

STATISTICS (STAT)

Courses primarily for undergraduates:

STAT 100: Orientation in Statistics

(1-0) Cr. R. F.

Opportunities, challenges, and the scope of the curriculum in statistics. For students planning or considering a career in this area.

STAT 101: Principles of Statistics

(3-2) Cr. 4. F.S.SS.

Prereq: 1 1/2 years of high school algebra

Statistical concepts in modern society; descriptive statistics and graphical displays of data; the normal distribution; data collection (sampling and designing experiments); elementary probability; elements of statistical inference; estimation and hypothesis testing; linear regression and correlation; contingency tables. Credit for only one of the following courses may be applied toward graduation: STAT 101, STAT 104, STAT 105, STAT 201, or STAT 226.

STAT 104: Introduction to Statistics

(2-2) Cr. 3. F.S.SS.

Prereq: 1 1/2 years of high school algebra

Statistical concepts and their use in science; collecting, organizing and drawing conclusions from data; elementary probability; binomial and normal distributions; regression; estimation and hypothesis testing. For students in the agricultural and biological sciences. Credit for only one of the following courses may be applied toward graduation: STAT 101, STAT 104, STAT 105, STAT 201, or STAT 226.

STAT 105: Introduction to Statistics for Engineers

(3-0) Cr. 3. F.S.

Prereq: MATH 165 (or MATH 165H)

Statistical concepts with emphasis on engineering applications. Data collection; descriptive statistics; probability distributions and their properties; elements of statistical inference; regression; statistical quality control charts; use of statistical software; team project involving data collection, description and analysis. Credit for only one of the following courses may be applied toward graduation: STAT 101, STAT 104, STAT 105, STAT 201, or STAT 226. Credit for both STAT 105 and STAT 305 may not be applied for graduation.

STAT 201: Introduction to Statistical Concepts and Methods

(3-2) Cr. 4. S.

Prereq: Credit or enrollment in MATH 165

Statistical thinking and applications of statistical concepts and methods in modern society. Display and summary of categorical and numerical data. Exploring relationships between variables, association, correlation, and regression. Observational studies and experiments. Probability concepts, random variables, discrete and continuous distributions. Elements of statistical inference; estimation and hypothesis testing. Credit for only one of the following courses may be applied toward graduation: STAT 101, STAT 104, STAT 105, STAT 201, or STAT 226.

STAT 226: Introduction to Business Statistics I

(3-0) Cr. 3. F.S.SS.

Prereq: MATH 150 or MATH 165

Obtaining, presenting, and organizing statistical data; measures of location and dispersion; the Normal distribution; sampling and sampling distributions; elements of statistical inference; estimation and confidence intervals; hypothesis testing; inference for simple linear regression analysis; use of computers to visualize and analyze data. Credit for only one of the following courses may be applied toward graduation: STAT 101, STAT 104, STAT 105, STAT 201, or STAT 226.

STAT 231: Probability and Statistical Inference for Engineers

(4-0) Cr. 4. F.S.

Prereq: Credit or enrollment in MATH 265

Emphasis on engineering applications. Basic probability; random variables and probability distributions; joint and sampling distributions. Descriptive statistics; confidence intervals; hypothesis testing; simple linear regression; multiple linear regression; one way analysis of variance; use of statistical software.

STAT 301: Intermediate Statistical Concepts and Methods

(3-2) Cr. 4. F.S.

Prereq: STAT 101 or STAT 104 or STAT 105 or STAT 201

Statistical concepts and methods used in the analysis of data. Statistical models. Analysis of single sample, two sample and paired sample data. Simple and multiple linear regression including polynomial regression. Analysis of residuals. Regression diagnostics. Model building. Regression with indicator variables. Credit for only one of the following courses may be applied toward graduation: STAT 301, STAT 326, or STAT 401

STAT 305: Engineering Statistics

(3-0) Cr. 3. F.S.SS.

Prereq: MATH 165 (or MATH 165H)

Statistics for engineering problem solving. Principles of engineering data collection; descriptive statistics; elementary probability distributions; principles of experimentation; confidence intervals and significance tests; one-, two-, and multi-sample studies; regression analysis; use of statistical software; team project involving engineering experimentation and data analysis. Credit for both Stat 105 and 305 may not be applied for graduation.

STAT 322: Probabilistic Methods for Electrical Engineers

(Cross-listed with E E). (3-0) Cr. 3. F.S.

Prereq: E E 224

Introduction to probability with applications to electrical engineering. Sets and events, probability space, conditional probability, total probability and Bayes' rule. Discrete and continuous random variables, cumulative distribution function, probability mass and density functions, expectation, moments, moment generating functions, multiple random variables, functions of random variables. Elements of statistics, hypothesis testing, confidence intervals, least squares. Introduction to random processes.

STAT 326: Introduction to Business Statistics II

(2-2) Cr. 3. F.S.

