STATISTICAL LABORATORY

established 1933

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THE STATISTICAL LABORATORY
Iowa State University
1976-77 Annual Report

Personnel

Iowa State University's Statistical Center is directed by H. A. David. The Center 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 Engineering Research Institutes. Many faculty members have duties in more than one of the Center's components.

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T. A. Bancroft, director of the Statistical Laboratory and head of the Department of Statistics 1950-1972, and professor of statistics since then, retired at the end of spring quarter. He will become Professor Emeritus as of July 1.

The following citation honoring Dr. Bancroft was received with acclamation at the May 16 departmental faculty meeting:

> On the retirement of Dr. T. A. Bancroft, the staff of the Statistical Laboratory and the Department of Statistics wishes to express its appreciation for his long service as Director and Professor. He contributed greatly to the growth of the statistical group and to its continued national and international status.
>
> It may be recalled that in the late 40's, the group had a handful of professorial staff. At his retirement as Director, this had grown to some 25 or so. The growth of teaching and research was huge. He was surely the driving force in the expansion of the whole statistical activity with respect to program and physical facilities. It cannot be doubted that the efforts of Dr. Bancroft were both fertile and irreplaceable.
>
> The staff also wishes to acknowledge the very effective role of Mrs. Bancroft in the essential social life of staff and particularly of student wives.
>
> The staff extends its best wishes to Dr. and Mrs. Bancroft for a well-earned retirement.

•

Malay Ghosh, on leave of absence from the Indian Statistical Institute, has been a visiting associate professor in the Department doing teaching and research in the areas of probability and statistical inference for the past three years. Dr. Ghosh returned to India June 1.

Richard Mensing, associate professor, resigned effective June, 1977, to accept a position as a statistician at Lawrence Livermore Laboratory, University of California, Livermore, where he will work on cooperative research and consulting activities.

•

Chaturvedula Asok, postdoctoral associate, resigned June 30, 1976, to accept a position as reader in the Department of Biometry, Maharashtra Association for the Cultivation of Science, Poona, India.

•

H. A. David presented a lecture tour in Australia July 15-August 15 under CSIRO sponsorship. B. V. and Shashikala Sukhatme gave lectures and seminars in India during June and July, 1976. Titles of lectures and seminars and universities visited by Dr. David and the Drs. Sukhatme are listed elsewhere in this report.

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Barry Arnold spent the summer of 1976 in Denver, Colorado, working with the National Assessment of Educational Programs under the auspices of the National Science Foundation Faculty Research Participation Project. This June he taught a course on statistical methods (in Spanish) to personnel of the Agricultural Research Stations and Biometry Office of the Peruvian Ministry of Food (sponsored by the Iowa Universities Mission and AID). July and August, 1977, he will be employed by Bell Labs, Holmdel, New Jersey.

•

Glen Meeden was on Faculty Improvement Leave during the academic year 1976-77 visiting at Florida State University, Tallahassee.

•

Barton Bixenstine, assistant professor in statistics and political science and Jeff Goebel, assistant professor with major duties in the Survey Section, joined the staff this fiscal year—Mr. Bixenstine, September 1, and Dr. Goebel, July 1.

•

Jim Huang was a visiting associate professor from September through December doing research in the area of order statistics and nonparametric statistics. Dr. Huang was on leave from his position as associate professor, Department of Mathematics and Statistics, University of Guelph, Guelph, Ontario.

Margaret Kirwin, administrative assistant since 1956, retired from this position June 30. She was recognized at the May 16 faculty meeting with the following citation:

> Margaret Kirwin has served the Statistical Laboratory and Department of Statistics for some 30 years in a critical position as general office administrator and general office aide.
>
> Her devotion to the whole statistical enterprise has been remarkable in its strength, efficiency, loyalty, and persistence.
>
> The staff wishes to place on record its very deep appreciation for her efforts. It surmises and hopes that her retirement years will be equally effective in the directions she chooses.

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Avonelle Jacobson, who has been program coordinator since 1973, has accepted the duties of administrative assistant beginning July 1. Avonelle began her career with the Statistical Laboratory in 1963 as a secretary and served as a supervisor from 1967-73.

•

Dr. W. J. Conover, professor of mathematics and statistics, Texas Tech University, will be a visiting professor in the Department of Statistics second summer session, July 14-August 17. During the 1976-77 academic year, Dr. Conover has been a visiting professor at the University of California, Davis. A 1958 alumnus of Iowa State, he received higher degrees from Catholic University of America. While at Iowa State, Dr. Conover will offer a seminar on Ranking Methods and be involved in research in the area of nonparametric statistics.

•

Dr. James Cornette, Department of Mathematics, ISU, is a visiting professor in the Mathematical and Statistical Genetics Section for the summer, 1977.

•

Paul Hinz will be on a 12-month leave of absence beginning September 1. He has accepted a position as visiting scientist in the Department of Forest Science, Oregon State University, Corvallis.

•

On September 1 Kenneth Koehler will join the faculty as an assistant professor. Mr. Koehler received the B.S. degree in 1972 from the University of Wisconsin, Parkside, with a major in mathematics. He expects the Ph.D. degree in statistics from the University of Minnesota this summer. From 1973-1977 Mr. Koehler has been employed as a teaching assistant in the Department of Statistics, University of Minnesota. His research interests are in the area of statistical methods, particularly sparse contingency tables. He will be involved in the teaching of the new graduate methods core courses 500 and 501, as well as in the 401-402 sequence. A portion of his time will also be allocated to consulting activities.

•

Craig Van Nostrand will begin duties as a temporary assistant professor in the Department September 1. Mr. Van Nostrand received the M.S. degree in 1973 and expects the Ph.D. degree this summer—both in statistics from the University of Wisconsin. In 1971 Cornell University granted him an M.S. degree in operations research. He earned the Sc.B. in applied mathematics from Brown University in 1970. His duties at Iowa State will include teaching courses in engineering statistics and consulting.

Statistical Laboratory Staff—Fiscal Year 1976-77 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, through May
C. Philip Cox
David F. Cox
Herbert A. David
Herbert T. David, joint appointment with Department of Industrial Engineering
Wayne A. Fuller, faculty status in Economics as well as Statistics
Richard Groeneveld
Chien-Pai Han
David A. Harville
Roy D. Hickman
Donald K. Hotchkiss
David V. Huntsberger

Dean Isaacson, joint appointment with Department of Mathematics
Oscar Kempthorne, Distinguished Professor, College of Sciences and Humanities
Edward Pollak, joint appointment with Department of Genetics
Robert F. Strahan, joint appointment with Department of Psychology
Norman Strand, Professor Emeritus
B. V. Sukhatme
Richard D. Warren, joint appointment with Department of Sociology and Anthropology
Leroy Wolins, joint appointment with Department of Psychology

Debabrata Basu, visiting, summer 1976
James Cornette, visiting, summer, 1977
William F. Taylor, Collaborator, in residence at Mayo Clinic

Associate Professors

Malay Ghosh, visiting
Paul N. Hinz, faculty status in Forestry as well as Statistics
William J. Kennedy
Glen D. Meeden, Faculty Improvement Leave, Florida State University, Tallahassee
Richard W. Mensing, through June 24
Lawrence Promnitz, faculty status in Statistics as well as Forestry
Vincent A. Sposito, joint appointment with Computation Center

J. S. Huang, visiting, September-December

Assistant Professors

Theodore B. Bailey, Jr.
Harold D. Baker
Barton A. Bixenstine, joint appointment with Department of Political Science beginning September 1
James E. Gentle
J. Jeffery Goebel
William Meeker
Shashikala B. Sukhatme
Gordon Booth, USDA Collaborator
Peter C. O'Brien, Collaborator, in residence at Mayo Clinic

Instructors and Associates

Kim Andriano, beginning May 1
Tom Bubolz
Richard Dorsch
Paul DuBose, through March
Ted Emigh, through September 17
Wendell Ponder
Barry Simon
Dale Umbach, through August

Graduate Assistants

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

Andriano, Kim
Auer, Richard
Bhattacharyay, Biswanath
Biyani, Shriram
Carter, Randy
Chandhok, Promod
Chang, Shen-Lan Chu
Chen, Jengrong
Chen, Mon-Gy
Dahm, P. Fred
David, Jeffrey
Diaz, Francis
Dickey, David
Escobar, Luis
Esimai, Grace Iwuora
Ferree, Rita
Grapentine, Terry
Hale, Michael
Hammond, Cheryl
Hand, Michael
Hanson, Thomas
Hasza, David
Ho, Chung Man
Hong, Emile
Hsieh, Wen-Tai
Hsu, Shun-Hsia (Dorothy)
Johnson, Steven
Kackar, Raghu Nath
Kim, Geung Ho
Lewis, Jerry
Lin, Cherng-Tarng
Midha, Chand
Mo, Wing-Hung
Motoyama, Tetsuro
Mowrey, Daniel
Penner, Don
Ponder, Wendell
Protz, Steven
Rangachari, Lakshmi
Sallas, William
Scholl, Lorie
Scott, Mark
Sedcole, Richard
Shenk, Debra
Shu, Ven-Shion
Skalland, Kent
Stewart, John
Tu, Ching-Tsao
Werner, Neil
Williams, Rick Lee
Yang, Shie-Shien

Supported Graduate Students

Aain, Sukor—MARA, Malaysia
Abdel-Megeed, Samir—AFME
Alders, Clarence Dean—Department of Mathematics, ISU
Anselmi, Luis—Government of Venezuela
Arnold, Robert—Department of Mathematics, ISU
Aziz, Mohammad—Ag. Development Council Fellowship
Carvalho, José—University of Sao Paulo, Brazil
Chen, Jiunn-Charn—Institute of International Education
Chiyenda, Simeon S.—AID
Crouse, Ken—Ames Lab, ISU
Cruz, Vivaldo—USAID, Brazilian Government
Dehghan-Nayeri, Majid—Department of Mathematics, ISU
El-Shereif, Saad—Egyptian Government
Ervan, Mahamad—FAO
Galmes, Miquel—FAO
Herrera-Haro, José—Nat. Council of Sci. and Tech. and Ford Foundation

Huang, Cheng-Chi—Department of Mathematics, ISU
Islam, Shaikh Sirajul—FAO
Khuantham, Ananchai—Kasetsart University, Thailand
Lamyordmakpol, Anuchit—Government of Thailand
Liberty, T. Edward—USAID
Lo-Utai, Sue—Government of Thailand
Megahed, Abdel Razek—Egyptian Government
Niknian, Minoo—AFME
Nkansah, Paul—University of Ghana
Noorbaloochi, Siamak—Iranian Government
Osho, Johnson—Nigerian Government
Parsian, Ahmad—Pahlavi University, Iran
Peixoto, Julio—AID
Pongsrihadulchai, Apichart—USAID
Sainumtip, Nida—Government of Thailand
Sakia, Remi—Institute of International Education
Sirisukdi, Vannapha—USAID
Sivira, José—University de Los Andes, Venezuela
Sotres, David—Nat. Council of Sci. and Tech. and Ford Foundation
Sridodo—USAID
Stangenhaus, Gabriela—University of Sao Paulo, Brazil
Sung, Bok Park—Department of Mathematics, ISU
Sung, Chang Sup—Department of Industrial Engineering, ISU
Tajdari, Parviz—AFME
Tobey, Malcolm—National Science Foundation Fellowship
Viroonsri, Boonchai—USAID
You, Young-Kyun—Korean Government
Young, Shirley—Department of Mathematics, ISU
Zaher, Adel—AFME

Self-Supporting Graduate Students

Bondy, Eric
Caravavattana, Rattana
Clark, Cynthia
Fernandez, Irma
Glosemeyer, William
Hanley, Janet
Jan, Yih-Ming
Johnson, Ervin
Martinez, Daniel
Mayo, Ralph
Mellon, James
Perez, Margarita
Razmpour, Ahmad
Richards, Winston
Shen, Arn-Shi
Wang, Bei-Li
Yih, Wei
Yu, Fu-hau

Survey Section

Caroll Arthur, Statistical Data Processor
Glenda Love Ashley, Key Punch Operator
Karen Bruce, Statistical Clerk
Carol Charlson, Statistical Clerk—beginning May 16
Hazel Cook, Survey Supervisor
Sheryl Davis, Secretary—through August
Margaret Fowler, Statistical Clerk—beginning September 1
Mary A. Genalo, Statistical Clerk—beginning July 20
Evelyn Green, Survey Supervisor
Sylvia Larson, Statistical Clerk
Marion Martin, Statistical Data Processor
Marjorie Mason, Survey Supervisor
Sylvia McNulty, Bookkeeper
Helen Nelson, Secretary—beginning September 1
Margaret Nichols, Secretary
Donna Omundson, Statistical Clerk
Melinda Boyd Oppedahl, Key Punch Operator
Florence Osam, Statistical Clerk
Harvey Terpstra, Junior System Analyst
Margaret Whitehill, Statistical Clerk

Statistical Data Processing Service

Bud J. Meador, Supervisor
Heitsu Chou (Helen) Tu, Data Analyst

General Office Staff

Margaret G. Kirwin, Administrative Assistant
Avonelle Jacobson, Program Coordinator
Betty Ibrahim, Accountant
Kathleen Shaver, Information Assistant
Cheryl Balko, Secretary—beginning October 1
Phyllis Carr, Secretary—Experimental Design—Genetic Statistics Section
Norma Elwick, Secretary
Peggy Nelson Fay, Secretary—through March 4
Karen Gogerty, Secretary—through September
Suzanne Kay Hull, Secretary—beginning March 23
Donna Leinen Muell, Secretary—Statistical Numerical Analysis and Data Processing Section—beginning March 7
Nancy Piersol, Secretary—Statistical Numerical Analysis and Data Processing Section—through March
Beverly Upchurch Simpson, Secretary
Dallis Sonksen, Secretary

Consulting and Cooperative Research

The consulting arm of the Statistical Laboratory is designed to assist Iowa State University faculty members and graduate students with statistical facets of their research projects. Individual researchers seek statistical advice on a variety of topics relating to their research such as design of the experiment including data collection, selection of the sample population to be studied, methods of processing and analyzing data, and interpretation of results.

Arrangements for statistical consulting may be made with any faculty member, but some faculty members and graduate assistants are budgeted primarily in this area. These staff members are also actively engaged in their own research to develop software which will improve available statistical techniques.

Due to an increased demand for advice on statistical computing, a consulting room staffed by graduate assistants from the Statistical Numerical Analysis and Data Processing Section opened this year. Faculty and student researchers are assisted on a "walk in" basis with problems encountered in computer use.

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

Examples of this year's consulting follow.

Social Sciences

Over fifty graduate students and faculty members were assisted with the statistical aspects of their research by Robert Strahan, joint appointment in psychology and statistics. Research topics ranged from rats' eating behavior given certain brain lesions, to human aggression in response to certain laboratory frustrations, to family planning in other countries, and to teaching styles in physical education.

Engineering Research Institute

H. T. David and R. W. Mensing consulted for the Engineering Research Institute (ERI) assisted by Neil Werner, who holds a one-half time consulting assistantship in ERI. Examples of this year's projects follow.

Civil Engineering. Assisted a student in the statistical analysis (AOV and regression) of data from an experiment designed to study the effect of (i) chemical additives (9 chemicals) and (ii) different amounts (3 amounts) on the optimal moisture content and dry density of various types of soils.

Assisted in the statistical analysis of data from an experiment designed to predict the shear strength of tropical soils given the normal force and other properties of the soil. A sequential procedure of first fitting shear strength as a function of normal force and then relating the model parameters to the physical properties of the soil was suggested. A meaningful physical interpretation of the parameters was developed from this analysis.

Discussed the design of an experiment to measure the effect of curing time length on the fatigue life of concrete.

Assisted a student in testing several models for the service times at the Marshalltown railyard of the Northwestern Railroad.

Physics. Assisted a student in the estimation of the relative frequency of energy levels throughout a body of material.

Assisted a student in modeling the difference between satellite derived temperature data and radiosonde temperature data collected at different atmospheric pressure levels. Discussed with him ways of using the data to estimate the unknown variance of the satellite data.

Geology. Discussed with a faculty member the design of an experiment involving a large number of factors. Various combinations of treatments of coal were being considered to reduce the levels of pollution of the off-gases. Several suggestions of ways to reduce the number of experimental runs were made.

Ames Lab. Assisted staff members at the lab in the interpretation of output from a program designed to control the accuracy of analytic procedures for measuring the existence of radioactive materials in water and soil samples. Both control chart and multiple comparison techniques were used in the analysis.

Chemical Engineering. Discussed with a faculty member the comparison of the variability of two methods of measurement, one a direct measurement of the primary variable of interest, and the second an indirect method of measurement of a secondary variable and evaluation of the primary variable through a theoretical model.

Discussed the modeling of the concentration of sulfur in coal as a function of time in a packed bed reactor used to desulfurize coal. A comparison of the model parameters was made for different reactor conditions (volume, flow rate).

Suggested a composite design for an experiment planned to determine the optimal values of four factors (chemical concentration, particle size of coal, process time, process temperature) for a process designed to desulfurize coal. Additional assistance will be given in the analysis at the completion of the experiment.

Industrial Engineering. Set up the analysis of the data from an experiment designed to measure the effect of color contrasts, size opening, and speed of object on the ability of a subject to recognize a passing target. The analysis involved modeling the percentage recognized as a function of speed and then comparing the model parameters for different levels of color contrast and size opening.

Assisted a student in designing an experiment to test the distribution of interarrival times and service times of customers passing through a service facility (the cash register at the grill at the Memorial Union).

Assisted a student in the analysis of data from a simulation experiment designed to model the average time to complete a job in a job shop as a function of the job arrival rates and job shop capacity. Several regression models were developed.

Electrical Engineering. Reviewed a paper on the effect of the sampling rate of stochastic process on the "level of significance" of the Kolmogorov-Smirnov statistic when it is used to test for (1) gaussianity and (2) stationarity of the process. Discussed the implications of the paper on an experiment designed to compare EEG measurements under normal and stimulating conditions.

Mechanical Engineering. Discussed with a faculty member the effect of different sources of experimental error in regression analysis associated with a study of the hardness of steel alloys for different combinations of iron with other metals.

Agriculture and Home Economics Experiment Station

The arrival of the latest version of the Statistical Analysis System (SAS-76) has increased the computing power available for statistical consulting in the Agriculture Experiment Station. One of the most important features in the new system is the capability to program matrix algebra. This capability in SAS now greatly reduces the need for OMNITAB, and thus SAS is becoming the chief mode of computing used in all the 400-level courses taught to graduate students from the disciplines represented in the Experiment Station.

Staff members responsible for statistical consulting within the Agriculture Experiment Station continue to work on strengthening the capabilities of modern-data analysis. The data handling and analytical tools provided by SAS-76 continue to be the basic computing package for most of the work.

Specialized programming is still required from time to time. For example, Mike Hale recently completed a program to carry out some of the diagnostic plots suggested by the group at Princeton as useful in exploratory data analysis.

Another program was devised by Shriram Biyani to handle data submitted from the Department of Animal Ecology. In this work, a radio transmitter was implanted in several fish, and the fish returned to a lake. The fish were followed by tracking equipment and located two or more times a day on a two-dimensional grid covering the lake. It was necessary to use these coordinates to trace the paths of individual fish, and from this trace a definition of their home range was developed. Mr. Biyani used the CalComp plotter and additional programming to draw maps of the paths of fish as they were followed through the summer in Lake Okoboji in northwest Iowa.

