Statistics is the science concerned with developing and studying methods for collecting, analyzing, interpreting, and presenting empirical data. Statistical principles and methods are important for addressing questions in public policy, medicine, industry, and virtually every branch of science. Interest in statistical methods has increased dramatically with the abundance of large databases in fields like computer science (Internet and Web traffic), business and marketing (transaction records), and biology (the human genome and related data). It is the substantive questions in such areas of application that drive the development of new statistical methods and motivate the mathematical study of the properties of these methods.

Undergraduate Program in Statistics

The Department of Statistics offers lower-division undergraduate courses designed to introduce students to the field of statistics (STATS 7, STATS 8, STATS 67) and upper-division undergraduate courses on the theoretical foundations of probability and statistics (STATS 120A-STATS 120B-STATS 120C, STATS 121) and statistical methodology (STATS 110-STATS 111-STATS 112). The Department is in the process of planning an undergraduate degree program in Statistics. In the interim, students interested in focusing on statistics are encouraged to consider a minor in Statistics along with a major in a field of interest.

Minor in Statistics

The minor in Statistics is designed to provide students with exposure to both statistical theory and practice. The minor requires a total of seven courses. These include a mathematics course, five core statistics courses, and an elective that may be taken from among several departments. Some of the courses used to complete the minor may include prerequisites that may or may not be part of a student’s course requirements for their major. Because of this, the minor is somewhat intensive, but it is a useful complement to a variety of undergraduate fields for mathematically inclined students. The minor, supplemented with a few additional courses (mathematics and computing), would provide sufficient background for graduate study in statistics. Students considering a minor in Statistics should meet with the Director of Undergraduate Studies in Statistics as early as possible to plan their course work.

NOTE: Students may not receive both a minor in Statistics and a specialization in Statistics within the Mathematics major.

Requirements for the Minor

Required Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>MATH 3A</td>
<td>Introduction to Linear Algebra</td>
</tr>
<tr>
<td>or MATH 6G</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>STATS 110-111</td>
<td>Statistical Methods for Data Analysis I and Statistical Methods for Data Analysis II</td>
</tr>
<tr>
<td>STATS 120A-120B-120C</td>
<td>Introduction to Probability and Statistics and Introduction to Probability and Statistics and Introduction to Probability and Statistics</td>
</tr>
</tbody>
</table>

Select one elective from the following: ¹

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
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<tbody>
<tr>
<td>I&amp;C SCI 21</td>
<td>Introduction to Computer Science I</td>
</tr>
<tr>
<td>MATH 105A</td>
<td>Numerical Analysis</td>
</tr>
<tr>
<td>or MATH 105B</td>
<td>Numerical Analysis</td>
</tr>
<tr>
<td>MATH 130B</td>
<td>Probability and Stochastic Processes</td>
</tr>
<tr>
<td>or MATH 130C</td>
<td>Probability and Stochastic Processes</td>
</tr>
<tr>
<td>STATS 7</td>
<td>Basic Statistics (or equivalent course)²</td>
</tr>
<tr>
<td>STATS 112</td>
<td>Statistical Methods for Data Analysis III</td>
</tr>
<tr>
<td>STATS 121</td>
<td>Probability Models</td>
</tr>
</tbody>
</table>

¹ Or can substitute another course with approval of the Director of Undergraduate Studies.
² Only if taken prior to STATS 110

NOTE: A maximum of two courses can be taken Pass/Not Pass toward a minor.
Graduate Program in Statistics

Research in statistics can range from mathematical studies of the theoretical underpinnings of a statistical model or method to the development of novel statistical models and methods and a thorough study of their properties. Frequently, statistics research is motivated and informed by collaborations with experts in a particular substantive field. Their scientific studies and data collection efforts may yield complex data that cannot be adequately handled using standard statistical methodology. Statisticians aim to develop methods that address the scientific or policy questions of the researcher. In doing so, statisticians must consider how efficiently and effectively the proposed methodology can be implemented and what guarantees can be provided as to the performance of the proposed methods. Such questions can often be answered using a combination of mathematical, analytical, and computational techniques.

Background: Individuals from a variety of backgrounds can make significant contributions to the field of statistics as long as they have sufficient background in statistics, mathematics, and computing. Undergraduate preparation in statistics, mathematics, and computing should include multivariate calculus (the equivalent of UCI courses MATH 2A-MATH 2B, MATH 2D-MATH 2E), linear algebra (MATH 121A), elementary analysis (MATH 140A-MATH 140B), introductory probability and statistics (STATS 120A-STATS 120B-STATS 120C), and basic computing (I&C SCI 21). For students with undergraduate majors outside of mathematics and statistics, it is possible to make up one or two missing courses during the first year in the program.

Students may be admitted to either the master’s program or the doctoral program. For additional information about the Bren School of ICS’s graduate programs and admissions information, click here (http://catalogue.uci.edu/previouseditions/2014-15/donaldbrenschoolofinformationandcomputersciences/#graduatetext).

