

STATISTICAL LABORATORY

established 1933



annual report

July 1, 1979 to June 30, 1980

IOWA STATE UNIVERSITY, AMES

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THE STATISTICAL LABORATORY



Iowa State University
1979-80 Annual Report

Personnel

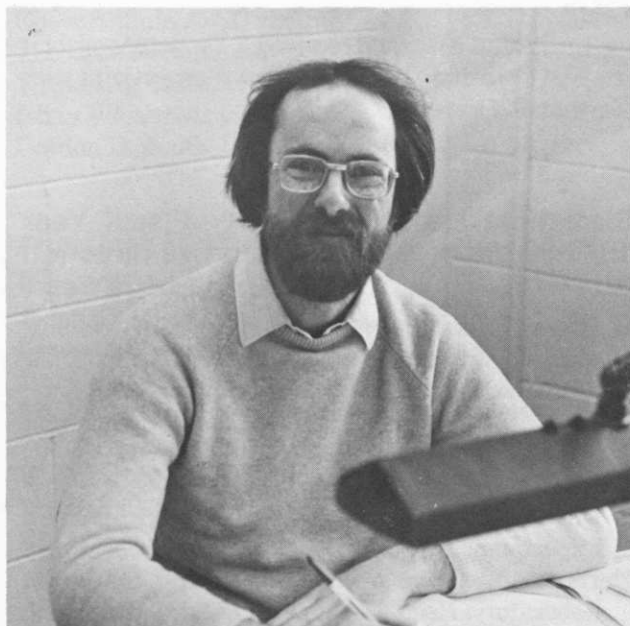
Personnel are shared among all the components of Iowa State's Statistical Center. H. A. David is the director of the Center which consists of the Statistical Laboratory (an Institute under the President's Office), the Department of Statistics in the College of Sciences and Humanities, the Statistics Department in the Agriculture and Home Economics Experiment Station, and the statistics participants in the Sciences and Humanities and the Engineering Research Institutes.

The year 1979-80 was an active one. Two new staff members, along with three visitors, joined the statistics faculty. Four positions for 1980-81 were filled. In addition, members of the ongoing faculty were recognized in a variety of ways.

Looking back to September 1: Drs. Mack C. Shelley II and Robert Stephenson joined the staff as assistant professors. Mack is a joint appointee in Statistics and Political Science. Bob filled the position vacated by Dr. Huntsberger.

During the year, Chaturvedula Asok, a former Ph.D. student of B. V. Sukhatme, served as a visiting associate professor in Bal Sukhatme's survey sampling position. He taught advanced courses in survey sampling and worked on a new edition of *Sampling Theory of Surveys with Applications* by P. V. and B. V. Sukhatme.

Mary Ralston served as a visiting assistant professor in the Numerical Analysis Section. She received her Ph.D. in biostatistics at UCLA. Prior to joining the Department, she was a lecturer and assistant research statistician in the Department of Biomathematics, UCLA.



Assistant Professor Bob Stephenson



Kathy and Mack Shelley. Kathy is a Junior Data Analyst in the Statistical Numerical Analysis Section; Mack, an Assistant Professor

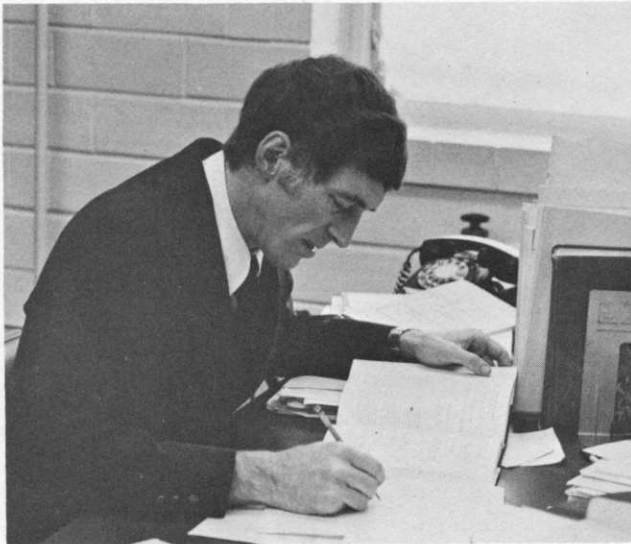
Ishay Weissman, Senior Lecturer, Technion-Israel Institute of Technology, Haifa, was a visiting associate professor. During spring quarter he taught Statistics 648, "Asymptotic Theory of Order Statistics," in which he emphasized extreme-value theory.

Looking ahead to July 1: Robert Johnson, Mervyn Marasinghe, and Talluri J. Rao, will join the statistics faculty.

Dr. Johnson will have a joint appointment with Sociology and Anthropology. He was awarded an A.B. in sociology from Oberlin College in 1970, an M.A. (1972) in sociology, an M.A. (1978) in statistics, and a Ph.D. (1979) in sociology, all from the University of Michigan. His research and teaching interests include population studies and demography, sociological research methods, and social statistics.

Mervyn Marasinghe, who recently completed a Ph.D. in statistics at Kansas City University, will replace Jim Gentle in the Statistical Numerical Analysis Section. He received the B.Sc. (1971) in natural sciences and a diploma in statistics (1974) from the University of Sri Lanka. In 1977 he earned an M.S. from Kansas State University. Among his research interests are data analysis, model building, design of experiments, and computing.

Talluri J. Rao, an associate professor in the Indian Statistical Institute, Calcutta, will be a visiting associate professor in the survey sampling position. He will teach survey sampling at various levels, perform research, and act as a consultant to the Survey Section.



Dean Isaacson, "Outstanding Teacher for 1979-80"

Dr. George Battese, Senior Lecturer in Economic Statistics, the University of New England, Armidale, Australia, will return to the Department in July to spend the coming year in the Survey Section. He will be engaged in teaching and research activities as part of his sabbatical leave.

Another person visiting us on sabbatical leave as an associate professor will be Dr. Thomas O'Donovan, who is at the University College, Cork, Ireland.

On August 1, Krishna Athreya, currently a visiting professor at the University of Wisconsin—Madison and Milwaukee, will join the Department in a joint appointment with mathematics, thus replacing Barry Arnold. He was awarded a B.A. (1959) and an M.A. (1962) in mathematics from Loyola College, Madras, India. In 1967 he earned a Ph.D. in mathematics from Stanford University. Dr. Athreya has published widely in both statistical and mathematical journals and has also taught extensively in both fields. With Peter Ney, he is co-author of *Branching Processes* published by Springer Verlag. Another book, *Markov Chains and Renewal Theory*, is under preparation with Ney as co-author. Dr. Athreya is a Fellow of the Institute of Mathematical Statistics.

On December 1, Fred Lorenz, a graduate teaching assistant in the Department during the past year, will hold a joint appointment with Sociology and Anthropology. In 1970 he received a B.S. in mathematics from Mankato State College and, in 1972, an M.S. in economics from South Dakota State University. He is completing a Ph.D. in sociology from ISU. Fred Lorenz and Robert Johnson will in effect be replacing Richard Warren who had long been overextended. This two-for-one replacement, made possible with help from the

Dean's Office, College of Sciences and Humanities recognizes the strong interest in quantitative methods of the Department of Sociology and of related social science departments.

During June and July 1980, Edward Pollak is on leave without pay. He is spending these months as a visiting professor at the Center for Demographic and Population Genetics at the University of Texas Health Science Center at Houston. Dr. Pollak will be on a Faculty Improvement Leave during the fall and winter quarters at the University of Michigan at Ann Arbor in the Department of Human Genetics.

Leroy Wolins will be on leave without pay fall quarter. He is working on a book tentatively entitled *Statistical Mistakes in Social Science Research*.

Shashikala Sukhatme will be a full-time assistant professor beginning next fall.

During winter and spring quarters, T. A. Bancroft was a distinguished visiting professor at San Diego State University.

Herbert A. David was awarded the title of Distinguished Professor in Sciences and Humanities at the annual general faculty meeting held in May.

During the year, Malay Ghosh was elected a member of the International Statistical Institute.

Dean L. Isaacson, Professor of Mathematics and Statistics, was one of eight ISU faculty members named as "Outstanding Teacher" for the current academic year.

William J. Kennedy was one of 30 new Fellows elected by the American Statistical Association during its Washington meeting. He was cited "for continued leadership in defining and expanding the role of statistical computing in the statistics profession, and for extensive contributions to research in this field."

Craig Van Nostrand received a Youden Award for the best expository paper in *Technometrics* (joint with Norman R. Draper).

Statistical Laboratory Staff—Fiscal Year 1979-80 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
- 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

T. A. Bancroft, Professor Emeritus
C. Philip Cox
David F. Cox
Herbert A. David, Distinguished Professor, College of Sciences and Humanities
Herbert T. David, joint appointment with Department of Industrial Engineering
Wayne A. Fuller, faculty status also in Economics
Malay Ghosh
Richard Groeneveld
Chien-Pai Han
David A. Harville
Roy D. Hickman
Paul Hinz, faculty status also in Forestry
Donald K. Hotchkiss
David V. Huntsberger, Professor Emeritus
Dean Isaacson, joint appointment with Department of Mathematics
Oscar Kempthorne, Distinguished Professor, College of Sciences and Humanities
William J. Kennedy
Glen Meeden
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
Leroy Wolins, joint appointment with Department of Psychology

Associate Professors

Chaturvedula Asok, visiting
Theodore B. Bailey, Jr.
William Q. Meeker, Jr.
Ishay Weissman, visiting
Gordon D. Booth, USDA collaborator

Assistant Professors

Harold D. Baker
J. Jeffery Goebel
Kenneth Koehler
Mary Ralston, (temporary)
Mack C. Shelley II, joint with the Department of Political Science
W. Robert Stephenson
Shashikala Sukhatme
R. Craig Van Nostrand

Adjunct Assistant Professor

Thomas Bubolz

Instructors and Associates

Richard Dorsch
Dan Mowrey
Debra Shenk
Fu-Hau Yu

Graduate Assistants

The status of graduate students often changes. Students who have held regular appointments as graduate assistants during the year are listed here.

| | |
|-------------------------|----------------------|
| Amemiya, Yasuo | Lin, Cherng-Tarn |
| Auer, Richard | Lin, Josephine |
| Badrena, Joseph A. | Londhe, Anil |
| Bergstralh, Erik | Lorenz, Frederick |
| Bhattacharyay, Bisu | Martin, Cindy |
| Bloor, George | Mee, Robert |
| Blough, David K. | Midha, Chand |
| Brandon, Dennis L. | Mowrey, Daniel |
| Burdge, Sallie A. | Nagaraja, H. N. |
| Callanan, Terrance P. | Niknian, Minoo |
| Chandhok, Promod K. | Noma, Akihiro |
| Chang, Stephen Fu-Chung | Noorbaloochi, Siamak |
| Christenson, Peter D. | Ostrouchov, George |
| Chua, Tin Chiu | Pantula, G. Sastry |
| Crump, Peter M. | Parsian, Ahmad |
| Dahm, P. Fred | Peixoto, Julio |
| Dehghan-Nayeri, Majid | Rangachari, Lakshmi |
| Devin, Jeanne A. | Razmpour, Ahmad |
| Drew, James | Reed, Thomas |
| Duke, Steven | Rees, Mark |
| Ebrahimi, Nader | Ridpath, Harold |
| Enger, Cheryl | Rossi, Richard |
| Escobar, Luis | Roy, Joanne |
| Fahrenholtz, Steven | Royalty, Daniel |
| Guerrero, Margarita | Sallas, William M. |
| Hale, Michael | Scott, Mark |
| Harter, Rachel | Seyedsadr, Seyed |
| Hines, Merlon | Skarpness, Bradley |
| Hung, Hsien-Ming | Stangl, Pamela |
| Ihnen, Leigh | Tveite, Michael |
| Jobe, John Marcus | van Schaik, Jan |
| Kackar, Raghu Nath | Wang, John Lih-Gow |
| Kinyon, Lawrence | Werner, Neil |
| Kruger, Gregory A. | Werner, Richard |
| Kuo, Tsuey-Fen | Wilson, Robert |
| Lee, Edward Henry | Yeo, Woon Bang |
| Lee, Moun-Shen Carl | Yih, Wei |
| Lewis, Jerry | |
| Lin, Char-Lung | |

Supported Graduate Students

Ahmad, Noorani—Malaysian Government
Briceno, Rodrigo—Agency for International Development (AID)
Da Silva, Antonio—CAPES (an agency of the Brazilian Ministry of Education and Culture)

Filos, Victor—Fullbright Scholarship
 Herrera-Hoyos, Carlos—Mexican Government
 Ho, Chung-Man—Industrial Engineering, ISU
 Ihnen, Leigh—Entomology, ISU
 Lamyordmakpol, Anuchit—Government of Thailand
 Liberty, T. Edward—INDP Fellow, Liberia
 Mazlom, Reda—Egyptian Government
 Megahed, Abdel Razek—Egyptian Government
 Mohamad, Bader Eldeen—Government of Sudan
 Mowers, Ron—Agronomy, ISU
 Mt. Piah, Abdul Rahni—Malaysian Government
 Niknian, Minoo—College of Statistics and Information, Tehran
 Nkansah, Paul—Department of Mathematics, ISU
 Parsian, Ahmad—Pahlavi University, Iran
 Petenate, Ademir—UNICAMP
 Pongshrihadulchai, Apichart-AID
 Ramos, Juan—Mexican Government
 Saad Eldin, Mohamed—University of Gezira
 Sastrosoewignjo, Soetarto—Government of Indonesia, AID
 Slamet—Surabaya Institute of Technology Project, Indonesia
 Tegene, Ababayehu—USAID
 Wilson, Jeffrey R.—Government of Trinidad

Self-Supporting Graduate Students

Ahmad, Adnan Bin
 Fakiya, James O.
 Hsu, Sheue-Wen
 Kim, Byung C.
 Kim, Byung H.
 Lamb, Robert
 Lee, Youngjo
 Morel, Jorge
 Nguyen, Cung Nang
 Richards, Winston
 Tsui, Susan Y.

Survey Section

Carrol Arthur, Statistical Data Processor through September 30
 Glenda Ashley, Key Entry Operator
 Joanne Clark, Statistical Data Processor through October 25
 Hazel Cook, Survey Supervisor
 Julie Ann Cummings, Statistical Clerk
 Theo Doran, Key Entry Operator through November 16
 Dorothy Edwards, Statistical Clerk
 Frances Elefant-Woolsey, Statistical Clerk beginning May 8, 1979
 Margaret Fowler, Statistical Data Processor
 Evelyn Green, Survey Supervisor
 Vimlesh Gupta, Key Entry Operator beginning January 1
 John Highland, Research Assistant

Howard Hughes, Research Assistant
 Marion Martin, Statistical Data Processor
 Sylvia McNulty, Account Clerk
 Helen Nelson, Secretary
 Margaret Nichols, Secretary through July 31
 Donna Omundson, Statistical Clerk
 Florence Osam, Statistical Clerk
 Linda Price, Secretary beginning June 25, 1979
 Kathie Reinertson, Statistical Clerk beginning December 17
 Christine Rock, Statistical Clerk through November 26
 Jasmine Seagrave, Statistical Clerk beginning October 1
 Jeanne Sorenson-Wright, Statistical Data Processor
 Harvey Terpstra, Junior Systems Analyst
 Elaine J. Widmann, Key Entry Operator

Statistical Data Processing Service

Bud J. Meador, Supervisor
 Kathleen Shelley, Junior Data Analyst from August 6

General Office Staff

Avonelle C. Jacobson, Administrative Assistant
 Betty Ibrahim, Accountant
 Nancy J. Barry, Information Specialist
 Phyllis Carr, Secretary—Experimental Design Genetics Statistics Section
 Norma Elwick, Secretary
 Sandy Howard, through September
 I. Joyce, Johnson, Secretary—Statistical Numerical Analysis and Data Processing Section through November 6
 Marylou Nelson, Secretary
 Janice Peters, Secretary
 Laura Robinson, Secretary
 Sharon Shepard, Secretary beginning in October
 Linda Wheeler, Secretary
 Darlene Wicks, Secretary—Statistical Numerical Analysis and Data Processing Section beginning in November

B. V. Sukhatme Lecture

During May, J. N. K. Rao, professor of statistics, Carleton University, Ottawa, Canada presented the first annual B. V. Sukhatme Memorial Lecture. He discussed "Chi-squared tests for categorical sample survey data." The lecture honors the late Bal Sukhatme, professor of statistics, ISU 1967-79, who attained wide recognition for his work in survey sampling. A goal of this seminar series, supported by the B. V. Sukhatme Memorial Lecture Fund, is to bring outstanding lecturers in survey sampling to the ISU campus. For Dr. Rao this was a return visit. He obtained his Ph.D. here in 1961 and served as an assistant professor until 1963.

Consulting and Cooperative Research

At Iowa State University, statistical consulting is a highly developed activity, backed by funding from the Statistical Laboratory and the Agriculture Experiment Station. The primary aim is to assist Iowa State University faculty members and graduate students with statistical facets of their research projects. Individual researchers seek statistical advice on a variety of topics relating to their research, such as design of the experiment including data collection, selection of the sample population to be studied, methods of processing and analyzing data, and interpretation of results.

Arrangements for statistical consulting may be made with any faculty member, but certain faculty members and graduate assistants are budgeted primarily in this area. Some of these staff members are also actively engaged in developing software which will improve available statistical techniques.

Consulting services are partially financed by various types of contracts between the Statistical Laboratory and governmental or educational agencies.

Examples of this year's consulting follow.

Engineering Research Institute

R. Craig Van Nostrand was assisted by Mike Hale, whose consulting assistantship was supported by the Engineering Research Institute.

The largest project was an errors in variables problem in the comparison of particle counters for Ames Labs. Work with Civil Engineering included the fitting of multi-response data with unequal variances, a multi-dimensional time series of Des Moines River water quality as affected by the construction of the Saylorville Dam, comparisons of regressions of filtering data, and a non-linear least squares fitting of equipment life data. A project with Chemical Engineering has focused on designing experiments to compare treatments of coal desulfurization and distinguishing between mechanistic models for these treatments.

Agriculture and Home Economics Experiment Station

The statistical consulting with members of the Agriculture Experiment Station and other biological scientists continues on a daily basis. The tools to handle the work have been improved by additional computer terminals, new versions of the Statistical Analysis System, and improved data editing and management systems. The number of requests for consulting services can not be met by the permanent staff. Much of the work must be done by the re-

search assistants who are graduate students in the Department. During the past year these assistants have been Erik Bergstralh, Peter Crump, Cheryl Enger, Greg Kruger, Moun-Shen Lee, and Dan Mowrey. The University has been well served by their efforts. As these students gain experience they undertake more responsibility and come to a point where they handle entire consulting jobs from initial contact to final interpretation. This is a broadening educational experience for them and provides the University with services that would otherwise be unavailable. The main support for this work comes from the Agriculture Experiment Station and, more recently, from the College of Veterinary Medicine where the research effort and use of statistical methods have expanded. It is in the nature of the operation that just when these students become most effective, they graduate and move out into other jobs and we begin again to train new people for the work.

