STATISTICAL
LABORATORY

Contents

THE STATISTICAL LABORATORY
Iowa State University
1978-79 Annual Report

From the Director of the Statistical Laboratory

The year 1978-79 proved to be eventful. We were shocked and saddened by the death of one of our most valuable senior faculty members, Dr. Bal Sukhatme. Earlier, Dr. David Huntsberger announced his plans to retire after 30 years at ISU. See stories elsewhere in this issue.

Resignations of James Gentle, Barry Arnold, and Richard Warren were also received. Dr. Gentle has accepted an attractive offer to join the International Mathematical and Statistical Libraries (IMSL) in Houston, Texas. After 14 years, Dr. Arnold is leaving to accept a position as professor of statistics in the University of California, Riverside. Since 1963 Dr. Warren has held, with extraordinary success, a joint appointment in Sociology and Statistics. He has been named director of the Research Institute for Studies in Education within the ISU College of Education.

The loss of five such fine faculty members is a distinct blow to the Department. During the year several faculty members freely gave of their time to take on additional assignments. Fortunately the statistics faculty can be counted on continuing this in various ways during the coming year since most of the resignations came too late to permit us to seek regular replacements.

Dr. Huntsberger's position has been filled by W. Robert Stephenson, currently an instructor of statistics in the University of Connecticut. He received a B.A. in mathematics from Gettysburg College in 1974, and both an M.S. in statistics in 1976, and a Ph.D. in statistics in 1979 from the University of Connecticut. Dr. Stephenson's area of specialization is nonparametric statistics and he is especially interested in applications of statistics to the fields of law, biology, and ecology.

We are and will be making strenuous efforts to secure strong replacements for the other vacant positions. Most especially we hope to retain our eminence in the survey sampling area by appointment of a recognized leader in the field. The university's administration is fully in support of our various plans. We have been authorized to replace Dr. Warren by two assistant professors joint with the Department of Sociology. For the coming year we have been fortunate in securing the services of Dr. Ishay Weissman as a visiting associate professor. He is at present a senior lecturer on the faculty of Industrial and Management Engineering, Technion-Israel Institute of Technology, Haifa. Dr. Weissman will be doing research in extreme value theory and will be teaching classes in statistical theory.

I would welcome receiving suggestions from alumni and other readers of this report for filling our various vacancies. We here at the Statistical Laboratory are looking confidently toward the future.

Herbert A. David

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.

James Cornette was a visiting professor during second summer session, 1978, and first summer session, 1979. With Edward Pollak and Oscar Kempthorne, Dr. Cornette worked on Project 1669 doing research in mathematical genetics.

Christopher J. Hansen who earned a Ph.D. in psychology from ISU in 1978 was a temporary assistant professor in the Department during 1978-79. He taught statistical methods courses to students in the social sciences.

Mack C. Shelley II, currently an assistant professor at Mississippi State University will join the Statistical Laboratory staff in a joint appointment with political science. He was awarded a B.A. in international studies and economics from American University in 1972. Dr. Shelley earned the following degrees from the University of Wisconsin—Madison: an M.S. in economics in 1973, an M.A. in political science in 1974, and a Ph.D. in political science in 1977. His current research interests include Congress, the Presidency, political parties and elections, time series and regression analysis, and statistical forecasting.

Statistical Laboratory Staff— Fiscal Year 1978-79 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

Barry C. Arnold, joint appointment with Department of Mathematics

T. A. Bancroft, Professor Emeritus

C. Philip Cox

David F. Cox

Herbert A. David

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

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

B. V. Sukhatme (died April 30)

Richard D. Warren, joint appointment with Department of Sociology and Anthropology

Leroy Wolins, joint appointment with Department of Psychology

James Cornette, visiting professor SSII 1978 and SSI 1979

William F. Taylor, collaborator in residence at Mayo Clinic

Associate Professors

Theodore B. Bailey, Jr.

James E. Gentle

William Q. Meeker, Jr.

Gordon D. Booth, USDA collaborator

Assistant Professors

Harold D. Baker

J. Jeffery Goebel

Christopher J. Hansen (temporary)

Kenneth Koehler

Shashikala Sukhatme

R. Craig VanNostrand

Peter O'Brien, collaborator in residence at Mayo Clinic

Adjunct Assistant Professor

Thomas Bubolz

Instructors and Associates

Kim Andriano through August 31

Richard Dorsch

Debra Shenk beginning September 1

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	Lee, Edward Henry
Auer, Richard	Lewis, Jerry
Bergstralh, Erik John	Lin, Char Lung
Bhattacharyay, Bisu	Lin, Cherng-Tarng
Biyani, Shriram	Londhe, Anil
Blough, David K.	McClellan, Paul
Castonguay, Joy	Mee, Robert
Chandhok, Promod Kumar	Mei, Maria
Christenson, Peter D.	Midha, Chand
Chua, Tin Chiu	Motoyama, Tetsuro
Crump, Peter M.	Mowers, Ron
Dahm, P. Fred	Mowrey, Daniel
Der, William	Nagaraja, H. N.
Drew, James	Noma, Akihiro
Duke, Steven	Ponder, Wendell
Ebrahimi, Nader	Protz, Steven
Enger, Cheryl	Rangachari, Lakshmi
Escobar, Luis Alberto	Razmpour, Ahmad
Eskridge, Kent	Richards, Winston A.
Fahrenholtz, Steven	Sallas, William M.
Fox, Kenneth	Scott, Mark
Guerrero, Margarita	Sedcole, Richard
Hale, Michael Don	Shenk, Debra
Hand, Michael L.	Shu, Ven-Shion
Ho, Chung Man	Skalland, Kent
Hong, Emile	Skarpness, Bradley
Huang, Michael	Vest, Linda
Ihnen, Leigh	Werner, Neil
Kackar, Raghu Nath	Werner, Richard
Kaluzny, Stephen	Wu, Amy Tei-Mei
Kim, Geung Ho	Yih, Wei
Kinyon, Laurence	Yu, Fu-Hau
Kivior, Susan	Yuen, Kapo James

NSF Fellow

Steven Duke

Supported Graduate Students

Abdel-Megeed, Samir—American Friends of the Middle East (AFME)

Anselmi, Luis—Institute of International Education

Aziz, Mohammad—Agricultural Development Council Fellowship

Beck, Marvin—Metallurgy, ISU

Briceno, Rodrigo—Agency for International Development (AID)

Chen, Juinn-Charn—Ministry of National Defense, Taiwan

Chiyenda, Simeon—AID

Crouse, Ken—Ames Lab, ISU

Cruz, Vivaldo F.—USAID

DaSilva, Antonio—CAPES (an agency of the Brazilian Ministry of Education and Culture)

Dehghan-Nayeri, Majid—Department of Mathematics, ISU

Ebrahimi, Nader—MEE, Iranian Government

Fakiya, James O.—Ondo-State Government Post-Graduate Scholarship, Nigeria

Laidig, Friedrich—DAAD (Deutscher Akademischer Austauschdienst)

Lamyordmakpol, Anuchit—Government of Thailand

Liberty, T. Edward—INDP Fellow, Liberia

Lo-Utai, Sue—Government of Thailand

Mazlom, Reda—Egyptian Government

Megahed, Abdel Razek—Egyptian Government

Mo, Wing-Hung David—Department of Industrial Engineering, ISU

Niknian, Minoo—AFME

Noorbaloochi, Siamak—Iranian Government

Parsian, Ahmad—Pahlavi University, Iran

Peixoto, Julio—AID

Pongsrihadulchai, Apichart—USAID

Ridpath, Harold—Department of Mathematics, ISU

Saad-Eldin, Mohamed—University of Gezira

Sakia, Remi—Ford Foundation

Sastrosowignjo, Soetarto, Government of Indonesia, AID

Sivira, Jose—University of Los Andes, Venezuela

Slamet—Surabaya Institute of Technology Project, Indonesia

Steiner, Michael—USDA

Sung, Chang Sup—Department of Industrial Engineering, ISU

Tegene, Abebayehu—USAID

Wilson, Jeffrey—Government of Trinidad

Zaher, Adel—AFME

Self-Supporting Graduate Students

Caravavattana, Rattana
Hsu, Sheue-Wen
Kuo, Tsuey Lin
Ramos, Juan
Seyedsadr, Seyed Mahmoud
Simon, Barry
Tan, Hsien-Hui
Tsui, Susan Y.
Wang, John Lih
Yeo, Woon Bang

Survey Section

Caroll Arthur, Statistical Data Processor

Glenda Love Ashley, Key Entry Operator

Leilani Bassett, Key Entry Operator

Carol Charlson, Statistical Clerk through January 19

Joanne Wagner Clark, Statistical Data Processor

Hazel Cook, Survey Supervisor

Julie Ann Cummings, Statistical Clerk beginning May 15

Theo Doran, Key Entry Operator beginning May 21

Dorothy Edwards, Statistical Clerk beginning May 8

Margaret Fowler, Statistical Clerk

Mary A. Genalo, Statistical Clerk through May 31

Evelyn Green, Survey Supervisor

Sylvia Larson, Statistical Clerk

Jodee Lewis, Statistical Clerk, temporary July 15, 1978 through May 24, 1979

Marion Martin, Statistical Data Processor

Marjorie Mason, Survey Supervisor through October 6
Sylvia McNulty, Bookkeeper
Helen Nelson, Secretary
Margaret Nichols, Secretary
Donna Omundson, Statistical Clerk
Florence Osam, Statistical Clerk
Chris Holst Rock, Statistical Clerk beginning July
Jeanne Sorenson-Wright, Statistical Clerk through May 15
Randy Tanaka, Programmer
Harvey Terpstra, Junior Systems Analyst
Elaine Widmann, Key Entry Operator

Statistical Data Processing Service

Bud J. Meador, Supervisor
Bernice Matrow, Junior Data Analyst from July 1 through May 29

General Office Staff

Avonelle Jacobson, Administrative Assistant
Betty Ibrahim, Accountant
Nancy J. Barry, Information Specialist
Cheryl Balko, Secretary
Phyllis Carr, Secretary—Experimental Design Genetic Statistics Section
Norma Elwick, Secretary
Valerie Engeltjes, Secretary—Statistical Numerical Analysis and Data Processing Section through December
Suzanne Kay Gordon, Secretary through October
Sandy Howard, Secretary
I. Joyce Johnson, Secretary—Statistical Numerical Analysis and Data Processing Section beginning December 18
Marylou Nelson, Secretary
Janice Peters, Secretary
Laura Robinson, Secretary beginning October 16

David V. Huntsberger Retires

After a long and distinguished association with the Statistical Laboratory, Professor David V. Huntsberger retired June 30, 1979. He was feted at a banquet held in his honor at the Gateway Center in Ames on May 16. On July 1 he became professor emeritus of statistics.

After an interruption of four years in his undergraduate studies to serve as a pilot and captain in the US Air Force, he received a B.S. (cum laude) in mathematics from Bethany College in 1947. He holds an M.S. (1948) in mathematics from West Virginia University and a Ph.D. (1954) in statistics from Iowa State University.

Dave joined the ISU statistics faculty as an instructor in 1951 and soon played a key role in the undergraduate teaching program. He became a Fellow of the American Statistical Association in 1967, received a Faculty Citation in 1970, and an Outstanding Teacher Award in 1971. He was elected

to Phi Kappa Phi in 1968. During 1969-70 he served as president of the ISU chapter of Sigma Xi.

Dr. Huntsberger is the author of a number of research articles but his name has become internationally known through several undergraduate textbooks. Most successful among these is his *Elements of Statistical Inference* first published in 1961 by Allyn and Bacon, and now in its fourth edition (with Patrick Billingsley as co-author). *Elements* also forms the basis of two other co-authored texts, *Statistical Inference for Management and Economics* and *Elements of Statistical Inference for Education and Psychology*. All of these books reflect Dr. Huntsberger's extensive teaching experience and the skill and clarity of his exposition.

We wish Dave and his wife Anna Mae a very happy and active retirement.
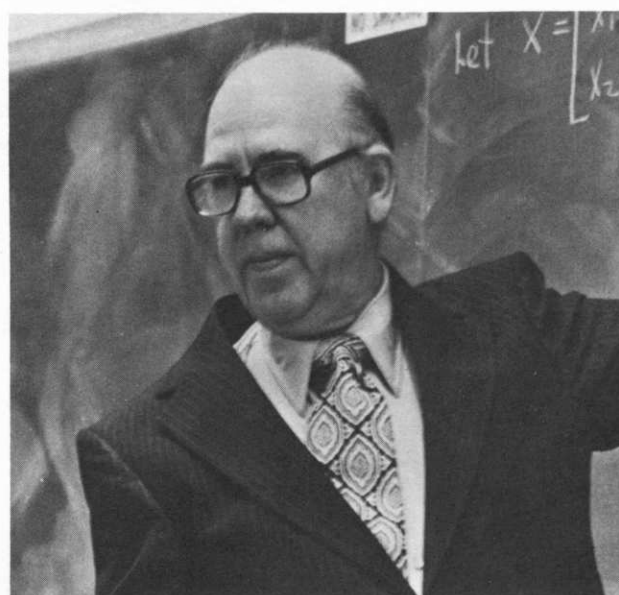
David Huntsberger lecturing during a class

Consulting and Cooperative Research

The Statistical Laboratory provides consulting services to ISU faculty and students who request assistance with research design, data collection, or data analysis and interpretation. A variety of contracts and arrangements enable consultants and supporting staff to serve off-campus agencies.

Although some are budgeted primarily in this area, all faculty members and some graduate research assistants are available for consulting. A consulting room staffed by graduate assistants from the Statistical Numerical Analysis and Data Processing Section serves ISU researchers on a "walk-in" basis concerning problems encountered with computer use.

Statistical Laboratory consultants continually update statistical procedures and techniques and add new equipment to keep abreast in their field

and to provide the highest quality consulting services.

Examples of this year's consulting follow.

Social Sciences

Dr. Strahan consulted on a variety of studies with students and faculty from the Departments of Psychology, Child Development, Industrial Engineering, Economics, Agricultural Education, and Zoology. He also consulted on projects associated with professional studies in education, general graduate studies, and the Toxicology Unit of Veterinary Medicine.

Richard Warren, who holds a joint appointment in Statistics and Sociology, consulted with faculty and graduate students on research activities from the Departments of Sociology, Family Environment, Economics, Industrial Education, Child Development, Secondary Education, Professional Studies, Elementary Education, Home Economics Education, Agricultural Education, and Political Science. The research interests ranged from basic research issues to applied research projects. The areas of consulting activities included overall research project designs, hypothesis formulation, questionnaire construction, data collection processes, evaluation of measurement, data analysis, interpretation of findings, and implications for relevant client systems. Dr. Warren engaged in consulting where appropriate emphasis was placed on using recent developments in causal analysis, in making adjustments for measurement error and estimates of structural equations, and in using multiple indicators. During the year 76 graduate and 32 faculty members requested consulting help on some phase of their research.

Engineering Research Institute

Professors H. T. David and Craig Van Nostrand carried out ERI-sponsored consulting, together with Neil Werner, who continued in the third year of his consulting assistantship in the Engineering Research Institute.

Among the most interesting projects that Van Nostrand and Werner worked on were:

Chemical Engineering: Work on a coal desulfurization project was extended to non-linear models. A second project involved obtaining approximate marginal confidence intervals for rate constants in an essentially linear equation.

Civil Engineering: The largest project used censored pavement lifetime data to analyze the effects of factors on regression coefficients. Pleistocene soil deposition was studied using stochastic processes techniques. A multi-factor grossly unbalanced sanitary engineering experiment was analyzed.

Earth Science: Response surface methodology was used to help establish stratigraphic correspondence between drill cores of underground coal beds.

Nuclear Engineering: H. T. David, William Q. Meeker, and Tony Lin contributed to research on operator errors. Assuming a non-homogeneous Poisson process model for the occurrence of documentable operator errors, a Bayesian methodology was developed for choosing among several possible intensity function types, and the fitting of the parameters of the type selected.

A computer program was developed for monitoring the consistency among readers and interpreters of operator error logs. Areas of application were explored for Weibull and hazard plotting.

Agriculture and Home Economics Experiment Station

Many different projects were handled during the year by the section responsible for statistical consulting within the Experiment Station. Some consulting takes a few minutes by telephone while other projects last for months. The following are typical of the types of work handled by the consultants.

A study of the nesting habits of red-tailed and red-shouldered hawks in Iowa was made by researchers in Animal Ecology. Debra Shenk was able to use many multivariate methods such as clustering, principal components, and discriminant functions in analyses of the numerous measurements made at the nest sites of the hawks.

Erik Bergstrahl assisted workers in Entomology in studies of populations of corn borers. Comparisons were made between recently captured insects with other groups that have been raised in the laboratory for many generations. Like most such studies, the work was designed as a randomized block experiment with use of split-plot techniques.

One of the most extensive profiles of serum progesterone ever done in cattle was carried out by reproductive physiologists in Animal Science. The study included three groups of pregnant cows, one with hypophyseal stalk transection, another consisting of sham operated controls, and a third of intact, untreated controls. Radioimmunoassays were used to determine progesterone levels in the serum from samples taken every four days in the last six months of pregnancy. Dan Mowrey helped in the analyses of these data which also sought to establish if any common environmental variables such as temperature and humidity influenced progesterone levels.

Workers in Food and Nutrition continued to investigate dietary factors involved in serum cholesterol levels. Cheryl Enger carried out the analyses for a large study in this area where cholesterol and various enzymes were monitored in rats fed different diets over an extended time.

