STATISTICS

Faculty Offices East (25), Room 107D
Phone: 805.756.2709
https://statistics.calpoly.edu

Department Chair: Andrew Schaffner

ACADEMIC PROGRAMS

Program name	Program type
Actuarial Preparation	Minor
Cross Disciplinary Studies Minor in Bioinformatics	Minor
Cross Disciplinary Studies Minor in Data Science	Minor
Statistics	BS, MS, Minor

The Statistics Department offers a variety of introductory courses to students majoring in diverse disciplines across the University, in addition to providing a vibrant undergraduate degree program in Statistics for students who want to pursue careers in industry or graduate study in the discipline. The department also offers a minor in Statistics and contributes to a minor program in Actuarial Preparation and two cross-disciplinary studies minor programs: Data Science and Bioinformatics.

Data abound in everyday life, in most academic disciplines, and in many industries. Professionals in many fields need to design studies, collect data, analyze results, and draw sound conclusions. In addition, professional statisticians must apply mathematical underpinnings of the discipline to new problems, use computing skills to organize and manipulate data, and communicate effectively with clients as well as with peers.

Employment prospects for professionals with skills in statistics and data science are very bright. Recent graduates of Cal Poly's program in statistics are working for companies in fields as varied as banking, social media, retail, entertainment, insurance, education, and pharmaceutical development.

Undergraduate Programs
BS Statistics

The statistics degree program requires students to develop a strong foundation in mathematics and computer science, as well as experience with a field of application. Coursework in the statistics program can be classified into four areas. Some courses provide mathematical background in probability and theoretical statistics. Others focus on computational thinking and coding skills with software packages. Most courses teach particular statistical methods for various types of data analysis such as regression, experimental design, categorical data analysis, time series techniques, multivariate methods, and survival analysis. Finally, some course specifically develop students' skills with oral and written communication and consulting with clients. Throughout the program students encounter the entire process of conducting statistical investigations, from asking questions and designing studies through drawing conclusions and communicating results. Statistics students repeatedly process and analyze real data from genuine studies and also acquire extensive experience coding, using statistical software, and writing technical reports of their analyses and findings for varied audiences.

Actuarial Preparation Minor

For information regarding the Actuarial Preparation Minor, please see Bailey College of Science and Mathematics (https://catalog.calpoly.edu/collegesandprograms/collegeofsciencemathematics/) section.

Cross Disciplinary Studies Minor in Bioinformatics

For information regarding the Cross Disciplinary Studies Minor in Bioinformatics, please see the Biological Sciences (https://catalog.calpoly.edu/collegesandprograms/collegeofsciencemathematics/biologicalsciences/) section of the catalog.

Cross Disciplinary Studies Minor in Data Science

Through an inter-college collaboration, the Computer Science and Statistics departments offer a cross-disciplinary minor in Data Science -- a rapidly evolving discipline that uses elements of statistics and computer science to gather, organize, summarize, and communicate information from a variety of data sources and data types.   Job opportunities for data scientists are growing as the availability of data becomes ever abundant via the internet, consumer transactions, sensor arrays, medical records, embedded biometrics, bioinformatics, etc.

The CDSM provides an opportunity for both statistics and computer science students to complement their major training with foundational skills for data science. Statistics majors will acquire essential programming, database, distributed computing, and data mining skills from the Computer Science Department while computer science majors will acquire essential probability, regression modelling, statistical programming, and multivariate analysis skills from the Statistics Department.

Statistics Minor

The statistics minor program allows students from across the University to acquire substantial statistical skills that can be applied in their own disciplines. Please consult the Statistics Department website or the Statistics Department Minor Advisor for admissions requirements for the minor.

Graduate Program
Master of Science in Statistics
New program, effective Fall 2023
General Characteristics

The Masters of Science in Statistics program is designed to provide advanced training to students preparing for careers in statistics and data analysis. The program consists of coursework that lays the conceptual and methodological foundations of the discipline, as well as consulting and research experiences. The program is intended for students with an undergraduate major or minor degree in Statistics.

Admission Requirements

All students must have taken the equivalent of:
MATH 206 Linear Algebra I, MATH 241 Calculus IV, CPE 101/CSC 101 Fundamentals of Computer Science, and STAT 302 Statistics II.

In addition, students are expected to have taken the equivalent of:
STAT 323 Design and Analysis of Experiments I; STAT 331 Statistical Computing with R; STAT 334 Applied Linear Models.
Students without these courses may be admitted conditionally, taking up to 12 units (not applicable to the degree) in these areas to make up for any deficiencies.

Prerequisites

Completion of a bachelor's degree from an accredited college/university with a minimum grade point average of 3.0 and completion of the following undergraduate coursework:
Statistics: At least two courses
Mathematics: Multivariable calculus (equivalent to Cal Poly MATH 241) and linear algebra (equivalent to Cal Poly MATH 206)
Computer Science: At least course, equivalent to Cal Poly CPE 101/CSC 101.

Beyond the minimum requirements, the following considerations are relevant:
Completion of undergraduate coursework in probability, regression, experimental design, and R. An exceptional applicant who lacks prerequisite coursework may be admitted as a conditionally classified student and must make up any deficiencies (12 unit limit) before advancement to classified graduate standing.

