected extensive data on the limitations of taste panels when they are presented with many samples in one day. Carl Lee assisted with data analysis for two other projects in food and nutrition. The first one, on effect of premature weaning on cholesterol metabolism in later life, involves the analyses of various parameters of cholesterol metabolism of rats of different ages (age effect), weaned prematurely or normally (treatment effect), and fed diets different in kinds and amounts of

lipid and carbohydrate (diet effect). The second project, an ISU World Food Institute study of the effect of nutrient intake on pregnancy hyperlipidemia and effect of breast-feeding on the maternal serum lipid status of Chinese women, involves chemical data of serum lipid from 24th week of pregnancy to 6th week postpartum, nutrient intake analyses derived from 24-hour recall and weekly food intake pattern, food beliefs and supplement consumptions of Chinese women in pregnancy and postpartum, and breast-feeding practice.

Dan Jeske has helped several people, including a staff member in animal ecology, with setting up, running, and interpreting discriminant function analyses. Dale Zimmerman dealt with data on mammals in the Andes mountains of South America, screwworm infestations in the cattle of Texas, and earthworm regeneration processes from a zoological laboratory.

Hugh Voigt has worked with students and staff from the Department of Plant Pathology on stalk rot in corn. Michael Tveite consulted with a research worker from the departments of Agronomy and Earth Science on the analysis of climatological data and modeling of rainfall patterns. Carl Lee analyzed numerous experiments from the federal corn borer laboratory in Ankeny, Iowa, and helped in consulting with a visiting scientist from the People's Republic of China who was working there. The distinctive feature of that consulting was that it was conducted in the Chinese language.

One major continuing consulting activity is for CARD, the university's Center for Agricultural and Rural Development, whose work typically deals with agricultural economic models involving a very large number of variables. Such models have in the past been handled primarily by formulating them as linear (or quadratic) programming problems *or* by treating them by the use of time series. It has been possible to link the two approaches by the development of an interface between the two separate computing systems previously used. V. A. Sposito assisted Wen-Yuan Huang of CARD in interfacing subroutines to IBM's MPSX system. These are being used to convert certain economic linear programming models to the proper MPSX format and to condense the output of such runs into useful summarized tables. Sposito assisted other CARD members in formulating linear and quadratic programming models and in developing graphic displays of farm energy profiles.

Ted Bailey participated in an interdisciplinary research study group in the area of statistical and quantitative genetic problems with respect to achieving genetic improvement in species that reproduce by self-pollination. The group focused on two aspects: identification and discussion of recent relative research articles, and identification of topics that might be included in a one-semester course on the subject. The group included visiting professors in the Department of Agronomy from Nanjing University, China, and the College of Agriculture, São Paulo, Brazil.

Bailey also cooperated with agronomy faculty, from Iowa State University and Nanjing University, in several physiological studies aimed at understanding the role of environmental factors on the growth and development of corn and soybean plants. A statistical model was developed that gave the amount of soybean leaf growth per day as a function of daily increase in leaf width, initial leaf width, and position of the leaf on the plant. Then the influence of a number of environmental factors on leaf growth were studied. The variables that best described leaf growth were a combination of night, day and day^2 temperatures. In a separate study, corn and soybean yields during the last 40 years at four locations in Iowa were associated with weekly temperature and rainfall. Two nonstatistical methods and one statistical method all showed that greater than normal rainfall during the planting or harvesting season decreased yields in southeast Iowa, but had only a small effect in northwest Iowa, which is the driest part of the state. In contrast, greater than normal rainfall during tasseling increased yield in northwest Iowa, but had a smaller effect in southeast Iowa. Warmer than normal spring temperatures increased yield, whereas hot temperatures during tasseling decreased it.

Statistical Numerical Analysis and Data Processing Section

As in past years, Bud Meador and Tom Bubolz continued to supervise the two service support groups in the section. Research activities within the section were supervised by Bill Kennedy, Vince Sposito, and Mervyn Marasinghe.

Three new IBM Personal Computers were installed in the section area during the year. One is used exclusively by Darlene Wicks for text editing and other administrative-type processing. The remaining two machines are being incorporated into the overall section data processing environment. The role that this type of machine will finally have is yet to be determined, but having the machines readily available has certainly provided valuable educational benefits to date. Software for communications and scientific word processing operations has been developed by section personnel. Also, several programs for specific project support have been written.

Readers of recent issues of this report will not be surprised that the group supervised by Bud Meador again produced data analysis and a data processing service very similar to what was produced last year. Too, requests frequently came from the same research workers, departments, private companies, etc. However, the more the routine stayed the same, the more it changed.

At the end of the year, the section gave up its last IBM 026 Card Punch, which had been virtually abandoned in favor of smart terminals, as well as dumb terminals, as a means of communicating with the university's AS/6 research computer. Card decks were used extensively together with floppy diskettes,

computer tapes, and on-line and mountable disk storage to store observations, programs, and computed results. However, work stations frequently were at a terminal, and FORTRAN Coding Pads were not in demand.

The section's three IBM Personal Computers played a functional role in the group's regular activities. The data storage and data communication components were frequently used in completing work to execute batch-processing jobs on the research computer. The personal computers were used together with portable data collection computers to enter observations into the research computer; two such data recorders were involved, namely, a Polycorder and a Datamyte.

Two relatively new components of the university's research computer are an IBM Laser Printer and a ZETA 3653SX Plotter. Kathy Shelley, a full-time data analyst in the group, has developed and modified several procedures to use the laser printer for exhibiting results. She and Byung Kim, a research assistant, used the plotter to exhibit results of a survey for the university's Center for Industrial Research and Service (CIRAS), for its Economic Development Administration project. Kim also developed software for the IBM Personal Computer.

Lee Ann Josvanger and Fatt Gan are the remaining members of the group. Josvanger handled virtually all aspects of work for the College of Veterinary Medicine as well as a number of projects from agronomy and education. Gan did his share of work on off-campus projects. He also developed programs and procedures for using the IBM Personal Computers to further interface the data recording equipment and the research computer.

Tom Bubolz and his group were equally busy during the past year. In addition to custom programming activities, this group installs and maintains large program packages. SAS.82, SPSS-X, and BMDP.82 were installed in the Computation Center's NAS/6. These packages have gained wide acceptance by researchers, teachers, and others. Their capabilities have become ever more complex and varied. They were originally designed with only statistical analysis in mind. The latest releases of the major packages now support file handling utilities, report writers, and procedural and mathematical programming. In a sense, the best of the packages represents a completely self-contained system offering something for everyone. Package usage on campus has increased every year. The greater demand placed upon the section's consulting group is indicated by the fact that SAS and SPSS jobs are currently being submitted at the rates of 120,000 and 35,000 runs per year, respectively.

A substantial part of the year was devoted to refining the Cultural Practices Evaluation System. This is a very large integrated data management and reporting system designed and programmed for the Iowa Conservation Commission's State Forest Nursery. The purpose of the project is to identify factors that have a significant impact on the quality of seedlings grown and shipped to buyers. Reports, generated from information stored in an on-line database, give nursery management a view of the current status of labor and materials used to produce any of 50 different species of trees. During the coming year the focus of systems design will shift to the collection and processing of data on lifting, storage, and grading operations. During the past year Dan Schnell and Kevin Kramer contributed insight and expertise to maintaining existing capabilities and developing new ones for the system.

Presently, raw data are entered via an interactive program on ISU's AS/6 computer. Current plans specify the acquisition of a microcomputer and programming to support data entry and edit operations. Microcomputer tasks will be expanded as experience is gained with the system.

The microcomputer is also expected to play a role in entry and verification of data for the nursery's Customer Order Processing System. Demand for processing in this aspect of nursery operations will increase because of a subsidiary facility under development in another part of the state.

Computer analysis of kinship data was provided by Sallie Keller McNulty working with Professor Andre Plakans (History). The program maintains and uses a very large database consisting of geneological information about approximately 50,000 persons who lived in a single European community during a 150-year period around the 17th century. The program generates printed tables of kinship relations. It is possible to begin at any point in a lineage and work backward or forward to identify relatives of any designated individual.

Work continues on a similar project to identify the impact of formal marriage contracts on social mobility in 17th century France. Steve Chang has completed preliminary data entry and edit operations. Initial tabulations are now being run. A total of about 2,000 marriage contracts are being analyzed.

Data were analyzed for clients in the fisheries division of the Iowa Conservation Commission. This is a continuation of work done during the past several years. Youngjo Lee, working with staff in the College of Education, designed a program to analyze performance of teachers who attended teachers training workshops. In other projects, data were analyzed for researchers at the Department of English writing center, and revisions were made to the database used by the *Bulletin 72* nutrition analysis program of the Department of Food and Nutrition.

At the request of Jerome Sacks, a short course on WYLBUR and SAS was offered to 57 staff members of the U.S. Department of Agriculture by William J. Kennedy, Jr., and Tom Bubolz in March.

The section was well represented at the annual "Interface Conference" this year. Kennedy, Sposito, Bubolz, and Meador all made the trip to Houston in March. A former member of the section, Jim Gentle, was the conference chair.

Raymond J. Jessen, acting director of the Laboratory and acting head of the new Department of Statistics, 1947 to 1950. He was one of the leaders in developing the Master Sample Project here, the basis for national area probability sampling.

Survey Section

The Survey Section completed work on four case-control studies of cancer incidence in Iowa that were begun in previous years. These studies were done in cooperation with the Department of Preventive Medicine, University of Iowa, and the National Cancer Institute (NCI).

In a five-year study designed to identify familial and environmental factors associated with the occurrence of brain tumors in children, the Survey Section completed interviews with parents of 61 cases and 183 randomly selected controls. Cases were identified by the Iowa Cancer Registry, and controls were selected by the Survey Section using the random digit dialing method. Researchers at the Children's Hospital Medical Center in Boston are analyzing the data.

Interviews were completed on 239 cases and 371 controls in a study of long-term survivors of childhood cancer. In order to compare psychosocial morbidity between surviving cases and closely matched controls, two siblings were interviewed as controls. Field work for this study was also conducted in four other states by other organizations. NCI researchers are currently completing the analyses.

Work was completed on an epidemiologic study to investigate a possible cause-effect relationship between acute lymphoid leukemia virus in humans and bovine leukemia virus and other factors in the rural agricultural environment. The Survey Section assisted with construction of the questionnaire and field forms and was responsible for the live control selection, for all interviewing, and for the initial editing of the questionnaire. Cases diagnosed from 1970 to 1980, that also had residence in one of 80 rural counties in Iowa, were studied. For each case, two controls matched by age, sex, and geographic area were selected and interviewed.

Finally, the interviewing phase of a study designed to assess the association of oral contraceptive use with the subsequent development of breast, endo-

metrial, and ovarian cancer in women was completed. Survey Section personnel interviewed cases and controls, edited, and validated the data.

Two additional epidemiologic studies are in progress. The objective of the first project is to develop a better understanding of the established relationship between leukemia and non-Hodgkins lymphomas (NHL) and rural residency by searching for associations between these diseases and specific elements of agricultural practice. Over a three-year period, 600 cases and 600 controls are to be interviewed. The second study is identical to the leukemia-NHL project but involves 200 cases diagnosed with multiple myeloma. For both projects, the Survey Section is selecting controls for live cases; controls for deceased cases will be selected by researchers at the University of Iowa. The section will interview all cases and controls, perform initial data edit, and validate 10 percent of the completed interviews.

Three studies were conducted for researchers in the Department of Economics. The first project was designed to analyze and interpret the factors that affect soil erosion in western Iowa. Personal interviews were conducted with 132 farm operators associated with 66 randomly selected sections of land. The study sought farmers' opinions of alternative soil conservation plans designed for their land. Data on the farmers' operations were also collected.

The second project is the latest in a series of farmland ownership studies carried out over the past 35 years. The study seeks to identify characteristics of owners of agricultural land in Iowa, as well as to learn how land is acquired, held, and transferred. A sample of 350 farm corporations was drawn from the files of the Iowa Secretary of State. From those shareholders owning at least 10 percent of the stock in the corporation, one was selected at random to provide information about both the corporation's land holdings and his/her own private agricultural land holdings. The information was collected by telephone. Land owners not associated with incorporated farms were selected by means of a stratified area sample, the 99 counties being the strata. First, 705 40-acre units of land were selected. Units were allocated to counties in proportion to land areas. Within counties, units were selected in a random systematic manner. County auditors provided the names and addresses of all persons owning agricultural land in the sample units. Telephone interviews were conducted with these land owners. The Survey Section designed and selected the sample, assisted in writing the questionnaire, conducted the interviews, and will edit and code the data.

County road use by rural residents is the topic of the third study being conducted for researchers in the Department of Economics. Personal interviews were conducted with residents of a 10-mile square area in each of three Iowa counties. Approximately 550 farmers and 600 nonfarm rural residents will be interviewed during the data collection phase. Survey Section personnel assisted with the questionnaire

design, conducted the interviews, edited and validated the information, and are currently coding the data.

Personal interviews with 201 residents of a central Iowa community were completed by Survey Section field interviewers. The project, conducted by a research worker in the Department of Family Environment, seeks to learn about the relationship between money management knowledge, attitudes, and practices and the financial decision-making in a household. Survey Section staff drew the area sample, conducted the interviews, edited, and coded the data.

A sample of names from farm and ranch directories for four Iowa counties was selected for an investigator in the Department of Sociology. This sample was selected as a control group for an earlier project in which 600 telephone interviews were conducted with farm operators to determine the use of certain tillage practices on Iowa farms.

Separate random-digit samples of telephone numbers were chosen in each of nine Iowa counties selected purposively by a researcher in the Department of Food and Nutrition. Volunteers in the counties will do the telephoning. Households contacted in this manner will be screened and, if a household contains a person meeting certain age and sex criteria, permission for a personal interview with that person will be sought. Completed interviews with about 50 men and 50 women between the ages of 35 and 54 are desired from each county.

Random-digit dialing was also used to select a sample of households for researchers in the departments of Sociology and Family Environment. The study is concerned with how families deal with stress. Survey Section personnel carried out a telephone screening operation to identify households meeting certain eligibility criteria. Personnel from the departments of Sociology and Family Environment conducted personal interviews with the households so identified. A similar service was provided for a Home Heating Index Study. Again, the Survey Section selected the sample of numbers and carried out a screening operation to identify eligible households. In this study, data was collected by mail. Survey Section personnel handled the mailing operation, involving approximately 1,000 questionnaires.

Coding is being completed on 1,100 questionnaires filled out by veterinarians and livestock operators for a researcher in the College of Veterinary Medicine. The study will help determine practices associated with drug usage in livestock production. The Survey Section assisted with writing the questionnaire, coded the data, completed the data processing, and will assist with analyses.

Assistance in designing a sample of ISU faculty was given to a member of the Department of English interested in determining what faculty consider to be acceptable levels of English writing skills for students whose native language is not English. Assistance was given to staff from CIRAS in designing a sample of Iowa manufacturing firms.

Assistance in questionnaire construction was given to a researcher in ceramic engineering interested in obtaining opinions about a professional publication from its subscribers, to a researcher in veterinary pathology interested in obtaining data on employment and income of practicing pathologists, and to the ISU Council on Instruction investigating student and faculty opinions on the "plus-minus" grading system.

Finally, critique of a sampling plan being used in a study of tillage practices in a river basin in Ohio was provided. The study is to be repeated periodically; consequently, the researchers desired an appraisal of the procedure before its next use.

Social Sciences

Mack C. Shelley II consulted with students and faculty in the departments of Political Science, Family Environment, English, and Industrial Relations. Special consulting projects included a study of the post-graduation career development of distributed studies majors, sponsored by the College of Sciences and Humanities, and analysis of Nursing Admissions Remediation study data compiled by Northeast Iowa Technical Institute. Other topics included congressional voting on rural electrification, child visitation rights, home design and home energy conservation, English mistakes by nonnative speakers, salaries of Iowa county officials, and accident rates in Iowa foundries. Shelley also served as tabulation coordinator for collection of 1982 Iowa election data by the News Election Service.

Leroy Wolins consulted on the research of a doctoral candidate in psychology who surveyed nonmedical psychotherapists. The questions asked dealt with stress, anxieties, and irrational beliefs held by these therapists. The percentage of returns and the quality of responses were not better than for other groups responding to mail questionnaires. Consistent with this, the correlations among the questions were rather high, indicating a particular response set typically found in attitude and personality measurement. Generally, despite what would appear to be a rather sophisticated group of respondents, the results provided no evidence of being more informative than results typically found in mail surveys. Factor analysis revealed several correlated factors that were related to therapists' attitudes, such as sex, age and setting (e.g., private practice, clinic, hospital). The mean responses, relating to the kinds of incidents considered most stressful or the more frequently held irrational beliefs, seemed more informative than the correlational results.

Engineering Research Institute

Consulting on the following projects, on the part of H. T. David, S. Vardeman, and Michael Tveite, was made possible through the support of the Engineering Research Institute, in the form of an assistantship for Tveite.

Bonding strength of mortar to brick was studied for various brick treatments and mortar mixtures; a covariance analysis provided a model incorporating both the unquantified brick treatments and the mortar mixture component levels. Related projects called for regression studies of earthquake magnitudes and the evaluation of alternative construction protocols.

A predictive time series model, based on plant records, was developed for sewage flow through a treatment plant. The intent was to improve plant efficiency. Emissions from a municipal power plant also were modeled, on the basis of data obtained from atmospheric samples.

Conversion of starch to glucose was studied, in the first phase of a project concerned with the conversion of corn to alcohol. Response surface methodology was employed with the aim of determining energy efficient combinations of starch concentration and temperature. A related project, in quantitative chemical analysis, called for a multivariate analysis of variance.

The retirement of railroad capital investments was studied, using modifications of standard failure time models. These modifications allowed for parameter heterogeneity, as well as for the fact that the pertinent retirement data are recorded in dollars, rather than in the form of item counts. A related study called for inference on the parameters of extreme value distributions.

Interpolation methodologies, in particular, kriging and the multiquadric method of geodesy, were studied and applied. Special attention was given to the definition and estimation of error for such procedures.

Other Consulting

C. Philip Cox consulted with graduate students and faculty in the departments of Veterinary Physiology and Pharmacology, Immunobiology, Animal Science, and Entomology on a variety of problems. Two involved determination of a bioassay response/dose relationship and the design and analysis of an EPA bioassay, using fathead minnows in aquaria, to estimate LC50's of insecticides. Other problems ranged from the analysis of data, involving repeated measures, from an investigation of swine immunological responses, to assessment of the relevance of a statistical model for describing prenatal growth, and to fitting a Poisson-type distribution to sets of variate values for which it is known that $P[\text{variate} = 0] = 0$.

For a graduate student in civil engineering, the parametrically nonlinear regression model:

$$\sqrt{(x_{ij}^2 + y_{ij}^2)} + \varepsilon_{ij} = \beta_0/(\sin \theta_i - \beta_1 \cos \theta_i)$$

where $i = 1,...,I$ and $j = 1,...,J$, was theoretically devised by Cox as the basis for estimating the parameters β_0 and β_1 which are measures of characteristics of materials being tested. Standard nonlinear regression programs confirmed the relevance of the model, which gave excellent fits to laboratory data.

Current Research

This section summarizes research sponsored by contracts or supported by grants, as well as individual research. Research funds are made available through the budgets of the Statistical Laboratory, the Iowa Agriculture and Home Economics Experiment Station, the Engineering and the Sciences and Humanities Research Institutes 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

Work on foundations of statistics by Oscar Kempthorne has continued, and is summarized below.

Undoubtedly the processes of science call on some processes of inference. However, it is thought that the methods of inference used in science do not address the so-called classical problem of inference, which is to determine probabilities of causes. It is clear that one can obtain a probability from a logical development only if probability is entered at the beginning. So, then, to obtain probabilities of causes it is necessary to start from an assumed prior distribution: In other words, one must be a Bayesian. But then the total obscurity of how one is to choose a prior distribution makes the classical problem totally unsolvable, except in a personal and subjective way. It might be thought that one can justify a choice of a prior by data analysis and by assuming that the situation being addressed is a random member of a class of situations of which past data situations are also random members. This is, of course, a sort of empirical Bayes procedure in that it assumes existence of a prior distribution which one then estimates. But the classical problem of inference still remains because completion of the development requires a prior distribution on the prior distribution. The processes of science depend instead on the development of models by data collection and analysis, and then by falsification of suggested models by the use of tests, which are very often statistical. The process is then completed by inversion of statistical tests. The outcome is a partial inference, of the type that is presented in ordinary statistical methods. This line of thought places statistical tests, and not estimation, at the center of what is called statistical inference. To avoid assumptions that are unprovable and often untenable in the case of controlled experiments, the use of experiment randomization and of randomization tests is essential. The direction of thought has required extensive study of the work of past leaders.

