Prior to 1963, a graduate program leading to the degree Master of Arts in Statistics was offered in the School of Business and Public Administration. The present Department of Statistics was established as a separate department in the College of Arts and Science in the fall of 1963. The department began with a staff of four faculty members and since 1963, has benefited from considerable growth and expansion. The department currently has fifteen faculty members, including one member who has a joint appointment.

The Department of Statistics has offered graduate programs leading to the Master of Arts and Doctor of Philosophy degrees since 1963. The field of statistics is a rapidly expanding one, both at the theoretical and applied level. In addition to academia, statisticians are in demand not only from the business community and various branches of state and federal government but also in the biomedical area. To this end, graduate study and thesis direction are available in various areas of probability and statistics, both theoretical and applied.

The faculty and graduate students of the Department of Statistics are housed in the air-conditioned Mathematical Sciences Building. Also located in this building are the Dept. of Math, Dept. of Computer Science, University Computer Network, with an AMDAHL 470/N7, IBM 3031, as well as a PDP 11/20 and an excellent Mathematical Sciences Library.

The Graduate School requires that a student take the verbal aptitude and quantitative aptitude portions of the Graduate Record Examination before the end of the student's first semester. The Department of Statistics recommends that the student also take the advanced mathematics portion of the G.R.E. If a prospective student will send an unofficial transcript, we would be glad to make an initial judgment as to whether he should officially apply for admission.

The Statistical Consulting Center, which is located in the Mathematical Sciences Building, provides opportunities for statistical consulting and assists faculty and students in cooperative research with people in other fields. The role of the Center is (a) to promote good statistical practices by providing advice to campus personnel who request statistical assistance from the Department on their research projects, (b) to provide an educational opportunity to graduate students in gaining practical experience in consulting and applied statistics, and (c) to be a source of new research topics in statistics which are motivated by specific "real" problems.

The Department offers a special course to facilitate student involvement in statistical consulting on re-
plines, such as the physical, social, biological, and medical sciences. Through participation, students gain experience in communicating with people from diverse areas, formulating statistical problems and interpreting statistical solutions in a manner understandable to users who may have little background in statistics. The course complements many of the lecture-oriented courses and is primarily for second and third year students.

Stipends for half-time teaching assistants currently range from $6,600 to $11,000. Currently, fees are about $900 for the academic year and out-of-state tuition is $2,704 for the academic year. Additional funds may be earned through jobs such as paper grading, working after the Statistical Laboratory, etc. Duties normally consist of teaching six hours per week. Research assistantships, fellowships, and some summer support are available. Graduate students with an assistantship of one-quarter time or more, and most fellowship holders, do not have to pay out-of-state tuition. Applications for financial assistantships should be made as early as possible, preferably by March 1. There is very little support for students from other countries, especially during the first year.

Courses and Descriptions

31 ELEMENTARY STATISTICS (3). Collection, presentation of data; averages; dispersion; introduction to statistical inference, correlation and regression. Prerequisite: Math 10. f.w.s., cor.

150 INTRODUCTION TO PROBABILITY AND STATISTICS I (3). Designed primarily for students in College of Business and Public Administration. Prerequisite for 250. This two-semester sequence (in lieu of 31 and 234) covers fundamentals of probability and statistics for students who have some knowledge of calculus. Probability theory; random variables; expectation; probability distributions. One section uses the computer to assist in learning statistical concepts. No prior computing experience necessary. Prerequisite: Math 61. f.w.s.

198-199 HONORS (2 hrs. each). Special work for Honors candidates in Statistics.

207 STATISTICAL ANALYSIS (3). For graduate students and superior seniors with no previous training in statistics. Intensive study of concepts, techniques of statistical analysis, and their applications. Prerequisite: Math 10 or equivalent. f.w.s.

234 INTERMEDIATE STATISTICS (3). Probability

eses; methods of estimation; regression and correlation. Prerequisite: 31, f.w.s.

250 INTRODUCTION TO PROBABILITY AND STATISTICS II (3). This course is a continuation of Statistics 150. Estimation; hypothesis testing; regression; correlation; statistical decision theory; nonparametric methods. One section uses the computer to assist in learning statistical concepts. No prior computing experience necessary. Prerequisite: 150. f.w.s.

300 PROBLEMS (1-3). Independent investigations. Reports on approved topics. Prerequisite: consent of faculty member involved. f.w.s.

301 TOPICS (cr. arr.) Organized study of selected topics. Subjects and earnable credit may vary from semester to semester. Repeatable with departmental consent. Prerequisite: junior standing and instructor's consent.