Program of Study

The Master's program requires 45 units of coursework. Students take 29 units of required coursework, 8 units of elective coursework, and an 8-unit culminating thesis. Each quarter students are enrolled, satisfactory progress on the Formal Study Plan is expected to be made. Satisfactory academic progress shall be defined as maintaining a 3.0 GPA on all courses listed on the formal study plan. In addition, per University requirement, graduate students are required to maintain continuous enrollment from the time of first enrollment in a graduate program until completion of the degree.

Blended BS + MS Statistics Program

A blended program provides an accelerated route to a graduate professional degree, with simultaneous conferring of both Bachelor's and Master's degrees. Students in the blended program are provided with a seamless process whereby they can progress from undergraduate to graduate status. Students are required to complete all requirements for both degrees, including senior project for the Bachelor's degree.

A blended program is available for MS Statistics.

Eligibility

Students majoring in BS Statistics are eligible for the blended program in MS Statistics.

Participation in a blended program is based upon prior academic performance and other measures of professional promise. Refer to Graduate Education (https://catalog.calpoly.edu/graduateeducation/#graduateandpostbaccalaureateadmissionrequirements/) for more information and for the minimum criteria required to be eligible for a blended program at Cal Poly. Contact the Graduate Program Coordinator in the Statistics department for any additional eligibility criteria.

DATA Courses

DATA 100. Data Science for All I. 4 units
Term Typically Offered: F, W, SP
2020-21 or later catalog: GE Area B4
2019-20 or earlier catalog: GE Area B4
Prerequisite: MATH 115, MATH 116, MATH 118, or Appropriate Math Placement Level.

Basic approaches for answering questions using data. Emphasis on working with tabular data in spreadsheet software to provide insights via descriptions and visualizations. Methods of acquiring data. Sampling bias, variability, and multi-variable thinking. Introduction to data modeling and data ethics. Intended for students in non-computing disciplines. Not open to students with credit in STAT 150, STAT 252, STAT 302, STAT 312, or STAT 313. Course may be offered in a classroom-based, online, or hybrid format. 4 lectures. Fulfills GE Area B4 (GE Area B1 for students on the 2019-20 or earlier catalogs); a grade of C- or better is required in one course in this GE area.

DATA 301. Introduction to Data Science. 4 units
Term Typically Offered: F, W, SP
Prerequisite: CPE/CSC 202; and one of the following: IME 326, STAT 302, STAT 312, or STAT 313.

Introduction to the field of data science and the workflow of a data scientist. Types of data (tabular, textual, sparse, structured, temporal, geospatial), basic data management and manipulation, simple summaries, and visualization. Course may be offered in classroom-based, online, or hybrid format. 3 lectures, 1 laboratory.

DATA 401. Data Science Process and Ethics. 3 units
Term Typically Offered: F
Prerequisites: DATA 301; CSC 365; and CSC 466. Concurrent: DATA 402 and DATA 403.

Complete life cycle of a data science project. Requirements engineering and data acquisition. Management and integration of data of high volume, velocity, and variety. Deployment of data science products. Engagement with stakeholders. Ethical considerations, including privacy and fairness. 3 lectures.

DATA 402. Mathematical Foundations of Data Science. 3 units
Term Typically Offered: F
Prerequisites: CSC 466; DATA 301; and STAT 334. Concurrent: DATA 401 and DATA 403.

Mathematical foundations of machine learning and data science. Principle of maximum likelihood. Inferential and predictive modeling and their comparison. Optimization techniques. Linear regression and linear classifiers. Mathematical foundations of neural networks and neural network analysis. Dimensionality reduction and its use in supervised and unsupervised learning. 3 lectures.

DATA 403. Data Science Projects Laboratory. 1 unit
Term Typically Offered: F
Concurrent: DATA 401 and DATA 402.

Project-based lab component of DATA 401 and DATA 402. Projects involving comparison of predictive and interpretable regression models, implementing linear classifiers with gradient descent, implementing neural networks from scratch, and deep learning. 1 laboratory.

DATA 441. Bioinformatics Capstone I. 2 units
Term Typically Offered: W
Prerequisite: BIO 351 or CHEM 373; BIO 441 or CSC 448; DATA 301.

Working with clients to design bioinformatics solutions to biological questions. Software requirements, elicitation techniques, data gathering, project planning, and project team organization. Ethics and professionalism. 2 laboratories.

DATA 442. Bioinformatics Capstone II. 2 units
Term Typically Offered: SP
Prerequisite: DATA 441.

Continue projects initiated in DATA 441. Team-based design, implementation of bioinformatics solutions and management of development teams. Technical documentation, quality assurance, and systems testing. Design and conduct empirical studies. Data visualization. Oral and written presentation. 2 laboratories.

DATA 451. Data Science Capstone I. 2 units
Term Typically Offered: W
Prerequisite: DATA 401.

Working with clients to develop data-driven solutions for systems to be constructed in DATA 452. Specification and design requirements, elicitation techniques, research and data gathering methods; project planning, time and budget estimating; project team organization. Ethics and professionalism. 2 laboratories.

DATA 452. Data Science Capstone II. 2 units
Term Typically Offered: SP
Prerequisite: DATA 451.

