# STATISTICS (STAT)

**STAT 801 Statistical Methods in Research**  
**Prerequisites:** Introductory course in statistics.  
**Description:** Statistical concepts and statistical methodology useful in descriptive, experimental, and analytical study of biological and other natural phenomena. Practical application of statistics rather than on statistical theory.  
**Credit Hours:** 4  
**Max credits per semester:** 4  
**Max credits per degree:** 4  
**Format:** LEC  
**Prerequisite for:** AGRO 816E; NRES 803; STAT 803; STAT 802; STAT 841; STAT 850; STAT 870; STAT 873; STAT 874; STAT 875; STAT 876  

**STAT 802 Design and Analysis of Research Studies**  
**Prerequisites:** STAT 318 or STAT 801  
**Description:** Essential statistical characteristics of a research study intended to assess the impact of treatment, environmental or population conditions on response. Focus is on both designed experiments and on studies for which controlled experiments are not feasible but characteristics of controlled experiment must be mimicked to the extent possible. Methods to assess power and compare efficiency of alternative designs are considered. Course covers major design structures, including blocking, nesting, multilevel models, split-plot and repeated measures, and statistical analysis associated with these structures.  
**Credit Hours:** 4  
**Max credits per semester:** 4  
**Max credits per degree:** 4  
**Format:** LEC  
**Prerequisite for:** AGRO 816E; ASCI 944; STAT 844; STAT 822; STAT 870; STAT 873; STAT 874; STAT 875; STAT 876  

**STAT 803 Ecological Statistics**  
**Crosslisted with:** NRES 803  
**Prerequisites:** STAT 801 or equivalent; prior experience with "R" software  
**Notes:** Available online.  
**Description:** Model-based inference for ecological data, generalized linear and additive models, mixed models, survival analysis, multi-model inference and information theoretic model selection, and study design.  
**Credit Hours:** 4  
**Max credits per semester:** 4  
**Max credits per degree:** 4  
**Format:** LEC  

**STAT 804 Survey Sampling**  
**Prerequisites:** STAT 880 or IMSE 321 or permission  
**Description:** Sampling techniques: simple random sampling, sampling proportions, estimation of sample size, stratified random sampling, ratio and regression estimates.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  

**STAT 810 Alpha Seminar**  
**Prerequisites:** Statistics graduate student  
**Description:** Program requirements, resources available, tips for academic success, professional statistical organizations, career paths, history of statistics, ethics, statistical conferences, statistical blogs and online forums, frequentist and Bayesian paradigms, current research in department.  
**Credit Hours:** 1  
**Max credits per semester:** 1  
**Max credits per degree:** 1  
**Format:** LEC  

**STAT 811T Statistics for Middle-Level Teachers**  
**Prerequisites:** A valid teaching certificate or permission. An undergraduate course in introductory statistics is desirable, but not essential.  
**Notes:** Not open to MA or MS students in mathematics or statistics.  
**Description:** Designed primarily to develop and equip middle-level teachers with the statistical knowledge they need for teaching. The course follows an inquiry/discovery design, dedicating much of class time to activities, discussion and group work. The course emphasizes topics in statistics that are part of the middle-school mathematics curriculum, as well as their application in other disciplines. The course also includes statistics that are used in education and school-based research.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  

**STAT 812T Statistics for High School Teachers**  
**Prerequisites:** A valid secondary mathematics teaching certificate or permission.  
**Notes:** Not open to MA or MS students in mathematics or statistics.  
**Description:** The statistical concepts typically taught in a high school statistics class, including linear regression, two-way tables, sampling distributions, statistical inference for means and proportions, chi-square tests, and inference for regression. Some experience with basic statistical concepts (mean, standard deviation, elementary probability) is necessary. The course is inquiry-based, and will emphasize applications and statistical thinking.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  