304 STATISTICAL COMPUTING (3). Intended to acquaint students with requisite computing tools for organizing, summarizing, and manipulating large data sets, applying various statistical procedures, and simulation. Prerequisite: Statistics 207 or 234 or 320 or consent of instructor.

307 NONPARAMETRIC STATISTICAL METHODS (3). Statistical methods when the functional form of the population is unknown. Applications emphasized. Comparisons with parametric procedures. Goodness-of-fit, chi-square, comparison of several populations, measures of correlation. Prerequisite: 207 or 234 or equivalent.

320 INTRODUCTION TO MATHEMATICAL STATISTICS (3) (same as Mathematics 320). Introduction to theory of probability and statistics using concepts and methods of calculus. Prerequisite: Math 201 or instructor's consent. f.w.s.

325 INTRODUCTION TO PROBABILITY THEORY (3) (same as Mathematics 325). Probability spaces; random variables and their distributions; repeated trials; probability limit theorems. Prerequisite: Math 201 or instructor's consent. f.w.s.

326 STATISTICAL INFERENCE I (3) (same as Mathematics 326). Sampling; point estimation; sampling distribution; tests of hypotheses; regression and linear hypotheses. Prerequisite: 325.

328 INTRODUCTION TO STOCHASTIC PROCESSES (3). Study of random processes, including topics selected from: Markov chains, birth and death processes, random walks, Poisson processes, renewal theory, Brownian motion and Gaussian processes, white noise, spectral...
sequential probability ratio test. Prerequisite: 325.

329 APPLIED PROBABILITY (3). Probability in its
applied context. Designed for seniors and begin-
ning graduate students. Construction of proba-
bility models. Examples in physical and behavioral
sciences. Multivariate normal and exponential
distributions, extreme value distributions,
stochastic processes, queuing. Prerequisite: 325 or equivalent.

360 INDUSTRIAL STATISTICS (3). Study of proba-
bility and statistical techniques as applied in con-
trolling quality of manufactured products. Pre-
quisite: 207 or 234 or 250 or 320 or 326.

370 SAMPLING TECHNIQUES (3). Theory of proba-
bility sampling designs, Unrestricted random
sampling, Stratified sampling, Cluster sampling,
Multi-stage of subsampling, Ratio estimates,
Regression estimates, Double sampling. Prerequi-
site: 207 or 234 or 250 or 320 or 326.

375 OPERATIONS RESEARCH (3). Study of mathe-
matical and statistical models employed in oper-
ations research. Prerequisite: 207 or 234 or 250
or 320 or 326.

380 STATISTICAL FORECASTING (3) (same as Man-
agement 380, Marketing 330, Finance 380).

385 REGRESSION AND CORRELATION ANALYSIS
(3). Measurement of relationships among vari-
bles including multiple regression, partial corre-
lation, and some nonparametric methods. Pre-
requisisite: 207 or 234 or 250 or 320 or 326 &
Math 80.

395 ANALYSIS OF VARIANCE (3). Study of prob-lems
of measuring separate and joint effects of two or
more factors on results of an experiment. Prerequi-
site: 207 or 234 or 250 or 320 or 326.

400 PROBLEMS AND SPECIAL READINGS (cr. arr.)
Approved reading and study, independent inves-
tigations, and reports on approved topics. Pre-
requisisite: graduate standing & consent of faculty
member involved.

401 PROBABILITY THEORY (3) (same as Mathemat-
ics 401). More sophisticated treatment of topics
in 325. Introduction to probability integral;
characteristic functions; probability limit theorems;
Borel-Cantelli lemmas and strong law of large
numbers. Prerequisite: Math 310 or Math 302 or
instructor's consent.

403 STATISTICAL INFERENCE II (3). Multivariate dis-
tribution functions. Multivariate normal. Asym-
ptotic methods. Asymptotic distributions of

maximum likelihood estimators and chi-square
goodness-of-fit statistic. Optimal statistical pro-
cedures. Statistical decision theory. Prerequi-
sites: 326, Math 310 or Math 302, & Math 331.

406 MEASURE THEORY (3) (same as Mathematics
408).

407 DESIGN AND ANALYSIS OF RESEARCH (3).
Advanced treatment of methods and models
associated with operations research. Prerequi-
sites: 326, 375, & Math 331 or instructor's con-
sent.