Team-based design, implementation, deployment and delivery of a system or analytical methodology that involves working with and analyzing large quantities of data. Technical management of research and development teams. Technical documentation, quality assurance, integration and systems testing. Design and conduct of empirical studies. Visualization and presentation of results orally and in writing. 2 laboratories.

DATA 472. Data Science Seminar. 1 unit
Term Typically Offered: F, W, SP
CR/NC
Prerequisite: DATA 301.

Discussions of technical, societal and ethical aspects of modern data science theory and practice, concentrating on topics not covered in other courses. 1 seminar. Total credit limited to 4 units. Credit/No credit grading only.

STAT Courses

STAT 130. Introduction to Statistical Reasoning. 4 units
Term Typically Offered: F, W, SP
2020-21 or later catalog: GE Area B4
2019-20 or earlier catalog: GE Area B1
Prerequisite: MATH 96; or MATH 115; or appropriate Math Placement Level.

Survey of statistical ideas and philosophy. Emphasis on concepts rather than in-depth coverage of statistical methods. Topics include sampling, experimentation, data exploration, chance phenomena, and methods of statistical inference. Not open to students with credit in any statistics course. 4 lectures. Fulfills GE Area B4 (GE Area B1 for students on the 2019-20 or earlier catalogs); a grade of C- or better is required in one course in this GE area.

STAT 150. Introduction to the Discipline of Statistics. 2 units
Term Typically Offered: F
Prerequisite: Statistics major.

Orientation to the statistics program, introduction to the discipline of statistics, including the development of the discipline, professional ethics, data visualization and the role of statistics in the scientific enterprise. Note: Course is intended for students in their first quarter at Cal Poly. 2 lectures.

STAT 200. Special Problems for Undergraduates. 1-2 units
Term Typically Offered: F, W, SP
Prerequisite: Consent of department chair.

Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter.

STAT 217. Introduction to Statistical Concepts and Methods. 4 units
Term Typically Offered: F,W,SP,SU
2020-21 or later catalog: GE Area B4
2019-20 or earlier catalog: GE Area B1
Prerequisite: MATH 96; or MATH 115; or appropriate Math Placement Level.

Sampling and experimentation, descriptive statistics, confidence intervals, two-sample hypothesis tests for means and proportions, Chi-square tests, linear and multiple regression, analysis of variance. Substantial use of statistical software. Not open to students with credit in STAT 218 or STAT 251. Course may be offered in classroom-based, online, or hybrid format. 4 lectures. Fulfills GE Area B4 (GE Area B1 for students on the 2019-20 or earlier catalogs); a grade of C- or better is required in one course in this GE area.

STAT 218. Applied Statistics for the Life Sciences. 4 units
Term Typically Offered: F,W,SP,SU
2020-21 or later catalog: GE Area B4
2019-20 or earlier catalog: GE Area B1
Prerequisite: MATH 96; or MATH 115; or appropriate Math Placement Level.

Data collection and experimental design, descriptive statistics, confidence intervals, parametric and non parametric one and two-sample hypothesis tests, analysis of variance, correlation, simple linear regression, chi-square tests. Applications of statistics to the life sciences. Substantial use of statistical software. Course may be offered in classroom-based, online, or hybrid format. Not open to students with credit in STAT 217 or STAT 251. 4 lectures. Fulfills GE Area B4 (GE Area B1 for students on the 2019-20 or earlier catalogs); a grade of C- or better is required in one course in this GE area.

STAT 251. Statistical Inference for Management I. 4 units
Term Typically Offered: F, W, SP
2020-21 or later catalog: GE Area B4
2019-20 or earlier catalog: GE Area B1
Prerequisite: Appropriate Math Placement Level or MATH 118.

Descriptive statistics. Probability and counting rules. Random variables and probability distributions. Sampling distributions and point estimation. Confidence intervals and tests of hypotheses for a single mean and proportion. Course may be offered classroom-based, online, or hybrid format. 4 lectures. Fulfills GE Area B4 (GE Area B1 for students on the 2019-20 or earlier catalogs); a grade of C- or better is required in one course in this GE area.

STAT 252. Statistical Inference for Management II. 5 units
Term Typically Offered: F,W,SP,SU
2020-21 or later catalog: GE Area B4
2019-20 or earlier catalog: GE Area B1
Prerequisite: STAT 251 with a minimum grade of C- or consent of instructor.

Confidence intervals and tests of hypotheses for two means and two proportions. Introduction to ANOVA, regression, correlation, multiple regression, time series, and forecasting. Statistical quality control. Enumerative data analysis. Substantial use of statistical software. Course may be offered in classroom-based, online, or hybrid format. 5 lectures. Fulfills GE Area B4 (GE Area B1 for students on the 2019-20 or earlier catalogs); a grade of C- or better is required in one course in this GE area.

STAT 270. Selected Topics. 1-4 units
Term Typically Offered: TBD
Prerequisite: Open to undergraduate students and consent of instructor.

Directed group study of selected topics. The Class Schedule will list topic selected. Total credit limited to 8 units. 1 to 4 lectures.

STAT 301. Statistics I. 4 units
Term Typically Offered: F, W
Corequisite: MATH 141.