The techniques of cluster analysis continue to be well received by customers of the consulting services. Often they throw light on unsuspected relationships in multivariate situations. Debra Shenk has acquired the skills needed to use the clustering routines we presently have operational and has investigated other systems with the view of upgrading our present capability. She also attended a meeting of the Classification Society, North American Branch at Dartmouth College where current work in this developing branch of data analysis was reviewed.

Kim Andriano has handled large data sets from Agronomy where the work involved studies of plant physiology. The workers take many measurements on individual plants and often repeat the measures daily throughout the growing season. The data handling tasks are formidable—the data analysis, multivariate and complex.

Dan Mowrey who just recently joined the consulting section is already involved in a major piece of data analysis from Animal Science involving studies of the pituitary gland using rats. The analyses have involved standard six-point bioassays as well as investigations of weight gains and feed consumptions under various hormonal treatments after destroying the pituitary function.

Statistical Numerical Analysis and Data Processing Section

This section of the Statistical Laboratory is responsible for providing consultation and operational assistance to educational and research applications of digital computers. Faculty members of the section also do research and conduct courses in statistical computing.

One major change in section support operations, initiated during the past year, was the establishment of the Statistical Computing Consulting

Service. Room 121 in Snedecor Hall was used to provide space for consultants and remote terminal equipment. Section personnel were used, under a rotating schedule, to staff this facility. The need for this more formal consulting arrangement was apparent from the large number of faculty and students who asked for, and received, assistance on problems related to scientific computing. Current plans call for expansion of this service next year.

Installation and maintenance of scientific software systems is one important operational support activity of the section. New releases of SAS, SPSS, and BMDP were installed during the year. Tom Bubolz had supervisory responsibility of these operations. Dr. Bubolz also produced a new three-part videotape series on the SAS programming language. These tapes have already been used for instructional purposes in several academic departments.

Programming and data processing support for a wide variety of projects was provided by section personnel during the year. A few of these projects, and the people who supported them, are mentioned below to indicate the general nature of the section's customer job mix.

Analyses of data from several Iowa Conservation Commission studies were completed. These studies were directed toward 1) Iowa deer harvest, 2) small game harvest, 3) turkey harvest, 4) roadside pheasant count, and 5) gamefish surveys in many Iowa lakes. Section personnel involved in this work were Fred Ho, Steve Protz, Mike Hand, and Emile Hong with Dr. Bubolz providing direct supervision.

Section personnel are currently assisting staff from the ISU Engineering Research Institute in the analysis of power plant emission data. These data are collected at the Ames Power Plant which is currently utilizing some fuels derived from the Ames Solid Waste Disposal Plant.

Mike Hand and Tom Bubolz worked on another project related to power plants. This project was initiated by Ames Laboratory researchers. The purpose of the research was to compare levels of trace elements found in living plants from terrestrial and aquatic ecosystems surrounding a large coal-fired power generating station with expected levels of these trace elements present in remote areas.

Computer data analytic support for an economic study of rural family life in Peru is being provided by Emile Hong. The data for this study were prepared by the Peruvian Ministry. Scores of economic characteristics on each of eight thousand families form a part of the total data set.

Personnel in the group supervised by Bud Meador were also actively engaged in many interesting projects during the year. Members of this group are Helen Tu, a full-time Statistical Data Processor; James Chen, Luis Escobar, Tom Hanson, and Tetsuro Motoyama, graduate student assistants.

Mrs. Tu worked on several projects from the Agronomy Department and the Veterinary Medicine Clinic at ISU. She also completed data processing projects for six different seed companies. Mrs. Tu is the section's resident COBOL language expert and is equally skilled in the use of the other major compiler languages and statistical package languages.

Programming and data processing on the Swine Breeders' Record System, for researchers in Veterinary Medicine, continued throughout the year. Tom Hanson was most heavily engaged in these operations. The system is now fully operational and is currently providing weekly reports on twelve large swine herds.

Tetsuro Motoyama and James Chen completed several projects for the Veterinary College and the Departments of Psychology and Sociology. Luis Escobar, who joined the section late in the year, also assisted in this work. Continuing support for Iowa Development Commission data processing projects was provided by James Chen.

Members of the section attended national and regional meetings related to Statistical Computing during the year. Bill Kennedy and James Gentle participated in the "Interface Symposium." Tom Bubolz and Bud Meador attended the Statistical Analysis System Users meeting. Gentle, Kennedy, and Vince Sposito participated in the ASA Statistical Computing Section sponsored session at the spring IMS central regional meeting held in Madison.

Several optimization projects were handled during the year. Some of these large-scale linear programming problems which were formulated and solved were as follows.

One project from the Center for Agricultural and Rural Development (CARD) involved a linear programming model of U.S. Agriculture which minimized two-goal objective functions. One objective function involved minimizing production and transportation costs; the other pertained to minimum soil erosion. The model involved 24,000 structural variables and 1200 restrictions and simulated the use of available resources (land, water, and nitrogen) for production of crop and livestock products. The objective of this research was to obtain trade-off information about the cost of providing adequate food for domestic and foreign demands, while at the same time maintaining a high quality environment.

Another large LP model, this one for the Health Services Research Center, University of Iowa, was handled via the computer link. This transportation model involved obtaining optimal allocation to identify dental service shortage areas. Patient visits from 1155 communities in Iowa and associated rural service areas were incorporated into the model which involved 80,000 variables and 1300 constraints.

Survey Section

The Survey Section has the responsibility of providing consultation and direct operational assistance to research workers in sample design and the plan-

ning and execution of sample surveys. The Section staff engages in all areas pertaining to the operational conduct of surveys, and professional staff members also conduct research and teach courses in the areas of sampling, survey design, and statistical methods.

The 1975 Iowa Conservation Commission outdoor recreation study was completed during the past year. Using data collected from approximately 1,700 Iowa residents over a one-year time period, estimates of the amount of participation by Iowans in various outdoor recreation activities were computed. Data from this study were also used to provide estimates for the Iowa Natural Resources Council. Also completed during the past year were two studies of Iowa manufacturers, one involving the use of energy and the other the handling of hazardous materials. In the first study, data collected by the Civil Engineering Department were analyzed to determine the present and projected uses of fuels by Iowa manufacturers. In the second study a sample of 594 Iowa firms was designed and selected. These firms were interviewed by a private research firm and asked to provide information about the type of hazardous materials handled and the methods used to dispose of them. Statewide estimates of the amounts of hazardous material handled and disposed of were computed, as well as estimates of the average characteristics of the workers who handled these materials.

The Home Economics Research Institute and the Department of Family Environment were asked by the Iowa Legislature to conduct a study to aid in the comprehensive development of a standard of need for Iowa ADC recipients. The Survey Section drew a statewide sample of both rural and urban households. The sample included middle and higher income households as well as lower income families. Assistance was provided in the construction of a screening sheet and questionnaire to be used, and personal interviews were conducted with 664 selected households. The questionnaires were edited and coded and analysis was completed by the researchers.

In order to obtain detailed information about various types of family farms in Iowa, an extensive project is being carried out for the College of Agriculture. An area sample of approximately 900 farm households located in every county in the state was selected. The homemaker provided information about the farm family and its activities; the farm operator provided information about the farming operation. Both were asked to express their opinions and attitudes on selected subjects. Thirty-four interviewers participated in the field data collection phase of the project. Questionnaires are currently being edited and coded, and the final analysis will be made by the researchers involved.

A statewide sample of business and manufacturing firms, governmental agencies, and educational institutions was selected for the Iowa Department of Public Instruction. A total of about 5,700 firms was selected, the relatively large sample being necessitated by the desire to make separate estimates for each of 15 geographic strata. The primary purposes of the study are to provide estimates of the demand for workers in various categories for which training programs have been established in the area community colleges and to determine the need for additional programs. This marks the third time this project has been carried out; the Survey Section has participated each time.

Fifteen midwestern states are involved in a regional Quality of Life project. The Department of Family Environment at Iowa State is working closely with the University of Nebraska on this project, with personal interviews of households concentrated in the Council Bluffs-Omaha area and a few nearby small towns. The Survey Section drew the samples for all cities involved in the two states, and assisted in the final preparation of the questionnaire and the training of the interviewers working in Nebraska. Interviewing to be done by Survey Section personnel will begin in September, with editing and coding also to be done by the Survey Section. Final analysis will be made by Family Environment staff members.

Assistance was provided a committee appointed by the city of Ames to investigate the use of existing Ames and Iowa State University bikeways, the preferences for different types of bikeways, and the perceived need by citizens for additional bikeways. Survey Section personnel helped with the questionnaire and advised on selecting a sample from the telephone directory.

An area sample from the open country area of six counties in Wisconsin was drawn for the Department of Agricultural Economics, University of Wisconsin, Madison, for a study of farm transfers and enlargements. This study was a continuation of a study first conducted in 1950 and repeated in 1961. The sample was intended to yield about 200 completed interviews.

A list sample was selected for a graduate student in the Department of Journalism and Mass Communication for the purpose of investigating, by means of a mail survey, soap opera viewership by adult women. The sample was selected from the city directory covering Des Moines and its suburbs. The city directory was used rather than the telephone directory because, where applicable, it gave the name of the wife as well as the husband, thus enabling the researcher to use the wife's name in addressing the letter (which, it was hoped, would increase the response rate) and to avoid sending questionnaires to households apparently containing no adult women. In addition to drawing the sample, the Survey Section assisted in constructing the questionnaire and coded and processed the data.

Married women under 55 years of age comprise the sample in a study entitled "Household Decision Making with Respect to the Use of Credit" conducted in Des Moines. Approximately 200 women in the greater Des Moines area were questioned by interviewers of the Survey Section about their use of credit and its effect on their shopping habits. The

project was sponsored by the Department of Family Environment.

Personnel of the Survey Section cooperated with the ISU Faculty Development and Welfare Committee in carrying out a survey of the faculty to assess their attitudes toward two issues—early retirement and taking courses at ISU for credit. The Survey Section assisted with the questionnaire and drew the sample. Data were collected by members of the committee by telephone.

Another intra-university project concerned the amount of time spent by faculty members in their teaching and research activities. A sample of faculty, stratified by rank and department, was selected and divided into 16 subsamples corresponding to the 16 weeks covered by the study. Each week the members of one of the subsamples were mailed questionnaires asking them to report their hours worked during the previous week. The data were used to estimate the average number of hours worked per week by all Iowa State University faculty members. The State Board of Regents had agreed to accept an estimate based on a random sample in lieu of requiring all faculty to complete quarterly reports as had been done previously.

Special Topics Meeting on Time Series to Be Held at ISU

An Institute of Mathematical Statistics Special Topics Meeting on Time Series will be hosted by Iowa State University at the Scheman Continuing Education Center, May 1-3, 1978.

There will be a reception on Sunday evening, April 30; sessions will run from Monday morning, May 1, through Wednesday noon, May 3. A detailed announcement will appear in the March, 1978, issue of the IMS Bulletin.

Program co-chairmen are David Brillinger of the University of California at Berkeley and George Tiao of the University of Wisconsin. Jeff Goebel is serving as assistant program secretary in charge of local arrangements.

Off-Campus Consulting

T. A. Bancroft consulted with a faculty member and two students from the Department of Mathematical Sciences at the University of Missouri, St. Louis, on an economic investigation involving: (i) establishing of a representative variable for each of nine categories of unequal variables, and (ii) a selection of the "best" subset of three out of the nine representative variables as "independent" variables for each of several dependent variables for prediction. Doane Agricultural Service, Inc., of St. Louis was cosponsor of the investigation.

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D. F. Cox participated in a review of the Biometrics Unit in the Department of Plant Breeding and Biometry at Cornell University, Ithaca, New York, March 21-23.

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H. A. David was a member of a Peer Review Committee of the Mathematics Research Center, University of Wisconsin, Madison, May 26-27.

H. A. David Gave Australian Lecture Tour

Under the sponsorship of the Commonwealth Scientific and Industrial Research Organization (CSIRO), H. A. David was invited to Australia to give a series of lectures July 29-August 15. "The Theory of Competing Risks" was given as the inaugural G. H. Knibbs Memorial Lecture in Canberra. The lecture was named in honor of the first Australian Commonwealth statistician.

Additional lectures drawn from "Some Uses of Order Statistics," "Robustness of Linear Functions of Order Statistics in the Presence of an Outlier," "Concomitants of Order Statistics," and "Paired Comparisons and Tournaments" were presented at the following universities: Sydney; New South Wales; Macquarie; Australian National University; Melbourne; Monash; Latrobe; and Queensland.

Dr. David also consulted with the CSIRO staffs in Sydney, Canberra, Melbourne, and Brisbane during his Australian tour.

Current Research

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

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

AES Project 2039

The U.S. Bureau of the Census continues to support joint research in sample survey and time series methodology through Project 2039 with the Agriculture Experiment Station. Personnel working on the project include Wayne Fuller, principal investigator, Jeffery Goebel, David Hasza, and Fred Dahm.

A number of distributional results were obtained for nonstationary autoregressive time series. Time series with polynomial trends and with roots of the characteristic equation greater than or equal to one were studied. The distribution of several likelihood ratio tests for unit roots were obtained and tabulated. Estimation for the noninvertible moving average process was also studied.

Estimators for the nonlinear errors in variables model were investigated. The computer program SUPERCARP was extended to provide estimators for errors in variables problems with nondiagonal error covariance matrices.

Growth Models

Cooperative research with the Statistical Reporting Service of the U.S. Department of Agriculture is being conducted under the direction of Wayne Fuller, project leader. Cheryl Hammond is graduate assistant on the project. Simulation models and algebraic models for plant growth are being investigated as possible methods of improving crop yield forecasts. Modifications of the logistic model have been estimated for sorghum data collected by the Department of Agriculture.

Order Statistics and Nonparametric Statistics

Together with V. S. Shu, H. A. David, principal investigator of the Army Research Office grant named above, has investigated the robustness in the presence of an outlier of location estimators expressible as linear functions of order statistics, e.g. median, trimmed means, Winsorized means, etc. Specific attention is paid to the cases when the outlier differs from the target population either in location or scale. When the target population is normal, exact numerical values of bias and mean square error have been obtained for $n = 5$, 10, and 20.

Malay Ghosh, Visiting Associate Professor, jointly with D. A. Sotres, has completed two papers dealing with the Bahadur representation of sample quantiles and the asymptotic properties of linear functions of order statistics in non-stationary mixing processes. Another of their papers was on strong convergence of linear rank statistics for mixing processes. Teaming up with Barry Arnold, Dr. Ghosh studied characterizations of geometric distributions by distributional properties of order statistics and of the uniform distribution by identical distributions of sample spacings, the latter coauthored by J. S. Huang. Dr. Ghosh also completed a paper on the rate of convergence to normality for random means and U-statistics, with applications to sequential estimation.

Continuing earlier work, S. S. Yang has prepared a paper on the general distribution theory of the concomitants of order statistics.

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 and Oscar Kempthorne are project leaders.

Dr. Pollak conducted research related to the further development of the theory of selection in large populations with overlapping generations. He considered a diploid population, measured at time 0,1,2,. . ., in which there are h age groups among males and k age groups among females. It was assumed that, initially, there is random mating and no linkage disequilibrium, and that there is weak selection applied only once, at time 0. A formula was derived for the difference between the predicted mean of individuals of a particular age-sex class at time t and the mean of the individuals of this age-sex class in the original population. This generalizes other formulas for selective advance in the animal breeding literature. In the derivation the view was taken that if a descendant and an ancestor are observed at different ages, the character of the descendant is different from the character in the ancestor. It was

then necessary to obtain a general expression for the covariance between a random pair of relatives with a certain pattern of relationship, if one is measured in attribute X and the other in attribute Y. This general expression has application to human populations as well as those of domestic plants and animals.

Dr. Kempthorne has continued work on the problems of model formulation and interpretation of data on relatives in human populations. He also prepared a critical assessment of the status of the theory of quantitative genetics.

Drs. T. H. Emigh and E. Pollak have done further research on the effects of finite population size on genetic populations with overlapping generations. Results have been obtained for both monoecious and dioecious populations.

Dr. Emigh has completed a theoretical study of the analysis of determination and commonality and its implications for interpretation of data in humans on attributes in which both heredity and environment play a role.

J. R. Sedcole has made a critical study of the literature on heterosis.

J. Lewis has begun research on the mathematical theory for situations in which two or more species interact, such as, for example, the pathogen-host relationship. It is assumed that the probability that a host individual reproduces decreases as the probability of reproduction of the pathogen, with which it interacts, increases.

Linear Statistical Inference

David Harville pursued research on various topics related to linear models. A long review paper on maximum likelihood approaches to variance component estimation and to related problems was completed. Earlier results on the estimation of the effects of mixed linear models were extended. This work was supported by Air Force Office of Scientific Research Grant No. 76-3037, entitled "New Techniques for Linear Statistical Inference."

AES Project 2155

Research in sample design and estimation techniques for soil and farm characteristics was continued in the Survey Section under Agriculture Experiment Station Project 2155, with Roy D. Hickman as principal investigator. Cooperative work with the Soil Conservation Service (SCS), USDA, includes the design and analysis of several surveys: a study of windbreaks in five Great Plains states, an analysis of the effectiveness of the wind erosion model, and studies to estimate various types of potential soil erosion. To aid in the design of future surveys, work continues on variance estimation using data from past studies.

A three-phase inventory is currently being designed for the SCS. Almost 200,000 specific sample sites will be used in this national inventory, the primary objective of which is to provide estimates of soil erosion for each of the fifty states. Phase I of the study involves sheet, rill, and wind erosion; data are also being collected on land use, conservation needs, prime farmland, and potential cropland. Phase II will deal with erosion on streambanks, gullies, roadsides, and construction areas. Phase III will focus on sediment yields. Estimates obtained from this survey will assist the SCS in responding to a request for information from a select Senate Oversight Committee on Agriculture, Nutrition, and Forestry; it will also aid the SCS in planning future conservation programs.

Work continued on the storage, retrieval, and manipulation of the interpretive data of soil series in the United States, with interpretations for over 10,000 series now on file. Computer generated soil interpretations have assisted SCS field staff in requesting revisions to over 5,000 of the data records currently in storage. These data were printed in tabular format to be published in the SCS soil survey manuscripts for over 200 soil surveys. New methods of arranging the data to help the SCS staff compare and analyze this large data set are being developed. Other governmental and private agencies have requested portions of the interpretive data file to aid in their current work. Harvey Terpstra, who has primary direction of the soil interpretations project, continues to work closely with federal and regional SCS personnel in the design and development of this extensive data storage and analysis system.

Construction of area sampling frames continued under a cooperative agreement with the Statistical Reporting Service (SRS), USDA. This year sampling frames have been completed for North Dakota, Tennessee, and North Carolina. Using maps, aerial photographs, and information furnished by the states, strata are constructed on the basis of degree and type of cultivation; within strata, the land is subdivided into area sampling units. These area frames enable the SRS to design more efficient agricultural surveys. One of their primary purposes is to provide a basis for selecting the sample for the annual crop and livestock reporting survey conducted in June of each year.

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T. A. Bancroft and C. P. Han have been conducting joint research on estimating regression coefficients under conditional specifications.

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Robert Strahan continued research in three primary areas: personality assessment, psychometrics and statistics, and psychophysiology.

In personality assessment, Dr. Strahan conducted a number of studies investigating the construct validity of the internal-external locus of control

scale, personality characteristics of subjects volunteering for psychological experiments, various test-taking "sets" or attitudes, male versus female views of the ideal man and woman, and methodological issues in retrospective dream reports.