Other aspects that have been pursued by Kempthorne, in collaboration with doctoral students, are as follows: best linear unbiased prediction and kriging; use of shrinkage estimators in linear model theory; model fitting for a logistic stochastic model; linear models with patterned error structure as in split-plot experiments.

Small Area Estimation

Cooperative research with the Statistical Reporting Service, United States Department of Agriculture, continued under the direction of Wayne Fuller. Yasuo Amemiya and graduate assistants Rachel Harter and Hsien-Ming Hung worked on the project. The objective of the study was to improve methods of combining satellite information with information collected in the June Enumerative Survey.

Hung investigated the use of alternative functions of the vector of satellite readings in regression estimation. Estimates of the probability that a reading was generated by a particular crop were constructed.

Research was conducted on extensions and modifications of the small area estimation procedure based upon the nested error model. The computer program was expanded to permit the inclusion of prior estimates of variance components in the analysis. Extension of the procedure to stratified sampling led to a study of the estimation of multivariate components of variance.

AES Project 2155

During the past year, a major portion of this project centered around the 1982 National Resources Inventory, a national survey that includes nearly 1,000,000 sample sites. Data have been collected on land use and cover, wind and water erosion, characteristics of soils, conservation needs, prime farmland availability, wetlands, and other natural resources.

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 has continued to grow, over 21,000 records currently being stored. The rate of updating this dynamic data set has again increased as the SCS field staff attempt to keep the data current and to meet deadlines for compatibility with the 1982 NRI. Over 12,000 records were updated during the year. Immediate access to the interpretations data from remote processing stations in the SCS state offices is an increasingly popular enhancement. Numerous programs for tabular and other output have been made available. The main new addition to the data system this year has been the creation of the Map Unit Use File (MUUF). This file will eventually contain a record for each map unit

T. A. Bancroft, Statistical Laboratory director and department head from 1950 to 1972, takes part in the 1970 dedication of Snedecor Hall.

Yasuo Amemiya, Tin-Chiu Chua, Jason Jones, and Neerchal Nagaraj.

A model for the response error associated with reported categorical data was developed. The model was used to construct estimators for the interior cells of a two-way table with marginal proportions subject to independent response error. The estimation procedure was applied to the two-month table of employment status obtained from the U.S. Current Population Survey. A limited number of tests suggest that the data are consistent with the model.

Methods of constructing predictions in a population with independent variables subject to measurement error were investigated. Large sample properties of the predictors were derived and the procedures were applied in a study of earthquake magnitudes.

Estimation of the parameters of an autoregressive process with a mean that is a function of time was studied. Approximate expressions for the bias of the least squares estimator of the autoregressive parameters that is due to estimating the unknown mean function were derived. Using the approximate expressions, a method of modifying the least squares estimators of the autoregressive parameters was developed. The approximate theory was checked with a Monte Carlo study and, generally speaking, the modified least squares estimators performed better than the least squares estimators.

AES Project 2596

Ronaldo Iachan, one of two principal investigators of a National Marine Fisheries Service grant project, "A Sampling Design to Survey Offshore Populations of Surf Clams and Ocean Quahogs," has started to develop sampling strategies for shellfish surveys. Different stratification and clustering techniques have been examined. A graduate student in animal ecology, Chris Gledhill, is currently studying the effect of changing stratum boundaries in the NMFS clam surveys. Estimators using auxiliary information will also be investigated.

Mathematical and Statistical Genetics

Research in mathematical and statistical genetics has been conducted by Edward Pollak. It was shown that the Ewers sampling formula can be extended to a situation in which the sequence of population sizes at times 0,1,2, . . . is generated by a finite irreducible Markov chain, which may possibly be periodic, and offspring are produced in accordance with the Wright-Fisher model. The outcome is that this formula holds if the fixed population size N is replaced by the effective population size N_e, which is the reciprocal of the asymptotic average, over possible population sizes, of the reciprocals of these sizes.

A second topic that was investigated was the theory for two sex-linked loci in infinite random mating age-structured populations. It was assumed that there is a single life table for all genotypes and both sexes and that the proportions among the sexes and age groups do not change with time. It has long been known for the corresponding discrete generation theory that the differences between allele frequencies in the two sexes, as well as the gametic disequilibrium, approach zero geometrically in the long run. In age-structured populations the corresponding quantities among individuals in age group 0 seem to decrease in a comparable way, if the "generation interval" is approximated by the mean age of parents.

Pollak has also initiated research on the sampling theory for finite monoecious populations that reproduce partially by selfing and partially by random mating.

Order Statistics and Nonparametric Statistics

Under a grant from the Army Research Office, H. A. David has completed research, joint with W. B. Yeo, on selection through an associated characteristic. In subsequent work he is using a somewhat different approach for selection of the best object in which inferences are conditional on the observed values of the associated measurements. The earlier more general work on the selection of the best k out of n objects is unconditional, being concerned with planning selection prior to the availability of any observations. David has also prepared the entry on Order Statistics for the *Encyclopedia of Statistical Sciences*.

Malay Ghosh is working on the asymptotic theory of jackknifed and bootstrapped estimators. Sharpest Berry-Esseen rates are obtained for studentized jackknife estimators and jackknifed functionals of U-statistics under the weakest possible moment conditions. Also, some results justifying the asymptotic validity of a bootstrapped estimator of the population median are obtained. Another subject under investigation is the study of the rate of convergence to normality for linear functions of concomitants of order statistics. Some of this research was done on a visiting appointment subsequent to Ghosh's resignation from Iowa State.

Ghosh and W. Robert Stephenson are studying the two-sample location problem. Using a subsampling scheme, they have developed a general class of test statistics that includes the Mann-Whitney-Wilcoxon statistic. Efficiency and power considerations indicate that some members of the class do well in comparison to existing test statistics.

Bayesian and Decision Theoretic Statistics

Research in the general area of Bayesian and decision theoretic statistics was done by Glen Meeden and Stephen Vardeman. Particular areas of interest were admissibility and uniform admissibility considerations for finite population sampling, the comparison of probability assessors and Bayesian set estimation. This work was supported by a grant from the National Science Foundation.

Limit Theorems for Branching Processes and Markov Chains

During a visit to this campus in October 1982 Larry Shepp posed a problem on Cascades on a binary tree. K. B. Athreya solved this and extended the work to a more general supercritical Galton-Watson branching tree.

Other recent work concerned Harris recurrence and Strong mixing. It is known that a positive recurrent aperiodic Markov chain with discrete state space is necessarily Strong mixing for any initial condition. It is now shown by Athreya, using the methods of regenerative atoms, that the same result holds for the more general Harris recurrent chains that are aperiodic and admit a finite invariant measure. Some applications to nonexplosive autoregressive processes are given.

This work was supported by a grant from the National Science Foundation.

Sciences and Humanities Research Institute (SHRI)

SHRI funds help to support the research activities of Yasuo Amemiya, Dean Isaacson, Mervyn Marasinghe, and Glen Meeden. Areas of research covered by these faculty members include multivariate analysis, linear models and statistical computing, stochastic processes, and Bayesian statistics.

Yasuo Amemiya investigated estimation problems for several versions of multivariate structural and functional relationships. For the model with an independent estimator of the covariance matrix of the measurement error, the limiting behavior of maximum likelihood type estimators was investigated for a wide class of assumptions about the unobservable true values. An estimation procedure was proposed for the functional model, when observations on instrumental variables are available. Large-sample properties of the estimator were investigated.

Dean Isaacson's work centered on Markov chains with special emphasis on nonhomogeneous chains. Work in progress includes work on the ergodicity of constant causative Markov chains in continuous time and the determination of the basis for discrete time chains.

Results of a study by Mervyn Marasinghe on the effects of a single location shift type outlier on several robust t-statistics were presented at the 50th Anniversary Conference held here in June. Research on methods for multiple outlier detection in linear regression and on tests for nonadditivity in two-way classification continues. Marasinghe also began new research on computational aspects of analysis of variance models.

Glen Meeden considered several problems in Bayesian statistics, working with Malay Ghosh, Dean Isaacson, and Stephen Vardeman. Part of this work was supported by grants from the National Science Foundation and is reported earlier.

Other research

Currently used methods for the exact interval estimation of relative potency in direct assays, when tolerances are normally distributed, involve cumbersome iteration, based on the Sukhatme d-statistic, because of heterogeneous variance, or are approximate. A procedure has now been obtained by C. Philip Cox which is both exact and noniterative.

Emmanuel Yashchin considered the following topics of research during the year: Tauberian theory related to extreme value theory; weak asymptotic properties of iterated distribution functions and their applications; estimation of the exponent of regular variation based on a Type II censored sample in the presence of an unknown threshold parameter.

While visiting the department for the fall of 1982, John T. Webster worked on developing analytic methods for comparing two-way classification layouts for the estimation of variance components. He also continued research on the changes in the latent roots and vectors of a variance matrix when the diagonal elements are reduced. The results were applied to factor analysis and the evaluation of multivariate normal probabilities.

Sonny Loo engaged in research in the areas of concomitants of order statistics and the theory of competing risks. Chang Dorea has been working with H. T. David on general statistical optimization problems.

Professional Activities

H. A. David attended the 11th International Biometric Conference, Biométrie 82, held September 6-11 in Toulouse, France, in his capacity as president of the Biometric Society. On June 30 he completed a three-year term on the U.S. Army Basic Research Committee, National Research Council.

Wayne Fuller and Bill Meeker completed their 1982 terms as chair and secretary-treasurer, respectively, of the Business and Economics Section, American Statistical Association. ASA committee memberships include the following: H. A. David, Ad Hoc Committee on Filming of Distinguished Statisticians; Herbert T. David, Committee on Publications (through 1982); Leroy Wolins, *Journal of Educational Statistics* Management Committee. Kenneth J. Koehler has been secretary of the Iowa chapter of the American Statistical Association.

Oscar Kempthorne continued to chair the R. A. Fisher Award Committee under the Committee of Presidents of Statistical Societies (COPSS).

Donald Hotchkiss was vice president (president-elect) of the Iowa State chapter of Phi Kappa Phi. He was selected to represent Iowa State University at the triennial convention of Phi Kappa Phi, held on August 15-18 at the University of Maryland; he also served as discussion leader regarding chapter budgeting, finance, and scholarship funds.

Jauvanta Walker was elected to a two-year term as second vice president of the Iowa Poetry Association.

Hotchkiss went to San José, Costa Rica, for the period May 29-July 29, 1982, to take part in a faculty exchange program between Iowa State University and the University of Costa Rica. He served as statistical consultant to the College of Agriculture, and presented a short course on basic statistical methods and design of experiments to the food technology faculty.

Oscar Kempthorne chaired the H. O. Hartley Memorial Session at the 1982 joint statistical meetings in Cincinnati, Ohio. Hartley was a member of the faculty here from 1953 to 1963. Herbert T. David chaired a session on Education of Engineers to Use Statistics to Get the Most Quality and Productivity out of Technology; Wayne Fuller chaired a session on Outliers in Economic Data, as well as the Economic Outlook Luncheon. William Q. Meeker, Jr., chaired a session on Life Testing. He also served as an instructor—with W. B. Nelson and J. I. McCool—for a short course, "Applied Life Data Analysis," offered on August 14-15 under American Statistical Association sponsorship in conjunction with the annual meetings.

William J. Kennedy chaired the arrangements committee for a reunion banquet for alumni and friends of the Iowa State University Department of Statistics and Statistical Laboratory. This was held on August 18 during the Cincinnati meetings.

Richard Groeneveld is receiving an honorable mention award for most outstanding presentation, for a contributed paper with Glen Meeden given at the Cincinnati meetings. Announcement of the award came from the ASA Section on Physical and Engineering Sciences.

Krishna Athreya and three graduate students attended the 4th Midwest Probability Colloquium held at Northwestern University October 15-16.

Thomas Bubolz and Kennedy attended Computer Science and Statistics: the 14th Annual Symposium on the Interface, held at Rensselaer Polytechnic Institute July 5-7, 1982. Joined by Bud Meador and Vincent Sposito, they attended the 15th symposium, in Houston, Texas, March 16-18, 1983, for which Kennedy was a program committee member and Sposito chaired a session on Numerical Algorithms.

David F. Cox attended the SAS Users Group International Conference held in New Orleans, La. in January.

Herbert T. David visited Louisiana State University on October 14-15 to chair an evaluatory committee to review an M.S. program in applied statistics. Wayne Fuller went to Washington, D.C., for the same period to attend a meeting of a panel on redesign of demographic surveys, held at the Bureau of the Census. On October 24-25 Kenneth J. Koehler served on a panel, in Washington, D.C., of reviewers for grant proposals submitted to the National Institutes of Health.

Ping Fang attended the 1st China/USA Soybean Symposium and Working Group Meeting, held at the University of Illinois-Champaign/Urbana, July 26-30, 1982.

Fred Lorenz was organizer and chair of the Survey Research Methods Session for the Midwest Sociological Society meetings in April.

Harvey Terpstra was honored as Business Associate of the Year 1983 by the Silver Satellite chapter of the American Business Women's Association. His nominator, Survey Section co-worker Margaret Fowler, is shown here with him.

Stephen Vardeman attended a conference on Statistics, Product Design and Quality Control, sponsored by the University of Wisconsin, American Society for Quality Control, and the American Statistical Association, and held in Madison, Wis., June 1-3.

Papers Presented, Lectures, and Seminars

At the 1982 joint statistical meetings of the American Statistical Association, the Biometric Society (ENAR and WNAR), and the Institute of Mathematical Statistics, Cincinnati, Ohio, August 15-19:

Auer, Richard E. (Loyola College) and Chien-Pai HAN (University of Texas—Arlington): "Shrinkage estimators for the mean of a stratified normal population";

DAVID, Herbert A.: "Order statistics in overlapping samples, moving order statistics and U-statistics" (E.S. Pearson Memorial Session);

Escobar, Luis A. (Louisiana State University) and William Q. MEEKER, Jr.: "Planning accelerated life tests with Type II censored data";

FULLER, Wayne A.: discussion leader, Roundtable Luncheon on Errors in Variables, Business and Economic Statistics Section;

GROENEVELD, Richard A., and Glen MEEDEN: "Measures of skewness";

Hale, Michael D. (Monsanto Research Corporation and Iowa State University): "Attainable bounds for generalized moments via mathematical programming";

HARVILLE, David A., and Robert W. Mee (Southern Methodist University): "A mixed-model procedure for analyzing ordered categorical data";

KEMPTHORNE, Oscar: "Biometry: The Pearson and Fisher controversies";

KOEHLER, Kenneth J.: "Making inferences from categorical data: Illustrating the limitations of observational studies";

MEEDEN, Glen, and Stephen VARDEMAN: "Admissible Hidiroglou-Srinath type estimators for a population total";

STEPHENSON, W. Robert: "In search of undergraduates" and "A wary look at the rank transform in regression."

At the Midwest Sociological Society meetings, Kansas City, Mo., April 13-14:

LORENZ, Frederick O., and David L. Rogers: "Impact of federal grants on local government capacity";

Nelson, Gary D., and Frederick O. LORENZ: "A case study of regional councils of government."

At other locations:

AMEMIYA, Yasuo: "Estimation for the nonlinear errors-in-variables model," at North Carolina State University, March 25, 1983.

ATHREYA, Krishna B.: "Modeling of random phenomena with special reference to Brownian motion" and "A brief look at information theory and entropy," at the Institute for Advanced Studies of the Assam Science Society, Guwahati, Assam, India, August 5-6, 1982.

BAILEY, Theodore B., Jr.: "A comparison of three root viability tests to determine freeze injury in container-grown evergreens," by Frank D. Gibbons, III, John P. Mahlstede, Cecil R. Stewart, and Bailey, at the 79th annual meeting of the American Society for Horticultural Science, Ames, Iowa, held on August 8-13.

"Estimation of genetic effects and errors from use of the Design II," at the annual North Central Regional-2 meetings (Corn Quantitative Genetics session), Chicago, Illinois, February 22.

COX, David F.: "Multiple comparison procedures for data evaluation," Agronomy seminar, Iowa State University—cosponsored by the Iowa chapter of the American Statistical Association, February 21.

"Experiments in animal breeding," Animal Science seminar, Iowa State University, February 28.

DAVID, Herbert T.: "Saddlepoint solutions as behavioral norms," at the State University of New York—Albany, April 6.

FULLER, Wayne A.: "Estimators of changes in employment status," at the Statistical Research Division, U.S. Bureau of the Census, Washington, D.C., February 22.

"Estimating changes in employment status" and "Measurement error models," at Montana State University, May 3 and 4.

GHOSH, Malay (University of Florida): "A new Bayesian analysis of a random effects model," by Ghosh and Glen MEEDEN, at the NBER-National Science Foundation Seminar on Bayesian Inference and Econometrics, Gainesville, Fla., April 1.

GOEBEL, J. Jeffery: "Integrating soil, water, and related resource data through survey sampling," on October 13, at the 1982 Integrated Data Users Workshop cosponsored by the U.S. Geological Survey and Oak Ridge National Laboratory, held in Reston, Va.

"The NRI data: Geographical display and accuracy," on February 23, at the Data Users Workshop held at the Soil Conservation Service Southern Technical Center, Ft. Worth, Texas.

GROENEVELD, Richard A.: "Maximal deviations between finite population parameters and their sample estimates with extensions," at Virginia Polytechnic Institute and State University, April 1.

"Maximal deviation between certain finite population parameters and sample estimates," at The Wharton School, University of Pennsylvania, April 22.

HARVILLE, David A.: "Assigning probabilities to the outcomes of horse races and other multi-entry competitions," at meetings of the North Texas chapter of the American Statistical Association, Dallas, Texas, February 23, and the Austin chapter, in Austin, Texas, May 26.

"Unbiased quasi-linear prediction in mixed linear models and in general," at Southern Methodist University, February 24; at

the University of Texas, Austin, March 9; at Texas A&M University, March 23; and at the University of Houston, May 6.

"Confidence intervals for variance ratios in mixed linear models," at the 1983 Conference for Texas Statisticians, Baylor University, April 22.

HINZ, Paul N.: "The influence of substrate on muskellunge egg mortality," by Michael P. Dombeck, Bruce W. Menzel, and Hinz, at the 44th Midwest Fish and Wildlife Conference, held in Des Moines, Iowa, December 12-15.

ISAACSON, Dean: "Markov chains and their applications," at Luther College and Wartburg College, November 4 and 5.

JOHNSON, Robert A.: "Analysis of cohort effects in marital fertility," at the U.S. Bureau of the Census, Washington, D.C., March 30, and at Carnegie-Mellon University, March 31.

"Urbanization and growth of cities," for ISU World Population Day, Iowa State University, March 15.

KENNEDY, William J.: "An advanced tutorial on random number generation," by Kennedy and James E. Gentle, December 6 at the Winter Simulation Conference 1982, held by the Society for Computer Simulation, San Diego, Calif.

LORENZ, Frederick O.: "Spatial allocation rules, community characteristics and the LWCF distribution patterns in New England: Is there a funding bias?" by Gary Mattson and Lorenz, at the 15th annual meeting of the Mid-continent Regional Science Association, Oklahoma City, Okla., June 6.

MEEDEN, Glen: "Some admissible pseudo Bayes estimators in finite population sampling," by Meeden and **Stephen B. VARDEMAN,** at the spring meeting of the Institute of Mathematical Statistics, Central Region, Nashville, Tenn., March 23.

"Unbiasedness as the dual of being Bayes," at the University of Florida, April 4—based on joint work by **Siamak Noorbaloochi** (Tehran, Iran) and Meeden.

SHELLEY, Mack C., II: panel discussant on the 1982 Iowa gubernatorial contest, Iowa State University, sponsored by Pi Sigma Alpha, October 19.

"United States Senate elections, 1914-1980," Political Science seminar, Iowa State University, November 11.

"U.S. Senate elections, 1914-1982: Regional differences and historical trends," at the annual meeting of the Midwest Political Science Association, Chicago, Ill., April 23.

"The upcoming Presidential election," general lecture, Iowa State University, June 30.

SPOSITO, V. A.: "L_1 norm estimates using a descent approach," by **Lee Ann Josvanger** and Sposito, at Computer Science and Statistics: 15th Symposium on the Interface, Houston, Texas, March 18.

STRAHAN, Robert F.: "Methods for the measurement and statistical analysis of psychological androgyny," at the annual convention of the American Psychological Association, held in Washington, D.C., August 23-27.

WOLINS, Leroy: "Looking at data derived from social science research," at Mississippi State College, Jackson, December 16.

