ACADEMIC PROGRAM

THE DEPARTMENT OF STATISTICS
TEXAS A&M UNIVERSITY
COLLEGE STATION, TEXAS

Contents

This statement of regulations and requirements complements the University's regulations and requirements which are contained in the Graduate College Catalog. The degree requirements contained herein apply to all students entering as of September 1, 2008.

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Graduate Program in Statistics

The Department of Statistics offers a graduate program, leading to the degrees of Master of Science and Doctor of Philosophy. The Department also jointly sponsors graduate work with all subject matter area departments in setting up flexible minor programs in statistics.

The Department of Statistics offers two options in its master's degree programs: (1) the Master of Science degree (thesis option) which requires the preparation of a thesis and (2) the Master of Science (non-thesis option) which requires more formal course work in lieu of the thesis. Within either option, students are allowed to choose either a broad-based or specialized program of study. All choices, however, provide a balanced training in statistical methods, computational statistics, and statistical theory, and are intended to prepare the student to adapt statistical methodologies to practical problems.

The aim of the Ph.D. program is to provide comprehensive and balanced training in statistical methods, computational statistics, and the theory of statistics. Particular emphasis is placed on training students to independently recognize the relevance of statistical methods to the solution of specific problems and to enable them to develop new methods when they are needed. The training aims to convey a sound knowledge of existing statistical theory, including the mathematical facility to develop new results in statistical methodology. At the same time, the program is kept sufficiently flexible to permit students to develop their specific interests.

Master of Science Program

Non-Thesis Option

A student seeking the Master of Science degree under the Non-Thesis Option must fulfill the following requirements:

A. Coursework. Note that STAT 601, 651, 652, 653, 658, and 667 may not be used to fulfill any of the coursework requirements listed below.
1. STAT 604, 608, 641 and 642.
2. One credit hour of STAT 681.
3. Two semester credit hours of statistical consulting experience (STAT 684) earned in a minimum of two semesters. Rules governing completing this requirement are given below in Item B.
4. Three semester credit hours of STAT 685 for the preparation of a special problem (see item C below).
5. Eighteen semester credit hours based on one of the emphasis areas outlined below.
6. A total of 36 semester credit hours.

Broad-Based Plan
1. STAT 610, 611
2. Three additional approved statistics courses.
3. One course from a supporting field.

Biostatistics Emphasis
1. STAT 610, 611, 643 and 644
2. One additional approved statistics courses.
3. One course from a supporting field.

Computational Emphasis
1. STAT 610 and 611
2. Two courses in Mathematics (e.g., MATH 609, MATH 610 or MATH 660).
3. Two courses in Computer Science (e.g., CPSC 603, CPSC 654 or CPSC 659).

Applied Emphasis
1. STAT 630, 636, 657, 659
2. One additional statistics courses.
3. One course from a supporting field.

B. Consulting Experience. One semester credit hour of STAT 684 can be obtained through the completion of any of the experiences listed below.
1. One semester of service in the Statistical Consulting Center.
2. One semester of a departmentally approved internship.
3. Special experiences, with prior approval from either the Department Head or the Associate Department Head that involve the following:
   a. At least one semester of activity
   b. The application of statistical knowledge
   c. Working with non-statisticians
   d. Sufficient statistical supervision.

C. Form a master's advisory committee and complete a special project under the direction of the chairman of the advisory committee. Three semester credit hours of STAT 685 are earned by completion of this project. Upon completion, the student is required to compose a written report and make an oral presentation on the work. The purpose of this project is to familiarize the student with the type of problems that may be encountered in future work and to give the student a chance to develop the ability to present results both verbally and in writing. In many cases, work done during an internship may be used as the basis for the student's master's project. However, this project must be completed under the supervision of the chairperson of the student's advisory committee.

D. Pass the departmental MS examination (see below).

E. Pass a final oral examination. This examination is concerned with the student's coursework and special problem. It is administered by the student's advisory committee.

Thesis Option

A student seeking the Master of Science degree under the Thesis Option must fulfill the following requirements:

A. Coursework. Note that STAT 601, 651, 652, 653, 658, and 667 may not be used to fulfill any of the coursework requirements listed below.

1. STAT 604, 608, 610, 611, 641 and 642.
2. One credit hour of STAT 681.
3. Six semester credit hours of STAT 691 for preparation of a thesis (see item B below).
4. Nine semester credit hours based on one of the emphasis areas outlined below. STAT 691 semester credit hours may not be used to satisfy this requirement.
5. A total of 34 semester credit hours.

Broad-Based Plan

1. Two additional approved statistics course.
2. One course from a supporting field.

Biostatistics Emphasis

1. STAT 643 and 644
2. One course from a supporting field.

Computational Emphasis

1. At least one course in Mathematics (e.g., MATH 609, MATH 610 or MATH 660).
2. At least one course in Computer Science (e.g., CPSC 603, CPSC 654 or CPSC 659).