During last year Dr. Bailey conducted a short course consisting of ten lectures on statistical methods for participants in the 1979 Soil Science Institute. The course was designed to update the statistics knowledge of 30 field soil scientists from the US Conservation Service, the US Forest Service, and the Bureau of Land Management. Dr. Bailey was also involved in cooperative research with two visiting professors in Agronomy. Dr. Ivan Langer

from Czechoslovakia was assisted in a project which reviewed the production characteristics of oat cultivars developed over the last 40 years. Dr. B. S. Jalani from Malaysia was helped in an investigation of the potential higher seed protein yields in oats.

The Statistical Analysis System remains the main computing tool used in the section and additional typewriter terminals have increased the efficiency and flexibility of the computer work. The more one understands about the nature of the research carried out by the Experiment Station, the more intelligent and productive the statistical consulting will be. In order to acquaint the graduate students involved in this work with various parts of the Experiment Station, several field trips have been taken to nearby and outlying research stations in Iowa where the data we eventually analyze are being collected.

Statistical Numerical Analysis and Data Processing Section

Members of the Section were actively engaged in many activities related to statistical computing during the year. Such activities fell under the general headings of consulting, research, and computer programming and data processing support.

Professors Kennedy and Gentle continued research work related to LP computational algorithms. This work led to the creation of a new algorithm for computing estimates for a linear model under linear inequality restrictions. They also were involved as consultants in several different projects during the year.

Dr. Thomas Bubolz and Bradley Skarpness continued with design and implementation of an interactive information storage and retrieval system for the Iowa State Forest Nursery. The system, which became operational in November 1978, handles order processing, billing, reports for field representatives, and inventory control for over 2.5 million trees. The system combines features of the WATFIV language, IBM's O.S. Utilities, and EXECUTE files that run under control of the WYLBUR text editor.

Assistance was given in the design of a questionnaire to be sent to tree buyers, and in developing a method for identifying demand, independently of tree sales, for various species of trees. Computer graphics techniques are being investigated as potential management tools for the state forest nursery. The primary application would be in the areal distribution of planting and demand data.

A variety of new and continuing projects for the Iowa Association of School Boards was undertaken during the year. Three surveys involving teachers' salaries and insurance, school board elections, and characteristics of boards of directors were analyzed by Akihiro Noma and Fu-hau Yu. Annual teacher contract reports were analyzed by Fred Ho using a program he has developed over the past two years.

Fred Ho completed a complex data analysis project for an Ames Lab-ERDA study of trace element composition of terrestrial and aquatic plants adjacent to coal-fired power plants. The final program analyzed the contents of four data sets simultaneously, each containing data sampled in a different time period. Automatic adaptation was made for unequal observations in a category or missing categories in some, but not all, time periods. Kapo Yuen was involved in programming several algorithms for estimating relative variation in the sample data.

Programming, data processing, and data analysis support were provided for the annual game harvest surveys of the Iowa State Conservation Commission. Kapo Yuen assisted in analyzing the deer harvest data and Akihiro Noma was responsible for the small game data.

Section personnel provided programming and data analysis support for on-campus research conducted by faculty and graduate students. Fu-hau Yu, with the assistance of Dr. Wayne Fuller, provided programming support for a dissertation research project in econometrics. Under the supervision of Dr. Bubolz, she also gave considerable programming support to thesis research of graduate students in the Professional Studies and in Economics. Kapo Yuen assisted in the analysis of food recall data for a project in the Department of Food and Nutrition. The objective of the research was the assessment of recall stability over time. Akihiro Noma provided programming support for a series of studies from the Biochemistry Department. The objective of the research was the analysis of Vitamin A concentration in fetal livers obtained in three different countries. Bradley Skarpness provided programming support for a project in Civil Engineering where the objective was the development of statistical models for describing cyclical patterns in monthly and annual rainfall data.

Dr. Bubolz supervised the installation of at least one update to each of the package programs SAS, SPSS, BMDP, and MINITAB. The MINITAB package was installed on the newly acquired VAX computing system.

The data processing group, supervised by Bud Meador, worked on a large number of research projects from various university offices as well as on a substantial number from off-campus sources.

Susan Kontos and Char-lung Lin were responsible for most of the work on an extensive flex-time study involving university employees. The direction and scope of the study were determined by Dr. Cheedle W. Millard, Industrial Administration, and the project support came from the Personnel Office. The initial work on the first of three phases of the flex-time data analysis was handled by Dr. Tetsuro Motoyama who left the Section early in the year after graduation.

Bernice Matrow provided the Section's primary support to the Iowa Crop Improvement Association's Corn Yield Test, Master Corn Grower, and Master Soybean Grower programs. Additional new com-

puter programs and current data as well as programs and data from prior years were required to produce ready-to-publish tables for these projects. Ms. Matrow, who worked most of the year in the Section's junior data analyst's position, also handled the data analysis for Golden Harvest Seeds as well as that for numerous university projects. Bernice moved to Kansas at the end of the year.

A continuing project involved the Section in data analysis support of the North Central Regional Project: A Life Span Analysis of Rural Children's Mental and Social Ills. Luis Escobar and other members in the Section worked with Dr. Wolins and research workers from Child Development on this study.

Anil Londhe continued to handle recruiting work from the College of Veterinary Medicine and the Iowa Development Commission. Again, as he did last year, Anil developed a unique interactive computer application for a university faculty member. This time it was on the university's new VAX Computer. The interactive program is for student use in evaluating Home Mortgage Interest Rates. This program is used in a course offered by the Department of Family Environment.

The Section's program for generating planting plans for crop experiments was used extensively for research workers in Agronomy as well as for a number of commercial seed companies. The plans' program not only takes care of randomizations but also prints field books suitable for recording data in the field. Pressure-sensitive labels are also printed to assist research workers in packaging seed and harvest specimens for transportation, say from the seed barn to the planting site, the field to the laboratory, etc. Maria Mei handled several of these projects as well as the related analysis of data from crop experiments.

V. A. Sposito and Bill Boggess from CARD developed several transformations for converting nonlinear programming models to a separable programming format. These transformations were used on several large-scale quadratic programming models for CARD, and optimal solutions were obtained using separable linear programming procedures.

Another optimization project conducted by V. A. Sposito involved converting all the I/O subroutines in ZORILLA, (quadratic programming software package), to run efficiently on the ITEL AS6 computer.

Also, during the year various time studies were conducted for the Computation Center to compare the CPU times of the AS5, AS6, and the 370 computer.

Survey Section

The Section continues to cooperate with the University of Iowa and the National Cancer Institute. Data collection was completed on the National Survey of Environment and Health. The study employed a case-control design in which the cases were incident cases, that is, persons in Iowa with cancer of the urinary bladder first diagnosed during 1978. The control group was randomly selected and matched with incident cases on age and sex. Data were collected on 354 cases and 752 controls. The Survey Section was responsible for all field interviewing, validation, and the initial data edit. Analysis will be completed by National Cancer Institute Researchers.

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

Family relationships as they influence food habits are the subject of a research project being conducted for the Sociology Department. The objective is to study how certain changes in our society have affected families and their eating habits. The Survey Section will conduct all field interviewing and will edit and code the data. This statewide project will include a random sample of approximately 540 households located in cities of three population sizes: under 10,000, 10,000 through 50,000, and over 50,000. The sampling scheme was structured so as to produce an equal number of households containing (1) single parents; (2) single adults over 60 years of age; (3) children under 6 years of age; (4) children 6-18; (5) married couples with the wife between 45 and 60; (6) married couples with the wife over 60 years of age. In households containing married couples, both husband and wife will complete questionnaires for purposes of comparison.

A mail questionnaire study will query 913 Iowa farmers who participated in the Family Farm study two years ago. This project will ask farmers to express their views on the appropriate level of responsibility (local, county, state, federal) with regard to land use planning and their attitudes toward the use of their land and tax dollars under land use planning. A similar questionnaire is being mailed to about 1,000 county commission members and approximately 200 persons who attended district meetings on land use planning. The Survey Section assisted with the development of the questionnaire and will edit and code the data. Final analysis will be made by researchers in the Sociology Department.

The Survey Section cooperated with the State Legislative Leaders Foundation in a pilot study of the Iowa State Legislature in order to assess the impact of various changes made in the legislature on legislative performance and policies. About 150 state

legislators were interviewed; both telephone and personal interview procedures were used. The Legislative Leaders Foundation will complete the data analysis.

A study of jointly administered vocational education programs in Iowa high schools was conducted for the College of Education. Funded by the interim Study Committee of the House Budget Committee, Iowa Legislature, the survey queried administrators of 114 secondary schools about their experiences with jointly administered programs and their ideas regarding program improvements. The data were coded and edited and the analysis made by Survey Section personnel.

Data summarization and tabulation continue on the Family Farm data set collected in 1977 for the College of Agriculture. Staff members in various agricultural departments are making use of the data set in on-going research. Assistance was provided to the Department of Economics in developing a general computer program to produce tabulations from data collected from farm management students regarding the types of farm machinery used on their home farms.

A sample was selected from the Ames telephone directory for a professor in Animal Science wishing to establish a taste panel for testing meat products. Assistance in selecting a sample from the Des Moines telephone directory was given to a student in Journalism. A student in Education received assistance in drawing a sample of students enrolled in the Des Moines Area Community College.

Assistance in constructing a questionnaire was given to a state senator interested in surveying attitudes of recent high school graduates toward their school and the quality of its educational program. ISU library personnel were given assistance in constructing questionnaires designed to elicit opinions from faculty, graduate students, and undergraduate students about the services provided by the library. A statewide area sample of quarter-section (160-acre) units was selected for a representative of the State Preserve Board. This sample is to be used to conduct a bird census.

A sampling plan was designed for the State Entomology Department to be used in inspecting fields of corn being raised for seed for export. To be eligible for export, seed must come from fields certified as being free of certain seed-transmitted diseases—the particular diseases varying by country of destination. The plan developed was designed to detect the presence of any disease having as much as 5 percent incidence with a probability of 0.98 in the worst possible situation in which the intraclass correlation coefficient among plants within plots is equal to 1. Field instructions for carrying out the sampling were also prepared.

A sampling plan was designed for personnel at the ISU Library to enable them to measure usage of their card and serial catalogs. Results of the study will be used in planning future library needs.

A sample of school districts in Iowa was selected for researchers in Home Economics Education studying certain specially funded home economics courses. The 28 largest districts, in terms of numbers enrolled in the courses being studied, were included with certainty. From the remaining districts, a sample of 73 was selected with equal probability in a systematic manner after first ordering the districts by size.

A sampling plan was developed for an agronomy student to be used for taking soil samples in a terraced area that has been reclaimed from a coal strip mine.

Members of the Survey Section consulted with personnel of the Department of Environmental Quality on a study concerning the legislative bill requiring deposits on soft drink and beer containers. The study will attempt to assess the effect of the bill on prices of soft drinks and beer. Price surveys in Iowa to be carried out both before and after the bill goes into effect were discussed. Surveys in other states to be used as controls were also discussed.

The program package SUPER CARP developed in the Survey Section was expanded and improved during the year. The computation of variances of survey statistics was expanded to include the computation of covariance matrices of total and ratio estimates. Additional procedures were added to the measurement error portion of the program. Kenneth Fox added the options and introduced modifications that reduced the cost of running the program. Paul McClellan is working on additional procedures for SUPER CARP.

Persons interested in obtaining a copy of SUPER CARP should write to Professor Wayne A. Fuller.

Off-Campus Consulting

Dr. T. A. Bancroft consulted with a research professor at the University of Minnesota on the analysis of data involving disproportionate and unequal subclass members.

Wayne Fuller, Jeff Goebel, and Roy Hickman were in Oklahoma City, Oklahoma May 22 to consult with members of the Soil Conservation Service regarding the development of a national handbook for inventorying and monitoring soil and water resources.

C. P. Cox consulted with (1) Wayne Fuller on his response to a *Biometrics* query and response submission describing a linear model related the counts of two types of cells in individual mice; (2) with James Stephenson, a professor in Economics, on the possibility of using probit analysis to estimate a labor supply function; and (3) with M. E. Zirakparvar, a graduate student in Botany and Plant Pathology, on the analysis of a factorial experiment on nematode growth. Despite unforeseen modifications to the original experimental design, plant pathology investigators regarded the experiment as highly successful in demonstrating the importance of soil temperatures and types as factors influencing nematode concentrations.

B. V. Sukhatme

Balkrishna V. Sukhatme, 1924-1979

Balkrishna V. Sukhatme is deeply missed by friends and colleagues in the Statistical Laboratory, the University, and the world of research statistics. A B. V. Sukhatme Memorial Fund has been established with the ISU Achievement Fund.

Bal Sukhatme died April 30, 1979, at the Mayo Clinic, Rochester, Minnesota. He was born November 3, 1924, in Poona, India. After receiving an M.A. in mathematics at the University of Delhi, he obtained a diploma with high distinction in agricultural statistics at the Institute of Agricultural Research Statistics, New Delhi. In 1955 he received a Ph.D. in mathematical statistics from the University of California, Berkeley. From 1955 to 1967, except for a year spent as a visiting associate professor of statistics at Michigan State University in 1959-60, Dr. Sukhatme worked at the Indian Council of Agricultural Research, New Delhi. He was a senior professor of statistics in the Council and joint director of statistics in the Indian Statistical Service at the time of accepting an appointment to ISU's statistics faculty. From 1968 he held the rank of professor.

Professor Sukhatme attained wide recognition for his work in survey sampling theory. With his brother P. V. Sukhatme, he co-authored a well-known text, *Sampling Theory of Surveys with Applications,* published by Iowa State University Press. He was also the author or co-author of some 60 research articles.

Dr. Sukhatme was a Fellow of the American Statistical Association and an elected member of the International Statistical Institute. From 1958-1968 he served as editor of the Journal of the Indian Society of Agricultural Statistics.

During his life at ISU, Professor Sukhatme was a leader in the area of sampling theory. At Iowa State he directed the studies of nine Ph.D. and seven M.S. candidates, and was currently the advisor of three Ph.D. candidates. He was responsible for a number of research grants.

Bal was deeply involved in many activities of the University and the Statistical Laboratory. He enjoyed ISU sports and was a member of the departmental bowling team.

Dr. Sukhatme is survived by his wife, Shashikala, an assistant professor of statistics at ISU, by one daughter, Vidya of Ames, and by two brothers, P. V. and A. V., and a sister, Mrs. Padma Katti, all three living in India. A number of expressions of sympathy were received from various friends and are gratefully acknowledged.

Current Research

Statistical research in theory and methodology is a regular activity of the Statistical Laboratory staff and is financed by various sources. Projects of special interest to regular university research programs are supported by the Statistical Laboratory budget. Cooperating campus research institutes and the agricultural experiment station provide additional funds. Off-campus contracts and grants continue to be a major source of funds for the research of students and faculty.

AES Project 890

Dr. 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.

Effort has continued on the foundations of statistical thinking and reasoning on the role of significance tests as procedures for quantifying evidence given by data. A particular example of frequent practical occurrence is the 2 x 2 table for which the view is reached that the Fisher exact test is appropriate only for some of the situations that arise.

Growth Models

Cooperative research with the Statistical Reporting Service of the U.S. Department of Agriculture is being conducted by Henry Lee and Yasuo Amemiya under the direction of Wayne Fuller, project leader. Nonlinear models for the early season forecast of corn yields were constructed. Also investigated were models combining time series data with current season data.

AES Project 2039

The U.S. Bureau of the Census supported joint research in measurement error models and time series through Project 2039 with the Agriculture Experiment Station. Personnel working on the project include Wayne Fuller, principal investigator, Jeffery Goebel, Fred Dahm, Bisu Bhattacharyay, Kenneth Fox, and Paul McClellan.

Prediction for three types of autoregressive processes was studied: (a) processes with all charac-

teristic roots less than one in absolute value, (b) processes with a root of unit absolute value, and (c) processes with a root greater than one in absolute value. It was demonstrated that the least squares prediction theory holds asymptotically for the three types of processes. The limiting distribution of the least squares estimators of the parameters of certain nonlinear time series models was derived.

Estimators of the parameters of the linear functional multivariate errors in variables model were developed. Examples from agronomy and genetics were investigated.

AES Project 2155

Research in agricultural-related sample survey methodology continues in the Survey Section under Agricultural Experiment Station Project 2155, with Roy D. Hickman as project leader. Cooperative work with the Soil Conservation Service (SCS) of the U.S. Department of Agriculture includes estimation procedures, variance estimation techniques, sampling design, questionnaire and form construction, quality evaluation procedures, and computing methodology in handling large data sets. A major portion of this project is the SCS National Resource Inventories, a three-phase survey containing about 200,000 specific sample sites. Field work and data processing have been completed for Phase I, which focuses on sheet and rill erosion, wind erosion, land use, conservation needs, potential cropland, prime farmland, and other natural resources. Particular efforts during the year included a quality-control check of the collected data, as well as various other edit checks. The quality evaluation process consisted of SCS state officials visiting a subsample of the original sample sites. Toll-free telephone lines were used to transmit portions of the data to the Statistical Laboratory and to aid in the reconciliation of incompatible responses. Preliminary estimates have been tabulated from the Phase I data for each state and are currently being analyzed; some of these figures have been released to the news media by the USDA.