Master of Science in Statistics

Statistics Course Requirements: Intermediate Probability & Statistical Theory (STATS 200A-STATS 200B-STATS 200C); Statistical Methodology (STATS 202, STATS 203, STATS 210); STATS 205; three quarters of Seminar in Statistics (STATS 280); five other graduate courses in or related to statistics, at least two of which are offered by the Department of Statistics. STATS 211 and STATS 212 may be substituted for STATS 202 and STATS 203.

At most one of the five elective courses may be an Individual Study (STATS 299), and only with prior approval of the Department Graduate Committee.

The entire program of courses must be approved by the Statistics Department Graduate Committee. Students with previous graduate training in statistics may petition the Committee to substitute other courses for a subset of the required courses. Students are required to pass a written comprehensive examination ordinarily at the end of the first year, covering the material from STATS 200A-STATS 200B-STATS 200C, and either STATS 202, STATS 203, and STATS 210 or STATS 210, STATS 211, and STATS 212.

Doctor of Philosophy in Statistics

Statistics Course Requirements: Intermediate Probability and Statistics (STATS 200A-STATS 200B-STATS 200C); Statistical Methodology (STATS 210, STATS 211, STATS 212); Advanced Probability & Statistics Topics (STATS 220A-STATS 220B); Bayesian Statistical Analysis (STATS 225); Statistical Computing Methods (STATS 230); five other graduate courses in or related to statistics, at least two of which are offered by the Department of Statistics. These courses must be completed prior to candidacy.

In addition, continual enrollment in Seminar in Statistics (STATS 280) is required in all quarters.

Additional Ph.D. requirements:

Each Ph.D. student is required to take a written comprehensive examination, ordinarily at the end of the first year, covering the material from STATS 200A-STATS 200B-STATS 200C, STATS 210, STATS 211, and STATS 212. In addition, each student is required to take a written comprehensive examination after completion of the second year course work, covering material from STATS 220A-STATS 220B, STATS 225, and STATS 230.

Ph.D. students who have passed the written comprehensive examinations are required to give a post-comprehensive research presentation each year.

Ph.D. students are required to serve as teaching assistants for at least two quarters.

Ph.D. students are required to demonstrate substantive knowledge of an application area outside of statistics (e.g., computer science, economics, cognitive sciences, biology, or medicine). Such knowledge can be demonstrated by course work in the application area (three quarter courses), co-authorship of publishable research in the application area, or other evidence of supervised collaborative work that is substantiated by an expert in the field. In the case of a theoretically oriented student, the outside application area may be mathematics.

The normative time for advancement to candidacy is three years. The normative time for completion of the Ph.D. is five years, and the maximum time permitted is seven years.

Master of Science in Statistics for Students Enrolled in a Doctoral Program at UCI

Students who are currently enrolled in a doctoral program at UCI and wish to pursue a Master of Science degree in Statistics at the same time should consult with the Director of Graduate Studies in Statistics to register their interest with the Department, to develop a program of study, and to establish a relationship with a faculty advisor in Statistics. The degree requirements including the comprehensive examination are the same as those listed under
the Master of Science in Statistics. The Statistics Department Graduate Committee must be petitioned for permission to sit for the comprehensive examination. The petition should include the proposed plan of study and a current official UCI transcript. A petition for the degree must be filed with the Statistics Department Graduate Committee for approval two quarters before the degree is awarded.

Faculty

Brigitte Baldi, Ph.D. Massachusetts Institute of Technology, Lecturer of Statistics
Scott Bartell, Ph.D. University of California, Davis, Associate Professor of Program in Public Health; Environmental Health Sciences; Epidemiology; Social Ecology; Statistics
Carter Butts, Ph.D. Carnegie Mellon University, Professor of Sociology; Electrical Engineering and Computer Science; Statistics (mathematical sociology, social networks, quantitative methodology, human judgment and decision making, economic sociology)
Daniel L. Gillen, Ph.D. University of Washington, Associate Professor of Statistics; Epidemiology; Program in Public Health
Stacey A. Hancock, Ph.D. Colorado State University, Lecturer with Potential Security of Employment of Statistics
Ivan G. Jeliazkov, Ph.D. Washington University, Associate Professor of Economics; Statistics
Wesley O. Johnson, Ph.D. University of Minnesota, Professor of Statistics
Hernando C. Ombao, Ph.D. University of Michigan, Professor of Statistics
Dale J. Poirier, Ph.D. University of Wisconsin-Madison, Professor of Economics; Statistics
Babak Shahbaba, Ph.D. University of Toronto, Assistant Professor of Statistics; Computer Science
Patrick J. Smyth, Ph.D. California Institute of Technology, Professor of Computer Science; Statistics
Hal S. Stern, Ph.D. Stanford University, Dean of the Donald Bren School of Information and Computer Sciences, Ted and Janice Smith Family Foundation Endowed Chair in Information and Computer Science, and Professor of Statistics; Cognitive Sciences
Jessica Utts, Ph.D. Pennsylvania State University, Professor of Statistics
Max Welling, Ph.D. Utrecht University, Professor of Computer Science; Statistics
Yaming Yu, Ph.D. Harvard University, Associate Professor of Statistics
Zhaoxia Yu, Ph.D. William Marsh Rice University, Associate Professor of Statistics