B. Form an advisory committee and complete a thesis under the direction of the chairman of the advisory committee. The Department does not insist that this represent an original contribution to the field of statistics. It is intended to train the student in carrying out independently a piece of research; this may represent an application of existing statistical methods in a new area or a comparative evaluation of statistical methods.

C. Pass the departmental MS examination (see below).

D. Pass a final oral examination. This examination is concerned with the student's coursework and thesis. It is administered by the student's advisory committee.

Master's Diagnostic Examination

The MS examination covers basic statistical methods. The examination is evaluated with the performance judged to be "Pass" or "Fail." To receive a Master's Degree, a student must take and pass the exam.

The qualifying exam is offered twice a year--prior to the beginning of the fall semester and prior to the beginning of the spring semester, and must be taken at the earliest possible time after the student has completed the required courses: STAT 610, 611 (or 630), 604, 608, 641, and 642. Any exception to this time limit must be obtained in writing from the head of the Department.

The results of a student's examination are reported to the faculty of the Statistics Department. If the student's performance is judged to be deficient, the examination may be retaken the next time it is offered. Only one retake of the examination is allowed.

Doctor of Philosophy Program

The breadth of the field of statistics as well as the frontiers of knowledge in a particular research area are emphasized in the Ph.D. program. The student seeking a Ph.D. in statistics is required to fulfill the following requirements. A Ph.D. selection committee will examine the background of entering students to determine if they have the appropriate math/stat background to successfully complete the program. Those students determined to have the appropriate background will need to complete the courses under Option I and the remaining students will take the courses under Option II.

A. Coursework. Note that STAT 601, 651, 652, 653, 658, and 667 may not be used to fulfill any of the coursework requirements listed below.

1a. Required Courses - Option I: STAT 605, 612, 613, 614, 620, 632, 648, (621 or 642).

1b. Required Courses - Option II: STAT 604, 608, 610, 611, 641, 642, 605, 612, 613, 614, 620, 632, 648.

2. At least four courses from the elective course list provided below.

3. If entering with a Bachelor's degree then complete three additional courses from the elective course list.

4. For those students selecting the Methodology / Applications emphasis, two semester credit hours of statistical consulting experience (STAT 684) earned in a minimum of two semesters. Rules governing acceptable methods for completing this requirement are given below in Item B. No consulting experience is required of students selecting the Theory/Methodology emphasis.

5. Four semester credit hours of STAT 681.

6. A sufficient number of research hours, STAT 691, to achieve a total of at least 96 semester credit hours beyond a Bachelor's degree or 64 semester credit hours beyond a Master's degree.

Elective Course List

607, 608, 615, 616, 621, 623, 626, 627, 631, 636, 643, 644, 647, 657, 659, 661, 662, 665, 671, 673, 674, 689 (may be taken repeatedly) MATH 607, MATH 615, MATH 625, MATH 628

B. Consulting Experience. One semester credit hour of STAT 684 can be obtained through the completion of any of the experiences listed below.

1. One semester of service in the Statistical Consulting Center.
2. One semester of a departmentally approved internship.
3. Special experiences, with prior approval from either the Department Head or the Associate Department Head that involve the following:
   a. At least one semester of activity
   b. The application of statistical knowledge
   c. Working with non-statisticians
   d. Sufficient statistical supervision.

C. Ph. D. Examinations:

Ph.D. students in Option I:

There will be three examinations covering Theory (614, 620), Methodology (612,613), Applied / Computational Statistics (605,648). The exams are evaluated as Pass or Fail. The exams will be offered during the second week in August every year and students must take at least two out of the three exams at the end of their first year in the Ph.D. program. To continue in the Ph.D. program, a student must pass two of the three exams within two years of entering the Ph.D. program.

Each year, after the Ph.D. exams are graded, the Ph.D. Examination Committee will report the results of the exams to the faculty. The committee will also make recommendations concerning the appropriate advisement of those students who did not pass the required number of exams. A report of these recommendations will also be presented to the faculty prior to meeting with the individual students. Based on the results of the exams and the student's performance in their first year Ph.D. courses, the students will be given one of several options concerning their continuation in the Ph.D. program.

Possible Options given to students:

1. Take the second year of courses, and then take the exams again during August of the next year. If a student passed 1 of the 2 examination, then he/she would only need to pass one more exam during the next offering of the exams.
2. Discontinue the Ph.D. program and take the necessary M.S. courses to receive an M.S. in statistics.

3. If after two attempts a student has not passed two of the exams, he/she will be given the option to complete the required courses for an M.S. and will not be allowed to continue for a Ph.D.

Ph.D. students in Option II:

Ph.D. students in Option II will not take the Ph.D. exam at the end of their first year. Instead, they will take the MS Diagnostic Exam at the end of their first year. The Ph.D. Examination committee will review the performance of all Option II students with respect to their performance in courses and their performance on the M.S. Diagnostic Examination. Based on this review, a recommendation will be made concerning the continuation of these students in the Ph.D. program.