410 PROBABILITY SEMINAR (cr. arr.)

411 STATISTICS SEMINAR (cr. arr.)

416 STATISTICAL CONSULTING (3). Statistical con-
sulting under faculty supervision. Formulation of
statistical problem. Planning of surveys and ex-
periments. Statistical Computing. Interpretation
and summarization of results in statistical prac-
tice. (Prerequisite: 326 and 464 or 385 and 395;
and instructor's consent.)

423 EXPERIMENTAL DESIGN (3). Examination and
analysis of modern statistical techniques appli-
cable to experimentation in social, physical, or
biological sciences. Prerequisite: 395 or instruc-
tor's consent.

430 LIFE TESTING AND RELIABILITY (3). Statistical
failure models. Parametric life test procedures.
Robustness considerations. Nonparametric life
test procedures, Bayes methods in reliability.
System reliability. Accelerated life testing. Pre-
requisite: 403 or instructor's consent.

440 ADVANCED PROBABILITY (3) (same as Mathemat-
ics 440). Measure theoretic probability
theory. Characteristic functions; conditional
probability and expectation; sums of indepen-
dent random variables including strong law of
large numbers and central limit problem. Pre-
requisites: 325 or 401, & 406; or instructor's con-
sent.

441 STOCHASTIC PROCESSES (3) (same as Mathemat-
ics 441). Markov processes, martingales, or-
thonormal sequences, processes with independent
and orthogonal increments, stationarity, linear
prediction. Prerequisite: 440.

451 SPECIAL TOPICS IN PROBABILITY (cr. arr.)
Prerequisite: instructor's consent.

452 SPECIAL TOPICS IN STATISTICS (cr. arr.) Prere-
quist: instructor's consent.

460 THEORY OF ESTIMATION AND HYPOTHESIS
TESTING (3). Methods of estimation and small
and large sample optimality criteria. Least

461 ADVANCED INFEERENCE (3). Uniformly most powerful tests; unbiasedness; invariance; the general linear hypothesis; Bayes and minimax procedures; sequential tests. Prerequisite: 403.

464 LINEAR MODELS I (3). Elementary regression (curve fitting) and analysis of variance (crossed classification, blocking, and analysis of covariance) applied to scientific examples. Various numerical examples will be provided. Pre-requisites: Calculus, a first course in statistical inference.

465 LINEAR MODELS II (3). Mathematically more mature study and application of the general linear model. Other related regression and analysis of variance models. Prerequisite: 464. Corequisite: 326, Math 302 or 310, Math 331.

466 MULTIVARIATE ANALYSIS (3). Distribution of sample correlation coefficients. Derivation of generalized T^2 and Wishart distributions. Distribution of certain characteristic roots, vectors, tests of hypotheses about covariance matrices and mean vectors. Discriminant analysis. Prerequisite: 403 or instructor's consent.

470 THEORY OF NONPARAMETRIC STATISTICS (3). Estimation, hypothesis testing, confidence intervals, etc., when functional form of the population distribution is unknown. Prerequisite: 403 or instructor's consent.

490 RESEARCH (cr. arr.)

Requirements for the Master of Arts degree

A. General Requirements
   1. 30 semester hours of course work numbered 300 or higher, of which at least 15 hours must be taken from listings of the Department of Statistics.
   2. The 30 semester hours must include 15 semester hours of course work numbered 400 or higher, of which at least 12 semester hours (4 courses) must be taken from listings of the Department of Statistics. The 12 semester hours cannot include 400 and 490.

B. Specific Requirements
   1. Mathematics. The following courses are required if equivalent courses were not taken as undergraduate.
      a. 302 or 310 or the equivalent.
      b. 331 or the equivalent.
   2. Statistics
      a. 325 and 326 if the equivalent courses were not taken as an undergraduate.
   b. 464
   c. Additional courses which are recommended but not required: Math 303 or 311, at least one course in Computer Science and additional courses in an area of application, and Statistics 416.
   d. An MA examination, usually taken during the last semester of the program of studies. The examination may be taken over the course work, by reviewing a set of papers in statistics, by taking a Ph.D. qualifying examination or by writing a thesis at the discretion of the advisor.

There is considerable flexibility in the program leading to the Master of Arts Degree in Statistics. The following four programs are currently acceptable and are intended to give some idea of the flexibility of the program. It is possible for a student to follow a program which is more applied than any of the four listed.

PROGRAM 1

Mathematics
Background in matrix algebra, advanced calculus and elementary computer programming, equivalent to Mathematics 331, Mathematics 302, and Computer Science 104, is presumed.