The consulting work is more interesting and, perhaps, more effective, when one has some appreciation for the actual experimental or survey situations involved in generating the numbers. The group responsible for consulting took a trip out into the state of Iowa this spring visiting some typical sites where the numbers we process originally arise. One is impressed by the magnitude of sampling problems involved in understanding the fisheries in a pool of Mississippi when one rides over the area in a small boat and considers the factors in the system over which the research worker has no control. The meaning of total confinement rearing in pigs is impressed on your visual and olfactory senses when you are led through a single building holding 1500 pigs by the owner, a former ISU student, and his wife who holds an M.S. degree in Statistics from this Department. The difference between how you think agronomic field experiments are done and what actually takes place is emphasized by a field worker at an outlying farm who says he always has trouble with those randomization plans statisticians send to him because invariably two or three check plots occur adjacent to each other. His solution to such unreasonable plans has always been to modify the randomization some to get a more sensible coverage of the area by the check plots! There is no question that such trips are educational. They are also enjoyable due to things like the ability of the Mississippi to provide enough Walleyes for a huge fish dinner.

Philip Cox consulted with a graduate student and professor in Animal Science on planning experiments on the induction of follicular growth and ovulation by calculated dosage and timing of

gonadotrophin-releasing hormone administrations. He consulted with a graduate student in Agronomy on the interpretation, presentation, and collation of results on the relative yields of mixtures and monocultures of oat genotypes with complications due to obscure effects and error structures. He also consulted with Physical Plant and Campus Operations personnel with advice on the selection of native wild flowers for planting on College Creek, on the identification of suitable planting niches, and on the actual planting operations.

Statistical Numerical Analysis and Data Processing Section

Many different activities and projects served to make the past year an exceptionally busy one for section personnel. An unusually large number of personnel changes increased the burden on incoming and continuing members of the section.

Mainstay statistical analysis package programs such as SAS, SPSS, BMDP, and MINITAB continue to be maintained by the section. These packages are, on the average, updated twice a year. This year, major new releases of SAS and BMDP were installed. To assist new users of statistical packages in learning fundamentals of their use, a series of introductory short courses on videotape were prepared for SAS, SPSS, and MINITAB. These packages, coupled with the IMSL software, provide much of the software needed to support many research project computing requirements.

Tom Bubolz, Bradley Skarpness, and Jan van Schaik continued with design improvements and maintenance on an interactive tree order information system developed for the Iowa State Forest Nursery. This system, in its second year of operation, has streamlined the record processing for sales of 3.2 million trees.

Another State Forest Nursery project involves the design and implementation of a computerized cost-accounting/inventory control system. One goal of this project is to determine the actual cost of growing each of 40 different species of trees over time periods of one to three years. Another goal of this system is the development of "optimum" formulas for growing different species of trees. The system will permit this by keeping complete and accurate records of soil preparation, time and type of fertilization, germination rates, and survival rates for each of over 1200 seedbeds. Steven Duke, Tom Bubolz, and Jan van Schaik are responsible for developing this system.

Larry Kinyon, Woon Bang Yeo, and Stephen Chang programmed the analysis of soil test data collected from 1973 to 1979 for the ISU Soil Testing

Laboratory. Over 80,000 records were analyzed. Output from the programs will be photo-reduced and used in a report to be published by the Soil Testing Laboratory.

Jan van Schaik wrote a program which analyzes dietary recall data and yields an accurate summary of an individual's daily food intake in terms of calories and 10 vitamins and nutrients. The program was applied to data collected from 900 individuals who were interviewed as part of a joint study between the Departments of Food and Nutrition and Sociology to identify social-psychological correlates of food consumption.

Steve Chang has worked closely with the Department of Food and Nutrition to develop new programs and modify existing programs for analyzing dietary data. He also gave programming support for thesis research in this department. Steve has also been responsible for analyzing the annual game harvest surveys conducted by the Iowa State Conservation Commission. Two major surveys were conducted this year for the harvest of deer and small game animals.

Larry Kinyon has provided programming support for a history professor's investigation of kinship patterns among residents of 19th-century European villages. A rather complicated customized information storage and retrieval system was developed for this project.

Tom Bubolz and Jan van Schaik completed an analysis of trend log data for KIOWA Corporation. The objectives of the study were the identification of interrelationships among characteristics of a die-casting machine and the number of casting defects produced under a prespecified set of operating conditions.

Anil Londhe left the section during the spring quarter for a career in industry. Anil's experience in numerical procedures made him an invaluable employee throughout his stay.

Susan Kontos also completed the requirements for her Ph.D. degree in Child Development. Susan has worked in the section for two years as a research assistant supported by the Graduate College. Susan left the University late in the year to join the faculty at the University of Northern Colorado.

Luis Escobar and Char-Lung Lin, both research assistants in the section, shared heavily in the transfer of work formerly done by Londhe and Kontos.

Another project, the NC-124 Regional Project, involving the study of rural children by the Child Development Department and other midwest universities, required the services of several different section members at one time or another throughout the year. A composite data file was constructed for this project from various data files supplied by the six participating universities.

A series of bi-weekly meetings was initiated between section personnel and James Hoekstra and other representatives from the Computation Center. The emphasis of each meeting was directed to the various programming solutions to a difficult data-handling problem. This interaction with Computation Center personnel provides valuable exposure to computer-processing tools that are on hand at Iowa State University, and gives all participants ample opportunity to study problem types which frequently arise in research.

Survey Section

The Survey Section continues to cooperate with the University of Iowa and the National Cancer Institute (NCI) on studies of cancer incidence. Data collection was completed on a personal interview study of persons with various types of cancer. These cancer cases were matched on age, sex, and geographic location with case-control data collected last year in the study of incidence cases of persons in Iowa with cancer of the urinary bladder. Cases were identified by the Iowa Cancer Registry at the University of Iowa. Data were collected on 356 cases; the Survey Section was responsible for field interviewing, validation, and the initial data edit. Analyses will be completed by NCI researchers.

Data continue to be collected in a case-control epidemiologic study designed to identify familial and environmental factors that are associated with the occurrence of brain tumors in children. The cases are children under 16 years of age at the time of diagnosis of certain types of brain tumors. Controls are randomly selected and matched with cases on age, sex, and geographic area. Data were collected on 17 cases and 51 controls. It is expected that this five-year project will obtain data from approximately 100 cases and 300 controls in Iowa. Cases will be identified by the University of Iowa Cancer Registry. The Survey Section is in charge of control selection, field interviewing of parents of cases and controls, and initial data edit. Data analysis will be completed by researchers at the Children's Hospital Medical Center in Boston.

A project conducted by the Department of Sociology studied societal changes and family relationships as they may affect food consumption habits. The Survey Section designed the sample of Iowa households located in cities stratified by population. Under the supervision of Harold Baker, the sampling scheme was structured to produce an equal number of households containing (1) single parents; (2) single adults over 60 years of age; (3) married couples with children under 6 years of age; (4) married couples with children 6-18; (5) married couples with the wife between 45 and 60; (6) married

couples with the wife over 60 years of age. Data were collected by personal interview on 503 households. In households containing married couples, the husband and wife completed separate questionnaires. The Survey Section edited, coded, and transferred the data to computer storage; researchers in Sociology will complete the analyses.

Data summarization continues on the Family Farm data set collected in 1977 for the College of Agriculture. Staff members in various departments are making use of these data in their ongoing research programs. Sastry Pantula provided programming assistance and was responsible for revising and updating the master data set.

Jeanne Devin provided the Section's primary support to the Department of Economics in updating a general computer program designed to produce tabulations from data collected from farm management students regarding types of machinery used on their home farms.

A study conducted for the Department of Sociology queried 319 farm operators by telephone in 39 counties in central Iowa about information sources commonly used in purchasing and selling agricultural products. The sample was selected from county farm directories, and sample listings were screened to identify farm operators in the households. A follow-up mail questionnaire was also sent to the farm operators asking about additional agricultural market information sources and about the soil conservation practices they used. The data were edited and coded, and preliminary tabulations were produced by the Survey Section. Researchers in Sociology completed the analyses.

A pretest of study procedures and questionnaire format and content was conducted for the U.S. General Accounting Office (GAO). Designed to study the effect of estate tax provisions on estates including either farm land or timberland, three groups were studied: (1) inheritors; (2) administrators or executors of the estates; and (3) farm owner-operators. After field pretests with individuals associated with 14 estates, the procedures and questionnaires were revised and submitted to the GAO for evaluation.

In a five-state regional project designed to study the organizational structure of regional councils of governments and the programs and services they provide to local governments, the Section is cooperating with researchers in Sociology. City mayors, chairpersons of county boards of supervisors, and representatives of regional councils in two Iowa area councils will be interviewed in person. Section staff will be in charge of field data collection, editing, and coding, and will assist in analysis of all data collected in the five states.

A study to assess attitudes of Iowa residents toward education in the state and to elicit opinions on how the quality of education may be improved is

being made in cooperation with the College of Education. A random sample of approximately 800 citizens will be selected through telephone screening of randomly selected telephone numbers. Depending upon whether the selected individual is available at the time of telephone contact, data will be collected either by telephone or mail. Section personnel assisted in the planning of the study procedures and in questionnaire development, and will collect, edit, and code the data, and prepare preliminary tabulations.

The Faculty Budgetary Advisory Committee was given assistance in constructing a questionnaire on departmental faculty evaluation procedures. The questionnaire was mailed to all Iowa State University faculty members. The Survey Section also processed the 922 returned questionnaires and tabulated the results for the committee.

A sample of fields and the farm operators of these fields was selected from drainage districts in the Des Moines River Basin in north central and northern Iowa for a study of drainage characteristics and farmer attitudes toward drainage improvement. The Survey Section is cooperating with the Department of Economics and the Soil Conservation Service on this study. Altogether, 295 separate fields and 252 separate farm operators in 61 drainage districts were selected. The Survey Section helped write the questionnaire, designed and drew the sample, completed personal interviews with the farm operators, and is processing the data.

Staff members cooperated with the Department of Economics in a study of farm operators who had stored grain under the farmer-owned grain reserve program. Data concerning grain marketing and storage facilities were collected by telephone for 169 farmers in Iowa. Analyses were completed by Economics researchers.

Why farmers adopt or fail to adopt various soil conservation practices was the subject of a research project conducted jointly with the Department of Sociology. Personal interviews were conducted with 194 farm operators in three Iowa counties. Re-interviews will be conducted after two years to see what effect various combinations of educational programs and government subsidies may have on adoption of practices.

As part of a six-state regional study, telephone interviews were conducted with 68 residents located within the boundaries of a regional rural water system in Wapello County, Iowa. Conducted in cooperation with the Departments of Sociology and Civil Engineering, this study seeks to identify effects of rural water systems on local property values and attitudes of eligible rural residents. The Section helped in the design of the questionnaire and field procedures, collected the data, and made initial

tabulations. Analyses will be made by the primary researchers.

The Section and the Department of Economics are conducting a study of possible effects of foreign ownership of farm land. Under a cooperative agreement with the U.S. Department of Agriculture, operators of a sample of farm tracts under foreign and domestic ownership located in California, Iowa, and Mississippi will be interviewed. Section personnel assisted in questionnaire and field form construction, selected the sample, and will supervise field data collection. Analyses will be completed by researchers in Economics.

Assistance in constructing questionnaires was given to a student in Agronomy interested in surveying oat producers and to a professor in Community and Regional Planning investigating the experiences of rural towns in Iowa with various government programs.

Samples were drawn for a variety of researchers. A nationwide sample of public schools was selected for a group in Home Economics Education studying the course content of certain specially funded courses in home economics. A sample of students at three grade levels (3rd, 7th, and 10th) was selected from the public and private schools in Iowa for another researcher in Home Economics Education concerned with the nutritional knowledge of students. A sampling plan was devised to enable ISU Library personnel to estimate the total number of monograph titles and volumes in the library on the basis of a sample from the card catalogue. Another plan was formulated for other library personnel to be used to estimate the numbers of times various publications in the library collection have been cited by ISU faculty members in their research papers. A sample of hospitals in Iowa was selected for an Iowa Hospital Association study of the accuracy and completeness of hospital abstracting procedures. Two statewide samples were selected for a representative of the State Preserve Board to be used in taking bird censuses. One sample was selected from the cities and towns of Iowa and the other from wetland areas. A sample of approximately 10,000 names was selected from the county farm and ranch directories of Iowa to be used in a mail survey seeking information about the varieties of corn being planted by Iowa farmers. A professor in Family Environment was given assistance in drawing a statewide sample of approximately 600 households from telephone directories to be used in a mail survey concerned with attitudes toward family planning.

The Survey Section again conducted the biennial school census for the Ames Community School District. The primary purpose of this census, which is required by state law, is to obtain an accurate count of the number of persons less than 21 years of age

residing in the school district.

For the fourth time, a statewide sample of business and manufacturing firms, government agencies, and educational institutions was selected for the Iowa Department of Public Instruction. A total of about 6,000 firms was selected because separate estimates were desired for each of 15 geographic strata. The primary purposes of the study are to provide estimates of the demand for workers in various categories for which training programs have been established in the area community colleges and to determine the need for additional programs. In addition to selecting the sample, the Survey Section will also be processing the collected data.

The Survey Section worked with the Iowa Conservation Commission on a study of duck and goose hunting on public hunting lands in Iowa. A sample of observation periods was selected for each hunting site covering the hunting season and randomly allocated to the access points. After the data were collected by Conservation Commission personnel, processing and estimation were completed by Survey Section personnel using the SUPER CARP computer program.

The program package SUPER CARP, developed by the Survey Section, has been expanded and improved. The package will now compute variances of means, totals, ratios, and regression coefficients for two-stage samples with finite correction terms at both stages. Dan Scott spent the summer of 1979 modifying the program. Persons interested in obtaining the current version of SUPER CARP should write to Professor Wayne A. Fuller.

Social Sciences

Mack Shelley consulted with associate professor Joel Moses, ISU Department of Political Science, on a paper "The Impact of *Nomenklatura* in Soviet Regional Elite Recruitment," prepared for delivery at the Second World Congress on Soviet and East European Studies, Garmish-Partenkirchen, West Germany, September 30-October 4, 1980.

He consulted with students on topics dealing with public transportation, physically handicapped teenagers, design of office work space, survey of Nigerian agricultural policy officials, foreign students' attitudes at ISU, high school students' attitudes on coaches teaching social studies courses, and the impact on teachers of a special instructional seminar.

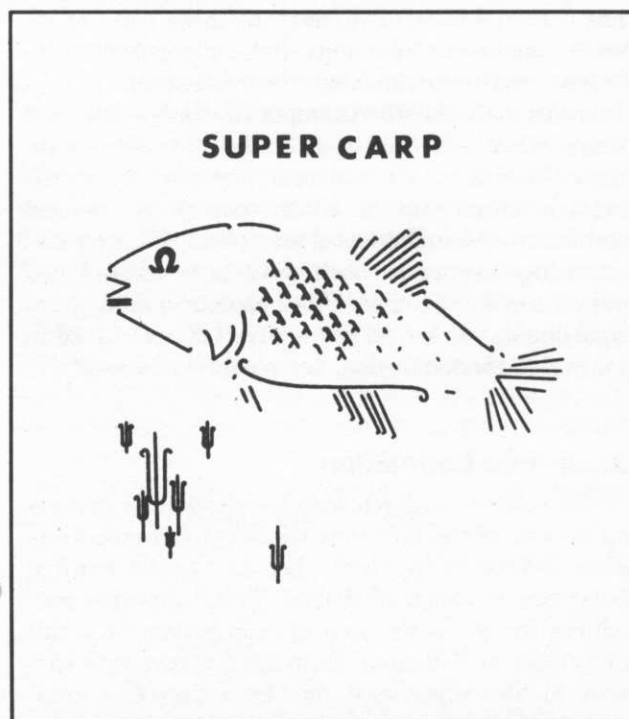
Robert Strahan was a consultant for faculty members and graduate students in Child Development, Education, Industrial Education, Elementary Education, and Chemical Engineering. He also consulted with members of the Student Counseling Service and Veterinary Medicine.

Off-Campus Consulting

T. A. Bancroft consulted with Brian Joiner, head of the Statistical Laboratory at the University of Wisconsin, on information relative to the early development of statistics at ISU (in particular, to that related to statistical consulting).

During the year, Jeff Goebel and Wayne Fuller were in Fort Worth, Texas to consult with Soil Conservation Service (SCS) officials re: sampling designs that might facilitate various graphical displays of sample data.

In September Dr. Goebel was in Lincoln, Nebraska to consult with SCS officials about pilot projects to evaluate the use of remote sensing and photo interpretation in sample survey work. During November, he was in Fort Worth, Texas to participate with engineers and agronomists in a workshop dealing with the validity of the Universal Soil Loss Equation as a means of estimating soil erosion.



Along with being the account clerk for the Survey Section, Sylvia McNulty is an artist. She designed "Super Carp" for Wayne Fuller.

Current Research

Statistical Laboratory staff members are actively engaged in statistical theory and methodology research. Research funds are made available through the budgets of the Statistical Laboratory, the Agriculture and Home Economics Experiment Station, the Engineering and Sciences and Humanities Research Institutes, and government contracts and grants.

A brief summary of research sponsored by contracts as well as some staff members' individual research is reported in this section.

AES Project 890

Oscar Kempthorne worked on Project 890 of the Iowa Agriculture and Home Economics Experiment Station under the title Design of Experiments and Analysis of the Data.

Work continued in directions of previous years. Controversies on foundations of statistics continue. One paper (Sankhya) attempts to make the case that it is important to distinguish three types of inference: sampling from a given finite population, inference from experiments, and inference in purely observational studies. Attempts to modify standard Neyman-Pearson-Wald decision theory to remove incongruities that are obviously present were examined (Discussion of Kiefer paper). A general evaluation of foundations of statistical thinking and reasoning was made. Such work is never finished and continues, of course. Other aspects of analysis of experiments worked on are: analysis of covariance in relation to randomization, and residual analysis.

Small Area Estimation

Cooperative research with the Statistical Reporting Service of the U.S. Department of Agriculture is being conducted by Henry Lee and Sallie Burdge under the direction of Wayne Fuller. Possible procedures for the estimation of crop yields for small areas were investigated. Estimators of corn and soybean yields constructed on the basis of a components-of-variance model were studied using a group of Iowa counties. Estimators based on alternative variance models were also constructed.

