

STATISTICS

The Department of Statistics offers undergraduate service courses and an undergraduate minor, as well as graduate courses and programs leading to the MA, MS, and PhD degrees or to a minor for an advanced degree in other fields. Students planning to major in statistics at the graduate level should have a minimum of mathematics through multivariable calculus, linear algebra, and an upper-division sequence in mathematical statistics.

Survey Research Center

Website: <http://stat.oregonstate.edu/src/survey-research-center>

Established in 1973, the Oregon State University Survey Research Center (OSU-SRC) provides comprehensive survey services including proposal development, questionnaire design and layout, survey administration and data collection, survey analysis and professional report writing. Our staff offers customized options, working with our clients to determine the best approach to collect survey data based on the study objectives, population of interest, and budgetary concerns. Our past and current clients include federal, state, and local agencies, national non-profit organizations, and OSU-affiliated entities. The OSU-SRC maintains several contracts with clients to provide our services on a recurrent basis, from monthly, annually, to ever few years.

Operating as a center for research in survey methodology, the OSU-SRC routinely conducts experiments using self-administered surveys with an aim to contribute to survey methodology research. The OSU-SRC subsequently publishes related material in scientific journals and presents experimental findings at professional meetings. The OSU-SRC provides expertise using survey best practices to maximize response rates and reduce non-response bias. Various sampling plans are examined for each survey to minimize total survey error. The OSU-SRC also offers consulting for OSU community members on research-based survey design and analysis.

Undergraduate Programs

Minor

- Statistics (<http://catalog.oregonstate.edu/college-departments/science/statistics/statistics-minor>)

Graduate Programs

Majors

- Data Analytics (<http://catalog.oregonstate.edu/college-departments/science/statistics/data-analytics-ms>)
- Statistics (<http://catalog.oregonstate.edu/college-departments/science/statistics/statistics-ma-ms-phd-mais>)

Minor

- Statistics (<http://catalog.oregonstate.edu/college-departments/science/statistics/statistics-graduate-minor>)

Certificate

- Data Analytics (<http://catalog.oregonstate.edu/college-departments/science/statistics/data-analytics-graduate-certificate>)

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Faculty

Professors Gitelman, Lesser, Pantula, Rojo

Associate Professors Di, Emerson, Madsen, Xue

Assistant Professors Bhattacharyya, Fuentes, D. Jiang, Y. Jiang, McLaughlin, Mondal, Sharpton, Wickham

Senior Research Associate Newton

Research Associates Nawrocki, Sifneos

Senior Instructor II Kollath

Instructors Jager, Moore

Statistics

ST 199. SPECIAL TOPICS. (3 Credits)

This course can only be taken once unless instructor permission is provided.

ST 201. PRINCIPLES OF STATISTICS. (4 Credits)

Study design, descriptive statistics, the use of probability in statistical arguments, sampling, hypothesis tests and confidence intervals for means and proportions. Lec/rec.

Recommended: High school algebra

ST 202. PRINCIPLES OF STATISTICS. (4 Credits)

Comparisons of means and proportions between two populations (t-tests, chi-square tests, nonparametric tests), simple linear regression, correlation. Lec/rec.

Prerequisites: ST 201 with D- or better

ST 314. INTRODUCTION TO STATISTICS FOR ENGINEERS. (3 Credits)

Probability, common probability distributions, sampling distributions, estimation, hypothesis testing, control charts, regression analysis, experimental design.

Prerequisites: MTH 252 with D- or better or MTH 252H with D- or better

ST 351. INTRODUCTION TO STATISTICAL METHODS. (4 Credits)

Study designs, descriptive statistics, collecting and recording data, probability distributions, sampling distributions for means and proportions, hypothesis testing and confidence intervals for means and proportions in one- and two-sample inference, and chi-square tests. Lec/lab.

Equivalent to: ST 351H

Recommended: High school algebra with statistics

ST 351H. INTRODUCTION TO STATISTICAL METHODS. (4 Credits)

Study designs, descriptive statistics, collecting and recording data, probability distributions, sampling distributions for means and proportions, hypothesis testing and confidence intervals for means and proportions in one- and two-sample inference, and chi-square tests. Lec/lab.