Data are presently being collected for Phase II of this survey, which will focus on erosion from gullies, streambanks, channel bottoms, construction sites, roads, and roadsides. Sediment yields and the amount of eroding materials actually entering the nation's waterways will be investigated during Phase III.

Construction of area sampling frames continues under a Cooperative Agreement with Economics, Statistics and Cooperative Service (ESCS), USDA. Strata are constructed according to degree and type of cultivation as indicated by maps, aerial photographs, and other information furnished by the states. Land within strata is then subdivided into area sampling units. These state area frames are used by ESCS to design and draw samples included in their agricultural surveys. A sampling frame was completed for South Carolina; the Pennsylvania frame is presently under development.

Work continues on the storage, retrieval, and analysis of the interpretive data of Soil Series in the United States. Series records presently stored number over 12,000, and SCS field staff continue to revise and add to the data base. The primary use of this data is to generate tables for inclusion in published soil surveys. Other public and private agencies request subsets of the data file for use in their work. A major revision was made of the program which produces interpretive ratings from the soil properties. Harvey Terpstra continues to work closely with regional and national SCS personnel in the development and use of the data system.

This national resource and erosion study will serve SCS as a guide in the allocation of funds for future conservation programs and will furnish input data needed for programs mandated under the Soil and Water Resources Conservation Act of 1977. Included in future programs are county-level studies. The Statistical Laboratory is currently cooperating with the SCS in developing a sampling methodology to help answer questions concerning erosion and resources for individual counties.

Order Statistics and Nonparametric Statistics

The above-mentioned Army Research Office grant was recently renewed with H. A. David as principal investigator and Malay Ghosh as co-investigator. Dr. David has been concentrating on the preparation of the second edition of his 1970 Wiley text *Order Statistics*. His monograph with M. L. Moeschberger, University of Missouri, *The Theory of Competing Risks* was published by Griffin.

Dr. Ghosh has been working on rates of convergence to normality (uniform and nonuniform) for linear functions of order statistics, U-statistics and linear rank statistics. Jointly with R. Dasgupta, he has published a paper in *Sankhyā A* entitled "On some non-uniform rates of convergence to normality" and submitted another, "Limit laws of U-statistics in the non iid case." Also under investigation is the asymptotic theory for some robust estimators under dependence.

A research assistant, H. N. Nagaraja has had an article, "Some relations between order statistics generated by different methods" accepted by *Communications in Statistics B.* V. S. Shu completed his Ph.D. dissertation on "Robust estimation of a location parameter in the presence of outliers."

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 also have worked on this project and J. Richard Sedcole and Jerry W. Lewis have served as research assistants.

Dr. E. Pollak prepared a review article in which comparisons were made between what is expected if the usual theory of viability selection holds or some other type of selection is taking place. If, for example, there is selection for fecundity with one locus, the mean fecundity may steadily decrease or oscillate rather than increase. This and the fact that a Hardy-Weinberg structure may not exist at any stage of life affects the correlation between relatives and the prediction of progress from artificial selection on reproductive characters.

E. Pollak also continued his research on a theory for finite diploid populations in which several age groups may be present at one time. A new derivation was given for the effective population number in monoecious populations and an expression was also derived for the mean time to extinction of a line of $A_1 A_2$ heterozygotes descended from a single ancestral $A_1 A_2$ individual in age group i.

Dr. W. G. Hill, during his visit to Iowa State University, developed a new derivation for the effective population number of a population with overlapping generations, which is simpler than his previously published one.

Dr. O. Kempthorne continued his study of statistical methodology in quantitative genetic research with populations, such as the human one, in which there may be association of genotypes and environment and there is assortative mating. He also worked on the study of quantitative variation in populations in which there is viability variation along with genotypically caused quantitative variation.

Dr. J. L. Cornette studied the effects of varying environments on the retention of polymorphism in a population. He found that certain sufficient conditions for the maintenance of polymorphism which are widespread in the literature are in fact not valid. A much weaker version of one of these conditions was found to hold.

J. R. Sedcole studied models that describe populations in which genotypes interact competitively in groups. Situations in which exactly one individual of each group survives, as well as those in which the expected number of survivors depends on the genotypes composing the groups, were studied. Related models in quantitative genetics were also considered.

J. W. Lewis continued his research on models involving selection and the interaction of a host and a pathogen. It was found, for example, that the maintenance of polymorphism in diploid selfing hosts and haploid pathogens could only occur under severe epidemic conditions coupled with strong heterozygote superiority in the host.

Linear Statistical Inference

Research is pursued on various topics related to linear models and is supported by Air Force Office of Scientific Research Grant No. 76-3037, entitled "New Techniques for Linear Statistical Inference." Dr. David Harville is the principal investigator

while Raghu Kackar and Bill Sallas have served as research assistants.

Results on Kalman filtering, smoothing and prediction, found in the engineering literature are being related to various results on linear models, found in the statistics literature. Recursive computational formulas are being developed for the maximum likelihood estimation of variance components and other variance-related parameters. Work continues on test and interval procedures for linear combinations of the effects of mixed linear models for the case where the ratios of variance components are unknown and must be estimated from the data.

Optimization Problems

H. T. David, Vince Sposito, Michael Hale, and Brad Skarpness continued work on the development of programming formulations well matched to each of a variety of optimization, duality, and algorithmic problems of interest in statistics and probability. Topics include, respectively, Bayes and generalized —UMVU estimation, large deviations of sample averages for certain classes of stochastic processes, duality formulations for linear-fractional objective function and constraints, and minimax linear-fractional regression algorithms. H. T. David also has been exploring, together with R. Berger and D. Royalty, an asymptotic stochastic view of the split-second hesitation occurring in the optimum strategies for noisy duels. Geung-Ho Kim joined the project during June of 1979.

Sciences and Humanities Research Institute (SHRI)

The following five faculty members received some support from SHRI funds: Barry C. Arnold, Chien-Pai Han, Dean L. Isaacson, Glen D. Meeden, and B. V. Sukhatme.

Drs. Arnold, Isaacson, and Meeden together with Malay Ghosh make up the most theoretical group in the Department. There is a good deal of interaction between these four as well as with certain other faculty members. Drs. Meeden and Ghosh have been examining various inferential problems arising in finite population sampling. Their ideas have provided fresh insights and, among other things, a simplified proof of the admissibility property of the Horvitz-Thompson estimator. This estimator has received a great deal of attention since it was introduced in 1952 by two ISU Ph.D. candidates in statistics.

Dean Isaacson's major research activity was in the area of geometric ergodicity. He also continued his work on Markov chains in collaboration with Barry Arnold and their joint research student, Mark Scott. Barry Arnold, jointly with R. A. Groeneveld, studied two problems in distribution theory. He completed a bibliography on the Pareto distribution, related distributions, and the measurement of inequality. This will be used in the preparation of a monograph to be (tentatively) titled: Pareto distribu-

tions. An initial draft of some introductory sections has been completed.

C. P. Han continued work in the areas of multivariate analysis, inference based on conditional specification, and sample surveys.

Individual Research

Drs. T. A. Bancroft and Chien-Pai Han engaged in research on inference based on conditional specification. A paper entitled "Inference based on conditionally specified ANOVA models incorporating preliminary testing" has been prepared. This will be included as a chapter in Volume 1 of *Handbook of Statistics*, edited by P. R. Krishnaiah.

C. P. Cox researched indices for measuring the strength of the association between two factors in contingency tables. With Chien-Pai Han, Professor Cox investigated multivariate contexts in which it is possible to transform data so that the covariance matrix has a special form. Under C. P. Cox, Wendell Ponder (now at Texas Instruments) has continued investigations into the effects on residuals when incorrectly specified linear models are fitted.

H. A. David prepared a review article on cyclic designs for the *Encyclopedia of Statistical Sciences* and a biographical sketch of E. S. Pearson for the *Biographical Supplement of the Encyclopedia of the Social Sciences.*

Kingman Conference Held at ISU

J. F. C. Kingman, professor of mathematics, University of Oxford, England, delivered a series of ten lectures entitled "Aspects of Mathematical Population Genetics" for the NSF supported Conference Board of the Mathematical Sciences Regional Conference held at ISU, June 4-8, 1979. Professor Kingman, a renowned probabilist and a superb lecturer, focused on probabilistic problems of theoretical population genetics, applying an array of known and newly created mathematical techniques.

Professor Kingman, a Fellow and currently a Council member of the Royal Society of London, has been the chairman of the Mathematical Institute of the University of Oxford since 1976. He received B.A., M.A., and Sc.D. degrees from Cambridge University, and held positions at the University of Cambridge and University of Sussex before joining the Oxford faculty in 1969. He is a Fellow of the Institute of Mathematical Statistics and was that institute's Wald Memorial Lecturer in 1977. Professor Kingman has been a visiting professor at Stanford University, the University of Western Australia, and the Australian National University. He is the author of three books and of many papers on mathematical, statistical, and biological journals.

In addition to funding the lecturer, the NSF provided travel and other expenses for 25 of the 40 participants. Professor Oscar Kempthorne served as the conference director with a committee composed of Edward Pollak, Dean Isaacson, and James Cornette.
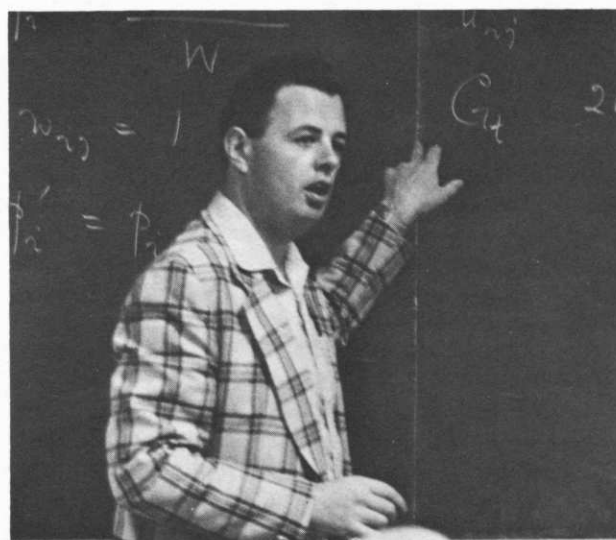
Professor Kingman lecturing during the Conference

Statistical Laboratory Visitors

Among the longer term visitors was Betty Laby, a statistical consultant at Melbourne University, Australia. Staying five weeks, she worked on problem-solving with statistical packages and on revising a book of mathematical tables that she edits for school children in Australia.

Dr. John Unbehaun, from the University of Wisconsin—La Crosse, visited the department for four months to observe the undergraduate program in statistics.

Dr. Vijay K. Sharma, Indian Agricultural Research Institute, New Delhi, spent five months researching two fields of interest: (a) the design and analysis of experiments involving sequences of treatments and (2) the estimation of simultaneous equation models. He visited with the Statistical Laboratory under a special program sponsored by the United Nations Development Program.

Zyskind Memorial Lecture Presented

Professor Herman Chernoff, MIT, presented the Statistical Laboratory's fourth annual George Zyskind Memorial Lecture. He gave a lively discussion on "The use of faces to represent points in N dimensional space."

A former president of the Institute of Mathematical Statistics, Chernoff has made distinguished contributions to different areas of statistics including inference, sequential analysis, and optimal design of experiments. He co-authored "Elementary Decision Theory" in 1959.

Professional Activities

Officers serving in the American Statistical Association from the Statistical Laboratory are: H. A. David, Board of Directors and a member of the Budget Committee; Bill Kennedy, Board of Directors for the period 1979-81 representing the Statistical Computing Section; Wayne Fuller on the Council for the period 1979-80 representing the Section of Survey Research Methods; and Jim Gentle, 1979-80 publications chairman of the Business and Economic Statistics Section in addition to serving as the program chairman-elect for 1979 and the program chairman for 1980 of the Statistical Computing Section. During the year, Jeff Goebel served as secretary of the Iowa Chapter of the ASA.

Bill Kennedy served as chairman of the Statistical Computing Section during 1978 and presided at executive committee and business meetings of the section.

Barry C. Arnold spent June-August, 1978, as a visiting professor at the Institute of Mathematics and Computation in the University of São Paulo, São Carlos, Brazil where he gave lectures in Portuguese and acted as a consultant.

Thomas Bubolz and Bud Meador attended the Fourth Annual SAS Users' Group International Conference in Clearwater, Florida, during January, 1979

David F. Cox participated in the annual meetings for the following: the American Association for the Advancement of Science in Houston, Texas, January 3-8, 1979; the SAS Users' Group International Conference, January 29-31, 1979; and the American Dairy Science Association in Logan, Utah, June 25-27, 1979.

In recognition of long and outstanding service to the University, H. T. David received a Faculty Citation during Alumni Days, June 1-2, 1979.

Wayne A. Fuller spent approximately three weeks in March as a visiting professor at the Departments of Food and Resource Economics and Statistics, University of Florida, Gainesville. He gave a series of lectures on measurement error models and time series. During May he participated in the NBER/NSF Seminar on Time Series held at Madison, Wisconsin.

Jeff Goebel and Roy Hickman were in Reno, Nevada on March 5, 1979, to discuss a Nevada-state natural resource survey with various state and federal officials.

Roy D. Hickman chaired a committee appointed by the Survey Research Methods Section, American Statistical Association, to study various alternative methods of informing the section's membership of activities and issues related to it.

From July 12-August 10, 1978, Oscar Kempthorne was intensively engaged in presenting seminars and holding discussions with Australian statisticians. During January 8-12, 1979, he was a distinguished visiting professor at New Mexico State University. The topics of his talks presented in Australia and at New Mexico State are listed elsewhere in this issue.

During fall quarter, Dr. Kempthorne participated in the ONR/FSU Workshop on the Statistical Design and Analysis of Weather Modification Experiments held at Florida State University, Tallahassee, October 26-27.

In late October, Dr. Kempthorne was named chairperson-elect of the Section on Statistics of the American Association for the Advancement of Science.

During May 10-11, 1979, Dr. Kempthorne participated in the Statistical Consulting Workshop at the Computer Science and Statistics 12th Annual Symposium on the Interface held at Waterloo, Ontario, Canada. Jim Gentle and Bill Kennedy presented a paper at the symposium.

Bill Meeker is a member of the National Research Council's "Panel on Experimental Techniques for the Investigation of the Degradation of Electrical Insulation."

Richard D. Warren participated in a seminar entitled "Linear structural relationships and analysis of covariance structure factor analysis," at Chicago, August 29-September 2, 1978.

Papers Presented, Lectures, and Seminars

At the 1978 annual joint meetings of the American Statistical Association, the Biometric Society, and the Institute of Mathematical Statistics held in San Diego, August 14-17

Andriano, K., James E. GENTLE, and V. A. SPOSITO: "Comparisons of some estimators of the mode."

DAVID, Herbert A.: "Robust estimation in the presence of outliers."

de Carvalho, José Ferreira and Oscar KEMPTHORNE, "Data analysis of multiway tables."

Doctor, P. G. and H. T. DAVID, "Completeness and sufficiency for stop rules on exchangeable 0-1 processes."

HARVILLE, David A.: "Football ratings and predictions via linear models."

Hidiroglu, M. A., Wayne A. FULLER, and Roy D. HICKMAN: "SUPER CARP: cluster analysis and regression program."

Huang, Elizabeth T. and Wayne A. FULLER: "Nonnegative regression estimation for sample survey data."

ISAACSON, Dean: "Strongly ergodic Markov chains and rates of convergence using spectral conditions."

KEMPTHORNE, Oscar: "The teaching of statistics: content vs. form."

KEMPTHORNE, Oscar: "The utility of the Mather-Jinks approach to quantitative genetics."

MEEDEN, Glen and Malay GHOSH: "An alternative proof of the admissibility of the Horvitz-Thompson estimator."

MEEKER, William Q. Jr.: "A conditional sequential test for the equality of two binomial proportions."

POLLAK, Edward: "Effective population numbers and mean times to extinction in finite populations with overlapping generations."

Ryan, T. A. Jr. and William Q. MEEKER, Jr.: "Time series capabilities in MINITAB '78."

Scott, Mark: "Strong ergodicity for continuous time Markov chains."

STRAHAN, Robert F.: "Comparing indices of magnitude of effect."

SUKHATME, B. V. and Lal Chand: "Multivariate ratio-type estimators II."

SUKHATME, S.: "Bahadur efficiencies of Cramér-Smirnov-von Mises tests."

Talwar P. P. and James E. GENTLE: "Detecting a scale shift in a random sequence at an unknown time point."

At the San Diego meetings, B. V. Sukhatme was a discussant at a contributed papers session entitled "Satellite agriculture surveys." James E. Gentle participated in a discussion of the Statistical Computing Session. Bill Kennedy was the chairman at a roundtable luncheon about "Teaching statistical computing." At the same luncheon, J. E. Gentle discussed "Publication of statistical algorithms." Oscar Kempthorne participated in the panel discussion of "The teaching of statistics," organized by members of Mu Sigma Rho with the assistance of Holly Fuchs.

At the Rural Sociological Society Meetings, San Francisco, August, 1978

Faisal, Caroline S. and Richard D. WARREN: "Reexamining a causal model of effectiveness in organizations for measurement error."

Mulford, Charles L., Richard D. WARREN, Gerald E. Klonglan, William D. Lawson, Paula C. Morrow, and Lacey Tillotson: "Organizational effectiveness and impact: a framework for analysis."

WARREN, Richard D., Frank A. Fear, and Gerald E. Klonglan: "Social-indicator model building: a multiple indicator design.