50th Anniversary Conference Statistics: An Appraisal

STATISTICS: AN APPRAISAL, a three-day international conference, was held at Iowa State University, on June 13-15, to mark the 50th anniversary of the Statistical Laboratory. The planning committees were, for program: H. A. David, chair; David F. Cox, Herbert T. David, Wayne A. Fuller, Oscar Kempthorne, and William J. Kennedy; for local arrangements: T. B. Bailey, chair and housing; J. Jeffery Goebel, registration and publicity; Donald K. Hotchkiss, hospitality; Dean L. Isaacson, transportation; Kenneth J. Koehler, banquet; and Jauvanta M. Walker, information services. Roy Hickman and W. Robert Stephenson were in charge of historical and other exhibits.

The detailed program is given below. As in the preceding section, Statistical Laboratory staff and graduate students participating are named in boldface type. A proceedings volume covering the invited sessions and including abstracts of contributed papers will be edited by H. A. David and H. T. David for publication by the Iowa State University Press.

The conference was made possible in part through grants and gifts from the U.S. Army Research Office, U.S. Office of Naval Research, National Science Foundation, Pioneer Hi-Bred International, Inc., the university Graduate College, alumni, faculty, and special friends.

Monday, June 13, Morning

Welcome

H. A. DAVID and W. Robert Parks, president, Iowa State University

Historical Setting

Chair: Emil H. Jebe (University of Michigan)

Eisenhart, Churchill (National Bureau of Standards): "The state of statistics in 1933"

DAVID, H. A.: "The Iowa State Statistical Laboratory: Antecedents and early years, 1914-47"

BANCROFT, T. A.: "Highlights of some expansion years of the Iowa State Statistical Laboratory, 1947-72" [presented by **Herbert T. DAVID**]

George W. Snedecor Lecture

Chair: Oscar KEMPTHORNE

Cox, D. R. (Imperial College, London, England): "Long-range dependence: A review" [photo on p. 46]

Monday, June 13, Afternoon

Experimental Design

Chair: Paul C. Homeyer (formerly Research Triangle Institute)

Federer, Walter T. (Cornell University): "Principles of statistical design with special reference to experiment and treatment design"

Raghavarao, D. (Temple University): "A review of the constructions and combinatorial problems in block designs"

John, Peter W. M. (University of Texas—Austin): "The growth of experimental design in engineering"

Discussant: Virgil L. Anderson (Purdue University)

Contributed Papers Session I—Ordered Observations and Information

Chair: Vincent A. SPOSITO

DOREA, Chang C. Y. (Universidade de Brasilia and Iowa State University): "Applications of extreme value theory to random optimization methods"

Jobe, J. Marcus: "Limiting error rates for discrimination between two Poisson intensity functions"

Nagaraja, H. N. (Ohio State University): "On the information contained in an order statistic"

Papaioannou, Takis (University of Ioannina, Greece): "On measures of statistical information and their properties"

YASHCHIN, Emmanuel: "Estimation of the exponent of regular variation in the presence of an unknown threshold parameter"

Data Analysis

Chair: Klaus Hinkelmann (Virginia Polytechnic Institute and State University)

Ehrenberg, Andrew S. C. (London Business School, England): "Data analysis with prior knowledge"

Tukey, John W. (Princeton University and Bell Laboratories): "Data analysis: history and prospects"

Wilk, Martin B. (Statistics Canada): "The role of data in data analysis" [Speaker/discussant]

Contributed Papers Session II—Multivariate and Univariate Problems

Chair: S. Sukhatme

Dickey, David A. (North Carolina State University): "Testing for stationarity in multivariate autoregressions"

Lee, Youngjo: "Estimation of multivariate normal means and its application to the mixed linear model"

Pantula, Sastry G. (North Carolina State University): "Computing estimators and estimated covariance matrices for the factor model"

Yang, Shie-Shien (Kansas State University), and Yejain Lee (ibid.): "A method of identifying outlying multivariate observations"

Singh, H. P. (Indian School of Mines, Dhanbad, India), L. N. Upadhyaya (ibid.), and Ronaldo IACHAN: "On unbiased product type estimators"

Tuesday, June 14, Morning

Interpolation and Estimation

Chair: Herbert T. DAVID

Wahba, Grace (University of Wisconsin—Madison): "Cross-validated spline methods in the estimation of functions from data on functionals"

Journel, André G. (Stanford University): "Geostatistics, simple tools applied to difficult problems"

Henderson, Charles R. (Cornell University): "ANOVA, MIVQUE, REML, and ML algorithms for estimation of variances and covariances"

Discussant: David A. HARVILLE

Contributed Papers Session III—Sampling

Chair: Harold D. BAKER

Chua, Tin-Chiu: "A response model for categorical data classified in a two-way table"

IACHAN, Ronaldo, and Carol Francisco: "A study of ratio and regression estimators"

Mazloum, Reda: "Uniform admissibility in finite problems with some applications in finite population sampling"

Wright, Roger L. (University of Michigan): "Model-based stratified sampling"

Wilson, Jeffrey: "Comparing proportions for several populations when primary units are repeatedly sampled"

Models and Multivariate Applications

Chair: Robert L. Launer (U.S. Army Research Office)

Pielou, E. C. (University of Lethbridge, Alberta, Canada): "Ecological modeling and environmental protection"

Gnanadesikan, R. (Bell Laboratories), and Jon R. Kettenring (ibid.): "A pragmatic review of multivariate methods in applications"

Discussant: J. Leroy Folks (Oklahoma State University)

Contributed Papers Session IV—Design

Chair: **Leroy WOLINS**

Anderson, Virgil L. (Purdue University): "Methods to evaluate migration of radioactive wastes"

Bohidar, N. R. (Merck Sharp and Dohme Research Laboratories): "Conditional effects and interactions in symmetrical factorial confounding"

Dean, A. M. (Ohio State University): "Upper bounds for factorial efficiency factors"

Chaddha, R. L. (Bell Laboratories): "Quality improvement in product and process design"

Kackar, Raghu Nath (Bell Laboratories): "The use of factorial experiments for improving production processes"

Contributed Papers, Poster Session

Drew, David (Sheffield City Polytechnic, England): "The statistics of ethnic minorities in the United Kingdom"

Fecso, Ron (Statistical Reporting Service, U.S. Department of Agriculture) and Robert D. Tortora (ibid.): "Area frame sampling in agriculture: Developments and prospects"

Gill, Jelena Bulatovic (Michigan State University): "Markovian reductions and extensions of a filtration"

Klemm, Rebecca (Georgetown University): "A toast to Fisher and his tea lady"

Lund, Richard E. (Montana State University): "MSUSTAT—an interactive statistical analysis package, microcomputer version"

Raudsep, John (R. J. Reynolds Tobacco Company), and **Mervyn MARASINGHE:** "Confidence interval robustness under the mean shift outlier model"

Tuesday, June 14, Afternoon

Linear Models and Categorical Data Analysis

Chair: Bernard Ostle (University of Central Florida)

Rao, C. R. (University of Pittsburgh): "Recent developments in inference from linear models"

Anderson, R. L. (University of Kentucky): "Recent developments in the use of linear-plateau models to estimate response relationships"

Fienberg, Stephen E. (Carnegie-Mellon University): "Towards a comprehensive aproach to the analysis of categorical data"

Discussant: Justus F. Seely (Oregon State University)

Contributed Papers Session V—Operations Research

Chair: **Stephen B. VARDEMAN**

Fahrenholtz, Steven K. (Pillsbury Company): "Normal Bayesian two-armed bandits"

Lin, C. T.: "Traveling salesman's odyssey"

Nkansah, Paul Twum (University of Minnesota—Morris): "Network p-median problems"

Statistical Inference

Chair: Robert V. Hogg (University of Iowa)

Lehmann, Erich L. (University of California—Berkeley): "Specification problems in the Neyman-Pearson-Wald Theory"

Hinkley, David V. (University of Texas—Austin): "A hitchhiker's guide to the galaxy of theoretical statistics"

Lindley, Dennis V. (formerly University College, London): "A Bayesian lady tasting tea"

Discussant: Robert J. Buehler (University of Minnesota—Minneapolis)

Contributed Papers Session VI—Sampling Applications

Chair: **Roy HICKMAN**

Clark, Cynthia Z. F. (U.S. Office of Management and Budget): "Polling the private user of statistics and aiding his prognostications—the role of the federal overseer"

Cohen, Ayala (Stanford University): "A statistical analysis on the effect of class size on the evaluation of lecturers' performance"

Crouse, Kenneth R. (NASA/Lyndon B. Johnson Space Center): "A statistical examination of the spectral reflectance of soils"

Harter, Rachel: "Small area estimates for crop acres"

Hung, Hsien-Ming: "The use of LANDSAT conditional probabilities as auxiliary variables for crop estimation"

Sen, A. R. (Northern Illinois University): "Pattern-dependent stratification in a moving population"

Tuesday, June 14, Evening

Banquet

KEMPTHORNE, Oscar: "Revisiting the past and anticipating the future"

Wednesday, June 15, Morning

Time Series and Stochastic Processes

Chair: Edward J. Wegman, U.S. Office of Naval Research [Chair pro tem: **Wayne A. FULLER**]

Box, George E. P. (University of Wisconsin—Madison): "Aspects of the analysis of serial data"

Rosenblatt, Murray (University of California—San Diego): "Stochastic processes with short-range and long-range dependence"

Discussant: **K. B. ATHREYA**

Contributed Papers Session VII—Computing and Quality Control

Chair: **Frederick O. LORENZ**

DuBien, Janice L. (Mississippi State University): "Average retrieval under random clustering"

Mee, Robert W. (Southern Methodist University): "Lower tolerance limits for items produced in batches"

Wickremasinghe, N. (Rubber Research Institute of Ceylon), and **T. B. BAILEY:** "Estimation of effects and errors in a crossed mating design"

Survey Sampling

Chair: Daniel G. Horvitz (Research Triangle Institute) [Chair pro tem: **Roy HICKMAN**]

Hansen, Morris H. (Westat), Tore Dalenius (Brown University), and Benjamin J. Tepping (Consultant): "Some recollections and expectations on survey sampling"

Rao, J. N. K. (Carleton University, Ottawa, Canada): "Some current topics in sample survey theory"

FULLER, Wayne A.: "The Master Sample of Agriculture"

Discussant: Raymond J. Jessen (University of California—Los Angeles)

Contributed Papers Session VIII—Stochastic Processes and Graduation; Surveys

Chair: **William Q. MEEKER, Jr.**

Micali, Artibano (Université de Montpellier II, France): "Lie algebras in genetics"

Myers, Donald E. (University of Arizona): "Co-kriging: the matrix form"

Petenate, Ademir J.: "Prediction of stochastic processes using kriging and splines"

King, Donald W. (King Research, Inc.), and Jose-Marie Griffiths (ibid.): "An approach to enhancement of statistical survey databases"

Wednesday, June 15, Afternoon

Statistical Computing

Chair: Foster B. Cady (Cornell University)

Goodnight, James H. (SAS Institute): "Portable SAS"

Thisted, Ronald A. (University of Chicago): "An appraisal of statistical graphics"

Boardman, Thomas J. (Colorado State University): "Smaller computers: Impact on statistical data analysis"

Discussant: **William J. KENNEDY**

Contributed Papers Session IX—Regression

Chair: **C. Philip COX**

AMEMIYA, Yasuo: "Instrumental variable estimation for the nonlinear functional relationship model"

Escobar, Luis (Louisiana State University) and Bradley Skarpness (Virginia Polytechnic Institute and State University): "Closed form for the least squares estimator with linear inequality constraints"

Folks, J. Leroy (Oklahoma State University): "Regression models for the inverse Gaussian distribution"

Kanji, G. K. (Sheffield City Polytechnic, England): "Power aspects in analysis of variance in various models"

Searle, Shayle R. (Cornell University): "What hypotheses are tested by sums of squares produced by statistical computing packages?"

Kitagawa, Tosio (Fujitsu Limited, Tokyo, Japan): "Experimental factorial design process" [presented by **Yasuo AMEMIYA**]

(L to R) Foster B. Cady, session chair, reviews the final invited session on statistical computing with discussant William J. Kennedy and speakers Thomas Boardman and Ronald Thisted.
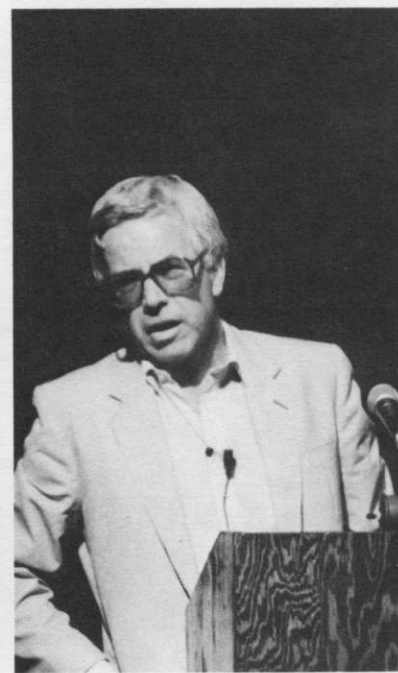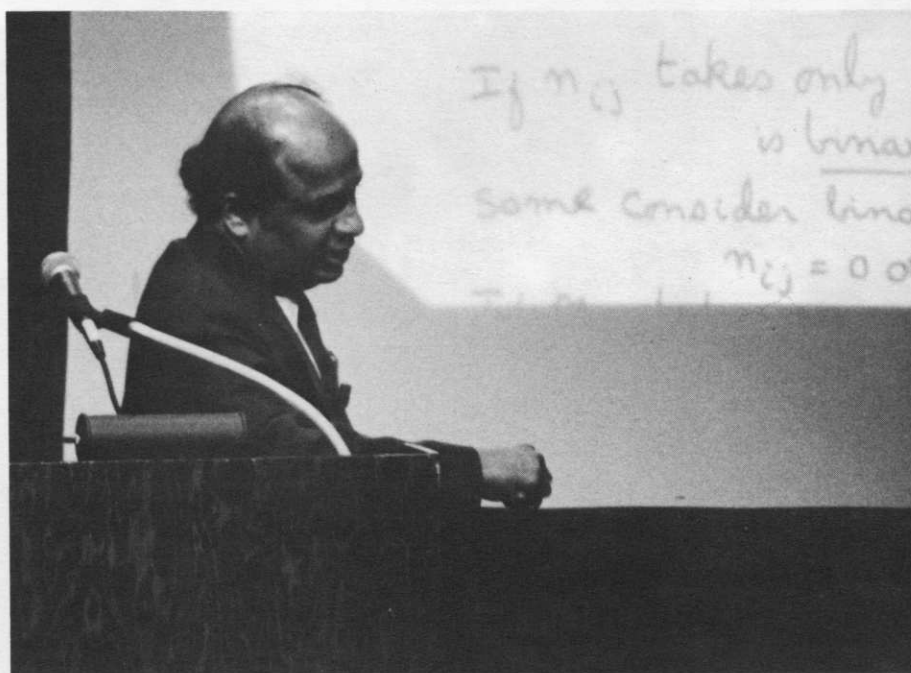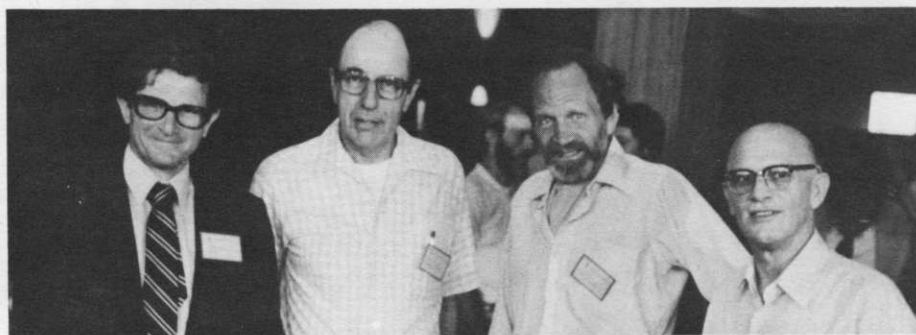
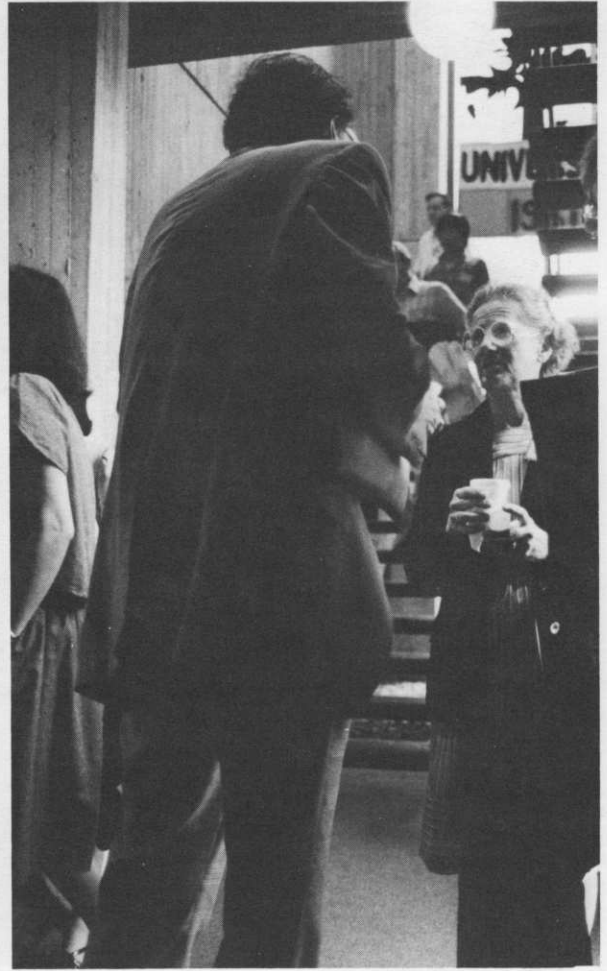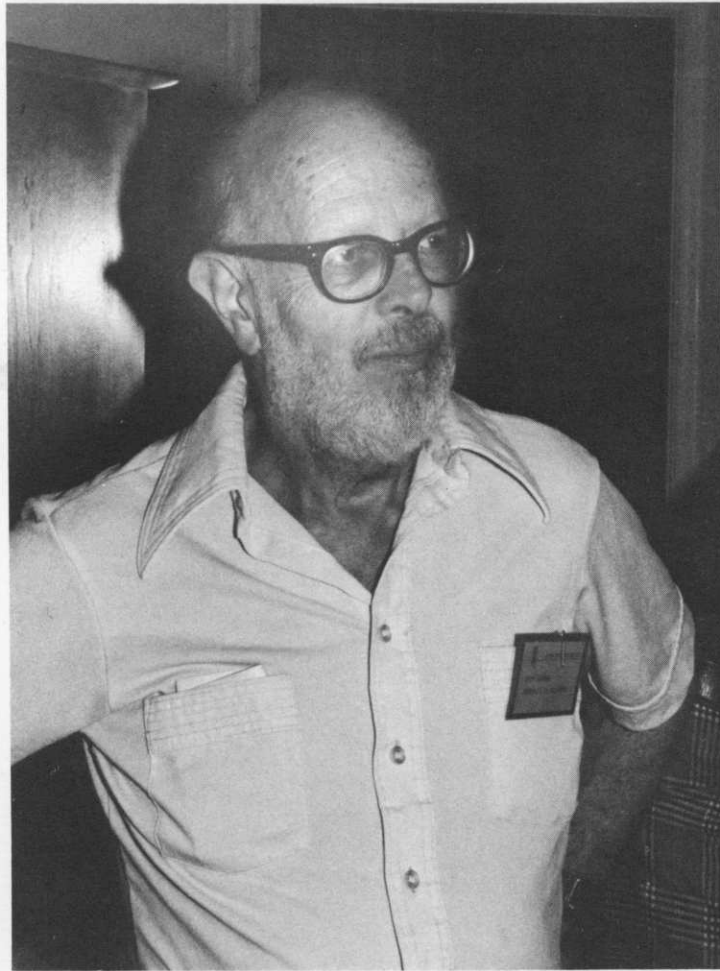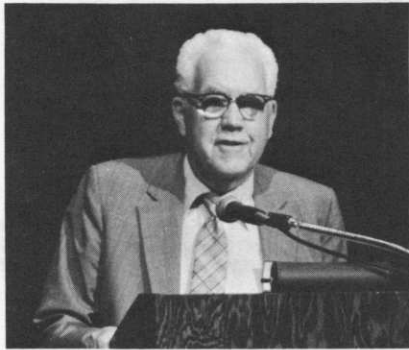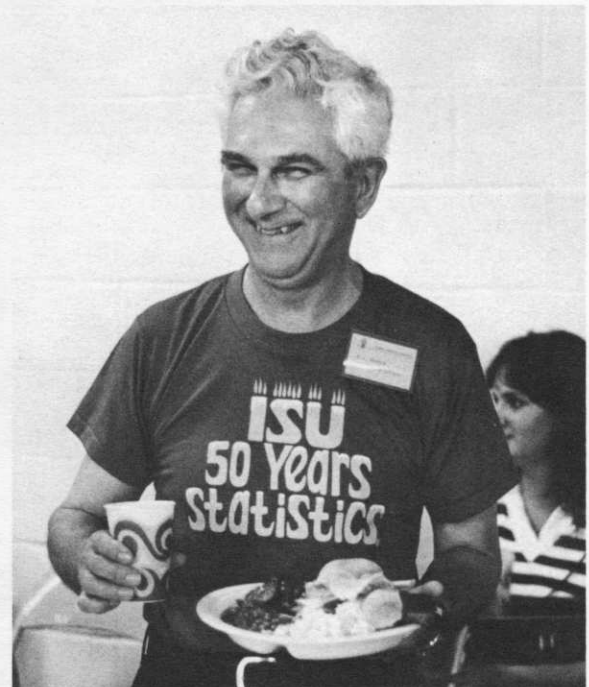# An Inside View: Conference and Celebration