Attributes: HNRS – Honors Course Designator

Equivalent to: ST 351

Recommended: High school algebra with statistics

ST 352. INTRODUCTION TO STATISTICAL METHODS. (4 Credits)

Randomization tests and other nonparametric tests for one- and two-sample inference, simple and multiple linear regression, correlation, one- and two-way analysis of variance, logistic regression. Lec/lab.

Prerequisites: ST 351 with D- or better or ST 351H with D- or better

ST 406. PROJECTS. (1-16 Credits)

Section 1: Projects, graded P/N. Section 2: Teaching Experience, graded P/N. Section 3: Directed Work, graded P/N.

This course is repeatable for 16 credits.

ST 407. SEMINAR. (1 Credit)

Attendance at consulting practicum. Graded P/N.

ST 410. INTERNSHIP. (1-16 Credits)

Graded P/N.

This course is repeatable for 16 credits.

ST 411. METHODS OF DATA ANALYSIS. (4 Credits)

Graphical, parametric and nonparametric methods for comparing two samples; one-way and two-way analysis of variance; simple linear regression. Lec/lab.

Recommended: ST 351

ST 412. METHODS OF DATA ANALYSIS. (4 Credits)

Multiple linear regression, including model checking, dummy variables, using regression to fit analysis of variance models, analysis of covariance, variable selection methods. Lec/lab.

Prerequisites: ST 411 with D- or better

Recommended: ST 351

ST 413. METHODS OF DATA ANALYSIS. (4 Credits)

Principles of experimental design; randomized block and factorial designs; repeated measures; categorical data analysis, including comparison of proportions, tests of homogeneity and independence in cross-classified frequency tables, Mantel-Haenszel test, logistic regression, log-linear regression. Introduction to multivariate statistics. Lec/lab.

Prerequisites: ST 412 with D- or better

Recommended: ST 351

ST 415. DESIGN AND ANALYSIS OF PLANNED EXPERIMENTS. (3 Credits)

Principles of experimental design; uses, construction and analysis of completely randomized, randomized block and Latin square designs; covariates; factorial treatments, split plotting; random effects and variance components.

Prerequisites: ST 352 with D- or better or ST 411 with D- or better or ST 511 with D- or better

ST 421. INTRODUCTION TO MATHEMATICAL STATISTICS. (4 Credits)

Probability, random variables, expectation, discrete and continuous distributions, multivariate distributions.

Recommended: MTH 253

ST 422. INTRODUCTION TO MATHEMATICAL STATISTICS. (4 Credits)

Sampling distributions, Central Limit Theorem, estimation, confidence intervals, properties of estimators, and hypothesis testing.

Prerequisites: ST 421 with D- or better

Recommended: MTH 253

ST 431. SAMPLING METHODS. (3 Credits)

Estimation of means, totals and proportions; sampling designs including simple random, stratified, cluster, systematic, multistage and double sampling; ratio and regression estimators; sources of errors in surveys; capture-recapture methods.

Recommended: ST 411 or ST 511

ST 435. QUANTITATIVE ECOLOGY. (3 Credits)

Overview of statistical methods that are useful for analyzing ecological data, including spatial pattern analysis, multivariate techniques, logistic regression, Bayesian statistics and computer-intensive methods. Consideration of special topics such as population dynamics, food webs and ecological indicators. Not offered every year.

Prerequisites: ST 412 with D- or better or ST 512 with D- or better

ST 439. SURVEY METHODS. (3 Credits)

Survey design, data collection and analysis, general methodology.

Prerequisites: ST 201 with D- or better or ST 351 with D- or better

ST 441. PROBABILITY, COMPUTING, AND SIMULATION IN STATISTICS. (4 Credits)

Review of probability, including univariate distributions and limit theorems. Random-number generation and simulation of statistical distributions. Bootstrap estimates of standard error. Variance reduction techniques. Emphasis on the use of computation in statistics using the MATLAB programming language. Lec/lab.