Introduction to statistics for mathematically inclined students, focused on process of statistical investigations. Observational studies, controlled experiments, randomization, confounding, randomization tests, hypergeometric distribution, descriptive statistics, sampling, bias, binomial distribution, significance tests, confidence intervals, normal model, t-procedures, two-sample procedures. Substantial use of statistical software. Course may be offered in classroom-based, online, or hybrid format. 4 lectures.

STAT 302. Statistics II. 4 units
Term Typically Offered: W, SP
Prerequisite: STAT 301 with a grade of C- or better; or consent of instructor.

Continued study of the process, concepts, and methods of statistical investigations. Association, chi-square procedures, one-way ANOVA, multiple comparisons, two-way ANOVA with interaction, simple linear regression, correlation, prediction, multiple regression. Substantial use of statistical software. Course may be offered in classroom-based, online, or hybrid format. 4 lectures.

STAT 305. Introduction to Probability and Simulation. 4 units
Term Typically Offered: F, W
Prerequisite: one of the following: BUS 392, CPE/CSC 101, CSC 232, CPE/CSC 235, ECON 395, or STAT 331; and MATH 142.

Basic probability rules, counting methods, conditional probability. Discrete and continuous random variables, expected values, variance and covariance. Properties of linear combinations of random variables with applications to statistical estimators. Simulation analysis of random phenomena using a modern computer language. Not open to students with credit in STAT 321. Course may be offered in classroom-based, online, or hybrid format. 4 lectures.

STAT 312. Statistical Methods for Engineers. 4 units
Term Typically Offered: F,W,SP,SU
2020-21 or later: Upper-Div GE Area B
2019-20 or earlier catalog: GE Area B5, B6, or B7
Prerequisite: Junior standing or one of the following majors: CPE, CSC, EE, GENE, IE, MATE, MFGE, or SE; completion of GE Area A with grades of C- or better; and one course in GE Area B4 with a grade of C- or better (GE Area B1 for students on the 2019-20 or earlier catalogs); and MATH 142.

Descriptive and graphical methods. Discrete and continuous probability distributions. One and two sample confidence intervals and hypothesis testing. Single factor analysis of variance. Quality control. Introduction to regression and to experimental design. Substantial use of statistical software. Not open to students with credit in STAT 252 or STAT 302. Course may be offered in classroom-based, online, or hybrid format. 4 lectures. Fulfills GE Area Upper-Division B (GE Areas B5, B6, or B7 for students on the 2019-20 catalog).

STAT 313. Applied Experimental Design and Regression Models. 4 units
Term Typically Offered: F, W, SP
2020-21 or later: Upper-Div GE Area B
2019-20 or earlier catalog: GE Area B5, B6, or B7
Prerequisite: Junior standing or one of the following majors: ASCI, BIO, CRP, DSCI, EESS, ENVE, ENVM, HLTH, KINE, MCRO, MSCI, POLS, PSY or SOC; completion of GE Area A with grades of C- or better; MATH 118 with a grade of C- or better, or appropriate Math Placement Level; and one of the following courses: STAT 217, STAT 218 or STAT 312 with a minimum grade of C- or better.

Applications of statistics for students not majoring in statistics or mathematics. Analysis of variance including one-way classification, randomized blocks, and factorial designs; multiple regression, model diagnostics, and model comparison. Course may be offered in classroom-based, online, or hybrid format. 4 lectures. Fulfills GE Area Upper-Division B (GE Areas B5, B6, or B7 for students on the 2019-20 catalog).

STAT 314. Statistical Methods for Food Science. 4 units
Term Typically Offered: F, W
Prerequisite: STAT 218.

Statistical methods for sensory analysis and food product development. Discrimination testing: paired, duo-trio, triangle. Two-way ANOVA, 2^k, fractional factorial, response surface, mixture designs. Quality and process control. Not open to students with credit in STAT 323. 4 lectures.

STAT 321. Probability and Statistics for Engineers and Scientists. 4 units
Term Typically Offered: F, W, SP
2020-21 or later: Upper-Div GE Area B
2019-20 or earlier catalog: GE Area B5, B6, or B7
Prerequisite: Junior standing or one of the following majors: AERO, ARCE, CSC, EE, GENE, IE, MATE, MFGE or SE; completion of GE Area A with grades of C- or better; and one course in GE Area B4 with a grade of C- or better (GE Area B1 for students on the 2019-20 or earlier catalogs); and MATH 142.

Tabular and graphical methods for data summary, numerical summary measures, probability concepts and properties, discrete and continuous probability distributions, expected values, statistics and their sampling distributions, point estimation, confidence intervals for a mean and proportion. Use of statistical software. Not open to students with credit in STAT 301. Course may be offered in classroom-based, online, or hybrid format. 4 lectures. Fulfills GE Area Upper-Division B (GE Areas B5, B6, or B7 for students on the 2019-20 catalog).

STAT 323. Design and Analysis of Experiments I. 4 units
Term Typically Offered: W, SP
Prerequisite: IME 326 or STAT 252 or STAT 302 or STAT 312 or STAT 313.