AES Project 2155

The Survey Section, under the leadership of Roy D. Hickman, has continued its research in agricultural-related sample survey methodology. The U.S. Department of Agriculture supports this work through Project 2155 with the Agriculture Experiment Station. Cooperative research with the Soil

Conservation Service (SCS) on natural resource inventories constitutes most of the work under Project 2155 and is one of the larger research agreements administered by AES at Iowa State University. Included in this work are sample design, questionnaire and form construction, variance estimation investigations, research in ratio and regression estimation, large data set methodology, and evaluation of sample data quality. Jeff Goebel serves as coinvestigator for this project. Also involved are Wayne Fuller and Survey Section staff members Richard Dorsch, Howard Hughes, and John Highland, as well as research assistants Tin-Chiu Chua and Rachel Harter. Sample selection, mapping, coding and editing, and data manipulation also require the efforts of a number of Survey Section clerical personnel.

This cooperative work with the SCS includes analysis of past surveys, as well as supervision of ongoing studies and planning for future resource inventories. Data from the 1977 SCS National Resource Inventories and other past surveys are being analyzed in an effort to produce more efficient sampling schemes for future studies. These studies will attempt to inventory land use and cover, soil-related items, the potential for conversion of non-cropland into cropland, wind and water erosion, prime farmland, conservation needs, wetlands, and many other agriculture-related resources. Results of these natural resource inventories are desired by the U.S. Congress at the national level or at regional levels. State and local governments and various planning groups are interested in estimates at the county level or by certain types of physiographic subregions within a state or region. The Survey Section is cooperating with the SCS in the development of sampling methodology that will help answer questions concerning these agricultural resources for the many geographical universes of interest.

Also included in the SCS cooperative work is the storage, retrieval, and analysis of the interpretation data of soil series in the United States. This data file continues to expand, with nearly 14,000 soil series now in storage. Updating of these records has increased as the SCS field staff attempts to keep the data as current as possible. A primary use of this data is to generate tables for inclusion in published soil surveys. Various subfiles of the data set have been provided to a number of land-use planning, environmental, and research organizations. Preliminary work was completed to associate soil interpretive data with records in the National Resource Inventory data sets. Harvey Terpstra continues to work with regional and national SCS personnel in the development and use of this data system.

Construction of area sampling frames continued under a cooperative agreement with Economics,

Statistics and Cooperative Service (ESCS), USDA. Strata are constructed according to degree and type of cultivation as shown on maps, aerial photography, and other materials furnished by states. Land within strata is then subdivided into area sampling units, providing a sampling frame used by ESCS in their agricultural surveys. The sampling frame for Pennsylvania was completed during the year.

AES Project 2383

The U.S. Bureau of the Census and the Iowa Agriculture and Home Economics Experiment Station supported joint research in measurement error models, survey design, and time series through AES Project 2383. Personnel working on the project include Wayne Fuller, principal investigator; Yasuo Amemiya; Hsien-Ming Hung; and Fu-hau Yu.

Alternative estimators of the parameters of time series models were studied. Properties of the estimators were studied for both stationary and non-stationary processes. A computer program was developed for certain kinds of estimation procedures.

The construction of survey designs and estimators under a model that postulates prior information in the form of a regression model with known covariance structure was studied. The approach has been coupled with the development of consistency ideas for finite populations.

Maximum likelihood estimators and likelihood ratio tests were investigated for certain structural errors-in-variables models. The relationship of some tests to statistics of the F-type was established.

FAA Towered Airport Project

The U.S. Department of Transportation has supported the development of methodologies to carry out a study of aircraft operations at FAA towered airports. The research was conducted by Wayne A. Fuller, principal investigator, and James Drew. The objectives of the study were to develop strategies for the sampling of aircraft operations, to develop methods for the estimation of the parameters of the hourly distribution of aircraft activities and to develop efficient forecasting procedures.

Order Statistics and Nonparametric Statistics

H. A. David, principal investigator for the above grant, has completed preparing the second edition of his *Order Statistics*. He has also written a paper on the theory and applications of concomitants of order statistics which was presented in a symposium of the Lisbon Academy of Sciences and is to appear in a proceedings volume on Recent Advances in Statistics.

Malay Ghosh, co-investigator, has been working on problems involving uniform and nonuniform rates of convergence to normality for U-statistics and linear functions of order statistics. In addition, Malay has been engaged in the development of a suitable notion of sequential Pitman efficiency as well as in point and interval estimation of means of U-statistics.

The research assistant, H. N. Nagaraja, has investigated the distribution of the selection differential when k individuals are selected out of n . Asymptotic theory has been developed for k fixed and for $k/n \rightarrow \lambda$ ($0 < \lambda < 1$) as $n \rightarrow \infty$. The selection differential, slightly modified, is also of interest in tests for outlying observations.

A visitor, Ishay Weissman, of the Technion (Israel Institute of Technology) has been partially supported by the grant. He is an expert in extreme-value theory and is investigating, from this point of view, the estimation of tail parameters under Type I censoring.

Mathematical and Statistical Genetics

Research in mathematical and statistical genetics is supported by Project 1669, Iowa Agriculture and Home Economics Experiment Station and the National Institutes of Health. Edward Pollak is the principal investigator. Oscar Kempthorne and James L. Cornette have also worked on this project and Jerry W. Lewis and Terrence P. Callanan have been the research assistants.

J. L. Cornette and E. Pollak did research on the dynamics of an infinite age-structured population observed at times $0, 1, 2, \dots$. An attempt was made to find conditions under which there is a stable polymorphism when there are two alleles. Stability was shown for two special cases, one being an approximation involving the assumption that the age structure of the population is stable. On the other case, it was assumed that the number of matings is the same at each of times $0, 1, 2, \dots$.

E. Pollak extended his research on finite age-structured diploid populations to situations in which the population is dioecious and the locus being considered may be either autosomal or sex-linked. The effective population number was derived for each type of locus, as was the mean time to extinction of a line of individuals carrying one copy of a gene, when such a line is descended from a single individual of a particular age and sex.

O. Kempthorne continued his examination of the validity of applications of biometrical genetics to humans. In regard to this topic, it should be noted that the application of quantitative genetic theory to human populations requires that the theory take account of assortative mating and the only purported Mendelian theory available for this circumstance is

that of the classical 1918 paper of R. A. Fisher. However, the nature and accuracy of this theory are still very much under debate. Attempts have been made to remove obscurities in the theory that are still clearly present.

J. W. Lewis has completed his work on models involving selection and the interaction of a host and a pathogen. Allowance is made for selfing, random mating, or a mixture of the two systems of mating in the host species. He also developed a program for calculating genetic distances on a desk calculator. This includes instructions for the computation of Cavalli-Sforza's chord distance and the distance measures of Nei.

Linear Statistical Inference

Research is being pursued on various topics related to linear models. This work is supported in part by Air Force of Scientific Research Grant No. 76-3037, entitled "New Techniques for Linear Statistical Inference." David Harville is the principal investigator. Raghu Kacker and William Sallas served as research assistants until their graduation. At present, the research assistant is Robert Mee.

Attempts are being made to develop a unified approach to Kalman filtering, time series analysis, and the analysis of variance. Considerable emphasis is being placed on the development of point-estimation, test, and confidence-interval procedures for the fixed and random effects and for the variance-related parameters of mixed linear models. In particular, the development of "on-line" procedures for the simultaneous estimation of the effects and the variance-related parameters is being investigated. Ways are being sought in which mixed-model procedures might be extended in a useful way to the analysis of categorical data. Simplified proofs are being devised for certain fundamental theorems on the distribution of quadratic forms and for certain generalizations of those theorems.

Optimization Problems

H. T. David and V. A. Sposito continued their work under this contract in the areas of optimum estimation, generalized-convex duality and optimality, homogeneous programming, and game theory. Geung-Ho Kim and Gabriela Stangenhans respectively from the University of Buffalo, SUNY and the University of Sao Paulo, visited the project during the summer. Roger Berger and J. Colby Kegley, respectively from the Department of Industrial Engineering and the Department of Mathematics, and Dan Scott, Stanford University, also contributed to the project during the year. Participating

graduate assistants included Steven Fahrenholtz, Michael Hale, Larry Kinyon, Daniel Royalty, Brad Skarpness, and Neil Werner.

Sciences and Humanities Research Institute (SHRI)

Soon after the preparation of last year's SHRI report, B. V. Sukhatme died and Barry Arnold resigned. As a result, support from SHRI was confined to C. P. Han, D. L. Isaacson, and G. D. Meeden.

Areas of research covered by these three faculty members include multivariate analysis (Han), statistical inference (Han, Meeden), sample survey theory (Han, Meeden), and probability (Isaacson).

Chien-Pai Han continued to be active in three different areas: (a) inference based on conditional specification, a subject which includes investigating the merit of preliminary testing prior to the main test; (b) multivariate analysis, including computational aspects; and (c) sample survey theory.

Dean Isaacson presented his publication, "A characterization of geometric ergodicity," at an international conference. On the basis of this presentation, he is now corresponding with an Australian probabilist regarding some extensions. He is also continuing work on Markov chains with a former Ph.D. student, Mark Scott, which goes beyond Scott's dissertation.

Glen Meeden, together with Malay Ghosh, continued the study of admissibility for finite problems. This work can be applied in proving admissibility for survey sampling problems. For example, an estimator proposed by D. Basu for estimating the population total was shown to be admissible, i.e., no other estimator of the total is always as good or better. For estimating the population variance the usual estimator was shown to be inadmissible and an admissible estimator was exhibited. Dr. Meeden also studied situations for which it is possible to identify good probability appraisers.

Simultaneous Estimation of Parameters in Exponential Families

Malay Ghosh is conducting research in regard to the improvement on the usual (maximum likelihood, minimum variance, unbiased, or best invariant) estimators in multidimensional problems.

A general class of estimators dominating the minimum variance unbiased estimator, or some constant multiple of it, has been obtained for the general exponential family of distributions. Proper Bayes minimax estimators dominating the usual maximum likelihood estimator are proposed for estimating the Poisson mean vector.

Professional Activities

For the American Statistical Association, H. A. David completed his term on the Board of Directors and as a member of the Budget Committee. He is now a member of the ASA Ad Hoc Committee on the filming of distinguished statisticians. Bill Kennedy is serving on the Board of Directors for 1979-81 representing the Statistical Computing Section. Wayne Fuller was on the Council for the period 1979-80 representing the Section of Survey Research Methods. David Harville is the Biometrics Section representative on the Council of the ASA for 1980-81. During the year, Jeff Goebel served as secretary of the Iowa Chapter of the ASA.

Thomas Bubolz, D. F. Cox, and Paul Hinz attended the Fifth Annual SAS Users Group, International in San Antonio, Texas, February 17-20.

D. F. Cox conducted a five-session Workshop on Statistical Methods and Data Analysis in Iowa City from November 20 to December 18 as part of a new graduate program for a professional degree in agriculture.

Herbert A. David presented an invited talk as part of a Bicentenary Symposium on Recent Advances in Statistics held by the Lisbon Academy of Sciences, Lisbon, Portugal.

Wayne Fuller, Jeff Goebel, Ken Koehler, and Robert Stephenson attended the Regional Meeting of the Institute of Mathematical Statistics, Iowa City, Iowa, April 28-30. Jeff chaired a session on time series at the meetings.

Wayne A. Fuller and Chien-Pai Han represented the ISU statistics faculty at two international conferences. They presented papers at the 42nd Session of the International Statistical Institute in Manila, Philippines, December 4-14, and at a satellite conference on Recent Developments in Statistical Methods and Applications in Taipei, Taiwan, December 15-19.

Chien-Pai stayed on in Taiwan until January 15 to conduct cooperative research at the Institute of Statistics, National Central University in Chungli, Taiwan. He gave a series of lectures (six two-hour sessions) on "Inference based on conditional specification," at the Institute of Statistics, National Central University, Chungli, Taiwan, December 20, 1979 to January 15, 1980.

Along with three co-authors, Paul Hinz won a plaque in recognition of excellence in the field of economic nematology, by the Society of Nematologists for a publication entitled "Corn yield increases relative to nonfumigant chemical control of nematodes." The presentation of the award was made during the banquet of the annual meeting of

the Society of Nematologists held at Salt Lake City, July 23-26, 1979. An abstract of the article appeared in the 1978-79 Annual Report on page 22.

Oscar Kempthorne was selected as chairman of the Committee on Fellows for IMS. He was also elected chairman for 1980 of Section U (Statistics) of the American Association for the Advancement of Science.

William Meeker is a member of the National Research Council "Panel on Experimental Techniques for the Investigation of the Degradation of Electrical Insulation." As part of his duties, he participated in a workshop held in conjunction with the 48th Annual Conference on Electrical Insulation and Dielectric Phenomena in White Haven, Pennsylvania, October 26.

William Meeker was involved in the production of a "Career Awareness" videotape, the purpose of which is to describe the statistics major and profession to ISU freshmen who have not chosen a major area of study. The tape contains interviews with three present or former ISU statistics students, Lisa Knutson, Greg Kruger, and Steve Johnson.

Mack C. Shelley II obtained support for the summer from the Iowa State University Research Foundation and the Sciences and Humanities Research Institute. He worked on the topic "The conservative coalition in the United States Congress."

At the Joint Annual Meeting of the American Statistical Association and the Biometric Society, Washington, D.C.:

Bhattacharyay, Biswanath and Wayne FULLER: "Varying parameter stochastic difference equations;"

FULLER, Wayne and D. A. Dickey: "Autoregressive estimation in seasonally nonstationary time series;"

FULLER, Wayne and D. P. Hasza: "Predictions for the first order autoregressive process;"

GENTLE, James E.: "Design of subroutine library for statistical analyses;"

GHOSH, Malay and B. K. Sinha: "On the robustness of least squares procedures in regression models;"

Grimes, J. E. and B. V. SUKHATME: "Testing hypothesis about regression coefficients in samples from a bivariate normal population;"

HAN, C. P.: "Selection of a preliminary test estimator in linear regression;"

Hand, M. L. and V. A. SPOSITO: "The relative efficiency of the midrange for estimation of the mean of a symmetric distribution;"

Ho, Fred C. M., James E. GENTLE, and William J. KENNEDY: "Generation of random variates from the multinomial distribution;"

KEMPTHORNE, Ocsar: "Where is the fault dear Brutus? Genes or environment?;"

KOEHLER, Kenneth J.: "A rectangular inequality involving multinomial probabilities;"

Londhe, Anil and James E. GENTLE: "Density estimation using kernels with variable size windows;"

Mc Govern, Paul G. and Robert F. STRAHAN: "What's in a number? Verbal equivalents of numerical p-values;"

MEEKER, William Q. Jr.: "Large sample accelerated life test procedures for comparing two products;"

MEEKER, William Q. Jr. and John Michael: "Planning accelerated life tests;"

Sen, P. K. and Malay GHOSH: "Asymptotically risk efficient nonparametric sequential point estimation;"

Werner, N. M. and H. T. DAVID: "Random stopping under asymptotic independence and Anscombe-tightness."

At other locations:

BAILEY, Theodore: "Comparison among test environments," at the Interregional Corn Improvement Conference, Atlanta, Georgia, February 11-14.

"Some results on the problem of identifying the test environment that will result in the maximum response to selection," at the ISU Department of Horticulture, April 14.

BANCROFT, T. A.: "Some cooperative arrangements for dispersed statistical programs," at Cornell University, Ithaca, New York, October 16.

"Inference for some conditionally specified ANOVA models," at Cornell University, Ithaca, New York, October 17.

"The dual nature of statistics and the reduction of

specification errors in statistical inferences," at the Mathematics Faculty Colloquium, San Diego State University, March.

"Mutually beneficial statistical consulting arrangements," at the spring meeting of the Southern California Section of the ASA held at San Diego State University, April.

"Opportunities for extending the usual statistical program in universities," at the Statistics Faculty Colloquium, San Diego State University, April 24.

Boggess, W. G. and V. A. SPOSITO: "Solving quadratic programming problems via separable programming," at the Southern Agricultural Economics Association Meetings, Hot Springs, Arkansas, February 5.

BOOTH, Gordon D.: "Statistics in integrated pest management," at the Conference on Integrated Management of Insects, Ticks, and Mites on Livestock, at Kansas State University, Manhattan, Kansas, March 5-8.

COX, D. F.: "Applications of statistics in agriculture from the viewpoint of the statistical consultant," and "Applications of statistics in the design and analysis of animal experiments," at the University of Nebraska, April 10-11.

DAVID, Herbert A.: "Concomitants of order statistics," at a symposium on Recent Advances in Statistics, Lisbon Academy of Sciences Bicentenary, Lisbon, Portugal, April 13-19.

DAVID, Herbert T.: "Bayesian updating of reliability data," at the Nuclear Engineering Meetings, Knoxville, Tennessee, April 9.

"An asymptotic stochastic view of split-second hesitation," at the Colloquium of the Department of Mathematical Sciences, The Johns Hopkins University, April 23.

FULLER, Wayne A.: "Testing the autoregressive process for a unit root," at the 42nd Session of the International Statistical Institute, Manila, Philippines, December 11.

"Samples and surveys," at the American Mathematical Society Meeting, San Antonio, Texas, January 7.

"Estimation of nonstationary autoregressive processes," at Texas A&M University, January 9, and at the University of New York at Albany, March 17.

"Measurement error models," at Stanford University, March 12.

"Survey sampling," at the Iowa Joint Mathematics Meeting at Simpson College, April 18.

"Prediction for autoregressive time series," at the NSF-NBER Seminar on Time Series at the U.S. Census Bureau, Washington, D.C., June 13.

FULLER, Wayne A. and C. Isaki: "Optimal survey designs under superpopulation models," at the Conference on Recent Developments in Statistical Methods and Applications, Academia Sinica, Taipei, Taiwan, December 15.

"Survey design under the regression superpopulation model," at the Symposium on Survey Sampling, Carleton University, May 8.

GHOSH, Malay: "On the robustness of least squares procedures in regression models," at the University of North Carolina, Chapel Hill, February 15, and at Oklahoma State University, April 7.

"Consistency and asymptotic efficiency of two stage and sequential estimation procedures," at the University of Maryland, College Park, February 18.

"Berry-Esseen theorems for U-statistics in the non iid case," at a meeting of the Janos Bolyai Mathematical Society, Budapest, Hungary, June 23-28.

GOEBEL, Jeffery J.: "Phase II of the National Resource Inventories—preliminary results and future possibilities," at the Soil Conservation Service Sedimentation Geologists' Meeting, Brownsville, Texas, March 4.

"Sampling techniques and sample size requirements for inventorying natural resources," at the training session for the USDA 1981-82 Multiresource Inventory, Denver, Colorado, March 28.