Prerequisites: ST 422 with D- or better or ST 522 with D- or better

ST 443. APPLIED STOCHASTIC MODELS. (3 Credits)

Development of stochastic models commonly arising in statistics and operations research, such as Poisson processes, birth-and-death processes, discrete-time and continuous-time Markov chains, renewal and Markov renewal processes. Analysis of stochastic models by simulation and other computational techniques.

Prerequisites: ST 421 with D- or better or ST 521 with D- or better

Recommended: Experience with a high-level programming language or mathematical computation package

ST 499. SPECIAL TOPICS. (1-4 Credits)

May be repeated for credit.

This course is repeatable for 8 credits.

ST 501. RESEARCH. (1-16 Credits)

This course is repeatable for 16 credits.

ST 503. THESIS. (1-16 Credits)

This course is repeatable for 999 credits.

ST 505. READING AND CONFERENCE. (1-16 Credits)

This course is repeatable for 16 credits.

ST 506. PROJECTS. (1-16 Credits)

Section 1: Projects. Section 2: Teaching Experience. Section 3: Directed Work.

This course is repeatable for 16 credits.

ST 507. SEMINAR. (1 Credit)

Section 1: Attendance at consulting practicum, 1 credit. Section 3: Research Seminar, 1 credit. Section 4: Computing Facilities, 1 credit. All sections graded P/N.

This course is repeatable for 99 credits.

ST 509. CONSULTING PRACTICUM. (2 Credits)

The student provides statistical advice, under faculty guidance, on university-related research projects.

This course is repeatable for 99 credits.

Recommended: ST 507 and ST 553

ST 510. INTERNSHIP. (1-16 Credits)

Graded P/N.

This course is repeatable for 16 credits.

ST 511. METHODS OF DATA ANALYSIS. (4 Credits)

Graphical, parametric and nonparametric methods for comparing two samples; one-way and two-way analysis of variance; simple linear regression. Lec/lab.

Recommended: ST 351

ST 512. METHODS OF DATA ANALYSIS. (4 Credits)

Multiple linear regression, including model checking, dummy variables, using regression to fit analysis of variance models, analysis of covariance, variable selection methods. Lec/lab.

Prerequisites: ST 511 with C or better

Recommended: ST 351

ST 513. METHODS OF DATA ANALYSIS. (4 Credits)

Principles of experimental design; randomized block and factorial designs; repeated measures; categorical data analysis, including comparison of proportions, tests of homogeneity and independence in cross-classified frequency tables, Mantel-Haenszel test, logistic regression, log-linear regression. Introduction to multivariate statistics. Lec/lab.

Prerequisites: ST 512 with C or better

Recommended: ST 351

ST 515. DESIGN AND ANALYSIS OF PLANNED EXPERIMENTS. (3 Credits)

Principles of experimental design; uses, construction and analysis of completely randomized, randomized block and Latin square designs; covariates; factorial treatments, split plotting; random effects and variance components.

Recommended: ST 352 or (ST 411 or ST 511)

ST 516. FOUNDATIONS OF DATA ANALYTICS. (4 Credits)

Foundations of estimation and hypothesis testing; desirable properties of estimators; maximum likelihood; one- and two-sample problems; theoretical results are explored through simulations and analysis using R. Offered via Ecampus only.

Recommended: ST 351

ST 517. DATA ANALYTICS I. (4 Credits)

Methods for modeling quantitative data and statistical learning—simple and multiple linear regression; linear mixed effects models; data imputation; prediction and cross-validation; scaling up to large datasets. Simulations and data analysis using R. Offered via Ecampus only.

Prerequisites: ST 516 with C+ or better

ST 518. DATA ANALYTICS II. (4 Credits)

Statistical methods and data analysis techniques for count data. Topics include tests for tables of counts, logistic regression, log-linear regression, generalized linear mixed models, and issues for large datasets. Data analysis in R.