Glimpses
the Past
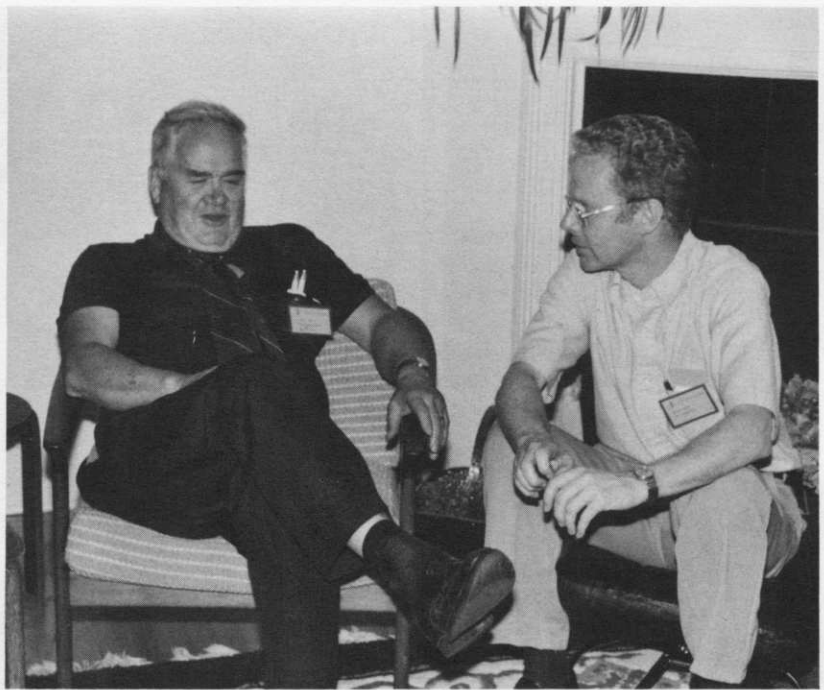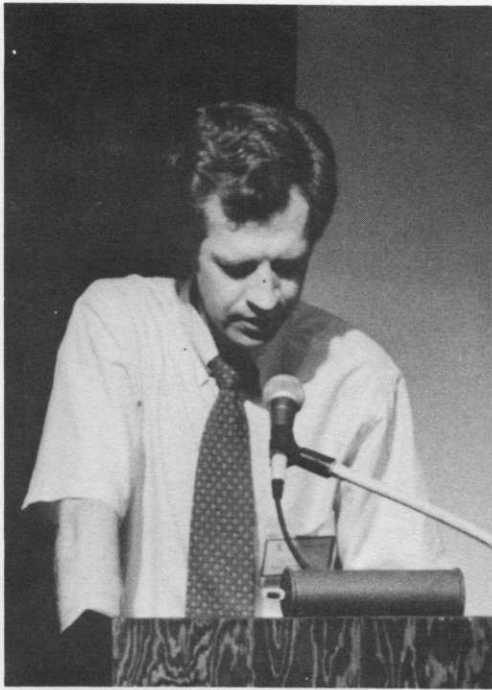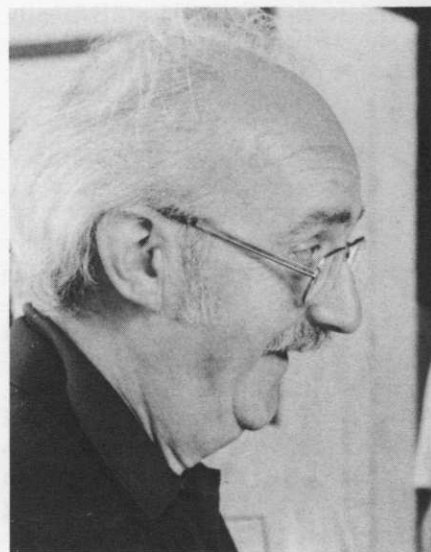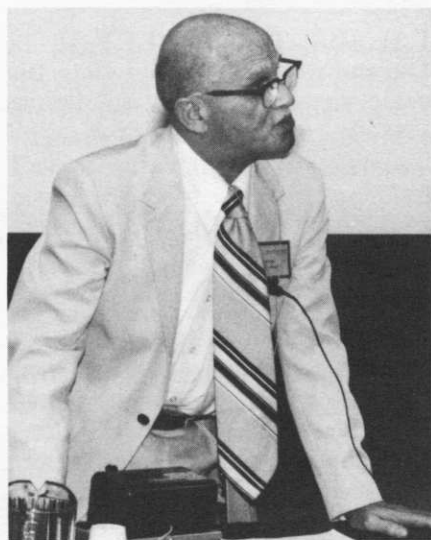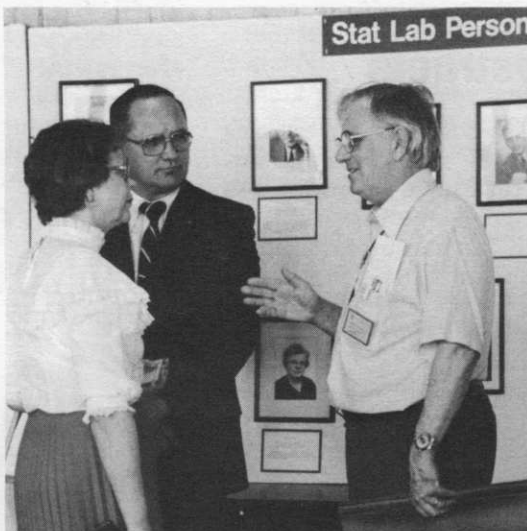
Publications and Dissertation Abstracts

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

Principal editorial positions of staff members are as follows:

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

Herbert T. David completed four years as book review editor of the *Journal of the American Statistical Association* (JASA), with Sharon Shepard as his editorial assistant.

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

Malay Ghosh has been a member of both the editorial board of *Communications in Statistics—Sequential Analysis* and the advisory board of *Statistics and Decisions*. He has also been a journal committee member for *Sankhyā* A and B.

David Harville was appointed associate editor of *JASA*.

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

Robert A. Johnson, Glen Meeden, and Malay Ghosh served as associate editors for the Book Review Section, *JASA*.

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

William J. Kennedy will serve as editor-elect of *The American Statistician* starting January 1, 1984. He has been associate editor of the journal, as well as editor of its section on New Developments in Statistical Computing. Kennedy is also coeditor of *Selected Tables in Mathematical Statistics* and both an editorial board member and coeditor of the Algorithms Section for *Communications in Statistics—Simulation and Computation*.

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

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

Book Note

It is a pleasure to see that the book on which Thomas O'Donovan was working here during the 1980-81 academic year, as visiting associate professor, has been published by Wiley. The title is *Short Term Forecasting—An Introduction to the Box-Jenkins Approach*. O'Donovan, now back at University College, Cork, Ireland, has included a dedication to William Q. Meeker, Jr.

Published Research

ATHREYA, K. B. Strong law for the Bootstrap. *Statistics & Probability Letters* 1:3 (1983) 147-150.

Let $X_1, X_2, X_3, \ldots$ be iid r.v. with $E \mid X_1 \mid < \infty$, $EX_1 = \mu$. Given a realization $X = (X_1, X_2, \ldots)$ and integers n and m, construct $Y_{n,i}$, $i = 1, 2, \ldots, m$ as iid r.v. with conditional distribution $P^*(Y_{n,i} = X_j) = 1/n$ for $1 \leq j \leq n$. (P^* denotes conditional distribution given X.) Conditions relating the growth rate of m with n and the moments of X_1 are given to ensure the almost sure convergence of $(1/m) \Sigma_{i=1}^{m} Y_{n,i}$ to μ. This question is of some relevance in the theory of Bootstrap as developed by Efron [*Annals of Statistics* 7 (1979) 1-26] and Bickel and Freedman [*ibid.* 9 (1981) 1196-1217].

Bryant, G. R., J. H. Hill, **T. B. BAILEY,** H. Tachibana, D. P. Durand, and H. I. Benner. Detection of soybean mosaic virus in seed by solid-phase radioimmunoassay. *Plant Disease* 66:8 (1982) 693-695.

Virus antigen content of soybean seeds from plants inoculated with soybean mosaic virus at different stages in field trials with 15 cultivars was determined by solid-phase radioimmunoassay. Data on yield, percentage of seeds with mottled seed coats, weight of 100 seeds, and ng virus antigen were analyzed with standard analysis of variance procedures, and treatment means were compared statistically. Correlation coefficients between seed coat mottlings and antigen content were calculated. Results of these analyses are presented and discussed.

*****BANCROFT, T. A.** Roots of the Iowa State University Statistical Center: 1914-1950. *Iowa State Journal of Research* 57:1 (1982) 3-10. SLRS 558.

The early history of statistics is outlined, and the pioneering role of Iowa State in this discipline is described. Prime mover George Snedecor, between 1914 and the mid-1920s, began a program of resident teaching, consulting services, and cooperative research. These led to work with Henry A. Wallace and creation of a Mathematics Statistical Service, which evolved into the Iowa State Statistical Laboratory, both unique in the United States prior to World War II in providing campuswide statistical consulting and computing ser-

vice. Iowa State's leadership in introducing new British statistical ideas and procedures produced extensive applications in biological and agricultural research. Snedecor's *Statistical Methods* spread the new methodology worldwide.

The growth of the statistical center at Iowa State is traced from an initial mathematics base through significant thresholds, including the development of federal support, the participation of eminent visiting statisticians, the structuring of an interdisciplinary faculty, and the organization, in 1947, of a new Department of Statistics.

Beam, C. A. Putting the shoe on the other foot. *Teaching Statistics* 4:3 (1982) 85-87.

An example is given of the use of an induction proof in elementary probability theory and its application in proving a theorem in number theory.

*COX, C. Philip, and **Chien-Pai HAN** (University of Texas—Arlington). Testing multivariate means when the covariance matrix has intraclass correlation structure. *Journal of Statistical Computation and Simulation* 16:2 (1982) 97-107. SLRS 567.

In some applications of p-variate normal analyses, the covariance matrix of the observations, or of these appropriately transformed, may depend on fewer than the $p(p + 1)/2$ parameters of the general matrix. Enhanced estimation precision and augmented power in hypothesis testing procedures may then be expected. Accordingly it can be expected that the estimation economy will increase with p (> 2) when the covariance matrix has intraclass correlation structure. It is shown that in such cases a statistic based on Fisher's method of combining independent tests can be used to test differences between means. Monte Carlo studies, and an example, illustrate the extent to which the method is more powerful than Hotelling's T^2-test in one and two sample situations.

COX, C. Philip. Reply to I. I. Good [re. The calculation of χ^2 for two-rowed contingency tables]. *The American Statistician* 37:1 (1983) 94.

Taber, H. G., and **D. F. COX.** Nitrogen effect on yield and kernel protein content of sweet corn grown on sandy soils. *Communications in Soil Science and Plant Analysis* 14.7 (1983) 585-599.

Journal Paper No. J-10847 of the Iowa Agriculture and Home Economics Experiment Station, Project 2137.

Early spring application of N to Iowa sandy, leachable soils results in reduced sweet corn yields and kernel protein content. Normally, split N applications are used to coincide with crop N demand. Our objectives were to determine if nitrapyrin, a nitrification inhibitor, applied with urea would provide high yields and kernel protein levels when applied at planting. Treatments consisted of the factorial combination of three N sources and four N rates. The

experimental design used in 1976 and 1978 employed four blocks with the main plots randomized to N rate and N sources randomized in three split plots in each main plot. Soil, ear leaf, and young and mature kernel samples were taken at appropriate intervals for analysis. Results of the treatment effects are presented and discussed.

DAVID, H. A. Cyclic designs. In *Encyclopedia of Statistical Sciences,* Vol. 2: *Classification—Eye Estimate,* pp. 256-260. Samuel Kotz and Norman L. Johnson, editors-in-chief. John Wiley & Sons, Inc. (New York). 1982.

Cyclic designs are incomplete block designs obtained by cyclic development of an initial block or blocks. Methods of systematic construction of cyclic designs, properties, and applications are reviewed.

*DAVID, H. A. Obituary notice—H. O. Hartley, 1912-1980. *International Statistical Review* 50:3 (1982) 327-330. SLRS 565.

Besides biographical information, this article gives a brief summary of Hartley's published work.

*DAVID, H. A. and **M. P. Rogers.** Order statistics in overlapping samples, moving order statistics and U-statistics. *Biometrika* 70:1 (1983) 245-249. SLRS 572.

Let $X_1, X_2, \ldots$ be a sequence of independent random variables with common distribution function $F(x)$. Also let $X^{(i)}_{r:n}$ ($i = 1, 2, \ldots$) denote the rth order statistic in ($X_i, \ldots, X_{i+n-1}$). An expression is obtained for cov ($X^{(1)}_{r:n_1}, X^{(n_1 + 1 - c)}_{s:n_2}$) in terms of the first two moments of order statistics in a sample of $n' = n_1 + n_2 - c$ drawn from $F(x)$. This result is used to study the behavior of order statistics in moving samples and to unify certain results for linear functions of order statistics expressible as U-statistics.

*DAVID, H. A., and **Lawrence C. Kinyon.** The probability that out of n events at least $r (\geq n - 2)$ occur within time span t. In *Contributions to Statistics: Essays in Honour of Norman L. Johnson,* pp. 107-113. P. K. Sen, editor. North-Holland Publishing Company (Amsterdam). 1983. SLRS 575.

The probability $P(r; n,t)$ that at least r out of n events occur within time span t has received much attention in the case where the events may be represented by n points dropped at random on the unit line (e.g. Neff and Naus, 1980). This note gives expressions for $P(n - 1; n,t)$ and $P(n - 2; n,t)$ when the times to occurrence of the events may be regarded as independently drawn from any absolutely continuous distribution. The cases $r \geq n - 2$ are of particular interest in studying the near-simultaneity of the events. For the normal distribution a table of $P(n - 1; n,t)$ is provided.

DOREA, Chang C. Y. Connectivity of random graphs. *Journal of Applied Probability* 19:4 (1982) 880-884.

We consider a random field $\{X_{ij}, i, j = 1, \ldots, n\}$ where the random variables X_{ij} take on values 1 or 0. The collection $\{X_{ij}\}$ can be viewed as a random graph with nodes $\{1, \ldots, n\}$ by interpreting $X_{ij} = 1$ as the existence of an arc emanating from the node i to the node j. Such a representation will enable us to study ordered and unordered graphs, being also the general representation of a random graph. In this note the probability that the graph is connected is computed.

DOREA, C. C. Y. Expected number of steps of a random optimization method. *Journal of Optimization Theory and Applications* 39:2 (1983) 165-171.

In this paper, we give an estimate of the expected number of steps of Matya's random optimization method applied to the constrained nonlinear minimization problem. It is also shown that, in a sense, this random optimization method can be optimized by the uniform distribution, in which case the exact value of the expected number of steps is computed.

FULLER, W. A. Cluster sampling. In *Encyclopedia of Statistical Sciences*, Vol. 2: *Classification —Eye Estimate*, pp. 22-24. Samuel Kotz and Norman L. Johnson, editors-in-chief. John Wiley & Sons, Inc. (New York). 1982.

Cluster samples are defined. Estimation and design for cluster samples are discussed.

FULLER, Wayne A. Editorial Statement: Discussion. *Journal of Business & Economic Statistics* 1:1 (1983) 6.

Hasza, David P., and **Wayne A. FULLER.** Testing for nonstationary parameter specifications in seasonal time series models. *The Annals of Statistics* 10:4 (1982) 1209-1216.

Let Y_t be an autoregressive process satisfying $Y_t = \alpha_1 Y_{t-1} + \alpha_2 Y_{t-d} + \alpha_3 Y_{t-d-1} + e_t$, where $\{e_t\}_{t=0}^{\infty}$ is a sequence of iid $(0, \sigma^2)$ random variables and $d \geq 2$. Such processes have been used as parametric models for seasonal time series. Typical values of d are 2, 4, and 12 corresponding to time series observed semiannually, quarterly, and monthly, respectively. If $\alpha_1 = 1$, $\alpha_2 = 1$, $\alpha_3 = -1$, then $\Delta_1 \Delta_d Y_t = e_t$, where $\Delta_r Y_t$ denotes $Y_t - Y_{t-r}$. If $(\alpha_1, \alpha_2, \alpha_3) = (1, 1, -1)$, the process is nonstationary and the theory for stationary autoregressive processes does not apply. A methodology for testing the hypothesis $(\alpha_1, \alpha_2, \alpha_3) = (1, 1, -1)$ is presented and percentiles for test statistics are obtained. Extensions are presented for multiplicative processes, for higher order processes, and for processes containing deterministic trend and seasonal components.

*Macpherson, Brian D., and **Wayne A. FULLER.** Consistency of the least squares estimator of the first order moving average parameter. *The Annals of Statistics* 11:1 (1983) 326-329. SLRS 571.

The consistency of the least squares estimator of the parameter of the first order moving average time series is proven for the parameter in the interval $[-1, 1]$.

Wang, George H. K., and **Wayne A. FULLER.** Estimators for a simultaneous equation model with lagged endogenous variables and autocorrelated errors. *Communications in Statistics—Simulation and Computation* 11:2 (1982) 123-142.

Two full information estimators and a limited information estimator for the simultaneous equation model with autocorrelated errors are studied by the Monte Carlo method. The estimators share features of the two-step Gauss-Newton procedure and of Aitken generalized least squares. One full information method generates the estimated endogenous variables used in the later stages of computation from the unrestricted reduced form, while the other uses a restricted reduced form. The observed small sample behavior was close to that suggested by asymptotic theory.

GHOSH, Malay (University of Florida), and **Nader Ebrahimi** (University of Missouri—Columbia). Multivariate NBU and NBUE distributions. *Egyptian Statistical Journal* 25 (1981) 36-55.

Various definitions of multivariate new better than used (NBU) and new better than used in expectation (NBUE) life distributions are introduced, and their interrelationship is studied. Examples are given to illustrate these concepts. Closure properties of multivariate NBU and NBUE distributions are also proved.

GHOSH, M., and R. Dasgupta. Berry-Esseen theorems for U-statistics in the non-iid case. *Proceedings of the International Conference on Nonparametric Inference,* organized by the Janos Bolyai Mathematica Societatis, Budapest, Hungary (1982) 293-313.

The paper obtains Berry-Esseen rates of convergence to normality for U-statistics in the non-iid case both when the sample size is fixed and when it is random.

GHOSH, Malay, and **Ahmad Razmpour** (University of Al-Fateh). Estimating the location parameter of an exponential distribution with known coefficient of variation. *Calcutta Statistical Association Bulletin* 31:123-124 (1982) 137-150.

The paper considers estimation of the location parameter of an exponential distribution with known coefficient of variation. Several estimators including the maximum likelihood estimator and the best scale invariant estimator are proposed and compared.

Huang, J. S., and **Malay GHOSH.** A note on strong unimodality of order statistics. *Journal of the American Statistical Association* 77:380 (1982) 929-930.

It is shown that order statistics from a strongly unimodal distribution are strongly unimodal.

GHOSH, Malay. Estimates of multiple Poisson means: Bayes and empirical Bayes. *Statistics and Decisions* 1:2 (1983) 183-195.