Principles, construction and analysis of experimental designs. Completely randomized, randomized complete block, Latin squares, Graeco Latin squares, factorial, and nested designs. Fixed and random effects, expected mean squares, multiple comparisons, and analysis of covariance. Course may be offered in classroom-based, online, or hybrid format. 4 lectures.

STAT 324. Applied Regression Analysis. 4 units
Term Typically Offered: F, W, SP
Prerequisite: IME 326 or STAT 252 or STAT 302 or STAT 312 or STAT 313.

Linear regression including indicator variables, influence diagnostics, assumption analysis, selection of 'best subset', nonstandard regression models, logistic regression, nonlinear regression models. Not open to students with credit in STAT 334. Not open to Statistics Majors. 4 lectures.

STAT 330. Statistical Computing with SAS. 4 units
Term Typically Offered: F, W
Prerequisite: IME 326 or STAT 252 or STAT 302 or STAT 312 or STAT 313.

Data acquisition, cleaning, and management using SAS; reading data into SAS from various sources, recoding variables, subsetting and merging data, exporting results in other formats. Graphical procedures, basic descriptive and inferential statistics. Introduction to SAS macros. Course may be offered in classroom-based, online, or hybrid format. 4 lectures.

STAT 331. Statistical Computing with R. 4 units
Term Typically Offered: F,W,SP,SU
Prerequisite: IME 326, STAT 252, STAT 302, STAT 312, or STAT 313; and BUS 392, CPE/CSC 101, CSC 231, CSC 232, CSC 234, or ECON 395.

Importing, managing, and cleaning data from a variety of sources. Use of regular expressions, exploratory data analysis, functional and object-oriented programming. Graphical, descriptive, and inferential statistical methods. Methods of simulation, randomization and resampling. Course may be offered in classroom-based, online, or hybrid format. 4 lectures.

STAT 334. Applied Linear Models. 4 units
Term Typically Offered: W, SP
Prerequisite: one of the following: STAT 252, STAT 302, STAT 312, STAT 313, or IME 326; and one of the following: MATH 206, or MATH 244.

Linear models in algebraic and matrix form, diagnostics, transformations, polynomial models, categorical predictors, model selection, correlated errors, logistic regression. Course may be offered in classroom-based, online, or hybrid format. Not open to students with credit in STAT 324. 4 lectures.

STAT 350. Probability and Random Processes for Engineers. 4 units
Term Typically Offered: F, W, SP
2020-21 or later: Upper-Div GE Area B
2019-20 or earlier catalog: GE Area B5, B6, or B7
Prerequisite: Junior standing; completion of GE Area A with grades of C- or better; and one course in GE Area B4 with a grade of C- or better (GE Area B1 for students on the 2019-20 or earlier catalogs); MATH 241; and CPE 327 or EE 228.

Random events, random variables, and random processes, with emphasis on probabilistic treatment of signals and noise. Specific topics include: sample spaces, probability, distributions, independence, moments, covariance, time/ensemble averages, stationarity, common processes, correlation and spectral functions. Course may be offered in classroom-based, online, or hybrid format. 4 lectures. Fulfills GE Area Upper-Division B (GE Areas B5, B6, or B7 for students on the 2019-20 catalog).

STAT 365. Statistical Communication. 2 units
Term Typically Offered: SP
Prerequisite: Completion of GE Area A2 with a grade of C- or better (GE Area A1 for students on the 2019-20 or earlier catalogs); completion of GE Area A3 with a grade of C- or better; and one of the following: STAT 252, STAT 302, or STAT 313.

Written communication of statistical ideas and content. Analyze data using appropriate methods from previous statistics courses. Writing technical reports with appropriate graphs and tables. Strategies to discern relevant and necessary information to communicate data, ideas, and results to different audiences. Course may be offered in classroom-based, online, or hybrid format. 2 lectures.

STAT 400. Special Problems for Advanced Undergraduates. 1-4 units
Term Typically Offered: F, W, SP
Prerequisite: Consent of department head.

Individual investigation, research, studies or surveys of selected problems. Total credit limited to 5 units, with a maximum of 4 units per quarter.

STAT 405. Applied Probability Models. 4 units
Term Typically Offered: TBD
Prerequisite: CPE/CSC 101 or CSC 232 or CPE/CSC 235; MATH 206 or MATH 244; and STAT 305 or STAT 350 or STAT 426.

Advanced probability models, their simulation and application. Poisson processes, Markov chains, random walks, and continuous-time Markov processes. Monte Carlo integration and simulation methods, including Markov chain Monte Carlo and Gibbs sampling. 4 lectures.

STAT 410. Statistics Education: Pedagogy, Content, Technology, and Assessment. 4 units
Term Typically Offered: W
Prerequisite: one of the following: STAT 130, STAT 217, STAT 218, STAT 251, STAT 301, STAT 312, STAT 321, STAT 511, STAT 512 or STAT 542.

Topics related to content, pedagogy, technology, and assessment for teaching statistics in grades 6-16 in accordance with current standards and research for teaching statistics including the Common Core State Standards for Mathematics. 4 lectures.

STAT 414. Multilevel and Mixed Modeling. 4 units
Term Typically Offered: F
Prerequisite: STAT 324 or STAT 334 or STAT 524.