Prereq: STAT 226

Multiple regression analysis; regression diagnostics; model building; applications in analysis of variance and time series; random variables; distributions; conditional probability; statistical process control methods; use of computers to visualize and analyze data. Credit for only one of the following courses may be applied toward graduation: STAT 301, STAT 326 or STAT 401.

STAT 330: Probability and Statistics for Computer Science

(3-0) Cr. 3. F.S.

Prereq: MATH 166

Topics from probability and statistics applicable to computer science. Basic probability; Random variables and their distributions; Stochastic processes including Markov chains; Queuing models; Basic statistical inference; Introduction to regression.

STAT 332: Visual Communication of Quantitative Information

(Cross-listed with ENGL). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: STAT 101, STAT 104, STAT 201 or STAT 226; ENGL 250

Communicating quantitative information using visual displays; visualizing data; interactive and dynamic data displays; evaluating current examples in the media; color, perception, and representation in graphs; interpreting data displays.

STAT 341: Introduction to the Theory of Probability and Statistics I

(Cross-listed with MATH). (3-0) Cr. 3. F.S.

Prereq: MATH 265 (or MATH 265H)

Probability; distribution functions and their properties; classical discrete and continuous distribution functions; multivariate probability distributions and their properties; moment generating functions; simulation of random variables and use of the R statistical package. Credit for both STAT 341 and STAT 447 may not be applied toward graduation.

STAT 342: Introduction to the Theory of Probability and Statistics II

(Cross-listed with MATH). (3-0) Cr. 3. F.S.

Prereq: STAT 341; MATH 207 or MATH 317

Transformations of random variables; sampling distributions; confidence intervals and hypothesis testing; theory of estimation and hypothesis tests; linear model theory; use of the R statistical package for simulation and data analysis.

STAT 361: Statistical Quality Assurance

(Cross-listed with I E). (2-2) Cr. 3. F.S.

Prereq: STAT 231, STAT 301, STAT 326 or STAT 401

Statistical methods for process improvement. Simple quality assurance principles and tools. Measurement system precision and accuracy assessment. Control charts. Process capability assessment. Experimental design and analysis for process improvement. Significant external project in process improvement.

STAT 398: Cooperative Education

Cr. R. F.S.SS.

Prereq: Permission of department chair

Off-campus work periods for undergraduate students in a field of statistics.

STAT 401: Statistical Methods for Research Workers

(3-2) Cr. 4. F.S.SS.

Prereq: STAT 101 or STAT 104 or STAT 105 or STAT 201 or STAT 226

Graduate students without an equivalent course should contact the department. Methods of analyzing and interpreting experimental and survey data. Statistical concepts and models; estimation; hypothesis tests with continuous and discrete data; simple and multiple linear regression and correlation; introduction to analysis of variance and blocking. Credit for only one of the following courses may be applied toward graduation: STAT 301, STAT 326, or STAT 401.

STAT 402: Statistical Design and the Analysis of Experiments

(3-0) Cr. 3. F.S.

Prereq: STAT 301 or STAT 326 or STAT 401

The role of statistics in research and the principles of experimental design. Experimental units, randomization, replication, blocking, subdividing and repeatedly measuring experimental units; factorial treatment designs and confounding; extensions of the analysis of variance to cover general crossed and nested classifications and models that include both classificatory and continuous factors. Determining sample size.

STAT 404: Regression for Social and Behavioral Research

(2-2) Cr. 3. F.S.

Prereq: STAT 301 or STAT 326 or STAT 401

Lorenz. Applications of generalized linear regression models to social science data. Assumptions of regression; diagnostics and transformations; analysis of variance and covariance; path analysis; logistic, multinomial and Poisson regression.

STAT 406: Statistical Methods for Spatial Data

(3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: Six hours of statistics at the 400-level

The analysis of spatial data; geostatistical methods, mapping and spatial prediction; methods for areal data; models and methods for spatial point processes. Emphasis on application and practical use of spatial statistical analysis. Use of R and R packages for spatial data analysis.

STAT 407: Methods of Multivariate Analysis

(2-2) Cr. 3. F.

Prereq: STAT 301 or STAT 326 or STAT 401, knowledge of matrix algebra

Techniques for displaying and analyzing multivariate data including plotting high-dimensional data using interactive graphics, comparing group mean vectors using Hotelling's T², multivariate analysis of variance, reducing variable dimension with principal components, grouping/classifying observations with cluster analysis and discriminant analysis. Imputation of missing multivariate observations.

STAT 410: Statistical Methods for Mathematics Teachers

(6-0) Cr. 6. Alt. SS., offered odd-numbered years.

Prereq: STAT 341 or equivalent

Descriptive statistics; data collection through experimentation and sampling; univariate statistical inference; contingency tables; design of experiments and ANOVA; simple linear regression; logistic regression; multiple linear regression; statistics pedagogy.

STAT 415: Advanced Statistical Methods for Research Workers

(1-0) Cr. 1. Repeatable, maximum of 3 credits. S.

