

Statistics and Data Sciences (SDS)

SDS 301 Elementary Statistical Methods 3 Hours

Covers the fundamental procedures for data organization and analysis. Subjects include frequency distributions, graphical presentation, sampling, experimental design, inference, and regression.

SDS 302F Foundations of Data Analysis 3 Hours

Introduction to data analysis and statistical methods. Subjects include random sampling; principles of observational study and experimental design; data summaries and graphics; and statistical models and inference, including the simple linear regression model and one-way analysis of variance.

SDS 313 Introduction to Data Science 3 Hours

Introduction to the principles and practice of data science. Explore R and reproducible data analysis; summarizing data using descriptive statistics; data visualization and storytelling; data wrangling and relational data; basic prediction and classification using regression models; and programming in R.

SDS 315 Statistical Thinking 3 Hours

Introduction to the fundamental ideas of statistical thinking with R programming. Explore survey, experimental, and observational study design; common sources of random and systematic error in data; the bootstrap as a tool for quantifying uncertainty; hypothesis testing; regression; and the role of statistics in an ethical and just society.

SDS 119S, 219S, 319S, 419S, 519S, 619S, 719S, 819S, 919S Topics in Statistics and Data Sciences 1-9 Hours

This course is used to record credit the student earns while enrolled at another institution in a program administered by the University's Study Abroad Office. Credit is recorded as assigned by the study abroad adviser in the Department of Statistics and Data Sciences. University credit is awarded for work in an exchange program; it may be counted as coursework taken in residence. Transfer credit is awarded for work in an affiliated studies program.

SDS 320E Elements of Statistics 3 Hours

Introduction to statistics. Subjects include probability; principles of observational study and experimental design; statistical models and inference, including the multiple linear regression model and one-way analysis of variance. R programming is introduced.

SDS 320H Elements of Statistics: Honors 3 Hours

Introduction to statistics. Subjects include probability; principles of observational study and experimental design; statistical models and inference, including the multiple linear regression model and one-way analysis of variance. R programming is introduced.

SDS 321 Introduction to Probability and Statistics 3 Hours

Covers fundamentals of probability, combinatorics, discrete and continuous random variables, jointly distributed random variables, and limit theorems. Using probability to introduce fundamentals of statistics, including Bayesian and classical inference.

SDS 322E Elements of Data Science 3 Hours

Explore data science tools and examine data wrangling; exploratory data analysis and data visualization; markdown and data workflow; simulation-based inference; and classification methods. R programming is emphasized and Python programming is introduced.

SDS 324E Elements of Regression Analysis 3 Hours

Explore the use of regression analysis in applied research and learn about multiple linear regression; ANOVA; logistic regression; random and mixed-effects models; and models for dependent data. Engage in the identification of appropriate statistical methods and interpretation of software output. R programming is introduced.

SDS 325H Honors Statistics 3 Hours

An introduction to the fundamental theories, concepts, and methods of statistics. Emphasizes probability models, exploratory data analysis, sampling distributions, confidence intervals, hypothesis testing, correlation and regression, and the use of statistical software.

SDS 326E Elements of Statistical Machine Learning 3 Hours

Introduction to the concepts and tools of data science, statistics, and machine learning used to draw inferences about large-scale and real-world data. Explore data visualization, linear and nonlinear models, regularization, classification, resampling, tree-based methods, support vector machines, and unsupervised learning.

SDS 129S, 229S, 329S, 429S, 529S, 629S, 729S, 829S, 929S Topics in Statistics and Data Sciences 1-9 Hours

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SDS 431 Probability and Statistical Inference 4 Hours

Introduction to probability and statistical inference. Examine events and random experiments; basic rules of probability; joint, conditional, and marginal probability and independence; discrete and continuous random variables; random sampling and estimation; large-sample theory results and central limit theorem-based inferential summaries; and maximum likelihood estimation.

SDS 334 Intermediate Statistical Methods 3 Hours

Introduction to applied regression analysis. Explore estimation and inference in multiple regression models; logistic regression; regression for count data; time-to-event models; and case studies in regression modeling in published work, emphasizing both the use and limitations of regression modeling in advancing scientific knowledge.

SDS 336 Practical Machine Learning 3 Hours

Introduction to machine learning for data science with an emphasis on Python programming. Explore comparing algorithm performance; decision-tree algorithms; classification algorithms; model averaging; unsupervised learning; and neural networks.

SDS 354 Advanced Statistical Methods 3 Hours

Explore advanced methods in statistics and data science. Examine modeling data with multilevel (hierarchical) structure and causal inference, including design and analysis strategies. Discuss smoothing methods; spatial and time series models; additive models; and models for network data.

SDS 357 Case Studies in Data Science 3 Hours

Explore advanced case studies in data science, with an emphasis on the full data analysis pipeline. Examine data collection, identification of data limitations; data privacy; data preparation and exploration; building, using, and evaluating models; creating data products; and communication and persuasion with data.