**STAT 821 Statistical Methods I**  
**Prerequisites:** Matrix Algebra; concurrently taking STAT 882, or passed STAT 882 with grade of B or higher, or passed STAT 880 with grade of B or higher.  
**Notes:** Designed for Statistics MS majors and minors.  
**Description:** Introduction to essential statistical methods and supporting design and modeling theory for professional statistical practice. First in a three semester sequence. Focus of this course on methods for single response variable and non-hierarchical study design.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**Offered:** FALL/SPR  
**Prerequisite for:** ASCI 944, STAT 844; STAT 822
STAT 822 Statistical Methods II  
**Prerequisites:** STAT 821; concurrently taking STAT 883, or passed STAT 883 with grade of B or higher, or passed STAT 880 with grade of B or higher.  
**Notes:** Course is designed for Statistics MS majors and minors.  
**Description:** A continuation of Statistical Methods I. Second in a three semester sequence on essential statistical methods and supporting design and modeling theory for professional statistical practice. Focus in this course of methods for single response variable and multiple sources of random variation.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**Prerequisite for:** STAT 823

STAT 823 Statistical Methods III  
**Prerequisites:** STAT 822; STAT 883 with grade of B or higher, or STAT 880 with grade of B or higher.  
**Notes:** This course is designed for Statistics MS Majors.  
**Description:** Introduction to essential statistical methods and supporting design and modeling theory for professional statistical practice. Third in a three semester sequence. Focus of this course on methods for situations that extend beyond the single-response-variable, designed study cases featured in Statistical Methods I and II. These include multivariate statistics, non-linear models, non- and semi-parametric statistics, observational studies, and other theory and methods deemed appropriate as statistical science continues to evolve.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**Prerequisite for:** STAT 950; STAT 983

STAT 825 Principles of Statistical Consulting and Interdisciplinary Collaboration  
**Prerequisites:** STAT 802 and STAT 970  
**Description:** Introduction to the role and purpose of statistical consulting and interdisciplinary collaboration. Topics include: asking good questions, dealing with difficult clients, communicating statistics to non-statisticians, determining solutions, and collaborating.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

STAT 830 Sensory Evaluation  
**Crosslisted with:** FDST 430, FDST 830, STAT 430  
**Prerequisites:** Introductory course in statistics.  
**Description:** Food evaluation using sensory techniques and statistical analysis.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

STAT 831 Spatial Statistics  
**Prerequisites:** STAT 802  
**Notes:** Offered odd-numbered calendar years.  
**Description:** Statistical methods for modeling and analyzing correlated data, with emphasis on spatial correlation. Descriptive statistics, time series, correlograms, semivariograms, kriging and designing experiments in the presence of spatial correlation.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

STAT 832 Statistics in Sports  
**Description:** Statistical methods useful for analyzing sports-related data. Descriptive statistics, graphical representations, experimental design, discriminant analysis and optimization.  
**Credit Hours:** 2  
**Max credits per semester:** 2  
**Max credits per degree:** 2  
**Format:** LEC

STAT 841 Statistical Methods for High Throughput Biological Data  
**Prerequisites:** STAT 801 or equivalent  
**Description:** Basic biological concepts. Multiple testing and false discovery rate. Second generation sequencing and statistical issues. ChIP-seq. RNA-seq. Empirical Bayes methods and software. Normalization, experimental design and commonly used models for microarray data. Metabolomics.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

STAT 842 Computational Biology  
**Crosslisted with:** BIOC 842, STAT 442, BIOC 442  
**Prerequisites:** Any introductory course in biology, or genetics, or statistics.  
**Description:** Databases, high-throughput biology, literature mining, gene expression, next-generation sequencing, proteomics, metabolomics, system biology and biological networks.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

STAT 843 Next-Generation Sequencing and Systems Biology  
**Prerequisites:** Any introductory course in biology, statistics, computer science or mathematics  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC
STAT 844 Quantitative Methods for Genomics of Complex Traits
Crosslisted with: ASCI 944
Prerequisites: ASCI 861U or AGRO/ASCI/HORT 931 or BIOS 818 or equivalent; STAT 802 or 821 or equivalent.
Description: Quantitative genetic analysis of complex traits. Quantitative methodologies for connecting phenotypes with high-dimensional genomic information to understand polygenic traits from both prediction and inference perspectives.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: SPRING