D. Form a Ph.D. advisory committee and pass the Preliminary Examination administered by the advisory committee (see below).

E. Write a Ph.D. Dissertation and pass the final Defense of Dissertation Examination (see below). The student is also required to present the results of their research in a regularly scheduled departmental seminar.

Preliminary Examination

Once a student has decided upon an area of research, a faculty member of the Statistics Department should be found to direct the research. The student and the advisor should work together to form a Ph.D. advisory committee and to submit a degree plan to the University Office of Graduate Studies. This degree plan must be approved by the Office of Graduate Studies before the student is allowed to take the preliminary exam.

The preliminary examination consists of the following parts:

1. A written examination developed by the statistics members of the student's advisory committee. This examination is not to be taken until the student has passed two of the Ph.D. exams. This exam may be waived at the discretion of the departmental committee members.
2. Written examinations administered by members of the student's advisory committee from outside the Statistics Department. These members may choose to waive these examinations.

3. An oral examination administered by the members of the student's advisory committee. This examination may not be taken until the student has successfully completed the first two parts of the preliminary examination, unless of course, both examinations are waived.

Note that the preliminary exam must conform to the time limits and scheduling requirements listed in the university graduate catalog. In particular, the exam is given no earlier than a date when the student is within approximately six credit hours of completion of the formal course work (i.e., all course work on the degree plan except 681, 684, and 691) or **no later than** the semester following the completion of the formal course work on the degree plan.

The Ph.D. Dissertation

After successfully completing the course work and the preliminary examination, a period of time is to be devoted to a research topic in either statistical methodology or statistical theory under the guidance of the student's advisor. The results of this research must be communicated in a written dissertation satisfying the guidelines established by the University. The research must constitute an original contribution to the science of statistics and may derive new results in statistical theory or methodology or may be concerned with developing statistical methodology in new areas of application.

Once the student's advisor feels that the student has completed the dissertation, a final oral examination is conducted by the advisory committee in which the student defends the dissertation.

Internship Program

Students after one year of coursework are eligible to participate in an internship with a sponsoring company, hospital, or federal agency. The internships are generally a semester's stay at the sponsor's site. If a student participates in one of the internship programs approved by the department head, then:

1. The student is given credit for one hour of STAT 684.
2. In many cases work done during the internship may be used as the basis for a Master's project. However, this project must be completed under the supervision of the chairperson of the student's advisory committee.

Faculty, 2008-2009

- **S. J. Sheather**, *Professor and Head*; Ph.D. in Statistics: LaTrobe University, 1986; development of regression diagnostics and robust and flexible regression methods, statistical models of wine quality.
- **M. T. Longnecker**, *Professor and Associate Head*; Ph.D. in Statistics: Florida State University, 1976; statistical education and consulting.
- **D. Akleman**, Lecturer; Ph.D. in Agricultural Economics: Texas A&M University, 1996; time series, risk analysis, econometrics.
- **M. Boggess,** Lecturer; Ph.D. in Mathematics: University of Newcastle, 1997; competings risks in parametric, semi-parametric and non-parametric survival models; neurotoxicology.
- **J. A. Calvin**, Professor and Executive Associate VP for Research; Ph.D. in Statistics: Colorado State University, 1985; multivariate variance components estimation, experimental design, biostatistics, applied statistics.
- **J. H. Carroll**, Senior Lecturer; MS in Statistics: Texas A&M University, 1990; Statistics education.
- **R. J. Carroll**, Distinguished Professor; Ph.D. in Statistics: Purdue University, 1974; data transformations, heteroscedastic regression, measurement error models and asymptotic theory.
- **W. Chen**, Associate Professor; Ph.D. in Statistics: New York University, 2001; econometric time series analysis.
- **D. B. H. Cline**, Professor; Ph.D. in Statistics: Colorado State University, 1983; stable laws, extreme values, distribution tails, time series, stationary processes, robust and nonparametric function estimation.
- **A. Dabney**, Assistant Professor; Ph.D. in Biostatistics: University of Washington, 2006; microarrays, bioinformatics, classification methods.
- **D. B. Dahl**, Assistant Professor; Ph.D. in Statistics: University of Wisconsin, Madison, 2004; Bayesian nonparameterics, statistical genomics, Bayesian computations, statistical computing.
- **P. F. Dahm**, Professor and Graduate Advisor; Ph.D. in Statistics: Iowa State University, 1979; measurement error models, biostatistics, econometrics.
- **R. Fan**, Associate Professor; Ph.D. in Biostatistics: University of Michigan, 1998; statistical genetics and applied probability.
- **R. J. Freund**, Professor Emeritus; Ph.D. in Experimental Statistics: North Carolina State University, 1955; statistical data analysis, applications of regression and linear models.
- **C. E. Gates**, Professor Emeritus; Ph.D. in Experimental Statistics: North Carolina State University, 1955; design and analysis of experimental data, estimation of wildlife abundance and modeling non-linear growth curves.
- **M. G. Genton**, Associate Professor; PhD. in Statistics: Swiss Federal Institute of Technology, Lausanne, 1996; robustness, spatial and spatio-temporal statistics, time series, multivariate analysis, and data mining.
- **J. D. Hart**, Professor; Ph.D. in Statistics: Southern Methodist University, 1981; nonparametric function estimation, time series, bootstrap methods.
- **K. Hatfield**, Lecturer; MBA in Operations Research **:** North Texas State University, 1980; Statistics education and consulting.
- **R. R. Hocking**, Professor Emeritus; Ph.D. in Statistics: Iowa State University, 1962; regression, mixed models and multivariate analysis.
- **J. Huang**, Associate Professor; Ph.D. in Statistics: University of California, Berkeley, 1997; nonparametric and semiparametric methods, statistical function estimation using polynomial splines, survival analysis, event history analysis, analysis of longitudinal data, functional data analysis, nonlinear time series.
- **O. C. Jenkins**, Associate Professor Emeritus; Ph.D. in Statistics: Texas A&M University, 1972; statistical sampling and experimental design.
- **M. Jun**, Assistant Professor, Ph.D. in Statistics: University of Chicago, 2005; statistical methodologies, environmental problems, space-time covariance modeling, numerical model evaluation in air quality problems, combining numerical model output with observed data.