HAN, Chien-Pai: "Pooling several means in normal populations," at the 42nd Session of the International Statistical Institute, Manila, Philippines, December 4-14.

"On estimating the variance of the sample mean in random models," at the Conference on Recent Developments in Statistical Methods and Applications, Academia Sinica, Taipei, Taiwan, December 15.

HARVILLE, David A.: "Recursive estimation using mixed linear models with autoregressive random effects," at Variance Components and Animal Breeding: A Conference in Honor of C. R. Henderson, Cornell University, Ithaca, New York, July 16-17.

"The Kalman filter and its extension to mixed linear models," (seminar) at Wright-Patterson Air Force Base, Ohio, August 15.

"Maximum-likelihood and pseudo-Bayesian approaches to mixed-model estimation and prediction," at Pennsylvania State University, University Park, Pennsylvania, December 13-14.

HICKMAN, Roy: "Combining data collection methods in general population surveys: mail and telephone," at the Southwestern Social Science Association Meeting, Houston, Texas, April 2-6.

ISAACSON, Dean: "Ergodicity, geometric ergodicity, and strong ergodicity," at the Ninth Conference of Stochastic Processes and Their Applications, Northwestern University, Evanston, Illinois, August 6-10, and at the University of Minnesota, February 29.

"Markov chains and their applications," at Grinnell College, November 2, and at Gustavus Adolphus College, November 20.

KEMPTHORNE, Oscar: "The 2×2 table," University of Sao Paulo, November 20.

"Aspects of mixed linear models," University of Piracicaba, November 22.

"Heredity and IQ," University of Campinas, November 23.

"The teaching of statistics," EMBRAPA, Brazilia, November 27.

"Foundations of statistics," Instituto de Matematica Pura, November 30.

"Classificatory structures and well-formed models," "The good generalized inverse," and "Controversies in statistics," at Cornell University, Ithaca, New York, May 1-2.

"Classificatory data structures and models," and "Arthur Jensen and bias in mental testing," at Ohio State University, Columbus, Ohio, May 27-29.

MEEKER, William Q. Jr.: "Computer programs for reliability and life data analysis," at Bell Laboratories, West Long Branch, New Jersey, June 26, 1979.

"Planning accelerated life tests," at Bell Laboratories, Whippany, New Jersey, August 1, and at Bell Laboratories, West Long Branch, New Jersey, August 6.

Shabana, R., T. BAILEY, and K. J. Frey: "Production traits of oats selected under low, medium, and high productivity," at the National Meeting of the American Society of Agronomy, Fort Collins, Colorado, August 6-9.

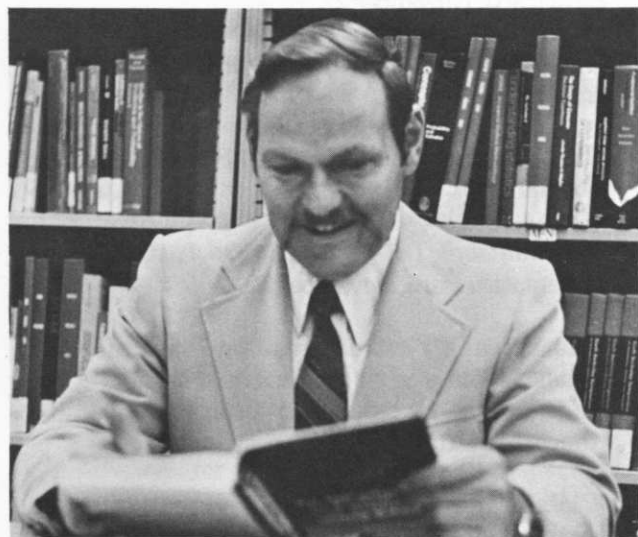
SHELLEY, Mack C. II: "The conservative coalition and the president, 1953-1978," at the 1979 Meeting of the Southern Political Science Association, Gatlinburg, Tennessee, November 1-2.

"Presidents, public policy, and the conservative coalition," at the ISU Department of Political Science, December 11.

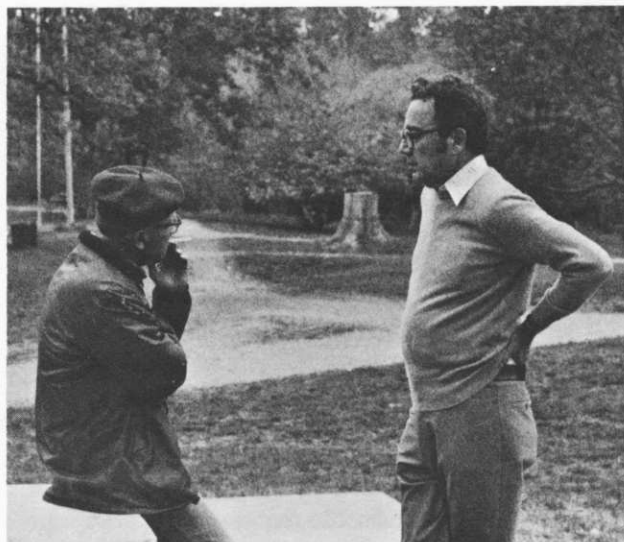
STRAHAN, Robert F.: "Statistical indices of magnitude of effect," at the American Psychological Association, New York City, September.

"Selecting the most reliable composite of subjective ratings," at the annual convention of the Midwestern Psychological Association, St. Louis, May.

STRAHAN, Robert F. and Carole K. Strahan: "Levels of generality in psychological description:



W. J. Kennedy co-authored *Statistical Computing*



"Our" two Distinguished Professors in the College of Sciences and Humanities—Oscar Kempthorne and H. A. David

a personality illustration," at the American Psychological Association, New York City, September.

Strahan, Carole K. and Robert F. STRAHAN: "Divisional membership of APA men and women," at the annual convention of the Midwestern Psychological Association, Chicago, May 1979.

VAN NOSTRAND, R. Craig: "Discussion of 'A critique of some ridge methods,'" at the joint annual meeting of the American Statistical Association and the Biometric Society, Washington, D.C., August.

"A wary look at ridge regression," at the regional Institute of Mathematical Statistics Meeting, Iowa City, Iowa, April 29.

WEISSMAN, Ishay: "Estimation of tail-parameters," University of Iowa, Iowa City, December 6.

"Tail estimation," at the University of Minnesota, St. Paul, January 26.

"Confidence intervals for the threshold parameter," at the 172nd Meeting of the Institute of Mathematical Statistics, Iowa City, Iowa, April 29.

Wong, See Meng and Kenneth J. KOEHLER: "Statistical analysis of reportable events due to maintenance and testing activities in nuclear power facilities," at the American Nuclear Society Topical Meeting on Thermal Reactor Safety, Knoxville, Tennessee, April.

Publications and Dissertation Abstracts

William J. Kennedy is co-author of the text *Statistical Computing*, published by Marcel Dekker.

Departmental faculty members serve in the following editorial and administrative capacities for statistical journals:

Chaturvedula Asok has been appointed to the editorial board of *The Journal of the Indian Society of Agricultural Statistics*.

H. A. David continued as chairman of the editorial board of *Biometrics*.

H. T. David is now book review editor of the *Journal of the American Statistical Association*.

Malay Ghosh is a member of the journal committee on *Sankhyā A* and *B*.

Chien-Pai Han is a member of the editorial board of *Communications in Statistics A*.

Paul N. Hinz is a consulting editor in statistics for the *Iowa Journal of Research*.

Oscar Kempthorne is an associate editor of *Theoretical Population Biology* and is on the editorial board of the *Journal of Statistical Planning and Inference*.

William J. Kennedy is a member of the editorial board and co-editor of the Algorithms Section of *Communications in Statistics B*; associate editor and also editor of the section entitled "New Developments in Statistical Computing" of *The American Statistician*; and co-editor of *Selected Tables in Mathematical Statistics*.

William Q. Meeker is an associate editor of *Technometrics*.

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

Book

KENNEDY, William J. and James E. Gentle. *Statistical Computing*. Marcel Dekker (New York). 1980. 608 pages.

This textbook is intended to satisfy the needs of research workers and graduate students who are interested in statistical computing. Emphasis is on numerical computational methods that are currently in use. Many different numerical methods and algorithms are discussed, and techniques for implementing given algorithms in a computer are considered. The diversity of statistical computer applications is reflected in the book through the twelve chapters, each of which deals with a relatively general but unique application area.

Published Research

ARNOLD, Barry C. Two modifications of Goodman's technique for improving estimates. *Trabajos de estadística y de investigación operativa* 29:3 (1978) 61-70.

***ARNOLD, Barry C.** and **Richard A GROENEVELD**. Some properties of the arcsine distribution. *Journal of the American Statistical Association* 75:369 (1980) 173-175. SLRS 491.

Three characterizations of the arcsine distribution are presented. A symmetric random variable X has the arcsine distribution if and only if X^2 and $(1 + X)/2$ are identically distributed. Also, a symmetric random variable has an arcsine distribution if and only if X^2 and $1 - X^2$ are identically distributed and X and $2X(1 - X^2)^{1/2}$ are identically distributed. A related result dealing with two i.i.d. random variables is also presented. The fact that the sine of a uniform random variable has the arcsine distribution is used to motivate these characterizations. One of the characterizations is used to quantify the heavy-tailed nature of the arcsine distribution.

Huang, J. S., Barry C. ARNOLD, and Malay GHOSH. On characterizations of the uniform distribution based on identically distributed spacings. *Sankhyā B* 41:1-2 (1979) 109-115.

Identical distribution of the first and the k -th spacings for some $k = 2, \dots, n$ of a sample of size n from a parent distribution satisfying certain conditions is sufficient to guarantee that the parent distribution is uniform. Under a different set of conditions, identical distribution of the first two spacings also characterizes the uniform distribution. Related exponential characterizations are also discussed.

Jalani, B. S., K. J. Frey and T. B. BAILEY, Jr. Contribution of growth rate and harvest index to grain yield of oats (*Avena sativa* L.) following and outcrossing of M_1 plants. *Euphytica* 28 (1979) 219-225.

Three populations of oats, each with 790 lines, were derived from CI 7555: (a) one (M population) consisted of M_2 -derived lines obtained from EMS treatment of naked seeds, (b) one (O population) consisted of F_2 -derived lines from crosses of M_1 with check plants, and (c) one (C population) consisted of check lines.

About 98% of the grain yield (GYD) variation in each population was due to variation in growth rate (GR) and harvest index (HI).

Mutation breeding, either with direct selection or outcrossing to release the induced mutations, does not appear to be a desirable method for improving GR or HI of oats.

Langer, I., K. J. Frey, and **Theodore B. BAILEY**. Associations among productivity, production response, and stability indexes in oat varieties. *Euphytica* 28 (1979) 17-24.

We tested three sets of oat varieties for grain yield in a series of environments and observed that generally more than 80% of the yield variation for individual varieties was due to linear regression response. Mean yields for varieties were significantly variable in all three sets, and regression response indexes were significantly variable in two of them.

Our materials were selected varieties, so evidently our results suggest what can be accomplished in breeding for combinations of mean production response and production stability.

Taylor, B. R. and **T. B. BAILEY**. Response of maize varieties to environment in West Africa. *Tropical Agriculture* 56:2 (1979) 89-97.

Maize cultivars from Africa and the U.S.A. were grown in replicated trials in West Africa from 1972 to 1974. Each year, regression coefficients were calculated giving responses to environmental indices based on location mean yields. Entries with high mean yields generally had regression coefficients exceeding unity and were equal to or better than entries having smaller responses even at poor locations. Mean location yields were positively correlated with rainfall and showed strong negative correlations with day and night temperatures though varieties responded differently. Anthesis was not consistently affected by night temperatures but was delayed by high day temperatures and low rainfall which are characteristics of northerly locations in West Africa.

Allison, Milton J., I. M. Robinson, J. A. Bucklin, and **G. D. BOOTH**. Comparison of bacterial populations of the pig cecum and colon based upon enumeration with specific energy sources. *Applied and Environmental Microbiology* 37 (1979) 1142-1151.

Davis, David G., Jeanette S. Mullins, Gary E. Stolzenberg, and **Gordon D. BOOTH**. Permeation of organic molecules of widely differing solubilities and of water through isolated cuticles of orange leaves. *Pesticide Science* 10 (1979) 19-31.

Hughes, D. E., R. H. Kohlmeier, G. W. Pugh, Jr., and **G. D. BOOTH**. Comparison of vaccination and treatment in controlling naturally occurring infectious bovine keratoconjunctivitis. *American Journal of Veterinary Research* 40 (1979) 241-244.

Kopecky, K. E., G. W. Pugh, D. E. Hughes, **G. D. BOOTH**, and N. F. Cheville. Biological effects of

ultraviolet radiation on cattle: bovine ocular squamous cell carcinoma. *American Journal of Veterinary Research* 40 (1979) 1783-1788.

Marston, N. L., W. A. Dicerson, W. W. Ponder, and **G. D. BOOTH**. Calibration ratios for sampling soybean lepidoptera: effect of larval species, larval size, plant growth stage and individual sampler. *Journal of Economic Entomology* 72 (1979) 110-114.

Moon, H. W., P. Y. Fung, R. E. Isaacson, and **G. D. BOOTH**. Effects of age, ambient temperature, and heat-stable *Escherichia coli* enterotoxin on intestinal transit in infant mice. *Infection and Immunity* 25 (1979) 127-132.

Pugh, G. W., Jr., T. J. McDonald, and **G. D. BOOTH**. Infectious bovine keratoconjunctivitis: influence of age on the development of disease in vaccinated and nonvaccinated calves after exposure to *Moraxella bovis*. *American Journal of Veterinary Research* 40 (1979) 762-766.

Simons, M. D., V. L. Youngs, **G. D. BOOTH**, and R. A. Forsberg. Effect of crown rust on protein and groat percentages of oat grain. *Crop Science* 19 (1979) 703-706.

Tachibana, H. and **G. D. BOOTH**. An efficient and objective survey method for brown stem rot of soybeans. *Plant Disease Reporter* 63 (1979) 539-541.

COX, C. Philip. Experiments on the evaluation of course instruction. *Educational and Psychological Measurement* 39:4 (1979) 813-821.

Two experiments on direct evaluation procedures are described. The first involved students' judgments on how well they understood well-defined terms and concepts presented in a course. The judgments were made anonymously to avoid instructor deprecation of poor performances and specific pressures for grade achievement. It was considered that such responses should reflect permanent aspects of instruction better than responses to less well-defined stimuli referring to broad aspects of instructional procedures. In the second experiment, responses to short examination-type questions were obtained again under the same conditions of anonymity. In both experiments a simple index was used to assess the merit of instruction and the variability attending the index was assessed. Analysis showed that the index was, in fact, sufficiently sensitive to detect differences due to instruction even though relatively small numbers of students were involved.

***COX, D. F.** Design and analysis in nutritional and physiological experimentation. *Journal of Dairy Science* 63:2 (1980) 313-321. SLRS 482.

Journal Paper J-9565, Iowa Agriculture and Home Economics Experiment Station, Project 101.

Planning, executing, analyzing, and interpreting experiments is part of research in nutrition and physiology. The principles and techniques of these endeavors have been recorded in an extensive literature. My objective is to review the basics of this enterprise and illustrate aspects that are widely misunderstood. The examples are from recent research reported in the *Journal of Dairy Science*. However, direct references to the original articles will not be cited, and their identity will be masked further by changing names of treatments and other small details. My intention is to point out some common mistakes I find widely repeated in the literature, not to criticize a few authors.

***DAVID, H. A.** Does stronger opposition make it harder to win? *Journal of Statistical Computation and Simulation: Comments, conjectures, and conclusions*. 9 (1979) 71-72. SLRS 477.

DAVID, Herbert A. E. S. Pearson. *International Encyclopedia of the Social Sciences, Biographical Supplement*. D. L. Sills, ed., 630-632. The Free Press, 1979.

***DAVID, H. A.** Robust estimation in the presence of outliers. In: Launer, R. L. and G. N. Wilkinson (Eds.) *Robustness in Statistics*, Academic Press: (1979) 61-74. SLRS 468.

The bias and mean-square error of various scale estimators, expressible as linear functions of order statistics, are studied in a sample of size n . Specific attention is paid to the cases when the outlier comes from a population differing from the target population either in location or scale (slippage models). Exact numerical results for 12 estimators of the standard deviation are given for $n = 10$ in the case of slippage of the mean when the target population is normal. Also discussed are relations between: (a) models for outliers and mixture models and (b) robust estimation and tests for outliers.

***Der, William and Chien-Pai HAN.** Selection of a preliminary test estimator in linear regression. *American Statistical Association 1979 Proceedings of the Business and Economic Statistics Section* 441-446. SLRS 487.

When tests are performed for testing linear restrictions on the parameter space in linear regression, and the estimators depend on the out-

comes of the tests, such estimators are preliminary test estimators. This paper discusses three different approaches for selecting a preliminary test estimator using the mean square error criterion. A table of maximum and minimum efficiencies of the preliminary test estimator relative to the unbiased estimator is given.

***Dickey, David A.** (North Carolina State University) and **Wayne A. FULLER.** Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association* 74:366 (June, 1979) 427-431. SLRS 476.

Let n observations Y_1, Y_2, \dots, Y_n be generated by the model $Y_t = \rho Y_{t-1} + e_t$, where Y_0 is a fixed constant and $\{e_t\}_{t=1}^n$ is a sequence of independent normal random variables with mean 0 and variance σ^2 . Properties of the regression estimator of ρ are obtained under the assumption that $\rho = \pm 1$. Representations for the limit distributions of the estimator of ρ and of the regression t test are derived. The estimator of ρ and the regression t test furnish methods of testing the hypothesis that $\rho = 1$.

***Emigh, Ted H.** The dynamics of finite haploid populations with overlapping generations. I. Moments, fixation probabilities, and stationary distributions. *Genetics* 92 (1979) 323-337. SLRS 473.

Journal Paper No. J-9009 of the Iowa Agriculture and Home Economics Experiment Station, Project 1669; partial support from Public Health Service Grant GM 13827.

Much of the work on finite populations with overlapping generations has been limited to deriving effective population numbers with the tacit assumption that the dynamics of the population will be similar to a population with nonoverlapping generations and the appropriate population number. In this paper, some exact and approximate results will be presented on the behavior of the first two moments of the gene frequencies. The probability of fixation of a neutral gene is found equal to the initial average reproductive value of the gene, and the means and covariances of the stable distribution with mutation in both directions are found by a simple extension of the values found by assuming nonoverlapping generations.

***Emigh, Ted H.** The dynamics of finite haploid populations with overlapping generations. II. The diffusion approximation. *Genetics* 92 (1979) 339-351. SLRS 474.

Journal paper No. J-9011 of the Iowa Agriculture and Home Economics Experiment Station, Project 1669; partial support from the Public Health Service Grant GM 13827.