STAT 847 Biometrical Genetics and Plant Breeding
Crosslisted with: AGRO 932
Prerequisites: AGRO 931
Notes: STAT 802 recommended. Offered odd-numbered calendar years.
Description: Theoretical concepts involved in planning breeding programs for the improvement of measurable morphological, physiological, and biochemical traits that are under polygenic control in crop plants of various types.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

STAT 850 Computing Tools for Statisticians
Prerequisites: STAT 801 or equivalent; STAT 462, 880, or equivalent is recommended
Description: Introductions to statistical computing packages and document preparation software. Topics include: graphical techniques, data management, Monte Carlo simulation, dynamic document preparation, presentation software.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LEC

STAT 862W Applied Variance Component Estimation in Livestock Genetics
Crosslisted with: ASCI 862W
Prerequisites: ASCI 862V
Notes: This is a 5-week course taught by Speidel and Enns (Colorado State University). Permission required before registering. Contact the Animal Science Department at 402-472-6440.
Description: Principles in the estimation of (co)variance components and genetic parameters required to solve mixed models typical in livestock genetics. Focus on applied knowledge of approaches used to estimate the G and R sub-matrices of the mixed model equations. Demonstrate models commonly used in parameter estimation. Introduce scientific literature concerning implementation, and attributes of the solutions, of variance component estimation strategies.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

STAT 868 An Introduction to R Programming
Crosslisted with: ASCI 868
Prerequisites: Graduate Standing
Notes: This is a 5-week course taught by Maltecca (North Carolina State University).
Description: Introduction to the R environment for statistical computing, including use of R as a high-level programming language and as a gateway for more formal low-level languages. Material includes language structure, basic and advanced data manipulation, statistical analysis with R, and using R as a programming language.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC
Prerequisite for: ASCI 869, STAT 869

STAT 869 MCMC Methods in Animal Breeding: A Primer
Crosslisted with: ASCI 869
Prerequisites: ASCI 868.
Notes: This is a 5-week course taught by Maltecca (North Carolina State University).
Description: Principles of Markov Chain Monte Carlo (MCMC) methods in animal breeding. Materials include random variable generation, Monte Carlo integration, stochastic search, Expectation-maximization (EM) algorithm and Monte Carlo EM, Markov Chain principles, Metropolis-Hastings algorithm, Gibbs sample, and MCMC for genomic data. Illustrations developed using R software.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

STAT 870 Multiple Regression Analysis
Prerequisites: STAT 801, STAT 802
Description: Linear regression and related analysis of variance and covariance methods for models with two or more independent variables. Techniques for selecting and fitting models, interpreting parameter estimates, and checking for consistency with underlying assumptions. Partial and multiple correlation, dummy variables, covariance models, stepwise procedures, response surfaces estimation, and evaluation of residuals.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

STAT 873 Applied Multivariate Statistical Analysis
Prerequisites: STAT 801
Description: Multivariate techniques used in research. Reduction of dimensionality and multivariate dependencies, principle components, factor analysis, canonical correlation, classification procedures, discriminant analysis, cluster analysis, multidimensional scaling, multivariate extensions to the analysis of variance, and the general linear model.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: STAT 973
STAT 874 Nonparametric Statistics  
Prerequisites: STAT 801 or STAT 880  
Description: Statistical methods useful when data does not adhere to classical distributional assumptions. Analysis of interval/ordinal/categorical data for one, two and k sample problems, correlation and regression, goodness-of-fit methods and related topics.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

STAT 875 Categorical Data Analysis  
Prerequisites: STAT 801, STAT 802 or STAT 870 recommended  
Description: Measures of associating contingency tables analysis, chi-squared tests, log-linear and logistic models, generalized estimating equations, planning studies involving categorical data.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

STAT 876 Introduction to Survival Analysis  
Prerequisites: STAT 801  
Notes: Offered every other odd-numbered calendar year. Knowledge of at least one statistical package (SAS, R, Splus, SPS) is required.  
Description: Application, theory and computational aspects of survival analysis. Survival and hazard functions; parametric models for survival data; censoring and truncation mechanisms; nonparametric estimation (confidence bands for the survival function, interval estimation of the mean and median survival time); univariate estimation of the hazard function; hypothesis testing; regression models (with fixed covariates, with time dependent covariates); and model diagnostics.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