Prerequisites: ST 517 with C+ or better

ST 521. INTRODUCTION TO MATHEMATICAL STATISTICS. (4 Credits)

Probability, random variables, expectation, discrete and continuous distributions, multivariate distributions.

Recommended: MTH 253

ST 522. INTRODUCTION TO MATHEMATICAL STATISTICS. (4 Credits)

Sampling distributions, Central Limit Theorem, estimation, confidence intervals, properties of estimators, and hypothesis testing.

Prerequisites: ST 521 with C or better

Recommended: MTH 253

ST 525. APPLIED SURVIVAL ANALYSIS. (3 Credits)

Statistical methods for analyzing survival data or time-to-event data, which may be censored and/or truncated. Specific topics can vary term to term, and could include Kaplan-Meier estimator; K-sample hypothesis tests for survival data; Accelerated failure time model; Cox proportional hazard regression model.

Prerequisites: ST 516 with C or better and ST 517 [C] and ST 518 [C]

ST 531. SAMPLING METHODS. (3 Credits)

Estimation of means, totals and proportions; sampling designs including simple random, stratified, cluster, systematic, multistage and double sampling; ratio and regression estimators; sources of errors in surveys; capture-recapture methods.

Recommended: ST 411 or ST 511

ST 535. QUANTITATIVE ECOLOGY. (3 Credits)

Overview of statistical methods that are useful for analyzing ecological data, including spatial pattern analysis, multivariate techniques, logistic regression, Bayesian statistics and computer-intensive methods. Consideration of special topics such as population dynamics, food webs and ecological indicators. Not offered every year.

Recommended: ST 412 or ST 512

ST 537. DATA VISUALIZATION. (3 Credits)

Perceptual principles for displaying data; critique and improvement of data visualizations; use of color in visualization; principles of tidy data; strategies for data exploration; select special topics.

Prerequisites: ST 512 with C or better or ST 517 with C or better or ST 552 with C or better

Recommended: Familiarity with linear regression and using R

ST 538. MODERN STATISTICAL METHODS FOR LARGE AND COMPLEX DATA SETS. (3 Credits)

Provides students with the tools and experience to analyze big and messy data and work effectively in a data science team. Covers the tools to handle big data and answer statistical questions based on the data. Includes three big data analysis projects that students work on in groups. Focuses on proper use of modern data analysis techniques related to regression, classification and clustering for data coming from a variety of application fields. R will be the lingua franca.

Prerequisites: ST 512 with C or better or ST 517 with C or better or ST 552 with C or better or ST 412 with C or better

ST 539. SURVEY METHODS. (3 Credits)

Survey design, data collection and analysis, general methodology.

Recommended: ST 201 or ST 351

ST 541. PROBABILITY, COMPUTING, AND SIMULATION IN STATISTICS. (4 Credits)

Review of probability, including univariate distributions and limit theorems. Random-number generation and simulation of statistical distributions. Bootstrap estimates of standard error. Variance reduction techniques. Emphasis on the use of computation in statistics using the S-Plus or MATLAB programming language. Lec/lab.

Recommended: ST 422 or ST 522

ST 543. APPLIED STOCHASTIC MODELS. (3 Credits)

Development of stochastic models commonly arising in statistics and operations research, such as Poisson processes, birth-and-death processes, discrete-time and continuous-time Markov chains, renewal and Markov renewal processes. Analysis of stochastic models by simulation and other computational techniques.

Recommended: (ST 421 or ST 521) and experience with a high-level programming language or mathematical computation package.

ST 551. STATISTICAL METHODS. (4 Credits)

Properties of t, chi-square and F tests; randomized experiments; sampling distributions and standard errors of estimators, delta method, comparison of several groups of measurements; two-way tables of measurements.

Recommended: Concurrent enrollment in MTH 341 and (ST 422 or ST 522)

ST 552. STATISTICAL METHODS. (4 Credits)

Simple and multiple linear regression including polynomial regression, indicator variables, weighted regression, and influence statistics, nonlineal regression and linear models for binary data.