At the Annual Convention of the American Psychological Association, Toronto, Canada, September 1-5, 1978

STRAHAN, Robert F.: "Cautionary remarks on the use of absolute difference scores."

STRAHAN, Robert F. and Thomas W. Barsch: "Remarks on Ciochetti's method of pairwise comparisons following significant interaction."

At New Mexico State University, January 8-12, 1979

KEMPTHORNE, Oscar: "R. A. Fisher on tests of significance."

KEMPTHORNE, Oscar: "Inferences from surveys."

KEMPTHORNE, Oscar: "Foundations of statistical thinking and reasoning."

KEMPTHORNE, Oscar: "The teaching of statistics."

KEMPTHORNE, Oscar: "Population genetics, quantitative genetics, and biometrical genetics."

At other locations

ARNOLD, Barry C.: "On characterization and decomposition of Cauchy random variables," at the 3rd National Symposium on Probability and Statistics, São Paulo, Brazil, July 28, 1978.

ARNOLD, Barry C.: "Some marginally determined constraints on order statistics," at the University of California, Riverside, October 24, 1978.

BUBOLZ, Thomas A. and James E. GENTLE: "The role of package programs in statistical methods courses," at the SAS Users' Group, International Conference in Clearwater, Florida, January 29-31, 1979.

BUBOLZ, Thomas: "SPSS applications," (seminar) at the State Comptroller's Office April 10-11, 1979.

BUBOLZ, Thomas A. and Robert B. Dahlgren, "Characteristics of members in conservation-related organizations," at the annual meeting of the Iowa Academy of Science, April 21, 1979, Cornell College, Mount Vernon.

COX, D. F.: "New and old ideas on data analysis," at the annual conferences of the Northcentral Regional Technical Poultry Breeding Committee (NC-89) and the Northeastern Regional Poultry Breeding Technical Committee (NE-60,) October, 1978.

COX, D. F.: "Recent developments in data analysis," at the Northcentral Regional Dairy Cattle Breeding Project (NC-2), November, 1978.

COX, D. F.: "Design and analysis in nutritional and physiological experimentation," at the American Dairy Science Association Meetings, Logan, Utah, June, 1979.

FULLER, Wayne A.: "Estimation of stochastic difference equations," (seminar) at the Bureau of the Census, Washington, D.C., January, 1979.

GENTLE, James: "Algorithms for estimation in regression models with linear restrictions," (seminar), University of Alberta, Canada, March 8, 1979.

GENTLE, James: "Random numbers: generation, tests, and applications," and "Problems and issues at the Interface of Statistics and Computer Science," presented for the Distinguished Lecturer Series in Statistical Computing, University of Texas, Dallas, April 16-20, 1979.

GENTLE, James E. and William J. KENNEDY: "Least squares estimation with linear restrictions," at the 12th Annual Symposium on the Interface: Computer Science and Statistics, Waterloo, Ontario, Canada, May 10-11, 1979.

GOEBEL, Jeffery: "Progress on the National Erosion Inventory: a view from the Statistical Laboratory," at the Soil Conservation Service Sedimentation Geologist's Meeting, Natchez, Mississippi, November 26-29, 1978.

HAN, Chien-Pai: "Discriminant analysis based on binary and continuous variables," at the University of Maryland, November 20-22, 1978.

Lavender, D. P., R. K. Hermann, and P. N. HINZ: "Controlled environmental facilities for predicting vigor in outplanted Douglas-fir seedlings" at the Proceedings of the Fifth North American Forest Biology Workshop, March, 1978.

ISAACSON, Dean: "Markov chains and their applications," at St. Olaf College, November 16, 1978, and at North Dakota State University, April 26, 1979.

ISAACSON, Dean: "Ergodicity, geometric ergodicity, and strong ergodicity," at North Dakota State University, April 25, 1979.

KEMPTHORNE, Oscar. "Foundations of statistical thinking and reasoning," at the Australian Statistical Conference, Knibbs Lecture, Canberra, July 12, 1978.

KEMPTHORNE, Oscar: "Population genetics, quantitative genetics, and biometrical genetics," at Adelaide University Genetics Department, July 17.

KEMPTHORNE, Oscar: "Mixed linear models," at Flinders University and Adelaide University, July 18.

KEMPTHORNE, Oscar: "Randomization: the scientific world needs it," at the Adelaide Statistical Society, July 19.

KEMPTHORNE, Oscar: "Analysis of variance: linear and non-linear," Monash University, Melbourne, July 21.

KEMPTHORNE, Oscar: "The teaching of statistics," Melbourne University, July 24.

KEMPTHORNE, Oscar: "R. A. Fisher on tests of significance," Melbourne Statistical Society, July 25.

KEMPTHORNE, Oscar: "Algebraic structures in experimental designs," La Trobe University, Melbourne, July 26.

KEMPTHORNE, Oscar: "IQ and heredity: a deep statistical problem," Sydney Statistical Society, Sydney, July 27.

KEMPTHORNE, Oscar: "Varieties of inference," University of New South Wales, July 28.

KEMPTHORNE, Oscar: "The teaching of statistics," University of Sydney, August 10.

MEEKER, William Q., Jr.: "Introduction to accelerated life testing methodology," "Planning accelerated life tests," and "Special topics in accelerated life testing," (seminars) at Bell Telephone Laboratories, Holmdel, New Jersey, July 31-August 4, 1978.

MEEKER, William Q., Jr.: "Accelerated life testing," (seminar) at Bell Telephone Laboratories, Reading, Pennsylvania, August 3, 1978, and Murray Hill, New Jersey, August 7, 1978.

STRAHAN, R. F. and C. J. HANSEN: "Intuitive statistical estimation: the correlation coefficient and its relations," at the Annual Meeting of the Psychometric Society, Hamilton, Ontario, Canada, August, 1978.

SUKHATME, B. V.: "Preliminary testing, designing, and analysis of survey data," at North Carolina State University, December 1, 1978.

WOLINS, Leroy: "Mistakes in statistical analysis of social science data," (seminar) presented to the Department of Educational Measurement, SUI, April 26, 1979.

Publications and Dissertation Abstracts

R. A. Groeneveld is the author of the text *An Introduction to Probability and Statistics Using BASIC*, published by Marcel Dekker.

A short monograph entitled *The Theory of Competing Risks* by H. A. David and M. L. Moeschberger was published by Charles Griffin (London) and Mac-Millan. An earlier Griffin monograph, *The Method of Paired Comparisons* (1963), by H. A. David has just appeared in a Russian edition put out, with additions, by Statistics Publishing House, Moscow.

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

H. A. David served as chairman of the editorial board of *Biometrics* and has been reappointed to that position for 1979-80.

H. T. David is an associate editor of the methods and theory section of the *Journal of the American Statistical Association*.

C. P. Han is a member of the editorial board of *Communications in Statistics*.

With W. J. Kennedy, James Gentle is coeditor of the Algorithms Section in *Communications in Statistics, Part B*. Dr. Gentle is also a member of the editorial board of the IMS Committee on Mathematical Tables.

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

During the year, Oscar Kempthorne served as associate editor of *Biometrics*. He is an associate editor of *Theoretical Population Biology* and is on the editorial advisory board of the *Journal of Statistical Computation and Simulation*. In addition, he serves on the editorial board of the *Journal of Statistical Planning and Inference*.

William J. Kennedy is an associate editor of *The American Statistician* and a co-editor of *Selected Tables in Mathematical Statistics*. Dr. Kennedy is also a member of the editorial board of *Communications in Statistics*.

B. V. Sukhatme served on the editorial board of the *Journal of the Indian Society of Agricultural Statistics*.

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*.

Along with dissertation excerpts, abstracts of papers and books published by staff members and graduate students are included in this section. When research was conducted at Iowa State but the author has since accepted a new position, his current location is listed in parentheses after his name. Some of these publications are included in the Statistical Laboratory's Reprint Series (SLRS), and copies are available upon request. These are indicated by an asterisk (*).

Books

GROENEVELD, Richard A. *An Introduction to Probability and Statistics Using BASIC*. Marcel Dekker (New York). 1979. 464 pages.

This text provides an introduction to probability and statistics for students who have had an introductory course in the calculus of functions of a single variable. A central theme throughout is the introduction of theoretical ideas in probability and statistics by example. The interactive computer language BASIC is used extensively to simulate the repetitions of random experiments, summarize and present data and to take over the burden of routine and tedious calculations. Forty-eight BASIC programs are included in the text. The topics covered include those recommended by the Committee on the Undergraduate Program in Mathematics for the course Mathematics 2P, with, however, a heavier concentration on statistics.

The text is intended to provide students having a modest background in calculus with an opportunity to see a demonstration of the power of this mathematics at an early stage in their undergraduate studies. A coequal aim is to provide an adequate background in statistics to serve as a basis for additional study of statistical methods or theory.

Monographs

DAVID, H. A. and M. L. Moeschberger. *The Theory of Competing Risks*. Charles Griffin (London) and MacMillan. 1978. vii + 103 pages.

The theory of competing risks is concerned with the assessment of a specific risk in the complicating presence of other risks. It is of particular interest to statisticians confronted by reliability or survival analyses, as well as to vital statisticians, demographers, and actuaries. Non-experimental applications to life table data have a long history. The emphasis of this monograph is, however, on experimental situations or observational studies, often of modest size, for which the more traditional actuarial methods are not designed.

An individual's death from one of several competing causes is analogous to the failure of a series system due to the malfunctioning of an *identified* component. This parallel is exploited to unify applications to biometry and reliability. Parametric assumptions on distributions of lifetime are examined in detail when the risks are assumed to be independent. A number of models for dependent risks are also studied and problems of non-identifiability in this case are discussed. Recent developments incorporating concomitant measurements are reviewed.

SPOSITO, Vincent, Wendell Smith, and Gary McCormick. *Minimizing the Sum of Absolute Deviations. Applied Statistics and Econometrics* No. 12. Vandenhoeck and Ruprecht, Göttingen. 1978. 60 pages.

Various aspects of linear regression under the criteria of minimizing the sum of absolute deviations, (L_1), are presented. Linear programming-based computational procedures are described, and several geometrical properties of L_1 estimators are established.

Published Research

*ARNOLD, Barry C. Some elementary variations of the Lyapunov inequality. *SIAM Journal on Applied Mathematics* 35:1 (July, 1978) 117-118. SLRS 442.

A moment inequality derived by Petrov (1975, *Theory of Probability and its Applications* 20, 391-392) is shown to follow from the classical Lyapunov inequality applied to a certain conditional distribution. A general conditional version of the Lyapunov inequality is presented. The performance of the Petrov inequality is compared with that of a related tighter inequality (also obtained by conditioning) in the case of a geometrically distributed random variable.

*ARNOLD, Barry C. and **Richard A. GROENEVELD.** Bounds on deviations of estimates arising in finite population regression models. *Communications in Statistics; Theory and Methods* A7:12 (1978) 1173-1179. SLRS 451.

Bounds for the maximum deviation between parameters of a finite population and their corresponding sample estimates are found in the multiple regression model. The parameters considered are the vector of regression coefficients and the value of the regression function for given values of the independent variable (or variables). Applications are considered to several widely employed sampling methods.

ARNOLD, Barry C. and **Richard A. GROENEVELD.** Bounds on expectations of linear systematic statistics based on dependent samples. *The Annals of Statistics* 7:1 (1979) 220-223.

David summarized distribution-free bounds for $E(X_{k:n})$, the expected value of the kth order statistic, and for the expected value of certain linear combinations of the order statistics, when sampling n i.i.d. observations from a population with expectation μ and variance σ^2. Here the problem of finding distribution-free bounds for the expectations of linear systematic statistics is considered in the case in which the observations X_i, $i = 1,2,\ldots,n$, satisfy only $E(X_i) = \mu$ and $\text{Var}(X_i) = \sigma^2$. The observations may be dependent and have different distributions. Bounds are obtained for the expectations of the kth order statistic, the trimmed mean, the range, and quasiranges, the spacings and Downton's estimator of σ. The sharpness of these bounds is considered. In contrast with the i.i.d. case all the bounds obtained are shown to be sharp.

*ARNOLD, Barry C. and **Dean L. ISAACSON.** On normal characterizations by the distribution of linear forms, assuming finite variance. *Stochastic Processes and Their Applications* 7 (1978) 227-230. SLRS 444.

If X_1 and X_2 are independent and identically distributed (i. i. d.) with finite variance, then $(X_1 + X_2)/\sqrt{2}$ has the same distribution as X_1 if and only if X_1 is normal with mean zero (Pólya, 1923, *Zeitschrift* 18, 96-108). The idea of using linear combinations of i. i. d. random variables to characterize the normal has since been extended to the case where $\Sigma_{i=1}^{\infty} a_i X_i$ has the same distribution as X_i. In particular if at least two of the a_i's are non-zero and X_1 has finite variance, then Laha and Lukacs (1965, *Bull. Inst. Internat. Statist.* 41, 828-840) showed that X_1 is normal. They also (1965, *Pac. J. Math.* 15, 207-214) established the same result without the assumption of finite variance. The purpose of this note is to present a different and easier proof of the characterization under the assumption of finite variance. The idea of the proof follows closely the approach used by Pólya (1923, *Zeitschrift* 18, 96-108). The same technique is also used to give a characterization of the exponential distribution.

*ARNOLD, Barry C. and Lenor Laguna. On generalized Pareto distributions with application to income data. *International Studies in Economics* 10 (1977) 1-48. SLRS 435.

Several families of generalized Pareto distributions are introduced. Distributional properties of these families are investigated. Particular attention is given to order statistics and measures of inequality (especially the Gini index). One subfamily is identified in which the Gini index appears as a natural parameter. This family is shown to be closed under geometric minimization. A related limit theorem and characterization are used to suggest a possible stochastic mechanism to explain generalized Paretian behavior of income distributions. Estimation and hypothesis testing techniques are suggested for the generalized Pareto distribution and an example of one of the inference techniques is presented using Peruvian income data.
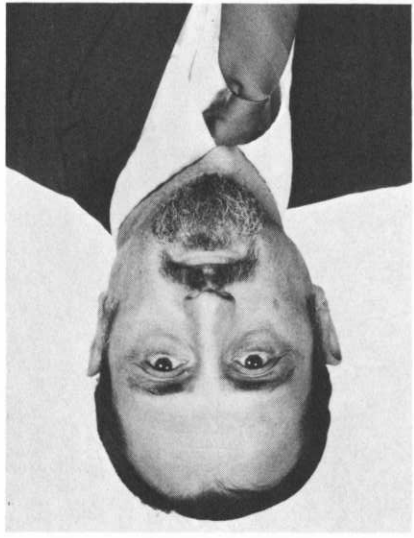
Langer, I., K. J. Frey and **T. B. BAILEY.** Production response and stability characteristics of oat cultivars developed in different eras. *Crop Science* 18 (1978) 938-942.

Leosch, P. J., Jr., W. J. Wiser, and **G. D. BOOTH.** Emergence comarisons between opaque and normal segregates in two maize synthetics. *Crop Science* 18 (1978) 802-805.

Gedge, D. L., W. R. Fehr, and **D. F. COX.** Influence of intergenotypic competition on seed yield of heterogeneous soybean lines. *Crop Science* 18 (1978) 233-236.
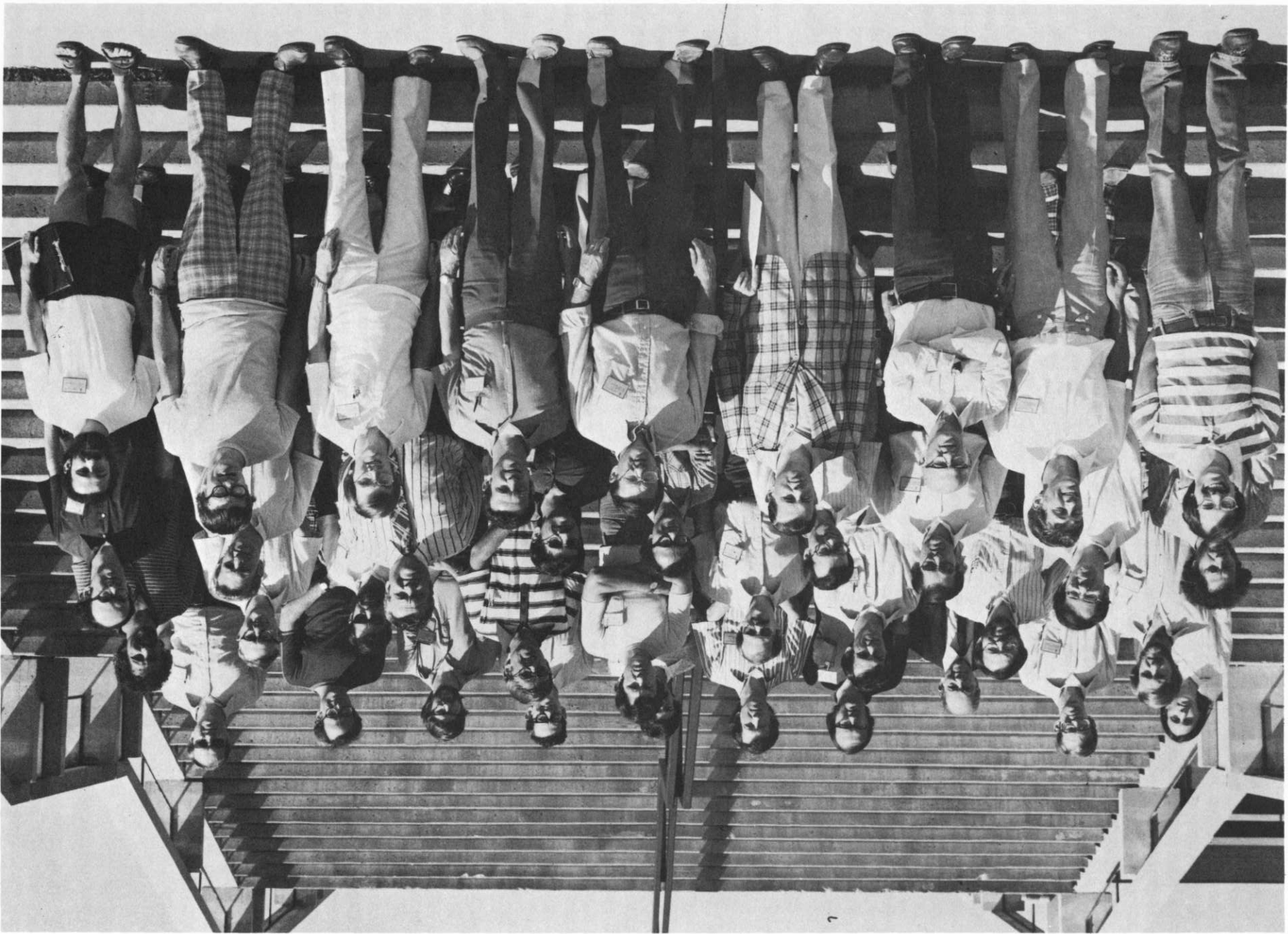
Guthrie, Wilbur D., Wilbert A. Russell, G. L. Reed, Arnel R. Hallauer, and **David F. COX.** Methods of evaluating maize for sheath-collar-feeding resistance to the European corn borer. *Maydica* 23 (1978) 45-53.