Research associated with intuitive perception of statistical relations, the analysis of absolute difference scores, and a power-like analysis relevant to hypothesis-testing was conducted in the psychometrics and statistics field. Critiques of papers dealing with the fixed versus random effects models, on the one hand, and the prediction of peak scientific creativity, on the other, were pursued.

Several studies in psychophysiology explored the properties of a new water bottle measure of emotional sweating.

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William Meeker has continued his research on accelerated life tests. Such tests are often necessary to obtain timely estimates of product reliability. Some of this work has been done in collaboration with statisticians at the General Electric Company Research and Development Center, Schenectady, New York.

Work is continuing on the development of a user-oriented computer program for identifying, fitting and forecasting ARIMA time series models.

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C. P. Cox carried out two preliminary experiments towards obtaining a simple procedure for assessing the effectiveness of instruction in a course such as Statistics 401. Questionnaires covering key terms and concepts were administered during the course, and student responses in terms of degrees of understanding were obtained in the first experiment. The results did permit assessment of increased comprehension attributable to repeated coverage of material but, expectedly, revealed appreciable differences between objective and subjectively assessed comprehension. The second experiment, accordingly, concentrated on the former and the results did show that the questionnaire procedure used could detect differences due to instructional techniques. This preliminary research is reported in a paper, "Experiments on the Evaluation of Course Instruction," which has been provisionally accepted for publication in the journal *Educational and Psychological Measurement.*

In other research, Mr. Cox has examined the structures of mathematical models for radio-immunoassay with particular reference to sources of variability which arise in practical assays.

Towards their M.S. creative component papers, Lorie Scholl and Sunday Osho have collaborated in these investigations by studying data supplied by Dr. A. H. Trenkle.

H. O. Hartley Retires as Director of the Institute of Statistics, Texas A & M

Having reached the age of 65, H. O. Hartley is retiring as Director of the Institute of Statistics, Texas A & M University. He will remain at Texas A & M on a part-time basis.

To mark the occasion of the 65th birthday, a volume honoring HOH will be published by Academic Press. It will contain 20 technical articles by former students, former and present colleagues, and other friends. Contributors from the Statistical Laboratory are Oscar Kempthorne, former colleague, as well as H. A. David and J. E. Gentle, former students. In a Greeting, one of three included in the volume, T. A. Bancroft points out that during HOH's decade at ISU (1953-63) he directed 17 Ph.D. theses, was author and co-author of some 40 research papers, and completed several books! Anyone who has been in contact with HOH will know that he did all these things unassumingly and with a twinkle in his eyes.

HOH continues to be held in the highest esteem here. We were delighted to have him back in Ames last year as Mu Sigma Rho Lecturer. Our warm wishes go to him for many more good years ahead.

Statistical Laboratory Visitors

The Statistical Laboratory welcomes a number of visitors and guests each year. Among those who visited this year was Ian Cox (August 30-September 2) from the Royal Melbourne Institute of Technology, Melbourne, Australia. Mr. Cox was gathering information and surveying the statistics courses offered in this Department. He is a senior lecturer responsible for the statistics courses within the Department of Mathematics and Computer Science.

Roger Arroyo, head of the biometry office of the Peruvian Ministry of Agriculture, visited the Statistical Laboratory September 6-10. He is in charge of in-service statistical training of agricultural experiment station staff members and was interested in ideas related to such educational programs.

Betty Laby, Department of Statistics, University of Melbourne, Australia, visited the Statistical Laboratory September 8-10 to exchange information on consulting and computing activities.

Professional Activities

Oscar Kempthorne was awarded an Iowa State University Faculty Citation at the Alumni Awards Convocation June 4. Dr. Kempthorne was recognized for his outstanding contributions in two major fields—statistics and statistical genetics. He is the author or co-author of several major books and many important research articles. He is a member of numerous statistical and scientific organizations; an elected member of the International Statistical Institute; and a Fellow of the American Statistical Association, Institute of Mathematical Statistics, and the American Association for the Advancement of Science.

Dr. Kempthorne received three degrees from Cambridge University, England: B.A., 1940; M.A., 1943; Sc.D., 1960. He began his career in the Department of Statistics, Iowa State University in 1947, attaining the rank of professor in 1951. In 1964 he was named a Distinguished Professor in the College of Sciences and Humanities.

Dr. Kempthorne at the fall Stat Lab picnic.

W. A. Fuller was elected to membership in the International Statistical Institute, a body of some 800 statisticians, now including six from Iowa State.

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For the American Statistical Association, H. A. David is a member of the Board of Directors; Bill Kennedy served as chairman, and James Gentle as secretary of the Statistical Computing Section. Dr. Gentle is also vice president of the Iowa chapter of the American Statistical Association.

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Bill Kennedy is chairman and James Gentle is an editorial board member of the Institute of Mathematical Statistics Committee on Mathematical Tables. H. A. David is chairman of the Committee on Fellows.

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H. T. David concluded two years as director of the national Visiting Lecturer Program in Statistics on December 31.

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D. F. Cox attended a conference on New Techniques in Data Analysis given by Drs. John W. Tukey and David Hoaglin at Southeastern Massachusetts University, North Dartmouth, June 13-17.

Malay Ghosh and Richard Groeneveld attended the regional conference on Robust Statistical Procedures at the University of Iowa, July 19-23. Ten lectures were given by Professor Peter J. Huber, ETH, Zurich, Switzerland.

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William Meeker is a member of an advisory board for a project entitled "Diagnostic and Instructional Service for Undergraduate Students in Statistics." The project is being funded through a National Science Foundation grant to the University of New Hampshire. As part of his duties, Dr. Meeker attended a meeting of the participants and the advisory board in Boston May 20-22.

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Harvey Terpstra spent September 27-30 in Lincoln, Nebraska, meeting with Soil Conservation Service personnel regarding the soil survey interpretations data systems. He met with SCS personnel in Washington, D.C., October 18-20 to discuss programming revisions for computer generated soil survey tables.

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Jeff Goebel held discussions and meetings relating to Soil Conservation Service projects at the SCS Washington, D.C., office on three occasions in November, March and June. He spent December 3 in Lubbock, Texas, conducting a project training session.

Tom Bubolz chaired a session at the second international conference of the Statistical Analysis Systems Users Group in New Orleans, Louisiana, January 3-5.

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Paul Hinz, Jeff Goebel, James Gentle, and Wayne Fuller attended an Institute of Mathematical Statistics Special Topic Conference, "Analysis of Large Data Sets," University of Texas, Dallas, February 23-25.

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Cardinal Key (Iowa State's highest honorary for junior and senior men) initiated Donald Hotchkiss as an honorary faculty member on May 6. Dr. Hotchkiss was one of three faculty men so honored.

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Iowa State University councils and committees for 1976-77 included the following members from the Statistics Department: Richard Mensing, Faculty Council and Faculty Council observer on the Athletic Council; Donald Hotchkiss, All-University Community Council, Committee on Instruction and chairperson of the Academic Standards Committee; H. T. David, Annuities and Insurance; and Bill Kennedy, Computer Advisory Committee.

Papers, Lectures, and Seminars

At the International Conference on Quantitative Genetics, Iowa State University, Ames, August 15-21:

Bailey, T. B.: "Selection Limits in Populations Formed from Homozygous Lines";

Kempthorne, O.: "The International Conference on Quantitative Genetics: Introduction";

Kempthorne, O.: "Status of Quantitative Genetic Theory";

Pollak, E.: "Selective Advance in Populations with Overlapping Generations."

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At the Institute of Mathematical Statistics meetings, Yale University, New Haven, Connecticut, August 18-21:

Ghosh, Malay and **Glen Meeden:** "An Admissible Estimator of the Number of Defectives";

Isaacson, Dean and C. C. Huang: "Strong Ergodicity Using Mean Visit Times";

Sotres, D. A. (Centro de Estadistica Y Calculo, Chapingo, Mexico) and **Malay Ghosh:** "Bahadur Representation of Quantiles in Non-Stationary Mixing Processes";

Sukhatme, Shashikala: "Bahadur Representation of Quantiles in Nonregular Cases."

H. T. David attended these meetings as director of the National Visiting Lecturer Program in Statistics.

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At the 1976 joint meetings of the American Statistical Association and the Biometric Society, Boston, Massachusetts, August 25-28.

Arnold, Barry and Leonor Laguna: "A Stochastic Mechanism Leading to Asymptotically Paretian Distributions";

Asok, C. (Maharashtra Association for the Cultivation of Science, Poona, India) and **B. V. Sukhatme:** "On the Efficiency of Two πPS Sampling Strategies";

Carter, R. L. (Department of Statistics, University of Florida, Gainesville) and **Wayne A. Fuller:** "Instrumental Variable Estimation of the Errors-in-Variables";

David, H. A. and **M. L. Moeschberger** (Department of Statistics, University of Missouri, Columbia): "Some Aspects of the Theory of Competing Risks";

Dickey, David (Department of Statistics, North Carolina State University, Raleigh) and **Wayne A. Fuller:** "Distribution of First Order Autoregressive Estimator";

Emigh, Ted (Department of Statistics and Computer Science, The University of Georgia, Athens): "The Effects of Finite Population Size on Genetic Populations with Age Structure";

Fuller, Wayne and **Michael Hidiroglu** (Statistics Canada, Ottawa): "Properties of the Correction for Attenuation Estimator";

Gentle, J. E., W. J. Kennedy, and **V. A. Sposito:** "Properties of the L_1-Estimate Space";

Goebel, Jeffery: "Applications of an Iterative Regression Technique to a National Potential Cropland Survey";

Hinz, Paul N. and Howard A. Eagles: "Estimation of a Transformation for the Analysis of Some Agronomic and Genetic Experiments";

Klemm, R. J. (Department of Statistics, Temple

University, Philadelphia) and **V. A. Sposito:** "Closed Form Least Squares Solutions over Inequality and Interval Constraints";

Meeker, William Q., Jr., and G. J. Hahn: "Optimum Allocation Schemes for Accelerated Tests to Estimate Survival Probability at a Design Stress";

Wolins, Leroy: "Secondary Analysis of Published Research in the Behavioral Sciences."

H. T. David attended the Boston meetings as an associate editor of the *Journal of the American Statistical Association* and participated in an editorial meeting. W. J. Kennedy served as Program Chairman of the Statistical Computing Section during these meetings. Edward Pollak was a discussant in a session, "Statistical Methods in Genetics."

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At the 42nd North American Wildlife and Natural Resources Conference, Atlanta, Georgia, March:

Wright, Vernon, **Thomas A. Bubolz,** Alice Wywialowski, and Robert B. Dahlgren: "Characteristics of Individuals Involved in Different Types of Hunting";

Dahlgren, Robert B., Alice Wywialowski, **Thomas A. Bubolz,** and Vernon L. Wright: "Influence of Knowledge of Wildlife Management Principles on Behavior and Attitudes Toward Resource Issues."

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At the Institute of Mathematical Statistics meetings, Chapel Hill, North Carolina, April 18-20:

Arnold, Barry and **Richard A. Groeneveld:** "Sounds on Expectations of Linear Systematic Statistics Based on Dependent Samples";

David, H. T. and **G. H. Kim:** "Bivariate Densities as Saddle Points of Mutual Information."

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At the joint meetings of the American Statistical Association and the Institute of Mathematical Statistics, University of Wisconsin, Madison, May 15-18:

Clark, Cynthia (Census Bureau, Washington, D.C.) and **H. T. David:** "Ergodicity and the Convergence of Conditional Distributions";

Ghosh, Malay: "On Characterizations of the Uniform Distribution Based on Identically Distributed Spacings";

Kennedy, W. J., J. E. Gentle, and **V. A. Sposito:** "Comparisons of Algorithms for L_1 Estimation in the Linear Model";

Kim, G. H., M. F. A. El Sabbagh (Gar Younis University, Benghazi, Libya), and **H. T. David:** "Lagrangian Duality and Large Deviations for Markov Chains";

Stangenhaus, Gabriela (University of Sao Paulo, Brazil) and H. T. David: "Kurtosis Revisited."

James Gentle organized and chaired a session "Computing for Robust Estimation" sponsored by the Statistical Computing Section.

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Arnold, Barry: "Marginally Determined Constraints on the Distribution of a Random Vector and Its Maximum Coordinate" (colloquium), Bell Labs, Holmdel, New Jersey, August 27;

"Distribution-free Bounds on the Mean of the Maximum of a Dependent Sample" (colloquium), Statistics Department, University of Missouri, Columbia, October 15.

Bailey, Ted: "Theoretical Evaluation of Some Alternative Breeding Schemes for the Development of Inbred Lines of Maize," at the joint meetings of the North Central Regional-21 Population Genetics Technical Committee, the Corn Quantitative Genetics Group and the North Central Regional-2 Corn Breeding Technical Committee, Chicago, Illinois, February 28-March 2;

"Interpretation of Results from Experimental Studies," Department of Horticulture, ISU, February.

Bancroft, T. A.: "The Dual Nature of Statistics: A Mathematical Science and a Part of Scientific Methodology," Department of Mathematical Sciences (Mathematics, Statistics, Computer Science), University of Missouri, St. Louis (Visiting Lecturer Program in Statistics), March 31.

Fuller, Wayne: "Errors in the Variables and the Correction for the Attenuation Estimator" (seminar), Carleton University, Ottawa, Canada, August 10.

Gentle, James: "Robust Estimation in a Transportation Model" at the Federal Energy Administration staff seminar, July 6;

"Testing for Outliers in a Linear Model" at University of Texas Graduate College of Business (seminar), Austin, February 24.

Goebel, Jeffery: "The Potential Cropland Survey and Other Work the Iowa State University

Statistical Laboratory Is Doing for SCS" (seminar), at the Natural Resources Economics Division of the Economic Research Service, USDA, Washington, D.C., November 18.

Hinz, Paul: "Some Graphical and Statistical Descriptions of Interaction," at the second International Annual Conference of the Statistical Analysis Systems Users Group, New Orleans, Louisiana, January 3-5.

Isaacson, Dean: "Ergodicity Versus Strong Ergodicity" (seminar), Mathematics Department, ISU, May 10.

Kempthorne, Oscar: "The Mixed Linear Model and Components of Variance," and "Heredity and I. Q." (seminars), University of Nebraska, Lincoln, February 3-4; University of North Carolina, Chapel Hill, February 15-16.

Kennedy, W. J. and **J. E. Gentle:** "Comparison of Algorithms for Minimum L_p Norm Linear Regression," at the tenth Annual Symposium on the Interface of Computer Science and Statistics, National Bureau of Standards, Gaithersburg, Maryland, April 14-17.

Meeden, Glen: "Choosing a Prior for a Binomial Testing Problem with Incomplete Knowledge," at the Regional Research Conference on Nonparametric Decision Theory, Columbus, Ohio, July 8-12.

Meeker, William Q., Jr.: "Optimum Allocation Schemes for Accelerated Tests to Estimate Survival Probability at a Design Stress" (seminar), Statistics Seminar Series, General Electric Corporate Research and Development Center, Schenectady, New York, August 6;

"Some Aspects of Over-stress Testing when Binary Responses Are Observed" (mathematics colloquium), Western Illinois University, May 6.

Strahan, Robert F. and Janet E. Nash: "Impact of the Straight-Leg Stressor on Two Palmar Sweat Measures and Skin Conductance" at the 16th annual convention, Society for Psychophysiological Research, San Diego, 1976;

Gilbert, Lucia, **Robert F. Strahan** and Connie J. Deutsch: "Clarification of the Bem Sex-Role Inventory" at the 84th annual convention of the American Psychological Association, Washington, D.C., 1976.

Sukhatme, B. V.: "Some Problems in Designing Surveys," Institute of Agricultural Research Statistics, New Delhi, India, June 28 and 30, 1976;

"Sampling with Unequal Probabilities and without Replacement," Indian Statistical Institute, Calcutta, July 1 and 2.

Sukhatme, Shashikala: "Bahadur Representation of Quantiles" (seminar), University of Poona, India, July 20.

International Conference on Quantitative Genetics Held at ISU

Between August 15 and August 21, 1976, Iowa State University hosted an International Conference on Quantitative Genetics organized by Edward Pollak, Oscar Kempthorne, and Theodore B. Bailey, Jr. The conference was fortunate in having presentations by many of the leading workers of the world in theory and applications.

Topics were discussed under the following themes:

(1) Implications of population genetics and molecular biology.
(2) What have we learned from laboratory species?
(3) Mathematical and statistical genetics.
(4) Theory of response and limits to selection.
(5) Results and theory with plants.
(6) Results and theory with animals.
(7) Mixed model theory in quantitative genetics.

There were also general papers, a special invited paper, invited discussions and contributed paper sessions.

Approximately 250 registrants attended the sessions including 36 invited speakers and 11 additional persons who presented contributed papers. Dr. Sewall Wright, Emeritus Professor of Genetics, University of Wisconsin, was a featured speaker for an evening session. His address, "Modes of Evolutionary Change of Characters," was one of the conference highlights.

Drs. Pollak, Kempthorne, and Bailey are editors of the conference *Proceedings,* which is being published by the Iowa State University Press.

Financial support for the conference was received from the National Science Foundation, National Institutes of Health, Pioneer Hi-Bred International, Inc., and the Iowa Beef Industry Council.

Participants of the International Conference on Quantitative Genetics are pictured on the steps of Fisher Theater, Iowa State Center. Front row (left to right) are conference organizers Drs. Bailey, Kempthorne, and Pollak; special invited speaker Sewall Wright, Professor Emeritus of Genetics, University of Wisconsin; and program committee member Jay L. Lush, ISU distinguished professor, Animal Science.

Publications and Dissertation Abstracts

Introduction to Statistical Time Series by Wayne Fuller and *Elements of Statistical Inference,* 4th edition, by David Huntsberger and Patrick Billingsley were published this year. Edward Pollak, Oscar Kempthorne and Ted Bailey are co-editors of the *Proceedings of the International Conference on Quantitative Genetics* currently being published by the Iowa State University Press.

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

H. T. David is methods and theory associate editor and book review associate editor of the *Journal of the American Statistical Association.* Wayne Fuller completed in December his term as applications associate editor for this journal.

T. A. Bancroft and Oscar Kempthorne are members of the editorial advisory board of the *Journal of Statistical Computation and Simulation.*

Oscar Kempthorne is an associate editor of *Theoretical Population Biology.*

H. A. David is chairman of the editorial board and Oscar Kempthorne is an associate editor for *Biometrics.*

Dr. Kempthorne is also a member of the editorial board of the *Journal of Statistical Planning and Inference.*

Bill Kennedy is an associate editor of *The American Statistician* and co-editor of *IMS Selected Tables in Mathematical Statistics.* Dr. Kennedy is a member of the editorial board for *Communications in Statistics, Series B.*

Reviewers for *Mathematical Reviews* during the year were: Barry Arnold, T. A. Bancroft, H. T. David, James Gentle, Malay Ghosh, C. P. Han, Dean Isaacson, Glen Meeden, and Edward Pollak.

Abstracts of papers and books published by staff members and graduate students and dissertation abstracts 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 (*).

Published Research

Four papers from staff members have appeared in the following volume:

Essays in Probability and Statistics, Ogawa Volume, (Ikeda, Hayakawa, Hudimoto, Okamoto, Siotani, Yamamoto, editors), Shinko Tsusho Co., Ltd., Tokyo, Japan, 1976.

