

# STATISTICS (STAT)

## STAT 100 Career Explorations in Statistics

**Description:** Introduction to the field of statistics, and exploration of careers available to those trained in statistics.

**Credit Hours:** 1

**Max credits per semester:** 1

**Max credits per degree:** 1

**Grading Option:** Graded

## STAT 101 Introduction to Data

**Notes:** Removal of all entrance deficiencies in mathematics.

**Description:** An introduction to statistics through exploratory data analysis and data visualization. Topics include data types, chart types, methods for working with and reducing data, simple regression, regression diagnostics. Focuses on how to communicate statistical information and how to critically consume statistical information presented in the media and popular press.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Graded

**Prerequisite for:** STAT 102

## STAT 102 Principles of Statistical Analysis

**Prerequisites:** STAT 101

**Description:** Introduction to formal statistical inference and elementary probability for statistics majors. Explores the practical application of statistical techniques to meaningful scientific problems. Inference topics will be implemented using both simulation-based approaches and classical, theory-based methods.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Graded

**Prerequisite for:** STAT 212; STAT 262; STAT 349

## STAT 151 Introduction to Statistical Computing

**Description:** Introduction to programming for statistical analysis. Covers basic programming concepts necessary for statistics, good computing practice, and use of built-in functions to complete basic statistical analyses.

**Credit Hours:** 1

**Max credits per semester:** 1

**Max credits per degree:** 1

**Grading Option:** Graded

**Prerequisite for:** STAT 251; STAT 349

## STAT 212 Principles of Study Design

**Prerequisites:** STAT 102 or STAT 318

**Description:** Introduction to statistical aspects of study design. Both designed experiments and observational studies are covered. Sampling techniques, major experimental and treatment design structures, as well as power and sample size considerations.

**Credit Hours:** 4

**Max credits per semester:** 4

**Max credits per degree:** 4

**Grading Option:** Graded

**Prerequisite for:** STAT 301; STAT 325; STAT 412

**Experiential Learning:** Research

## STAT 218 Introduction to Statistics

**Prerequisites:** Removal of all entrance deficiencies in mathematics. Credit towards the degree may be earned in only one of CRIM 300 or ECON 215 or ECON 215H or EDPS 459 or STAT 218

**Notes:** Credit toward the degree cannot be earned in STAT 218 if taken after or taken in parallel with STAT 380.

**Description:** The practical application of statistical thinking to contemporary issues; collection and organization of data; probability distributions; statistical inference; estimation; and hypothesis testing.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Graded with Option

**Prerequisite for:** ACCT 308; AECN 340; AECN 436; ASCI 330; BLAW 371H; BLAW 372; ECON 311A; ECON 311B; ECON 312A; ECON 312B; ECON 315; ECON 417; ECON 448; ECON 452; FDST 369; FINA 361; FINA 361A; FINA 361H; FORS 411; MNGT 430; MRKT 345; MRKT 350; MRKT 446; SCMA 331; SCMA 350; SCMA 350H; SOCI 333; STAT 318

**ACE:** ACE 3 Math/Stat/Reasoning

## STAT 251 Statistical Computing I: Data Wrangling

**Prerequisites:** STAT 151

**Description:** Techniques for processing, cleaning, and visualizing messy data. Topics include data reduction strategies, data transformations, combining multiple data sources, and special types of data (text, spatial, dates and times, hierarchical).

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Graded

**Prerequisite for:** STAT 325; STAT 351; STAT 443; STAT 452; STAT 485

## STAT 262 Probability for Statisticians

**Prerequisites:** STAT 102; MATH 208

**Description:** Probabilistic undergirding of statistical procedures including moments, common parametric families, marginal and conditional densities, sufficient statistics, modes of convergence, laws of large numbers and the central limit theorem and how they apply to estimators.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Graded

**Prerequisite for:** STAT 301; STAT 414

## STAT 301 Mathematical Statistics and Modeling I

**Prerequisites:** MATH 314, STAT 212, STAT 262

**Description:** Essential statistical theory and methods for professional statistical practice. Broad statistical topics include estimation and hypothesis testing, elementary Bayesian concepts, multiple linear regression, linear mixed effects models, analysis of variance (ANOVA), logistic regression, Poisson regression, and nonparametric methods.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Graded