Prerequisites: ST 551 with C or better

Recommended: ST 422 or ST 522.

ST 553. STATISTICAL METHODS. (4 Credits)

Principles and analysis of designed experiments, including factorial experiments, analysis of covariance, random and mixed effect models. Lec/lab.

Prerequisites: ST 552 with C or better

ST 555. ADVANCED EXPERIMENTAL DESIGN. (3 Credits)

Designs leading to mixed models including split plots, repeated measures, crossovers and incomplete blocks. Introduction to experimental design in industry including confounding, fractional factorials and response surface methodology. Analysis of unbalanced data.

Prerequisites: ST 553 with C or better

ST 557. APPLIED MULTIVARIATE ANALYSIS. (3 Credits)

Multivariate data structures, linear combinations; principal components, factor and latent structure analysis, canonical correlations, discriminant analysis; cluster analysis, multidimensional scaling. Not offered every year.

Recommended: (ST 412 or ST 512) and (MTH 252 or MTH 245)

ST 558. MULTIVARIATE ANALYTICS. (3 Credits)

Basics of matrix algebra, principal components analysis, cluster analysis, factor analysis, multidimensional scaling.

Prerequisites: ST 518 with C- or better

ST 559. BAYESIAN STATISTICS. (3 Credits)

Bayesian statistics for data analysis. Characterizations of probability; comparative (Bayesian versus frequentist) inference; prior, posterior and predictive distributions; hierarchical modeling. Computational methods include Markov Chain Monte Carlo for posterior simulation.

Recommended: ST 562

ST 561. THEORY OF STATISTICS. (4 Credits)

Distributions of functions of random variables, joint and conditional distributions, sampling distributions, convergence concepts, order statistics. Lec/rec.

Recommended: ST 422 or ST 522

ST 562. THEORY OF STATISTICS. (4 Credits)

Sufficiency, exponential families, location and scale families; point estimation: maximum likelihood, Bayes, and unbiased estimators; asymptotic distributions of maximum likelihood estimators; Taylor series approximations.

Prerequisites: ST 561 with C or better

Recommended: ST 422 or ST 522

ST 563. THEORY OF STATISTICS. (4 Credits)

Hypothesis testing: likelihood ratio, Bayesian, and uniformly most powerful tests; similar tests in exponential families; asymptotic distributions of likelihood ratio test statistics; confidence intervals.

Prerequisites: ST 562 with C or better

Recommended: ST 422 or ST 522

ST 565. TIME SERIES. (3 Credits)

Analysis of serially correlated data in both time and frequency domains. Autocorrelation and partial autocorrelation functions, autoregressive integrated moving average models, model building, forecasting; filtering, smoothing, spectral analysis, frequency response studies, Offered winter term in even years.

Recommended: (ST 412 or ST 512) and (ST 422 or ST 522)

ST 566. TIME SERIES ANALYTICS. (3 Credits)

Focuses on statistical and analytical tools for analyzing data that are observed sequentially over time. Specific topics can vary term to term, and could include methods for exploratory time series analysis, linear time series models (ARMA, ARIMA), forecasting, spectral analysis and state-space models. The focus will be on applied problems, though some mathematical statistics is necessary for a solid understanding of the statistical issues. This course is designed for students in Data Analytics MS and Certificate programs.

Prerequisites: ST 516 with C or better and ST 517 [C] and ST 518 [C]

ST 567. SPATIAL STATISTICS. (3 Credits)

The analysis of spatial data. Graphical tools for exploring spatial data, geostatistics, variogram estimation, kriging, areal models, hierarchical spatial models, and spatio-temporal modelling. Offered winter term in odd years.

Recommended: (ST 412 or ST 512) and (ST 422 or ST 522)

ST 591. INTRODUCTION TO QUANTITATIVE GENOMICS. (3 Credits)

Provides an overview of how genomic data is generated and analyzed. It focuses on the underlying biological motivation, theoretical concepts, and analytical challenges associated with genomic research, especially the generation of statistics that summarize genomic data. The class is organized as a combination of lectures and group literature review discussions. Students are expected to actively participate in the class. Students from diverse backgrounds, including quantitative, biological, and computational sciences, are encouraged to enroll.