- **S. Lahiri**, Professor; Ph.D. in Statistics: Michigan State University, 1989; asymptopic expansions, environmental statistics, resampling methods, spatial statistics, small area estimation, time series, wavelets.
- **E. Li**, Assistant Professor, Ph.D. in Statistics: North Carolina State University, 2004; longitudinal data analysis, mixed models, semiparametric methods, multiple endpoints, biostatistics.
- **F. Liang**, Associate Professor, Ph.D. in Statistics: University of Hong Kong, 1998; Bayesian computation and bioinformatics.
- **Y. Ma**, Assistant Professor, Ph.D. in Statistics: Massachusetts Institute of Technology, 1999; semiparametric methods, mixed effect models with non-normally distributed random effect, skew-elliptical distributions, HIV modeling and analysis, inverse problem using Markov Chain Monte Carlo approach.
- **B. Mallick**, Professor; Ph.D. in Statistics: University of Connecticut, 1994; Bayesian nonparametric and semiparametric modeling, survival analysis, generalized linear models, neural networks, spatial statistics.
- **J. H. Matis**, Professor; Ph.D. in Statistics: Texas A&M University, 1970; biomathematics, compartmental analysis, statistical ecology and applied stochastic processes.
- **Y. Mu**, Assistant Professor, Ph.D. in Statistics: University of Illinois, Urbana-Champaign, 2005; linear and nonlinear quantile regression models, semi-parametric statistical methods, applied and computational statistics, biostatistics.
- **U. Müller-Harknett**, Assistant Professor; Ph.D. in Mathematics: University of Bremen, 1997; non- and semi-parametrics, efficient estimation.
- **H. J. Newton**, Professor and Dean; Ph.D. in Statistics: State University of New York at Buffalo, 1975; time series analysis, computational statistics.
- **E. Parzen**, Distinguished Professor; Ph.D. in Mathematics: University of California (Berkeley), 1953; statistical science-developing statistical methods for time series analysis, data analysis, and change analysis.
- **J. Perrett,** Assistant Professor, Ph.D. in Statistics: Kansas State University, 2004, Statistical programming, unreplicated experiments, linear mixed models, design of experiments, regression.
- **M. Pourahmadi,** Professor, Ph.D. in Statistics: Michigan State University, 1980, time series analysis and prediction theory, multivariate analysis, longitudinal data analysis, mixed-effects models, data mining, stochastic volatility models.
- **L. J. Ringer**, Professor Emeritus; Ph.D. in Statistics: Texas A&M University, 1966; applied statistics, survey sampling and reliability.
- **H. Sang,** Assistant Professor, Ph.D. in Statistics: Duke University, 2008; Bayesian statistics with focus on spatial and spatio-temporal statistics.
- **H. Schmiediche,** Senior Lecturer; Ph.D. in Statistics: Texas A&M University, 1993; computational statistics.
- **M. Sherman**, Professor; Ph.D. in Statistics: University of North Carolina at Chapel Hill, 1992; biostatistics, spatial statistics.
- **S. Sinha**, Assistant Professor, Ph.D. in Statistics: University of Florida, 2004; methodological research: missing data technique, measurement error, splines, Bayesian methods: parametric and nonparametric methods, application: epidemiology, genetic epidemiology.
- **W. B. Smith**, Professor Emeritus; Ph.D. in Statistics: Texas A&M University, 1967; multivariate analysis, missing data methods, correspondence analysis.
- **F. M. Speed**, Professor and Associate Dean for Technology Mediated Instruction; Ph.D. in Statistics: Texas A&M University, 1969; computational statistics, biostatistics, linear models, applied statistics, multivariate methods, environmental and industrial statistics, teaching statistics real time.
- **C. H. Spiegelman**, Professor; Ph.D. in Statistics & Applied Mathematics: Northwestern University, 1976; calibration curves, measurement error models, applied statistics, especially to chemistry.
- **S. Subba Rao**, Assistant Professor; Ph.D. in Statistics: University of Bristol, UK, 2001; time series, nonstationary processes, nonlinear processes, recursive online algorithms, spatio-temporal models.