**Prerequisite for:** STAT 302; STAT 452; STAT 475; STAT 478

**STAT 302 Mathematical Statistics and Modeling II****Prerequisites:** STAT 301**Notes:** A continuation of STAT 301.**Description:** Essential statistical theory and methods for professional statistical practice. Topics include data transformation, multiple sources of error, elementary model selection, generalized linear mixed models, Bayesian models, 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**Grading Option:** Graded**Prerequisite for:** STAT 432; STAT 443; STAT 451; STAT 464; STAT 471; STAT 474; STAT 485; STAT 486**STAT 318 Introduction to Statistics II****Prerequisites:** STAT 218 or STAT 380**Description:** Tests for means/proportions of two independent groups, analysis of variance for completely randomized design, contingency table analysis, correlation, single and multiple linear regression, nonparametric procedures, design of experiments.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded with Option**Prerequisite for:** STAT 212; STAT 412; STAT 414; STAT 450**STAT 325 Statistical Collaboration I****Prerequisites:** STAT 212, STAT 251**Description:** Introduction to the role and purpose of statistical consulting and interdisciplinary collaboration. Covers processes for successful interdisciplinary collaboration, including asking good questions, dealing with difficult clients, communicating statistics to non-statisticians, working in teams and determining solutions to answer the client's research question.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded**Prerequisite for:** STAT 425**STAT 349 Technical Skills for Statisticians****Prerequisites:** STAT 151, STAT 102**Description:** Creation of research reports, business reports, and executive summaries. Presentation strategies, consequences of statistical modeling for real-world decision making, and countering common misconceptions and errors in statistical reasoning. Focus on real-world applications in research, business, and public service.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded**Prerequisite for:** STAT 351**STAT 351 Statistical Computing II: Data Management and Visualization****Prerequisites:** STAT 251, STAT 349**Description:** Computational skills for management, visualization and analysis of large and complex data which are necessary for modern statistics. Includes a wide range of topics necessary for data analytics, including harvesting data from websites and common data structures, setting up and working with databases, and designing interactive data displays.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded**Prerequisite for:** STAT 425; STAT 451; STAT 471**STAT 380 Statistics and Applications****Crosslisted with:** RAIK 270H**Prerequisites:** A grade of P, C, or higher in MATH 107 or MATH 107H.**Notes:** Credit toward the degree can not be earned in STAT 218 if taken after or taken in parallel with RAIK 270H/STAT 380.**Description:** Probability calculus; random variables, their probability distributions and expected values; t, F and chi-square sampling distributions; estimation; testing of hypothesis; and regression analysis with applications.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded with Option**Prerequisite for:** BLAW 371H; BLAW 372; BSAD 371H, RAIK 371H; CIVE 950; ECEN 850, ECEN 450; ECON 311A; ECON 311B; ECON 312A; ECON 312B; ECON 315; ECON 417; ECON 448; ECON 452; ENVE 430; FINA 361; FINA 361A; FINA 361H; MECH 343; MECH 380; MRKT 345; MRKT 350; MRKT 446; RAIK 370H, CSCE 370H; SCMA 331; SCMA 350; SCMA 350H; STAT 318; STAT 414**ACE:** ACE 3 Math/Stat/Reasoning**STAT 412 Advanced Statistical Design****Prerequisites:** STAT 212 or STAT 318**Description:** Advanced statistical designs, including complex treatment and experimental designs and analyses. Incomplete Blocks, Response Surfaces, Advanced Row-Column designs, Split-Plots, Repeated Measures, Crossover designs, Analysis of Covariance, and Meta-analysis.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded with Option**STAT 414 Introduction to Survey Sampling****Prerequisites:** STAT 262 or STAT 318 or STAT 380**Description:** Sampling frames, sampling methodology, questionnaire design. Basics of standard sampling plans including simple random sampling, ratio estimators, stratified sampling, and cluster sampling. More advanced topics may include complex surveys, nonresponse, confidentiality problems, and adaptive methods.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded with Option

**STAT 425 Statistical Collaboration II****Prerequisites:** STAT 325; STAT 351**Description:** Practical experience in applying collaboration skills, working with domain experts to strategically plan and analyze the domain experts' research data. Collaboration with the domain expert will include proposing a design and sample size for a research study, determination and implementation of appropriate statistical analyses, and summarization and presentation of analysis results.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded**ACE:** ACE 10 Integrated Product**STAT 430 Sensory Evaluation****Crosslisted with:** FDST 430, FDST 830, STAT 830**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**Grading Option:** Graded with Option**Course and Laboratory Fee:** \$10**STAT 432 Introduction to Spatial Statistics****Prerequisites:** STAT 302 or STAT 463 (could be concurrent to either)**Description:** Introduces statistical analysis of spatial and spatiotemporal data. Topics include statistical theory, methods and applications for geostatistical, lattice and point processes. The focus is on methods and applications, but necessary and essential theories and proofs will also be covered.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded with Option**STAT 442 Computational Biology****Crosslisted with:** BIOC 842, STAT 842, 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**Grading Option:** Graded with Option**STAT 443 Statistical Analysis of Genomics Data****Prerequisites:** STAT 251, STAT 302**Notes:** Familiarity with R or Python highly recommended**Description:** Introduction to basic statistical analyses in bioinformatics. Techniques for processing and analysis of commonly occurring genomic data types such as GWAS, micro-arrays, mass. spec, and RNAseq. Estimation of gene networks and visualization of data and results from analysis.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded with Option**STAT 450 Introduction to Regression Analysis****Prerequisites:** STAT 301 or STAT 463**Notes:** Previous knowledge of matrix algebra is beneficial.**Description:** Practical tools and techniques for building linear regression models using real-world data and assessing their validity; necessary theory and supporting proofs will also be covered. Topics include introduction of simple/multiple linear regression, parameter estimation and inference in both frequentist and Bayesian frameworks, model diagnostics, and variable selection.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded with Option**Prerequisite for:** STAT 475; STAT 478**STAT 451 Development of Statistical Software****Prerequisites:** STAT 302, STAT 351**Notes:** ACE 10 scholarly product will be a statistical software package which fills a need in the ecosystem.**Description:** Advanced statistical software development. Packaging code into functions, intelligent software design, compiled languages to speed up code, development and release cycles.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded**ACE:** ACE 10 Integrated Product**STAT 452 Advanced Computational Statistics****Prerequisites:** STAT 251, STAT 301**Description:** Comprehensive treatment of modern and classical computational statistics, including algorithms for statistical prediction, inference, numerical optimization, Markov Chain Monte Carlo methods, bootstrapping and computing tools for big data problems.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded with Option**STAT 462 Introduction to Mathematical Statistics I: Distribution Theory****Prerequisites:** Grade of C or better in MATH 208 or MATH 107H.**Notes:** STAT 380 or equivalent is strongly recommended.**Description:** Sample space, random variable, expectation, conditional probability and independence, moment generating function, special distributions, sampling distributions, order statistics, limiting distributions, and central limit theorem.**Credit Hours:** 4**Max credits per semester:** 4**Max credits per degree:** 4**Grading Option:** Graded with Option**Offered:** FALL**Prerequisite for:** STAT 463