Emigh, Ted H. (University of Georgia) and **Edward POLLAK.** Fixation probabilities and effective population numbers in diploid populations with overlapping generations. *Theoretical Population Biology* 15 (1979) 86-107.

A finite diploid population, observed at times $t = 0,1,2,...$, is studied. An individual is said to be in age group i at time t if its age is between i and $i + 1$ units at that time, where $i \geq 1$. It is assumed that the number of individuals in a particular age-sex class is the same for every t and that the probability that a male offspring was produced by a mating of a male in age group i and a female in age group j is p_{ij}^m (with a corresponding probability p_{ij}^f for a female offspring), regardless of when the individual is born. The probability of ultimate fixation of an allele A_1 and the inbreeding effective number, for large populations, is calculated under the further assumptions that A_1 is neutral and that mating is random, given the ages of the mates.

FULLER, Wayne A. Response to query: an affine model for the relation between two sets of frequency counts. *Biometrics* 34:3 (1978) 516-521.

An analysis of the counts of two kinds of cells occurring in the spleens of fetal mice is presented. Nonlinear errors in variables models are formulated and estimates of the parameters obtained.

*FULLER, Wayne A. and J. N. K. Rao. Estimation for a linear regression model with unknown diagonal covariance matrix. *The Annals of Statistics* 6:5 (1978) 1149-1158. SLRS 445.

A method of estimating the parameters of a linear regression model, when the covariance matrix is an unknown diagonal matrix, is investigated. It is assumed that the observations fall into k groups with constant error variance for a group. The estimation is carried out in two steps, the first step being an ordinary least squares regression. The least squares residuals are used to estimate the covariance matrix and the second step is the calculation of the generalized least squares estimator using the estimated covariance matrix. The large sample properties of the estimator are derived for increasing k, assuming the numbers in the groups form a fixed sequence.

*GENTLE, James E. Least absolute values estimation: an introduction. *Communications in Statistics; Simulation and Computation* B6: 4 (1977) 313-328. SLRS 441.

A brief review and bibliography of least absolute values (LAV) estimation is given. This paper serves to introduce the other articles in this special issue on the computational aspects of LAV estimation.

*GENTLE, James E. and Vincent A. SPOSITO. On the invariance of certain estimators. *Bulletin of the Australian Mathematical Society.* 14:3 (1976) 405-408. SLRS 458.

In this note, L_p estimators for the parameters in the linear model $y = X\beta$ are considered. In particular, it is shown that these estimators are invariant under scale transformations on the dependent variable; that is, if $\hat{\beta}$ (y, X) is an L_p estimator for β, then $a\hat{\beta}$ $(y, X) = \hat{\beta}$ (ay, X) for any nonzero scalar a. It is shown that this result does not extend to more general transformations on y, and the invariance property does not hold for general nonlinear models.

Talwar, Prem P. and **James E. GENTLE.** A robust test for the coincidence of regressions. *Journal of Statistical Computation and Simulation* 7:2 (1978) 107-113.

When the disturbances in regression models do not have normal distributions, the usual F-test for coincidence of regressions is not appropriate. A simple robust test for coincidence of regressions is proposed and properties of the test are considered. A simulation study of the power of the test is presented.

Babu, G. J. **Malay GHOSH,** and K. Singh. On rates of convergence to normality for ϕ - mixing processes. **Sankhyā** A 40:3 (1978) 278-293.

For standardized sums of non-stationary ϕ-mixing random variables, uniform and nonuniform Berry-Esseen bounds are obtained. These bounds are applied to prove convergence of absolute moments of such sums to the corresponding moments of the normal (0,1) distribution, and also in proving L_r-versions of the Berry-Esseen theorem. Further application of these bounds consists in proving probabilities of moderate deviations for nonstationary ϕ-mixing processes.

GHOSH, Malay and R. Dasgupta. On some nonuniform rates of convergence to normality. *Sankhyā A* 40:4 (1978) 347-368.

For row sums of independent random variables in a triangular array nonuniform rates of convergence to normality are studied. These results unify and extend earlier available results in this direction. Included as special cases are rates for standardized sums of iid random variables. Next these results are used in proving moment convergences of such sums, in deriving L_p versions of the Berry-Esseen theorem, and also in finding probabilities of moderate deviations. Also, some general results regarding nonuniform rates of convergence to normality for nonlinear statistics are given. Applications are made in the case of L - statistics.

GHOSH, Malay and **Glen MEEDEN.** Admissibility of the MLE of the normal integer mean. *Sankhyā B* 40:1-2 (1978) 1-10.

Consider the problem of using a random sample to estimate the mean of a normal population with known variance when the mean is assumed to be an integer. For this problem the maximum likelihood estimator is the integer nearest to the sample mean. Khan (1973, *Ann. Statist.*, 756-762) shows that this is inadmissible for squared error loss. In this note the admissibility of the maximum likelihood estimator within the class of integer-valued estimators is shown for a general type of loss which includes the squared error loss as a special case. Admissibility is also proved in the class of all estimators with respect to concave loss. Inadmissibility in the class of all estimators, not necessarily integer valued is also proved for convex loss.

GHOSH, Malay and Nitis Mukhopadhyay. Sequential point estimation of the mean when the distribution is unspecified. *Communications in Statistics: Theory and Methods* A8:7 (1979) 637-652.

Two problems have been discussed in this paper. First, for independent and identically distributed random variables with unknown mean and unknown variance, a sequential procedure is proposed for point estimation of the mean when the distribution is unspecified. Second, a sequential procedure is proposed for estimating the difference of the means of two populations when the variances are unknown (and not necessarily equal). The loss structure for both the problems is the cost of observations plus the squared error loss due to estimating the unknown mean or the difference of means. Without any assumption on the nature of the distribution functions other than the finiteness of the eighth moment, the two procedures are shown to be "asymptotically risk efficient" in the sense of Starr (1966, *Ann. Math. Statist.* 37, 1173-1185).

Mohberg, N. R., **M. GHOSH,** and J. E. Grizzle. Linear models analysis of small samples of categorized ordinal response data. *Journal of Statistical Computation and Simulation* 7 (1978) 237-251.

A study of the small sample properties of linear models analyses of contingency tables with ordered response categories is presented. Analytical and empirical study of the linear models approach of Williams and Grizzle (1972, *J. Amer. Statist. Assoc.*, 67, 55-63) suggests that modification would improve its performance in small sample situations. Subsequent simulation studies of the modified procedure show that for small samples it has acceptable performance with respect to Type 1 errors and is robust with respect to response distribution form and inequality among the sample sizes in the contingency table.

*HAN, Chien-Pai. Estimating means when a group of observations is classified by a linear discriminant function. *Journal of the American Statistical Association* 73:363 (1978) 661-665. SLRS 450.

Suppose that a group of observations is known to have come from either one of two normal populations with unknown means and common variance. After the group is classified by the linear discriminant function, it is pooled with the sample from the population to which it belongs to estimate the unknown mean. Weighted estimators of the population means are defined. The biases and mean squared errors of the estimators in the univariate case are obtained. Estimators of the population means using the estimated weighting constant are proposed, and the relative efficiencies of the estimators are studied.

*HAN, Chien-Pai. Nonnegative and preliminary test estimators of variance components. *Journal of the American Statistical Association* 73:364 (1978) 855-858. SLRS 453.

Nonnegative estimators of variance components involving preliminary tests are studied. The restricted maximum likelihood estimator and other truncated estimators may be viewed as preliminary test estimators. A new preliminary test estimator is proposed and studied. Recommendations of the levels of preliminary tests are made.

HARVILLE, David A. Alternative formulations and procedures for the two-way mixed model. *Biometrics* 34 (1978) 441-453.

It is shown that various alternative formulations for the two-way mixed model can be used interchangeably in analyzing data, provided that certain relationships between the formulations with respect to the variance components and the random effects are recognized and that certain differences between the parameter spaces do not come into play. The balanced two-way classification is used to illustrate how Henderson's mixed-model procedures for estimating linear functions of fixed and random effects differ from procedures that treat all effects as fixed. Explicit expressions are obtained, for the balanced two-way model, for variance-component estimators yielded by each of three procedures: maximum likelihood (ML), restricted maximum likelihood (REML), and a pseudo-Bayesian modification of REML. Mean squared error comparisons among these three procedures tend to favor the pseudo-Bayesian procedure.

HARVILLE, David. Football ratings and predictions via linear models. *American Statistical Association: 1978 Proceedings of the Social Statistics Section,* 74-82.

Results on mixed linear models were used to develop a procedure for predicting the outcomes of National Football League games. The predictions are based on the differences in score from past games. The

underlying model for each difference in score takes into account the home-field advantage and the difference in the yearly characteristic performance levels of the two teams. Each team's yearly characteristic performance levels are assumed to follow a first-order autoregressive process. The predictions for 1320 games played between 1971 and 1977 had an average absolute error of 10.68, compared with 10.49 for bookmaker predictions.

HARVILLE, David A. Some useful representations for constrained mixed-model estimation. *Journal of the American Statistical Association* 74:365 (March, 1979) 200-206.

Mixed-model computations can be accomplished efficiently by using the Henderson mixed-model equations. An augmented version of the equations is developed for the case where there are constraints on the fixed effects. Equations comparable to the conjugate normal equations are also developed. These equations are useful for direct computation and, in the case of patterned designs, lend themselves well to algebraic simplification.

Smith, Joan K. and **Roy D. HICKMAN.** The impact of a foundations of education course on attitudes: results of a longitudinal study. *Educational and Psychological Measurement* 38:3 (1978) 761-770.

This study investigated attitude changes of university undergraduate students enrolled in a foundations of education course assigned two different types of reading materials, (1) materials of a controversial and very persuasive nature, and (2) a traditional foundations textbook. Attitudes toward 13 concepts were measured by an evaluative form of the semantic differential. Ss were tested on the first and last days of class and again three and one-half years later. Results indicated that, for 10 concepts, the experimental approach produced attitude changes in the Ss; such changes were maintained over time for nine concepts. Furthermore, for five of the 10 concepts, the experimental approach resulted in greater attitude changes than did the traditional approach.

Norton, D. C., J. Tollefson, **Paul HINZ,** and S. H. Thomas. Corn yield increases relative to nonfumigant chemical control of nematodes. *Journal of Nematology* 10:2 (April, 1978) 160-166.

Corn yields were measured after application of nematicides in 16 experiments, mostly in medium-to-heavily textured soil, at 12 locations in Iowa during 1973-76. The average maximum yield increase in plots treated with nematicides was 21% over yields in untreated plots. Yields were correlated negatively with nematode numbers or nematode biomass in nearly all comparisons.

Perry, D. A., J. E. Lotan, **P. N. HINZ,** and M. A. Hamilton. Variation in lodgepole pine: family response to stress induced by polyethylene glycol 6000. *Forest Science* 24 (1978) 523-526.

Lodgepole pine seedlings from 19 wind-pollinated families representing six populations were grown under varying levels of osmotic stress induced by polyethylene glycol 6000. Measurements of dry weight and vigor responses showed that families varied significantly in stress resistance, but populations did not. Purposeful alteration of the forest genetic system should consider stress resistance, as well as growth characteristics. Individual tree selection for resistance to the type of stress imposed here may be more efficient than the provenance approach.

Kraft, A. A., K. V. Reddy, J. G. Sebranek, R. E. Rust and **D. K. HOTCHKISS.** Effect of composition and method of freezing on microbial flora of ground beef patties. *Journal of Food Science* 44 (1979) 350-354.

This study was designed to evaluate effects of meat composition and freezing by conventional or cryogenic methods on microbial numbers and types in beef patties. Beef patties of different fat content or containing soy protein were frozen by liquid nitrogen, liquid carbon dioxide, or by mechanical freezing and stored at $-18°$ C for 5 months.

ISAACSON, Dean and **Barry ARNOLD.** Strong ergodicity for continuous-time Markov chains. *Journal of Applied Probability* 15 (1978) 699-706.

The concept of strong ergodicity for discrete-time homogeneous Markov chains has been characterized in several ways by Dobrushin (1956, *Theory Prob. Appl.* 1, 65-80; 329-383), Lin (1975, *Ann. Inst. H. Poincaré* 11, 345-354), and Isaacson and Tweedie (1978, *J. Appl. Prob.* 15, 87-95). In this paper the characterization using mean visit times (Huang and Isaacson (1977, *J. London Math. Soc.* 14, 570-576)) is extended to continuous-time Markov chains. From this it follows that for a certain subclass of continuous-time Markov chains, $X(t)$, is strongly ergodic if and only if the associated embedded chain is Cesaro-strongly ergodic.

ISAACSON, Dean and Glenn R. Luecke. Strongly ergodic Markov chains and rates of convergence using spectral conditions. *Stochastic Processes and Their Applications* 7 (1978) 113-121.

For finite Markov chains the eigenvalues of P can be used to characterize the chain and also determine the geometric rate at which P^n converges to Q in case P is ergodic. For infinite Markov chains the spectrum of P plays the analogous role. It follows from Theorem 3.1 that $||P^n - Q|| \leq O\beta^n$ if and only if P is strongly ergodic. The best possible rate for β is the spectral radius of P - Q, which in this case is the same as $\sup\{|\lambda|:\lambda\epsilon\sigma(P), \lambda\neq 1\}$. The question of when this best rate equals $\delta(P)$ is considered for both discrete and continuous time chains. Two characterizations of strong ergodicity are given using spectral properties of P - Q (Theorem 3.5) and spectral properties of a submatrix of P (Theorem 3.16).

ISAACSON, Dean and Richard L. Tweedie. Criteria for strong ergodicity of Markov chains. *Journal of Applied Probability* 15 (1978) 87-95.

For finite Markov chains, the concepts of ergodicity and strong ergodicity are equivalent, but this is not necessarily the case when the state space is infinite. In this note we give some new characterizations of strong ergodicity. These lead to simple necessary or sufficient criteria for strong ergodicity, which readily enable us to classify a number of examples.

*KENNEDY, W. J. and James E. GENTLE. Examining rounding error in least absolute values regression computations. *Communications in Statistics; Simulation and Computation* B6:4 (1977) 415-420. SLRS 440.

Two techniques for detecting inaccuracies in least absolute values (LAV) regression computations are presented and discussed. Examples of the use of the methods are given. The techniques are shown to apply to the more general case of M-estimation.

*Kim, Geung Ho (SUNY, Buffalo, New York) and H. T. DAVID. Bivariate distributions as saddle points of mutual information. *Journal of Applied Probability* 15 (1978) 523-530. SLRS 452.

Fix a bivariate distribution F on X x Y, considered as a pair $(\alpha, \{F_x\})$, where α is a marginal distribution on X and $\{F_x\}$ is a collection of conditional distributions on Y. For essentially every $(\beta, \{G_x\})$ satisfying a certain pair of moment conditions determined by $(\alpha, \{F_x\})$, $J(\beta, \{F_x\}) \leq J(\alpha, \{F_x\}) \leq J(\alpha, \{G_x\})$, where J is mutual information. This relates to two sorts of extremizations of mutual information of relevance to communication theory and statistics.

KOEHLER, Kenneth. A general formula for moments of the Pearson goodness-of-fit statistic for alternatives. *Biometrika* 66:2 (1979) 641-643.

Levikson, Benny. The age distribution of Markov processes. *Journal of Applied Probability* 14 (1977) 492-506.

Iowa Agriculture and Home Economics Experiment Station, Project 1669; partial support by National Institutes of Health Grant GM 13827.