- **E. Toby**, Lecturer; Ph.D. in Mathematics: University of California, San Diego, 1988; biostatistics, diffusions processes.
- **M. Vannucci**, Professor; Ph.D. in Statistics, University of Florence, Italy, 1996; wavelets, nonparametric estimation, smoothing of time series, Bayesian methods, variable selection, statistical computing.
- **N. Wang**, Professor; Ph.D. in Statistics: Cornell University, 1992; semiparametric methods, regression, missing data.
- **S. Wang**, Professor; Ph.D. in Statistics: University of Texas at Austin, 1988; saddlepoint approximations, bootstrap methods, measurement error models, survey sampling, biostatistics.
- **T. E. Wehrly**, Professor; Ph.D. in Statistics: University of Wisconsin, 1976; stochastic models, directional data, mathematical statistics, nonparametric function estimation.
- **W. West**, Associate Professor; Ph.D. in Statistics: Rice University, 1994; computational and graphical statistics, toxicological risk assessment, Nonparametric statistics, stochastic modeling.
- **J. Wickersham**, Assistant Lecturer; MS in Statistics: Texas A&M University, 2006; Statistical education, biostatistics, linear models, stochastic processes.
- **L. Zhou,** Assistant Professor, Ph.D. in Statistics: University of California, 1997; statistical Methodology and application in bioinformatics, nutrition and epidemiology, functional/longitudinal data analysis.
- **L. Zhu**, Assistant Professor; Ph.D. in Biostatistics: University of Minnesota, 2000; spatial statistics and Bayesian modeling.
- **J. Zinn**, Professor of Mathematics and Statistics; Ph.D. in Mathematics: University of Wisconsin, 1972; empirical processes, bootstrapping.

Undergraduate Course Offerings

201. Elementary Statistical Inference. (3-0). Credit 3. Data collection, tabulation, and presentation. Elementary description of the tools of statistical inference; probability, sampling, and hypothesis testing. Applications of statistical techniques to practical problems. May not be taken for credit after any other course in statistics or INFO 303 has been taken.

211. Principles of Statistics I. (3-0). Credit 3. Introduction to probability and probability distributions. Sampling and descriptive measures. Inference and hypothesis testing. Linear regression, analysis of variance. Prerequisite: MATH 152 or 172.}

212. Principles of Statistics II. (3-0). Credit 3. Design of experiments, model building, multiple regression, nonparametric techniques, contingency tables, and short introductions to response surfaces, decision theory and time series data. Prerequisite: STAT 211.

301. Introduction to Biometry. (3-0). Credit 3. Intended for students in animal sciences. Introduces fundamental concepts of biometry including measures of location and variation, probability, tests of significance, regression, correlation, and analysis of variance which are used in advanced courses and are being widely applied to animal-oriented industry. Credit will not be allowed for more than one of STAT 301, 302 or 303. Prerequisite: MATH 141 or 166 or equivalent.

302. Statistical Methods. (3-0). Credit 3. Intended for undergraduate students in the biological sciences and agriculture (except agricultural economics). Introduction to concepts of random sampling and statistical inference; estimation and testing hypotheses of means and variances; analysis of variance; regression analysis; contingency tables. Credit will not be allowed for more than one of STAT 301, 302 or 303. Prerequisite: MATH 141 or 166 or equivalent.

303. Statistical Methods. (3-0). Credit 3. Intended for undergraduate students in the social sciences. Introduction to concepts of random sampling and statistical inference, estimation and testing hypotheses of means and variances, analysis of variance, regression analysis, contingency tables. Credit will not be allowed for more than one of STAT 301, 302 or 303. Prerequisite: MATH 141 or 166 or equivalent.

307. Sample Survey Techniques. (3-0). Credit 3. Concepts of population and sample; the organization of a sample survey; questionnaire design. Basic survey designs and computation of estimates and variances. Prerequisites: STAT 301, 302, 303, or INFO 303.

407. Principles of Sample Surveys. (3-0). Credit 3. Principles of sample surveys and survey design; techniques for variance reduction; simple, stratified and multi-stage sampling; ratio and regression estimates; post-stratification; equal and unequal probability sample. Prerequisite: STAT 212.

408. Introduction to Linear Models. (3-0). Credit 3. Introduction to the formulation of linear models and the estimation of the parameters of such models, with primary emphasis on least squares. Application to multiple regression and curve fitting. Prerequisites: MATH 304; STAT 212.