**STAT 463 Introduction to Mathematical Statistics II: Statistical Inference****Prerequisites:** C or better in STAT 462**Description:** Interval estimation; point estimation, sufficiency, and completeness; Bayesian procedures; uniformly most powerful tests, sequential probability ratio test, likelihood ratio test, goodness of fit tests; elements of analysis of variance and nonparametric tests.**Credit Hours:** 4**Max credits per semester:** 4**Max credits per degree:** 4**Grading Option:** Graded with Option**Offered:** SPRING**Prerequisite for:** STAT 432; STAT 450; STAT 486**STAT 464 Model Selection and Prediction****Prerequisites:** STAT 302**Description:** Methods for selecting models applicable to real-world problems. Prediction as a modeling goal, models for prediction as opposed to inference. Methods for emerging data types, such streaming data, social network data, censored data, and others.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded**STAT 471 Analysis of Messy Data****Prerequisites:** STAT 302, STAT 351**Description:** Analysis of complex, real-world data sets. Analysis techniques will vary depending on interest and availability of data sets.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded**ACE:** ACE 10 Integrated Product**STAT 474 Introduction to Nonparametric Statistics****Prerequisites:** STAT 302**Description:** Most commonly used nonparametric techniques in statistics including rank-based methods for testing and estimation, nonparametric estimators of parameters, distributions, and curves, assessing the properties of data, and permutation tests including how to cope with multiple comparisons. Comparisons between methods will be emphasized throughout.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded with Option**STAT 475 Introduction to Categorical Data Analysis****Prerequisites:** STAT 301 or STAT 450**Description:** Introduction to methodology for analyzing categorical data, including contingency table methods, binary regression, multinomial regression, and loglinear regression.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded with Option**STAT 478 Introduction to Time Series Analysis****Prerequisites:** STAT 301 or STAT 450**Description:** A basic introduction to modern time series analysis including time series regression and exploratory data analysis, the classical decomposition, ARIMA models, model identification/estimation/forecasting, seasonality, Fourier analysis, spectral estimation, and state space models.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded with Option**STAT 485 Statistical Learning****Prerequisites:** STAT 251, STAT 302**Notes:** Proficiency in a statistical computing language may replace STAT 251**Description:** An introduction to supervised and unsupervised methods for statistical learning and data mining. Bias-variance trade-off, classification, regression, factor analysis, and neural networks for modeling and prediction.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded with Option**STAT 486 Introduction to Bayesian Analysis****Prerequisites:** STAT 302 or STAT 463**Description:** Principles of Bayesian analysis including forming posteriors from priors and likelihoods. Bayesian estimation, testing, linear regression, and hierarchical models. Computing posterior distributions using existing software and standard classes of algorithms such as MCMC.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded with Option**STAT 494 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**Grading Option:** Graded with Option**STAT 496 Independent Study****Prerequisites:** Prior arrangement with a faculty member and submission of proposed study plan to department office.**Credit Hours:** 1-5**Min credits per semester:** 1**Max credits per semester:** 5**Max credits per degree:** 5**Grading Option:** Graded with Option



**STAT 499 Undergraduate Thesis**

**Prerequisites:** Permission

**Description:** Independent research project carried out under the guidance of a faculty member in the Department of Statistics. Culminates in the presentation of a thesis to the department.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Graded

**ACE:** ACE 10 Integrated Product