A limiting distribution for the age of a class of Markov processes is found if the present state of the process is known. We use this distribution to find the age of branching processes. Using the fact that the moments of the age of birth and death processes and of diffusion processes satisfy difference equations and differential equations respectively, we find simple formulas for these moments. For the Wright-Fisher genetic model we find the probability that a given allele is the oldest in the population if all the gene frequencies are known. The proofs of the main results are based on methods from renewal theory.

*MEEKER, William Q. TSERIES—A user-oriented computer program for time series analysis. *The American Statistician* 32:3 (August, 1978) 111-112. SLRS 446.

This note describes TSERIES, a computer program for time series analysis. TSERIES performs Box-Jenkins-type analyses on univariate time series data. It provides outputs for identifying, fitting, and forecasting autoregressive integrated moving average (ARIMA) time series models. TSERIES is both versatile and easy to use, program input being accomplished by a series of simple commands. The program has been used extensively in practical applications as well as for giving students "hands-on" experience in courses on applied time series analysis.

Hahn, G. J., P. I. Feder, and W. Q. MEEKER. Evaluating the effect of incorrect specification of regression model, part 2: further example and discussion. *Journal of Quality Technology* 10:3 (July, 1978) 93-98.

The first part of this paper (April, 1978, *Journal of Quality Technology*, 10:2, 61-72) dealt with statistical models, model underspecification and overspecification, and bias and root mean square error. A new computer program, EXPLOR II, which permits evaluation of the consequences of model misspecification, was briefly described. Finally, the concepts were illustrated with an example involving a rubber tear-strength test program. In this part of the paper, the concepts are applied to evaluating the alias structure of fractional factorial test plans. Various effects of model underspecification are described and some concluding remarks are made. The formulae that are used to evaluate bias are given in the appendix.

MEEKER, William Q. Jr. and Gerald J. Hahn. A comparison of accelerated test plans to estimate the survival probability at a design stress. *Technometrics* 20:3 (August, 1978) 245-247.

In a previous paper (1977, *Technometrics* 19, 381-399), the authors presented large sample optimum accelerated test plans to estimate the survival probability at a design stress assuming a linear logistic model, i.e. a linear relationship between stress and the log survival odds at that stress. The optimum plans required testing at two accelerated stresses with a larger allocation of units assigned to the lower of the two stresses. In practice, however, it is often desirable to conduct the accelerated tests at more than two stresses and/or use equal or otherwise prespecified allocation. In this paper we compare the large sample variance of each of ten such non-optimum test plans (and also that of testing exclusively at the design stress) with that of the optimum plan under a variety of conditions.

*POLLAK, Edward. Some models of genetic selection. *Biometrics* 35 (March, 1979) 119-137. SLRS 455.

This paper begins with a description of the classical theory of viability selection in which probabilities that individuals of various genotypes survive are in proportions that do not change with time and are independent of population structure. Salient features of viability selection with one and two loci are reviewed. This theory is intimately connected with the usual theory of mass selection in quantitative genetics.

It is well known that the mean of the relative viabilities does not necessarily increase if there is viability selection at more than one locus. It also turns out that if there is selection for fecundity with one locus, the mean fecundity may steadily decrease or oscillate rather than increase. This and the fact that a Hardy-Weinberg structure may no longer exist at any stage of life may have a bearing on predicting progress from artificial selection on reproductive characters.

Classical viability selection theory does not completely describe natural selection. Other possibilities are discussed. Among these is the density and frequency dependent selection induced when the population lives in a limited habitat. Implications in quantitative genetics are discussed.

*POLLAK, Edward. With selection for fecundity the mean fitness does not necessarily increase. *Genetics* 90 (1978) 383-389. SLRS 454.

A population with two alleles at one locus is considered. It is assumed that there is a random mating of adults and that matings in which a particular pair of genotypes is involved may have a different mean number of offspring, or fecundity, than other types of matings. There is assumed to be no other selection. It is shown that the genotypic frequencies that maximize the mean fecundity of the population are not necessarily the same as the stable equilibrium frequencies. Thus, examples can be found for which the mean fecundity decreases from one generation to the next, and one such example is presented. An example in which there is no stable equilibrium, and the mean fecunity oscillates, is also given.

*ROUX, C. Z. (Animal and Dairy Science Research Institute, Republic of South Africa). Sex differences in linkage between autosomal loci. *Theoretical Population Biology* 13:3 (June, 1978) 295-303. SLRS 447.

In the case of conventional selection theory with multiplicative gene action between loci and no sex differences except in crossover frequencies, it is shown that the usual conditions for stability hold when the mean of the recombination frequencies for the two sexes is used. For additive gene action between loci, it is shown that, after one generation of random mating, the gene frequencies of male and female origin are the same. This equality implies the nondecreasing property of the mean fitness function. Some attention is also given to neutral loci.

*Sedcole, J. R. Selection pressures and plant pathogens: stability of equilibria. *Phytopathology* 68 (1978) 967-970. SLRS 443.

A model in which a host species and a pathogen species interact is considered. Necessary conditions had earlier been given by K. J. Leonard for the frequencies of a host resistance gene and a pathogen virulence gene to be at nontrivial equilibrium values. It is shown in this paper that this equilibrium is locally unstable. A numerical analysis verifies that there is instability, with gene frequencies oscillating more and more violently as time passes.

SPOSITO, Vincent A. Quadratic programming. *Encyclopedia of Computer Science and Technology* 12 (1978) 393-415.

The classical theory of quadratic programming as well as the Kuhn-Tucker optimality conditions of quadratic programming are discussed. Various linear programming-based algorithms are described which utilize the Kuhn-Tucker conditions. Statistical applications are also given.

Alders, C. D. and **V. A. SPOSITO.** Necessary optimality conditions for programming problems. *Mathematische Operationsforschung und Statistik, Serie Optimization* 9:4 (1978) 527-534.

In earlier results by Sposito and David, Kuhn-Tucker type duality associated with a certain saddle-point problem was established over convex cone domains (not necessarily polyhedral) without differentiability. Recent variants have established necessary optimality conditions of the Fritz John and Kuhn-Tucker type for programming problems over convex polyhedral cone domains which require differentiability assumptions. This paper extends the present results in the literature to programming problems over arbitrary convex cone domains (not necessarily polyhedral).

*Alders, D. C. and **V. A. SPOSITO.** A note on "Real and complex Fritz John theorems." *Journal of Mathematical Analysis and Applications* 67:1 (January, 1979) 92-93. SLRS 457.

In a recent paper by Craven and Mond a unified proof is given of the Fritz John necessary theorem for nonlinear programming problems over cone domains. This note will underscore some necessary assump-

tions that are needed to establish this generalization which are not stated, but assumed in the proofs given by Craven and Mond.

STRAHAN, Robert F. Six ways of looking at an elephant. *American Psychologist* 33 (1978) 693.

This note is in response to an evaluation (Smith and Glass, 1977 *American Psychologist,*) of nearly 400 psychotherapeutic and counseling studies. It was found that "the average study showed a .68 standard deviation superiority of the treated group over the control group [and] thus the average client receiving therapy was better off than 75% of the untreated controls." The present work points out that there is in fact more than one way to look at the magnitude of a statistical effect and that other approaches tend to portray a less sanguine picture of therapy's impact.

STRAHAN, Robert F. On the nonintuitive nature of the correlation coefficient: subjective estimation of three-variable relations. *Multivariate Behavioral Research* 14 (1979) 115-123.

The misleading character of the correlation coefficient was investigated in two studies of intuitive statistical behavior: subjective estimation of partial correlation and subjective estimation of the minimum possible correlation between two variables given their equal correlation with a third.

STRAHAN, Robert F. and **Chris J. HANSEN.** Underestimating correlation from scatterplots. *Applied Psychological Measurement* 2:4 (Fall, 1978) 543-550.

Eighty subjects estimated the correlation coefficient, r, for each of 13 computer-printed scatterplots. Making judgments were 46 students in a graduate-level statistics course and 34 faculty and graduate students in a psychology department.

Gilbert, Lucia A., Connie J. Deutsch, and **Robert F. STRAHAN.** Feminine and masculine dimensions of the typical, desirable, and ideal woman and man. *Sex Roles* 4:5 (1978) 767-778.

A sample of 432 college men and women used the items of the Bem Sex Role Inventory (BSRI) to describe either a typical, desirable, or ideal man or woman. Although both sexes endorsed a relatively more androgynous ideal and desirable description in comparison to the typical description, traditional views of a man and a woman appear to be alive and well.

SUKHATME, B. V. and Lal Chand. Multivariate ratio-type estimators II. *1978 Social Statistics Section Proceedings of the American Statistical Association* 294-299.

Let a finite population consist of N distinct identifiable units U_i with values $x_{0i}, x_{1i}, ..., x_{\lambda i}$, i = 1,2,...,N of the characteristics $X_0, X_1, ..., X_\lambda$. Consider the problem of estimating the population mean $\bar{x}_{0N} = \frac{1}{N} \sum_{i=1}^{N} x_{0i}$ of the characteristic X_0 when data on two or more characteristics X_i, i = 1,2,...,λ correlated with X_0 are available or can be obtained easily. In this situation, it is customary to use data on auxiliary characteristics to obtain ratio-type estimators of $\bar{x}_{0N}$ which are more efficient than the sample mean $\bar{x}_{0N_0}$ based on sample size n_0. Several authors have proposed ratio-type estimators utilizing data on several auxiliary characteristics. It is well known that ratio-type estimators are biased. Using Tin's technique Sukhatme and Lal Chand developed almost unbiased multivariate ratio-type estimators.

Hartley and Ross (1954) were the first to propose an unbiased ratio-type estimator using data on one auxiliary characteristic only. Sukhatme (1962) has given a double sampling version of the Hartley-Ross ratio-type estimator which is also unbiased. The object of this paper is to develop multivariate unbiased ratio-type estimators when data on two or more auxiliary characteristics are available and discuss their efficiency. Unlike other well-known estimators, these estimators assume, at the most, knowledge of the population mean of the auxiliary characteristic least correlated with the main variate X_0.

David I. P. and **B. V. SUKHATME.** Unbiased ratio-type estimation in simple random sampling from stratified populations. *Journal of the Indian Society of Agricultural Statistics* 30:2 (1978) 33-48.

We present here, together with its variance for large or infinite populations, a direct analog of the Hartley-Ross estimator, namely a combined unbiased ratio-type estimator in simple random sampling from a stratified population.

Mulford, Charles L., Gerald E. Klonglan, **Richard D. WARREN,** and David A. Hay. Examination of nonresponsive bias from mailed questionnaires. *Political Methodology* 5:1 (1978) 87-108.

Nonresponse biases of mailed questionnaires were examined for a population of subjects who participated in a training school. The various waves of the returned questionnaires were analyzed in terms of distributions and relationships among variables for both demographic and model variables.

Dissertation Abstracts

Andriano, Kim Niles. Aspects of univariate mode estimation. Ph.D. thesis, Iowa State University Library, August, 1978.

The (unique) mode, M, of a bounded density function f(x) can be defined as that value of x which maximizes f(x). That is, M satisfies $f(M) \geq f(x)$ with equality if and only if x = M. The basic problem considered in this study is the estimation of M given a random sample $x_1, ..., x_n$ from a distribution whose density f(x) is bounded and satisfies certain regularity conditions.

Mode estimators can generally be classified into two groups—indirect and direct estimators. For indirect methods one estimates f(x) by $f_n(x)$ and then chooses as the estimate of M that value of x that maximizes $f_n(x)$. For direct methods one simply estimates M directly from the random sample $x_1,\ldots,x_n$. The direct estimator of Grenander (1965) is studied in detail. The asymptotic bias of the estimator is considered and a modification of the estimator is proposed that should be useful in skewed distributions. A simulation study exploring the sampling properties of the modified estimator is also presented along with a study whose main goal is to see how well the normal distribution approximates the true distribution of Grenander's estimator for vairous sample sizes and underlying parent distributions.

Other techniques (both direct and indirect) in mode estimation that have occurred since 1962 are also presented (prior to 1962 the limited work done on mode estimation was mostly low level and fragmentary). In addition, useful extensions and modifications of these techniques are presented as an original contribution to the field.

A large Monte Carlo study exploring the relationships and sampling properties of the various estimators (and modifications) described in the study is presented. The study is concluded with the development of a two-stage estimator. A proof showing the strong consistency of the two-stage estimator is also given.

Biyani, Shriram Harikishan. On some estimation problems in finite population sampling. Ph.D. thesis, Iowa State University Library, November, 1978.

A major part of this dissertation deals with the estimation of the variance of the Horvitz-Thompson estimator of the population total. Examples are given in Chapter II to show that for certain designs, the Yates-Grundy estimator can be inadmissible in the class of nonnegative unbiased quadratic estimators. It is also shown with an example that even when it is the unique non-negative unbiased estimator, it can be rationally unacceptable, because it can take values known to be impossible after the sample is drawn.

Chapter III gives a method based on a general symmetric model for obtaining optimal estimators (predictors) for a wide class of functions. This includes the population moments, other U-statistics and also certain asymmetric functions, including in particular, the variance of the Horvitz-Thompson estimator. Numerical comparisons of several estimators of this variance are made in the last chapter.

Crouse, Kenneth Ray. Proportion estimation and classification of mixed pixels in multispectral data. Ph.D. thesis, Iowa State University Library, August, 1978.

A pixel is one part of a picture picked up from satellite data. Data from the LANDSAT satellite is being extensively utilized in a wide range of applications in agriculture, geology, hydrology, environmental monitoring, and other fields. The multispectral scanner aboard the satellite records the electromagnetic radiation at several wavelengths emanating from the objects within its field of view. Different materials reflect radiation differently at various wavelengths, enabling one to distinguish objects on the basis of their spectral responses recorded at several wavelengths.

Whenever the objects being viewed by a multispectral scanner are not large relative to the size of a resolution element, a significant portion of the data recorded will consist of a mixture of the responses of two or more objects. To accurately determine the percent of a region covered by each type of object, it becomes necessary to estimate the proportions of objects within a resolution element. Two types of proportion estimators are examined and compared: an estimator based on maximum likelihood and a shortcut method. Both are tested under point-by-point estimation and estimation with data averaging.

The assumption that the class covariance matrices are equal and the assumption that the classes follow normal distributions are also examined. Covariance matrices extracted from LANDSAT data are subjected to a likelihood-ratio test for equality, and the effect of assuming equal covariance matrices when the actual covariances are unequal to various degrees is assessed. A classification procedure based on the L_1 norm is presented as an alternative to the usual least squares procedure when normality does not hold. Tests are run to compare the accuracy of the two classification procedures using both normal and nonnormal data.

Hand, Michael Lawrence. Aspects of linear regression estimation under the criterion of minimizing the maximum absolute residual. Ph.D. thesis, Iowa State University Library, August, 1978.

Consider the linear model $y = X\beta + e$ - where y is an n-vector of observations on a dependent variable, X is an nxp fixed design matrix representing n observations on each of p explanatory variables, β is a fixed but unknown p-vector of parameters, and e is an n-vector of disturbances. Classically, β is estimated by the least squares criterion. We shall consider, instead, estimators $\tilde{\beta}$ which minimize the maximum absolute residual. This criterion is typically referred to as the Chebyshev or L_∞ criterion.

It is shown that the Chebyshev estimator can be formulated and solved as a linear program and how this formulation relates to the classical exchange algorithm of approximation theory. Several properties of the Chebyshev solution which derive as a natural consequence of linear programming are also given.

Considerable attention is devoted to the development of efficient algorithms for Chebyshev estimation. The linear programming algorithm of Barrodale

and Phillips (1974 and 1975) is examined and two major modifications are proposed; one involving the incorporation of an initial approximation to the Chebyshev estimator as a starting value and the other involving the application of concepts from nonlinear optimization theory.

The problem of the distribution of the estimated parameter vector, $\tilde{\beta}$, is examined. It is shown that this distribution is not asymptotically normal and some useful characterizations are derived which may, in the course of future research, lead to the limiting distribution of the Chebyshev estimator.

Also a study of the efficiency of Chebyshev estimation relative to least squares under a variety of distributional assumptions about the error vector, $\underline{e}$ is given.

Kim, Geung-Ho. Constructive optimization for infinite-dimensional problems in probability and statistics. Ph.D. thesis, Iowa State University Library, August, 1978.

This thesis concerns a certain pragmatic programming approach and its application to infinite-dimensional constrained optimization problems arising in probability and statistics. The approach exploits the notion of weak duality of mathematical programming, and, in the treatment of nonlinear problems, has recourse to the notion of subgradient from convex analysis. The latter notion not only simplifies formulating a "hyperplane" problem D formally dual to the given problem P, but also facilitates establishing weak duality of the pair (P,D). Once weak duality has been established for (P,D), the required optimization proceeds pragmatically by verifying, with a suitably constructed candidate pair of solutions for (P,D), the equality of the two object functions of P and D. The ideas are applied to problems in large deviations, information transmission, reliability, and thermodynamics.

Lewis, Jerry Wayne. Maintenance of genetic polymorphism for two species in a host-pathogen relationship. M.S. thesis, Iowa State University Library, November, 1978.

Standard agronomic practice has been to plant pure stands of a variety which is resistant to prevalent pathogen strains. This homogeneous host population provides very strong selection in favor of pathogen strains which are virulent on it. The result has usually been a spiral of increasing host resistance and pathogen virulence. This situation contrasts sharply with that of occurring ecosystems where the host and pathogen populations appear to be in equilibrium.