Statistics
307. Nonparametric Statistical Methods (3)
325. Introduction to Probability Theory (3)
326. Statistical Inference I (3)
329. Applied Probability (3), or 328, Introduction to Stochastic Processes (3)
370. Sampling Techniques (3)
375. Operations Research (3)
403. Statistical Inference II (3)
407. Design and Analysis of Research (3)
430. Life Testing and Reliability (3)
464. Linear Models I (3)
465. Linear Models II (3)
466. Multivariate Analysis (3)

PROGRAM 2

Mathematics
Background same as for Program 1.

Statistics
307. Nonparametric Statistical Methods (3)
The Ph.D. Program

The Ph.D. program is very flexible. In order to qualify, a student must take an exam on the basic course work in mathematics, theoretical statistics and applied statistics. A student joining with a Bachelor's degree usually takes it during the last part of his Master of Arts program. A student joining with a Master's degree usually takes it at the end of his first year.

Faculty


Nader B. Ebrahimi, Visiting Assistant Professor of Statistics. Ph.D., Iowa State University 1980. His areas of specialization include reliability and applied statistics. The title of his dissertation is "Some Topics in Reliability Theory." His current research is devoted to
stress model. He has published several articles including: “Multivariate Negative Dependence,” “The Ordering of Negative Quadrant Dependence,” “Multivariate New Better than Used and Multivariate New Better than Used in Expectation,” and “Shock Models Leading to Multivariate Increasing Failure Rate and Decreasing Mean Residual Life.”


John E. Hewett, Professor of Statistics, Ph.D., State University of Iowa 1965. His areas of specialization include multivariate analysis, distribution theory and biostatistics. His current research interests are double sample tests of hypotheses, tests of hypotheses pertaining to regression curves and prediction. He is currently consulting with people who are using statistical methods in their own biological and medical research. Present Director of Statistical Consulting Center. Some of his publications are “Comparison of Two Regression Lines Over a Finite Interval” in Biometrics, 1978; “Some Two-Stage k-Sample Tests,” JASA 1979; “Comparison of Two Populations With Multivariate Date,” Biometrics 1980.

James E. Holstein, Associate Professor of Statistics and Director of Undergraduate Studies, Ph.D., State University of Iowa 1962. He is in charge of the multisection beginning course in statistics and the statistics laboratory. His areas of specialization include regression analysis and design of experiments. He serves as a consultant to graduate students, staff on campus as well as to various government agencies and private industry. In addition to his published articles, he and Professor Williams are joint authors of “An Introduction to Probability,” Published by Lucas Brothers in 1965. Fellow of the American Association for the Advancement of Science.

Shrinivas K. Katti, Professor of Statistics, Ph.D. Iowa State 1960. He was a faculty member at Florida State University prior to joining the University of Missouri-Columbia. He was a Visiting Professor at the University of New South Wales summer of 1971 and deliver statistical papers. He is a Fellow of the American Statistical Association and has been an Associate Editor of the Biometrics Society. He is interested in computer applications and teaches a computer oriented course. His current research interests are illustrated by his publications, “An Adaptive Estimator for a Parameter of the Log-Zero-Poisson Distribution” in Communications, 1979, “Developing New Statistical Methodology Through APL Language” in the Proceedings of the Computing Section of ASA, 1980 and “Testing Fishing Quality Index” in the Transaction of the American Fisheries Society, 1979.

Gary F. Krause, Professor of Statistics and Agronomy, Ph.D., Virginia Polytechnic Institute 1963. He taught at Kansas State University prior to coming to the University of Missouri-Columbia. His areas of specialization are in design of experiments, estimation and statistical genetics. As Agricultural Experiment Station Statistician he consults with researchers with a wide variety of problems. Over fifty refereed publications attest to the scope and variety of Statistical problems encountered. He has also done research in recreational use of public facilities and designed many surveys to permit estimates of fish and game harvests.


John Panaretos, Visiting Assistant Professor of Statistics, Ph.D. University of Bradford, England U.K. 1977. He was a faculty member at Trinity College, University of Dublin prior to coming to the University of Missouri-Columbia. His field of interest is distribution theory and especially characterization of distributions. He has presented statistical papers in international meetings in Hungary, Romania, Italy, etc. Two of his recent publications are: “Some Results Related to the Rao Rubin Characterization of the Poisson Distribution” in the Australian Journal of Statistics, 1979 (with D. N. Shanbhag) and “On Moran’s Property of the Poisson Distribution” in the Proceedings of the 6th Conference in Probability Theory, 1979, Brasov Romania.
Statistics. Ph.D., University of Rochester, 1980. His areas of specialization include statistical computing and data analysis. His current research interests include linear models, binary data and shrinkage estimation. He has published several articles including: Inflation of R² in Best Subset Regression” Technometrics 1980 (with A. C. Rencher) and “Binary Predictions of Weather Events with Several Predictors” Sixth Conference on Probability and Statistics in Atmospheric Science, 1979 (with K. R. Gabriel).