414. Mathematical Statistics. (3-0). Credit 3. Introduction to the mathematical theory of statistics, including random variables and their distributions, expectation and variance, point estimation, confidence intervals and hypothesis testing. Prerequisite: MATH 221, 251 or 253.

415. Mathematical Statistics II. (3-0). Credit 3. Continuation of the mathematical theory of statistics, including sampling and limiting distributions, principles for statistical inference and inference for bivariate and categorical data. Prerequisite: STAT 414.

485. Problems. Credit 1 to 6. Special problems in statistics not covered by another course in the curriculum. Work may be in either theory or methodology. Prerequisite: Approval of instructor.

489. Special Topics in Statistics. Credit 1 to 4. Selected topics in an identified area of statistics. Topics may be of interest to applied mathematics majors as well as majors in other disciplines. May be repeated for credit. Prerequisite: Approval of instructor.

Graduate Course Offerings

601. Statistical Analysis. (3-2). Credit 4. For students in engineering, physical, and mathematical sciences. Introduction to probability, probability distributions, and statistical inference; hypotheses testing using t and F tests; introduction to methods of analysis such as tests of independence, regression, analysis of variance with some consideration of planned experimentation. Prerequisite: MATH 152 or 172.

604. Topics in Statistical Computations. (3-0). Credit 3. Efficient uses of existing statistical computer programs (SAS, R, etc.), generation of random numbers and statistical variables, programming of simulation studies, data management issues. Prerequisites: MATH 221, 251, or 253.

605. Advanced Statistical Computations. (3-0). Credit 3. Programming languages, statistical software, and computing environments; Development of programming skills using modern methodologies; Data extraction and code management; Interfacing lower-level languages with data analysis software. Methodology topics include optimization, simulation and Monte Carlo integration, Markov-chain Monte Carlo, permutation tests, and bootstrapping. Prerequisite: STAT 612 and STAT 648.

607. Sampling. (3-0). Credit 3. Planning, execution, and analysis of sampling from finite populations; simple, stratified, multistage, and systematic sampling; ratio estimates. Prerequisite: STAT 601 or 652 or concurrent enrollment in STAT 641.

608. Regression Analysis. (3-0). Credit 3. Multiple, curvilinear, nonlinear, robust, logistic and principal components regression analysis. Regression diagnostics, transformations, analysis of covariance. Prerequisite: STAT 601 or 641.

610. Theory of Statistics - Distribution Theory. (3-0). Credit 3. Brief introduction to probability theory; distributions and expectations of random variables, transformations of random variables, and order statistics; generating functions and basic limit concepts. Prerequisite: MATH 409 or concurrent enrollment in MATH 409.

611. Theory of Statistics - Inference. (3-0). Credit 3. Theory of estimation and hypothesis testing; point estimation, interval estimation, sufficient statistics, decision theory, most powerful tests, likelihood ratio tests, chi-square tests. Prerequisite: STAT 610 or equivalent.

612. Theory of Linear Models. (3-0). Credit 3. Matrix algebra for statisticians, Gauss-Markov theorem, estimation subject to linear restrictions, multivariate normal distribution and its sampling distribution, inference for linear models, issues with multiple regressors, variable selection, regression diagnostics, ANOVA models, selected topics from random- and mixed- effects models, dynamic linear models, generalized linear models. Prerequisite: Linear Algebra course.

613. Statistical Methodology I. (3-0). Credit 3. Elements of likelihood inference; exponential family models, group transformation models, survival data, missing data; estimation and hypothesis testing; nonlinear regression models; selected topics from conditional and marginal inference, complex models (Markov chains, Markov random field, time series and point processes). Prerequisite: STAT 612.

614. Probability for Statistics. (3-0). Credit 3. Probability and measure, expectation and integral, Kolmogorov's extension theorem, Fubini's theorem, inequalities, uniform integrability, Radon-Nikodym theorem, conditional expectation, laws of large numbers, central limit theorem, Brownian motion. Prerequisite: Advanced calculus, STAT 610 or its equivalent.

615. Stochastic Processes. (3-0). Credit 3. Survey of the theory of Poisson processes, discrete and continuous time Markov chains, renewal processes, birth and death processes, diffusion processes, and covariance stationary processes. Prerequisites: MATH 409; STAT 611.

616. Multivariate Analysis. (3-0). Credit 3. Multivariate normal distributions and multivariate generalizations of classical test criteria, Hotelling's T^2, discriminant analysis and elements of factor and canonical analysis. Prerequisites: STAT 611 and/or 612.

620. Asymptotic Statistics. (3-0). Credit 3. Review of basic convergence theorems, delta method (finite dimensional), Bahadur representation theorem, asymptotic distribution of the MLE and the LRT statistic; asymptotic efficiency, U- and V-statistics --- the projection theorem and limit distributions, differentiable statistical functionals and their limit distributions, with illustrations from M-,L-,R- estimation. Prerequisite: STAT 614.