Prereq: STAT 301 or STAT 326 or STAT 401

Advanced statistical methods for modeling and analyzing data. Taught as separate 1 cr. sections, each of 5 weeks. Three sections taught in one semester. Areas covered: Logistic and Poisson regression; Structural equation modeling; Smoothing and nonparametric regression; Nonparametric and distribution free methods; Bootstrapping and randomization tests; Visualization of high dimensional data; Analysis of species composition data; Missing data and measurement error.

STAT 416: Statistical Design and Analysis of Gene Expression**Experiments**

(3-0) Cr. 3. S.

Prereq: STAT 301 or STAT 326 or STAT 401

Introduction to high-throughput technologies for gene expression studies (especially RNA-sequencing technology): the role of blocking, randomization, and biological and technical replication in the design of gene expression experiments; normalization methods; methods for identifying differentially expressed genes including mixed linear model analysis, generalized linear model analysis, generalized linear mixed model analysis, quasi-likelihood methods, empirical Bayes analysis, and resampling based approaches; procedures for controlling false discovery rate for multiple testing; clustering and classification problems for gene expression data; testing gene categories; emphasis on practical use of methods.

STAT 421: Survey Sampling Techniques

(2-2) Cr. 3. S.

Prereq: STAT 301 or STAT 326 or STAT 401

Concepts of sample surveys and the survey process; methods of designing sample surveys, including: simple random, stratified, and multistage sampling designs; methods of analyzing sample surveys including ratio, regression, domain estimation and nonresponse.

STAT 430: Empirical Methods for the Computational Sciences

(3-0) Cr. 3. F.

Prereq: STAT 330 or an equivalent course, MATH 166, knowledge of linear algebra.

Statistical methods for research involving computers; exploratory data analysis; selected topics from analysis of designed experiments - analysis of variance, hypothesis testing, interaction among variables; linear regression, logistic regression, Poisson regression; parameter estimation, prediction, confidence regions, dimension reduction techniques, model diagnostics and sensitivity analysis; Markov chains and processes; simulation techniques and bootstrap methods; applications to computer science, bioinformatics, computer engineering - programs, models and systems as objects of empirical study; communicating results of empirical studies. Statistical software: R.

STAT 432: Applied Probability Models

(3-0) Cr. 3. F.

Prereq: STAT 231 or STAT 341 or STAT 447

Probabilistic models in biological, engineering and the physical sciences. Markov chains; Poisson, birth-and-death, renewal, branching and queuing processes; applications to bioinformatics and other quantitative problems.

STAT 444: Bayesian Data Analysis

(2-2) Cr. 3. S.

Prereq: STAT 301 or STAT 326 or STAT 401; STAT 342 or STAT 447.

Probability models and prior distributions; updating priors through the likelihood function. Computational and simulation-based methods for deriving posterior distributions and for estimating parameters. Basic statistical and hierarchical models. Model adequacy and posterior predictive checks. Markov Chain Monte Carlo methods and introduction to WinBUGS or similar software. Emphasis on applications and examples from the social, biological and physical sciences.

STAT 447: Statistical Theory for Research Workers

(4-0) Cr. 4. F.S.SS.

Prereq: MATH 151 and permission of instructor, or MATH 265

Primarily for graduate students not majoring in statistics. Emphasis on aspects of the theory underlying statistical methods. Probability, probability density and mass functions, distribution functions, moment generating functions, sampling distributions, point and interval estimation, maximum likelihood and likelihood ratio tests, linear model theory, conditional expectation and minimum mean square error estimation, introduction to posterior distributions and Bayesian analysis, use of simulation to verify and extend theory. Credit for both STAT 341 and STAT 447 may not be applied toward graduation.

STAT 451: Applied Time Series

(3-0) Cr. 3. S.

Prereq: STAT 301 or STAT 326 or STAT 401

Meeker. Methods for analyzing data collected over time; review of multiple regression analysis. Elementary forecasting methods: moving averages and exponential smoothing. Autoregressive-moving average (Box-Jenkins) models: identification, estimation, diagnostic checking, and forecasting. Transfer function models and intervention analysis. Introduction to multivariate time series methods.

STAT 457: Applied Categorical Data Analysis

(3-0) Cr. 3. S.

Prereq: STAT 301 or STAT 326 or STAT 401

Statistical methods for the analysis of categorical data: graphical summaries, estimation and inference for proportions, sample size determination, chi-square tests, measures of relative risk, odds and association, analysis of paired data and measures of agreement, logistic regression models, log-linear models.

STAT 479: Computer Processing of Statistical Data

(3-0) Cr. 3. F.

Prereq: STAT 301 or STAT 326 or STAT 401

Structure, content and programming aspects of the Statistical Analysis System (SAS) software package. Advanced techniques in the use of SAS for data analysis including statistical graphics, regression diagnostics, and complex analysis of variance models. The SAS graphical interfaces Enterprise Guide and Enterprise Miner will be introduced.

STAT 480: Statistical Computing Applications

(3-0) Cr. 3. S.