The dynamics of a gene in a haploid population can be explained approximately by considering the average reproductive value of the gene. The dynamics

of the average reproductive value are similar to those of a gene in a population with nonoverlapping generations with the following modifications: The effective population size, N_e , replaces N ; the average mutation rates μ^* and ν^* replace μ and ν ; the average overall selection $r^* + (T - 1)s^{**}$ replaces s ; and time is measured in terms of generations, T . The implications of the average selection coefficient to adaptive life histories are discussed.

***FULLER, Wayne A.** The use of indicator variables in computing predictions. *Journal of Econometrics* 12(1980) 231-243. SLRS 481.

The use of indicator variables to construct predictions and to estimate the variances of prediction errors is illustrated for systems of equations, nonlinear regressions and autoregressions.

***FULLER, Wayne A.** Properties of some estimators for the errors-in-variables model. *The Annals of Statistics* 8:2 (1980) 407-422. SLRS 488.

The limiting behavior of estimators for several errors-in-variables models is investigated. It is assumed that an estimator of the covariance matrix of the measurement error is available. Models are delineated on the basis of the prior knowledge of the error structure. In all cases the limiting distribution of the estimators, standardized by $n^{1/2}$, is normal. Modifications of the estimators that guarantee finite moments and improve the small sample behavior of the estimators are presented.

***Jobson, J. D. and W. A. FULLER.** Least squares estimation when the covariance matrix and parameter vector are functionally related. *Journal of the American Statistical Association* 75:369 (1980) 176-181. SLRS 490.

Estimation for the linear model $y = X_p + e$ with unknown diagonal covariance matrix G is considered. The diagonal elements of G are assumed to be known functions of the explanatory variables X and an unknown parameter vector θ , where θ is permitted to contain elements of β . A weighted joint least squares estimator is developed that is asymptotically equivalent to the maximum likelihood estimator. Asymptotic properties of the simple least squares estimator and of the weighted joint least squares estimator are obtained. A sampling experiment is used to compare the estimators.

Wang, George H. K., Michael Hidirolou, and Wayne A. FULLER. Estimation of seemingly unrelated regression with lagged dependent variables and autocorrelated errors. *Journal of Statistical Computation and Simulation* 10(1980) 133-146.

An asymptotically efficient method of estimating the parameters of seemingly unrelated regression equations with lagged dependent variables and autocorrelated errors is presented. The procedure is an adaptation of the two-step Gauss-Newton method of estimating distributed lag models. The procedure is applicable to both vector and simple autoregressive processes. The estimator and two competitors are compared in a Monte Carlo study. The suggested procedure performs relatively well and is clearly superior for the estimation of the autocorrelation coefficients.

Galmes, Miguel and Chien-Pai HAN. Some aspects of the crop survey in Uruguay. *Estadistica* 33 (1979) 177-187.

It was realized that there was no probabilistic estimation of crops in Uruguay until 1973. By "probabilistic estimation" we mean estimation based on random samples. Estimates made before 1973 were based on reports from officials of the Ministry of Agriculture and Fisheries in the country. In 1973 it was decided to incorporate sample surveys for the estimation of area and for the production of some crops.

The survey consisted of the estimation of area that the farmers intended to plant, of the sown area and production of wheat, linseed, oat, barley, corn, sorghum, and sunflower. For sugar beet and sugar cane, the population values are known because the cultivation is made under contract agreements between the farmers and the firm which operates the corresponding sugar mill; then the latter has accurate information about the data of interest. In the case of rice, there is an official institute to which the rice planters have to present a declaration of area and production of rice. These data are believed to be very precise.

In this paper we discuss the methodology used for the crop survey in Uruguay and some difficulties encountered. Solutions to overcome these difficulties are given.

GHOSH, Malay and David A. Sotres. On Bahadur's representation of sample quantiles for non-stationary mixing processes. *Calcutta Statistical Association Bulletin* 27 (1978) 23-36.

For sequences of independent and identically distributed random variables, Bahadur (1966, *Annals of Mathematical Statistics*, 37, 577-580) obtained, under certain mild conditions, an elegant, almost sure representation of a sample quantile as an average of independent and identically distributed random variables plus a remainder term converging to zero almost surely at a faster rate. J. K. Ghosh (1971,

Annals of Mathematical Statistics, 42, 1957-1961) obtained, under milder regularity conditions, a weaker version of the result. The present paper obtains under certain conditions Bahadur-type results for nonstationary ϕ -mixing processes and J. K. Ghosh-type results for nonstationary strongly mixed processes.

***GHOSH, Malay** and Nitis Mukhopadhyay. Sequential point estimation of the difference of two normal means. *The Annals of Statistics* 8:1 (1980) 221-225. SLRS 484.

A sequential procedure for estimating the difference of two normal means when the variances are unknown and not necessarily equal is proposed, and an asymptotic expression for "regret" is given. This generalizes the corresponding one sample result of Woodroffe.

Sotres, David A. and **Malay GHOSH**. Asymptotic properties of linear functions of order statistics for nonstationary mixing processes. *Calcutta Statistical Association Bulletin* 28 (1979) 19-36.

For nonstationary ϕ -mixing processes, an almost sure representation for linear functions of order statistics is given under certain conditions. As corollaries to this main result, central limit theorems and laws of the iterated logarithm are established for such linear functions of order statistics.

***HAN, Chien-Pai**. On the computation of noncentral chi-squared distributions with even degrees of freedom. *Journal of Statistical Computation and Simulation* 9 (1979) 25-29. SLRS 463.

A computational formula for computing the cumulative distribution function of noncentral chi-squared distributions with even degrees of freedom is given.

***HAN, Chien-Pai**. Alternative methods of estimating the likelihood ratio in classification of multivariate normal observations. *The American Statistician* 33:4 (1979) 204-206. SLRS 483.

An observation is to be classified into one of two multivariate normal distributions with equal covariance matrices. When the parameters are unknown, four methods of estimating the likelihood ratio are reviewed: the plug-in method, the test procedure, the Bayesian approach, and the best invariant estimate method. The assumptions, interpretations, and consequences of the four approaches are given. It is shown that the last three methods yield the same classification procedure.

***Hand, M. L.** and V. A. **SPOSITO**. Using the least squares estimator in Chebyshev estimation. *Communications in Statistics; Simulation and*

Computation B9:1 (1980) 43-49. SLRS 480.

This note investigates the advantage of using the least squares estimator as a starting point in Barrodale and Phillip's L_∞ -algorithm.

HARVILLE, David A. Recursive estimation using mixed linear models with autoregressive random effects. *Variance Components and Animal Breeding: Proceedings of a Conference in Honor of C. R. Henderson*, L. D. Van Vleck and S. R. Searle, eds., Ithaca, New York: Cornell University (1979) 157-179.

Recursive estimation techniques for fixed and completely random linear models are extended to mixed linear models. The techniques are such that it is unnecessary to store old data in order to process new data. Rather, only old estimates of fixed effects and of certain random effects need be retained.

***HILL, William G.** A note on effective population size with overlapping generations. *Genetics* 92 (May, 1979) 317-322. SLRS 478.

Journal Paper J-9263, Iowa Agriculture and Home Economics Experiment Station, Project 1669; partial support by National Institutes of Health Grant GM13827.

A simple derivation is given for a formula obtained previously for the effective size of random-mating populations with overlapping generations. The effective population size is the same as that for a population with discrete generations having the same variance of lifetime family size and the same number of individuals entering the population per generation.

Ching, K. K. and P. N. **HINZ**. Provenance study of Douglas fir in the Pacific Northwest Region. III Field performance at age twenty years. *Silvae Genetica* 27 (1978) 229-233.

Height growth and DBH of twenty-year-old trees from 14 seed sources of Douglas fir were assessed and analyzed in 10 outplanting areas located on the west side of the Cascade Range in the Pacific Northwest. Differences in traits measured from trees of various provenances were statistically significant at $P < .01$. The analysis indicated a significant interaction between seed sources and outplanting locations. Almost all this interaction is because of the provenance originating from Shelton, Washington.

Platt, K. B., C. J. Mare, and P. N. **HINZ**. Differentiation of vaccine strains and field isolates of pseudorabies (Aujeszky's Disease) virus: thermal sensitivity and rabbit virulence markers. *Archives of Virology* 60 (1979) 13-23.

Eleven cloned North American pseudorabies virus (PRV) strains and the European vaccine strains K

and BUK were characterized by their thermal sensitivity and rabbit virulence markers. When individual strains were described according to their marker profiles, five of nine possible marker combinations were revealed. The two vaccine strains were each described by separate profiles. Virulent field isolates were characterized by one of three different profiles.

Tollefson, J. J., J. F. Witkowski, J. C. Owens, and P. N. HINZ. Influence of sampler variation on adult corn rootworm population estimates. *Environmental Entomology* 8(1979) 215-217.

A study was conducted to determine if adult corn rootworm (*Diabrotica* spp.) population estimates were influenced by training and experience of the sampler and/or if they were affected by inherent personal differences between individuals of equal training and experience. The plant counts and ear-tip collections were not significantly influenced by the investigators' inherent abilities or level of experience.

Bair, Craig W., William W. Marion, and Donald K. HOTCHKISS. Relationship of yolk cholesterol and onset of egg production. *Poultry Science* 59:3 (1980) 666-668.

Tomasiewicz, Diane M., Donald K. HOTCHKISS, George W. Reinbold, Ralston B. Read, Jr., and Paul A. Hartman. The most suitable number of colonies on plates for counting. *Journal of Food Protection* 43:4 (1980) 282-286.

Major events that led to acceptance of 30 to 300 as the most suitable number of colonies on plates for counting were reviewed. Three new sets of data were collected, involving triplicate plates of fifteen 1:1.4 serial dilutions of 65 samples of raw milk. Statistical methods were developed to analyze bias (variability introduced primarily by crowding and analyst counting errors) and variance (sampling and dilution errors). Bias and variance were combined as a mean-squared error, which was expressed as a function of the number of colonies per plate. The counting range that minimized the mean-squared error could then be determined for selected dilution series. For two-fold, five-fold, and ten-fold dilution series, respectively, the most suitable limits on plates for counting were 70 to 140, 40 to 200, and 25 to 250 colonies/plate. A range of 25 to 250 colonies/plate was suggested for the analysis of dairy products. Limitations in application of the data to other systems are discussed.

ISAACSON, Dean. A characterization of geometric ergodicity. *Zeitschrift für Wahrscheinlichkeitstheorie und verwandte Gebiete* 49(1979) 267-273.

A homogeneous Markov chain on a countable state space can be classified as ergodic, geometrically

ergodic, or strongly ergodic. Ergodicity and strong ergodicity have been characterized using the δ -coefficient. In this paper, the δ -coefficient is used to characterize geometric ergodicity.

KEMPTHORNE, Oscar. In dispraise of the exact test: reactions. *Journal of Statistical Planning and Inference* 3(1979) 199-213.

Journal Paper J-9379, Iowa Agriculture and Home Economics Experiment Station, Project 890.

Berkson (1978) performed a very valuable service by raising anew the question of tests of significance for 2x2 tables. Furthermore he has presented some arguments that the statistical profession must take account of. Even though I do not agree with all that he advocates, the questions he raises are of great significance. The purpose of the present note is to record some reactions to the whole situation. This involves carefully examining some writings of Fisher (1956) that bear on the matter. Also Barnard (1947a) and McDonald, Davis, and Milliken (1977) are strongly relevant. Necessarily discussion revolves around the nature and purpose of significance tests.

KEMPTHORNE, Oscar. Sampling inference, experimental inference and observation inference. *Sankhyā: The Indian Journal of Statistics* 40:B:3-4 (1979) 115-145.

Journal Paper J-8085, Iowa Agriculture and Home Economics Experiment Station, Projects 890 and 1669; partial support by National Institutes of Health Grant GM13827-08.

This essay consists of a discussion of present dilemmas and controversies in statistics. The role of axiomatics is discussed. The view is taken that the effort to encompass all ideas of statistical evaluation of data in one grand theory has failed. In contrast, it is proposed that three types of inference—finite sampling inference, finite randomized experiment inference, and observational inference—must be recognized. Underlying the discussion is the view that attempts to place the whole of the applications of statisticking under the umbrella of one very specific interpretation of the word "inference" should be abandoned. Otherwise, the statistical profession should "read out" of its province the great bulk of applications of statistical ideas that the world of scientific thinking and investigation uses.

*KEMPTHORNE, Oscar. The teaching of statistics: content versus form. *The American Statistician* 34:1 (1980) 17-21. SLRS 489.

Journal Paper No. J-9366, Iowa Agriculture and Home Economics Experiment Station, Project 890.

How to teach statistics has been a perennial ques-

tion. There have been over the years many papers and panel discussions that have had little impact. There has been a huge outpouring of teaching texts. These are based largely on perceptions of statistics that are not reconcilable. So, for instance, we see the results of false equations: statistics=probability calculus, statistics=decision theory, statistics=belief calculus, statistics=data analysis. The view is expressed that there is a proper sequence that starts from problems, questions, and data. This leads to data collection analysis as critical first steps. This must be followed by probability modeling with model selection as an obvious essential component. A teaching of statistics at beginning levels should consist of interrelated applications and theory. Programs of teaching teachers of statistics are failing if they do not insist on a decent respect for the relation of their theory to the real world. In the past three decades statistics has been captured and enslaved by mathematicians who regard mathematical form as the ultimate criterion of worth.

***Kim, Geung Ho** (SUNY, Buffalo, New York) and **H. T. DAVID**. Large deviations of functions of Markovian transitions and mathematical programming duality. *The Annals of Probability* 7:5 (1979) 874-881. SLRS 471.

The duality-related point of view of Hoeffding for i.i.d. large deviations is extended to the Markov case. This reconciles Koopmans' "function-analytic" view of Markovian large deviations with Boza's "information theoretic" view, and extends the validity of the latter to the not-necessarily-finite case.

***MEEDEN, Glen**. Comparing two probability appraisers. *Journal of the American Statistical Association* 74:366 (1979) 299-302. SLRS 462.

Consider the situation in which an expert is required to express his/her prior opinion by specifying a probability distribution. Suppose after a series of trials a third person wishes to decide which of two experts he/she prefers. This article discusses two methods for making this decision and illustrates them in the context of a study of forecasting rain.

***MEEDEN, Glen and Barry C. ARNOLD**. The admissibility of a preliminary test estimator when the loss incorporates a complexity cost. *Journal of the American Statistical Association* 74:368 (1979) 872-874. SLRS 479.

Consider the problem of estimating the mean by using a random sample from a normal population. Let \bar{X} denote the sample mean and consider the estimator that assumes the value zero when $|\bar{X}| < c$ and the value \bar{X} when $|\bar{X}| \geq c$. This is called a preliminary test estimator. For most of the usual loss functions it

is inadmissible. In this article we show that for some loss functions, which include a complexity cost, the estimator is admissible. The results are related to Cohen's work on hybrid estimation and hypothesis-testing problems.

***Nagaraja, H. N.** Some relations between order statistics generated by different methods. *Communications in Statistics; Simulation and Computation* B8:4 (1979) 369-377. SLRS 467.

Two techniques used in the machine generation of order statistics are considered. For a sample X_1, X_2, \dots, X_n from a uniform (0, 1) population, the joint distribution of the largest order statistics $X_{(n)}, X_{(n)}^*$ resulting from the two methods is obtained, and the distributions of $X_{(n)}^* - X_{(n)}$ and of $\max(X_{(n)}, X_{(n)}^*)$ are derived. In the case of the exponential distribution, the correlation coefficient between corresponding order statistics generated by two different techniques is calculated.

***Nagaraja, H. N.** Some distributional problems connected with order statistics. *Communications in Statistics: Theory and Methods* A9:9 (1980) 935-942. SLRS 492.

Two characterizations of distributions symmetric about zero are given. These are based on the distributional properties of the squares of the order statistics from a random sample from these distributions. A result exploring the relation between the distribution functions of two unordered (not necessarily independent) variables and those of their order statistics is presented. This has some interesting applications.

***NARAIN, Prem**. On the statistical properties of the conditional equilibrium distribution under steady flux of mutations. *Proceedings of the Indian National Science Academy* B45:3 (1979) 239-246. SLRS 486.

Journal Paper J-8637 of the Iowa Agriculture and Home Economics Experiment Station, Project 1669; partial support by National Institutes of Health Grant GM 13827.

The statistical properties of a conditional equilibrium distribution of mutant frequency resulting from the balance between the continued production of new mutants over many generations and their loss from the population because of random drift are discussed. The revised estimates of the average number of heterozygous sites in mammals are found to be lower than those given earlier in which the underlying stochastic process is not conditioned.

***POLLAK, Edward**. Effective population numbers and mean time to extinction in monoecious populations with overlapping generations. *Mathematical Biosciences* 46 (1979) 87-106. SLRS 446.

We consider a finite monoecious population that is observed at times 0, 1, ... and is divided into age classes 0, 1, ..., K. It is assumed that the numbers of individuals in the various age classes do not change with time and that there is no mutation, selection, or migration. If the allele A_1 is initially rare and the population large, the underlying Markov chain can be approximated by a nonsingular positively regular and critical multitype branching process. Functional equations are given for the generating functions of the invariant measure and the Green's function of the branching process, and properties of the solutions of these equations are obtained. These properties lead to expressions for the effective population number and the mean time to extinction of a line of A_1A_2 heterozygotes descended from a single A_1A_2 individual in class i.

STRAHAN, Robert F. and Thomas Andre. On predicting the age of achievement in psychologists: reply to Zusne. *American Psychologist* 34 (1979) 562.

This note criticizes Zusne's characterization of the harmonic mean as "a step beyond the merely descriptive stage in our understanding of the relationship between age and achievement." We show that a theory-free linear regression model predicts at least as well, and claim that no beyond-descriptive ground has been given for preferring the harmonic mean model.

STRAHAN, Robert F. and Margaret B. Howard. Connotations of psychology experiment titles. *Bulletin of the Psychonomic Society* 14:1 (1979) 41-42.

Fifty-nine undergraduate psychology student volunteers rated three psychological studies, referred to only by title, on six semantic differential dimensions. The titles were "Dream Study," "Experiment in Attitudes," and "Visual Perception." Subjects do make connotative distinctions among psychology experiment titles, a factor of potential relevance in assessing the influence of the volunteer subject on the outcome of psychological research.

VAN NONSTRAND, R. Craig. Comment. *Journal of the American Statistical Association* 75 (1980) 92-94.

The article questions the mechanical use of ridge regression. The computer simulations which seem to support ridge regression are shown to be flawed. Problems associated with the use of the ridge trace are discussed.

Draper, Norman R. and **R. Craig VAN NOSTRAND.** Ridge regression and James-Stein estimation: review and comments. *Technometrics* 24:4 (1979) 451-466.