621. Advanced Stochastic Processes. (3-0). Credit 3. Introduction, conditional expectation, stopping times; discrete Markov processes, birth-death processes, queueing models; discrete semi-markov processes; Brownian motion, diffusion processes, Ito integrals. Prerequisite: STAT 614.

623. Statistical Methods for Chemistry. (3-0). Credit 3. Chemometrics topics of process optimization, precision and accuracy; curve fitting; chi-squared tests; multivariate calibration; errors in calibration standards; statistics of instrumentation. Prerequisites: STAT 601 or STAT 652 or STAT 641 or approval of instructor.

626. Methods in Time Series Analysis. (3-0). Credit 3. Introduction to statistical time series analysis; autocorrelation and spectral characteristics of univariate, autoregressive, moving average models; identification, estimation and forecasting. Prerequisite: STAT 601 or 642 or approval of instructor.

627. Nonparametric Function Estimation. (3-0). Credit 3. Nonparametric function estimation; kernel, Fourier series and spline methods; automated smoothing methods including cross-validation; large sample distributional properties of estimators; recent advances in function estimation. Prerequisites: STAT 611 or equivalent.

630. Overview of Mathematical Statistics. (3-0). Credit 3. Basic probability theory including distributions of random variables and expectations. Introduction to the theory of statistical inference from the likelihood point of view including maximum likelihood estimation, confidence intervals, and likelihood ratio tests. Introduction to Bayesian methods. Prerequisites: Math 221, 251, or 253.

631. Statistical Finance. (3-0). Credit 3. Regression and the capital asset pricing model, statistics for portfolio analysis, resampling, time series models, volatility models, option pricing and Monte Carlo methods, copulas, extreme value theory, value at risk, spline smoothing of term structure. Prerequisites: STAT 610, 611, and 608.

632. Bayesian Modeling and Inference (Statistical Methodology II). (3-0). Credit 3. Elements of decision theory; fundamentals of Bayesian inference; single and multi-parameter models, Gaussian model, linear and generalized linear models; Bayesian computation, asymptotic methods, non-iterative Monte Carlo, Markov Chain Monte Carlo; selected topics from hierarchical models, nonlinear models, random effect models, survival analysis, and spatial models. Prerequisite: STAT 613.

636. Methods in Multivariate Analysis. (3-0). Credit 3. Multivariate extensions of the chi-square and t-tests, discrimination and classification procedures. Applications to diagnostic problems in biological, medical, anthropological, and social research; multivariate analysis of variance, principal component and factor analysis, canonical correlations. Prerequisites: MATH 304 and STAT 642 or 653.

641. Statistical Methods I. (3-0). Credit 3. An application of the various disciplines in statistics to data analysis, introduction to statistical software; demonstration of interplay between probability

models and statistical inference. Prerequisites: STAT 604 and 610 or 630 (or concurrent enrollment in these courses).

642. Statistical Methods II. (3-0). Credit 3. Design and analysis of experiments; scientific method; graphical displays; analysis of nonconventional designs and experiments involving categorical data. Prerequisites: STAT 641.

643. Biostatistics I. (3-0). Credit 3. Bio-assay for quantitative and quantal responses; statistical analysis of contingency, including effect estimates, matched samples and misclassification. Prerequisites: STAT 608, 610 or 630, and 642.

644. Biostatistics II. (3-0). Credit 3. Generalized linear models; survival analysis with emphasis on nonparametric models and methods. Prerequisites: STAT 643 or approval of instructor.

647. Spatial Statistics. (3-0). Credit 3. Spatial correlation and its effects; spatial prediction (kriging); spatial regression; analysis of point patterns (tests for randomness and modelling patterns); sub sampling methods for spatial data. Prerequisite: STAT 601 or STAT 611 or equivalent.

648. Applied Statistics and Data Analysis. (3-0). Credit 3. Examines complex data sets; exploratory data analysis, numerical measures, data visualization; basic ideas of sampling; parametric distributions; statistical testing, permutation tests, comparing k populations; regression analysis, model building and diagnostics; multivariate analysis, smoothing, classification, time series, spatial data. Prerequisite: Concurrent enrollment in STAT 612.

651. Statistics in Research I. (3-0). Credit 3. For graduate students in other disciplines. A non-calculus exposition of the concepts, methods, and usage of statistical data analysis. T-tests, analysis of variance, and linear regression. Prerequisite: MATH 102 or equivalent.

652. Statistics in Research II. (3-0). Credit 3. Continuation of STAT 651. Concepts of experimental design, individual treatment comparisons, randomized blocks and factorial analysis, multiple regression, chi-square tests and a brief introduction to covariance, non-parametric methods, and sample surveys. Prerequisite: STAT 651.