For estimating multiple Poisson means, Bayes and empirical Bayes estimates are proposed. Such estimates, under suitable loss, sometimes dominate the usual maximum likelihood estimates. A study of the "relative savings loss" of such estimates as compared to maximum likelihood estimates is also undertaken, using a Bayesian viewpoint.

*****GHOSH, Malay,** Jiunn Tzon Hwang, and Kam-Wah Tsui. Construction of improved estimators in multiparameter estimation for discrete exponential families [with a Reply to invited discussions]. *The Annals of Statistics* 11:2 (1983) 351-367 and 375-376. SLRS 573a and 573b.

This paper extends and unifies the theory of simultaneous estimation for the discrete exponential family. The authors discuss construction of estimators which theoretically dominate the uniformly minimum variance unbiased estimator (UMVUE) under a weighted squared error loss function, and show, by means of computer simulation results, that new simultaneous Poisson means estimators perform more favorably than those previously proposed. The improved estimators shift the UMVUE towards a possibly nonzero point or a data-based point. A response is given to issues raised in discussions by Berger, Morris, and Hudson, with implications for further research.

GOEBEL, J. Jeffery, and Keith O. Schmude. Quality control and evaluation for the SCS National Resources Inventories. In *In-Place Resource Inventories: Principles and Practices,* Society of American Foresters, Publication No. 82-02 (1982), pp. 871-876.

This paper discusses methods of developing and insuring quality data when studying the nation's natural resources. Particular emphasis is given to the Soil Conservation Service's National Resources Inventories of 1977 and 1982. A study to evaluate measurement error bias and variance is discussed, and results are presented.

*****GROENEVELD, Richard A.** Best bounds for order statistics and their expectations in range and mean units with applications. *Communications in Statistics—Theory and Methods* 11:16 (1982) 1809-1815. SLRS 554.

Best bounds for the order statistics are obtained in terms of the sample range and, for nonnegative samples, in terms of the sample mean. Best bounds for the differences of two order statistics are found in this case also. Corresponding bounds on the expectation of order statistics and their differences are also found. Several applications of these bounds are considered.

GROENEVELD, Richard A., and **Glen MEEDEN.** Properties of a family of location parameters for skewed distributions. *Scandinavian Journal of Statistics* 9:4 (1982) 237-240.

For a class of probability densities we study the properties of a particular family of location parameters discussed by P. J. Bickel and E. L. Lehmann [*Annals of Statistics* 5 (1975) 1045-1069]. Certain unimodal asymmetric distributions are considered. For these distributions the location parameter is monotonic in the natural parameter indexing the family. Additionally, for such distributions the closure of the set of location parameters of the family is identical to the closure of the set of all possible location measures of Bickel-Lehmann type. In the case that the support of the distribution is finite this closure is the interval from the median to the midrange. Application to Bayesian estimation is considered.

Kanwar, R. S., H. P. Johnson, D. Schult, T. E. Fenton, and **R. D. HICKMAN.** Drainage needs and returns in north-central Iowa. *Transactions of the American Society of Agricultural Engineers* 26:2 (1983) 457-464.

Journal Paper No. J-10699 of the Iowa Agriculture and Home Economics Experiment Station, Project 2450.

Current status of drainage and estimated drainage needs of the soils in the Des Moines River basin as indicated from an extensive sample survey are presented. A high percentage of the area has the potential for receiving benefits by improving county mains and on-the-farm drainage. Analyses have been made of the economic potential for drainage improvements by comparing three drainage input levels. Benefit-cost ratios indicate drainage of very poorly drained and poorly drained soils is a good investment for corn and soybean production.

Steffey, Kevin L., Jon J. Tollefson, and **Paul N. HINZ.** Sampling plan for population estimation of northern and western corn rootworm adults in Iowa cornfields. *Environmental Entomology* 11:2 (1982) 287-291.

Journal Paper No. J-9609 of the Iowa Agriculture and Home Economics Experiment Station, Projects 2250 and 2280, in part supported by Environmental Protection Agency Grant R-805429.

Sample sizes were determined for three adult corn rootworm sampling techniques. Sources of variation in the sampling plan used were analyzed with a nested analysis of variance. Plant-to-plant, ear-to-ear, and trap-to-trap variation accounted for the greatest percentage of variability, on a within-field basis, in their respective analyses. Optimum allocations of sample units were two plants per site, five ears per site, and one trap per site. Comparisons of

precision and cost of the three methods revealed that plant counts provide the most precise estimate of beetle populations for the least cost.

White, T. L., D. P. Lavender, K. K. Ching, and **P. HINZ.** First-year height growth of southwestern Oregon Douglas-fir in three test environments. *Silvae Genetica* 30:6 (1981) 173-178.

Douglas-fir seedlings from wind-pollinated seed collected from two trees at each of 36 locations throughout southwestern Oregon were grown in three test environments (growth room, greenhouse, and nursery) to assess environmental influence on genetic variation of first-year height growth. The 36 populations differed markedly in first-year height growth; the estimated variance among populations was about four times greater than both the estimated family-within-population and population × environment variances.

Regression models showed populations originating from higher elevations and southerly latitudes in the sampled areas grew slower in all test environments. While trends were consistent in all environments, the model for the nursery was not as efficient in accounting for variation in population means. This may have resulted from poorer differentiation among populations owing to the shorter nursery growing season.

IACHAN, Ronaldo. Systematic sampling: A critical review. *International Statistical Review* 50:3 (1982) 293-303.

The main purpose of this paper is to present the developments in systematic sampling posterior to the review by W. R. Buckland [*Journal of the Royal Statistical Society*, Series B, 1951].

*****ISAACSON, Dean,** and E. Seneta. Ergodicity for countable inhomogeneous Markov chains. *Linear Algebra and Its Applications* 48 (1982) 37-44.

A notion of ergodicity is defined by analogy to homogeneous chains, and a necessary and sufficient condition for it to hold for an inhomogeneous Markov chain is given in terms of matrix products. A comparison with the situation for homogeneous chains is made. A final section discusses the better-known notion of strong ergodicity in relation to geometric convergence rate.

Scott, Mark (Mayo Clinic), **Barry C. ARNOLD** (University of California, Riverside), and **Dean L. ISAACSON.** Strong ergodicity for continuous-time non-homogeneous Markov chains. *Journal of Applied Probability* 19:3 (1982) 692-694.

Characterizations of strong ergodicity for Markov chains using mean visit times can be found in several papers. In this paper a characterization of uniform strong ergodicity for a continuous-time non-homogeneous Markov chain is given.

Scott, Mark, and **Dean L. ISAACSON.** Proportional intensities and strong ergodicity for Markov processes. *Journal of Applied Probability* 20:1 (1983) 185-190.

By assuming the proportionality of the intensity functions at each time point for a continuous-time non-homogeneous Markov process, strong ergodicity for the process is determined through strong ergodicity of a related discrete-time Markov process. For processes having proportional intensities, strong ergodicity implies having the limiting matrix L satisfy $L \cdot P(s,t) = L$, where $P(s,t)$ is the matrix of transition functions.

*****KEMPTHORNE, Oscar,** and **Leroy WOLINS.** Testing reveals a big social problem. *The Behavioral and Brain Sciences* 5:2 (1982) 327-336. SLRS 561.

The causes and nature of human intelligence have been under recurring controversy over the past century, with the dominant question being the role of nature and nurture in the causation of mental abilities. The controversy reached a new height with the writings of Arthur Jensen starting from 1969, in which the thesis is that heredity or nature is the dominant force. Then, because the association of mental test results with genetic relationship was undoubtable, a criticism was raised that the mental tests are erroneous. Jensen wrote a book entitled *Bias in Mental Testing*. The present paper is an invited review of that book, and concludes that Jensen has made a strong case for his views that the common tests of mental ability are not biased against any minority groups. The paper also includes general discussion of the phenomenon of the existence of variability in mental ability, with the concomitant societal problems.

KEMPTHORNE, Oscar. Comments [on "Ethical Guidelines for Statistical Practice: Report of the Ad Hoc Committee on Professional Ethics"]. *The American Statistician* 37:1 (1982) 14.

This short note takes the view that there is a definite need for some guidelines, especially in view of the existence of strongly different basic philosophies of statistical data analysis.

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

The aim 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 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.

*KEMPTHORNE, Oscar. [invited Essay Review] A review of *R. A. Fisher: An Appreciation,* by S. E. Fienberg and D. V. Hinkley (eds.), *Lecture Notes in Statistics,* New York: Springer-Verlag, 1980. *Journal of the American Statistical Association* 78:382 (1983) 482-490. SLRS 574.

A seminar was held in 1979 at the University of Minnesota on the work of R. A. Fisher, and then a volume of presented papers was published under the title: *R. A. Fisher: An Appreciation.* This invited book review gives an appraisal of the volume, with evaluation of the various papers. It also includes discussion of the whole Fisher contribution to statistics, including, especially, that part of the contributions, fiducial inference, which Fisher himself valued, it seems, above all else.

KOEHLER, Kenneth J., and **Harold Ridpath** (National Veterinary Services Laboratory). An application of a biased version of the Bradley-Terry-Luce model to professional basketball results. *Journal of Mathematical Psychology* 25:3 (1982) 187-205.

Some extensions of the Bradley-Terry-Luce model for paired comparisons are presented and used to assess the nature of the home court advantage for professional basketball teams. It is shown how maximum likelihood estimates for these models can be obtained from a simple iterative scaling algorithm.

*KOEHLER, Kenneth J. A simple approximation for the percentiles of the t distribution. *Technometrics* 25:1 (1983) 103-105. SLRS 568.

Data-analytic techniques are used in the construction of a simple approximation for the percentiles of the t distribution. The approximation is a direction function of the degrees of freedom and the tail probability. It is easily evaluated with a pocket calculator and should provide sufficient accuracy for most applications.

Gladfelter, H. Lee, James M. Kienzler, and **Kenneth J. KOEHLER.** Effects of compound bow use on deer hunter success and crippling rates in Iowa. *The Wildlife Society Bulletin* 11:1 (1983) 7-12.

Logit models are used to analyze data from yearly samples of bow hunters in Iowa. It was found that,

after adjusting for the season, experience of the hunters, and number of days spent hunting, users of compound bows were associated with higher odds of killing a white-tailed deer. There was no strong association between bow type and the odds of crippling a deer.

*Lewis, Jerry W. (Louisiana State University), and **Edward POLLAK.** Genetic identity in subdivided populations. I. Two equal-sized subpopulations. *Theoretical Population Biology* 22:2 (1982) 218-240. SLRS 563.

Moments of the steady state frequency spectrum (probabilities of identity of samples of genes) are obtained for a subdivided population by using standard recursive identity by state calculations. These moments are used to obtain variances for some measures of genetic identity, including Nei's normalized genetic identity (I) and genetic distance ($- \log_e I$). The results are compared with those obtained from the corresponding undivided population theory, including adjustments to the effective number to try to account for subdivision. Undivided population approximations based on effective number are surprisingly accurate, regardless of the migration rate, when sampling exclusively from one subpopulation.

Yamanaka, Keiko, H. C. Chang, and **Frederick O. LORENZ.** Modernity and fertility preferences in Taiwan. *The Sociological Quarterly* 23:4 (1982) 539-551.

Data from interviews with 973 Taiwan women between the ages of 15 and 44 having at least one child and living with husbands are used to study the effects of modernity and social status on fertility preferences. The modern attitudes contribute significantly to the explanation of fertility preferences independent of social status variables. Social status variables also contribute directly to the explanation of fertility preferences. But there is little evidence to support theories that modernity acts as an intervening variable between social status and fertility preferences.

LORENZ, Frederick O., and John L. Tait. Regional councils in Iowa: Their development, structure, and activities. *Sociology Report* 154. Ames: Iowa State University. 1983. iv + 76 pp.

Regional councils are voluntary associations of local governments. This report describes the development of the 16 Iowa regional councils as they attempted to deal with problems that transcend traditional political boundaries, and as they respond to federal incentives and mandates. The study found that participation in regional councils was high among all types of local governments, but decision-making authority was concentrated among county goverment officials.

MARASINGHE, Mervyn G., and William J. KEN-NEDY, Jr. Direct methods for generating extreme characteristic roots of certain random matrices. *Communications in Statistics—Simulation and Computation* 11:5 (1982) 527-542.

Computer generation of extreme characteristic roots of random matrices is considered. The usual approach in Monte-Carlo applications is to randomly generate the matrix and then compute desired characteristic roots. There are, however, theoretical results about the distribution of individual characteristic roots which might be used as a basis for computing algorithms. This alternative approach is considered for the Wishart and Beta matrices.

*MARASINGHE, Mervyn G., and Dallas E. Johnson. A test of incomplete additivity in the multiplicative interaction model. *Journal of the American Statistical Association* 77:380 (1982) 869-877. SLRS 564.

Consider the multiplicative interaction model defined by $y_{ij} = \mu + \tau_i + \beta_j + \lambda\alpha_i\gamma_j + \epsilon_{ij}$, $i = 1, 2, \ldots, t$, $j = 1, 2, \ldots, b$, where it is assumed that $\Sigma_i \tau_i = \Sigma_j\beta_j = \Sigma_i \alpha_i = \Sigma_j \gamma_j = 0$ and $\Sigma_i \alpha_i^2 = \Sigma_j\gamma_j^2 = 1$. It is also assumed that the ϵ_{ij} are distributed NID $(0, \sigma^2)$. This article derives the likelihood ratio test of H_0: $H\alpha = 0$ and $G\gamma = 0$ vs. H_a: $H\alpha \neq 0$ or $G\gamma \neq 0$, where H is a $q \times t$ matrix of row contrasts of rank q and G is an $r \times b$ matrix of row contrasts of rank r. An approximation to the critical points of the test statistic is given, and tables are given for a few selected values of b, t, q, and r. An improved estimator of σ^2 is derived, and all results are illustrated with an example.

Kemp, K. E., and Mervyn G. MARASINGHE. Computational efficiency of Anova programs based on a reparameterization. *Journal of Statistical Computation and Simulation* 17:2 (1983) 79-89.

A technique that allows estimation and hypothesis testing with regard to the original parameters of an analysis of variance model using parameter estimates of a reparameterized model is discussed. The efficiency of using the proposed technique for solving the normal equations is also discussed.

*MEEDEN, Glen, and Malay GHOSH. Choosing between experiments: Applications to finite population sampling. *The Annals of Statistics,* 11:1 (1983) 296-305. SLRS 570.

Suppose that a statistician is faced with a decision problem involving an unknown parameter. Before making his decision he can carry out one of two possible experiments. Assume that he may choose at random which of the two experiments he will observe. For this problem a decision procedure for the statistician is a triple consisting of the randomizing probability measure he uses to choose between the experiments, the decision function he uses if he observes the first experiment, and the decision function he uses if he observes the second experiment. The main theorem of this paper identifies the set of such admissible triples when the parameter space and the sample spaces of the two experiments are finite. This result is then used to find some uniformly admissible procedures for some problems in finite population sampling.

Hahn, Gerald J., and William Q. MEEKER, Jr. Pitfalls and practical considerations in product life analysis—Part 1: Basic concepts and dangers of extrapolation. *Journal of Quality Technology* 14:3 (1982) 144-152.

Important decisions are frequently made from the analysis of product life and field data using various graphical and analytical methods. Simple methods, such as fitting a Weibull distribution to the data, however, may give wrong answers, especially when estimates beyond the data range are desired, under certain conditions. The first part of this paper reviews the major purposes of product life analyses, briefly describes some of the standard methods and indicates some pitfalls associated with the use of simple methods. The hazards are illustrated by the analysis of human mortality and electromechanical device data. The second part of the paper discusses pitfalls resulting from product mixtures, proposes some general models for product life analysis, and suggests remedial approaches.

Hahn, Gerald J., and William Q. MEEKER, Jr. Pitfalls and practical considerations in product life analysis—Part 2. Mixtures of product populations and more general models. *Journal of Quality Technology* 14:4 (1982) 177-185.

This is the second part of a two-part paper. The first part dealt with some basic concepts and pitfalls of the analysis of product life data and presented two examples that illustrated the problems of extrapolation. In this part, we discuss problems in dealing with life data from a mixture of product populations, propose some general models for product life, and suggest some remedial approaches.

MEEKER, William Q., and Gerald J. Hahn. Sample sizes for prediction intervals. *Journal of Quality Technology* 14:4 (1982) 201-206.

Prediction intervals provide bounds to contain the results of a future sample, based upon the results of a past sample from the same population. Such intervals are frequently required in quality control. This paper deals with sample size requirements for obtaining a prediction interval to contain a single future observation, and more generally the mean of a future sample, from a normal population. Charts, tables and a numerical example are provided. The extension of the concepts to other situations, such as a prediction interval to contain *all* of k future observations and one to contain the standard deviation of a future sample, is indicated.

*Nagaraja, H. N. (The Ohio State University). Some nondegenerate limit laws for the selection differential. *The Annals of Statistics* 10:4 (1982) 1306-1310. SLRS 566.

The difference between the average of the top k out of n order statistics and the population mean expressed in population standard deviation units is known as the selection differential. This paper obtains some nondegenerate limit laws for this quantity. The results are applied to the construction of tables used in testing for outliers.

*POLLAK, Edward. The rate of mutant substitution in populations with overlapping generations. *Genetical Research,* Cambridge. 40:1 (1982) 89-94. SLRS 557.

We consider an age-structured population that is observed at times t = 0, 1, 2, ... It is assumed that for each t there is the same number of individuals of a particular sex and age group. Another assumption we make is that an offspring of a specified sex has at all times the same probability of having a parent of a particular age and sex. It is shown that the rate of substitution of neutral mutants is $\bar{v}/L$, where $\bar{v}$ and L are respectively equal to the mean fraction of mutants among gametes succeeding in forming newborn individuals and the mean age of reproduction. This result also applies to monoecious populations. The substitution rate is also derived for advantageous mutants in a monoecious population. Once again, the mutation rate in the usual expression is replaced by $\bar{v}/L$. Implications of these results are discussed.

*POLLAK, Edward, and **Terrance P. CALLANAN.** Convergence of two-locus gamete frequencies in random mating age-structured populations. *Mathematical Biosciences* 62:2 (1982) 179-199. SLRS 562.

We study two models describing infinite random mating age-structured populations. Under model I, the number of matings at any time is proportional to the number of mature females at that time, and the fecundity of a mating is assumed to be a product of factors that depend upon the ages of the mates, but not upon sex. Under model II, individuals can mate only with others of the same age group, and the number of matings of individuals of an age group is, at any time, proportional to the number of females of that age group. If model II holds, or the special case of model I in which the fecundity of all matings is the same, it is possible to show that, in the long run, allele frequencies converge and the gametic disequilibrium approaches zero at a geometric rate. A heuristic argument and a numerical example suggest that these things are also more generally true for

model I. A good approximation to the time that it takes to reduce the gametic disequilibrium by a fraction equal to the recombination rate turns out to be the measure of the generation interval in Leslie's theory of population growth.

*Sedcole, J. Richard (Grasslands Division, Department of Scientific and Industrial Research, Palmerston North, New Zealand). A review of the theories of heterosis. *Egyptian Journal of Genetic Cytology* 10:2 (1981) 117-146. SLRS 556.

Heterosis may be defined as (1) the increased vigor of the F_1 over the mean of the parents, or (2) the increased vigor of the F_1 over the better parent. This review is mainly concerned with the second definition. Experimental results and theories about what causes heterosis are reviewed. It is concluded that the causes of heterosis remain somewhat enigmatic and that the existence of single-locus heterosis at the gross character level seems impossible to prove. On balance, it appears that, at the gross character level, heterosis seems to be caused by nonallelic interaction.

SHELLEY, Mack C., II. Presidents and the conservative coalition in the U.S. Congress. *Legislative Studies Quarterly* 8:1 (1983) 79-96.

The paper examines interactions between six modern presidents and the conservative coalition of Republicans and southern Democrats in the Congress from 1953 to 1980. Using simple index measures and some elementary nonparametric methods, it is shown that presidential party is strongly related to rates of policy agreement between individual presidents and congressional conservatives. Coalition size among conservatives in the House and Senate is an important determinant of a president's success and of the success of conservative proposals within Congress. It is found that Congress generally influences a president's program more than the president influences the conservatives' policy successes, and that both these influences are largely negative, rather than positive.

*SPOSITO, V. A. On unbiased L_p regression estimators. *Journal of the American Statistical Association* 77:379 (1982) 652-653. SLRS 560.

Consider the familiar linear model y = Xβ + e. In an ingenious article by Sielken and Hartley [*Journal of the American Statistical Association* 68 (1973) 639-641], it was shown how one can construct a computational scheme that will generate unbiased L_1 or L_∞ estimators even when multiple solutions exist. In a recent paper, Harvey [*Communications in Statistics* A7 (1978) 779-783] provides a simple proof of unbiasedness for L_p estimators, $1 < p < \infty$, under the assumption that the linear model is of full column rank; this insures that the estimator is unique.