Prereq: STAT 301 or STAT 326 or STAT 401

Modern statistical computing. Data management; spread sheets, verifying data accuracy, transferring data between software packages. Data and graphical analysis with statistical software packages. Algorithmic programming concepts and applications. Simulation. Software reliability.

STAT 490: Independent Study

Cr. arr. Repeatable, maximum of 9 credits.

Prereq: 10 credits in statistics

No more than 9 credits in Stat 490 may be counted toward graduation.

STAT 490H: Independent Study: Honors

Cr. arr. Repeatable, maximum of 9 credits.

Prereq: 10 credits in statistics

No more than 9 credits in Stat 490 may be counted toward graduation.

STAT 495: Applied Statistics for Industry I

(3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: STAT 101 or STAT 104 or STAT 105 or STAT 201 or STAT 226; MATH 166 (or MATH 166H)

Graduate students without an equivalent course should consult the

department. Statistical thinking applied to industrial processes.

Assessing, monitoring and improving processes using statistical methods. Analytic/enumerative studies; graphical displays of data;

fundamentals of six sigma; process monitoring; control charts; capability analysis.

STAT 496: Applied Statistics for Industry II

(3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: STAT 495

Statistical design and analysis of industrial experiments. Concepts of control, randomization and replication. Simple and multiple regression; factorial and fractional factorial experiments; application of ideas of six sigma; reliability; analysis of lifetime data.

Courses primarily for graduate students, open to qualified undergraduates:**STAT 500: Statistical Methods I**

(3-2) Cr. 4. F.

Prereq: STAT 447 or current enrollment in STAT 542; knowledge of matrix algebra.

Analysis of data from designed experiments and observational studies. Randomization-based inference; inference on group means; nonparametric bootstrap; pairing/blocking and other uses of restricted randomization. Use of linear models to analyze data; least squares estimation; estimability; sampling distributions of estimators; general linear tests; inference for parameters and contrasts. Model assessment and diagnostics; remedial measures; alternative approaches based on ranks.

STAT 501: Multivariate Statistical Methods

(3-0) Cr. 3. S.

Prereq: STAT 500 or STAT 402; STAT 447 or STAT 542; STAT 579 or equivalent; knowledge of matrix algebra.

Statistical methods for analyzing and displaying multivariate data; the multivariate normal distribution; inference in multivariate populations, simultaneous analysis of multiple responses, multivariate analysis of variance; summarizing high dimensional data with principal components, factor analysis, canonical correlations, classification methods, clustering, multidimensional scaling; introduction to basic nonparametric multivariate methods. Statistical software: SAS or R.

STAT 502: Applied Modern Multivariate Statistical Learning

(3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: STAT 500, STAT 542, STAT 579.

A Statistics-MS-level introduction to Modern Multivariate Statistical Learning. Theory-based methods for modern data mining and machine learning, inference and prediction. Variance-bias trade-offs and choice of predictors; linear methods of prediction; basis expansions; smoothing, regularization, kernel smoothing methods; neural networks and radial basis function networks; bootstrapping, model averaging, and stacking; linear and quadratic methods of classification; support vector machines; trees and random forests; boosting; prototype methods; unsupervised learning including clustering, principal components, and multi-dimensional scaling; kernel mechanics. Substantial use of R packages implementing these methods.

STAT 503: Exploratory Methods and Data Mining

(2-2) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: STAT 301 or STAT 326 or STAT 401; STAT 341 or STAT 447 or STAT 542; STAT 480 or STAT 579

Approaches to finding the unexpected in data; exploratory data analysis; pattern recognition; dimension reduction; supervised and unsupervised classification; interactive and dynamic graphical methods; computer-intensive statistical techniques for large or high dimensional data and visual inference. Emphasis is on problem solving, topical problems, and learning how so-called black-box methods actually work.

STAT 505: Environmental Statistics

(3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: STAT 341 or STAT 447; STAT 401

Statistical methods and models for environmental applications. Emphasis on environmental toxicology. Analysis of data with below detection-limit values. Dose-response curve modeling, including overdispersion and estimation of safe doses. Trend analysis; analysis of autocorrelated data. Equivalence testing.

STAT 506: Statistical Methods for Spatial Data

(3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: STAT 447 or STAT 542

The analysis of spatial data; geostatistical methods and spatial prediction; discrete index random fields and Markkov random field models; models for spatial point processes.

STAT 510: Statistical Methods II

(3-0) Cr. 3. S.

Prereq: STAT 500, STAT 447 or credit/enrollment in STAT 543

Model selection and collinearity in linear regression. Likelihood analysis for general models and models with non-normal random components; linear model results in the context of likelihood; linear mixed models and their application; estimation, inference, and prediction. Computational issues in iterative algorithms; expectation-maximization algorithm and its use in mixed models. Case studies of applications including problem formulation, exploratory analysis, model development, estimation and inference, and model assessment.

STAT 512: Design of Experiments

(3-0) Cr. 3. F.

Prereq: STAT 511

Basic techniques of experimental design developed in the context of the general linear model; completely randomized, randomized complete block, and Latin Square designs; factorial experiments, confounding, fractional replication; split-plot and incomplete block designs.