A possible solution to this problem is to plant host populations which are heterogeneous with respect to their resistance. While such stands would receive some damage from prevalent pathogen strains it is hoped that the pathogen population would stabilize and that the average yield of the heterogeneous host population would be higher than that of a series of pure stands with their "boom and bust" cycles.

A deterministic model is postulated for the interaction of a host and obligate pathogen population based on the genotypes of interacting individuals. This model is analyzed to determine when stable polymorphic equilibria exist.

Conditions are given for the existence of a stable polymorphism when a random mating diploid host population interacts with a haploid pathogen population. However, no stable polymorphisms exist if both populations are haploid. This indicates that any model which demonstrates a stable polymorphism for a selfing host population and a haploid pathogen population must consider heterozygosity of the hosts and possibly the sexuality of the pathogen.

It is shown that a haploid pathogen population annot maintain heterogeneity if it interacts only with a static host population, regardless of the structure of the host population. This suggests that the resistance of a single multiline variety of wheat or oats will not be permanent if universally used.

Motoyama, Tetsuro. Comparison of three methods for prediction: the least square method, ridge regression, and equal weighting. Ph.D. thesis, Iowa State University Library, August, 1978.

Monte Carlo procedures were used to compare ridge regression to least square regression using various diagonal values in four covariance matrices and two criteria for evaluating the results, the multiple correlation, and the sum of the squared residuals. The solution to ridge regression is given to be $(X'X+kI)^{-1}X'y$. When k is set at p/n, where p is the number of parameters estimated and n is the number of observations, ridge regression is slightly better than least square when p is large, 8, and n is small, 25. Otherwise the two methods are either equal or the least square is better.

The two criteria gave somewhat different results. The truncation of the x variables may result in extreme bias in the estimation of the y values from the regression even when the estimated y's are correctly ordered.

Sedcole, John Richard. Genetic theory of intraspecific competition. Ph.D. thesis, Iowa State University Library, February, 1979.

Four basic models of intra-specific competition were developed and studied analytically and numerically to determine the influence of various competition parameters on the rate of change and stability of gene frequency.

The first model assumes that from a fixed number of individuals competing in a group, exactly one member would survive. In this model the rate of change in gene frequency increased with the number in a group, but the equilibrium frequency, if it existed, remained unaffected.

The second model relaxed the requirement of there being exactly one survivor from a competing group. The rate of change in gene frequency as well as the equilibrium frequency were both affected by changes in the number in a group.

The third model considered the case of individuals arranged in a linear fashion, such as crop plants in a row. It was shown that various selection procedures based on the performance of individuals within groups consisting of genetically related individuals were effective in selecting genotypes able to perform well in competition with similarly selected genotypes.

The fourth model considered the case of competition occurring in square planting. Although no analytical results could be developed, numerical studies showed empirically the effect of the competition parameters on the rate of change of gene frequency, as well as the existence of stable equilibria.

Shu, Ven-Shion. Robust estimation of a location parameter in the presence of outliers. Ph.D. thesis, Iowa State University Library, November, 1978.

The primary aim of this dissertation is an investigation of bias and mean square error for various location estimators when outliers are present. These outliers are assumed to have a distribution differing from that of the main sample by either a location shift or a scale change, the emphasis here being on the former asymmetric contamination model. Numerical results are limited to the Gaussian case with one or two outliers. In the one-outlier situation exact values are obtained for location estimators expressible as linear functions of order statistics. Monte Carlo methods are needed in all other cases.

The relationship between the above outlier model and the well-known mixture model is explored both in small samples and asymptotically. Theoretical and numerical results indicate that variances and covariances of order statistics obtained under the two models can be very different in the case of asymmetric contamination.

Some general results on the properties of linear functions of order statistics in the presence of one outlier are derived. Most of these results may be extended to the case of multiple outliers. For symmetric underlying distributions, the absolute bias and the mean square error of linear functions of order statistics with symmetric weights are shown to be increasing functions of the absolute value of the location or scale change parameter of the outlier. This property is not shared by redescending M-estimators.

In the Monte Carlo studies variance reduction techniques are utilized throughout. A specific technique is developed for the case of shift in location. Based on tabulated numerical results as well as graphical comparisons, some remarks and recommendations are made on the relative merits of the various estimators studied.

Book Review

WOLINS, Leroy. Girls and science: an international study of sex differences in school science achievement, by Alison Kelly. Reviewed in *Science* 204:4390 (20 April 1979) 295-296.

Department of Statistics

In the words of W. G. Cochran, professor emeritus of statistics, Harvard University, "[ISU]...has always been one of the main sources, perhaps *the* main source, of highly trained statisticians in the country."

In ten of the last eleven years, ISU's Department of Statistics has ranked among the nation's top ten departments in the number of Ph.D. degrees awarded. During 1968-69, 1969-71, and 1976-77, ISU's statistics department ranked highest (second highest during 1967-68, 1970-71, 1974-75, and third highest during 1972-73, 1973-74, 1977-78) in the number of Ph.D. degrees granted. With the exception of 1969-71, these figures were taken from issues of *The American Statistician*. The December 1971 issue of *Notices of the American Mathematical Society* is the source ranking ISU's statistics department highest among 92 departments in the U.S. and Canada granting Ph.D.'s in probability and statistics for the three-year period 1969-71.

Course work 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 can lead 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.

Iowa State University will be changing to the semester system in the fall of 1981 as a result of a vote by the general faculty. The quarter system has been in use since 1912—a year before George Snedecor joined the ISU faculty! To smooth the transition in the Department of Statistics, four committees were formed. In each committee faculty and students were represented. Committee A was responsible for revising 100-399 level courses; B for 400-level courses; C for 500-level courses; and D for the 600-level courses. A first draft of proposed courses was prepared and forms part of a bound collection covering the entire university.

The current undergraduate enrollment is 42 of whom 8 are joint majors with other departments. This compares with 32 at the same time last year.

Malay Ghosh taught Statistics 590A during the

winter quarter. Reliability models and the first six chapters of the Barlow-Proschan text *Statistical Theory of Reliability and Life Testing* were covered. The course was built around structural properties and the reliability of coherent systems. In this context, various univariate and multivariate life distributions were introduced.

1978-79 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 Castonguay Christenson Fahrenholtz Hotchkiss Kivior Mee Midha Sallas
104	Introduction to Statistics	5	W,S,SSI	Auer Blough Christenson C. P. Cox Kivior Hotchkiss Rangachari S. Sukhatme
105	Introduction to Statistics	3	F,S	Arnold Christenson Guerrero Huntsberger Sallas S. Sukhatme
127	Elementary Business Statistics	5	F,W,S	Auer Isaacson Kackar Kivior Mee Meeker
305	Engineering Statistics	3	S	Van Nostrand
327	Elementary Business Statistics	4	F,W,S	Der Groeneveld Meeker Scott
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	Huntsberger Meeden Pollak
342	Introduction to Theory of Probability and Statistics	3	W,S	Groeneveld Pollak
343	Introduction to Theory of Probability and Statistics	3	S	Huntsberger
380	Statistical Applications of Digital Computers	3	F,S	Bubolz Gentle

Courses for Graduate Minors and Undergraduates

401	Statistical Methods for Research Workers	4	SSII,F, W,SSI	Bailey C. P. Cox D. Cox Groeneveld Hansen Hickman Hinz Hotchkiss Koehler Warren Wolins
402	Statistical Methods for Research Workers	4	SSII, W,S	Bailey C. P. Cox D. Cox Groeneveld Han Hansen Hickman Hotchkiss Koehler Strahan Warren
403	Nonparametric Statistical Methods	3	F	Groeneveld
407	Methods of Multivariate Analysis	3	F	Hinz
411	Experimental Design for Research Workers	3	S,SSI	D. Cox Gentle Hinz Strahan
421	Survey Designs for Research Workers	4	SSII,S	Baker B. Sukhatme
422	Survey Sampling for Social Scientists	4	W	Baker
431	Elementary Statistical Quality Control	4	S	Van Nostrand
432	Applied Probability Models	3	W	Van Nostrand
436	Genetic Statistics for Research Workers	3	F	Bailey
446	Statistical Theory for Research Workers	3	F	Huntsberger
447	Statistical Theory for Research Workers	3	W,SSI	Han Scott
448	Statistical Theory for Research Workers	3	SSII,S	Han Huntsberger
451X	Applied Time Series	3	S	Meeker
481	Computer Processing of Statistical Data	3	W	Gentle
490H	Special Topics (Honors)	Arr	F,W,S	Strahan

Courses Primarily for Graduate Students, Major or Minor

500	Statistical Methods	4	W	Hinz
501	Intermediate Statistical Methods	3	S	Koehler
504	Linear Composites	3	S	Wolins
508	Sociometric Statistics	3	F	Warren
511	Design of Experiments	3	S	Harville

512	Design of Experiments	3	F	Harville
521	Design of Surveys	3	W	B. Sukhatme /Han
522	Design of Surveys	3	S	Han
531	Industrial Statistics: Process Control	3	F	Van Nostrand
538	Econometric Statistics	3	F	Fuller
539	Operations Research	3	W	H. T. David
540	Operations Research Methods and Economic Analysis	3	SSI	Sposito
541	Theory of Probability and Statistics	3	F	Ghosh
542	Theory of Probability and Statistics	3	W	H. A. David
543	Theory of Probability and Statistics	3	S	Meeden
545	Stochastic Processes	3	SSII	Isaacson
547	Asymptotic Methods in Statistics	3	F	S. Sukhatme
549	Mathematical Programming	3	S	Sposito
579X	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	Arnold Booth

590 Special Topics instructors: Kennedy, Koehler, Meeden, Meeker, Pollak, Sposito, B. Sukhatme, Van Nostrand, Warren, Wolins, D. Cox, Fuller, Gentle, Goebel, Groeneveld, Han, Hickman, Hinz, Hotchkiss, Isaacson, Kempthorne

601	Advanced Statistical Methods	3	F	C. P. Cox
611	Advanced Design of Experiments	3	W	Harville
612	Advanced Design of Experiments	3	S	Kempthorne
641	General Theory of Linear Hypothesis	3	F	Kempthorne
642	Probability and Distribution Theory	3	W	Arnold
643	Theory of Estimation and Testing of Hypotheses	3	S	Ghosh
647	Multivariate Analysis	3	F	Han
648	Topics in Inference	3	SSI	Meeden
648	Topics in Multivariate Analysis	3	SSI	Han
651	Time Series	3	W	Fuller
652	Time Series	3	S	Fuller

699	Research	Arr	Arnold
		Hinz	D. Cox
		Isaacson	H. A. David
		Kempthorne	H. T. David
		Pollak	Fuller
		Strahan	Gentle
		B. Sukhatme	Ghosh
			Han
			Harville

Graduate Students

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

M.S. Recipients

Samir Abdel-Megeed (Winter, 1979, under Malay Ghosh) has transferred to the ISU Department of Economics to work on a Ph.D.

Luis Anselmi (Summer, 1978, under Edward Pollak) is a statistician working for the Ministerio del Ambiente y Recursos Naturales Renovables in Caracas, Venezuela.

Rattana Caravavattana (Winter, 1979, under Chien-Pai Han) works for the Thai government as a statistician in the Family Planning Research Unit of the Cherlalongkorn Hospital in Bangkok, Thailand.

Joy Castonguay (Winter, 1979, under William Q. Meeker) is a research assistant at the Aerodyne Research Corporation, Bedford, Massachusetts.

Juin Charn Chen (Winter, 1979, under William Q. Meeker) is teaching statistical theory at Chung Cheng Institute of Technology in Taiwan.

Simeon Sandaramu Chiyenda (Spring, 1979, under Kenneth Koehler) returned to Malawi, Africa, to teach undergraduate courses in statistics at Bunda College in the University of Malawi.

Antonio Guilherme da Silva (Spring, 1979, under Chien-Pai Han) is returning to Brazil but plans to return to the Department to work on a Ph.D.

Majid Dehghan-Nayeri (Spring, 1979, under H. T. David) remains in the Department to work on a Ph.D.

William Der (Spring, 1979, under Chien-Pai Han) who also has a Ph.D. in economics has accepted a research assistant professorship with the University of Southern California. He works extensively with SAS applications.

Emile Tchen-Chau Hong (Summer, 1978, under James E. Gentle) is a statistician in the Economic and Marketing Research Division of Farmland Industries, Inc., Kansas City, Missouri. His job duties include economic and marketing forecasting based on computer usage. He also does statistical consulting.

Michael Jin-Rong Huang (Spring, 1979, under William Q. Meeker) works for the Chung Ho Textile Trading Company in Taipei, Taiwan.

Leigh Allen Ihnen (Spring, 1979, under James E. Gentle) is working towards a Ph.D. in the Department. His field of interest is statistical computing.

Yih Ming Jan (Fall, 1978, under Don Hotchkiss) is a statistical analyst for the Department of Social Services, Bismarck, North Dakota. He designs, develops, and applies research methods and techniques in the analysis and presentation of statistical data.

Stephen Paul Kaluzny (Spring, 1979, under Gordon D. Booth) is studying towards a Ph.D. in biomathematics at the University of Washington.

Susan Kivior (Spring, 1979, under William Q. Meeker) is a professional intern with the Weyerhaeuser Company in Tacoma, Washington.

Jerry Wayne Lewis (Fall, 1978, under Edward Pollak) continues his studies working toward a Ph.D. in statistics with this Department.

Sue Lo-Utai (Summer, 1978, under Chien-Pai Han) is employed as a level 4 junior statistician in the Statistical Techniques Division of the National Statistical Office, Bangkok, Thailand. His duties entail data analysis and quality control of survey data.

Abdel Moh Megahed (Winter, 1979, under Kenneth Koehler) is pursuing a Ph.D. in economics at ISU.

Julio Peixoto (Winter, 1979, under J. Jeffery Goebel), currently in Uruguay, plans to return to ISU to pursue a Ph.D. in statistics.

Apichart Pongsrihadulchai (Winter, 1979, under J. Jeffery Goebel) continues to study at ISU as a Ph.D. candidate with a joint major in economics and statistics.

Remi Mrume Sakia (Spring, 1979, under Kenneth Koehler) has joined the staff of the University of DSM, Morogoro, Tanzania.

Arn-Shi Shen (Summer, 1978, under Barry C. Arnold) accepted a position in the Department of Statistics at Fu-Jen Catholic University, Taipei, Taiwan.

Jose Sivira (Winter, 1979, under J. Jeffery Goebel) is an instructor, researcher, and consultant at the University of Los Andes, Venezuela.

Shien-Hui Tan (Winter, 1979, under Glen Meeden) accepted a statistical position with the Animal Industry Research Institute in Chunau, Taiwan.

Amy Rei-Mei Wu (Spring, 1979, under James E. Gentle) is seeking employment in Santa Monica, California.

Adel M. Zaher (Spring, 1979, under S. Sukhatme) is pursuing a Ph.D. in the Department. Nonparametric statistics is his area of specialization.

Ph.D. Recipients

Kim Andriano (Summer, 1978, under James E. Gentle) held a one year appointment as a visiting assistant professor with the Department of Statistics at the University of Wisconsin, Madison. The appointment will be regular in 1979-80.

Shriram H. Biyani (Fall, 1978, under B. V. Sukhatme) is teaching undergraduate courses in the Department of Applied Statistics at the University of Minnesota. He also does statistical consulting.

Kenneth Ray Crouse (Summer, 1978, under V. A. Sposito and R. J. Lambert) is a geological analyst of satellite data for the EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota.

Michael Hand (Summer, 1978, under V. A. Sposito) is an assistant professor of statistics at the University of Denver, Colorado. He teaches courses in introductory statistics and statistical computation. In addition, he does research on Chebyshev estimation.

Geung Ho Kim (Summer, 1978, under H. T. David and Keith McRoberts) is an assistant professor of statistics at SUNY in Amherst, New York.

Tetsuro Motoyama (Summer, 1978, under Leroy Wolins and W. J. Kennedy) is an associate research scientist with the American Institutes for Research. He provides statistical and computer support for ongoing projects.

J. Richard Sedcole (Winter, 1979, under Edward Pollak and Kenneth Frey) returned to New Zealand to work with plant breeding in the Grasslands Division, Department of Scientific and Industrial Research, North Palmerston.

Ven-Shion Shu (Fall, 1978, under H. A. David) is a biostatistician for the Upjohn Company, Kalamazoo, Michigan. His work entails the design and analysis of preclinical and clinical trials for new drugs.

During March, H. N. Nagaraja, Julio Peixoto, and Dale Zimmerman were initiated into Phi Kappa Phi. The honorary recognizes superior scholarship in all fields of study and takes into membership the upper ten percent of graduating students from all branches of learning.

P. Fred Dahm and J. Richard Sedcole were initiated as full members and Jerry W. Lewis as an associate member of the ISU chapter of Sigma Xi. Initiates were chosen on the basis of research achievement and aptitude.