The literature of ridge regression and James-Stein estimation is broadly reviewed, and critical comments are interpolated on a number of papers. The authors also express their viewpoints on ridge regression and their antipathy to its mechanical use.

Hanser, Lawrence M., Raymond M. Mendel, and Leroy WOLINS. Three flies in the ointment: a reply to Arvey and Mossholder. *Personnel Psychology* 32 (1979) 511-516.

Significant legal, practical, and statistical issues regarding the use of the Arvey and Mossholder procedure for determining similarities and differences among jobs are discussed. On the basis of these issues the authors recommend against using this procedure.

Book Review

BOOTH, Gordon D. Statistics for experimenters: an introduction to design, data analysis, and model building by G. E. P. Box, W. G. Hunter, and J. S. Hunter. Reviewed in *Journal of the American Statistical Association* 74 (1979) 731-732.

Dissertation Abstracts

Bhattacharyay, Biswanath. Estimation for varying parameter stochastic difference equations. Ph.D. thesis, Iowa State University Library, August, 1979.

Let Y_t satisfy a varying parameter stochastic difference equation

$$Y_t = \sum_{i=1}^p a_i f_i(Y_{t-1}, X_t; t) + e_t$$

$t = 1, 2, \dots$, where $\{e_t\}$ is a sequence of independent $(0, \sigma^2)$ random variables and $(Y_{-p+1}, Y_{-p+2}, \dots, Y_0)$ is an initial vector of fixed constants. It is assumed that the $f_i(Y_{t-1}, X_t; t)$ are functions of $\{Y_{t-s}, X_{t-k+p}; 1 \leq s \leq t-p-1, 1 \leq k \leq t\}$, and $\{X_t\}$ is a fixed sequence or a time series.

The least squares estimator of $\alpha = (\alpha_1, \alpha_2, \dots, \alpha_p)'$ denoted by $\hat{\alpha}_n$ is investigated. The least squares estimator is obtained by regressing Y_t on $f_1(Y_{t-1}, X_t; t), f_2(Y_{t-1}, X_t; t), \dots, f_p(Y_{t-1}, X_t; t)$ for $t = 1, 2, \dots, n$. Under suitable assumptions $\hat{\alpha}_n$ is shown to be consistent for α and the limiting distribution of the normalized $\hat{\alpha}_n$ is shown to be normal.

Let Y_t satisfy $Y_t = \rho(t) Y_{t-1} + e_t$, $t = 1, 2, \dots$, where $\{e_t\}$ is a sequence of independent $(0, \sigma^2)$ random variables and Y_0 is a fixed constant. It is assumed that $\rho(t)$ satisfies $\rho(t) = a_0 + a_1 X_t$, where $\{X_t\}$ is a sequence of random variables. Three sequences, $\{X_t\}$ a fixed sequence, $\{X_t\}$ a sequence of random variables

independent of $\{e_t\}$, and $\{X_t\}$ a sequence of random variables such that X_t is independent of $\{e_k; k = t, t+1, \dots\}$ for all t , are considered. For all three cases the least squares estimator is shown to be consistent for the parameter vector. Maximum likelihood estimation is considered for one of the three cases. For all three cases the limiting distribution of the suitably normalized least squares estimator is normal.

Examples of stochastic difference equations for which the above results are applicable are presented.

Dahm, Paul Frederick. Estimation of the parameters of the multivariate linear errors in variables model. Ph.D. thesis, Iowa State University Library, August, 1979.

Estimation of the multivariate linear errors in variables model is investigated. The multivariate linear errors in variables model is defined by

$$\begin{aligned} Y_t &= x_t \beta + e_t \\ X_t &= x_t + u_t, \quad t = 1, 2, \dots, n, \end{aligned}$$

where Y_t and X_t are observable random row vectors of dimension p and k , respectively, e_t and u_t are unobservable error vectors of dimension p and k , x_t is an unobservable random or fixed row vector of dimension k , β is a $k \times p$ matrix of parameters, $\xi_t = (e_t, u_t)$ and

$$E(\xi_t x_{t'}') = 0,$$

for all $t = 1, 2, \dots, n$, $t' = 1, 2, \dots, n$, $i = 1, 2, \dots, p+k$, and $j = 1, 2, \dots, k$. The ξ_t are independent identically distributed $(p+k)$ -variate random vectors with mean zero and covariance matrix $\Sigma_{\xi\xi}$. The model is said to be a structural model if the x_t are independent identically distributed random vectors, and a functional model if the x_t are vectors of unknown constants.

For the case where (ξ_t, x_t) are normal random vectors with mean $(0, \mu_x)$ and covariance matrix block diag $(\Sigma_{\xi\xi}, \Sigma_{xx})$, consistent estimators of β , $\Sigma_{\xi\xi}$, and Σ_{xx} are derived using a generalized least squares (G.L.S.) approach. In the G.L.S. procedure, the elements of the sample covariance matrix of (Y_t, X_t) are the observations. The G.L.S. approach is applied to the functional model where ξ_t is a normal random vector to obtain consistent estimators of β and $\Sigma_{\xi\xi}$. The limiting distribution of the vector of suitably normalized G.L.S. estimators is shown to be multivariate normal.

Best generalized least squares (B.G.L.S.) estimators can be constructed when a consistent estimator of the covariance matrix of the sample covariances is available. The B.G.L.S. estimators are best within the class of G.L.S. estimators in the sense that the difference between the asymptotic covariance matrix of any G.L.S. estimator and the asymptotic covariance matrix of a B.G.L.S. estimator is positive semidefinite. B.G.L.S. estimation of the structural and functional models where the unobservable random variables are normally distributed is considered. A large sample test for model

adequacy based upon the B.G.L.S. procedure is given.

The G.L.S. and B.G.L.S. procedures are generalized to include estimation of certain multivariate linear errors in variables models where x_t and ξ_t are not normally distributed. Two applications of the B.G.L.S. procedure are given.

Ebrahimi, Nader Baradaran. Some topics in reliability theory. Ph.D. thesis, Iowa State University Library, May, 1980.

Various notions of multivariate negative dependence are introduced and their interrelationship is studied. Examples are given to illustrate these concepts. Applications of the results in statistics and probability are given.

A partial ordering is developed among negative quadrant dependent distributions with fixed marginals. Basic properties and closure under certain statistical operations are derived. Applications of the results in statistics and probability are given.

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. Various closure properties of multivariate NBU and NBUE distributions are proved. Finally, it is shown how shock models governed by a general counting process satisfying certain conditions can generate multivariate NBU and NBUE distributions.

Kackar, Raghu Nath. Variance approximations for estimators of fixed and random effects in mixed linear models. Ph.D. thesis, Iowa State University Library, August, 1979.

One of the conventional methods for estimating estimable linear functions of fixed and random effects in mixed linear models is to first estimate the variance components and then to proceed as if the estimated values of the variance components were the true values. It is shown that such "two-stage estimation procedures" give unbiased estimators, provided the variance component estimators are translation invariant and also even functions of the data vector. The class of such variance component estimators includes the estimators obtained through Henderson's methods 1, 2, and 3, the maximum likelihood (ML) estimators and the restricted maximum likelihood (REML) estimators. An approximate variance formula is derived for the estimators obtained through these two-stage procedures. It is shown that this variance approximation is invariant with respect to non-singular linear transformations of the variance component vector, provided the variance component estimators are obtained through a procedure which "preserves" those linear transformations. The Henderson's estimators, ML

estimators and REML estimators preserve non-singular linear transformations of the parameter vector.

The approximate variance formula involves the variances and the covariances of the variance component estimators. Approximate variances and covariances for the ML and REML estimators of the variance components are derived. The computation of these approximate variances and covariances involves evaluating central product moments of quadratic forms of normally distributed random vectors up to the fourth order.

Alternative estimation procedures are derived by applying Bayesian concepts. Approximate procedures for interval estimation are also considered.

The performance of the approximate variance formula is investigated numerically in the context of estimation of treatment contrasts in balanced incomplete block designs. Computation of the approximate variance formula, for the case of the Yates-Rao estimator of treatment contrasts, involves evaluating the variance of the "truncated ANOVA estimator" of the ratio of the "inter-block error variance" per plot to the "intra-block error variance" per plot. The variances of various estimators of treatment contrasts, including the estimators derived through Bayesian ideas, are compared numerically. The mean-squared errors of four different estimators of the ratio of the "inter-block error variance per plot" to the "intra-block error variance per plot" are also compared numerically.

Liberty, T. Edward. An application of unequal probability sampling for the National Rice Survey in Liberia. M.S. thesis, Iowa State University, August, 1979.

The National Rice Survey is the current agriculture study conducted every year by the Ministry of Agriculture in Liberia. The purpose of the study is to assess the rice production (the staple diet for Liberians) and other agricultural products that are important in the economy of Liberia. In this thesis the survey methodology of the National Rice Survey is described and the Horvitz-Thompson variance estimator is discussed.

Parsian, Ahmad. Admissible and minimax multiparameter estimation in exponential families. Ph.D. thesis, Iowa State University Library, November, 1979.

In the general exponential family absolutely continuous with respect to Lebesgue, a class of estimators dominating the minimum variance unbiased estimator of the natural parameter is produced. Examples are given to illustrate this. For a subfamily of the general exponential family, a class of

estimators dominating the minimum variance unbiased estimator of the mean is also exhibited.

For the p-variate Poisson mean, a class of proper Bayes estimators dominating \bar{X} for $p \geq 3$ is obtained. A class of proper Bayes minimax admissible estimators is also produced.

For the p-variate normal mean with known variance, admissibility of the Lindley-Smith estimators is proved under symmetric bowl-shaped loss. When the variance-covariance matrix is unknown, generalized Bayes estimators are proposed under symmetric bowl-shaped loss, and their admissibility is proved. Finally, for the general linear model, under the sum of squared losses, similar generalized Bayes estimators are proposed and their admissibility is proved.

Royalty, Daniel R. An asymptotic stochastic view of split-second hesitation. M.S. thesis, Iowa State University, February, 1980.

Noisy duels involving discrete ammunition stores do not have saddle points, presumably due at least in part to the unfortunate juxtaposition of these discrete ammunition stores on the one hand, and a continuum of firing opportunities on the other. Remedies have included 1) "continuizing" of ammunition stores, 2) settling for only ϵ -good solutions, and 3) introducing certain "split-second hesitations" for the weaker duelist, paradoxically calling both for waiting and shooting at certain critical times. A fourth possible remedy is to allow only a finite set of firing opportunities, thus creating approximating finite simultaneous games, which, as finite games of perfect recall, admit behavioral solutions. This fourth remedy is adopted below, in the case of two equally accurate duelists possessing respectively 1 and 2 bullets. But the principal motivation for introducing a finite number of firing opportunities is not approximation; it is, rather, to study certain asymptotic firing time distributions that arise as limits of the above behavioral solutions when the number of firing opportunities is allowed to increase, and to view these asymptotic distributions as giving, in a sense, fine structure to Drescher's split-second hesitation.

Sallas, William Michael. Recursive mixed model estimation. Ph.D. thesis, Iowa State University Library, November, 1979.

Consider the mixed model $y = X\alpha + Zu$ where y is a vector of observations, X and Z are known matrices of constants, α is a vector of unknown parameters (fixed effects), and u is a vector of random effects and errors. It is assumed that u has mean zero and variance D which is known and that y has variance $V = ZDZ'$ which is positive definite. The mixed model estimators for estimating the linear combination $\lambda_1'\alpha + \lambda_2'u$ (provided $\lambda_1' = c'X$ for

some c) are given by $\lambda'_1 \hat{a} + \lambda'_2 \hat{u}$ where \hat{a} satisfies $X'V^{-1}X\hat{a} = X'V^{-1}y$ and $\hat{u} = DZ'V^{-1}(y - X\hat{a})$.

We obtain the mixed model estimators and their associated mean-squared error by considering a sequence of two-part random models given by: $y = Xa + Zu$, $E(a) = 0$, $E(u) = 0$, $\text{cov}(a, u) = 0$, $\text{var}(u) = D$, and $\text{var}(a) = P_n$ with P_n^{-1} approaching the matrix of all zeroes as n approaches infinity. It is shown that the limit of the optimal predictor for $\lambda'_1 a + \lambda'_2 u$ in the random model is $\lambda'_1 \hat{a} + \lambda'_2 \hat{u}$, the mixed model estimator. Also it is shown that the mean-squared error of the optimal predictor under the two-part random model converges to the mean-squared error for the mixed model estimator.

The Kalman filter is used to derive the recursive estimators for a two-part random model where the observations accumulate in time and the second random factor obeys a generalized multivariate autoregressive process. By passing to the limit appropriately the recursions for the mixed model are derived.

The mixed model recursions assume the variance structure is known up to a scalar constant σ^2 . Generally, the variance structure is not known but depends on additional unknown parameters θ . Assuming normality, it is shown that the restricted maximum likelihood function can be evaluated at a specific parameter point (θ', σ^2) as the observations arrive in time by writing down the joint distribution of the appropriately defined mixed model innovations (analogous to the innovations that arise in the Kalman filter). Derivative information can also be obtained recursively, but it requires additional computations and storage. An on-line procedure utilizing the method of scoring is presented for the simultaneous estimation of the fixed and random effects as well as the parameters θ and σ^2 .

Scott, Mark. Characterizations of strong ergodicity for continuous time Markov chains. Ph.D. thesis, Iowa State University Library, August, 1979.

This dissertation established new results in determining ergodic behavior for continuous time Markov chains. For a continuous time, homogeneous Markov chain, strong ergodicity is related to spectral conditions on the transition matrices, conditions on the intensity of passage matrix, and to strong ergodicity of a related discrete time chain. For a continuous time, nonhomogeneous Markov chain, uniform strong ergodicity is shown to be equivalent to having uniform ergodicity and constraints placed on the mean visit times. Strong ergodicity for a nonhomogeneous, continuous time chain may also be found to hold when the intensity of passage matrix satisfies certain properties.

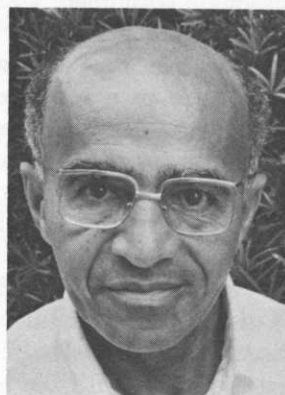
Werner, Neil Michael. Probabilistic and statistical aspects of random stopping. Ph.D. thesis, Iowa

State University Library, February, 1980.

"Local tightness" of the sequence to be stopped, $\{X_m\}$, and *asymptotic independence* of $\{X_m\}$ and the normalized stopping time sequence, $\{N/r\}$, are two essential ingredients of limit theorems for randomly stopped sequences. The latter ingredient has in the past appeared implicitly through mixing properties of $\{X_m\}$ and the convergence in probability of $\{N/r\}$.

This dissertation provides an approach making the role of asymptotic independence explicit in its own right, and covering situations apparently not accessible heretofore. It is natural in this context to invoke a certain modified Anscombe condition. It is shown that the invariance principle with norming factor \sqrt{n} implies the above-modified Anscombe condition. Thus, it is possible to duplicate certain prior results without intensive exploitation of C-space methodology. Generalizations of certain other prior results, for cases where $\{N/r\}$ does not necessarily converge in probability, are given as well, under a suitable type of asymptotic independence.

A natural bivariate extension of the above theory is applied to the problem of sequentially constructing a confidence interval for the common mean of two populations. The theory allows an asymptotically exact confidence statement for a large class of sampling-stopping rules, which is shown, in the normal case, to contain a certain heuristically attractive sub-family.



David H. Blackwell

George Zyskind Memorial Lecture

David H. Blackwell, professor of statistics at the University of California—Berkeley presented the fifth annual George Zyskind Memorial Lecture. He discussed "The Merging of Opinions."

A former president of the Institute of Mathematical Statistics, Dr. Blackwell is a member of the National Academy of Sciences and of the American Academy of Arts and Sciences. He has made distinguished contributions to mathematical statistics, probability, and mathematics.

Department of Statistics

Coursework in the Department of Statistics can culminate in a B.S., M.S., or Ph.D. degree in statistics through the College of Sciences and Humanities. A specialized biometry program of study leads to a B.S. degree conferred by the College of Agriculture.

Undergraduate statistics majors are prepared through a combination of theory and application courses for employment in industry or government or to pursue graduate studies.

Graduate students may specialize in experimental design, general methods, general theory, probability, statistical computing, survey sampling, or one of several areas of application. Operations research is offered cooperatively with the Department of Industrial Engineering.

A student may receive a graduate or undergraduate degree jointly with another department. An M.S. candidate may choose a thesis or nonthesis option. The latter requires six additional credits including a "creative component" of at least three credits of individual work.

Enrollment figures for 100- to 300-level courses have risen sharply over the past ten years. A study conducted by the Undergraduate Committee shows that Stat 127-327 courses directed to students in Industrial Administration accounted for 67% of the increase over the decade.

The undergraduate enrollment stands at 50 students of which seven are joint majors. This shows quite a sharp increase over the past few years.

For the second year in a row, the Department had about 100 graduate students during fall quarter. As of winter quarter, we were at the point where we had to turn down some normally adequate applications. However, applications for fall 1980 are being treated as usual.

During fall quarter, Don Hotchkiss taught Statistics 301X as an experimental 5-credit course for undergraduate students. The Statistics 401 syllabus was covered, and, with the help of the instructor, each student conducted a simple experiment, summarized it, and shared the results with the class.

Ken Koehler taught Statistics 507X during the winter quarter. Chapters 1-5, 9, and 11 of the Bishop-Fienberg-Holland text *Discrete Multivariate Analysis* were covered. Emphasis was placed on the application of statistical models. Homework assignments consisted of analyses of data sets.

During the spring quarter, David Harville taught a new course, Statistics 513X. The book, *Response Surface Methodology* by Raymond Myers, was used as a text. The course included an introduction (at an applied level) to the construction of "optimal" designs. Homework assignments centered on

the application of response surface techniques in actual experimental settings.