STAT 880 Introduction to Mathematical Statistics  
Prerequisites: MATH 208 or 107H; STAT 218 or equivalent  
Notes: STAT 880 is not open to students earning a MA or MS degree in mathematics or statistics. This course requires command of material covered in MATH 107 or 107H, and STAT 218. It is also recommended to have command of materials covered in MATH 208 or 208H.  
Description: Introductory mathematical statistics. Probability calculus; random variables, their probability distributions and expected values; sampling distributions; point estimation, confidence intervals and hypothesis testing theory and applications.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  
Prerequisite for: ECON 917; STAT 821; STAT 822; STAT 823; STAT 874

STAT 882 Mathematical Statistics I-Distribution Theory  
Prerequisites: MATH 208 or MATH 107H.  
Description: Sample space, random variable, expectation, conditional probability and independence, moment generating functions, special distributions, sampling distributions, order statistics, limiting distributions and central limit theorem.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  
Prerequisite for: ECON 917; STAT 821; STAT 883; STAT 971

STAT 883 Mathematical Statistics II-Statistical Inference  
Prerequisites: STAT 882  
Description: Interval estimation; point estimation, sufficiency and completeness; Bayesian procedures; uniformly most powerful tests, likelihood ratio test, goodness of fit tests.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  
Prerequisite for: STAT 822; STAT 823; STAT 950; STAT 971; STAT 980; STAT 982; STAT 983

STAT 884 Applied Stochastic Models  
Prerequisites: STAT 880 or IMSE 321 or equivalent  
Description: Introduction to stochastic modeling in operations research. Includes the exponential distribution and the Poisson process, discrete-time and continuous-time Markov chains, renewal processes, queueing models, stochastic inventory models, stochastic models in reliability theory.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

STAT 889 Statistics Seminar  
Prerequisites: Permission  
Credit Hours: 1  
Max credits per semester: 1  
Max credits per degree: 1  
Format: LEC

STAT 892 Topics in Statistics and Probability  
Prerequisites: Permission  
Description: Special topics in either statistics or the theory of probability.  
Credit Hours: 1-5  
Min credits per semester: 1  
Max credits per semester: 5  
Max credits per degree: 24  
Format: LEC

STAT 898 Statistics Project  
Prerequisites: Permission  
Credit Hours: 1-5  
Min credits per semester: 1  
Max credits per semester: 5  
Max credits per degree: 5  
Format: IND

STAT 899 Masters Thesis  
Prerequisites: Admission to the Masters Degree Program and permission of major adviser  
Credit Hours: 1-6  
Min credits per semester: 1  
Max credits per semester: 6  
Max credits per degree: 99  
Format: IND
STAT 902 Advanced Experimental Design  
Prerequisites: STAT 802  
Description: Advanced design concepts and methods used in research: construction, analysis and interpretation of incomplete block designs, split-plots, confounded and fractional factorials, response surface methods, and other topics.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  

STAT 904 Theory of Experimental Design  
Prerequisites: Permission  
Description: Theory of underlying construction and analysis of designed experiments. Multifactor designs, fractional factorials, incomplete block designs, row and column designs, orthogonal arrays, and response to surface designs. Optimality criteria. Mathematical and computer-aided design theory.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  

STAT 930 Advanced Statistical Consulting and Interdisciplinary Collaboration  
Prerequisites: Permission  
Notes: For advanced Masters degree students or PhD students in Statistics.  
Description: Exposure to more complex statistical consulting problems and how to resolve them. Topics include: major areas of consulting, interdisciplinary collaboration, and effective communication.  
Credit Hours: 2  
Max credits per semester: 2  
Max credits per degree: 2  
Format: LEC  

STAT 950 Computational Statistics I  
Prerequisites: STAT 883, STAT 823 or concurrent enrollment.  
Notes: Prior experience with "R" software is required.  
Description: Statistical computing needed for research and advanced statistical analyses. Topics include: bootstrap, high performance computing, jackknife, Linux, Markov chain Monte Carlo, Monte Carlo simulation, numerical differentiation and integration, optimization, parallel processing, permutation tests.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  
Prerequisite for: STAT 951  