Bancroft, T. A. and **Chien-Pai Han:** "On Pooling Means in Multivariate Normal Distributions," 353-363.

In estimating the mean of a multivariate normal distribution $N(\mu^{(1)}, \Sigma)$ a random sample of size N_1 is taken. Suppose a second independent random sample of size N_2 from $N(\mu^{(2)}, \Sigma)$ is available, and if $\mu^{(1)} = \mu^{(2)}$, then it is advantageous to pool the two samples and use the pooled estimator. In this paper we assume that Σ is known. In some experimental situations, it is not certain whether $\mu^{(1)} = \mu^{(2)}$. In such cases, one may perform a preliminary test of the hypothesis $\mu^{(1)} = \mu^{(2)}$. If the hypothesis is accepted, a pooled estimator for $\mu^{(1)}$ will be used; if the hypothesis is rejected, the experimenter uses only the first sample in the estimation procedure. The bias and mean square error of the preliminary test estimator are obtained and the relative efficiency to the estimator of $\mu^{(1)}$, based on the first sample alone, is discussed. Recommendations of the levels of the preliminary tests are made. A Bayes estimator is derived when the prior distribution of $\mu^{(1)} - \mu^{(2)}$ is multivariate normal.

Ghosh, Malay and Pranab Sen: Asymptotic Theory of Sequential Tests Based on Linear Functions of Order Statistics," 485-499.

Based on an almost sure Wiener process approximation for linear functions of order statistics along with the strong consistency of their variance estimates, a class of sequential tests is considered. These tests terminate with probability 1. Asymptotic OC and ASN functions are also studied.

***Kempthorne, Oscar:** "Best Linear Unbiased Estimation with Arbitrary Variance Matrix," 203-225. SLRS 386.

An elementary derivation is given of the basic aspects of best linear unbiased estimation in the case of a fixed linear model with an arbitrary covariance matrix, known apart from a scalar factor. The source of the difficulty with a singular matrix is pin-pointed. Two complementary approaches are given, one in terms of Lagrange multipliers and one in terms of linear operators on the space of vector observations. The results are given by Theorems 1, 2 and 3. Part of the thrust is to develop the matter with very *elementary* arguments so that the results will be available to a wide audience.

The relation of the material to finite randomization models is given. Asymptotic theory of randomized models is discussed.

O'Connell, M. J. (Upjohn Company, Kalamazoo, Michigan) and **H. A. David:** "Order Statistics and Their Concomitants in Some Double Sampling Situations," 451-466.

In double sampling the values of an auxiliary

variable X for n individuals are used to improve the estimate of the mean μ_y of the main variate Y, values of which are available only for k ($< n$) of the individuals. When Y is linearly related to X, except for an error term, this paper examines the question of which individuals should be selected for measurement of Y, the selection being based on their rank among the values of X and depending also on the particular estimator of μ_y employed. A natural regression estimator and several estimators requiring knowledge of only the ranks of the X's are investigated. When X is normal, numerical comparisons show that the simple average of k suitably selected Y-values is approximately as efficient as the regression estimator unless X and Y are highly correlated. A comparison with ranked-set sampling is also made.

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Alders, C. D. (Mankato State University, Mankato, Minnesota) and **V. A. Sposito:** "On a Sufficient Optimality Condition over Convex Feasible Regions," *Bull. Austral. Math. Soc.* 16 (1977) 199-202.

Kuhn-Tucker type conditions are shown to be sufficient optimality conditions for certain types of nonlinear programming problems. This larger class of problems involves models with pseudo-convex objective functions and convex feasible regions over arbitrary, not necessarily convex, cone domains. The proof of this result is based on a modified theorem of the alternative.

*__Andriano, Kim, James E. Gentle,__ and **V. A. Sposito:** "On the Asymptotic Bias of Grenander's Mode Estimator," *Commun. Statist.-Theor. Meth.* A6:8 (1977) 773-776. SLRS 401.

Grenander introduced a direct estimator of the mode for a large class of densities. This note considers a large subclass of these densities for which Grenander's estimator is asymptotically biased. Some of the distributions from this subclass include the F, gamma, and beta for which asymptotic expressions for the bias are given. To reduce the bias, it is recommended to choose larger values for one of the parameters of the estimator when the underlying distribution is nonsymmetric.

Arnold, Barry C. and **Malay Ghosh:** "A Characterization of Geometric Distributions by Distributional Properties of Order Statistics," *Scandinavian Actuarial Journal* (1976) 232-234.

Let X_1, X_2 be independent identically distributed positive integer valued random variables. If the X_i's have a geometric distribution, then the conditional distribution of $R = \max(X_1, X_2) - \min(X_1, X_2)$, given $R > 0$, is the same as the distribution of X_1. This property is shown to characterize the geometric distribution.

*__Arnold, Barry C.__ and Leonor Laguna: "A Stochastic Mechanism Leading to Asymptotically Paretian Distributions," Business and Economic Statistics Section, *Proceedings of the American Statistical Association* (1976) 208-210. SLRS 388.

A r.v. X is said to have a Pareto III distribution if its survival function is of the form

$$\overline{F}(x) = (1 + (\frac{x - \mu}{\sigma})^{1/\gamma})^{-1}; \quad x \geq \mu$$

and we write $X \sim P(III)(\mu, \sigma, \gamma)$. When $\mu = 0$, the Gini index of the distribution is equal to γ. Suppose X_1, $X_2 \ldots$ are i.i.d. nonnegative r.v.'s with common d.f. F. Let N be a geometric (p) r.v. independent of the X_i's and define $Z = \min(X_1, X_2, \ldots, X_N)$. Theorem:

$$[\lim_{x \to 0} x^{-1/\gamma} F(x) = (1/\sigma)^{1/\gamma} \text{ and } p^{\gamma} Z \stackrel{d}{=} X_1]$$

iff

$$[X_1 \sim P(III)(0, \sigma, \gamma)].$$

The condition on the behavior of F(x) for x near 0 can be dispensed with if we assume

$$p^{\gamma} Z \stackrel{d}{=} X_1, \ \forall p \epsilon (0, 1).$$

A related limit theorem suggests that a stochastic mechanism involving repeated geometric minimization would lead to Pareto (III) distributions. Thus if individuals ask for salaries cp^{-1} times as large as last year (cp^{-1} representing an inflation factor) and if the employer interviews a geometrically distributed number of individuals and hires the one requesting the smallest salary, then in the long run a Pareto (III) income distribution will be encountered. Related characterizations and limit theorems for the logistic distribution are obtainable by considering log X instead of X throughout.

Arnold, Barry C. and **Dean Isaacson:** "On Solutions to $\min(X, Y) \stackrel{d}{=} aX$ and $\min(X, Y) \stackrel{d}{=} aX \stackrel{d}{=} bY$, *Z. Wahrscheinlichkeitstheorie verw. Gebiete* 35 (1976) 115-119.

Suppose that the minimum of a pair of independent nonnegative random variables X and Y has the same distribution, up to a scale factor, as the first of the two random variables. The restricted class of possible distributions for X and Y is identified. If, in addition, it is required that X and Y have distributions only differing by a scale factor, it is shown under mild regularity conditions that X and Y have Weibull distributions.

*__Asok, C.__ (Maharashtra Association for the Cultivation of Science, Poona, India) and **B. V. Sukhatme:** "On Sampford's Procedure of Unequal Probability Sampling without Replacement," *Journal of the American Statistical Association* 71:356 (1976) 912-918. SLRS 384.

Among the unequal probability sampling without replacement procedures applicable for arbitrary sam-

ple size, those of Goodman and Kish and of Sampford are relatively simple to operate besides satisfying the criterion that the inclusion probability of each population unit is proportional to its size. Considering the Horvitz-Thompson estimator for estimating the population total, we show in this paper that Sampford's procedure is more efficient than the Goodman and Kish procedure. Our result is a generalization of Rao's result wherein he compared Durbin's procedure with that of Goodman and Kish.

*Asok, C. and B. V. Sukhatme: "On the Efficiency Comparison of Two πps Sampling Strategies," Social Statistics Section, *Proceedings of the American Statistical Association* (1976) 161-166. SLRS 391.

For estimating the population total of a characteristic y under study defined over a finite population we consider the πps sampling strategies of Goodman and Kish and of Hanurav. Using the asymptotic approach of Hartley and Rao, it is shown that the strategy of Goodman and Kish has a uniformly smaller variance than Hanurav's strategy when the variance is considered to $O(N^{-1})$. In order to have an idea in the case of smaller size populations the variances of the two strategies have been compared using a well known super population model and assuming that the auxiliary variable has a chi-square, beta or a uniform distribution. Results are illustrated with the help of actual data.

Battese, G. E. (Univ. of New England, Armidale, Australia), **W. A. Fuller,** and **R. D. Hickman:** "Estimation of Response Variances from Interview-Reinterview Surveys," *The Journal of Indian Society of Agricultural Statistics,* New Delhi, XXVIII:2 (1976) 1-14.

It is assumed that interview and reinterview responses are obtained under the same survey conditions from a sample of individuals. Estimators for the enumerator and respondent components of the response errors are presented. Also defined are estimators for the variances of the variance-component estimators. Empirical results are presented for a survey that was conducted in 1970 by the Statistical Laboratory of Iowa State University.

*David, H. A., M. J. O'Connell (Upjohn Company, Kalamazoo, Michigan), and S. S. Yang (Massachusetts Institute of Technology, Cambridge, Massachusetts): "Distribution and Expected Value of the Rank of a Concomitant of an Order Statistic," *The Annals of Statistics* 5:1 (1977) 216-223. SLRS 393.

Let (X_i, Y_i) be n independent rv's having a common bivariate distribution. When the X_i are arranged in nondecreasing order as the order statistics $X_{r:n}$ $(r = 1,2,\ldots,n)$, the Y-variate $Y_{[r:n]}$ paired with $X_{r:n}$ is termed the concomitant of the rth order statistic. The small-sample theory of the distribution and expected value of the rank $R_{r,n}$ of $Y_{[r:n]}$ is studied. In the special case of bivariate normality an illustrative table of the probability distribution of $R_{r,n}$ is given. A more extensive table of $E(R_{r,n})$ is also provided and it is found that asymptotic results require comparatively small finite-sample corrections even for modest values of n. Some applications are briefly indicated.

Fuller, Wayne: *Introduction to Statistical Time Series,* John Wiley and Sons, Inc., New York (1976) 470 pages.

The book provides an introduction to representations for statistical time series and to the estimation of time series models. Both the time domain and frequency domain approaches are developed. Univariate time series are emphasized, but vector time series are also discussed.

Estimation in the time domain is the book's strongest area. The description of the autoregressive and moving average representations and of the estimation for such models is relatively complete. Use of regression techniques and regression ideas in the estimation of these models is emphasized. Estimation of regression models with time series errors is also treated.

Graduate students or advanced undergraduates who have had a statistical theory course which included regression analysis are the target group for whom this textbook was written.

Fuller, Wayne A.: "Some Properties of a Modification of the Limited Information Estimator," *Econometrica* 45:4 (1977) 939-953.

Modifications of the limited information estimator and of the fixed k-class estimator that possess finite moments are presented. It is demonstrated that, through terms of $O(T^{-2})$ where T is the sample size, the fixed k-class estimator is dominated by the modification of the limited information estimator.

*Fuller, Wayne A: "Regression Analysis for Sample Survey," *Sankhyā* 27:C3 (1975) 117-132. SLRS 398.

The estimation of regression equations for a sample selected from a finite population is investigated. In all derivations, the finite population is treated as a sample from an infinite population. The regression coefficients are shown to be asymptotically normal, given mild assumptions. Relatively simple expressions for the covariance matrix of the regression coefficients are presented.

Procedures for estimating the structural parameters in the presence of response error are presented. Given knowledge of the response variance, the computations required to estimate the structural parameters and their standard errors are essentially equivalent to those required for the computation of the regression coefficient and its standard error in the absence of response error.

Gentle, J. E., V. A. Sposito, and **W. J. Kennedy:** "On Some Properties of L_1 Estimators," *Journal of Mathematical Programming* 12:1 (1977) 139-140.

This communication considers properties of optimal hyperplanes using the L_1 norm criterion, and relaxes conditions used in theorems given by Appa and Smith. In particular, it is shown that there always exists an optimal L_1 hyperplane which passes through r observation points, where r is the rank of the design matrix, and where the total number of observations exceeds the number of unknown parameters plus one.

Gentle, J. E., W. J. Kennedy, and **V. A. Sposito:** "Properties of the L_1 Estimate Space," Statistical Computing Section, *Proceedings of the American Statistical Association* (1976) 163-164.

***Ghosh, Malay** and **Glen Meeden:** "How Many Tosses of the Coin?" *Sankhyā* 37:A,4 (1975) 523-529. SLRS 397.

Let X be a binomial (θ, p) random variable where θ is an unknown parameter contained in the set $\Theta = \{0,1,2\ldots\}$ and where $p\epsilon(0,1]$ is a fixed known number. For estimating θ with squared error loss we show that X/p is admissible.

Ghosh, Malay and **Glen Meeden:** "Nonparametric Minimax Estimation of the Mean," *Calcutta Statistical Association Bulletin* 25 (1976).

The paper considers the problem of minimax estimation of the mean when no parametric model is assumed and when the loss is of a fairly general type including the quadratic loss as a special case. For a sample of size one, it investigates necessary and sufficient conditions under which the sample mean is the unique minimax estimator of the population mean.

Babu, G. Jogesh and **M. Ghosh:** "A Random Functional Central Limit Theorem for Martingales," *Acta Mathematica Academiae Scientiarum Hungaricae* 27:3-4 (1976) 301-306.

An invariance principle for martingales with random indices is proved. The results include all earlier available central limit theorem results for random martingales.

***Ghosh, Malay** and Gutti Jogesh Babu: "Probabilities of Moderate Deviations for Some Stationary ϕ-Mixing Processes," *The Annals of Probability* 5:2 (1977) 222-234. SLRS 394.

Probabilities of moderate deviations of the sample mean from the population mean are calculated for certain strictly stationary ϕ-mixing processes.

***Ghosh, Malay** and **Glen Meeden:** "On the Nonattainability of Chebyshev Bounds," *The American Statistician* 31:1 (1977) 35-36. SLRS 392.

Let $X_1, \ldots, X_n$ constitute a random sample of size n from a distribution with finite second moment. With the notations

$$\overline{X}_n = n^{-1}\sum_1^n X_i, \mu = E(X_1) \quad \text{and} \quad \sigma^2 = V(X_1),$$

the usual version of the Chebyshev inequality is

$$P(|\overline{X}_n - \mu| \geq K\sigma) \leq (nK^2)^{-1} \qquad (1)$$

for any $K > 0$. The present note proves a theorem which settles the question of attainability of the bound (1) for all $n \geq 1$ and all $K > 0$.

Gallant, A. Ronald and **J. Jeffery Goebel:** "Nonlinear Regression with Autocorrelated Errors," *Journal of the American Statistical Association* 71 (1976) 761-767.

An estimator of the parameters of a nonlinear time series regression is obtained by using an autoregressive assumption to approximate the variance-covariance matrix of the disturbances. Considerations are set forth which suggest that this estimator will have better small sample efficiency than circular estimators. Such is the case for examples considered in a Monte Carlo study.

Harville, David: "Maximum Likelihood Approaches to Variance Component Estimation and to Related Problems," *Journal of the American Statistical Association* 72:358 (1977) 320-340.

Several recent developments promise to increase greatly the popularity of maximum likelihood (ML) as a technique for estimating variance components. Patterson and Thompson (*Biometrika*, Vol. 58, December, 1971. 545-554) proposed a restricted maximum likelihood (REML) approach which takes into account the loss in degrees of freedom resulting from estimating fixed effects. Miller (Technical Report No. 12, Department of Statistics, Stanford University, 1973) developed a realistic asymptotic theory for ML estimators of variance components. There are many iterative algorithms that can be considered for computing ML or REML estimates of variance components. Some were developed specifically for the variance component problem and related problems. Others are general nonlinear optimization procedures. The computations on each iteration of these algorithms are those associated with computing estimates of fixed and random effects for given values of the variance components. MINQUE's of variance components can be computed from one iteration of the REML version of Anderson's (*Annals of Statistics*, Vol. 1, January, 1973, 135-141) iterative procedure.

Harville, David: "The Use of Linear-Model Methodology to Rate High School or College Football Teams," *Journal of the American Statistical Association* 72:358 (1977) 278-289.

A procedure for rating high school or college foot-

ball teams is developed by applying linear-model methodology to the point spread for each game. The model equation includes effects for the home-field advantage and for the mean performance levels of the participating teams. The procedure can be modified to use only win-loss information or to ignore victory margins greater than a given margin. When applied to the results of the 1975 college football season, it produced predictions for future games whose accuracy compares favorably with those of sportswriters and bookmakers.

*Hinz, P. N., R. Shorter, P. A. DuBose (Weyerhaeuser Technical Center, Longview, Washington), and S. S. Yang (M.I.T., Cambridge, Massachusetts): "Probabilities of Selecting Genotypes when Testing at Several Locations," *Crop Science* 17 (1977) 325-326. SLRS 403.

When lines are grown in each of several locations in a plant breeding program, the rankings will seldom agree. The extent of the disagreement depends on the heritability of the trait being measured. Probabilities of any given line being selected in at least one location are presented. Use of these probabilities to aid in making decisions about resource allocation concerning the number of lines to be selected per location, the number of replications to be used, and the number of locations to use in a plant breeding program is discussed. These probabilities are correct even in the presence of genotype-environmental interactions involving changes in magnitudes of means but not rankings.

Eagles, H. A., **P. N. Hinz,** and K. J. Frey: "Selection of Superior Varieties of Oats (*Avena sativa* L.) by Using Regression Coefficients," *Crop Science* 17 (1977) 101-105.

Regression on environmental mean was investigated for measuring production stability of grain and straw yields of 80 lines of oats (*Avena sativa* L.) tested in 24 field environments. Mean squares for heterogeniety among regressions suggested that the regression parameter was not heritable for grain yield, but may be heritable for straw yield. The regression lines for straw yield tended to converge at an environmental yield level below that level normally used for oat production. Therefore, selection with the use of mean yields alone would save cultivars that are superior at all yield levels. This situation was attributed to a high correlation between regression coefficients and mean yields.

Analyses were conducted on direct and cube-root scales of measurement. The cube-root scale was chosen to reduce the heterogeniety of error mean squares obtained from the 24 individual environments, but also was found to reduce the significance of the mean squares for heterogeniety among regressions. The effect of a transformation of the data on heterogeniety and usefulness of regression coefficients is discussed.

Chyr, Chu-Ying Lou, Homer W. Walker, and **Paul Hinz:** "Influence of pH, Temperature, Curing Agents, and Water Activity on Germination of PA 3679 Spores," *Journal of Food Protection* 40:6 (1977) 369-372.

Journal paper J-8603, Iowa Agriculture and Home Economics Experiment Station, Ames, Project 2201.

The influence of pH, temperature, water activity and curing agents on germination of spores of *Clostridium sporogenes* (PA 3679) was examined. The most influential factor was pH; least germination occurred at pH 5.5 and most at pH 7.0, the highest pH tested. Germination occurred over a temperature range of 4 to 55 C, with maximal germination at 35 and 45 C. NaCl was more inhibitory than $NaNO_2$ and $NaNO_3$ at pH 7.0 at the levels used. At pH 5.5 and 6.0, $NaNO_2$ stimulated germination.