In this note it is shown that Sielken and Hartley's computational scheme can be extended to include unbiased L_p estimators, $p \geq 1$, without requiring a rank condition.

Skarpness, Brad (Virginia Polytechnic Institute and State University), and **V. A. SPOSITO.** A note on Gordan's Theorem over cone domains. *International Journal of Mathematics and Mathematical Sciences* 5:4 (1982) 809-812.

This note presents a proof of Gordan's Theorem over general closed, convex cone domains which follows in a natural way appealing to the standard definitions of closed convex cones and their respective polar cones.

*Josvanger, Lee Ann, and **V. A. SPOSITO.** L_1 norm estimates for the simple regression problem. *Communications in Statistics, Part B—Simulation and Computation* 12:2 (1983) 215-221. SLRS 569.

It is well known that estimates of the parameters, (α,β), in the simple linear model $y = \alpha + \beta x + e$, can be obtained under L_1 by formulating the problem as a linear programming problem. This paper presents a computational procedure to obtain L_1 estimates using a descent technique. Moreover, a simulation study is conducted showing that this descent approach is considerably more efficient in terms of total computational time than the best known L_1 simplex algorithms.

SPOSITO, V. A., M. L. Hand, and **Bradley Skarpness.** On the efficiency of using the sample kurtosis in selecting optimal L_p estimators. *Communications in Statistics—Simulation and Computation* 12:3 (1983) 265-272.

This paper examines the efficiency of the sample kurtosis in obtaining L_p estimates as an estimate of central tendency for symmetric distributions. Moreover, guidelines are established for determining an optimal value of p based on the sample kurtosis.

STRAHAN, Robert F. More on JCP publication: Single versus multiple authorship. *Journal of Counseling Psychology* 29:4 (1982) 430-431.

The number of authors per article was recorded for volumes of the *Journal of Counseling Psychology* (JCP) at five-year intervals from 1954 to 1979. Consistent with publication trends in other scientific fields, there has been here as well a marked tendency toward multiple authorship. The percentage of multiple-author articles increased from about one-fourth in 1954, the first year of JCP's publication, to about three-fourths in 1979. Reasons are discussed for this long-term change in publication practice.

*STRAHAN, Robert F. Assessing magnitude of effect from rank-order correlation coefficients. *Educational and Psychological Measurement* 42:3 (1982) 763-765. SLRS 555.

While Spearman's rho (r_s) and Kendall's tau (t) are equally powerful rank-order correlation coefficients under conditions of normality, they have quite different metrics. When applied to the same data set, t typically is smaller in absolute value, often no more than two-thirds the size of r_s. Although these facts are duly stated in a number of works on nonparametric statistics, they are omitted in many other, less detailed presentations. Given increasing concern with the degree to which a statistical effect exists—rather than just whether an effect is present at all—this difference in correlational metric appears to need emphasis.

Tilton, James C., **Stephen B. VARDEMAN,** and Philip H. Swain. Estimation of context for statistical classification of multispectral image data. *IEEE Transactions on Geoscience and Remote Sensing* GE-20:4 (1982) 445-454.

Recent investigations by the authors have demonstrated the effectiveness of a contextual classifier that combines spatial and spectral information employing a general statistical approach. This statistical classification algorithm exploits the tendency of certain ground-cover classes to occur more frequently in some spatial contexts than in others. Indeed, a key input to this algorithm is a statistical characterization of the context: the context function. Here we discuss an unbiased estimator of the context function which, besides having the advantage of statistical unbiasedness, has the additional advantage over other estimation techniques of being amenable to an adaptive implementation in which the context-function estimate varies according to local contextual information. Results from applying the unbiased estimator to the contextual classification of three real Landsat data sets are presented and contrasted with results from noncontextual classifications and from contextual classifications utilizing other context-function estimation techniques.

Feigin, Paul D., and **Emmanuel YASHCHIN.** Extreme-value properties of the explosion-time distribution in a pure birth process. *Journal of Applied Probability* 19:3 (1982) 500-509.

In each of a large number N of independent cells a breakdown mechanism is under way and proceeds until the first of the cells actually fails. At such a time, in each cell, the situation reverts to some initial state and the mechanism restarts. In this paper we consider those mechanisms for which breakdown may be modeled as the explosion of a pure birth process. Of interest is the distribution of time between failures and the possibility of estimating N and/or model parameters by observing a sequence of failure times. Saddlepoint approximation methods are used in the relevant extreme-value theory analysis for two important cases.

Feigin, Paul D., and **Emmanuel YASHCHIN.** Asymptotic behaviour of integral functions connected with an infinite convolution of exponential

densities for small values of the argument. *Journal of Mathematical Analysis and Applications* 88:2 (1982) 348-354.

Consider a d.f. F of the infinite convolution of exponential densities ($\Sigma\, 1/\lambda_i < \infty$). The asymptotic expansions for several integral functions related to F [for example, $\tau(t) = \int_{-\infty}^{\infty} \exp\{-te^w - w\} \sin(2\pi\tau w)dw$] were obtained for $t \downarrow 0$. The results were shown to be related to the difference-differential equation considered by N. G. de Bruijn in connection with K. Mahler's partition problem.

Book Reviews

ATHREYA, K. B. *Martingale Limit Theory and Its Application,* by P. Hall and C. C. Heyde. New York: Academic Press, 1980. xii + 308 pp. Reviewed in *Journal of the American Statistical Association* 78:381 (1983) 210-211.

BUBOLZ, Thomas A. *Computer Science and Statistics: Proceedings of the 13th Symposium on the Interface,* by William F. Eddy (ed.). New York: Springer-Verlag, 1981. xiii + 378 pp. $24.00 (paperback). Reviewed in *Journal of the American Statistical Association* 78:382 (1983) 511.

IACHAN, Ronaldo. *Current Topics in Survey Sampling,* by D. Krewski, R. Platek, and J. N. K. Rao (ed.). New York: Academic Press, 1981. xv + 509 pp. $29.50. Reviewed in *Journal of the American Statistical Association* 77:380 (1982) 943-944.

KEMPTHORNE, Oscar. *Randomization Tests,* by Eugene S. Edgington. Marcel Dekker, New York, 1980, 304 pp. $29.50. Reviewed in *Biometrics* 38:3 (1982) 864-867.

How to make tests of significance in comparative experiments has been a concern for some decades. To avoid unverifiable assumptions, a procedure first given by Fisher, but not supported later by him, is the use of randomization tests. Such tests are now highly regarded by a subset of statisticians. The book under review is the first full booklength presentation of the topic.

MEEKER, William Q., Jr. *Statistical Software—A Comparative Review,* by Ivor Francis, North Holland, 1981, xx + 542 pp., $70.00. Reviewed in *Technometrics* 24:4 (1982) 339-340.

MEEKER, William Q., Jr. *Statistical Models and Methods for Lifetime Data,* by J. F. Lawless, John Wiley and Sons, Inc., New York, N.Y., 1982, and *Applied Life Data Analysis,* by Wayne Nelson, John Wiley and Sons, Inc., New York, N.Y., 1982. Reviewed in *Quality Progress* 16-1 (1983) 11-12.

SHELLEY, M. C. A review of three books: *Introductory Statistics for the Behavioral Sciences* (4th ed.), by Robert K. Young and Donald J. Veldman. New York: Holt, Rinehart and Winston, 1981. x + 687 pp. $19.95. *Basic Statistics for the Behavioral Sciences,* by Kenneth Pfeiffer and James N. Olson. New York: Holt, Rinehart and Winston, 1981. xv + 444 pp. $19.95. *Selltiz, Wrightsman and Cook's Research Methods in Social Relations* (4th ed.), by Louise H. Kidder. New York: Holt, Rinehart and Winston, 1981. xii + 483 pp. $14.95. Reviewed in *Journal of the American Statistical Association* 77:379 (1982) 692-694.

SHELLEY, Mack. *The Readable Maths and Statistics Book,* by Barry Edwards. London: George Allen & Unwin, 1980. ix + 328 pp. $29.50 ($13.50 paperback). Reviewed in *Journal of the American Statistical Association* 78:382 (1983) 504.

VARDEMAN, Stephen. *Finite Mixture Distributions,* by B. S. Everitt and D. J. Hand. New York: Methuen, 1981. xi + 143 pp. $14.95. Reviewed in *Journal of the American Statistical Association* 77:379 (1982) 691.

VARDEMAN, Stephen. *Probability and Statistics for Engineering and the Sciences,* by Jay L. Devore. Monterey, CA: Brooks/Cole Publishing, 1982. xii + 640 pp. $28.95. Reviewed in *Journal of the American Statistical Association* 77:380 (1982) 940.

WOLINS, Leroy. *Handbook in Research and Evaluation—for Education and the Behavioral Sciences,* by Isaac Stephen and William B. Michael. San Diego, California: EdITS, 1981. Pp. iv + 234. $8.95. Reviewed in *Educational and Psychological Measurement* 42:2 (1982) 710-711.

WOLINS, Leroy. *Rating Scale Analysis: Rasch Measurement,* by Benjamin D. Wright and Geofferey N. Masters. Chicago, IL: MESA Press, 1982. xi + 206 pp. $24.00 (paperback). Reviewed in *Journal of the American Statistical Association* 78:382 (1983) 497.
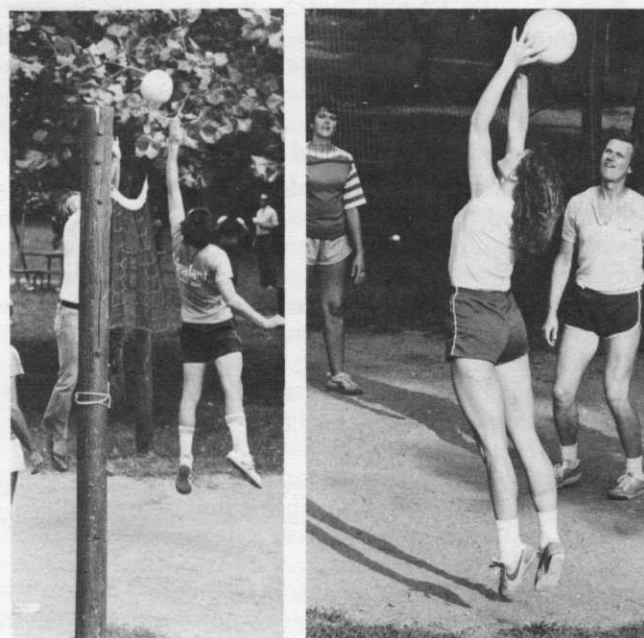
High jinks at the traditional fall picnic, 1982.

Thesis Abstracts

Amemiya, Yasuo. Estimators for the errors-in-variables model. Ph.D. thesis, Iowa State University Library, December 1982.

Estimators of the parameters of the multivariate linear errors-in-variables model and the nonlinear errors-in-variables model are investigated. The multivariate linear errors-in-variables model is defined by

$$\underline{Y}_t = \underline{\beta}_0 + \underline{x}_t \, \underline{\beta} + \underline{e}_t,$$
$$\underline{X}_t = \underline{x}_t + \underline{u}_t, \qquad t = 1,2,\ldots,n,$$

where $\underline{Y}_t$ and $\underline{X}_t$ are observable random row vectors of dimensions r and k, respectively, $\underline{e}_t$ and $\underline{u}_t$ are unobservable error vectors, $\underline{x}_t$ is an unobservable random or fixed vector, $\underline{\beta}_0$ is a $1 \times r$ vector of parameters, $\underline{\beta}$ is a $k \times r$ matrix of parameters, and $\underline{\varepsilon}_t = (\underline{e}_t, \underline{u}_t)$ are independently and identically distributed with mean zero and covariance matrix $\underline{\Sigma}_{\varepsilon\varepsilon}$. It is assumed that an independent estimator $\underline{S}_{\varepsilon\varepsilon}$ of $\underline{\Sigma}_{\varepsilon\varepsilon}$ is available.

Under the assumption that the $\underline{\epsilon}_t$ are normally distributed and that $\underline{S}_{\varepsilon\varepsilon}$ is a multiple of a Wishart matrix, the maximum likelihood estimators are obtained for the model with fixed $\underline{x}_t$ and the model with normally distributed $\underline{x}_t$. The asymptotic properties of the estimators are derived under minimal assumptions.

The nonlinear errors-in-variables model is defined by

$$Y_{nt} = f(\underline{x}_t; \underline{\beta}) + e_{nt},$$
$$\underline{X}_{nt} = \underline{x}_t + \underline{u}_{nt}, \qquad t = 1,2,\ldots,b_n,$$

where $\underline{x}_t$ is an unobservable fixed row vector of dimension q, $(Y_{nt}, \underline{X}_{nt})$ are observed in the n-th experiment, $\underline{\beta}$ is a $k \times 1$ vector of parameters, and $(e_{nt}, \underline{u}_{nt})$ are independently distributed with mean zero and covariance matrix Σ_n. It is assumed that $n = a_n b_n$ for all n and that $\Sigma_n = O(a_n^{-1})$. For the nonlinear model with known Σ_n, the asymptotic bias of the normal maximum likelihood estimator is obtained. A class of estimators adjusted for the nonlinearity bias is given. Three estimators in the class are discussed and compared in a Monte Carlo study.

The instrumental variable estimator of $\hat{\beta}_n$ of $\underline{\beta}$ is defined for the nonlinear model with unknown Σ_n when additional information is provided by an observable vector $\underline{W}_{nt}$. The asymptotic properties of $\hat{\beta}_n$ and of estimators of Σ_n and $\underline{x}_t$ based on $\hat{\beta}_m$ are derived. A modified instrumental variable estimator $\tilde{\beta}_n$ of $\underline{\beta}$ is constructed using $\hat{\beta}_n$ as a preliminary estimator. The estimator $\tilde{\beta}_n$ is shown to be asymptotically more efficient than $\hat{\beta}_n$.

Auer, Richard E. Shrinkage estimators for multiple parameters. Ph.D. thesis, Iowa State University Library, December 1982.

The estimation of a parameter vector for multivariate distributions has been studied extensively in the classical, Bayesian, empirical Bayes, and James-Stein framework. Shrinkage estimation procedures of Thompson [*Journal of the American Statistical Association* 63 (1968) 113-122] and Albert [*Journal of Multivariate Analysis* 11 (1981) 400-424] are extended to form new estimators of such parameter vectors. These estimators are given for the normal, Poisson and gamma setting and the consequences of varying the focus and flexibility of the shrinkers are studied. When possible, the resulting estimators are given an empirical Bayes interpretation.

These estimators are also utilized in estimating the mean of a stratified normal population.

Using the method of moments technique, an empirical Bayes estimator of a multivariate scale parameter vector is developed and studied.

Also, multivariate estimators are proposed that improve upon the simultaneous estimation procedures of Brown [*Journal of the American Statistical Association* 70 (1975) 417-427] and Shinozaki [*ibid.* 75 (1980) 973-976]. The major tool is the use of integration by parts techniques in solving basic differential inequalities.

When possible, the estimators are evaluated through simulation studies.

Brandon, Dennis Leroy. An investigation of the statistical analysis system as a data management tool. M.S. thesis, Iowa State University Library, December 1982.

Major considerations in the design and implementation of data base management systems are reviewed. The SAS software package is evaluated as a data base management system. While it is neither a fully relational nor a semirelational system, the SAS package does allow some flexibility and is found to be suitable for some specific applications.

Christenson, Peter David. Variable selection in multiple regression. Ph.D. thesis, Iowa State University Library, December 1982.

When using multiple regression models for predictive purposes, it may be desirable to exclude some possible regressor variables in order to reduce both the mean squared error (MSE) of the predictor and the cost incurred in taking observations. Some of the methods that have been proposed for this problem are discussed. The method of Lindley [*Journal of the Royal Statistical Society,* Series B, 30 (1968) 31-53] is discussed and is extended to include the case of unknown variance σ^2. A class of informative priors for the vector of unknown regression parameters is introduced.

An evaluation of Lindley's predictor, with respect to bias and MSE, which recognizes that the predictor variables have been selected, is considered. For the case of a predictor based on two observed regressors, numerical evaluations of the bias and the MSE of the predictor, conditional on selection, are performed for various configurations of data. The conditional bias

and MSE of the predictor are numerically compared with the unconditional bias and MSE of the same predictor.

Fahrenholtz, Steven Kenneth. Normal Bayesian two-armed bandits. Ph.D. thesis, Iowa State University Library, December 1982.

The undiscounted normal two-armed bandit is examined from a Bayesian point of view for independent and singular priors on the mean vector (θ_1, θ_2). Quantification is given to the well-accepted notion that an apparently inferior source needs to be sampled now and then. The optimal strategy is defined in terms of the source differential function, $\Delta^n = v_y^n - v_x^n$, where v_x^n and v_y^n are the valuations of sampling the two respective sources. For the independent prior case, bounds and linear approximations for Δ^n are obtained by recursion. The limiting behavior of Δ^n is discussed, in terms of certain summary parameters of location and information. In the more tractable singular case, the optimal strategy is myopic in the case of equal prior information on both sources.

Ihnen, Leigh Allen. Extended precision computation of the incomplete beta function. Ph.D. thesis, Iowa State University Library, May 1983.

In computing the incomplete beta function, numerical instability is encountered as the parameters increase. To provide a given number of significant digits, a multiple precision (MP) package for the computation of the incomplete beta function has been developed. Since MP arithmetic is time consuming, finding an efficient algorithm is important. To complement the MP package, a new algorithm, for computation of the inverse incomplete beta function, with convergence of order 4 has been developed.

Lin, Char-Lung (Charles). Statistical computing support for ℓ_p estimation in augmented linear models under linear inequality restrictions. Ph.D. thesis, Iowa State University Library, July 1982.

This research project deals with computationally related problems in the general area of ℓ_p $(p \geq 1)$ estimation in linear models. Methods for computing ℓ_p estimates in linear models are studied. In case of $p = 1$, descent methods from Bloomfield and Steiger [*Siam Journal of Scientific and Statistical Computing* 1 (1980) 290-301], and Usow [*Siam Journal of Numerical Analysis* 4 (1967) 233-244] are discussed. A proof of convergence of these methods is provided. In case of $p > 1$, Newton's method and Quasi-Newton method are discussed. A new method is proposed and studied. It performs extremely well for p close to 2. Also, closed form solutions of the ℓ_p estimation problem having design matrix of dimension $(m + 1) \times m$ or $(m + 2) \times m$ are derived, and methods of generating test problems for the general ℓ_p estimation problem are discussed. In another part of the research project, the objective function for computing ℓ_p esti-

mates, augmented by the pth power of ℓ_p norm of the parameter vector, has been studied. One result of this study is a way to identify the ℓ_p estimate having the least ℓ_p norm. Finally, the branch-and-bound method for computing ℓ_p estimates of linear models under linear inequality restrictions are discussed.

Nkansah, Paul Twum. Network p-median problems: Theory and applications. Ph.D. thesis, Iowa State University Library, May 1983.

The network p-median (supply point location) problem has been generalized to the case where demand is continuously distributed. For p = 1 and uniformly distributed demand, and with the objective of minimizing distance, membership of a "circuit" by an "edge" is sufficient for the disqualification of the interior points of the edge as possible supply point locations. Analogous conditions apply when demand is distributed in other than uniform fashion, and/or the objective is to minimize either a suitable function of distance or travel cost. For $p \geq 2$, with uniformly distributed demand and with the objective of minimizing distance, it is shown that the interior points of p edges belonging to p "disjoint minimal circuits" can be disqualified.

Pantula, Sastry Gouripathi. Properties of estimators of the parameters of autoregressive time series. Ph.D. thesis, Iowa State University Library, December 1982.

Assuming that the errors of an autoregressive process form a sequence of martingale differences, the limiting distribution of the least squares estimator is derived. The limiting distribution of the least squares estimator is normal if the roots of the characteristic equation are less than unity in absolute value. It is shown that the limiting distribution for the unit root case obtained under the assumption of independent errors holds for martingale errors.

For samples of the size encountered in practice, the least squares estimators are biased. Using large sample theory, approximations to the bias in the least squares estimators of the parameters of a stationary autoregressive process due to estimation of the mean are derived. The bias expression is used to develop modifications of the least squares estimator. The modification is extended to include the case when exactly one of the roots of the characteristic equation is equal to one.