STAT 513: Response Surface Methodology

(3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: STAT 402 or STAT 512, knowledge of elementary matrix theory and matrix formulation of regression

Analysis techniques for locating optimum and near-optimum operating conditions: standard experimental designs for first- and second-order response surface models; design performance criteria; use of data transformations; mixture experiments; optimization for multiple-response problems. Requires use of statistical software with matrix functions.

STAT 515: Theory and Applications of Nonlinear Models

(3-0) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: STAT 447 or STAT 543; STAT 510

Construction of nonlinear statistical models; random and systematic model components, additive error nonlinear regression with constant and non-constant error variances, generalized linear models, transform both sides models. Iterative algorithms for estimation and asymptotic inference. Basic random parameter models, beta-binomial and gamma-Poisson mixtures. Requires use of instructor-supplied and student-written R functions.

STAT 516: Statistical Design and Analysis of Gene Expression Experiments

(3-0) Cr. 3. S.

Prereq: STAT 500; STAT 447 or STAT 542

Introduction to high-throughput technologies for gene expression studies (especially RNA-sequencing technology): the role of blocking, randomization, and biological and technical replication in the design of gene expression experiments; normalization methods; methods for identifying differentially expressed genes including mixed linear model analysis, generalized linear model analysis, generalized linear mixed model analysis, quasi-likelihood methods, empirical Bayes analysis, and resampling based approaches; procedures for controlling false discovery rate for multiple testing; clustering and classification problems for gene expression data; testing gene categories; emphasis on current research topics for statistical analysis of high dimensional gene expression data.

STAT 520: Statistical Methods III

(3-0) Cr. 3. F.

Prereq: STAT 510, STAT 447 or STAT 543

Nonlinear regression; generalized least squares; asymptotic inference. Generalized linear models; exponential dispersion families; maximum likelihood and inference. Designing Monte Carlo studies; bootstrap; cross-validation. Fundamentals of Bayesian analysis; data models, priors and posteriors; posterior prediction; credible intervals; Bayes Factors; types of priors; simulation of posteriors; introduction to hierarchical models and Markov Chain Monte Carlo methods.

STAT 521: Theory and Applications of Sample Surveys

(3-0) Cr. 3. S.

Prereq: STAT 401; STAT 447 or STAT 542

Practical aspects and basic theory of design and estimation in sample surveys for finite populations. Simple random, systematic, stratified, cluster multistage and unequal-probability sampling. Horvitz-Thompson estimation of totals and functions of totals: means, proportions, regression coefficients. Linearization technique for variance estimation. Model-assisted ratio and regression estimation. Two-phase sampling and sampling on two occasions. Non-response effects. Imputation.

STAT 522: Advanced Applied Survey Sampling

(3-0) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: STAT 521 or both STAT 421 and STAT 447

Advanced topics in survey sampling and methodology: clustering and stratification in practice, adjustments and imputation for missing data, variance estimation in complex surveys, methods of panel and/or longitudinal surveys, procedures to increase response rates, and computing. Examples are taken from large, well-known surveys in various subject areas. Prior exposure to mathematical statistics, probability, and at least one course in survey sampling theory is assumed.

STAT 531: Quality Control and Engineering Statistics

(Cross-listed with I E). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: STAT 401; STAT 342 or STAT 447

Statistical methods and theory applicable to problems of industrial process monitoring and improvement. Statistical issues in industrial measurement; Shewhart, CUSUM, and other control charts; feedback control; process characterization studies; estimation of product and process characteristics; acceptance sampling, continuous sampling and sequential sampling; economic and decision theoretic arguments in industrial statistics.

STAT 533: Reliability

(Cross-listed with I E). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: STAT 342 or STAT 432 or STAT 447

Probabilistic modeling and inference in engineering reliability; lifetime models, product limit estimator, probability plotting, maximum likelihood estimation for censored data, Bayesian methods in reliability, system reliability models, competing risk analysis, acceleration models and analysis of accelerated test data; analysis of recurrence data; planning studies to obtain reliability data.

STAT 534: Ecological Statistics

(3-0) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: STAT 447 or STAT 542

Statistical methods for non-standard problems, illustrated using questions and data from ecological field studies. Estimation of abundance and survival from mark-recapture studies, deterministic and stochastic matrix models of population trends, integral projection models, and hierarchical modeling, especially of population dynamics. Additional topics vary based on student interest.

STAT 536: Statistical Genetics

(Cross-listed with GDCB). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: STAT 401, STAT 447; GEN 320 or BIOL 313

Statistical models and methods for genetics covering models of population processes: selection, mutation, migration, population structure, and linkage disequilibrium, and inference techniques: genetic mapping, linkage analysis, and quantitative trait analysis. Applications include genetic map construction, gene mapping, genome-wide association studies (GWAS), inference about population structure, phylogenetic tree construction, and forensic and paternity identification.

STAT 542: Theory of Probability and Statistics I

(4-0) Cr. 4. F.