1979-1980 Course Offerings in Statistics

Courses for Undergraduate Students Only

| | | | | |
|------|--|---|---------|--|
| 100 | Orientation in Statistics | R | F | Hotchkiss |
| 101 | Principles of Statistics | 5 | F,W,S | Auer Midha Rangachari Reed Stephenson |
| 104 | Introduction to Statistics | 5 | W,S,SSI | Badrena C. P. Cox Hotchkiss Lewis Peixoto Rossi Stephenson Tveite |
| 105 | Introduction to Statistics | 3 | F,S | Badrena Bloor Rossi Stephenson Sukhatme Weissman |
| 127 | Elementary Business Statistics | 5 | F,W,S | Isaacson Jobe Martin Meeker Ridpath Rossi Sukhatme Tveite |
| 301X | Statistical Methods with Applications | 5 | F | Hotchkiss |
| 305 | Engineering Statistics | 3 | S | Van Nostrand |
| 327 | Elementary Business Statistics | 4 | F,W,S | Blough Groeneveld Guerrero Meeker Rees |
| 331 | Probability for Engineers | 3 | F | Meeden Van Nostrand |
| 332 | Statistical Inference for Engineering Data | 3 | W | Meeden Van Nostrand |
| 341 | Introduction to Theory of Probability and Statistics | 3 | F,W | Groeneveld Stephenson Sukhatme Weissman |
| 342 | Introduction to Theory of Probability and Statistics | 3 | W,S | Groeneveld Sukhatme |
| 343 | Introduction to Theory of Probability and Statistics | 3 | S | Groeneveld |
| 380 | Statistical Applications of Digital Computers | 3 | F,S | Ralston |

Courses for Graduate Minors and Undergraduates

| | | | | | | | | | |
|------|--|-----|-------------|---|------|---|-----|--|--|
| 401 | Statistical Methods for Research Workers | 4 | F,W,SSI | Bailey C. P. Cox D. F. Cox Han Hickman Hotchkiss Koehler Lorenz Shelley Wolins | 507X | Analysis of Frequency Data | 3 | W | Koehler |
| 402 | Statistical Methods for Research Workers | 4 | SSII W,S | Bailey Blough C. P. Cox D. F. Cox Groeneveld Hotchkiss | 508 | Sociometric Statistics | 3 | F | Warren |
| 407 | Methods of Multivariate Analysis | 3 | F | Hinz | 511 | Design of Experiments | 3 | S | Kemphorne |
| 411 | Experimental Design for Research Workers | 3 | S,SSI | D. F. Cox Hinz Strahan Van Nostrand | 512 | Design of Experiments | 3 | F | Kemphorne |
| 421 | Survey Designs for Research Workers | 4 | SSII,S | Han Midha | 513X | Response Surface Methodology | 3 | S | Harville |
| 422 | Survey Sampling for Social Scientists | 4 | W | Baker | 521 | Design of Surveys | 3 | W | Goebel |
| 431 | Elementary Statistical Quality Control | 3 | S | Van Nostrand | 522 | Design of Surveys | 3 | S | Goebel |
| 432 | Applied Probability Models | 3 | W | Weissman | 533 | Industrial Statistics: Reliability | 3 | F | H. T. David |
| 436 | Genetic Statistics for Research Workers | 3 | F | Bailey | 536 | Genetic Statistics | 3 | F | Pollak |
| 446 | Statistical Theory for Research Workers | 3 | F | Blough | 537 | Genetic Statistics | 3 | W | Pollak |
| 447 | Statistical Theory for Research Workers | 3 | W,SSI | Auer Nagaraja | 538 | Econometric Statistics | 3 | F | Fuller |
| 448 | Statistical Theory for Research Workers | 3 | SSII,S | Goebel Han | 539 | Operations Research | 3 | W | H. T. David |
| 451 | Applied Time Series | 3 | S | Meeker | 540 | Operations Research Methods and Economic Analysis | 3 | SSI | Sposito |
| 481 | Computer Processing of Statistical Data | 3 | W | Ralston | 541 | Theory of Probability and Statistics | 3 | F | Ghosh |
| 490H | Special Topics (Honors) | ARR | F,W,S | Groeneveld Hotchkiss Van Nostrand | 542 | Theory of Probability and Statistics | 3 | W | Ghosh |
| | | | | | 543 | Theory of Probability and Statistics | 3 | S | Meeden |
| | | | | | 546 | Nonparametric Theory | 3 | S | Sukhatme |
| | | | | | 549 | Mathematical Programming | 3 | S | Sposito |
| | | | | | 559 | Advanced Econometric Statistics | 3 | W | Fuller |
| | | | | | 579 | Introduction to Statistical Computing | 1 | F | Kennedy |
| | | | | | 580 | Statistical Computations on Digital Computers I | 3 | F | Kennedy |
| | | | | | 581 | Statistical Computations on Digital Computers II | 3 | W | Kennedy |
| | | | | | 590 | Special Topics | ARR | SSII,F,W, S,SSI | Isaacson Kemphorne Kennedy Koehler Meeden Meeker Pollak Sposito Van Nostrand Wolins |
| | | | | | | | | Booth D. Cox Fuller Goebel Groeneveld Han Hickman Hinz Hotchkiss | |

Courses Primarily for Graduate Students, Major or Minor

| | | | | | | | | | |
|-----|----------------------------------|---|---|---------|-----|------------------------------|---|---|-----------|
| 500 | Statistical Methods | 4 | W | Hinz | 601 | Advanced Statistical Methods | 3 | F | C. P. Cox |
| 501 | Intermediate Statistical Methods | 3 | S | Koehler | 621 | Advanced Survey Design | 3 | W | Asok |
| 504 | Linear Composites | 3 | S | Wolins | 622 | Survey Design Seminar | 3 | S | Asok |

| | | | | |
|-----|---------------------------------------|-------------|-----|--------------------|
| 641 | General Theory of Linear Hypothesis | 3 | F | Harville |
| 642 | Probability and Distribution | 3 | W | Meeden |
| 643 | Testing Hypotheses | 3 | S | Ghosh |
| 645 | Order Statistics | 3 | W | H. A. David |
| 647 | Multivariate Analysis | 3 | F | Han |
| 648 | Topics in Inference | 3 | SSI | Meeden |
| 648 | Asymptotic Theory of Order Statistics | 3 | S | Weissman |
| 680 | Seminar on Statistical Computations | 3 | F | Kennedy Sposito |
| 699 | Research | ARR | | |
| | | D. Cox | | Hinz |
| | | H. A. David | | Isaacson |
| | | H. T. David | | Kempthorne |
| | | Fuller | | Kennedy |
| | | Ghosh | | Meeden |
| | | Han | | Pollak |
| | | Harville | | Sposito |
| | | | | Strahan |

Graduate Students

Eight Ph.D. degrees and twenty-five M.S. degrees were earned by students in the Department this fiscal year. Abstracts of the Ph.D. dissertations and of two M.S. theses appear in the publication section. Twenty-three of the M.S. degrees were conferred on a nonthesis basis. If educational or employment plans are known, a brief account is given for each student.

M.S. Recipients

Yasuo Amemiya (Spring, 1980, under Wayne A. Fuller) is continuing to work on a Ph.D. in the Department.

Erik Bergstrahl (Spring, 1980, under D. F. Cox)

Peter Crump (Spring, 1980, under Paul N. Hinz) is a computing consultant in the College of Agriculture and Life Sciences at the University of Wisconsin—Madison. He provides assistance with subroutines and offers advice on the use of systems and hardware.

Steven D. Duke (under William Q. Meeker) is a statistical consultant and systems analyst for the Weyerhaeuser Company in Hot Springs, Arkansas.

Cheryl Enger (Spring, 1980, under David A. Harville) is a research associate in the Survey Section. She helps with the programming of SUPER CARP.

Steven Fahrenholtz (Spring, 1980, under H. T. David) is working towards a Ph.D. in the Department.

Romulo Fuentes Grados (Summer, 1979, under Ike Van de Wetering and Wayne A. Fuller) has returned to Lima, Peru.

Margarita F. Guerrero (Summer, 1979, under Richard A. Groeneveld) is pursuing a Ph.D. in the Department.

Tsuey-Fen Kuo (Fall, 1980, under V. A. Sposito)

T. Edward Liberty (Summer, 1979, under Chien-Pai Han) does statistical sampling and research for the Liberian government in the Ministry of Planning and Economic Affairs.

Robert Mee (Summer, 1979, under David A. Harville) is working on a Ph.D. in the Department. Log-linear models are his area of specialization.

Maria Yun-Chu Mei (Summer, 1979, under William J. Kennedy)

Minoo Niknian (Fall, 1979, under Oscar Kempthorne) is working towards a Ph.D. in the Department. Experimental theory is her area of specialization.

Paul Nkansah (Fall, 1979, under H. T. David) is at ISU working towards a joint Ph.D. in statistics and industrial engineering.

Akihiro Noma (Spring, 1980, under Leroy Wolins) is a statistical consultant for the American Nurses Association in Kansas City, Missouri.

Juan Ramos (Spring, 1980, under Chien-Pai Han) is working towards a Ph.D. in the Department.

Ahmad Razmpour (Fall, 1979, under Oscar Kempthorne) is working toward a Ph.D. in the Department. He is interested in linear models.

Harold Ridpath (Winter, 1980, under Kenneth Koehler) is a statistician for The National Veterinary Services Laboratory in Ames.

Daniel Reed Royalty (Winter, 1980, under H. T. David and H. D. Meeks)

Mohmed Saad-Eldin (Winter, 1980, under Oscar Kempthorne) remains in the Department to pursue a Ph.D. His area of specialization is the design of experiments.

Seyed Mahmoud Seyedsadr (Spring, 1980, under David A. Harville) is continuing to work on a Ph.D. in the Department.

Bradley O. Skarpness (Fall, 1979, under V. A. Sposito) is working on a Ph.D. with special emphasis on statistical computing and operations research.

Slamet (Winter, 1980, under William Q. Meeker) is pursuing a joint Ph.D. in statistics and industrial engineering at ISU.

Susan Yuen-Shan Tsui (Winter, 1980, under Craig Van Nostrand)

Fu-hau-Yu (Summer, 1979, under Wayne A. Fuller) served as a research associate in the Survey Section before accepting a position with the Department of Public Instruction in Des Moines.

Ph.D. Recipients

Biswanath Bhattacharyay (Summer, 1979, under Wayne Fuller) is a visiting assistant professor in the Department of Statistics, University of Missouri—Columbia.

Fred Dahm (Summer, 1979, under Wayne Fuller) is an assistant professor of statistics in the Institute of Statistics, Texas A&M.

Nader Ebrahimi (Spring, 1980, under Malay Ghosh) has been offered a position with the Department of Statistics at the University of Missouri—Columbia. He will accept the offer if he can stay in the U.S. for another year.

Raghu Nath Kackar (Summer, 1979, under David A. Harville) is a visiting assistant professor of statistics in the Department of Statistics, Virginia Polytechnical Institute, Blacksburg, Virginia.

Bill Sallas (Fall, 1979, under David A. Harville) is an assistant professor of statistics, at the University of Houston. He teaches statistics for M.B.A. students.

Mark Scott (Summer, 1979, under Barry C. Arnold and Dean L. Isaacson) is a statistical consultant in the Medical Research Statistics Division of Mayo Clinic, Rochester, Minnesota.

Ahmad Parsian (Fall, 1979, under Malay Ghosh) is teaching undergraduate courses in the Department of Mathematics and Statistics, College of Arts and Sciences, Shiraz, Iran.

Neil Werner (Winter, 1980, under H. T. David) is a senior statistical engineer with Corning Glassware. He is involved with on-site consulting and in-house teaching along with developing software.

M.S. Candidates

Ahmad, Adnan Bin
 Ahmad, Noorani
 Amemiya, Yasuo
 Badrena, Joseph
 Bergstralh, Erik
 Bloor, George
 Brandon, Dennis
 Briceno, Rodrigo
 Callanan, Terrance
 Chang, Stephen Fu Chung
 Chiang, Yu-Kun
 Christenson, Peter D.
 Crump, Peter M.
 Devin, Jeanne
 Duke, Steven
 Enger, Cheryl
 Fahrenholtz, Steven
 Fakiya, James O.
 Filos, Victor
 Grados, Romulo Fuentes
 Guerrero, Margarita
 Harter, Rachel
 Herrera-Hoyos, Carlos
 Hines, Merlon
 Hsu, Sheue Wen
 Kim, Byung Hwee
 Keune, Cynthia
 Kruger, Gregory A.
 Kuo, Tsuey Lin
 Lamb, Robert
 Liberty, T. Edward
 Lin, Char Lung
 Lin, Josephine
 Martin, Cindy
 Mazlom, Reda
 Megahed, Abdel Razeq
 Mei, Maria
 Mohammad, Bader Eldeen
 Morel, Jorge
 Mt. Piah, Abdul Rahni
 Nguyen, Cung Nang
 Niknian, Minoo
 Nkansah, Paul
 Noma, Akihiro
 Ostrouchov, George
 Pongsrihadulchai, Apichart
 Ramos, Juan
 Razmpour, Ahmad
 Reed, Thomas L.
 Rees, Mark
 Ridpath, Harold
 Rossi, Rick
 Roy, Joanne
 Royalty, Daniel
 (joint industrial engineering-
 statistics)
 Saad-Eldin, Mohamed
 Seyedsadr, Seyed Mahmoud
 Skarpness, Bradley
 Slamet
 Stangl, Pamela
 Tegene, Ababayehu
 Tsui, Susan
 Tveite, Michael
 van Schaik, Jan
 Wang, John Lih-Gow
 Werner, Richard

Wilson, Jeffrey R.
 Wilson, Robert
 Yeo, Woon Bang
 Yih, Wei
 Yu, Fu-hau

Ph.D. Candidates

Auer, Richard
 Bhattacharyay, Biswanath
 Blough, David K.
 Burge, Sallie
 Chandhok, Promod
 Chua, Tin Chiu
 Dahm, P. Fred
 DaSilva, Antonio
 Dehghan-Nayeri, Majid
 Drew, James
 Ebrahimi, Nader
 Escobar, Luis
 Hale, Michael
 Ho, Chung-Man
 (joint industrial engineering-
 statistics)
 Hung, Hsien-Ming
 Ihnen, Leigh
 Jobe, J. Marcus
 Kackar, Raghunath
 Kim, Byung Chun
 Kinyon, Lawrence
 Lamyordmakpol, Anuchit
 Lee, Edward Henry
 Lee, Moun-Shen
 Lee, Youngjo
 Lewis, Jerry
 Lin, Cherng-Tarn
 Londhe, Anil
 Mee, Robert
 Midha, Chand
 Mo, Wing-Hung
 (joint industrial engineering-
 statistics)
 Mowers, Ron
 (joint agronomy-statistics)
 Mowrey, Daniel
 Nagaraja, H. N.
 Noorbaloochi, Siamak
 Pantula, Sastry
 Parsian, Ahmad
 Peixoto, Julio
 Petenate, Ademir J.
 Rangachari, Lakshmi
 Richards, Winston
 Sallas, William
 Sastrosoewignjo, Soetarto
 Scott, Mark
 Werner, Neil

Non-degree Students

Ebey, Sherwood F.
 Herring, Hillary A.
 Jang, In Shik
 Koehler, Anne Searle

Bancroft Award

Paul G. McGovern, psychology, and William G. Colclough, economics, were chosen as the recipients of the 1980 T. A. Bancroft Statistics Award. Presented at a departmental seminar, the award consisted of a cash prize and a subscription to a statistically oriented journal of the awardees' choice.

Given each year to the most outstanding doctoral candidate minoring in statistics or doing a joint degree, the award honors T. A. Bancroft, professor emeritus of statistics and former head of the Department of Statistics and director of the Statistical Laboratory.

McGovern received the B.A. degree from the University of Dublin. Colclough received the B.A. from Winona State University.

Snedecor Award

H. N. Nagaraja was chosen as the recipient of the 1980 George W. Snedecor Statistics Award. The award was presented at a departmental seminar on January 23 and consists of a year's membership in the Institute of Mathematical Statistics and a cash prize.

Given each year to the most outstanding Ph.D. candidate in the Department of Statistics, the award was established in 1954 to honor George W. Snedecor, founder and first director of the Statistical Laboratory.

H. N. Nagaraja received the B.S. and M.S. degrees from the University of Mysore, India. He has served as a graduate assistant in the Department of Statistics since 1977. Beginning fall 1980 he will be an assistant professor of statistics at Ohio State University.

A Word of Thanks

A fine gift has been received from Thomas Benedict, a 1968 B.S. graduate in Statistics. The Statistical Numerical Analysis Section is now the home for an HP-85 desktop computer. Tom is employed by Hewlett Packard and the firm matches such employee donations of HP products two to one.

Mu Sigma Rho

A lecture entitled "Nielsen TV Ratings: What, Why, and How?" was presented by Edward Schillmoeller, vice-president of A. C. Nielsen Co., at the annual banquet and spring initiation of the local chapter of Mu Sigma Rho. Six undergraduates and nine graduate students were initiated as new members of Mu Sigma Rho.

Officers for the 1980-81 academic year are:

President—Larry Kinyon

Vice-President—Paula Lasack

Secretary-Treasurer—Ron Mowers

Dan Mowrey and Steve Schuelka were co-recipients of the Mu Sigma Rho Award for academic excellence and service to the organization.

Iowa Stat-ers

A graduate student club named the Iowa Stat-ers was created last fall. The following students served as officers: Dan Mowrey, President; Richard Auer, Vice-President; Bradley Skarpness, Secretary; and Cheryl Enger, Treasurer.

The club serves several purposes—obtaining good speakers for the graduate student seminar series, providing a social outlet for members, and promoting academic stimulation between graduate and undergraduate students. This year the seminar series was diversified and featured ISU faculty members, a guest speaker, Lou Fisher, Vice-President of Washington Operations for Lou Harris and Associates, and some statistics graduate students.

The club sponsored a spring picnic and softball game. The Iowa Stat-ers plan to hold a contest in which three questions written by graduate students will be chosen. Then undergraduate students will submit answers to these questions. The answers will then be graded and two prizes, one for \$25 and the other for \$10 will be awarded at the end of the year.

Dan Mowrey served as founding father of the Iowa Stat-ers. Brad Skarpness, H. N. Nagaraja, and Peter Crump served as graduate student senators and were instrumental in getting funds from the graduate student senate.

Officers for 1980-81 are: Rachel Harter, President; Jerry Lewis, Faculty Representative; George Ostrouchov, head of the Seminar Committee; Henry Lee, head of the Speaker Committee; Rick Auer, head of the Undergraduate Contest Committee; Mike Tveite, head of the Social Committee; Yasuo Amemiya and Tin-chiu Chua, general Faculty Committee Representatives; and Brad Skarpness, Senator.

Undergraduates

At the Scholarship Recognition Dinners held May 5 and 6, five undergraduates were honored. At this annual dinner the upper 2 percent of students by class in each of the colleges and the high scholarship graduating senior in each individual major are recognized. Beth A. Huegli, a statistics freshman, Lisa R. Knutson, a statistics senior, and Barbara J. Kole, a statistics-industrial administration senior, were so recognized in the College of Sciences and Humanities. Paula M. Lasack, a biometry-pest management senior and Dale L. Zimmerman a biometry-animal ecology senior were recognized in the College of Agriculture. Barbara



As an intern for the Crop and Livestock Reporting Service, Stephanie Moss collected corn samples from an experimental plot

Kole was honored as the high scholarship graduate in both statistics and industrial administration. Dale Zimmerman was honored as the high scholarship graduate in both biometry and animal ecology.