Estimation of the parameters of an autoregressive process with a mean that is a function of time is considered. Approximate expressions for the bias of the least squares estimator that is due to estimating the mean function are derived. For the special case of a mean function that is a polynomial in time, a reparameterization that isolates the bias is developed. Using the approximate expressions, a method of modifying the least squares estimators is proposed. Methods are suggested for the seasonal autoregressive processes.

Two Monte Carlo studies examining the small sample properties of various estimators of the parameters of second-order autoregressive processes are considered. A second-order autoregressive process with constant mean, and a second-order autoregressive process with mean function linear in time are considered. Generally speaking, the modified estimators performed better than the least squares estimator.

Peixoto, Julio León. Estimation of random effects in the balanced one-way classification. Ph.D. thesis, Iowa State University Library, December 1982.

The balanced one-way random model can be written as

$$y_{ij} = \mu + a_i + e_{ij} \ (i = 1, \ldots, I; j = 1, \ldots, J),$$

where the random effects $a_1, \ldots, a_I$ are identically distributed as $N(0, \sigma_a^2)$, the random errors $e_{11}, e_{12}, \ldots, e_{IJ}$ are identically distributed as $N(0, \sigma_e^2)$, and $a_1, \ldots, a_I, e_{11}, e_{12}, \ldots, e_{IJ}$ are statistically independent. Let α_i be the realized, but unobservable, value of a_i. Solutions to problem of estimating the α_i's when $p = \sigma_e^2/(\sigma_e^2 + J\sigma_a^2)$ is known are well-established in the literature. The best linear unbiased estimator of α_1 when ρ is known is:

$$\hat{\alpha}_i = (1 - \rho) \ (\bar{y}_{i\cdot} - \bar{y}_{\cdot\cdot}).$$

We consider the estimation of linear combinations of $\mu, \alpha_1, \ldots, \alpha_I$ under the more realistic assumption that ρ is unknown. The parameter ρ in $\hat{\alpha}_i$ is replaced by $\hat{\rho}$, where $\hat{\rho}$ is an estimator of ρ. Eighteen different estimators of ρ are considered and are classified into five categories. The corresponding estimators of the α_i's are evaluated in terms of bias, total bias, conditional bias, total conditional bias, mean squared error, total mean squared error, conditional mean squared error, and total conditional mean squared error. It is found that the problem of individual estimation of the α_i's is closely related to the problem of simultaneous conditional estimation of the group mean $\mu_i = \mu + \alpha_i$ ($i = 1, \ldots, I$). Relationships to the James-Stein estimation of the mean vector of a multivariate normal distribution are discussed.

Ponder, Wendell Wayne. Investigations of linear model validity using residuals. Ph.D. thesis, Iowa State University Library, December 1982.

Procedures for assessing model adequacy have been investigated. Since any detection of model misspecification usually begins with an examination of a set of sample residuals resulting from a fitted model, residual predictors have been examined. A necessary and sufficient condition for a residual predictor to have zero expectation and a specified covariance matrix has been obtained. Within this class of residual predictors, the one that minimizes the expected sum of squared prediction errors was found.

Towards the detection of model misspecification, it was shown that a set of predicted residuals can be transformed to a set of independent Beta variables. Since the expected values of the Beta variables have a

known ordering under the null hypothesis, each ordering of a set of Beta values can be ranked from most likely to least likely based upon the probability of each possible ordering. Thus, if incorrect model specification causes an extreme ordering to appear, misspecification can, in principle, be detected by assessing the extremeness of the ordering.

The particular type of misspecification caused by the choice of an inappropriate degree in polynomial regression has been investigated, and a new procedure, based upon the Durbin-Watson d-statistic, has been proposed for determining the appropriate polynomial degree. It was shown that the d-statistic can be transformed to another statistic F_d, whose distribution, for the case of polynomial regression, differs from a central F-distribution only by quantities on the order of $1/n^2$. In the context of selecting the proper polynomial degree, the power of the F_d-test was compared to that of the forward selection F-test through examination of the probability limits of the two test statistics. This study showed that the F_d-test appears to be the more sensitive to under-specification. The probability limit of the Durbin-Watson d-statistic was also examined to derive a relationship between the amount of autocorrelation among the true residuals which would be needed to produce the same probability limit as that produced by an omitted variable. Finally, an example was given where the F_d-test did detect the real need for a quadratic term which the usual forward selection F-test failed to detect.

Lakshmi Rangachari. Aspects of the analysis of variance for classificatory data. Ph.D. thesis, Iowa State University Library, July 1982.

This thesis is directed toward data analysis and analysis of variance for data in a classificatory structure. Different approaches to looking at data by different authors are examined and some of their results extended.

An analysis of variance of data is a partial description of the data. The fitted model is an approximating description of the data. P. D. Finch [*Biometrika* 66 (1979) 195-206] has worked on the quantification of the quality of a description, in particular, the description of a strong ordering by an ordered dichotomy. His ideas have been extended to ordered polychotomous numerical data and data in some basic ANOVA type structures.

D. R. Cox [*ibid.* 45 (1958) 69-73] looked at one-way, two-way, and three-way classifications of data and obtained the expected mean squares under random permutation. These expected mean squares are expressed simply in terms of the quantities Σ which are defined as certain combinations of the variance components σ. The Σ are easily derived whether or not there is unit-treatment additivity. The derivations of the Σ are extended, in this thesis, to the general n-way classification of data.

Many authors have written about the mixed model. The controversy with respect to the proper

error term when testing for the random factor in the mixed model is examined from several viewpoints.

Razmpour, Ahmad. Estimation of common location and scale parameters in nonregular cases. Ph.D. thesis, Iowa State University Library, July 1982.

The problem of estimation of the common location parameter of two exponential distributions when the scale parameters are unknown and possibly unequal is considered. Three different estimators, namely, the maximum likelihood estimator (MLE), the uniformly minimum variance unbiased estimator (UMVUE) and a modified MLE, are proposed. Their performances are compared in terms of the mean squared error criterion. The biases of the MLE and the modified MLE are also compared. The case when the ratio of the scale parameters is known is also taken into account, and the uniformly minimum variance unbiased estimator of the common location parameter is proposed.

Next, the more general problem of estimating the common location parameter of several exponentials with unknown and possibly unequal scale parameters is addressed. Estimators similar to the ones mentioned in the preceding paragraph are proposed, and their performances are compared in terms of biases and mean squared errors.

Finally, the problem of estimating the location parameter of an exponential with known coefficient of variation is considered. The best (in the sense of minimum mean squared error) linear combination of the sample minimum and the sample sum of deviations from the minimum is obtained. This estimator is shown to be dominated by the best scale invariant estimator. Also, a class of Bayes estimators is proposed, and the best scale invariant estimator is shown to be a limiting Bayes estimator.

Yeo, Woon Bang. Selection through an associated characteristic. Ph.D. thesis, Iowa State University Library, July 1982.

Let y_i (i = 1, 2, . . . , n) be observations on n objects or individuals. The object with the largest y-value is taken as best. We consider the problem of selecting s($<$ n) objects which include the k($\leq$ s) best objects. In many experimental situations, the experimenter is faced with a problem of selecting one or more out of n possible treatments (or populations). There is a large literature on the problem of selecting the best population treated as a multiple decision problem. The formulation of this problem has been generally accomplished using either the "indifference zone approach" or the "subset selection approach" which have a common target, namely to ensure a specified "probability of correct selection." The methods and tables developed to date provide solutions to a variety of selection problems in the fixed-effects model (Model I).

Consider now the situation when y_i is expensive to measure (e.g., destructive testing is needed) or repre-

Distinguished alumni taking part in the 50th anniversary conference included J. N. K. Rao, who received his Ph.D. here under H. O. Hartley.

sents a future observation (e.g., in a second decisive test). Then, selection may be based on associated observations x_i which are respectively inexpensive or available now. The n pairs of observations (x_i, y_i) are assumed to be a random sample from a bivariate distribution. Moreover, we may assume that high values of x tend to be accompanied by high values of y. The following problems arise immediately: (a) If the set of objects with the s largest x-values is selected, what is the probability that the set will include the objects with the k($\leq$ s) largest y-values? (b) Determine s so that the subset of objects with the s largest x-values contains the k largest y-values with sufficiently high probability. When k = 1, these problems can be answered with the help of theory developed by David, O'Connell, and Yang [*Annals of Mathematical Statistics* 5 (1977) 216-223]. But when k $>$ l, no solution can be found in the literature. In this dissertation, the exact probabilities of various selections are obtained and extensive tables are given in the bivariate normal case. As a special application, interesting and useful connections are established with the components of variance model (Model II).

In Memoriam

E. J. Thomas, 1928-1981

Enathical John Thomas (M.S. in statistics and economics August 1961) died on February 20, 1981. He was a professor in the Department of Agricultural Statistics, College of Agriculture, Vellayani, Trivandrum, Kerala, India. E. J., as he preferred to be called, is survived by his wife, Sucy Chacko Thomas, and a son, John.

Department of Statistics

Coursework in the Department of Statistics can lead to a B.S., M.S., or Ph.D. degree with major in statistics through the College of Sciences and Humanities or the Graduate College. A specialized biometry curriculum, administered by the Department of Statistics, leads to a B.S. degree conferred by the College of Agriculture. In the fall, approximately 100 graduate majors and 43 undergraduate majors were enrolled; the latter included 7 in biometry.

A student may receive a degree jointly with another department. The most common undergraduate co-major is computer science. Graduate students interested in operations research usually choose co-majors in industrial engineering.

Undergraduate statistics and biometry majors are prepared through a combination of theory and applied methods courses for employment in industry or government or for pursuit of graduate studies.

Graduate students may specialize in experimental design, linear models, general methods, general theory, probability, statistical computing, survey sampling, or one of several areas of application. (More detail is given in the current brochure, "Iowa State University—Graduate Program in Statistics.") An M.S. candidate may choose either a thesis or a nonthesis option. The latter requires four additional credits, including a "creative component" of at least two credits of individual work. The doctoral program is research-oriented and requires completion of a thesis based on independent, creative work.

The Statistics Open House display for Veishea featured the Stat Lab 50th anniversary celebration.

According to *Amstat News,* November 1982, 101 U.S. universities have statistics or mathematics departments offering doctorates with specialization in statistics. In 1981-82, 77 of these granted doctorates in statistics or with statistics concentrations, with Iowa State University ranking highest in terms of number of degrees granted (13 Ph.D.'s).

An NBI word processor and a Qume printer were added to the main office facilities to complement equipment already installed in the Survey Section. Space and funds for new additions to the Reading Room library materials were freed by an auction of journals that duplicated present holdings.

Course offerings for the 1982-83 academic year and the 1983 summer session are listed below. The summer session for 1982 was covered in the last annual report.

1982-1983 Course Offerings in Statistics

Courses for Undergraduate Students Only

100	Orientation in Statistics and Biometry	R	F		Stephenson
101	Principles of Statistics	4	F,S		Beam Martin Stephenson Strahan
104	Introduction to Statistics	3	F,S,SS		
				Connor C. P. Cox Hotchkiss Jobe Martin	J. Morel Pareja Schroeder Sukhatme Wilson
105	Introduction to Statistics	2	F,S		
				Amemiya Cassell Iachan	Scott Yashchin
227	Introduction to Business Statistics	4	F,S,SS		
				Beam Chua Diiro Farmer Hung Isaacson	D. Jacobson Meeker Oñate Scott Silvis Wilson
228	Applied Business Statistics	3	F,S		Arnold Loubert Meeker Silvis
231	Probability and Statistical Inference for Engineers	4	S		Cassell Vardeman Yashchin
305	Engineering Statistics	3	S		Scott
341	Introduction to Theory of Probability and Statistics	3	F,S		Pollak Stephenson Sukhatme
342	Introduction to Theory of Probability and Statistics	3	F		Meeden

Courses for Graduate Minors and Undergraduates

401	Statistical Methods for Research Workers	4	F,S,SS	Bailey C. P. Cox D. F. Cox Groeneveld Hickman Hotchkiss	Koehler Lorenz McGovern Shelley Wolins
402	Statistical Design and the Analysis of Experiments	3	S,SS	D. F. Cox & Hinz Hotchkiss Marasinghe Strahan	
403	Nonparametric Statistical Methods	2	F	Stephenson	
404	Statistics for the Social Sciences	3	F	Johnson	
405	Applied Econometric Statistics	3	S	Hickman	
407	Methods of Multivariate Analysis	2	F	Hinz	
421	Survey Sampling Techniques	3	S	Baker	
431	Statistical Methods in Quality Control	2	F	Vardeman	
436	Genetic Statistics for Research Workers	3	F	Bailey	
446	Statistical Theory for Research Workers	2	F	Yashchin	
447	Statistical Theory for Research Workers	3	S,SS	Amemiya Anderson	
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	1	F	Wolins	

Courses Primarily for Graduate Students, Major or Minor

500	Statistical Methods	4	F	Koehler
501	Multivariate Statistical Methods	3	F	Koehler
511	Theory and Application of Linear Models	3	S	Kempthorne
512	Design of Experiments	3	F	Webster
521	Theory of Sample Surveys I	3	S	Goebel
522	Theory of Sample Surveys II	3	F	Iachan

531	Sequential Product and Process Control	3	S		Vardeman
534	Ecological Statistics	2	S		Pollak
535	Biological Statistics	2	SS		C. P. Cox
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		Meeden
546	Theory of Nonparametric and Asymptotic Methods	3	S		Sukhatme
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 Fuller Harville	Meeden Vardeman
	B. Methods			F,S,SS Bailey D. F. Cox Fuller Hinz Koehler Marasinghe	Meeker Shelley Stephenson Sukhatme Vardeman
	C. Design of Experiments			F,S,SS	Hinz Hotchkiss
	D. Design of Surveys			F,S,SS	Fuller Iachan Isaacson

Courses for Graduate Students, Major or Minor

611	Advanced Linear Model Theory	3	F	Kempthorne
639	Stochastic and Abstract Programming	3	SS	H. T. David & Sposito
642	Measure Theory and Probability	3	S	Athreya
643	Theory of Estimation and Testing of Hypotheses	3	F	Meeden
647	Multivariate Analysis	3	F	Amemiya
648	Seminar on Theory of Statistics and Probability (Theory of Log-linear Models for Frequency Data)	2 S	 Koehler	

(Inference for Finite Populations)	SS		Iachan
699 Research	Var	F,S,SS	

Athreya   Kennedy
H. A. David   Koehler
H. T. David   Marasinghe
Fuller   Meeden
Ghosh(†)   Sposito
Harville   Strahan
Isaacson   Vardeman
Kempthorne

Graduate Students

Thirteen Ph.D. degrees, including one for a joint major, and 15 M.S. degrees were earned in the Department of Statistics during the fiscal year. Abstracts of Ph.D. dissertations and a master's thesis appear in the Publications section. All but one of the masters' degrees were conferred on a nonthesis basis, with candidates each completing a creative component in lieu of a thesis. Employment or further educational plans of the degree recipients are indicated insofar as possible. The names of those who chose to remain at Iowa State to work toward doctorates in statistics are starred below.

M.S. Recipients

Geoffrey Earl Bergeron (Summer 1982, under Kenneth J. Koehler) joined Standard Oil of Indiana as a systems analyst working in Chicago.

Victoria Suzanne Black (Spring 1983, under William Q. Meeker), following her marriage to Mark Hench, became a statistician with Merck Sharp & Dohme Laboratories, West Point, Pa.

Dennis Leroy Brandon (Fall 1982, under Kenneth J. Koehler) is utilizing mathematical statistical methods and techniques in solving environmental problems, as statistician with the U.S. Army Engineer Waterways Experiment Station, Environmental Laboratory in Vicksburg, Miss.

Sze Wai Cheung (Spring 1983, under Mervyn Marasinghe) is remaining in Ames, Iowa while her husband works on his doctorate.

*Stephen Vernon Crowder (Spring 1983, under W. Robert Stephenson).

Victor Rino Filos (Summer 1982, under J. Jeffery Goebel) is working toward a Ph.D. in economics at Iowa State.

Komlan Augustin Hukportie (Spring 1983, under Wayne A. Fuller) resumed his duties as government statistician in the Togo Statistical Department (Direction de la Statistique, Lome).

*Daniel Robert Jeske (Summer 1982, under Paul N. Hinz).

*Chiho Kim (Spring 1983, under Glen Meeden) is pursing a joint Ph.D. here in statistics and economics.

*Jorge Guillermo Morel (Fall 1982, under Ronaldo Iachan).

*Julia Mercedes Uichanco Oñate (Fall 1982, under J. Jeffery Goebel.)

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† by special arrangement at the University of Florida

John Olliver Raudsep (Spring 1983, under Mervyn Marasinghe) joined the R. J. Reynolds Tobacco Company in Winston Salem, N.C., to work as junior statistician in the Process Control Quality Assurance Department.

Debra Jane Schroeder (Spring 1983, under William Q. Meeker, Jr.) is working as marketing research statistician in the Marketing Research Section of A. C. Nielsen Company, Northbrook, Ill.

Fernando Rosunda Silva Fuentes (Summer 1982, under Paul N. Hinz) resumed his position as consulting statistician and researcher in the Biometrics Unit, National Institute for Agricultural Research, Santiago, Chile (Instituto de Investigaciones Agropecuarias, Estacion Experimental La Platina).

Wickramaarachchige Nimalasiri Wickremasinghe (Spring 1983, under Theodore B. Bailey, Jr.) returned to Sri Lanka to his position as assistant statistician in the Rubber Research Institute of Ceylon, stationed at the Research Laboratories in Dartonfield, Agalawatte.

Ph.D. Recipients

Yasuo Amemiya (Fall 1982, under Wayne A. Fuller) is an assistant professor in the Department of Statistics at Iowa State.

Richard Eugene Auer (Fall 1982, under Malay Ghosh and Chien-Pai Han) continues as assistant professor in the Mathematics Department, Loyola College, and mathematical statistician, Office of Disability Studies and Division of Statistics and Research, Social Security Administration, in Baltimore, Md.

Peter David Christenson (Fall 1982, under David A. Harville) is an assistant professor in the Department of Mathematical and Computer Sciences, Michigan Technological University.

Steven Kenneth Fahrenholtz (Fall 1982, under Herbert T. David) continues as research statistician with the Pillsbury Company, Minneapolis, Minn.

Leigh Allen Ihnen (Spring 1983, under William J. Kennedy) is developing statistical software packages as statistical programmer at SAS, Inc.

Char-Lung (Charles) Lin (Summer 1982, under William J. Kennedy) is a statistician/computer specialist with BMDP Statistical Software, Inc., Los Angeles.

Paul Twum Nkansah (Spring 1983, in statistics and engineering valuation, under H. T. David and K. L. McRoberts) completed a nine-month appointment in the Department of Mathematics, University of Minnesota—Morris, and accepted a position teaching management science, as assistant professor in the Atlanta University Graduate School of Business Administration.

Sastry Gouripathi Pantula (Fall 1982, under Wayne A. Fuller) continues as assistant professor in the Department of Statistics, North Carolina State University.

Julio León Peixoto (Fall 1982, under David A. Harville) accepted an appointment as visiting assistant professor, Department of Quantitative Management Science, University of Houston.

Wendell Wayne Ponder (Fall 1982, under C. Philip Cox) is working as statistician with Criterion Incorporated, Dallas, Texas, on the application of statistical and computer methods to employment and litigation data.

Lakshmi Rangachari (Summer 1982, under O. Kempthorne) is a research statistician with Schering-Plough Corporation, Bloomfield, New Jersey.

Ahmed Razmpour (Summer 1982, under Malay Ghosh) has continued to teach at Al-Fateh University, Tripoli, Libya, as assistant professor in the Department of Statistics.

Woon Bang Yeo (Summer 1982, under H. A. David) has returned to Seoul, Korea, as senior researcher in the Korea Development Institute.

M.S. Candidates

Abdella, Blake
Abdul-Aziz, Yasmin
Abdurachman, Edi
Ab-Ghaffar, Mohamed
Adams, William D.
Beam, Craig A.
Bergeron, Geoffrey
Black, Victoria
Bondioli, Tammy
Brandon, Dennis L.
Calcaño-Collazo, José
Chang, Min-Shih
Cheung, Sze Wai
Connor, Carolyn
Crowder, Stephen V.
Diiro, Bruce W.
Eyink, Nancy
Filos, Victor
Funo, Eiichiro
Gazaui, Mirna Janet
Hawley, Arnold J.
Huang, Shun-Chuen
Hukportie, Komlan
Jacobson, David
Jacobson, Shawn D.
Jones, Jason R.
Kim, Byung Hwee
Kim, Chiho
Kramer, Kevin
Kumlung, Arunee
Lee, Mong-Hong
Lin, Jyh-Shiun
Loubert, Sharon K.