Overview of multilevel and mixed models, including hierarchical data, intraclass correlation, fixed vs. random coefficients, variance components, comparisons to traditional analyses. Use of statistical software for implementation of methods. 4 lectures.

STAT 415. Bayesian Reasoning and Methods. 4 units
Term Typically Offered: W
Prerequisite: one of the following: IME 326, STAT 252, STAT 302, STAT 312, STAT 313, or STAT 513; and one of the following: STAT 305, STAT 321, STAT 350, or STAT 425. Recommended: STAT 331.

Bayes' theorem, prior and posterior distributions, likelihood functions, Markov Chain Monte Carlo methods, hierarchical modeling. Bayesian data analysis, comparison of Bayesian and classical (frequentist) approaches. 4 lectures.

STAT 416. Statistical Analysis of Time Series. 4 units
Term Typically Offered: F
Prerequisite: STAT 324 or STAT 334 or STAT 524.

Time series components, descriptive smoothing methods, regression models for time series data, forecasting via exponential smoothing, evaluation of forecasts, autocorrelation, ARIMA models and Box-Jenkins methods, combining forecasts, frequency domain analysis, filtering. 4 lectures.

STAT 417. Survival Analysis Methods. 4 units
Term Typically Offered: W
Prerequisite: IME 326 or STAT 252 or STAT 302 or STAT 312 or STAT 313; and MATH 142.

Parametric and nonparametric methods for analyzing survival data. Topics include Kaplan-Meier and Nelson-Aalen estimates, Cox regression models, accelerated failure time models. Use of statistical software to implement methods throughout course. 4 lectures.

STAT 418. Categorical Data Analysis. 4 units
Term Typically Offered: W
Prerequisite: STAT 324 or STAT 334 or STAT 524.

Discrete multivariate statistics, including analysis of cross-classified data, log-linear models for multidimensional contingency tables, goodness of fit statistics, measures of association, model selection, and hypothesis testing. 4 lectures.

STAT 419. Applied Multivariate Statistics. 4 units
Term Typically Offered: W, SP
Prerequisite: One of the following: IME 326, STAT 252, STAT 302, STAT 312, STAT 313, STAT 513, or STAT 542; and one of the following: MATH 206, MATH 244, or graduate standing.

Continuous multivariate statistics. Multivariate linear model, principal components and factor analysis, discriminant analysis, clustering, classification, and canonical correlation. Use of statistical software throughout the course. 4 lectures.

STAT 421. Survey Sampling and Methodology. 4 units
Term Typically Offered: F
Prerequisite: IME 326 or STAT 252 or STAT 302 or STAT 312 or STAT 313 or STAT 511 or STAT 512 or STAT 513.

Survey planning, execution, and analysis. Principles of survey research, including non-sampling and sampling error topics. Survey sample designs, including simple random, systematic, stratified, cluster, and multi-stage. Estimation procedures and sample size calculations. Course may be offered in classroom-based, online, or hybrid format. 4 lectures.

STAT 423. Design and Analysis of Experiments II. 4 units
Term Typically Offered: SP
Prerequisite: STAT 323 or STAT 523.

Continuation of STAT 323. 2k factorial designs, 3k factorial designs, balanced and partially balanced incomplete block designs, nested designs, split-plot designs, response surface methodology, confounding, repeated measures, and other design approaches. 4 lectures.

STAT 425. Probability Theory. 4 units
Term Typically Offered: F
Prerequisite: MATH 241; MATH 248 or CSC 348; and STAT 305.
Recommended: STAT 301.

Rigorous development of probability theory. Probability axioms, combinatorial methods, conditional and marginal probability, independence, random variables, univariate and multivariate probability distributions, conditional distributions, transformations, order statistics, expectation and variance. Use of statistical simulation throughout the course. 4 lectures.

STAT 426. Estimation and Sampling Theory. 4 units
Term Typically Offered: W
Prerequisite: STAT 425. Recommended: STAT 302.

Continuation of STAT 425. Properties of statistics obtained from samples. Sample mean properties, convergence in probability, law of large numbers, and central limit theorem. Selected probability distributions. Theory of estimation. Sampling distribution of estimators. 4 lectures.

STAT 427. Mathematical Statistics. 4 units
Term Typically Offered: SP
Prerequisite: STAT 426.

Continuation of STAT 426. The theory of hypothesis testing and its applications. Power and uniformly most powerful tests. Categorical data and nonparametric methods. Other selected topics. 4 lectures.

STAT 431. Advanced Statistical Computing with R. 4 units
Term Typically Offered: TBD
Prerequisite: STAT 331.

Advanced techniques for efficient use of computers to perform statistical computations and to analyze large amounts of data. Includes version control systems; tools supporting reproducibility; functional programming; randomization and bootstrapping; dynamic data visualizations; and R package development. 4 lectures.

STAT 434. Statistical Learning: Methods and Applications. 4 units
Term Typically Offered: SP
Prerequisite: one of the following: STAT 324, STAT 334, or STAT 524.
Recommended: STAT 331 or STAT 531.

Modern methods in predictive modeling and classification. Splines, smoothing splines, ridge regression, LASSO, regression and classification trees, generalized additive models, logistic regression, and linear discriminant analysis. Model assessment and selection using cross validation, bootstrapping, AIC, and BIC. 4 lectures.