653. Statistics in Research III. (3-0). Credit 3. Regression analysis including analysis of messy data; non-linear regression; logistic and weighted regression, diagnostics and model building; emphasis on concepts, computing and interpretation. Prerequisite: STAT 652.

657. Advanced Programming Using SAS. (3-0). Credit 3. Programming with SAS/IML, programming in SAS data step, advanced use of various SAS procedures. Prerequisites: STAT 604, 642.

658. Transportation Statistics. (3-0). Credit 3. Design of experiments, estimation, hypotheses testing, modeling, and data mining for transportation specialists. Prerequisites: STAT 211 or STAT 651.

659. Applied Categorical Data Analysis. (3-0). Credit 3. Introduction to analysis and interpretation of categorical data using ANOVA/regression analogs; includes contingency tables, loglinear models, logistic regression; use of computer software such as SAS, GLIM, SPSSX. Prerequisite: STAT 601 or 641 or 652 or equivalent.

661. Statistical Genetics. (3-0), Credit 3. Basic concepts in human genetics, sampling designs, gene frequency estimation, Hardy-Weinberg equilibrium, linkage disequilibrium, association and transmission disequilibrium test studies, linkage and pedigree analysis, segregation analysis, polygenic models, DNA sequence analysis. Prerequisites: STAT 610 and 611.

662. Advanced Statistical Genetics. (3-0). Credit 3. This course is a continuation of the course, STAT 661 Statistical Genetics. A strong background in statistics, genetics, and mathematics is required. Topics include counting methods, EM algorithm, Newton's method, scoring in genetics, genetic identity coefficients, descent graph methods, molecular phylogeny, models of

recombination, sequence analysis, diffusion processes and linkage disequilibrium mappings. Prerequisite: STAT 610, 611, and 661.

665. Application of Wavelets. (3-0). Credit 3. Wavelet theory, wavelet-based statistical methods, smoothing of noisy signals, estimation of function data and representation of stochastic processes. Some emphasis on Bayesian procedures. Prerequisite: STAT 611 or equivalent.

667. Statistics for Advanced Placement Instruction. (3-0). Credit 3. Review of the fundamental concepts and techniques of statistics; topics included in Advanced Placement Statistics; exploring data, planning surveys and experiments, exploring models, statistical inference. Prerequisite: Approval of instructor.

671. Methods of Statistical Data Modeling I. (3-0). Credit 3. Introduction to new methods of statistical analysis, especially statistical data modeling, exploratory data analysis, adaptive and robust estimation. Prerequisite: STAT 611 or equivalent.

673. Time Series Analysis I. (3-0). Credit 3. An introduction to diverse modes of analysis now available to solve for univariate time series; basic problems of parameter estimation, spectral analysis, forecasting and model identification. Prerequisite: STAT 611 or equivalent.

674. Time Series Analysis II. (3-0). Credit 3. Continuation of STAT 673. Multiple time series, ARMA models, test of hypotheses, estimation of spectral density matrix, transfer function and forecasting. Prerequisites: STAT 673.

681. Seminar. Credit 1. Oral presentations of special topics and current research in statistics. Prerequisite: Graduate classification in statistics.

684. Professional Internship. Credit 1 to 3. Practicum in statistical consulting for students in Ph.D. program. Students will be assigned consulting problems brought to the Department of Statistics by researchers in other disciplines. Prerequisite: STAT 608 and 642.

685. Problems. Credit 1 to 6. Individual instruction in selected fields in statistics; investigation of special topics not within scope of thesis research and not covered by other formal courses. Prerequisites: Graduate classification; approval of instructor.

689. Special Topics in Statistics. Credit 1 to 4. Selected topics in an identified area of statistics. Open to non-majors. May be repeated for credit. Prerequisite: Approval of instructor.

691. Research. Credit 1 or more. Research for thesis or dissertation. Prerequisite: Graduate classification.

Scheduling Coursework

The following list indicates the Department's usual schedule of course offerings. Those courses marked even or odd are offered only in even numbered and odd numbered years, respectively. Because several courses are offered only every other year, it is important to plan a program of study and schedule of courses as early as possible.

Course	Semester(s) Offered	Course	Semester(s) Offered
201	1,2	627	2 (odd)
211	1,2,3	630	1,3
212	1,2	631	2 (odd)
301	1,2	632	2
302	1,2,3	636	1
303	1,2,3	641	1
307	1,2	642	2
407	1	643	1
408	2	644	2
414	1	647	1
415	2	648	1
485	1,2,3	651	1,2,3
601	1,2	652	1,2,3
604	1	653	2
605	2	657	2
607	1	658	4
608	2	659	2
610	1	661	2
611	2	662	1 (odd)
612	1	665	4
613	2	667	3
614	1	671	1 (odd)
615	1	673	1 (even)
616	2	674	2 (odd)
620	2	681	1,2
621	2	684	1,2,3
623	4	685	1,2,3
626	3	691	1,2,3

1: Fall, 2: Spring, 3: Summer, 4: As resources allow.