Prereq: MATH 414.

Sample spaces, basic probability results, conditional probability. Random variables, univariate distributions, moment generating functions. Joint distributions, conditional distributions and independence, correlation and covariance. Probability laws and transformations. Introduction to the multivariate normal distribution. Sampling distributions, normal theory, sums and order statistics. Convergence concepts, the law of large numbers, the central limit theorem and delta method. Basics of stochastic simulation.

STAT 543: Theory of Probability and Statistics II

(3-0) Cr. 3. S.

Prereq: STAT 542.

Point estimation including method of moments, maximum likelihood and Bayes. Properties of point estimators, mean squared error, unbiasedness, consistency, loss functions. Large sample properties of maximum likelihood estimators. Exponential families, sufficiency, completeness, ancillarity, Basu's theorem. Hypothesis tests, Neyman-Pearson lemma, uniformly most powerful tests, likelihood ratio tests, Bayes tests. Interval estimation, inverting tests, pivotal quantities. Nonparametric theory, bootstrap.

STAT 544: Bayesian Statistics

(3-0) Cr. 3. S.

Prereq: STAT 543

Specification of probability models; subjective, conjugate, and noninformative prior distributions; hierarchical models; analytical and computational techniques for obtaining posterior distributions; model checking, model selection, diagnostics; comparison of Bayesian and traditional methods.

STAT 546: Nonparametric Methods in Statistics

(3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: STAT 510, STAT 542

Overview of parametric versus nonparametric methods of inference; introduction to rank-based tests and/or nonparametric smoothing methods for estimating density and regression functions; smoothing parameter selection; applications to semiparametric models and goodness-of-fit tests of a parametric model.

STAT 547: Functional Data Analysis

(3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: STAT 543, STAT 511

Theory and methods for analyzing functional data, which are high dimensional data resulted from discrete, error-contaminated measurements on smooth curves and images. The topics include kernel and spline smoothing, basis expansion, semiparametric regression, functional analysis of variance, covariance modeling and estimation, functional principal component analysis, functional generalization linear models, joint modeling, dimension reduction, classification and clustering functional data.

STAT 551: Time Series Analysis

(3-0) Cr. 3. F.

Prereq: STAT 447 or STAT 542

Concepts of trend and dependence in time series data; stationarity and basic model structures for dealing with temporal dependence; moving average and autoregressive error structures; analysis in the time domain and the frequency domain; parameter estimation, prediction and forecasting; identification of appropriate model structure for actual data and model assessment techniques. Possible extended topics include dynamic models and linear filters.

STAT 554: Introduction to Stochastic Processes

(Cross-listed with MATH). (3-0) Cr. 3. F.

Prereq: STAT 542

Markov chains on discrete spaces in discrete and continuous time (random walks, Poisson processes, birth and death processes) and their long-term behavior. Optional topics may include branching processes, renewal theory, introduction to Brownian motion.

STAT 557: Statistical Methods for Counts and Proportions

(3-0) Cr. 3. F.

Prereq: STAT 500 or STAT 401; STAT 543 or STAT 447

Statistical methods for analyzing simple random samples when outcomes are counts or proportions; measures of association and relative risk, chi-squared tests, loglinear models, logistic regression and other generalized linear models, tree-based methods. Extensions to longitudinal studies and complex designs, models with fixed and random effects. Use of statistical software: SAS, S-Plus or R.

STAT 565: Methods in Biostatistics and Epidemiology

(Cross-listed with TOX). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: STAT 500 or STAT 401; STAT 543 or STAT 447

Statistical methods commonly used in epidemiology and human and animal health studies. Overview of cohort studies, case-control studies and randomized clinical trials. Topics include inference procedures for disease risk factors, analysis of time-to-event and survival data, analysis of longitudinal studies of disease progression and health status, approaches to handling missing data, and meta-analysis. Examples will come from recent studies of physical and mental health, nutrition and disease progression in human and animal populations. Use of statistical software: SAS or R.

STAT 568: Bioinformatics II (Advanced Genome Informatics)

(Cross-listed with BCB, COM S, GDCB). (3-0) Cr. 3. S.

Prereq: BCB 567 or (BIOL 315 and STAT 430), credit or enrollment in GEN 409

Advanced sequence models. Basic methods in molecular phylogeny. Hidden Markov models. Genome annotation. DNA and protein motifs. Introduction to gene expression analysis.

STAT 570: Bioinformatics IV (Computational Functional Genomics and Systems Biology)

(Cross-listed with BCB, COM S, CPR E, GDCB). (3-0) Cr. 3. S.

Prereq: BCB 567 or COM S 311, COM S 228, GEN 409, STAT 430

Algorithmic and statistical approaches in computational functional genomics and systems biology. Elements of experiment design. Analysis of high throughput gene expression, proteomics, and other datasets obtained using system-wide measurements. Topological analysis, module discovery, and comparative analysis of gene and protein networks. Modeling, analysis, simulation and inference of transcriptional regulatory modules and networks, protein-protein interaction networks, metabolic networks, cells and systems: Dynamic systems, Boolean, and probabilistic models. Multi-scale, multi-granularity models. Ontology-driven, network based, and probabilistic approaches to information integration.