STAT 951 Computational Statistics II  
Prerequisites: STAT 950; knowledge of a high-level programming language is recommended  
Description: A continuation of Computational Statistics I. Topics will be chosen from big data management and data analysis, data generation, high performance and throughput computing, importance sampling, machine learning, optimization, programming languages, web scraping, working with databases.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  

STAT 970 Linear Models  
Prerequisites: MATH 314/814.  
Description: Methods and underlying theory for analyzing data based on linear statistical models. General linear model with specific models as special cases: including linear models applications.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  
Prerequisite for: STAT 825; STAT 971; STAT 973  

STAT 971 Advanced Statistical Modeling  
Prerequisites: STAT 802, STAT 882, STAT 883, STAT 970 and take Statistics MS Comprehensive Exam prior to start of STAT 971  
Description: Statistical modeling beyond the "general linear model" normally-distributed data, fixed-effects-only case. Focus on, but not limited to, the theory and practice of generalized and mixed linear models. Issues include translation of study design to plausible models, inference space, data and model scale, conditional vs. marginal models, correlated data, zero-inflated data, likelihood-based estimation and inference.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  

STAT 972 Variance Component Estimation  
Prerequisites: STAT 970  
Description: Design and analysis of random effects and mixed models Basic theoretical background for models with fixed effects, distribution of quadratic forms, quadratic estimators including ANOVA methods, likelihood estimators including ML and REML, computing strategies, and optimal design for nested and cross classifications.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  

STAT 973 Theory of Multivariate Analysis  
Prerequisites: STAT 970  
Description: Statistical inference concerning parameters of multivariate normal distributions with applications to multiple decision problems.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  

STAT 974 Nonlinear Regression Analysis  
Prerequisites: STAT 870 and introductory calculus.  
Description: Basic concepts of nonlinear models and their associated applications. Estimating the parameters of these models under the classical assumptions as well as under relaxed assumptions. Major theoretical results and implementation using standard statistical software.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC
STAT 980 Advanced Probability Theory I
Prerequisites: STAT 883
Notes: This course requires command of material covered in MATH 325 or equivalent.
Description: Construction of probability spaces, random variables and expectations, monotone and dominated convergence theorems, Fatou's lemma, modes of convergence, Kolmogorov law of large numbers, central limit theory, conditional probability given a sigma field.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: STAT 981; STAT 984

STAT 981 Advanced Probability Theory II
Prerequisites: STAT 980
Description: A continuation of STAT 980 providing depth in probability theory and stochastic processes. Topics include convergence properties of random variables and treatment of several important stochastic processes.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

STAT 982 Advanced Inference
Prerequisites: STAT 883
Description: Uniformly minimum variance unbiased estimators, decision-theoretic Bayes estimation, frequentist testing (likelihood ratio tests, Neyman-Pearson lemma, uniformly most powerful tests), Bayes testing and Bayes factors, nonparametric tests, multiple comparisons procedures.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

STAT 983 Statistical Learning
Prerequisites: STAT 823, STAT 883
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

STAT 984 Asymptotics and Applications
Prerequisites: STAT 980
Description: A continuation of STAT 980 providing breadth in commonly occurring major subfields of statistics that rely heavily on probability theory. Large sample theory estimation, testing, expansion, and convergence in a variety of settings.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

STAT 992 Advanced Topics in Probability and Statistics
Prerequisites: Permission
Description: Special topics in either statistics or probability.
Credit Hours: 1-5
Min credits per semester: 1
Max credits per semester: 5
Max credits per degree: 24
Format: LEC

STAT 997 Practicum in Statistical Consulting
Prerequisites: STAT 930
Description: Participation in statistical consulting activities of the Statistics Department under faculty supervision. Prepare written reports to clients summarizing consultation results and to statistics supervisor summarizing statistical issues and findings.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: FLD

STAT 999 Doctoral Dissertation
Prerequisites: Admission to Doctoral Degree Program and permission of supervisory committee
Credit Hours: 1-24
Min credits per semester: 1
Max credits per semester: 24
Max credits per degree: 99
Format: IND