SDS 364 Bayesian Statistics 3 Hours

Introduction to the Bayesian approach for statistical inference. Explore prior, posterior, and predictive distributions: conjugate priors; informative and non-informative priors; models for normal, categorical, and count data; Bayesian computation, including MCMC and the Gibbs sampler; hierarchical models; and Bayesian model checking and model selection.

SDS 365 Special Topics in Statistics and Data Science 3 Hours

Examine concepts of statistics and data science.

SDS 365.1 Sports Analytics 3 Hours

Explore fundamental principles and methods of sports analytics. Participate in practical experience in collecting and analyzing sports data. Discuss data collection, metric estimation and evaluation, predictive modeling, match-up models, game simulation, and in-game decision making.

SDS 365.2 Data Product Development 3 Hours

Learn the fundamentals of creating data products using technologies like Shiny, R packages, and interactive graphics tools. Explore interactive maps, machine learning application programming interfaces, dashboards, and data storytelling. Focus on both the statistical details and the design process for building effective data products.

SDS 366 Data Visualization 3 Hours

Explore how to visualize data sets. Reason about, and communicate with, data visualizations.

SDS 368 Statistical Theory 3 Hours

Introduction to the mathematical theory of statistics. Explore maximum likelihood estimation, confidence intervals, hypothesis tests and statistical decision theory, tail and concentration bounds, concentration of measure, and nonparametric statistics.

SDS 374C Parallel Computing for Science and Engineering 3 Hours

Study of parallel computing principles, architectures, and technologies; and parallel application development, performance, and scalability. Designed to help prepare students to formulate and develop parallel algorithms to implement effective applications for parallel computing systems.

SDS 374E Visualization and Data Analysis for Science and Engineering 3 Hours

Scientific visualization principles, practices, and technologies, including remote and collaborative visualization. Introduces statistical analysis, data mining, and feature detection.

SDS 375 Special Topics in Scientific Computation 3 Hours

SDS 378 Introduction to Mathematical Statistics 3 Hours

Sampling distributions of statistics, estimation of parameters (confidence intervals, method of moments, maximum likelihood, comparison of estimators using mean square error and efficiency, sufficient statistics), hypothesis tests (p-values, power, likelihood ratio tests), and other topics.

SDS 378P Decision Analytics 3 Hours

Examine decision theory with utility functions, including the use of probability, optimization, constrained optimization, and linear algebra.

SDS 379H Honors Undergraduate Research 3 Hours

Design an individual research project under the supervision of one or more faculty members.

SDS 179R, 279R, 379R, 479R Undergraduate Research 1-4 Hours

Students work on an individual research project under the supervision of one or more faculty members.

SDS 380C Statistical Methods I 3 Hours

Introduction to the fundamental concepts and methods of statistics. Includes descriptive statistics, sampling distributions, confidence intervals, and hypothesis testing. May include simple and multiple linear regression, analysis of variance, and categorical analysis. Use of statistical software is emphasized.

SDS 380D Statistical Methods II 3 Hours

Continuation of Statistics and Data Sciences 380C (or Statistics and Scientific Computation 380C). Surveys advanced statistical modeling and may include random and mixed effects models, time series analysis, survival analysis, Bayesian methods, and multivariate analysis of variance. Use of statistical software is emphasized.

SDS 381M Topics in Statistics and Data Science Foundations 3 Hours

Examine core concepts of statistics and data science.

SDS 383C Statistical Modeling I 3 Hours

An introduction to core applied statistical modeling ideas from a probabilistic, Bayesian perspective. Topics include exploratory data analysis, programming in R, Bayesian probability models, an introduction to the Gibbs sampler, applied regression analysis, and hierarchical models.

SDS 383D Statistical Modeling II 3 Hours

Use of structured, probabilistic models that incorporate multiple layers of uncertainty to describe real-world systems. Topics include multivariate normal distribution, mixture models, nonparametric Bayesian analysis, advanced hierarchical models and latent-variable models, generalized linear models, and advanced topics in linear and nonlinear regression.

SDS 183K Topics in Data Analysis Applications 1 Hour

Introduction to the use of statistical or mathematical applications for data analysis.

SDS 384 Topics in Statistics and Probability 3 Hours

Concepts of probability and mathematical statistics with applications in data analysis and research.

SDS 384.1 Applied Probability 3 Hours

Basic probability theory, combinatorial analysis of random phenomena, conditional probability and independence, parametric families of distributions, expectation, distribution of functions of random variables, and limit theorems.

SDS 384.10 Stochastic Processes 3 Hours

Concepts and techniques of stochastic processes, with emphasis on the nature of change of variables with respect to time. Includes characterization, structural properties, and inference.

SDS 384.11 Theoretical Statistics 3 Hours

Examination of asymptotic theory and empirical processes. The former would include minimax theory, Bernstein von Mises theorem, and Bayesian asymptotics. The latter, would include U statistics and robust estimation.

SDS 384.2 Mathematical Statistics I 3 Hours

The general theory of mathematical statistics. Includes distributions of functions of random variables, properties of a random sample, principles of data reduction, an overview of hierarchical models, decision theory, Bayesian statistics, and theoretical results relevant to point estimation, interval estimation, and hypothesis testing.