STAT 579: An Introduction to R

(0-2) Cr. 1. F.

Prereq: Enrollment in STAT 500

An introduction to the logic of programming, numerical algorithms, and graphics. The R statistical programming environment will be used to demonstrate how data can be stored, manipulated, plotted, and analyzed using both built-in functions and user extensions. Concepts of modularization, looping, vectorization, conditional execution, and function construction will be emphasized.

STAT 580: Statistical Computing

(3-0) Cr. 3. S.

Prereq: STAT 579; STAT 447 or STAT 542

Introduction to scientific computing for statistics using tools and concepts in R: programming tools, modern programming methodologies, modularization, design of statistical algorithms. Introduction to C programming for efficiency; interfacing R with C. Building statistical libraries. Use of algorithms in modern subroutine packages, optimization and integration. Implementation of simulation methods; inversion of probability integral transform, rejection sampling, importance sampling. Monte Carlo integration.

STAT 590: Special Topics

Cr. arr. Repeatable.

STAT 590A: Special Topics: Theory

Cr. arr. Repeatable.

STAT 590B: Special Topics: Methods

Cr. arr. Repeatable.

STAT 590C: Special Topics: Design of Experiments

Cr. arr. Repeatable.

STAT 590D: Special Topics: Sample Surveys

Cr. arr. Repeatable.

STAT 590E: Special Topics: Statistics Education

Cr. arr. Repeatable.

STAT 590F: Special Topics: Statistical Computing and Graphics

Cr. arr. Repeatable. F.

STAT 598: Cooperative Education

Cr. R. F.S.SS.

Prereq: Permission of the department chair

Off-campus work periods for graduate students in a field of statistics.

STAT 599: Creative Component

Cr. arr.

Courses for graduate students:**STAT 601: Advanced Statistical Methods**

(3-0) Cr. 3. S.

Prereq: STAT 520, STAT 543 and MATH 414 or enrollment in STAT 641

Methods of constructing complex models including adding parameters to existing structures, incorporating stochastic processes and latent variables. Use of modified likelihood functions; quasi-likelihoods; profiles; composite likelihoods. Asymptotic normality as a basis of inference; Godambe information. Sample reuse; block bootstrap; resampling with dependence. Simulation for model assessment. Issues in Bayesian analysis.

STAT 602: Modern Multivariate Statistical Learning

(3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: STAT 520, STAT 543, STAT 579

Statistical theory and methods for modern data mining and machine learning, inference, and prediction. Variance-bias trade-offs and choice of predictors; linear methods of prediction; basis expansions; smoothing, regularization, and reproducing kernel Hilbert spaces; kernel smoothing methods; neural networks and radial basis function networks; bootstrapping, model averaging, and stacking; linear and quadratic methods of classification; support vector machines; trees and random forests; boosting; prototype methods; unsupervised learning including clustering, principal components, and multi-dimensional scaling; kernel mechanics.

STAT 606: Advanced Spatial Statistics

(3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: STAT 506, STAT 642

Consideration of advanced topics in spatial statistics, including areas of current research. Topics may include construction of nonstationary covariance structures including intrinsic random functions, examination of edge effects, general formulation of Markov random field models, spatial subsampling, use of pseudo-likelihood and empirical likelihood concepts in spatial analysis, the applicability of asymptotic frameworks for inference, and a discussion of appropriate measures for point processes.

STAT 611: Theory and Applications of Linear Models

(3-0) Cr. 3. F.

Prereq: STAT 510; STAT 542 or STAT 447; a course in matrix algebra

Matrix preliminaries, estimability, theory of least squares and of best linear unbiased estimation, analysis of variance and covariance, distribution of quadratic forms, extension of theory to mixed and random models, inference for variance components.

STAT 612: Advanced Design of Experiments

(3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: STAT 512

General theory of factorial experiments. Design optimality criteria, approximate design and general equivalence theory, computational approaches to constructing optimal designs for linear models, and extensions to nonlinear models. Advanced topics of current interest in the design of experiments, including one or more of: distance based design criteria and construction of spatial process models, screening design strategies for high-dimensional problems, and design problems associated with computational experiments.

STAT 615: Advanced Bayesian Methods

(3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: STAT 544 and STAT 601

Complex hierarchical and multilevel models, dynamic linear and generalized linear models, spatial models. Bayesian nonparametric methods. Specialized Markov chain Monte Carlo algorithms and practical approaches to increasing mixing and speed convergence. Summarizing posterior distributions, and issues in inference. Model assessment, model selection, and model averaging.

STAT 621: Advanced Theory of Survey Statistics

(3-0) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: STAT 521

Advanced topics of current interest in the design of surveys and analysis of survey data, including: asymptotic theory for design and model-based estimators, use of auxiliary information in estimation, variance estimation techniques, small area estimation, non-response modeling and imputation.