Eldridge, W. D., **P. N. Hinz,** and M. W. Weller: "Controlled Waterfowl Hunting at Lake Odessa, Louisa County, Iowa," *Proceedings of the Iowa Academy of Sciences* 83:12 (1976) 71-76.

The Lake Odessa Public Hunting Area supports two systems of regulated waterfowl hunting. Control Area A consists of 55 marked blind sites which are chosen randomly by hunters during a daily drawing. Hunters using the second area, Control Area B, are not restricted to blind sites and a daily fee is not required, but all parties must possess valid permits.

Hunter use and hunter success during the 1972 and 1973 seasons are discussed for each area. Differences in characteristics of hunters using the two areas are noted, and the relation of vegetation to hunter success is described.

Ho, Chung-Man and **James E. Gentle:** "Clock-Pulse and Event Algorithms for Simulation of Traffic Flow," *Simuletter* 8:1 (1976) 53-55.

The clock pulse and event algorithms are compared for efficiency at various activity levels of a simulation of traffic flow. For low levels of system activity the event algorithm is more efficient (in terms of ratio of real time to simular time). As system activity is raised, the increase in the relative efficiency of the clock pulse algorithm is studied empirically.

Huntsberger, David V. and Patrick Billingsley, *Elements of Statistical Inference,* 4th edition, Allyn and Bacon, Inc., Boston, 1977, 385 pp.

This book offers students from a variety of disciplines in engineering and the humanities an elementary text in statistical techniques. Emphasis is placed on understanding the reasoning underlying these techniques. Mathematical prerequisites are minimal; arithmetic and a little algebra will suffice. The methods covered are not peculiar to one field of application alone but apply to all subjects in which statistics is used. The book also provides a base from

which students can proceed to more advanced work, including specialized applications.

Huang, Cheng-Chi, **Dean Isaacson,** and B. Vinograde: "The Rate of Convergence of Certain Nonhomogeneous Markov Chains," *Z. Wahrscheinlichkeitstheorie Verwandte Gebiete* 35 (1976) 141-146.

Let $\{X_n\}_{n=1}^{\infty}$ be a nonhomogeneous Markov chain with transition matrices $\{P_n\}_{n=1}^{\infty}$. Assume that P_n converges to a stochastic matrix P and that P is strongly ergodic (that is, P^n converges to a row-constant stochastic matrix Q). It is known that in this case the product

$$P_{m+1}P_{m+2}\cdots P_{m+n}$$

converges uniformly in m to the row-constant matrix Q. In this paper the rate of convergence of the product $P_{m+1}P_{m+2}\cdots P_{m+n}$ to Q is determined in terms of the rate of convergence of P_n to P.

***Johnson, J. P.**(Aerospace Corporation, Riverside, California), **T. A. Bancroft,** and **C. P. Han:** "A Pooling Methodology for Regressions in Prediction," *Biometrics* 33 (1977) 57-67. SLRS 390.

When two or more regression equations are the same, it is advantageous to pool the data for making inference about the population regression model of interest. This paper derives the biases and mean square errors of estimation procedures subsequent to preliminary tests for the cases of pooling two or more linear regression lines, and pooling two multiple regressions. Relative efficiencies of the sometimes-pool predictor to the never-pool predictor are obtained, and recommendations of the levels of the preliminary tests are made so that the efficiency of predictions with the final fitted regression will be at a prescribed level.

Jordan, L. and **O. Kempthorne:** "Minaverage Bias Estimable Designs," *Estadistica* XXXI:116 (1977) 66-79.

This paper discusses designs which yield minimization of average mean square bias and estimation of this when a polynomial of lower degree than the true model is fitted to the data. Suppose we fit a polynomial of degree s and the true underlying model is a polynomial of degree t, with $t > s$. If we have an unbiased estimator of σ^2, a sufficient condition to have the average square bias estimable, is that the design moments up to the order 2t be equal to the corresponding moments of a beta distribution Be(1,1) over the region of interest. It is also suggested that one should incorporate terms only to the point at which the F ratio for lack of fit is less than 2. Some examples of designs for very simple cases are given.

Kempthorne, Oscar: "Discussion of 'On Rereading R. A. Fisher' by L. J. Savage," *Annals of Statistics* 4 (1976) 441-500.

The late L. J. Savage gave the Fisher Memorial Lecture in Detroit on 29 December, 1976. The lecture was written up by J. W. Pratt and was discussed by Kempthorne among others. Curiosities, possible defects and possible contradictions in some of Fisher's work are discussed.

*Giesbrecht, F. and **O. Kempthorne:** "Maximum Likelihood Estimation in the Three-parameter Lognormal Distribution," *Journal of the Royal Statistical Society, Series B* (1976) 257-263. SLRS 385.

Journal Paper J-7985, Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa, Project 890; partial support by the National Science Foundation Grant NSF-G14327.

Several authors (Hill, 1963; Box and Cox, 1964; Harter and Moore, 1966) have discussed the problem of estimating a. μ and σ^2 where observations x_i, $i = 1, 2, \ldots, n$, are available such that $y = \log(x+a)$ has normal distribution with mean μ and variance σ^2. In this paper it is shown that the difficulties encountered because the "likelihood" becomes unbounded are avoided if one takes into account the grouping error inherent in the data and uses the "correct" likelihood (Kempthorne and Folks, 1971; Copas, 1972). The behavior of the maximum likelihood estimators is investigated using asymptotic theory and Monte Carlo simulations.

***Kempthorne, Oscar:** "Of What Use Are Tests of Significance and Tests of Hypothesis," *Commun. Statist. Theor. Meth.*, A5:8 (1976) 763-777. SLRS 378.

This paper discusses the role of significance testing, in contrast to hypothesis testing. It takes the view that the two processes must be differentiated because they are in fact different even though they possess some common mathematical features. A supporting view of significance testing is presented. Difficulties and obscurities are discussed.

***Kempthorne, Oscar:** "Why Randomize?" *Journal of Statistical Planning and Inference* 1 (1977) 1-25. SLRS 399.

Journal Paper J-8506, Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 890.

This essay attempts to present forceful arguments that justify randomization and randomization inference as a procedure of experimental inquiry. Part of the basis is surely that there can be no unique way of analyzing data of an experiment. One wishes to compare treatments with the restriction that observations on different treatments are on different experimental units. Without the infusion of some unjustifiable assumptions, an observed difference between two treatments can be rationally explained as a difference between sets of units receiving each of

the treatments. One should surely search the data for the "best" model, but this platitude is of little definitive help because to state criteria for a "best" model is very difficult and perhaps impossible. Randomization leads to randomization analysis and randomization tests and these have the supporting property of known frequency behavior in repetitions. The critical and unarguable points about data analysis are that one never knows the true model and one must therefore follow a model search process. When this is done, properties relating to frequency in repetitions are lost. Randomization and randomization inference mitigates strongly this difficulty. General discussion is given. Finally, difficulties associated with randomization inference in the presence of concomitant variables are discussed briefly.

Klemm, R. J. (Temple University, Philadelphia) and **V. A. Sposito:** "Closed Form Least Squares Solutions over Constraints," Business and Economic Section, *Proceedings of the American Statistical Association,* (1976) 392-396.

Meeden, Glen and **Barry Arnold:** "Characterization of Distributions by Sets of Moments of Order Statistics," *Annals of Statistics* 3:3 (1975) 754-758.

It is known that the set $M = \{\mu_{r,n}; r = 1,2,\ldots,n; n = 1,2,3,\ldots\}$ of expectations of order statistics of samples from a distribution F completely determines F. Several authors have shown that certain subsets of M determine F. In this note, conditions are derived which are sufficient for a proper subset of M to determine F.

Meeker, William Q., Jr., Gerald J. Hahn, and Paul I. Feder: "New Bias Evaluation Features of EXPLOR—A Program for Assessing Experimental Design Properties," *The American Statistician* 31:2 (1977) 95-96

This note announces and describes EXPLOR II, a generalized version of EXPLOR, a previously available user-oriented program designed for use in evaluating, comparing, and selecting experimental designs and as a teaching tool. Based on a specification of the proposed design points and the assumed statistical model, EXPLOR provides information concerning the precision of the estimated model coefficients and predicted responses and calculates various design properties such as variance inflation factors, the eigenvalues and eigenvectors of the X′X and correlation matrices, the determinant of the X′X matrix and the trace of its inverse. In addition, EXPLOR II permits evaluation of bias due to incorrect model specification.

Hahn, Gerald J., **William Q. Meeker, Jr.,** and Paul I. Feder: "The Evaluation and Comparison of Experimental Designs for Fitting Regression Relationships," *Journal of Quality Technology* 8:3 (1976) 140-157.

The purpose of this paper is to show some of the many things one can learn about the adequacy of a proposed experimental plan before any data are collected. These permit one to evaluate whether a suggested design is appropriate and to compare alternative possible designs. The discussion deals with experiments involving controlled variables which are quantitative and which are to be related to the response variable by a least squares regression fit. A recently developed computer program which permits easy implementation of the procedures is indicated. The evaluations are illustrated in detail by a numerical example.

Kamen, Alec, Joseph Schmee, and **William Meeker:** "Propriety of Using Percentages in Reporting Anticariogenic Studies," *Journal of Dental Research* 55:4 (1976) 703.

Usually, when the efficacy of an anticariogenic agent is to be determined, a clinical trial is conducted in order to compare the treatment with a control. Although the statistical analysis of the data is on the difference between the two means of cariogenic increment, and confidence intervals are generally presented for this quantity, the discussion is usually in terms of percentage improvement. This note shows how a method of Bliss can be used to construct a confidence interval for percentage improvement which will give more insight into the practical value of the anticariogenic treatment. A numerical example is given.

***Narain, Prem** (Institute of Agricultural Research Statistics, New Delhi, India) and **Edward Pollak:** "On the Fixation Probability of a Gene under Random Fluctuations in Selection Intensities in Small Populations," *Genetical Research* 29:2 (1977) 113-121. SLRS 404.

Journal Paper J-8525, Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 1669; partial support by National Institutes of Health Grant GM-13827.

A population with N monoecious individuals, and having two alleles, is considered. The problem of calculating the fixation probability of a particular allele under random fluctuation of selection intensities is reexamined, employing finite Markov chain methods. An approximate but general expression for this probability is obtained, and the results obtained by previous workers are shown to be special cases of this result.

***Pollak, Edward** and **Barry C. Arnold:** "Distributions of Times Spent in Various States in Some Absorbing Processes Arising in Genetics," *Proceedings of the Washington State University Conference on Biomathematics and Biostatistics,* May, 1974 (1977) 145-169. SLRS 395.

Journal Paper J-7970, Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 1669; partial support by National Institutes of Health Grant GM-13827.

A finite monoecious population that is of size N in

every generation is considered. The distribution of V_{ij}, the number of visits to frequency j/2N, given the initial frequency i/2N, is geometric. The parameters of this distribution are dependent on b_{ij} and b_{ji}, where b_{uv} denotes the mean number of visits to frequency v/2N, given initial frequency u/2N. In principle, the set of b_{ij},s is computable by inverting a matrix with 2N-1 rows and columns. This is difficult if N is large so that recourse is usually had to the diffusion approximation or the branching process approximation. The accuracy of the approximations is checked for various values of N when there is no selection.

A formula is also derived for the covariance of the number of visits to frequencies j/2N and k/2N, given initial frequency i/2N, where $j \neq k$. Knowledge of these covariances, and of the means and variances of number of visits to particular states, allow for a way of testing whether there is no selection at a locus.

*__Pollak, Edward:__ "Effective Population Numbers and Their Interrelations," *Proceedings of the Washington State University Conference on Biomathematics and Biostatistics, May, 1974* (1977) 115-144. SLRS 396.

Journal Paper J-7913, Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 1669; partial support by National Institutes of Health Grant GM-13827.

It is assumed that there is originally a very large population having a Hardy-Weinberg structure, which is then divided into very many subpopulations that do not interbreed thereafter. The subpopulations, or lines, are then all subjected to the same sequence of finite sizes as generations pass and there is random union of gametes in every generation. The inbreeding effective number N_{eI} and the variance effective number N_{ev} play analogous roles in the respective changes, in one generation, of the inbreeding coefficient and the between lines variance of the frequencies of a particular gene.

A new derivation is given for N_{eI} in monoecious and dioecious populations. New derivations are then given for variance effective numbers, making use of the expressions for N_{eI}. The effective numbers in monoecious populations and N_{eI} in a dioecious population are the same as those given earlier in the literature. If the population is dioecious and large, N_{ev} is what N_{eI} would be if it were measured one generation later. If the population size changes from one generation to the next, this result is not consistent with an earlier result in the literature.

*__Pollak, Edward:__ "A Stochastic Theory for Rare Genes in Large Populations with Overlapping Generations," *Theoretical Population Biology* 10:2 (1976) 109-126. SLRS 383.

Journal Paper J-8240, Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 1669; partial support by National Institutes of Health Grant GM-13827.

In this paper there is developed a stochastic theory for rare and nonrecessive genes in large populations that may have individuals of several age groups present at one time. The analysis is based on an age-dependent branching process due to Goodman. An approximate formula for the probability of extinction of a line of mutant genes, originating in an ancestral heterozygote in age group 0, is calculated. Expressions are also given for the asymptotic rates of approach of the probabilities of extinction of lines at finite times to their limiting values. These expressions apply regardless of the age of the ancestral heterozygote or whether the line has a positive probability of surviving indefinitely. Mean frequencies at equilibrium are calculated when there is recurrent mutation to an unfavorable gene.

__Promnitz, Lawrence C.__ and John W. Hazard: "Multipurpose Surveys: A Question of Optimal Design," in Alan R. Ek, James W. Balsiger and Lawrence C. Promnitz (eds.) *Forest Modeling and Inventory,* Forest Service, U. S. Department of Agriculture, Washington D.C. (1975) 69-85.

__Promnitz, L. C.;__ "A Photosynthate Allocation Model for Tree Growth," *Photosynthetica* 9:1 (1975) 1-15.

Journal Paper J-7367, Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa, Projects 1872 and 1877.

A model based on the physiological processes of photosynthesis, respiration, and the distribution of photosynthate to growth areas of the plant is mathematically expressed as a system of differential equations. Dry weight data were collected for a *Populus* clone and analyzed in terms of the distribution of photosynthate. This information was then combined with independent laboratory research on photosynthetic and respiration rates in order to simulate individual tree growth. The results indicate that the model has a high degree of sensitivity to data inputs and should therefore be useful as a research tool in simulation studies.

__Sposito, V. A.:__ A Remark on Algorithm AS74: "L_1-norm Fit of a Straight Line," *Journal of the Royal Statistical Society, Series C,* 25:1 (1976) 96-97.

In a recent L_1-norm algorithm, Algorithm AS 74 (Sadovski, 1974), the author has incorporated a failure check (IFAULT) in his program. This indicator is set to 2 if convergence of the algorithm has not been achieved by the nth iteration. The author states in passing that this algorithm has never failed to converge and cycling "might be impossible."

This note provides a simple example which will never converge.

__Sposito, V. A.__ and __G. F. McCormick__ (John Deere, Hanover, Illinois): "Using the L_2 Estimator in L_1 Estimation," *SIAM Journal on Numerical Analysis* 13:3 (1976) 424-429.

This paper investigates the advantages of using prior knowledge as a starting point in the "improved" L_1-algorithm of Barrodale and Roberts. In particular, it is shown that if the least squares estimator is

available, then this estimator can be used to reduce considerably the number of iterations in Barrodale and Roberts' algorithm.

Sposito, V. A. and **K. Pinski** (Trane Company, LaCrosse, Wisconsin): "Consistency of the Normal Equations," *Communications in Statistics—Theor. Meth.*, A5:11 (1976) 1055-1057.

This educational note provides an alternative proof of consistency of the normal equations by appealing only to the well-known fundamental theorems of linear programming. A modified version of the classical Farkas' lemma is also proved in this note.

Sposito, V. A. and W. C. Smith: "On a Sufficient Condition and a Necessary Condition in L_1 Estimation," *The Journal of the Royal Statistical Society, Series C* 25:2 (1976) 154-157.

Recent published results by Appa and Smith (1973) establish necessary conditions for fitting a linear model to a set of points via the criterion of least sum of absolute deviations (called the L_1 criterion). This note identifies a sufficient condition and a necessary condition that can be utilized in combination with the necessary conditions of Appa and Smith to identify an optimal hyperplane under L_1 from a finite set of hyperplanes.

Sposito, V. A.: "On a Sufficient Optimality Condition in Nonlinear Programming over Mixed Cone Domains," *Cashiers du Centre d'Etudes de Recherche Operationnelle*, 19 (1977) 479-484.

This note extends recent optimality results of Bector and Grover. In particular, orthant domains are replaced by cone domains, convexity of the objective function is replaced by pseudoconvexity, and strict convexity of the constraint functions is replaced by strictly pseudoconvex functions.

With this modification it is shown that if the Fritz John Stationary point problem has an optimal solution, $(\bar{x}, \bar{r}, \bar{v})$, then $\bar{x}$ solves the associated nonlinear programming problem.

Sposito, V. A., W. J. Kennedy, and **J. E. Gentle:** "L_p Norm Fit of a Straight Line," *Journal of the Royal Statistical Society, Series C* 26:1 (1977) 114-118.

An algorithm is given for determining estimates of the parameters in the simple linear model

$$y = \alpha + \beta x + e,$$

under the criterion of minimizing the L_p norm

$$\sum_{i=1}^{n} |y_i - \alpha - \beta x_i|^p$$

for a set of n observations (x_i, y_i) and for values of p satisfying $1 \leq p \leq 2$.

This procedure extends recent results of Schlossmaker by minimizing

$$I = \sum_{i=1}^{n} W_i R_i^2$$

where the R_i are the residuals and W_i are weighting factors. Using an iterative process beginning with the unweighted least square estimates, we let

$$I(k+1) = \sum_{i=1}^{n} \frac{1}{|R(k)_i|^{2-p}} \{R(k+1)_i\}^2.$$

Consequently, if

$$|R(k)_i - R(k+1)_i| \approx 0 \quad \forall_i,$$

then $$I(k+1) \approx \sum_{i=1}^{n} |R(k+1)_i|^p.$$

Sposito, V. A.: "Quadratic Duality over Convex Cone Domains," *Journal of Mathematical Programming 10* (1976) 277-283.

In earlier work by Sposito and David, Kuhn-Tucker duality was generalized from finite-dimensional orthant domains to domains involving cone domains. In particular, duality was established between certain constrained optimization problems and a related Lagrangian saddlepoint problem.

This article extends some of these natural results to quadratic dual problems over *nonpolyhedral* cone domains. Classical quadratic dual becomes a special case of this extension.

Strahan, Robert F. and David W. Wilson: "Buffer Items, Insight, and the Marlowe-Crowne Social Desirability Scale," *Journal of Personality Assessment* 40:3 (1976) 320-323.

The influence of buffer items on response to the Marlowe Crowne Social Desirability Scale (MC) was examined. Thirty-four college student subjects received MC questionnaires with intermixed extraversion and neuroticism questionnaires, while 35 others received separate MC and extraversion-neuroticism questionnaires. MC means under the two conditions differed insignificantly, and confidence interval estimation spoke against the likelihood of any appreciable buffer item effect. Little insight into the purpose of MC was exhibited—less than half that previously reported by Shrauger (1972)—nor was it related to the buffer item manipulation.

Talwar, Prem (Department of Math & Statistics, University of Guelph, Ontario) and **James E. Gentle:** "A Robust Test for the Homogeneity of Scales," *Communications in Statistics—Theory and Methods* A6:4 (1977) 363-369.