Recommended: ST 411 or ST 511

ST 592. STATISTICAL METHODS FOR GENOMICS RESEARCH. (3 Credits)

Lectures include an overview of statistical methods commonly applied in genomics research. Specific methods can vary term to term, and could include cluster analysis, decision trees, dimension reduction tools, regression models, multiple testing adjustment, variable selection methods, etc. Journal clubs include team-based review and presentations of landmark papers in both statistical methodology and genomics research. Research experience includes whole-term collaboration between students from statistics and other disciplines on real projects.

Recommended: ST 411 or ST 511 or a higher level course such as ST 551

ST 595. CAPSTONE PROJECT. (3 Credits)

Provides an opportunity for students to integrate and apply the analytics skills learned in MS in Data Analytics program to solve real-world problems and to interpret and communicate their results. Student teams will engage in the entire process of solving data science projects in realistic settings, from placing the problem into appropriate statistical framework to applying suitable analytic methods to the problem. Problem solving, written and oral communication skills will be emphasized.

Prerequisites: ST 516 with C or better and ST 517 [C] and ST 518 [C] and ST 558 [C]

ST 599. SPECIAL TOPICS. (1-4 Credits)

May be repeated for credit when topic varies.

This course is repeatable for 16 credits.

ST 601. RESEARCH. (1-16 Credits)

This course is repeatable for 16 credits.

ST 603. THESIS. (1-16 Credits)

This course is repeatable for 999 credits.

ST 606. PROJECTS. (1-16 Credits)

Section 1: Projects; Section 2: Teaching Experience, graded P/N; Section 3: Directed Work, graded P/N.

This course is repeatable for 16 credits.

ST 623. GENERALIZED REGRESSION MODELS I. (3 Credits)

Maximum likelihood analysis for frequency data; regression-type models for binomial and Poisson data; iterative weighted least squares and maximum likelihood; analysis of deviance and residuals; overdispersion and quasi-likelihood models; log-linear models for multidimensional contingency tables.

Prerequisites: ST 553 with C or better and ST 563 [C]

ST 625. GENERALIZED REGRESSION MODELS II. (3 Credits)

Parametric methods for the analysis of censored survival data, based mostly on large-sample likelihood theory. Specific topics include the Kaplan-Meier estimator, the log-rank test, partial likelihood, and regression models, including the Cox proportional-hazards model and its generalizations.

Prerequisites: ST 553 with C or better or ST 563 with C or better

ST 651. LINEAR MODEL THEORY. (3 Credits)

Least squares estimation, best linear unbiased estimation, parameterizations, multivariate normal distributions, distributions of quadratic forms, testing linear hypotheses, simultaneous confidence intervals. Offered alternate years.

Recommended: ST 553 and ST 563

ST 652. LINEAR MODEL THEORY. (3 Credits)

Advanced topics including classification models, mixed-effects models and multivariate models. Offered alternate years.

Prerequisites: ST 651 with C or better

Recommended: ST 553 and ST 563

ST 661. ADVANCED THEORY OF STATISTICS. (3 Credits)

Exponential families, sufficient statistics; unbiased, equivariant, Bayes, and admissible estimation. Offered alternate years.

Recommended: ST 563 and MTH 511

ST 662. ADVANCED THEORY OF STATISTICS. (3 Credits)

Uniformly most powerful, unbiased, similar, and invariant tests. Offered alternate years.

Prerequisites: ST 661 with C or better

Recommended: ST 563 and MTH 511

ST 663. ADVANCED THEORY OF STATISTICS. (3 Credits)

First-order and higher-order asymptotics; likelihood ratio, score, and Wald tests; Edgeworth and saddlepoint approximations. Offered alternate years.

Prerequisites: ST 662 with C or better

Recommended: ST 563 and MTH 511