STAT 641: Foundations of Probability Theory

(Cross-listed with MATH). (3-0) Cr. 3. F.

Prereq: MATH 414 or MATH 501 or equivalent course.

Sequences and set theory; Lebesgue measure, measurable functions. Absolute continuity of functions, integrability and the fundamental theorem of Lebesgue integration. General measure spaces, probability measure, extension theorem and construction of Lebesgue-Stieljes measures on Euclidean spaces. Measurable transformations and random variables, induced measures and probability distributions. General integration and expectation, L_p -spaces and integral inequalities. Uniform integrability and absolute continuity of measures. Probability densities and the Radon-Nikodym theorem. Product spaces and Fubini-Tonelli theorems.

STAT 642: Advanced Probability Theory

(Cross-listed with MATH). (3-0) Cr. 3. S.

Prereq: STAT 641, or STAT 543 and MATH 515.

Probability spaces and random variables. Kolmogorov's consistency theorem. Independence, Borel-Cantelli lemmas and Kolmogorov's 0-1 Law. Comparing types of convergence for random variables. Sums of independent random variables, empirical distributions, weak and strong laws of large numbers. Convergence in distribution and its characterizations, tightness, characteristic functions, central limit theorems and Lindeberg-Feller conditions. Conditional probability and expectation. Discrete parameter martingales and their properties and applications.

STAT 643: Advanced Theory of Statistical Inference

(3-0) Cr. 3. F.

Prereq: STAT 543, STAT 642

Sufficiency and related concepts, completeness, exponential families and statistical information. Elements of decision theory, decision rules, invariance and Bayes rule. Maximum likelihood and asymptotic inference. Generalized estimating equations and estimating functions, M-estimation, U-statistics. Likelihood ratio tests, simple and composite hypotheses, multiple testing. Bayesian inference. Nonparametric inference, bootstrap, empirical likelihood, and tests for nonparametric models.

STAT 644: Advanced Bayesian Theory

(3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: STAT 544 and STAT 642

Exchangeability, parametric models, consistency and asymptotic normality of posterior distributions, posterior robustness, selection of priors using formal rules, improper priors and posterior propriety, Bayes factors, model selection, MCMC theory, irreducibility, Harris recurrence, regeneration, minorization, drift, ergodicity, limit theorems, techniques for speeding up convergence of certain MCMC algorithms.

STAT 645: Advanced Stochastic Processes

(Cross-listed with MATH). (3-0) Cr. 3. S.

Weak convergence. Random walks and Brownian motion. Martingales. Stochastic integration and Ito's Formula. Stochastic differential equations and applications.

STAT 647: Advanced Multivariate Analysis

(3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: STAT 543, knowledge of matrix algebra

Multivariate normal distribution, estimation of the mean vector and the covariance matrix, multiple and partial correlation, Hotelling's T^2 statistic, Wishart distribution, multivariate regression, principle components, discriminant analysis, high dimensional data analysis, latent variables.

STAT 648: Seminar on Theory of Statistics and Probability

Cr. arr. F.

Prereq: STAT 543.

Seminar topics change with each offering.

STAT 651: Advanced Time Series

(3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: STAT 551, STAT 642

Stationary and nonstationary time series models, including ARMA, ARCH, and GARCH. Covariance and spectral representation of time series. Fourier and periodogram analyses. Predictions. CLT for mixing processes. Estimation and distribution theory. Long range dependence.

STAT 680: Advanced Statistical Computing

(3-0) Cr. 3. F.

Prereq: STAT 543 and STAT 580

Normal approximations to likelihoods. The delta-method and propagation of errors. Topics in the use of the E-M algorithm including; its use in the exponential family, computation of standard errors, acceleration. Resampling methods: brief theory and application of the jackknife and the bootstrap. Randomization tests. Stochastic simulation: Markov Chain, Monte Carlo, Gibbs' sampling, Hastings-Metropolis algorithms, critical slowing-down and remedies, auxiliary variables, simulated tempering, reversible-jump MCMC and multi-grid methods.

STAT 690: Advanced Special Topics

Cr. arr. Repeatable.

*Prereq: Permission of instructor***STAT 690A: Advanced Special Topics: Theory**

Cr. arr. Repeatable.

*Prereq: Permission of instructor***STAT 690B: Advanced Special Topics: Methods**

Cr. arr. Repeatable.

Prereq: Permission of instructor

STAT 690C: Advanced Special Topics: Design of Experiments

Cr. arr. Repeatable.

Prereq: Permission of instructor

STAT 690D: Advanced Special Topics: Sample Surveys

Cr. arr. Repeatable.

Prereq: Permission of instructor

STAT 690E: Advanced Special Topics: Statistical Computing

Cr. arr. Repeatable.

Prereq: Permission of instructor

STAT 690F: Advanced Special Topics: Graphics

Cr. arr. Repeatable.

Prereq: Permission of instructor

STAT 699: Research

Cr. arr. Repeatable.