Many robust tests for the equality of variances have been proposed recently. Brown and Forsythe (1974) and Layard (1973) review some of the well-known procedures and compare them by simulation

methods. Brown and Forsythe's alternative formulation of Levene's test statistic is found to be quite robust under certain nonnormal distributions. The performance of the methods, however, suffers in the presence of heavy tailed distributions such as the Cauchy distribution.

In this paper a simple robust test is proposed and studied. The results obtained from the Monte Carlo study compare favorably with those of the existing procedures.

*__Thompson, Robin__ (ARC Unit of Statistics, University of Edinburgh): "Design of Experiments to Estimate Heritability when Observations Are Available on Parents and Offspring," *Biometrics* 32 (1976) 283-304. SLRS 380.

Journal Paper J-8255, Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 1669; partial support by National Institutes of Health Grant GM-13827.

The design of experiments to estimate heritability when data are available on both parents and offspring and the offspring data have a hierarchical structure is considered. Univariate maximum likelihood (ML) estimation is discussed, and extensions to the multivariate case are outlined. The efficiency of ML estimation is evaluated in cases where simple regression estimators are available. Optimum designs for ML estimation are given when various strategies of selecting and mating are followed. The variance of the heritability estimate can be approximately halved relative to designs in which no selection of parents is done.

*__Thompson, Robin:__ "Relationship between the Cumulative Difference and Best Linear Unbiased Predictor Methods of Evaluating Bulls," *Animal Production* 23 (1976) 15-24. SLRS 381.

Journal Paper J-8267, Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 1669; partial support by National Institutes of Health Grant GM-13827.

The relationship between two methods of sire evaluation (Bar-Anan and Sacks's cumulative difference method (CD) and Henderson's best linear unbiased predictor method (BLUP) is shown. This relationship suggests a modification, with more theoretical justification, to the CD method.

*__Thompson, Robin:__ "The Estimation of Maternal Genetic Variances," *Biometrics* 32:4 (1976) 903-917. SLRS 382.

Journal Paper J-9261, Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 1669; partial support by National Institutes of Health Grant GM-13827.

The estimation of maternal genetic variances by a multivariate maximum likelihood method is discussed. As an illustration, the method is applied to data on Tribolium using a model based on partitioning the maternal genetic effect into additive and dominance components. An alternative model due to Falconer (1965) is also fitted. The method is applied to designs suggested for estimating maternal variances by Eisen (1967). Modifications required when parents are selected on their phenotypic values are given.

Klonglan, Gerald E., __Richard Warren,__ Judy M. Winkelpleck, and Steven K. Paulson: "Interorganizational Measurement in the Social Services Sector: Differences by Hierarchical Level," *Administrative Science Quarterly* 21 (1976) 675-687.

Research on interorganizational relations (IOR) has been of limited utility because it has operationally obscured different levels of multiple-unit organizations and ignored the differential and cumulative intensity of different forms of IOR. An eight-item cumulative measure of IOR is introduced and then evaluated within each of three hierarchical levels of 156 social service organizations. The analysis produces three distinct item orderings which correspond to the three hierarchical levels of state, multicounty district, and county. The article concludes with an illustration of the use of the measure in the testing of five hypotheses by organization level.

__Warren, Richard D.,__ Charles L. Mulford, and Mervin J. Yetley: "Analysis of Cooperative Organizational Effectiveness," *Rural Sociology* 41:3 (1976) 330-353.

The objective of this research was to develop and test a causal model of organizational effectiveness in business organizations. Some of the variables included in the model are those used by Etzioni in his propositions relating correlates of compliance to effectiveness. A multiple-indicators approach to effectiveness was used, with effectiveness being measured by managerial performance and by economic factors. While the authors impute causality to Etzioni's propositions, linkages not discussed by Etzioni have been added to the model. In addition, other theoretically relevant variables are included in the analyses. Techniques were used to test the theoretical causal model and to estimate the path coefficients. Empirically supported models were developed around the measures of effectiveness. The models were then compared to a causal model of effectiveness for normative organizations previously reported in the literature.

Evers, Frederick T., Joe M. Bohlen, and __Richard D. Warren:__ "The Relationships of Selected Size and Structure Indicators in Economic Organizations," *Administrative Science Quarterly* 21 (1976) 326-342.

Interrelationships of size and structure variables in 153 farmer cooperatives are investigated in three stages of analysis. First, an extension of the functional equivalence hypothesis is presented and supported. Alternative indicators of size, other than the traditional one of number of employees, are found to be useful in the analysis. Second, size categories are

used to determine if structural differences occur. Differences appear in the structural indicators to varying degrees. The third stage focuses on relationships of size and structure indicators in groups. Major differences are found between small and large firms.

This study extends the feasibility of formal organizational theory to firms of fewer than 50 employees. Consistency occurs in firms of 10 or more employees; firms of fewer than 10 exhibit a more informal structure. Thus, a mediating point is hypothesized to be present between 9 and 10 employees; here, the structure becomes more formal and less informal.

*__Wolins, Leroy:__ "On Squaring Validity Coefficients," *Educational and Psychological Measurement* 37:2 (1977) 373-374. SLRS 400.

The squared validity coefficient appropriately describes the proportion of variance in a criterion measure explained by a predictor when the predictor precisely measures its target construct and is linearly related to the criterion. Since neither of these conditions is closely realized in psychological measurement, the squared validity coefficient is an inappropriate descriptive statistic.

*__Wolins, Leroy:__ "Secondary Analysis of Published Research in the Behavioral Sciences," Social Statistics Section, *Proceedings of the American Statistical Association* (1976) 109-117. SLRS 389.
Supported by National Institute of Education Contract NIE-C-74-0115.

Results of a study, "Sex Differentials in the Academic Reward System," by Alan E. Bayer and Helen S. Astin were published in the May, 1975, issue of *Science*.

The statistical procedure used by Bayer and Astin to estimate sex differences in salary was analysis of covariance where academic rank, departmental affiliation, number of publications, etc., were the covariates. Dr. Wolins asserts this analysis produced biased results because the covariances were nonlinearly related to salary and the covariates fallibly indicate what they were supposed to indicate. Inspection of mean differences and scatter plots suggests, for example, people of the same rank who publish the same amount receive the same pay. It is asserted further by Dr. Wolins that analysis of covariance is never useful for adjusting for group differences on covariates in social-behavioral science research.

Dissertation Abstracts

Alders, Clarence Dean: "Generalized Convex Programming over Cone Domains," Ph.D. thesis, Iowa State University Library, November, 1976.

This study extends the well-known necessary and sufficient optimality conditions of convex programming to optimization problems with generalized convex functions. In particular, this extension includes programming problems with functions which can be classified as quasiconvex or pseudoconvex. Hence, one aspect of this study is to establish useful sufficient conditions which can be used to identify these generalized convex functions.

A further consequence of this study is to extend the classical Kuhn-Tucker and Fritz John necessary and sufficient conditions of nonlinear programming to a broader class of problems; in particular, to nonlinear programming problems over arbitrary cone domains.

Some of the main results of this study are summarized in the following statements. If the generalized convex functions in any programming problem are differentiable at an optimal solution, then Fritz John necessary conditions similar to the classical type can be established. However, Kuhn-Tucker necessary conditions require, in addition to differentiability, constraint qualifications. Programming problems with a pseudoconvex objective function, strictly pseudoconvex constraints and certain constraint qualifications yield a sufficient Fritz John condition. The Kuhn-Tucker condition, as a sufficient condition, requires the feasible region of the nonlinear problem to be convex, or the constraints to be quasiconvex at its solution under certain constraint qualifications.

Carter, Randy: "Instrumental Variable Estimation of the Simple Errors in Variables Model," Ph.D. thesis, Iowa State University Library, November, 1976.

Estimation of the slope parameter β in the model

$$\begin{aligned} Y_t &= \beta x_t + e_t \qquad t = 1,2,\ldots,T \\ X_t &= x_t + u_t \\ X_t &= \delta z_t + \epsilon_t \end{aligned}$$

where the vectors (X_t, Y_t, z_t) are observed, z_t is an instrumental variable and the unobservable vectors (e_t, u_t, ϵ_t) are distributed as independent multivariate normal vectors, is considered. The two cases defined by σ_{ue} unknown and σ_{ue} known to be zero are investigated.

For the case σ_{ue} unknown the properties of the ordinary least squares estimator, the instrumental variable estimator and the modified limited information estimators are discussed. The modified limited information estimator with a minimum mean square error property is used to construct a randomly weighted average, $\hat{\beta}_W$, of the modified limited information estimator and the ordinary least squares estimator. It is shown that, for large sample sizes, β_W behaves like the randomly weighted average of two normally distributed random variables.

Under the assumption $\beta \neq 0$, the maximum likelihood estimator, $\hat{\beta}_{ML}$, is derived for the case in which σ_{ue} is known to be zero. The estimator is such that all variance estimates are nonnegative. It is shown that the restricted maximum likelihood

estimator is consistent for all β, including $\beta = 0$. Using the modified limited information estimator a modified maximum likelihood estimator is constructed. The limiting distributions of the maximum likelihood and modified maximum likelihood estimators are obtained. The information that $\sigma_{ue} = 0$ is used in the construction of a randomly weighted average estimator similar to $\tilde{\beta}_W$.

The modified maximum likelihood estimator and several randomly weighted average estimators are compared in a Monte Carlo study. A set of medical data is analyzed using the maximum likelihood estimation procedure.

Clark, Cynthia: "Convergence and Ergodicity for Conditional Distributions—Theory and Applications," Ph.D. thesis, Iowa State University, February, 1977.

Consider a measurable space (S,a), the sequence of functions

$\{ f_{n+1}(x_{n+1}|x_1,\ldots,x_n) \}$ that are measurable $(\pi_1^{n+1} a)$ and that, for fixed $(x_1,x_2,\ldots,x_n)$, are probability densities on S with respect to the σ-finite measure σ, and the stationary Markov kernel $h(x_{n+1}|x_n)$ that is measurable $(\pi_1^2 a)$ and for fixed x_n is a probability density on S with respect to σ. When $\{ f_{n+1}(x_{n+1}|x_1,\ldots,x_n) \}$ and $h(x_{n+1}|x_n)$ approach each other asymptotically and $h(x_{n+1}|x_n)$ satisfies a certain tail restriction, convergence statements can be made for the corresponding marginal densities. These statements have application to the convergence of Markov Chains, the convergence of marginal densities, and to the asymptotic behavior of Bayesian Markov Decision Processes. Extensions are given for not necessarily absolutely continuous conditional measures, which are most naturally phrased in terms of mutual convergence.

Dickey, David A.: "Estimation and Hypothesis Testing in Nonstationary Time Series," Ph.D. thesis, Iowa State University Library, August, 1976.

The autoregressive time series $\{ Y_t : t\epsilon(1,2,\ldots) \}$ where $Y_t = \rho Y_{t-1} + e_t$, $e_t : t\epsilon(1,2\ldots)$ is a sequence of normal independent $(0, \sigma^2)$ random variables and $Y_0 = 0$ is investigated. If $|\rho| \geq 1$, the process is called "explosive", and the variance is unbounded as $t \to \infty$.

The maximum likelihood estimator of ρ,

$$\hat{\rho} = \left(\sum_{t=2}^{n} Y_{t-1}^2\right)^{-1} \sum_{t=2}^{n} Y_t Y_{t-1}$$

is studied. Also investigated are the regression estimators of ρ obtained when a constant is included in the regression of Y_t on Y_{t-1} and when a constant and a time trend are included in the regression. These two estimators are denoted by $\hat{\rho}_\mu$ and $\hat{\rho}_\tau$ respectively. The statistics constructed by analogy to the t-statistics for the regression coefficients of Y_{t-1} are denoted by τ, τ_μ and $\hat{\tau}_\tau$ for the regression of Y_t on Y_{t-1}, Y_t on (1), Y_{t-1} and Y_t on (1), t, Y_{t-1} respectively.

It is demonstrated that the distribution of $\hat{\rho}$ given $\rho = -1$ is the mirror image of the distribution of $\hat{\rho}$ given $\rho = 1$. It is also shown that the limiting distributions of $\hat{\rho}_\mu$ and $\hat{\rho}_\tau$ are the same as that of $\hat{\rho}$ when $\rho = -1$.

The first and second moments for the numerators and denominators of $\hat{\rho}$, $\hat{\rho}_\mu$ and $\hat{\rho}_\tau$ are derived. The numerator and denominator of $\hat{\rho}$ are strongly correlated, but the numerators and denominators of $\hat{\rho}_\mu$ and $\hat{\rho}_\tau$ are asymptotically uncorrelated.

The eigenroots and eigenvectors for the numerator and denominator quadratic forms of $n(\hat{\rho}-1)$ and $n(\hat{\rho}_\mu-1)$ are derived. The limiting distribution of $n(\hat{\rho}-1)$ is approximated by using the limit results for the eigenvectors and eigenroots.

Percentage points for the distribution of $n(\rho-1)$, $n(\hat{\rho}_\mu-1)$ and $n(\hat{\rho}_\tau-1)$ are estimated using the Monte Carlo methods for $n = 25$, 50, 100, 250, 500, and ∞ (∞ being the above mentioned limit case). Tables of these percentage points and percentage points for the distribution of $\hat{\tau}$, $\hat{\tau}_\mu$, and $\hat{\tau}_\tau$ are presented. The percentage points for $\hat{\tau}$, $\hat{\tau}_\mu$, $\hat{\tau}_\tau$ differ substantially from those of Student's t. Extension theorems are presented which show that the distributional results hold if e_t is replaced by a stationary autoregressive time series.

The power of tests based on the above statistics is compared with the power of the Box and Jenkins Q statistic. Examples of tests using the statistics are given.

DuBose, Paul: "Nonadditivity in Two-Way Experiments with Multivariate Data," Ph.D. thesis, Iowa State University Library, May, 1977.

An analysis of variance of data from a randomized complete block design normally assumes the additivity of block and treatment effects. The most widely used methods to examine whether this assumption is met in the univariate situation are outlined by Tukey (1949) and Mandel (1961). The distributions of the Tukey (1949) and Mandel (1961) test statistics can be derived by using theorems from Graybill and Milliken (1969) that give sufficient conditions for (a) chi-square distribution of quadratic forms with random idempotent matrices and (b) the independence of such distributions.

One objective of this study is further development of multivariate tests for nonadditivity incorporating the ideas used in the Tukey (1949) and Mandel (1961) univariate tests. The thesis extends the Mandel (1961) analysis to the multivariate case by extending theorems by Graybill and Milliken (1969) to give sufficient conditions for (a) the Wishart distributions of

quadratic forms with matrix arguments and random idempotent matrices and (b) the independence of such distributions.

Another objective of this study is to investigate nonadditivity in composite variables, linear combinations of primary response variables. If there are many response variables, it may be a helpful simplification to consider such a linear combination. The composite variable displaying the greatest additivity is determined and this leads to a test for nonadditivity in all response variables. Finally, the thesis investigates scale and location invariance of all composite variable and multivariate tests.

Emigh, Ted: "The Effects of Finite Population Size on Genetic Populations with Overlapping Generations," Ph.D. thesis, Iowa State University Library, November, 1976.

A population model first considered by Felsenstein (1971, *Genetics* 68: 581-597) is examined. In this model, constant numbers of individuals are present in each of the age groups. A related model, with a random number of individuals in each age group except the newborn group, is also considered.

For each of these models, an inbreeding effective number is derived (first calculated by Felsenstein for the first model), as are the means and variances of the stable distributions. It is found that the second model differs from the first model only in that

$$\frac{1}{N(i)} \text{ is replaced by } E\left[\frac{1}{N(i,t)} \mid N(i,t) \neq 0\right],$$

where N(i,t) is the number of individuals in the ith age group at time t.

An approximate Fokker-Planck equation for a population with mutation and selection is calculated. The approximation is valid for large t, and, in particular, for the stable distribution. The diffusion equation is a simple extension of the diffusion equation for nonoverlapping generations.

Esimai, Grace Iwuora: "Regression Estimation for Multivariate Normal Distributions," Ph.D. thesis, Iowa State University Library, May, 1977.

The method of regression estimation is used widely in sample survey. Let the $p+1$ variates follow a normal distribution ($p \geq 1$). In estimating the mean μ of one variable, say Y, the investigator may use the remaining p variables, say X, as auxiliary variables to increase precision. If $\underline{\mu}_x$, the mean of X, is known, he may use the regression estimator. If $\underline{\mu}_x$ is completely unknown, he may use the simple mean $\bar{y}$ to estimate μ. In certain situations where the investigator may have partial information about $\underline{\mu}_x$, he can perform a preliminary test of the type H_0: $\underline{\mu}_x = \underline{\mu}_0$ and then use a regression estimator which depends on the result of this test. The bias, mean squared error and relative efficiency of the preliminary test estimator are obtained and discussed.

The method of double sampling with partial information on auxiliary variables, first studied by Han (1973) in the case of one auxiliary variable, is extended to the case where the auxiliary variable is a px1 vector. Again the bias, mean squared error (m.s.e.) and the relative efficiency of the preliminary test estimator are derived and discussed.

The method of shrinkage is applied to the estimation of the mean of the auxiliary variable in regression estimation. The m.s.e. of the shrunken regression estimator is derived. The efficiency of the preliminary test estimator relative to the shrunken regression estimator is studied for Σ known.

Klemm, Rebecca: "Aspects of Quadratic Programming with Statistical Applications," Ph.D. thesis, Iowa State University Library, August, 1976.

This study extends the concept of closed form least squares solutions to closed form least squares solutions over inequality constraints. Specifically, closed form solutions are derived for several types of models which are commonly classified as quadratic programming problems. These models include linear interval constraints $P_0 \leq A'\beta \leq P_1$ as well as linear inequality constraints $A'\beta \geq P$.

Typical duality theory is related to the determination of a saddle point of the Lagrangian function, $\phi(\beta,\lambda) = f(\beta) + \lambda'(P - A'\beta)$, where $\lambda \geq 0$ and β is unrestricted. In our development $f(\beta)$ is equal to the error sums of squares, which is to be minimized over the constrained region. Hence, if $(\beta^\circ,\lambda^\circ)$ is a saddlepoint solution of the Lagrangian, then β° solves the least squares problem over the appropriate side conditions. In several situations the derivation of useful closed form solutions can be formulated by appealing to the well-known Kuhn-Tucker conditions. Necessary and sufficient conditions to insure the existence of closed form expressions are developed.

A further consequence of this study is to investigate the bias and mean square error of the closed form estimators.

Finally, a generalized upper bounding algorithm is developed to solve a general class of quadratic programming problems. This algorithm reduces the size of the basic matrix so that the total number of computations is greatly reduced compared to other standard quadratic programming procedures.

Sotres, David: "Limit Theorems for Order Statistics and Rank Order Statistics for Mixing Sequences of Random Variables," Ph.D. thesis, Iowa State University Library, February, 1977.

Some of the asymptotic properties of sample quantiles, linear functions of order statistics and one-sample rank order statistics are established for nonstationary sequences of dependent (ϕ and α-mixing types) random variables. In particular, the asymptotic normality and the almost sure convergence of the above statistics are considered.

Umbach, Dale: "On the Behavior of the Posterior for an Extreme Observation in a Multivariate Set-

ting," Ph.D. thesis, Iowa State University Library, August, 1976.