STAT 440. SAS Certification Preparation. 2 units
Term Typically Offered: W
Prerequisite: STAT 330.

Programming, data management, and data analysis in preparation for the Certified Base Programmer Exam offered by the SAS Institute. Topics include accessing data, creating data structures, managing data, generating reports, and handling errors. 2 lectures.

STAT 441. SAS Advanced Certification Preparation. 2 units
Term Typically Offered: SP
Prerequisite: STAT 440.

Programming topics in preparation for the Certified Advanced Programmer Exam offered by the SAS Institute. Accessing data using PROC SQL, macro processing, applications for indexes, data look-up techniques including array processing, hash objects, and combining/merging. 2 lectures.

STAT 461. Senior Project I. 1 unit
Term Typically Offered: F, W, SP
Selection and completion of a project under faculty supervision. Projects typical of problems which graduates must solve in their fields of employment. Project results are presented in a formal report. Minimum 90 hours total time.

STAT 462. Senior Project II. 2 units
Term Typically Offered: F, W, SP
Prerequisite: Completion of GWR.

Selection and completion of a project under faculty supervision. Projects typical of problems which graduates must solve in their fields of employment. Project results are presented in a formal report. Minimum 90 hours total time.

STAT 465. Statistical Consulting. 4 units
Term Typically Offered: TBD
Prerequisite: STAT 323; STAT 330; STAT 331; STAT 334; STAT 365; Statistics major; and senior standing.

Blending of the theoretical and practical aspects of statistical consulting. Development of tools necessary to conduct effective consulting sessions, present oral arguments and written reports, work collaboratively to solve problems, and utilize professional publications in statistics. Not open to students with credit in STAT 466. 4 lectures.

STAT 466. Senior Project - Statistical Consulting. 4 units
Term Typically Offered: SP
Prerequisite: STAT 323; STAT 330; STAT 331; STAT 334; STAT 365; Statistics major; and senior standing.

Blending of the theoretical and practical aspects of statistical consulting. Development of tools necessary to conduct effective consulting sessions, present oral arguments and written reports. Work collaboratively to solve problems and utilize professional publications in statistics. Fulfills senior project requirement for Statistics major. Not open to students with credit in STAT 465. 2 lectures, 2 discussions.

STAT 470. Selected Advanced Topics. 1-4 units
Term Typically Offered: TBD
Prerequisite: Consent of instructor.

Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. The Class Schedule will list topic selected. Total credit limited to 8 units. 1 to 4 lectures.

STAT 485. Cooperative Education Experience. 6 units
Term Typically Offered: F, W, SP
CR/NC
Prerequisite: Sophomore standing and consent of instructor.

Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Major credit limited to 6 units; total credit limited to 12 units. Credit/No Credit grading only.

STAT 495. Cooperative Education Experience. 12 units
Term Typically Offered: F, W, SP
CR/NC
Prerequisite: Sophomore standing and consent of instructor.

Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Major credit limited to 12 units; total credit limited to 24 units. Credit/No Credit grading only.

STAT 500. Independent Study. 1-4 units
Term Typically Offered: F, W, SP
Prerequisite: Graduate standing and consent of instructor.

Individual research or advanced study planned and completed under the direction of a departmental faculty member. Total degree credit limited to 4 units. Total credit limited to 12 units.

STAT 511. Statistical Methods. 4 units
Term Typically Offered: F
Prerequisite: Graduate standing and intermediate algebra or equivalent.

Statistical methods in research for graduate students not majoring in mathematical sciences. Probability distributions, confidence intervals, hypothesis testing, contingency tables, linear regression and correlation, multiple regression, analysis of variance. Substantial use of statistical software. 4 lectures.

STAT 513. Applied Experimental Design and Regression Models. 4 units
Term Typically Offered: F, W, SP
Prerequisite: Graduate standing and a grade of C- or better in one of the following: STAT 217, STAT 218, STAT 252, STAT 312, STAT 511, STAT 512, or STAT 542; or consent of instructor.

Applications of statistics for graduate students not majoring in mathematics. Analysis of variance including the one-way classification, randomized blocks, and factorial designs. Introduction to multiple regression and to analysis of covariance. Substantial use of statistical software. Course may be offered in classroom-based, online, or hybrid format. 4 lectures. Not open to students with credit in STAT 313.

STAT 523. Design and Analysis of Experiments I. 4 units
Term Typically Offered: W, SP
Prerequisite: one of the following: IME 326, STAT 252, STAT 302, STAT 312, STAT 313, STAT 513, or STAT 542; and graduate standing.

Principles, construction and analysis of experimental designs. Completely randomized, randomized complete block, Latin squares, Graeco-Latin squares, factorial, and nested designs. Fixed and random effects, expected mean squares, multiple comparisons, and analysis of covariance. Not open to students with credit in STAT 323. Course may be offered in classroom-based, online, or hybrid format. 4 lectures.

STAT 524. Applied Regression Analysis. 4 units
Term Typically Offered: F, W, SP
Prerequisite: one of the following: IME 326, STAT 252, STAT 302, STAT 312, STAT 313, STAT 513, or STAT 542; and graduate standing.