Frederick Williams, Professor of Statistics. Ph.D., Northwestern University 1958. Held academic positions at Northwestern University and University of Illinois prior to coming to the University of Missouri-1966-71 and 1973-76. Acting Chairman 1980-81. Primary areas of specialization sampling techniques, operations research, and applied probability. He has served as a consultant to various government organizations as well as private industry. From 1959-65 he served on the staff of the Executive Development Program sponsored by the University of Missouri in Kansas City. In addition to published articles, Professor Williams jointly with Professor Holstein is the author of “An Introduction to Probability” published by Lucas Brothers in 1965.

Evdokia Yekelaki, Visiting Assistant Professor of Statistics. Ph.D., University of Bradford, England U.K., 1977. She was a faculty member at the University of Dublin, Trinity College prior to joining the University of Missouri-Columbia. Before that she taught at the Athens Graduate School of Economics. Her research interests lie mainly in the area of probability models, accident theory and generalized hypergeometric distributions. She is a Fellow of the Royal Statistical Society and has presented statistical papers in Hungary, Belgium, Romania, Italy, etc. Her publications include: “On the Bivariate Poisson, Binomial and Negative Binomial Distributions” in the proceedings of the 1977 Symposium on Analytic Function Methods in Probability Theory and “Chance Mechanisms for the Univariate Generalized Waring Distribution” in Statistical Distributions in Scientific Work, 1980.

Some recent alumni with M.A. and their status immediately following graduation:

Herbert, Carolyn M., M.A. 1974, Research Specialist, Agricultural Experiment Station.
McKee, Bonnie L., M.A. 1975, Research Specialist, Agricultural Experiment Station.
Whiteman, David E., M.A. 1975, Los Alamos Scientific Laboratory.
Aune, David J., M.A. 1976, USDA, Lincoln, Nebraska.
Lei, Chao-Min, M.A., 1979, Missouri State Government, Jefferson City, Missouri.
Wang, Wei-Lee, M.A., 1980, University of Missouri-Columbia, School of Business and Public Administration.

Some alumni with Ph.D. and their status immediately following graduation:

Robertson, Timothy J., Ph.D. 1966, Assistant Professor, University of Iowa.
Bowman, Raymond W., Ph.D. 1966, Monsanto Corporation.
Patterson, Robert A., Ph.D. 1967, Assistant Professor, Bowling Green State University.
Wright, Farrel Tim, Ph.D. 1968, Assistant Professor, University of Missouri, Rolla.
Tebbe, Dennis Lee, Ph.D. 1968, Assistant Professor, University of Missouri, Columbia, Electrical Engineering Department.
Engelhardt, Maxwell Eugene, Ph.D. 1969, Assistant Professor, University of Missouri, Rolla.
Mann, Charles Roy, Ph.D. 1969, Assistant Professor, George Washington University.
Pledger, Gordon Wayne, Ph.D. 1970, Research Associate, Florida State University.
Higgin, James J., Ph.D. 1970, Assistant Professor, University of Missouri, Rolla.
McDonald, Kendall L., Ph.D. 1970, Assistant Professor, Appalachian State University.
LeDuc, Sharon Kay, Ph.D. 1971, Lecturer and Programmer, Atmospheric Science Department, University of Missouri, Columbia.
Goodsell, Carole Ann, Ph.D. 1971, Assistant Professor, University of Wisconsin, Oshkosh.
Bentley, Adrian E., Ph.D. 1972, Assistant Professor, University of Manitoba.
Parke, Darrel W., Ph.D. 1972, Federal Reserve Bank.
Huque, Fazle M., Ph.D. 1973, Senior Statistician, Missouri Institute of Psychiatry.
Spurrer, John D., Ph.D. 1974, Assistant Professor, University of South Carolina.
Lee, Larry L., Ph.D. 1975, Assistant Professor, Virginia Polytechnic Institute.
Walgren, Cheryl, Ph.D. 1977, Assistant Professor, Illinois State University at Normal.
Laud, Purushottam W., Ph.D. 1977, Assistant Professor,