The initial concern is with the posterior of the natural parameter, a vector, Θ, in the multivariate exponential family. One observation $X = x = (x_1, \ldots, x_n)$ is taken from this distribution. Let Θ_n^* be the mode of the posterior. Sufficient conditions are presented for $(\Theta - \Theta_x^*)|X = x$ to converge in distribution to a multivariate normal distribution with mean vector zero as $||x||$ tends to infinity. The same conditions imply $||E(\Theta|X = x) - \Theta_x^*||$ converges to zero as $||x||$ tends to infinity.

The posterior of a location vector $\Theta = (\Theta_1, \Theta_2, \ldots, \Theta_n)$ for one observation $X = x = (x_1, x_2, \ldots, x_n)$ is taken up next. The behavior of the posterior is studied when the observed vector, x, is "large." In particular, the posterior is investigated as x gets large along a path, O, in R^n. Sufficient conditions are given to insure the existence of a limiting distribution for $O(t) - (\Theta|X = O(t))$ as t tends to infinity. The limiting distribution is identified in such cases. Slightly stronger conditions insure that $O(t) - E(\Theta|X = O(t))$ converges to the mean of the limiting distribution as t tends to infinity. Several paths and classes of paths are studied in detail.

These basic results about the posterior mean, the Bayes estimate, under norm-squared error loss, are extended to cover other estimators. In the one-dimensional case, loss functions which are convex functions of absolute error are considered. Let δ be a Bayes estimate for a loss function of this type. Generally, if $(\Theta - E(\Theta|X = x))|X = x$ converges to a symmetric distribution as x tends to infinity, it is shown that $\delta(x) - E(\Theta|X = x)$ converges to zero as x tends to infinity. The basic result is easily extended to the n-dimensional case when the loss is a sum of convex functions of the absolute error in each coordinate.

Yang, Shie-Shien: "Concomitants of Order Statistics," Ph.D. thesis, Iowa State University Library, August, 1976.

Let (X_i, Y_i) be n independent r.v.'s having a common bivariate distribution. When the X_i are arranged in nondecreasing order as the order statistics $X_{r:n}$ $(r = 1, 2, \ldots, n)$, the Y-variate $Y_{[r:n]}$ paired with $X_{r:n}$ is termed the concomitants of the r-th order statistic.

When the (X_i, Y_i) are from an arbitrary absolutely continuous bivariate distribution, both the exact and the asymptotic distribution theory of $Y_{[r:n]}$ are developed. In particular, the exact and the asymptotic distributions of $Y_{[r:n]}$ and of the rank of $Y_{[r:n]}$ are obtained. The results are applied to the following prediction problem in a Round Robin tournament: Suppose that at a certain stage of a Round Robin tournament among q teams of similar caliber, team A_i has rank r. What is the probability that A_i will have rank s at the end of the tournament? The case, when a superior team is present, is also considered.

The asymptotic distribution theory of concomitants is then extended to the multivariate situation. Let $(X_{1i}, X_{2i}, \ldots, X_{pi}, Y_i)'$ $(i = 1. 2. \ldots, n)$ be n independent r.v.'s having a common $(p+1)$-variate $(p \geq 1)$ normal distribution. If the r-th order statistic of $X_{k1}, X_{k2}, \ldots, X_{kp}$ is denoted by $X_{k(r)}$, then the Y-variate associated with $(X_{1(r_1)}, X_{2(r_2)}, \ldots, X_{p(r_p)})$ may be denoted by $Y_{[r_1, \ldots, r_p:n]}$ and termed the concomitant of $(X_{1(r_1)}, X_{2(r_2)}, \ldots, X_{p(r_p)})$.

The asymptotic distribution theory of $Y_{[r_1, \ldots, r_p:n]}$ and of the rank of $Y_{[r_1, \ldots, r_p:n]}$ is developed.

Two estimation problems using concomitants of order statistics for a p-variate $(p \geq 2)$ normal population, first in a censoring situation (Type II) and second in a double sampling situation are also considered.

Department of Statistics

A student majoring in statistics may earn a B.S., M.S., or Ph.D. degree through the College of Sciences and Humanities. A B.S. degree in Biometry is conferred by the College of Agriculture. Joint majors with other departments may be pursued at any level of study.

Graduate and undergraduate students complete a core of courses in basic statistical theory and methods. Graduate students may elect application courses leading to specialization in biometrics, econometrics, psychometrics, or sociometrics. Within the statistics major, the graduate student may concentrate his/her course work in experimental design, general methods or theory, probability, statistical computing, or survey sampling.

The M.S. degree is offered on either a thesis or nonthesis basis. The nonthesis option requires six additional hours of course work including a creative component of at least three credits of individual work.

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Beginning Fall, 1977, core requirements in statistical methods for M.S. candidates in statistics will be a sequence of three courses, 579X, 500, and 501, totaling 8 credits and taught fall-winter-spring. Statistics 579X will be a new one-credit course introducing students to statistical computing. Statistics 500 and 501 will be somewhat revised to recognize recent developments but will continue to emphasize the type of statistical methodology taught at Iowa State University by instructors such as George W. Snedecor and T. A. Bancroft.

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The Department is one of four participating in the interdisciplinary M.S. program in Industrial Administrative Sciences. There is also increasing departmental involvement in off-campus courses.

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A new statistical computer system, named MINITAB, was used successfully in teaching Statistics 327 during the winter and spring quarters. The system, developed at Penn State, is very easy for inexperienced students to learn. After only a thirty minute lecture, students who have never used the computer before are ready to begin using MINITAB to solve their own laboratory problems. Use of the computer in this course relieves much of the computational burden associated with solving, for example, multiple regression problems. This allows more time to give the students an appreciation of what statistics can (and cannot) do for them.

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To reduce time wasted by students in transcribing blackboard formulas, a 183-page summary of the formulas and procedures taught in Statistics 401 has been prepared by C. P. Cox for distribution in his classes. The archaic blackboard and chalk procedure is being replaced by overhead projected presentations of transparencies, some pre-prepared, some not. Both developments have been well received by Mr. Cox's students.

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Wayne Fuller and Jeff Goebel taught a two-quarter sequence, three hours each, on Time Series. The first course was offered as 648 winter quarter and the second, 646, spring quarter. Moving average and autoregressive processes, Fourier analysis, and spectral theory were topics covered in the courses.

Statistics 648, Topics in Parametric Estimation, was taught by Malay Ghosh winter quarter. Slightly more than half the time was spent on Bayes estimation, minimax estimation and different techniques of proving admissibility. The remaining period was devoted to the asymptotic theory of maximum likelihood estimation and the related probabilities concepts.

C. P. Han was the professor in charge of 648, Advanced Topics in Multivariate Analysis, offered SSII, 1976, and SSI, 1977. In this course principal components and canonical correlations were studied, and their optimum properties and asymptotic distributions derived. Under the normality assumption, tests of the equality of covariance matrices, a sphericity test, and multivariate analysis of variance were considered. In discriminant analysis the estimation of error rates was given.

Glen Meeden taught 648, Topics in Advanced Inference, SSI. The main topic covered in the course was invariance theory. Some additional topics from decision theory were also discussed.

1976-77 Course Offerings in Statistics

Courses for Undergraduate Students Only

100	Orientation in Statistics	R	F	Hotchkiss
101	Principles of Statistics	5	F,W,S	Groeneveld Mowrey Sallas Scott Simon
104	Introduction to Statistics	5	W,S,SSI	Ferree Hotchkiss Lewis Mowrey Scott S. Sukhatme Tu
105	Introduction to Statistics	3	F,S	Ferree Gentle Huntsberger Meeker Mensing S. Sukhatme
127	Elementary Business Statistics	5	F,W,S	Isaacson Kackar Meeker Midha Tu
305	Engineering Statistics	3	F	Mensing
327	Elementary Business Statistics	5	F,W,S	J. David Grapentine Groeneveld Meeker Simon
331	Probability for Engineers	3	F	Mensing
332	Statistical Inference for Engineering Data	3	W	Mensing
341	Introduction to Theory of Probability and Statistics	3	F,W	Huntsberger
342	Introduction to Theory of Probability and Statistics	3	W,S	Huntsberger
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 Bixenstine C. P. Cox D. Cox Gentle Han Hickman Hinz Hotchkiss Mensing Pollak Strahan Warren Wolins
402	Statistical Methods for Research Workers	4	SSII,F W,S	Bailey Bixenstine C. P. Cox D. Cox Hickman Hotchkiss Strahan Warren Wolins
403	Nonparametric Statistical Methods	3	F	Groeneveld
407	Methods of Multivariate Analysis	3	F	Hinz
411	Experimental Design for Research Workers	3	SSI,S	D. Cox Harville Hinz Strahan
421	Survey Designs for Research Workers	4	SSII,S	Han B. Sukhatme
422	Survey Sampling for Social Scientists	4	W	Baker
431	Elementary Statistical Quality Control	4	S	Mensing
432	Applied Probability Models	3	W	Groeneveld
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	Bancroft Goebel
448	Statistical Theory for Research Workers	3	SSII,S	Bancroft Huntsberger
481	Computer Processing of Statistical Data	3	W	Gentle
490H	Special Topics (Honors)	Arr	W,S	Hotchkiss Wolins

Courses Primarily for Graduate Students, Major or Minor

500	Statistical Methods	4	W	Hinz
501	Intermediate Statistical Methods	3	F	Bancroft
505	Psychometrics	3	5	Wolins
508	Sociometric Statistics	3	F	Warren
511	Design of Experiments	3	S	Kempthorne
512	Design of Experiments	3	F	Kempthorne
521	Design of Surveys	3	W	B. Sukhatme
522	Design of Surveys	3	S	B. Sukhatme
531	Industrial Statistics: Process Control	3	F	H. T. David
534	Ecological Statistics	3	5	Pollak
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	Arnold
545	Stochastic Processes	3	SSII	Isaacson

546	Nonparametric Statistical Theory	3	S	S. Sukhatme
549	Mathematical Programming	3	S	Sposito
580	Statistical Computations on Digital Computers I	3	W	Kennedy
581	Statistical Computations on Digital Computers II	3	S	Kennedy
590	Special Topics	Arr	SSII,F,W, S,SSI	Booth C. P. Cox D. Cox H. A. David Gentle Harville Hickman Hotchkiss Kennedy Meeker B. Sukhatme Warren Wolins

Courses for Graduate Students, Major or Minor

601	Advanced Statistical Methods	3	F	C. P. Cox
611	Advanced Design of Experiments	3	W	Harville
612	Advanced Design of Experiments	3	S	Harville
641	General Theory of Linear Hypothesis	3	F	Harville
642	Probability and Distribution Theory	3	W	Arnold
643	Theory of Estimation and Testing of Hypotheses	3	S	Ghosh
646	Time Series	3	S	Fuller Goebel
647	Multivariate Analysis	3	F	Han
648	Time Series	3	W	Fuller Goebel
	Topics in Parametric Estimation	3	W	Ghosh
	Advanced Topics in Statistical Inference	3	SSI	Meeden
	Advanced Topics in Multivariate Analysis	3	SSII,SSI	Han
699	Research	Arr	SSII,F,W, S,SSI	C. P. Cox D. Cox H. A. David H. T. David Fuller Gentle Ghosh Han Kempthorne Meeden Mensing Pollak Sposito B. Sukhatme

Graduate Students

Eleven Ph.D. degrees and twenty-one M.S. degrees were earned by students in the Department this fiscal year. Abstracts of Ph.D. dissertations written in partial fulfillment of the graduation requirements appear in the publication section. All of the M.S. degrees were conferred on a nonthesis basis. If educational or employment plans are known, a brief account is given for each student.

M.S. Recipients

Richard Auer (Spring, 1977, under David A. Harville) is continuing his graduate studies in the Department. Next year Richard will be a teaching assistant and plans to have survey sampling as his area of concentration.

Mon-Gy Chen (Spring, 1977, under David A. Harville) will look for employment at a future date, after her husband completes his program of study at Iowa State.

Francis Diaz (Spring, 1977, under D. F. Cox) is employed by the General Motors Proving Grounds in Milford, Michigan. He is working as a statistician in the Product Evaluation Department.

Irma Fernandez (Fall, 1977, under Donald Hotchkiss) has accepted a position with the U.S. Census Bureau, Washington, D.C.

Cathryn Gust (Summer, 1976, under James E. Gentle) is employed as a mathematical statistician for the Bureau of Veterinary Medicine of the Food and Drug Administration, Rockville, Maryland. The position consists of assisting with the statistical analysis and programming used on drug application reviews and in bureau-sponsored research.

Michael Hale (Summer, 1976, under Bill Meeker) continues his studies under H. T. David working towards a Ph.D. degree. General theory and operations research are his areas of interest. He taught an off-campus section of Statistics 127 in Mason City and is currently a graduate assistant working with the AES consulting group under Professors Cox and Hinz.

Michael Hand (Winter, 1977, under V. A. Sposito) is working in the Statistical Computing Section as a research assistant while studying towards a Ph.D. degree with Dr. Sposito as his major professor. Areas in which Michael is concentrating are mathematical programming and Tchebycheff estimation.

Janet Hanley (Fall, 1976, under V. A. Sposito) is employed by Air Products and Chemicals, Allentown, Pennsylvania. She is a member of the Applied Economics Group, a subset of the Operations Research Section. Her major responsibility is the development of models for economic forecasting for the corporate plan.

Thomas Hanson (Spring, 1977, under James Gentle) is a statistical engineer for Corning Glass, Corning, New York. His duties include production line studies involving quality control and experimental design.

Shaikh Sirajul Islam (Spring, 1977, under B. V. Sukhatme) returned to Chittagong, Bangladesh, where he is a statistician and senior research officer in the Forest Research Institute. While studying at Iowa State, he was on leave from this position.

Ananchai Khuantham (Fall, 1976, under D. F. Cox) has returned to Thailand to his position of junior lecturer, Department of Statistics, Kasetsart University, Bangkok.

Wing-Hung (David) Mo (Summer, 1976, under Edward Pollak) is studying towards a joint Ph.D. degree in statistics and industrial engineering at ISU.

Tetsuro Motoyama (Fall, 1976, joint psychology and statistics under Leroy Wolins) continues in this double major, working towards a Ph.D. degree under Drs. Wolins and Kennedy. He is a graduate assistant employed in the Statistical Computing Section as a programmer and statistical software package programming consultant.

Nida Sainumtip (Spring, 1977, under Gordon Booth) returned to Bangkok, Thailand, where she is employed as a statistician in the Agriculture Department, Government of Thailand.

William Sallas (Spring, 1977, under David Harville) remains in the Statistics Department studying under Dr. Harville. His areas of interest are linear modeling and Kalman filtering.

Mary (Lorie) Scholl (Spring, 1977, under C. Philip Cox) is employed by the University of Iowa, Department of Preventive Medicine and Environmental Health (biostatistics). Major duties include data management and data analysis for a psychosocial intervention project and statistical consulting in the biomedical sciences.

Vannapha Sirisukdi (Winter, 1977, under Donald Hotchkiss) is employed as a statistican concentrating in the area of data analysis for the Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Bangkok, Thailand.

Kuen-Jing (Joyce) Tai (Summer, 1976, under James Gentle) was employed in the Biostatistics Services Section of Baxter-Travenol Labs, Morton Grove, Illinois. Her duties included statistical analysis of clinical trials and various other data related to drug and prosthetic research and development. She has recently moved to Taiwan with her husband.

Boonchai Viroonsri (Spring, 1977, under Roy Hickman) returned to Bangkok, Thailand, where he is working in sampling designs as a statistician for the Division of Agricultural Economics, Ministry of Agriculture and Cooperatives. He was on leave from this position to pursue graduate work in the Department the last two years.

Rick Williams (Winter, 1977, under David Harville) accepted employment with the Research Triangle Institute as a statistician working in the Sampling Research and Design Center.

Ph.D. Recipients

Clarence Dean Alders (Fall, 1976, under V. A. Sposito) returned to Mankato State University, Mankato, Minnesota, as an associate professor. He has been a staff member there for twenty years and was on a leave of absence to complete the Ph.D. degree. He teaches undergraduate courses in the Department of Mathematics, Astronomy, and Statistics.

Randy Carter (Fall, 1976, under Wayne Fuller) is an assistant professor in the Department of Statistics, University of Florida, Gainesville. He has been providing statistical consulting services for faculty and graduate student medical researchers at the J. Hillis Miller Health Center Biostatistics Consulting Unit, University of Florida Medical School. His duties also include statistical research and teaching a sequence of courses in statistical methods in the Department of Statistics.

Cynthia Clark (Winter, 1977, under H. T. David) moved to McLean, Virginia, with her family. July 1 she began employment as a mathematical statistician with the Statistical Research Division, Bureau of the Census, Washington, D.C. Initially, her research is on a project concerning confidentiality of data.

David Dickey (Summer, 1976, under Wayne Fuller) is employed as an assistant professor, Department of Statistics, North Carolina State University, Raleigh. He has been teaching courses in time series and statistical methods and serving as advisor to the statistics club. David's research has been directed towards a study of the distribution of the drift parameter estimate in a random walk model with non-zero drift and the effect of seasonal nonstationarity.

Paul DuBose (Spring, 1977, under P. Hinz and D. F. Cox) is acting manager of the Statistics and Computer Programming Section at the Weyerhaeuser Technical Center in Longview, Washington.

Ted Emigh (Fall, 1976, under Oscar Kempthorne) is an assistant professor in the Department of Statistics and Computer Science, The University of Georgia, Athens. He has been teaching a course in introductory statistics and one in statistical methods.

Grace Iwuora Esimai (M.S. Summer, 1976, and Ph.D. Spring, 1977, under C. P. Han) moved to Cambridge, Massachusetts, where her husband is completing graduate school at M.I.T. They both have teaching appointments at the University of Nigeria and will return to their home country.

Rebecca Klemm (Summer, 1976, under V. A. Sposito) is an assistant professor in the Department of Statistics, Temple University, Philadelphia, teaching undergraduate courses. She is also involved with the Data Analysis Laboratory within the department and does private consulting.

David Sotres (Winter, 1977, under Malay Ghosh and H. T. David) teaches a graduate level course in statistics and an undergraduate level course in mathematics each quarter at the Centro de Estadistica Y Calculo, Chapingo, Mexico. He is also doing some research in the area of large-sample theory, multivariate analysis, and order statistics.

Dale Umbach (Summer, 1976, under Glen Meeden) joined the Statistics Department, Oklahoma University, Norman, as an assistant professor. He has been teaching mathematical statistics to seniors and beginning graduate students primarily with majors in engineering and mathematics. His research is in the area of decision theory and Bayesian statistics.

Shie-Shien Yang (Summer, 1976, under H. A. David) is a postdoctoral instructor in the Department of Applied Mathematics, M.I.T., Cambridge, Massachusetts. He teaches courses in statistical theory and methods and occasionally consults with researchers from other departments.

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Two statistics graduate students, Grace Esimai, Nigeria, and Gabriela Stangenhaus, Brazil, were recipients of international awards presented by the Faculty Women's Club for the 1976-77 year. The Faculty Women's Club recognizes outstanding graduate and undergraduate female students in four categories, including the international award. Women are nominated by their academic departments, and selection is made on the basis of scholarship, activities, and departmental recommendations. A cash award and certificate (presented at an awards luncheon) accompany the honor. Both women have now completed their Ph.D. programs.