In addition to the above, Steven J. Schuelka was selected as a member of Lampos, the Sciences and Humanities Honorary. Lisa Knutson, Barbara Kole, and Steven Schuelka were elected to Phi Kappa Phi. Dean Neubauer received a Laura Vernon Scholarship for 1980-81 at a ceremony during Veishea. Paula M. Lasack received a \$500.00 scholarship from Knights of Ak-Sar-Ben. George D. Buswell, Lisa Knutson, Barbara Kole, and Steve Schuelka were elected to Phi Beta Kappa in May. Dale Zimmerman was selected as a member of Cardinal Key, the Senior Honorary at ISU. Dale was also the recipient of a Phi Kappa Phi Graduate Fellowship of which only 40 are awarded nationally each year.

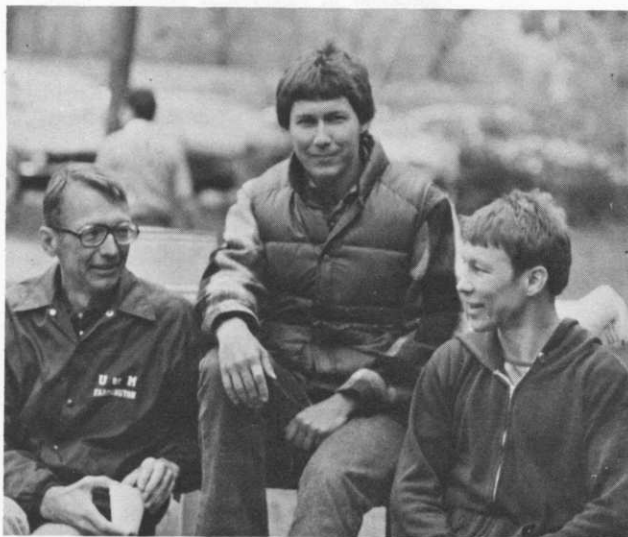
Undergraduate students were again aided in securing summer employment during 1980 in positions related to statistics. J. Robert Bartos began a six-month work period in June at the U. S. Bureau of Census, Washington, D.C., under a cooperative education program. Carolyn Connor worked for her second summer at the Johns-Manville Company, Denver, Colorado in the Health, Safety, and Environment Department. Marsha Kruse worked in agricultural statistics for the Crop and Livestock Reporting Service (USDA) in Des Moines. Paula Lasack was a field scout and research assistant for the Crop Protect Corporation in Illinois. Dean Neubauer returned to the Bureau of Census as a cooperative education student for the summer, completing his second required work period. Debra

Schroeder worked in statistical computing at the Mayo Clinic in Rochester, Minnesota. Such summer employment periods have proved important in providing students with a clear connection between statistical theory and practice. Other benefits include increased motivation towards academic work and development of a sense of responsibility and self-reliance on the part of the students.

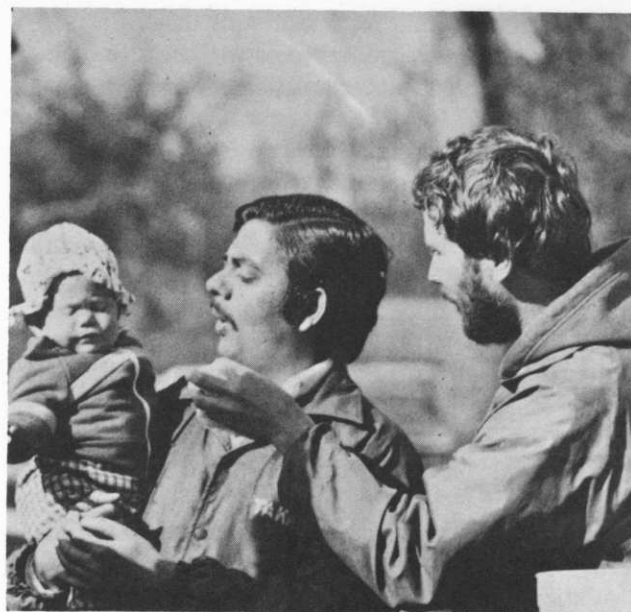
Richard A. Groeneveld, Donald K. Hotchkiss, William Q. Meeker, W. Robert Stephenson, and Shashikala B. Sukhatme served as undergraduate advisors during the year. The following students received the B.S. degree during the period July 1, 1979 to June 30, 1980:

Adnan Bin Ahmad
 Mark R. Aitken
 George D. Buswell
 Sheree K. Enquist
 Barry L. Garrett
 Lisa K. Knutson
 Barbara J. Kole (joint with Industrial Administration)
 Stephanie J. Moss
 Cleve K. Redmond
 Steven J. Schuelka
 Margaret C. Whipp (joint with Mathematics)
 Wai Nam Wong (joint with Mathematics)
 Unaizah Yahya
 Due Pin Zee
 Due Chin Zee (joint with Mathematics)
 Dale L. Zimmerman (biometry)

Adnan Ahmad is currently a graduate student at ISU in statistics; Mark Aitken is a mathematical statistician with the USDA Crop and Livestock Reporting Service in Lincoln, Nebraska; George



Paul Hinz, Peter Crump, and Dan Mowrey at a Stat Lab get together



A candid photo of Heidi Werner and graduate students Chand Midha and Neil Werner

Buswell joined the technical staff at Bell Labs in Holmdel, New Jersey and will attend graduate school in Operations Research to obtain a M.S. degree under the Bell Labs One Year on Campus Program; Sheree Enquist is a scientific analyst at Egan Air Force Base, Florida, having been commissioned a Second Lieutenant in the U. S. Air Force; Lisa Knutson will attend graduate school at the University of Wisconsin in Statistics; Barbara Kole will work as a marketing analyst with John Deere Company in Kansas City, Missouri; Stephanie Moss is an agricultural statistician for the Crop and Livestock Reporting Service in Des Moines; Steve Schuelka is working as a quality assurance analyst for Phillips Petroleum Company in Bartlesville, Oklahoma; Margaret Whipp is working in operational software development for Boeing Company in Seattle, Washington; Wai Nam Wong will attend graduate school in Statistics at the University of Chicago; Unaizah Yahya is a graduate student at ISU in the Industrial Administrative Sciences program; Dale Zimmerman will attend graduate school in an area of biology.

Statistics Club

The Statistics Club's activities are aimed at promoting interest among undergraduates in the field of statistics via campus visits and talks by statisticians, field trips to the sites of important users of statistics, and social events promoting interaction between students and faculty. The club's activities began with a picnic in September at the home of the club advisor Richard Groeneveld. Besides recrea-

tional activities, this gave statistics majors an opportunity to renew acquaintances with faculty members and with one another and to meet a new faculty member, Dr. W. Robert Stephenson, who will be the club advisor next year.

During the fall quarter a meeting was held to discuss the 1979 summer employment experiences of undergraduates in statistics. Mark Aitken and club president Stephanie Moss discussed their work with the USDA Crop and Livestock Reporting Service in Des Moines. Lisa Knutson talked about her experience at Bell Laboratories in Murray Hill, New Jersey. Margaret Whipp described her summer position in the Test Planning and Analysis Section at the General Motors Proving Ground in Milford, Michigan.

Guest speakers during the winter term were Ms. Kathy S. Dippo of the U. S. Bureau of Labor Statistics and Mr. Duane M. Skow, Statistician in Charge of the Crop and Livestock Reporting Service (USDA), Des Moines. Ms. Dippo discussed in general the functions of the Bureau of Labor Statistics and typical career patterns in the bureau. Duane Skow, an old friend of the club, talked about his recent trip to Indonesia and his experiences in designing agricultural surveys in that country.

A highlight of this year's activities was the spring field trip to the Mayo Clinic in Rochester, Minnesota. Mark Scott, a 1979 Ph.D. graduate of the Statistics Department hosted our visit and organized a very valuable presentation by members of the Statistics Section of the Clinic. Talks were presented by nine individuals on various aspects of statistics in medicine. Topics included data management, randomization in drug trials, ethical considerations in statistical consulting in medicine, as well as presentations of previous and ongoing statistical studies of medical practice.

The Veishea display this year concerned polling populations to obtain information about opinions. Different methods of polling were described and difficulties associated with the wording of questionnaires, the sampling of populations, and the interpretation of results were included. A poll was taken of Veishea visitors to obtain information about those visiting the display.

Paula Lasack was named the recipient of the 1980-81 Statistics Club scholarship. The following were elected officers for 1980-81:

President—Dean Neubauer
Vice-President—Carolyn Connor
Secretary—Ruth Paeth
Treasurer—Marsha Kruse

Seminars

Malay Ghosh, Roy Hickman, Vince Sposito, and

student representatives Erik Bergstralh and Steve Fahrenholtz comprised the committee which planned the weekly non-credit departmental seminars.

These seminars featured guest speakers, local faculty members, and students.

Topics and speakers for this year follow:

Statistical Laboratory Seminars

Summer, 1979

- July 25 Estimation for varying parameter stochastic difference equation, Biswanath Bhattacharyay
- August 1 Recursive mixed model estimation, William Sallas
- 8 Estimation of the parameters of the multivariate linear errors in variables model, Fred Dahm

Fall, 1979

- September 12 E. S. Pearson, H. A. David
- 19 Estimation based on sample extremes, Ishay Weissman, Technion—Israel Institute of Technology, Haifa, Israel
- 26 Random stopping under asymptotic independence, Neil Werner
- October 3 Compartmental models for regulation of N balance, Chaturvedula Asok, Maharashtra Association for the Cultivation of Science, Poona, India
- October 10 Borel-programmable functions, David H. Blackwell, University of California—Berkeley
- 17 Optimality conditions and dual problems, V. A. Sposito
- 24 Admissible and minimax multiparameter estimation in exponential families, Ahmad Parsian
- 25 Weak ratio theorems for Markov chains and the Chacon-Ornstein ergodic theorem, Krishna Athreya, University of Wisconsin—Madison
- 31 Admissibility of estimators in regular and non-regular cases, Bimal K. Sinha, Indian Statistical Institute, Calcutta
- November 7 Fitting models defined by differential equations, Mary Ralston

Winter, 1980

- 28 Survey sampling, Wayne A. Fuller
- December 5 Ergodicity, geometric ergodicity, and strong ergodicity, Dean Isaacson
- 12 A model for precedential value of appellate court decisions, W. Robert Stephenson
- January 9 Planning accelerated life tests, William Q. Meeker, Jr.

- 23 Some statistical considerations in the plus-minus grading system, Leroy Wolins
- 30 Inference based on conditionally specified random models, Chien-Pai Han
- February 1 Ergodic theory for some singular Markov models, Robert Sine, University of Rhode Island
- 6 Measurability of unions, Alexander Abian, ISU Department of Mathematics
- 8 On some problems of inference for diffusion processes, B. L. S. Prakasa Rao
- 13 On the risk performance of Bayes empirical Bayes procedures for classification between normal $(-1, 1)$ and normal $(1, 1)$, How Jan Tsao, Michigan State University
- 19 Sampling and non-sampling errors in the world fertility survey, Colm O'Muircheartaigh, London School of Economics
- 20 Marriage market models: trends in religious assortative marriage in the United States, Robert Johnson, University of Arizona—Tucson
- 21 A review of a structural equation model using LISREL, Fred Lorenz
- 21 Designing clinical trials as quasi-sequential experiments, Nell Sedransk, SUNY, Albany

Spring, 1980

- March 7 A Bayesian approach to smoothing large, sparse contingency tables, Jeffrey S. Simonoff, Yale University
- 10 Sequential procedures in identification, Nitish Mukhopadhyay, Oklahoma State University
- 11 Testing subhypotheses in the multiplicative interaction model, Mervyn G. Marasinghe, Kansas State University
- 12 Combining information from two samples to estimate viewing of television programs, Edward A. Schillmoeller, vice-president, A. C. Nielsen Company
- 19 Troubles with Gauss-Markov residuals, Bob Obenchain, Bell Telephone Laboratories, Holmdel, New Jersey
- 26 The selection differential, H. N. Nagaraja
- April 2 Finding good probability appraisers, Glen Meeden
- 9 Multivariate negative dependence, Nader Ebrahimi
- 16 Log-linear models: an interactive program for maximum likelihood estimation, Kenneth Koehler
- 23 A proper analysis of variation in the mixed model, Kenneth Brown, University of Maine
- May 7 The effect of inequality of variance and autocorrelated errors on tests of non-additivity, Daniel H. Mowrey

Statistics Graduate Student Seminar Series

The seminar series was diversified this year. It featured Iowa State faculty members and a visitor, in addition to graduate students.

Topics and speakers for the year follow:

- October 5 Controversies in statistics, Oscar Kempthorne
- November 2 Mode, median, and mean inequality and skewed distributions, Richard Groeneveld
- December 7 On the derivation and characterization of certain distributions, Malay Ghosh
- March 13 Aspects of industrial engineering, Keith McRoberts, Industrial Engineering
- March 21 Stability of equilibria with genetic applications, Jerry W. Lewis
- April 10 The art of questionnaire design and question wording, Victor J. Fisher, Vice-President of Washington Operations, Lou Harris Poll
- April 25 Statistical analysis of a fixed crop rotation experiment, Ron Mowers
- May 9 Home and away in the NBA, Kenneth Koehler
- May 16 Max-infinitely divisible bivariate discrete distributions, James Fakiya

In Memoriam

Sidney Addelman, 1932-1979

Many present and previous staff members and former students will be grieved by the death of Sidney Addelman on July 15, 1979. Sidney had become ill some months before and it seemed that treatment was being successful. Death was quite unexpected and came very quickly without the extreme discomfort that is common with cancer. Sidney obtained a B.A. at Carleton University in 1954 and an M.A. at the University of Delaware in 1956, both in mathematics. He then came to ISU and completed the Ph.D. under the direction of Professor Kempthorne.

After graduation, he worked at the Research Triangle Institute at North Carolina State University, and at Duke. In 1967, he went to SUNY at Buffalo as an associate professor. He was promoted to professor in 1974. He held offices in very many American Statistical Association positions, the most important of which was ASA Program Chairman in 1971. He was elected a fellow of the ASA.

Sidney's main area of activity was factorial experiments and fractional replication. His papers are among the basic ones in those areas and are widely recognized.

Sidney was a consistent contributor to the profession of statistics: associate editor of *Technometrics*, reviewer for many journals, and a

program chairman for SPES (Section on Physical and Engineering Sciences).

At the time of his death, he was chairman of the Statistics Department at SUNY—Buffalo. Above and beyond his professional integrity, his accomplishments, and his contributions to the profession, Sidney was a very fine person as all those who were associated with him will confirm.

We extend our condolences to his wife, Pat, whom many will recall with fondness, and to their offspring, David, Stephen, John, and Diane.

Leon Jordan Filho, 1934-1980

Some past students will recall Leon Jordan Filho. He came to ISU in 1965 after completing a B.S. in mathematics at the University of Brazil and an M.S. in mathematics at New York University. He completed the Ph.D. under the direction of Oscar Kempthorne with a thesis entitled *Bias and Mean Square Error in Experimental Designs*.

After working at the M. D. Anderson Hospital in Houston, Leon returned to Brazil. He taught for a short period at the University of Campinas, and had been working for some years at DATAPREV (Empresa de Processamento de Dados da Previdencia Social).

Professor and Mrs. Kempthorne visited Leon, his wife Marly, and their offspring Miriam, 17, and David, 12, in November 1979, all of whom were extremely hospitable to the Kempthornes.

Everyone was shocked to hear from Miriam that Leon, Marly, and David were killed in an automobile accident on April 19, 1980.

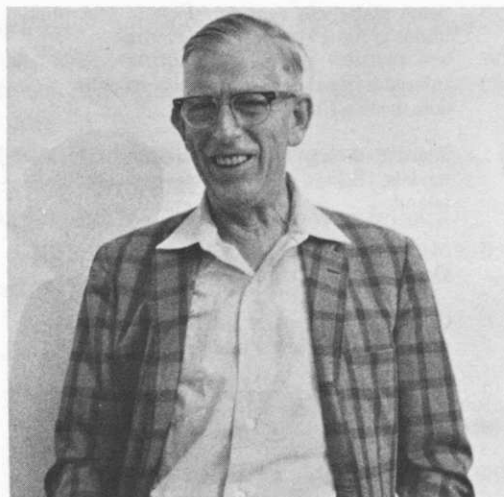
Leon was an active professional statistician, with later orientation to collection and interpretation of social statistics while continuing his research interests in optimal design. He was deeply appreciative of the training he obtained at ISU and was putting this to excellent use.

We extend our deepest condolences to Miriam, a daughter of whom Leon and Marly were justly very proud.

William G. Cochran, 1909-1980

William G. Cochran, professor emeritus of statistics, Harvard University, died in Massachusetts on March 29, 1980.

From 1939-1946 he was a professor of mathematical statistics at Iowa State College. During his years at Iowa State, he played a fundamental role in strengthening the theoretical side of statistics. Professor Cochran was instrumental in firmly establishing and developing Iowa State's Ph.D. program in statistics. In addition to the above and his considerable personal research, Professor Cochran contributed greatly to upgrading the level



W. G. Cochran

of research in many departments on the Iowa State campus by consultations on statistical aspects of research projects in many areas. His scientific treatises on experimental design and survey sampling received worldwide acceptance as definitive works in these areas and contributed greatly to the improvement of research methodology both in the United States and abroad.

Before joining the Iowa State staff, he was a statistician at the Rothamsted Experimental Station, England from 1934-39. He left Iowa State to become the associate director of the Institute of Statistics, of North Carolina from 1946-48. From 1948-57 he was a professor of biostatistics at the School of Hygiene and Public Health, The Johns Hopkins University. He served as a professor of statistics at Harvard University from 1957-76.

During the early 1960's, he was the statistical member of the advisory committee to the Surgeon-General responsible for the report on "Smoking and Health." He was a member of the National Academy of Sciences and served terms as president of the American Statistical Association, the Institute of Mathematical Statistics, the Biometric Society, and the International Statistical Institute.

He was the author or co-author of 100 published papers and of five books. With Gertrude Cox, he was coauthor of *Experimental Designs*. At the time of his death he was proofreading the 7th edition of *Statistical Methods* by G. W. Snedecor and W. G. Cochran to be published by the Iowa State University Press.

In 1978 Dr. Cochran returned to Iowa State for three weeks as a visiting professor. His lectures and comments were stimulating and very helpful for those engaged in daily statistical consulting.

Bill Cochran is deeply missed by friends and colleagues in the Statistical Laboratory. We offer our condolences to his wife and family.



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Iowa State University**

Editor, Nancy J. Barry