M.S. Candidates

Abdel-Megeed, Samir	Mee, Robert
Amemiya, Yasuo	Megahed, Abdel
Anselmi, Luis	Mei, Maria
Bergstralh, Erik John	Niknian, Minoo
Briceno, Rodrigo	Noma, Akihiro
Caravavattana, Rattana	Nguyen, Cung Nang
Castonguay, Joy	Park, Heung Sik
Chen, Jiunn-Charn	Peixoto, Julio
Chiyenda, Simeon	Pongsrihadulchai, Apichart
Christenson, Peter D.	Protz, Steven
Crump, Peter M.	Razmpour, Ahmad
Cruz, Vivaldo F.	Ridpath, Harold
DaSilva, Antonio	Rossi, Rick
Dehghan-Nayeri, Majid	Saad-Eldin, Mohamed
Der, William	Sakia, Remi
Duke, Steven	Seyedsadr, Seyed Mahmoud
Enger, Cheryl	Shen, Arn-Shi
Eskridge, Kent	Sivira, Jose
Fahrenholtz, Steven K.	Slamet
Fakiya, James O.	Skarpness, Bradley
Guerrero, Margarita	Tan, Hsien-Hui
Hong, Emile	Tegene, Abebayehu
Hsu, Sheue Wen	Tsui, Susan
Huang, Michael	Vest, Linda
Ihnen, Leigh	Wang, Bei-Li
Jan, Yih Ming	Wang, John Lih
Kaluzny, Stephen	Werner, Neil
Kim, Byung Hwee	Werner, Richard
Kivior, Susan	Wilson, Jeffrey R.
Kuo, Tsuey Lin	Wu, Amy Tei-Mei
Liberty, T. Edward	Yen, Shu-Mien
Lin, Char Lung	Yeo, Woon Bang
Lin, Josephine	Yih, Wei
Lo-Utai, Sue	Yu, Fu-hau
Mazlom, Reda	Zaher, Adel

Ph.D. Candidates

Andriano, Kim
Auer, Richard
Aziz, Mohammad (joint sociology-statistics)

Bhattacharyay, Biswanath
Biyani, Shriram
Blough, David K.
Chandhok, Promod
Chua, Tin Chiu
Crouse, Ken (joint computer
  science-statistics)
Dahm. P. Fred
Drew, James
Ebrahimi, Nader
Fox, Kenneth
Hale, Michael
Hand, Michael
Ho, Chung-Man
  (joint industrial engineering-
  statistics)
Kackar, Raghunath
Kim, Geung Ho
  (joint industrial engineering-
  statistics)
Lamyordmakpol, Anuchit
Lee, Edward Henry
Lewis, Jerry
Lin, Cherng-Tarng
Londhe, Anil
McClellan, Paul
Midha, Chang
Mo, Wing-Hung
  (joint industrial engineering- statistics)

Motoyama, Tetsuro
  (joint psychology-statistics)
Mowers, Ron
  (joint agronomy-statistics)
Mowrey, Daniel
Nagaraja, H. N.
Noorbaloochi, Siamak
Parisian, Ahmad
Ponder, Wendell
Ramos, Juan
Rangachari, Lakshmi
Richard, Winston
Sallas, William
Sastrosowignjo, Soetarto
Scott, Mark
Sedcole, Richard
  (joint agronomy-statistics)
Shenk, Debra
Shu, Ven-Shion
Simon, Barry

Non-degree Students

Beck, Marvin
Laidig, Friedrich
Steiner, Michael
Tobey, Malcolm

Bancroft Award

Donald A. Johnson was chosen as the recipient of the 1979 T. A. Bancroft Statistics Award. The award was presented at a departmental seminar January 3 and consisted of a cash prize and a subscription to a statistically oriented journal of the awardee's choice.

Given each year to the most outstanding doctoral candidate minoring in statistics or doing a joint degree, the award honors T. A. Bancroft, 3515 Woodland, professor emeritus of statistics and former head of the Department of Statistics and director of the Statistical Laboratory.

Johnson received the B.S. and M.S. degrees from Kansas State University. He is majoring in economics and has been actively involved in the ISU economic research program since 1976. He is currently working on a research project involving risk analysis in agriculture where he anticipates constructing both short and long term dynamic planning models of the farm firm that will be sequentially solved to determine the optimal production, marketing, and financial strategies that Midwest cattle feeders should adopt in a risky environment.

Snedecor Award

Anil Londhe, a doctoral candidate in statistics at ISU, was chosen as the recipient of the 1979 George W. Snedecor Statistics Award. The award was presented at a departmental seminar January 3 and consisted 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, an internationally recognized pioneer in applied statistics. Snedecor was the founder and first director of the Statistical Laboratory. His book,

Statistical Methods was translated into Spanish, Hindi, and Japanese and has sold more than 127,000 copies.

Londhe received the B.S. from Nagpur University, Nagpur, India, the M.S. from the Indian Institute of Technology, Kanpur, India, and another M.S. from the University of Alberta, Canada. He has been a research assistant in the numerical analysis section of the Statistical Laboratory since June, 1977.

A Word of Thanks for Contributions to the Statistical Laboratory

Although it has not been the practice in the Annual Report to solicit contributions to the Statistical Laboratory, it does seem appropriate to acknowledge receipt in these pages when a particularly fine donation has come in. We are grateful to Dr. Emil Jebe, B.S. '38, M.S. '41, a good friend of the Statistical Laboratory, for contributing to our Snedecor Award Fund. It is our hope to extend the Award beyond its current scope of honoring an outstanding Ph.D. student to also supporting, on an occasional basis, a G. W. Snedecor Lecture by a distinguished applied statistician. We take this opportunity to express our thanks also for other contributions to our various award funds (Snedecor, Bancroft, Zyskind, and B. V. Sukhatme).

We also appreciate the continued thoughtfulness of Mr. Roger Wilkinson, B.S. '24, in periodically contributing his collection of journals to our Reading Room. Dr. David Huntsberger has kindly donated a substantial number of books and periodicals. For both these gifts duplicate volumes will be sold, by silent auction, with the proceeds going to the acquisition of new books and journals for the Reading Room.

Mu Sigma Rho

A lecture entitled "Statistical science and its relation to mathematics, pure science, and professional science," was presented by Dr. Emanuel Parzen, distinguished professor of statistics, Texas A&M, at the annual banquet and spring initiation of the local chapter of Mu Sigma Rho. Nine graduate students, seven undergraduates, and two faculty members were initiated as new members of Mu Sigma Rho.

As in past years the organization continued its service project of organizing and copying old exam questions in Statistics 104 and 327. These packets are sold to interested students at a cost which is less than that of photocopying. The aim of the project is to assist students in identifying the course concepts and to aid in preparing for exams.

Officers for the 1979-80 academic year are:
President—Dale Lee Zimmerman
Vice President—George Bushwell
Secretary-Treasurer—Margaret Whipp
Advisor—Dr. Donald K. Hotchkiss

Dale Zimmerman was the recipient of the 1978-79 Mu Sigma Rho award for academic excellence and service to the organization.

Statistical Laboratory Seminars

Summer 1978

July 5   Effects of sampling errors on efficiency of genetic selection indices, William Hill, University of Edinburgh

13   Linear models for quadratic estimation of variance components, Lynn R. LaMotte, University of Houston

19   Robust estimation of a location parameter in the presence of outliers, Ven-Shion Shu

26   A comparison of three methods for prediction: the least square method, ridge regression, and equal weighting, Tetsuro Motoyama

August 8   Asymmetry, unfolding, and data analysis, J. C. Gower, Rothamsted Experimental Station

10   The computer generation of bivariate discrete random variables, C. D. Kemp, University of Bradford

Fall, 1978

September 12   Statistical problems of econometrics, Gerhard Tintner, Professor and Head, Institut für Ökonometrie, Technische Hochschule, Vienna, Austria (a joint seminar sponsored by the departments of statistics and economics)

13   Robust estimation and the treatment of outliers, H. A. David

20   Bahadur efficiencies of Cramér-Smirnov-von Mises tests, S. Sukhatme

27   Maximum likelihood and pseudo-Bayesian approaches to mixed-model estimation and prediction, David Harville

October 4   Some observations and views concerning statistics, Paul G. Homeyer, Research Triangle, North Carolina

11   Heredity and IQ: race and IQ, Oscar Kempthorne

18   Characterizations of strong ergodicity for continuous time homogeneous Markov chains, Mark Scott

25   Scientific inferences from statistical analyses —an example, Paul Hinz

November 2   Identifying an element of a large population in the presence of noise, Herman Chernoff, MIT

8   The foundations of analysis of variance: a group-theoretic approach, Terry P. Speed, University of Western Australia

Winter 1979

December 6   Genetics of competition, Richard Sedcole

8   PPS sampling, coupon collector's problem, and some large sample theorems, P. K. Sen, University of North Carolina

13   A mean square error criterion for subset selection, Sanford Weisberg, University of Minnesota

January 3   Experimental designs completely balanced for first and second residual effects of treatments, Vijay K. Sharma, Indian Agricultural Institute.

10   Compactification of diadic (0's and 1's) matrices, Alexander Abian, Department of Mathematics.

17   On single variable Poisson regression: a goodness-of-fit test and the comparison of regression coefficients, David A. Pyne, The Johns Hopkins University

24   How the properties of psychological scales constrain inferences from statistical analysis, Leroy Wolins

31   On the robustness of least squares procedures in regression models, Malay Ghosh

February 7   Time series recursions and stochastic approximation, Victor Solo, CSIRO, Australia

14   Least squares estimation with linear restrictions, James E. Gentle

Spring 1979

March 7   Multivariate distributions with specified marginals, Delores Conway, Stanford University

12   Estimation of an exponential parameter from life test data, Kenneth B. Fairbank, University of Missouri—Columbia

14   Predicting party identification, Carol Cassel, University of Georgia

23   Some problems of epidemic theory, Joseph Gani, Canberra, Australia

28   Calculations of transport and relaxation cross-sections, David K. Hoffman, Department of Chemistry

30   Tests using the null hypothesis of bivariate symmetry, James L. Kepner, University of Iowa

April 2   Weighted least squares estimation of the mean of a stationary autoregressive sequence, Michael Mack, Carnegie-Mellon University

9   A general class of one-sample nonparametric test statistics based on subsamples, William R. Stephenson, University of Connecticut

11   The miraculous chip, Roger Berger, Department of Industrial Engineering

18   Density-quantile approach to the nonparametric two-sample problem, Emanuel Parzen, Texas A&M

May 2   Influential observations in linear regression, R. Dennis Cook, University of Minnesota

7   The n^{-2} order mean squared errors of the maximum likelihood and the minimum logit chi-square estimator, Takeshi Amemiya, Stanford University

11   Minimum weighted Cramér-von Mises estimators, Tertius DeWet, University of Potchefstroom, South Africa

June 11   Identifiability of distributions under competing risks and complementary risks model, A. P. Basu, University of Missouri, Columbia

20   On some recent developments in theory and practice of multiple comparison procedures in unbalanced designs, Yosef Hochberg, Tel-Aviv University

Quantitative Genetics Seminars

January 23   Optimal foraging? An experimental test in bats. David L. Hartl, Purdue University

May 1   O' mice an' men, Susan R. Wilson, Australian National University, Canberra

Statistics Graduate Student Seminar Series

Seminars in this series were presented by graduate students to an audience primarily comprised of students. Speakers talked about a variety of statistical fields with which they were associated.

Topics and speakers for the year follow:

October 13   On the expected values of record values, H. N. Nagaraja

November 10   Statistics in industry: a summer at Corning Glass Works, Debra Shenk

February 16   The solution of a preliminary test estimator to optimize an objective function, William Der

February 16   Accelerated life testing when there is a linear relationship between product life and two accelerating stresses—product life is assumed to have a Weibull or smallest extreme value distribution, Joy Castonguay

In Memoriam

E. Eugene Dayhoff, 1935-1978

Gene Dayhoff, 43, died in a car accident in Togo, West Africa, during August, 1978, while serving as a fisheries statistician for the Food and Agriculture Organization (FAO) of the United Nations. He obtained B.S. and M.S. degrees in range management (with an extensive background in forestry, genetics, agronomy, and statistics) from Texas A&M before joining ISU's Ph.D. program in statistics. Under Professor Oscar Kempthorne, he completed a dissertation "Generalized polykays and application to obtaining variances and covariances of components of variation" which was partially supported by Wright Air Development. This research led to the publication of two papers in the *Annals of Mathematical Statistics*. Gene joined the Department of Statistics, Texas A&M, in 1963. After three years and reaching an associate professorship, he transferred to work for the University of Texas Medical School at Galveston. He then went to Vietnam as a statistican for Booz Allen. He worked in Iran for awhile before serving with the FAO in Togo.

Gertrude Mary Cox, 1900-1978

Dr. Gertrude M. Cox, 78, of Raleigh, professor emerita of statistics at North Carolina State University and the first head of the university's statistics department, died October 17.

Born in Dayton, Iowa, on January 13, 1900, Gertrude Cox received most of her education in Iowa. She graduated from Perry High School in 1918, from Iowa State College in 1929 with a B.S. in mathematics, and she continued at Iowa State under the guidance of Professor George W. Snedecor. Graduating with an M.S. in mathematics in 1931, she wrote the first thesis in statistics at Iowa State.

After doing graduate work at the University of California during 1932-33, Gertrude returned to Iowa State to assist Professor Snedecor in the newly organized Statistical Laboratory. From 1933-38 she was a staff member of the Statistical Laboratory, and from 1938-40, she served as an assistant professor. Working with Snedecor, W. G. Cochran, and others at Ames, she established herself in her principal field of interest, which was the design of experiments. Her association with Cochran led in 1950 to the co-authoring of the classic text *Experimental Designs*.

With Snedecor's recommendation, Gertrude Cox went to NCSU in 1940 to serve as the university's first head of its new department of statistics. Four years later, the Institute of Statistics, a joint program of the University of North Carolina at Chapel Hill and NCSU, was founded and Gertrude was named as its director. Retiring from NCSU, she became the head of the new Statistical Research Division of the Research Triangle Institute in 1960.

According to NCSU Chancellor Joab L. Thomas, "Gertrude Cox was the epitome of a brilliant scholar, an efficient administrator, an inspiring leader and a gracious lady. She brought national and international prominence to North Carolina State University and through her Institute of Statistics to the entire Triangle area."

According to David D. Mason, now head of the department of statistics that Gertrude founded in 1940 and headed until 1959, "Dr. Cox was always in command, always very impressive. She had a way of getting things done."

Indeed she did get things done. After her second retirement in 1965, she held various appointments as visiting professor and as an advisor and consultant to governmental, university, and foundation clients. In addition, Dr. Cox was active in many professional societies and was awarded many honors.

From 1945-55, Miss Cox served as the founding editor of *Biometrics*, the journal of the International Biometric Society. During 1956, she was the president of the American Statistical Association, and from 1968-69 she was president of the Biometric Society. She was a fellow of the ASA and the IMS, and an elected member of the ISU. In 1975 she became a member of the National Academy of Sciences.

At an anniversary meeting at the Research Triangle Institute in 1977 C. X. Larrabee, head of Public Relations, RTI, Monroe Wall, vice-president of RTI, Gertrude Cox, and William Eckerman, head of the Educational Assessment Division of RTI converse.

In 1959, Dr. Cox received the O. Max Gardner Award for excellence in teaching in the University of North Carolina system. In 1970, NCSU named a seven-story physics and statistics building Cox Hall in her honor. Her students, colleagues, and friends established a $200,000 Gertrude M. Cox Fellowship Fund for outstanding graduate students in statistics at NCSU in 1977.

An award rarely afforded an Iowa State graduate was conferred upon Gertrude Cox at Iowa State College's centennial celebration on March 22, 1958. In presenting her for the honorary degree of Doctor of Science, an Iowa State dean said, "I have the honor of presenting Gertrude Mary Cox, stimulating leader in experimental statistics. Her influence is world-wide, contributing to the development of national and international organizations, publications, and councils of her field. One of our graduates, she has helped build the accomplishments of our first century."

Mary A. Clem, 1905-1979

Mary A. Clem was born in Nevada, Iowa, in 1905. She held several clerical positions before 1931 when she joined George Snedecor's Mathematical Statistical Service as the only computer. When the Statistical Laboratory was established in 1933, she became its first computer. After Dr. Gertrude Cox left the Stat Lab in 1940, Mrs. Clem was officially put in charge of the Stat Lab's Computing Service as technician and chief statistical clerk. From then until the new Computation Center was established in 1962, she supervised the operations of the Computing Service as an all-college service unit. In addition, she helped train a number of workers in the operation of IBM punched-card equipment and calculating equipment, as well as in techniques of statistical analysis.

In 1951, Mrs. Clem was made an associate in Statistical Laboratory in recognition of the contributions she made through statistical consulting on research problems, especially on those of the Agricultural Experiment Station.

In addition, with P. G. Homeyer, W. T. Federer, C. C. Mosier, and G. F. Sprague, Mrs. Clem coauthored three publications.

Mary Clem held two off-campus assignments while on leave from Iowa State. She acted as junior statistician on the Second Allied Mission to Greece to observe the 1946 elections. Also, in 1952, she was the statistical consultant to the Atomic Bomb Casualty Commission (organized under the National Research Council) in Hiroshima and Nagasaki, Japan. There she helped organize a computing section for research workers on medical health, and genetic problems connected with the effects of the atomic bomb on the human population. She also worked on statistical analyses and trained Japanese IBM operators in Hiroshima.

Although offered a full-time position with the Atomic Bomb Casualty Commission in Japan, Mary Clem returned to the Stat Lab and stayed there until April 1, 1962, when the computing hardware was separated from the Statistical Laboratory. She then joined the staff of the new Computation Center where she remained until retirement.

A colleague, Dr. Oscar Kempthorne remembers "...the place that Mary had in the hearts of all those who were associated with the Stat Lab, staff, and students. She was a valued friend...and a very efficient helper...to all."