Lui, Anthony
Martinich, David
Mehailia, Abdelghani
Miller, Stephen
Morel, Grecia F.
Nelson, Deborah
Nicholson, Paulette
Paulissen, Jerome
Pohl, David D.
Putrus, Hilal
Ramírez C., Juan Esteban
Raudsep, John
Ray, Di-Ou
Saadun, Shaharuddin B.
Schnell, Daniel J.
Schroeder, Debra
Schuelka, Steven J.
Scott, Margaret
Silva, Fernando R.
Silvis, David L.
Tachia, Hon Richard
Tirol, Miriam B.
Torreblanca, Sergio
Tsay, Yan-Ling
Tsokou, Stavroula
Vanichbuncha, Kanlaya
Vijithakumara, Tilaka
Voigt, Hugh
Wagner, Annette
Wickremasinghe, W. N.
Winters, Franklin
Yu, Jin-ying

Nondegree Student

Heymans, Ricardo

Ph.D. Candidates

Amemiya, Yasuo
Anderson, Kevin
Arnold, Robert J.
Auer, Richard
Callanan, Terrance P.
Cassell, David L.
Chang, Stephen Fu-Chung
Chapline, Janella
Christenson, Peter D.
Chua, Tin-Chiu
Fahrenholtz, Steven
Farmer, Charles M.
Francisco, Carol A.
Gan, Fah Fatt
Guerrero, Margarita
Harter, Rachel
Homblé, Patrick
Hung, Hsien-Ming
Ihnen, Leigh
Jeske, Daniel
Jobe, John Marcus
Josvanger, Lee Ann
Kim, Byung Chun
Kinyon, Lawrence
  (joint economics-statistics)
Lee, Moun-Shen Carl

Lee, Youngjo
Lewis, Jerry
Lin, Char-Lung (Charles)
Lin, Cherng-Tarng (Tony)
  (joint industrial engineering-statistics)
McGovern, Paul
  (joint psychology-statistics)
McNulty, Mark
  (joint agricultural economics-statistics)
McNulty, Sallie Keller
Martin, Cindy Lynn
Mazloum, Reda
Miazaki, Edina
Morel, Jorgé
Nagaraj, Neerchal K.
Nkansah, Paul T.
  (joint statistics-engineering valuation)
Oñate, Julia
Ostrouchov, George
Pantula, Sastry G.
Pareja, Gilda
Park, Byung Sul
Peixoto, Julio

Petenate, Ademir
Ponder, Wendell
Rangachari, Lakshmi
Razmpour, Ahmad
Rogers, Michael P.
Saad Eldin, Saad Eldin M.
Seyed Sadr, S. Mahmoud
Slamet
  (joint industrial engineering-statistics)

Tveite, Michael
van Schaik, Jan
Wilson, Jeffrey R.
Yeo, Woon Bang
Younan, Fouad
  (operations research)
Zamudio, Francisco
Zimmerman, Dale

Under a cooperative agreement between Weyerhaeuser Co., Hot Springs, Ark., and the Statistical Laboratory and Department of Statistics, Jerome Paulissen spent six months as a trainee with the company.

Patrick Homblé was initiated into Phi Kappa Phi honor society in March and Michael Roger into Sigma Xi in April.

Jeff Wilson received an ISU Distinguished Service Award for his work in tutoring minority students in mathematics and statistics.

Mu Sigma Rho

A lecture entitled "Interesting biases in sample surveys" was presented by Barbara A. Bailar at the annual banquet and spring meeting of the Alpha chapter of Mu Sigma Rho statistics honorary society. Bailar is the associate director for Statistical Standards and Methodology, United States Bureau of the Census.

In addition to the guest speaker, four undergraduates, sixteen graduate students, and four faculty members were initiated as new members. Officers elected for the 1983-84 academic year are: Terrance Callanan, president; Daniel Jeske, vice president; Sarah Arterburn, secretary-treasurer. Yasuo Amemiya will become faculty adviser.

Carl Fritz and Rachel Harter were co-recipients of the Mu Sigma Rho Award for academic excellence and service to the organization and the department.

George Zyskind Memorial Lecture

The eighth George Zyskind Memorial Lecture was presented in October by Bradley Efron, chair of the mathematical sciences program at Stanford University, and professor in the Department of Statistics and the Department of Community, Family, and Preventive Medicine there. He spoke on "Bootstrap methods." Efron is a former editor of the Theory and Methods Section, *Journal of the American Statistical Association,* and was named "Outstanding Statistician of the Year" by the Chicago chapter, American Statistical Association, in 1981. The Zyskind lecture series honors the late George Zyskind, statistics professor at ISU from 1959 to 1974.

Snedecor Lecture

The second George W. Snedecor Lecture was given, as part of the 50th Anniversary Conference, by David R. Cox, professor of mathematics, Imperial College, London. His topic was "Long-Range Dependence: A Review." Professor Cox, one of the world's

$$Y_h = \int_{-\pi}$$

David R. Cox

leading statisticians, has published extensively in both theoretical and applied statistics. His many books include *Theoretical Statistics,* co-authored by D. V. Hinkley and published by Chapman and Hall in 1974. He is a Fellow of the Royal Society and has been editor of *Biometrika* since 1966.

Cox's lecture will be published in the conference proceedings volume. It is hoped to add a video tape of the talk to the American Statistical Association's library of films of distinguished statisticians.

The Snedecor Lecture program was initiated in 1980 as "a series of occasional lectures recognizing further George Snedecor's pioneering contributions to statistics in general and the Stat Lab in particular."

Bancroft Award

Mark McNulty, who has a joint graduate major in agricultural economics and statistics from Watertown, S.Dak., was named as winner of the 1983 T. A. Bancroft Statistics Award. McNulty, a graduate assistant in economics here, received his B.S. degree at the University of South Dakota in economics and mathematics. He was selected for the Bancroft award on the basis of outstanding performance as a doctoral candidate with a joint major in statistics. The award

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

No George W. Snedecor Statistics Award was given locally this year.

Iowa STAT-ers

Iowa STAT-ers, the statistics graduate student organization, started the year with production of a Statistics Department picture directory. George Ostrouchov and Rachel Harter put together a ten-page booklet of individual photos of faculty, staff, and graduate students. Photocopies were distributed to everyone pictured.

The traditional fall and spring pizza parties, organized by Cindy Martin, were a great success. In the spring more than 65 people enjoyed pizza provided by those who had passed the master's or prelim exam during the past year.

Craig Beam was in charge of the new Lunch-with-a-Prof program. Once a month graduate students took a faculty member to lunch, providing a chance for students to get to know the faculty on a personal, not solely academic, basis.

Another new idea was the master's-doctoral prelim panel discussion. Professors Isaacson and Meeden talked about the examinations and answered questions from the 45 students and faculty present.

Barbara Bailar of the U.S. Bureau of the Census gave the Mu Sigma Rho lecture, which was co-sponsored by Iowa STAT-ers. The STAT-ers provided some lecturers of their own for graduate student seminars, and also helped with the Veishea statistics display.

Spring semester a volunteer consulting service was set up by a committee led by Michael Rogers. STAT-ers' adviser, Kenneth J. Koehler, is also adviser to this project. Thirteen graduate students provided consulting, with 10 assigned regular duty hours in Room 120, Snedecor Hall. During the approximately nine-week period the service operated, there were 48 consulting sessions. Clients were mainly graduate students and included people from many different departments. Based on this project, STAT-ers was nominated for the Iowa State University Distinguished Service Award.

A contest sponsored by Iowa STAT-ers for design of a special Statistical Laboratory 50th Anniversary T-shirt was won by Sallie Keller McNulty. STAT-ers sold the red, gold, and white T-shirts during the conference to raise funds to cover conference expenses for some of their members. They also provided volunteer help during the conference.

Iowa STAT-ers' officers and regular committee members for the year were: Robert Arnold, president; Michael Rogers, vice president-secretary; David Cassell, treasurer; Shawn Jacobson, faculty meeting representative; Cindy Martin, Jerry Paulissen, and Kevin Anderson, social committee; Bob Arnold, Mohammed Saad Eldin, Dan Schnell, and Jan van Schaik, departmental committees.

Undergraduates

The undergraduate majors, though small in numbers, were recipients of numerous awards and recognitions during 1982-83. Beth Huegli graduated as one of six graduating scholars in the College of Sciences and Humanities. She was also recognized as the top scholar in statistics and in psychology. Carl Fritz was initiated into Phi Kappa Phi in 1983, while Sarah Arterburn, Eric Grau, Kathleen Taylor, and Steven Wall became members of Mu Sigma Rho at the annual initiation banquet. Carolyn Connor was inducted into Phi Beta Kappa following her graduation (B.S. in statistics) in 1982.

Ten students received B.S. degrees in the period July 1, 1982, to June 30, 1983—five with statistics majors, three with joint majors in statistics and another field, and two in the biometry curriculum. Where known, their employment or continuing education plans are indicated below.

Peter Wolfgang Boedeker (Fall 1982, biometry).

Kevin Scott Davison (Spring 1983, biometry) is an agricultural statistician with the U.S. Livestock and Crop Reporting Service, Fargo, N. Dak.

David Grant Devey (Spring 1983, computer science and statistics) joined Systems Development Corporation, Santa Monica, Calif., in programming.

Carl Eugene Fritz (Spring 1983, with distinction) is a statistician with General Motors Proving Grounds, Milford, Mich., working in quality control.

Matthew Jay Garrett (Summer 1982, computer science and statistics) is working as systems analyst with Exxon Corporation in Houston, Texas.

Carol Ann Griffith (Spring 1983) is working in Corning, New York for the Corning Glass Company in industrial statistics.

Lynnette Rae Halley (Spring 1983) is employed by the Pharmaceutical Card Company, Phoenix, Ariz.

Mohd Zain Hamzah (Summer 1982) is continuing his study of statistics as a graduate student at the University of Nebraska in Lincoln.

Beth A. Huegli (Spring 1983, statistics and psychology, with distinction) is working for the Bankers Life Insurance Company in Des Moines, Iowa, in marketing development of new insurance policies.

Tracy Joseph Sankot (Spring 1983).

Additional information is now available on first positions taken by some of the preceding year's graduates. Clifton Exley has been working for the U.S. Bureau of the Census, Chicago, Ill., as supervisory survey statistician. Robert Heinzen has been an actuarial trainee in the Pension Actuarial Division of Minnesota Mutual Life Insurance Company, St. Paul. Charles Helt became assistant manager of TG&Y Stores in Hannibal, Mo. Scott Iverson accepted a position with the Federal Crop Insurance Agency, Kansas City, Mo. Stephanie Leonard and Tet Feei Liew began graduate studies—Leonard in environmental sciences at the University of Iowa, Liew in computer science at Iowa State. Randall Parmer joined the Census Bureau as mathematical statistician in its Statistical Methods Division, Suitland, Md. Linda Lohmann is working as benefit analyst with Connecticut General Life Insurance in Kansas City. Douglas Tschopp has continued studies at Iowa State, with an emphasis on computer science.

Two statistics juniors have worked this summer in positions relating to statistics. Sarah Arterburn is a summer intern with IBM in Rochester, Minn., while Christine Jensen worked in statistical computing with the Iowa Commerce Commission in Des Moines.

Serving as academic advisers were Richard Groeneveld, Donald Hotchkiss, Frederick Lorenz, William Meeker, W. Robert Stephenson, and Shashikala Sukhatme.

Statistics Club

The purpose of the Statistics Club is to promote interest among undergraduates in the field of statistics. The club's activities began in September with a pizza party. Old and new members had an opportunity to get better acquainted with each other as well as with undergraduate instructors and advisers.

An important function of the Statistics Club is informing students of job opportunities in statistics. The first regular meeting in October featured students who held statistics related summer jobs. Beth Huegli and Carl Fritz talked about their experiences with the Iowa Commerce Commission. Carol Griffith discussed her work with a small market research firm in Oklahoma. Discussion followed on how to go about getting a summer job and possible summer employers were mentioned. After the formal meeting the undergraduate instructors met the challenge of the Statistics Club members on the bowling alleys of the Memorial Union.

On the Statistics Club spring field trip: W. Robert Stephenson with (L to R) Christine Jensen, Beth Huegli, Carl Fritz, Kathy Taylor, Wendy Iverson, and 1982 graduate Linda Nollen Wooster, who is an applied costing analyst with Union Pacific.

In the spring, Cathryn Dippo from the Bureau of Labor Statistics visited Iowa State University and spoke to the Statistics Club. Dippo talked about the role of a mathematical statistician in a government agency. She also discussed job opportunities, both summer and full time, in the Bureau of Labor Statistics.

This year's spring field trip involved a visit to the Union Pacific/Missouri Pacific Railroad in Omaha, Neb. A former undergraduate statistics major, Linda Nollen Wooster, gave an introduction to the UP/MoPac Railroad and also discussed how statistics is used in the finance department. In the afternoon, several people from the transportation department discussed models for forecasting equipment and revenue.

The 50th Anniversary of the Statistical Laboratory was highlighted in this year's Veishea display. Also included in the display was a brief overview of quality control, job opportunities, and job descriptions for B.S. graduates in statistics. Visitors to the display could also try their luck at cards playing against a computer. The display earned a Certificate of Participation, Silver Rating, from the Veishea Open House Display Committee.

Sarah Arterburn and Kathleen Taylor were named co-recipients of the 1983-84 Statistics Club Scholarship. The following were elected officers for 1983-84:

> president: Christine Jensen
> vice president: Jean Wells
> treasurer: Kathleen Taylor
> secretary: Sarah Arterburn.

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

Seminars

The program of regular weekly noncredit seminars offered by the Statistical Laboratory and the Department of Statistics for this year was planned by a committee comprised of Stephen B. Vardeman, Ronaldo Iachan, and student representative Dan Schnell. Topics and speakers follow. In addition Sheila Ben-Tuvia, Central Bureau of Statistics, Jerusalem, Israel, gave an informal seminar to the Survey Section on November 16 on the estimation of production functions from survey data.

Dan Scott presented a series of noncredit seminars for interested staff and students in the Department of Statistics during the fall. Three dealt with the theory of polyhedral sets, others with Fourier-Motzkin elimination and its application to the theory of linear programming.

On April 29 M. F. El-Sabbaugh of Control Data Corporation gave a special talk on "Statistical Quality Control at Control Data" for students in Statistics 531, a graduate course double-listed with the Department of Industrial Engineering.

Statistical Laboratory Seminars

Summer 1982

July 7	Normal Bayesian bandits, Steven K. Fahrenholtz
15	Inequality and approximation for integrated Bayes risk with application to second order efficiency, J. K. Ghosh, Indian Statistical Institute and University of Missouri—Columbia
21	Shrinkage estimators of the scale parameter vector for the multivariate gamma distribution, Richard E. Auer
27	Investigations of linear model validity using residuals, Wendell W. Ponder
August 4	Properties of the estimators of autoregressive parameters, Sastry G. Pantula
11	Variable selection in multiple regression, Peter D. Christenson

Fall 1982

September 1	Aids to research in statistics, H. A. David
8	Canonical analysis as a discriminant tool in a periodontal problem, John T. Webster, Southern Methodist University and Iowa State University
15	An American statistician in Latin America, Donald K. Hotchkiss
22	A stochastic model for chemical chromatography, Dan M. Scott
29	Modeling and analyzing breakdown phenomena in insulators—a stochastic approach, Emmanuel Yashchin, Technion—Israel Institute of Technology and Iowa State University
October 6	Statistical consulting in plant science—one experience, Theodore B. Bailey
13	Comparing non-nested linear models, Bradley Efron, Stanford University—cosponsored by the Iowa chapter, American Statistical Association
20	A unified asymptotic theory of nonlinear statistical models, A. Ronald Gallant, North Carolina State University and Northwestern University
26	Some applications of the FKG inequality to combinatorial probability, Larry Shepp, Bell Laboratories, Murray Hill, N.J.—cosponsored by the Department of Mathematics
November 3	Computation of the incomplete beta function and the inverse incomplete beta function, Leigh Ihnen
10	The population-sample decomposition applied to minimum distance estimators, Bernard B.M.S. van Praag, Leyden University, the Netherlands
17	Subset selection in censored samples from a trivariate population, Sonny G. Loo, Monash University, Melbourne, Australia
24	A response model for categorical data classified in a two-way table, Tin-Chiu Chua
December 1	Corn and soybean exports, a model for the 1990's, Lawrence C. Kinyon
8	Nonresponse in repeated surveys, Ronaldo Iachan

Spring 1983

January 19	Dynamics of Bayes estimates for the rate of a Poisson process with Gamma prior and convex loss, Robert F. Anderson, ISU Department of Mathematics
26	Optimal nonparametric function estimation, Edward J. Wegman, Office of Naval Research, U.S. Department of the Navy, Arlington, Va.

January 28	Likelihood ratio tests concerning stochastic orderings between multinomial populations, F. T. Wright, University of Missouri—Rolla
February 2	Dependent competing risks and summary survival curves, Eric Slud, University of Maryland
9	Variance reduction techniques for the bootstrap: "Bootstrapping on $5.00 a day," Terry M. Therneau, Stanford University
16	Asymptotic distributions of some modified goodness-of-fit statistics: A new approach, Shashikala B. Sukhatme
24	Multipurpose surveys and zero-variance estimators, Henryka Komanska, University of California at Riverside
March 2	An item response model for the estimation of demographic effects, Mark Reiser, Indiana University
9	Kriging, collocation, or multiquadric—What's the difference? Rolland L. Hardy, ISU Department of Civil Engineering
16	Calibration, sufficiency, and domination considerations for Bayesian probability assessors, Stephen B. Vardeman
30	Adjusting the 1980 Census, Barbara A. Bailar, U.S. Bureau of the Census
April 6	U.S. congressional elections, 1788-1980: A nonparametric view, Mack C. Shelley II
8	Estimation of multivariate normal means and its application to the balanced mixed linear model, Youngjo Lee
13	Estimating the effective population size from allele frequency changes, Edward Pollak
18	Inference for L_1 regression, Michael Tveite
25	Mathematical models of mutualism, Herbert I. Freedman, University of Alberta
May 4	Traveling salesman's odyssey, Cherng-Tarng Tony Lin
11	Exact generalized inverses and solution to least squares problems using multiple modulus arithmetic, Sallie Keller McNulty
13	Optimal allocation for kriging on a line, Ademir Petenate

Special Lectures and Seminars

October 12	8th George Zyskind Memorial Lecture: Bootstrap methods, Bradley Efron, Stanford University
March 29	Mu Sigma Rho Lecture: Interesting biases in sample surveys, Barbara A. Bailar, U.S. Bureau of the Census
April 26	Interdisciplinary Lecture: Indices of power as measures of centrality, Guillermo Owen, University of Iowa and University of California at Irvine

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. These are usually based on thesis work or on master's degree creative components. Topics and speakers for the year follow:

October 21	L_1 estimation: An alternative to the linear programming approach, Lee Josvanger
March 3	Small sample inference for L_1 regression, Mike Tveite
March 14	Estimation of multivariate normal means and its application to the balanced mixed linear model, Youngjo Lee

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Captions for photos on pp. 23-27 appear below. Layout design is by Walker.

P. 23 Clockwise, from upper left: Rachel Harter; Shirley [Mrs. Dan] Horvitz with Noma and Emil Jebe; former colleagues get together—Stephen P. H. Mandel, Robert J. Buehler, C. Philip Cox, and O. Kempthorne; Andrew S. C. Ehrenberg; D. Raghavarao.

P. 24 Top photo: Studying conference material in the registration and exhibit areas. Bottom photo (L to R): R. L. Anderson, Emil Jebe, Raymond J. Jessen, Paul G. Homeyer, Grace Homeyer, President W. Robert Parks, and Walter T. Federer.

P. 25 Clockwise, from upper left: C. R. Henderson; Shayle R. Searle with David Harville; A. R. Sen with E. C. Pielou; Erich L. Lehmann; Morris H. Hansen.

P. 26 Clockwise, from upper left: Theodore B. Bailey, chair of the conference local arrangements committee; John W. Tukey with Jon Kettenring; Neeti Bohidar; R. L. Anderson, who in 1941 received the second doctorate in statistics at Iowa State; barbecued chicken and much more.

P. 27 Clockwise, from upper left: Chandu Patel and Jeff Wilson read early correspondence between R. A. Fisher and George W. Snedecor; Avonelle and Charles Hefflefinger and Churchill Eisenhart discuss one of the special historical displays focusing on the statistical center's teaching, research, consulting, and publications; C. R. Rao; Ron Fecso discusses his joint paper during the poster session; Grecia Morel with Gilda Pareja at the banquet; George E. P. Box; Oscar Kempthorne.