M.S. Candidates

Aain, Sukor
Abdel-Megeed, Samir
Anselmi, Luis
Arnold, Robert
Bondy, Eric
Carvavattana, Rattana
Chiyenda, Simeon
Chang, Shen-Lan Chu
Chen, Jiunn-Charn
Chen, Mon-Gy
Dahm, P. Fred
David, Jeffrey
Dehghan-Nayeri, Majid
Diaz, Francis
El-Shereif Saad El-Sayed
Ervan, Mohamad
Escobar, Luis
Fernandez, Irma
Galmes, Miquel Angel
Glosemeyer, William
Grapentine, Terry
Gust, Cathryn

Hanley, Janet
Hanson, Thomas
Herrera-Haro, José
Hong, Emile
Hsieh, Wen Tai
Hsu, Shun-Hsia (Dorothy)
Islam, Shaikh Sirajul
Jan, Yih-Ming
Johnson, Ervin
Johnson, Steven
Khuantham, Ananchai
Lewis, Jerry
Liberty, T. Edward
Lin, Cherng-Tarng
Lo-Utai, Sue
Megahed, Abdel
Niknian, Minoo
Nkansah, Paul
Noorbaloochi, Siamak
Osho, Johnson
Penner, Don
Perez, Margarita
Peixoto, Julio
Pongsrihadulchai, Apichart
Protz, Steven
Razmpour, Ahmad
Sainumtip, Nida
Scholl, Lorie
Shen, Arn-Shi
Shenk, Debra
Sirisukdi, Vannapha
Sivira, José
Skalland, Kent
Sung, Bok Park
Sung, Chang Sup (joint industrial engineering-statistics)
Tajdari, Parviz
Tai, Kuen-Jing (Joyce)
Viroonsri, Boonchai
Wang, Bei-Li
Werner, Neil
Williams, Rick Lee
Yih, Wei
You, Young-Kyun
Yu, Fu-hau
Young, Shirley
Zaher, Adel

Non-degree Students

Cruz, Vivaldo Francisco
Martinez, Daniel
Mayo, Ralph
Sridodo
Tobey, Malcolm

Ph.D. Candidates

Alders, Clarence Dean
Andriano, Kim
Auer, Richard
Aziz, Mohammad (joint sociology-statistics)
Bhattacharyay, Biswanath
Biyani, Shriram
Carter, Randy
Carvalho, José
Chandhok, Promod
Chen, Jengrong James
Clark, Cynthia
Crouse, Ken (joint computer science-statistics)
Dickey, David
DuBose, Paul
Emigh, Ted
Esimai, Grace Iwuora
Ferree, Rita
Hale, Michael
Hammond, Cheryl
Hand, Michael
Hasza, David
Ho, Chung-Man
Huang, Cheng-Chi (joint mathematics-statistics)
Kackar, Raghunath
Kim, Geung Ho (joint industrial engineering-statistics)
Klemm, Rebecca
Lamyordmakpol, Anuchit
Mellon, James
Midha, Chand
Mo, Wing-Hung (David) (joint industrial engineering-statistics)
Motoyama, Tetsuro (joint psychology-statistics)
Mowrey, Daniel
Parsian, Ahmad
Ponder, Wendell
Rangachari, Lakshmi
Richards, Winston
Sallas, William
Scott, Mark
Sedcole, Richard (joint agronomy-statistics)
Shu, Ven-Shion
Simon, Barry
Sotres, David
Stangenhaus, Gabriela
Stewart, John
Tu, Ching-Tsao
Umbach, Dale
Yang, Shie-Shien

Bancroft Award

William Boggess, Ph.D. candidate in agricultural economics, was selected winner of the T. A. Bancroft Statistics Award. Presentation of the award, a year's membership in the American Statistical Association plus a cash prize, was made January 19 at a faculty-student seminar. Boggess was recognized as the outstanding doctoral candidate with a minor in statistics.

The award was established in 1973 to honor T. A. Bancroft, professor of statistics, and former director of the Statistical Laboratory and head of the Department of Statistics from 1950-1972.

Boggess received the B.S. degree from Iowa State University in 1974 with a joint major in agricultural business and farm operations. He was recipient of an ISU Graduate College Premium for Academic Excellence award for two academic years, 1974-1976. During this period he was employed by the Economics Department as a graduate research assistant. Since June, 1976, Mr. Boggess has been working as a research economist for the Center for Agricultural and Rural Development, ISU.

Dr. Bancroft presents the Bancroft Award to William Boggess.

Snedecor Award

Shriram Biyani, Ph.D. candidate, has been chosen as recipient of the 1977 George W. Snedecor Statistics Award. Presented at a departmental seminar January 19, the award consists of a year's membership in the Institute of Mathematical Statistics plus a cash prize.

Established in 1954 to honor Professor George W. Snedecor, founder and first director of the Statistical Laboratory, the award annually recognizes the most outstanding Ph.D. candidate in the Department of Statistics.

Biyani received the B.Sc. degree in 1971 from Nagpur University, Nagpur, India, with fields of emphasis in statistics, mathematics, and physics. The Indian Agricultural Research Institute, New Delhi, awarded Biyani a graduate student fellowship, and he received the M.S. degree in agricultural statistics from this institution in 1974. Biyani has been a graduate student research assistant in the Department of Statistics at Iowa State University since 1974.

Mu Sigma Rho

The local chapter of Mu Sigma Rho helped sponsor a lecture by Professor J. Wolfowitz from the University of Illinois at Urbana-Champaign at the fall meeting September 28. Dr. Wolfowitz's talk was entitled "Some Information on Information Theory." A short business meeting followed the presentation.

Dr. Shayle R. Searle, Cornell University, was the guest speaker for the spring initiation meeting on March 17 held at the Scheman Building. The topic of his talk was "Of Proof and Probability." Fifteen graduate students, one undergraduate, and three faculty members were initiated into the honorary, with an honorary membership being given to Dr. Searle.

During the spring quarter the local chapter undertook a service project to organize old exam questions in Statistics 104 and Statistics 327 into packets to be sold to students taking these classes. The cost to the students will be lower than the price they would have to pay to have the tests photocopied. The intent of the project is to aid students in learning the concepts of the courses and to assist them in preparing for exams.

Officers for the 1977-78 academic year are:
President—Bill Sallas
Vice President—Wendell Ponder
Secretary-Treasurer—Mike Hand
Advisor—Don Hotchkiss

Undergraduates

At the Scholarship Recognition Dinners May 9 and 10, one statistics student and one biometry student were honored. "High Scholarship Students by College and Class" honors the upper 2 percent of students by class in each of the six colleges. Dale Zimmerman, biometry sophomore, was recognized by the College of Agriculture. "High Scholarship Students by Curriculum and Major" identifies the graduating senior (summer, 1976, through spring, 1977) in each of the curricula who has attained the highest scholarship (at least 3.5). Steve Blume was the recipient from the Department of Statistics.

Lynne Hoeksema and Dave Rodas are participating in the summer cooperative work-study program with the Iowa Crop and Livestock Reporting Service (USDA) in Des Moines.

Dale Jergensen is employed for the summer at the Pioneer Research Station, Algona, Iowa, assisting with data analysis.

Positions accepted by current B.S. graduates are as follows:

Steve Blume will begin graduate studies at Northwestern University in the Department of Civil Engineering where he will be a research assistant. His area of interest is transportation systems analysis.

Gaylon Drape is an agricultural statistician with the USDA Crop and Livestock Reporting Service in Madison, Wisconsin.

Joe McCormick is a statistician in the Section of Medical Research Statistics, Mayo Clinic, Rochester, Minnesota.

Don Saboe is employed by the U. S. Crop and Livestock Reporting Service, Lansing, Michigan, as an agricultural statistician.

Bob Tegels has accepted a position as a statistician with the Census Bureau, Suitland, Maryland.

Richard Groeneveld, D. K. Hotchkiss, and D. V. Huntsberger served as undergraduate advisors both for students majoring in statistics and undeclared majors who indicated an interest in mathematical sciences. Students who received the B.S. degree this year are:

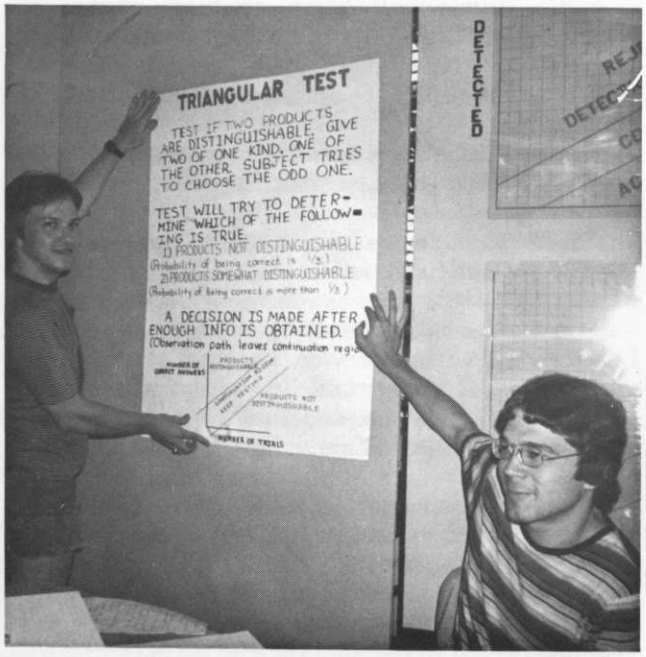
Steve Blume
Steven Cavanaugh
Gaylon Drape
John Host
Joe McCormick—joint industrial administration and statistics
Dennis Miller
Chan Kou Park
Donald Saboe
Bob Tegels
Lucinda Tuttle—joint economics and statistics
David Walters—joint computer science and statistics

Statistics Club

The year's Statistics Club activities began with the annual September picnic at Brookside Park for Stat Club members and statistics faculty. Later in the fall quarter, a meeting was held to discuss summer employment opportunities for undergraduates. Don Saboe commented on his experiences at the Statistical Reporting Service in Des Moines, and Michael Schillmoeller spoke about his work with Harris Polls in Chicago. Summer work in the Upjohn Company at Kalamazoo, Michigan, was described by Bob Tegels, and Steve Blume gave an account of his internship at Oak Ridge National Laboratory in Tennessee.

In January, Stat Club members met with members of the Math Club to hear Mr. Wayne Grove of the Hewlett Packard Company describe career opportunities for mathematicians in an electronics firm.

The spring field trip was to the new facilities of Pioneer Hi-Bred International, Inc., at Johnston, Iowa. Statistics Club members visited with two statisticians, one who works in computer services and data analysis for Pioneer's consulting firm, Impact Services, and one who does statistical analyses for the corn breeders at Pioneer.



Dale Jergensen (left) and Bob Tegels assisted in preparation of the Veishea display.

Visitors to this year's Veishea Open House display by the Statistics Club were greeted by a sign reading "Eat Peanut Butter and Challenge the Computer." Visitors were asked to participate in a triangle food-tasting experiment designed to determine whether there was a detectable difference in taste between the brands of peanut butter. Spectators could view the progress of the sequential tests on a chart. (Conclusion: No difference between Skippy and Hy Vee.) The second part of the exhibit was a computer game simulating the buying and selling of corporate stocks. Its purpose was to illustrate the elementary concepts of statistical decision making. William Meeker served as advisor to assist Statistics Club members with the Veishea display.

The recipient of the 1977 IBM-Statistics Club scholarship of $600 for tuition was Lynne Hoeksema.

Officers for 1977-78:

President—Dale Jergensen
Vice President—Lynne Hoeksema
Secretary—Dan Ivis
Treasurer—Dale Zimmerman
Sciences and Humanities Council Representative—Lynne Hoeksema
Sponsor—Richard Groeneveld

Seminars

Students and faculty members from Statistics and related disciplines were invited to attend the weekly non-credit seminars planned by C. P. Han, David Harville, William Meeker, and student representative, Eric Bondy. Oscar Kempthorne and Edward Pollak planned a quantitative genetics seminar.

Statistics Department faculty and graduate students discussed various aspects of their research efforts. Guest speakers included both staff members from other departments at Iowa State and campus visitors from universities, government, and industry.

Participants and topics for this year's programs were:

Statistical Laboratory Seminars

Summer, 1976

August 4	Computer Construction of Incomplete Block Designs, J. A. John, Department of Mathematics, The University of Southampton, England

Fall, 1976

September 15	Statistics in Australia, H. A. David
September 22	A Moment Problem on Order Statistics, J. S. Huang, Visiting from the University of Guelph
28	Some Information about Information Theory, J. Wolfowitz, University of Illinois, Urbana-Champaign
30	The Estimation of Parameters in Hierarchical Stochastic Models, Richard L. Tweedie, Division of Mathematics and Statistics, CSIRO, Canberra, Australia
October 6	Efficiency of Some πPS Sampling Strategies, B. V. Sukhatme
13	Procedures in Large-Scale Sample Surveys, Jeffery Goebel

October 20 — Mixed Linear Models and Incomplete Block Designs, Oscar Kempthorne

27 — Selective Advance in Populations with Overlapping Generations, Edward Pollak

November 3 — Generalized Convex Programming over Cone Domains, C. D. Alders

10 — Asymptotic Behavior of Order Statistics and One-Sample Rank Order Statistics under Dependence, David A. Sotres

Winter, 1977

December 1 — Research Activities and the U. S. Bureau of the Census, Kirk M. Wolter, U. S. Bureau of the Census

8 — Current Literature on Student Evaluation of Teachers, Leroy Wolins

15 — Who Will Win Super Bowl XI?, David Harville

January 5 — Convergence and Ergodicity of Conditional Distributions, Cynthia Clark

12 — What a Transportation Engineer Wants Out of Statistics and Probability Measures, Kenneth A. Brewer, Civil Engineering, ISU

19 — Minimum L_1 Estimation, James E. Gentle

26 — Kalman Filtering and Applications in Integrated Navigation Systems, R. G. Brown, Electrical Engineering, ISU

February 2 — Experimental Design in the National Health Insurance Study: Compromising between Optimal and Classical Design, Carl Morris, Rand Corporation, Santa Monica, California

February 9 — Modular Instruction in Introductory Statistics: An Overview, Judith Rich O'Fallon, Mayo Clinic

Reserpine and Breast Cancer: An Epidemiological Controversy, W. M. O'Fallon, Section of Medical Research Statistics, Mayo Clinic

16 — Regression Estimation for Multivariate Normal Distributions, Grace Iwuora Esimai

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March 9 — Non-Additivity in a Randomized Block Design with Multivariate Responses, Paul DuBose

16 — Some Novel Covariance Models, Shayle R. Searle, Cornell University

18 — Tests of Normality Designed to Detect Specific Types of Nonnormality, John D. Spurrier, Department of Mathematics and Computer Science, University of South Carolina

21 — Goodness of Fit Statistics for Large, Sparse Multinomials, Kenneth J. Koehler, School of Statistics, University of Minnesota

April 6 — Recent Trends in Statistical Computing, W. J. Kennedy

13 — Probabilities of Superior Genotypes in Homozygous Lines, Theodore B. Bailey, Jr.

20 — Estimation in Nonstationary Time Series, David Hasza

April 29 — On a Goodness of Fit Test, John J. Birch, University of Iowa

May 4 — Are Shrinkage Estimators Worthwhile? Richard Van Nostrand, University of Wisconsin

11 — Kurtosis Revisited, Gabriela Stangenhaus

18 — Data Analysis of Multiway Tables, José Carvalho

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June 28 — Analysis of Longitudinal Data, James E. Grizzle, University of North Carolina

Quantitative Genetics Seminar

July 2 — Carp Breeding: Hybridization, Growth and Yield in Farm Ponds; Genetic Improvement in Uncontrolled River Environments, Rom Moav, Department of Genetics, Hebrew University, Jerusalem, Israel

Statistics Graduate Student Seminar Series

A new seminar series was initiated this year by Eric Bondy. Seminars in this series were presented by statistics graduate students to an audience comprised mostly of students. Primary objective of the series of seminars was to give the speakers an opportunity to gain experience in seminar presentation before a sympathetic audience and to tell their friends about their statistical interests. It also gave all students a chance to learn about the variety of topics which interest their classmates, presented in a format more suitable for a student audience than the weekly departmental seminars.

Seminars were presented about every two weeks on Friday afternoons, and all competed for attendance with at least one graduate class. Nevertheless, the series was popular enough (attendance averaged about 11 students and 1 faculty member at each of the 12 seminars) to become a regular activity. Organization of this series for next year has been added to the regular duties of the seminar committee student representative by the Statistics Graduate Student Council.

Topics and speakers for this year follow:

October 8 — A Consulting Problem with Bioassay Data, Paul DuBose

22 — On Construction of PBIB Designs, Chand Midha

November 5 — Robustness of Estimation of the Mean in the Presence of an Outlier, Ven-Shion Shu

10 — Randomized Response, José Carvalho

January 14 — Genetic Correlations—Estimates of Parameters and Estimates and Standard Errors, Richard Sedcole

28 — Estimation for Nonstationary Time Series, David Hasza

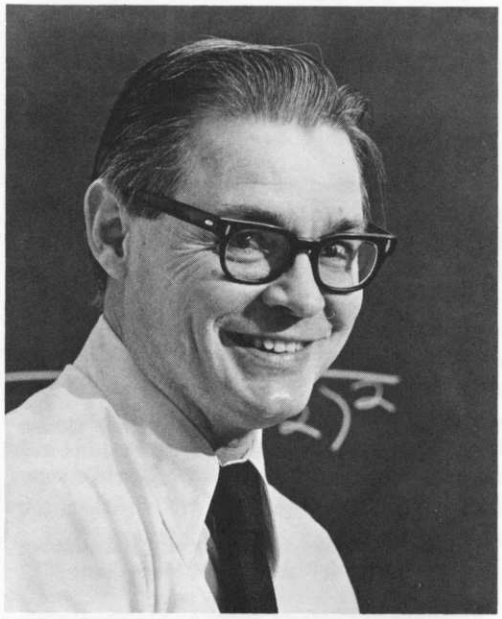
February 4	Numerical Algorithms for Restricted Maximum Likelihood Estimation, Rick L. Williams	April 1	Estimation of Baseball Team Effects, Richard Auer
11	Regression Estimation for Multivariate Normal Distributions, Grace Esimai	15	Testing for Outliers in Linear Regression, James J. Chen
March 25	Some Aspects of ℓ_∞ Estimation, Mike Hand	May 13	Fitting Multiplicative Components, José Carvalho

National Science Foundation Summer Science Training Program at ISU

Richard Groeneveld directed a National Science Foundation (NSF) Summer Science Training program for mathematically talented high school students. Approximately thirty students, principally from Iowa and surrounding states, attended the five-week session June 13-July 15. Dr. William Meeker, Mr. Barry Simon and Dr. Groeneveld taught courses in statistics, probability and high-speed digital computing. In addition to these courses, the participants took part in laboratories in statistics and computing which emphasized the analysis and interpretation of real data.

The National Science Foundation sponsors a variety of scientific and mathematical projects for high ability high school students throughout the United States. Students with strong potential for scientific and technical careers are given the opportunity to experience college-level instruction and laboratory usage, thus enriching their high school curriculums and encouraging them to pursue the study of scientific courses beyond the secondary level.

Students pay their own room, board, and travel, if possible, and NSF provides funds to the universities for tuition, salaries, supplies, and other operating expenses of the program.



Dr. Groeneveld

Kim Anderson (far left) of the Computer Center instructs four participants in the use of the IBM 2501 card reader. Students are Kathy Koster, Breda, Iowa; Don Loeffelholz, Malbur, Iowa; Brian Mealy, Omaha, Nebraska; and Jan Nieland, Breda, Iowa.

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