SDS 384.3 Mathematical Statistics II 3 Hours

Continuation of Computational Science, Engineering, and Mathematics 384R and Mathematics 384C.

SDS 384.4 Regression Analysis 3 Hours

Simple and multiple linear regression, inference in regression, prediction of new observations, diagnosis and remedial measures, transformations, and model building. Emphasis on both understanding the theory and applying theory to analyze data.

SDS 384.6 Design and Analysis of Experiments 3 Hours

Design and analysis of experiments, including one-way and two-way layouts; components of variance; factorial experiments; balanced incomplete block designs; crossed and nested classifications; fixed, random, and mixed models; and split plot designs.

SDS 384.7 Bayesian Statistical Methods 3 Hours

Fundamentals of Bayesian inference in single-parameter and multi-parameter models for inference and decision making, including simulation of posterior distributions, Markov chain Monte Carlo methods, hierarchical models, and empirical Bayes models.

SDS 384.8 Time Series Analysis 3 Hours

Introduction to statistical time series analysis. Includes autoregressive integrated moving average (ARIMA) and more general models, forecasting, spectral analysis, time domain regression, model identification, estimation of parameters, and diagnostic checking.

SDS 384.9 Computational Statistics 3 Hours

Modern, computation intensive statistical methods, including simulation, optimization methods, Monte Carlo integration, maximum likelihood estimation and expectation-maximization parameter estimation, Markov chain Monte Carlo methods, resampling methods, and nonparametric density estimation.

SDS 385 Topics in Applied Statistics 3 Hours

Theories, models, and methods for the analysis of quantitative data.

SDS 386M Topics in Statistics and Data Science Extensions 3 Hours

Examine concepts of statistics and data science.

SDS 386M.1 Data Visualization 3 Hours

SDS 387 Linear Models 3 Hours

An exploration of practical applications of the projection approach to linear models, building from a review of essential linear algebra concepts to the theory of linear models from a projection-based perspective. Introduction to Bayesian ideas. Additional topics include analysis of variance, generalized linear models, and variable selection techniques.

SDS 189R, 289R, 389R, 489R Graduate Research 1-4 Hours

Individual research project supervised by one or more faculty members.

SDS 190 Readings in Statistics 1 Hour

Faculty directed research seminar. Activities may vary, but will include readings of cutting-edge research papers, discussion of on-going student and faculty projects, and consulting projects.

SDS 391P Topics in Statistics and Data Science Foundations 3 Hours

Examine advanced core concepts of statistics and data science.

SDS 391P.1 Advanced Statistical Modeling and Applications I 3 Hours

SDS 391P.2 Advanced Statistical Modeling and Applications II 3 Hours

Examine the use of structured, probabilistic models that incorporate multiple layers of uncertainty to describe real-world systems. Analyze generalized linear models, Gaussian processes, advanced hierarchical models and latent-variable models, and advanced linear and nonlinear regression.

SDS 391P.3 Theory of the Linear Model 3 Hours

Explore the mathematical underpinnings and theory of linear regression modeling in likelihood and assumption-lean settings. Discuss linear algebra, regularization, asymptotic statistics, and minimax optimality.

SDS 391P.4 Computational Inference 3 Hours

Examine computational methods for inference in statistical models. Explore inference methods, their properties, and their applicability. Discuss deterministic and stochastic optimization, Monte Carlo methods, and variational inference.

SDS 391P.5 Concepts in Mathematical Statistics 3 Hours

Examine key concepts and ideas behind the mathematics associated with statistical procedures. Analyze derivations of well-known practices, such as point estimation, uncertainty quantification, hypothesis testing, nonparametric methods, and the analysis of various types of models, and their asymptotic properties.

SDS 391P.6 Theoretical Statistics and Machine Learning 3 Hours

Examine concentration inequalities and asymptotic theory. Explore Hoeffding, Chernoff, Bernstein, Martingale-based methods, the Efron-Stein inequality, the Gaussian Lipschitz theorem, U statistics, uniform laws of large numbers, VC dimension, covering and packing. Practice high-dimensional covariance estimation and resampling.

SDS 393C Numerical Analysis: Linear Algebra 3 Hours

Survey of numerical methods in linear algebra: floating-point computation, solution of linear equations, least squares problems, algebraic eigenvalue problems.

SDS 393D Numerical Analysis: Interpolation, Approximation, Quadrature, and Differential Equations 3 Hours

Survey of numerical methods for interpolation, functional approximation, integration, and solution of differential equations.

SDS 396P Topics in Statistics and Data Science Extensions 3 Hours

Examine advanced concepts of statistics and data science.

SDS 396P.1 Statistical Machine Learning Optimization 3 Hours

Introduction to machine learning and optimization methods from a statistical perspective with an emphasis on mathematical theory and applications.

SDS 398R Master's Report 3 Hours

Preparation of a report to fulfill the requirement for the master's degree under the report option.

SDS 398T Supervised Teaching in Statistics and Data Sciences 3 Hours

Supervised teaching experience; weekly group meetings, individual consultations, and reports.

SDS 399W, 699W, 999W Dissertation 3,6,9 Hours