Linear regression including indicator variables, influence diagnostics, assumption analysis, selection of 'best subset', nonstandard regression models, logistic regression, nonlinear regression models. Not open to students with credit in STAT 324 or STAT 334. 4 lectures.

STAT 530. Statistical Computing with SAS. 4 units
Term Typically Offered: F, W
Prerequisite: STAT 511 or STAT 512 or STAT 513 or STAT 542.

Techniques available to the statistician for efficient use of computers to perform statistical computations and to analyze large amounts of data. Use of the SAS software system. Includes data preparation, report writing, basic statistical methods, and a research project. Course may be offered in classroom-based, online, or hybrid format. Not open to students with credit in STAT 330. 4 lectures.

STAT 531. Statistical Computing with R. 4 units
Term Typically Offered: F, W, SP
Prerequisite: Graduate standing; STAT 513 or STAT 542; and one computer programming course; or consent of instructor.

Import, manage, and clean data. Use of regular expressions, exploratory data analysis, functional and object-oriented programming. Graphical, descriptive, and inferential statistical methods. Methods of simulation, randomization and resampling. Course may be offered in classroom-based, online, or hybrid format. Not open to students with credit in STAT 331. 4 lectures.

STAT 541. Advanced Statistical Computing with R. 4 units
Term Typically Offered: TBD
Prerequisite: STAT 331 or STAT 531; STAT 334; and STAT 426; and graduate standing; or consent of instructor.

Advanced techniques for efficient use of R software to perform statistical computations, analyze large amounts of data, and develop new software. Includes version control systems; code design, documentation, and unit testing; modern data and database software; dynamic data visualizations; special data types; efficient processing of big data; functional programming and recursion; and numerical integration and optimization. 4 lectures.

STAT 542. Statistical Methods for Engineers. 4 units
Term Typically Offered: TBD
Prerequisite: MATH 142 and graduate standing.

Descriptive and graphical methods. Discrete and continuous probability distributions. One and two sample confidence intervals and hypothesis testing. Single factor analysis of variance. Quality control. Introduction to regression and to experimental design. Substantial use of statistical software. Course may be offered in classroom-based, online, or hybrid format. Not open to students with credit in STAT 312. 4 lectures.

STAT 543. Advanced Design and Analysis of Experiments. 4 units
Term Typically Offered: SP
Prerequisites: STAT 323 or STAT 523; STAT 334; and graduate standing; or consent of instructor.

2^k and 3^k factorial and fractional factorial designs, balanced and partially balanced incomplete block designs, nested designs, split-plot designs, response surfaces, repeated measures, and other design approaches. Design matrices. Analysis and interpretation of fixed, random, and mixed effects models, analysis of covariance, and different parameterizations. 4 lectures.

STAT 545. Applied Stochastic Processes. 4 units
Term Typically Offered: W
Prerequisite: MATH 206 or MATH 244; and STAT 426; and graduate standing; or consent of instructor.

Properties, simulation, and application of stochastic processes. Discrete-time and continuous-time Markov chains, hidden Markov models, Poisson processes, Gaussian processes, continuous-state Markov processes. Markov chain Monte Carlo (MCMC) simulation methods and applications. Estimation methods for stochastic processes. 4 lectures.

STAT 550. Generalized Linear Models. 4 units
Term Typically Offered: W
Prerequisite: STAT 334 and STAT 427; and graduate standing; or consent of instructor.

Theory and application of linear and generalized linear models (GLMs). Logistic regression, nominal and ordinal responses, Poisson GLMs, correlated responses, random and mixed effects models, Bayesian GLMs, model selection and model checking. 4 lectures.

STAT 551. Statistical Learning with R. 4 units
Term Typically Offered: F
Prerequisite: STAT 305 or STAT 350; STAT 331 or STAT 531; STAT 334; and graduate standing; or consent of instructor.

Modern methods in predictive modeling. Supervised and unsupervised learning. Regression, classification, and clustering methods, including SVM, LASSO, splines, trees, and random forests. Model assessment and selection using cross validation, bootstrapping, and information criteria. Use of the R programming language. 4 lectures.

STAT 566. Graduate Consulting Practicum. 2 units
Term Typically Offered: SP
Prerequisite: STAT 466 and graduate standing.

Practice in statistical consulting. Observing faculty-led consulting sessions. Organizing and leading consulting projects with faculty supervision. Discussion of statistical consulting cases in a seminar format. 2 seminars.

STAT 570. Selected Advanced Topics. 1-4 units
Term Typically Offered: TBD
Prerequisite: Graduate standing or consent of instructor.

Directed group study of selected topics for graduate students. Open to undergraduate and graduate students. The Class Schedule will list topic selected. Total credit limited to 8 units. 1 to 4 lectures.

STAT 590. Graduate Seminar in Statistics. 1 unit
Term Typically Offered: F, W, SP
Prerequisite: Graduate standing in Statistics.

Topics in advanced statistics selected by the faculty. Discussion of current research papers in statistics and implementation of methods. Total credit limited to 3 units. 1 seminar.

STAT 599. Thesis. 1-4 units
Term Typically Offered: TBD
Prerequisite: Graduate standing and consent of instructor.

Individual research under faculty supervision, leading to a graduate thesis. Total credit limited to 8 units.