Courses

STATS 7. Basic Statistics. 4 Units.
Introduces basic inferential statistics including confidence intervals and hypothesis testing on means and proportions, t-distribution, Chi Square, regression and correlation. F-distribution and nonparametric statistics included if time permits. Course may be offered online.
Overlaps with STAT 8, MGMT 7.
Restriction: STAT 7 may not be taken for credit if taken after STAT 67.
(Va)

STATS 8. Introduction to Biological Statistics. 4 Units.
Introductory statistical techniques used to collect and analyze experimental and observational data from health sciences and biology. Includes exploration of data, probability and sampling distributions, basic statistical inference for means and proportions, linear regression, and analysis of variance. Course may be offered online.
Overlaps with SOCECOL 13, MGMT 7.
(Va)
STATS 67. Introduction to Probability and Statistics for Computer Science. 4 Units.
Introduction to the basic concepts of probability and statistics with discussion of applications to computer science.
Prerequisite: MATH 2B.
Overlaps with STATS 7, MGMT 7.
Restriction: STATS 7 and MGMT 7 may not be taken for credit if taken after STATS 67.

(Va)

STATS 110. Statistical Methods for Data Analysis I. 4 Units.
Introduction to statistical methods for analyzing data from experiments and surveys. Methods covered include two-sample procedures, analysis of variance, simple and multiple linear regression.
Prerequisite: STATS 7 or (STATS 120A and STATS 120B and STATS 120C).
Concurrent with STATS 201.

STATS 111. Statistical Methods for Data Analysis II. 4 Units.
Introduction to statistical methods for analyzing data from surveys or experiments. Emphasizes application and understanding of methods for categorical data including contingency tables, logistic and Poisson regression, loglinear models.
Prerequisite: STATS 110.
Concurrent with STATS 202.

STATS 112. Statistical Methods for Data Analysis III. 4 Units.
Introduction to statistical methods for analyzing longitudinal data from experiments and cohort studies. Topics covered include survival methods for censored time-to-event data, linear mixed models, non-linear mixed effects models, and generalized estimating equations.
Prerequisite: STATS 111.
Concurrent with STATS 203.

STATS 115. Introduction to Bayesian Data Analysis. 4 Units.
Basic Bayesian concepts and methods with emphasis on data analysis. Special emphasis on specification of prior distributions. Development for one-two samples and on to binary, Poisson, and linear regression. Analyses performed using free OpenBugs software.
Prerequisite: STATS 120C. Recommended: STATS 110 or STATS 202 or STATS 210 or STATS 211.
Concurrent with STATS 205.

STATS 120A. Introduction to Probability and Statistics. 4 Units.
Introduction to basic principles of probability and statistical inference. Axiomatic definition of probability, random variables, probability distributions, expectation.
Prerequisite: MATH 2A and MATH 2B and (MATH 2D or MATH 4).
Overlaps with MATH 130A.

STATS 120B. Introduction to Probability and Statistics. 4 Units.
Introduction to basic principles of probability and statistical inference. Point estimation, interval estimating, and testing hypotheses, Bayesian approaches to inference.
Prerequisite: STATS 120A.

STATS 120C. Introduction to Probability and Statistics. 4 Units.
Introduction to basic principles of probability and statistical inference. Linear regression, analysis or variance, model checking.
Prerequisite: STATS 120B.

STATS 121. Probability Models. 4 Units.
Advanced probability, discrete time Markov chains, Poisson processes, continuous time Markov chains. Queuing or simulation as time permits.
Prerequisite: STATS 120A.
Concurrent with COMPSCI 278.
STATS 140. Multivariate Statistical Methods. 4 Units.
Theory and application of multivariate statistical methods. Topics include: statistical inference for the multivariate normal model and its extensions to multiple samples and regression, use of statistical packages for data visualization and reduction, discriminant analysis, cluster analysis, and factor analysis.
Prerequisite: STATS 120C or MATH 121A.
Concurrent with STATS 240.

STATS 199. Individual Study. 2-5 Units.
Individual research or investigations under the direction of an individual faculty member.
Repeatability: May be repeated for credit unlimited times.

STATS 200A. Intermediate Probability and Statistical Theory. 4 Units.
Basics of probability theory, random variables and basic transformations, univariate distributions—discrete and continuous, multivariate distributions.
Prerequisite: STATS 120C.

STATS 200B. Intermediate Probability and Statistical Theory. 4 Units.
Random samples, transformations, limit laws, normal distribution theory, introduction to stochastic processes, data reduction, point estimation (maximum likelihood).
Prerequisite: STATS 200A.

STATS 200C. Intermediate Probability and Statistical Theory. 4 Units.
Interval estimation, hypothesis testing, decision theory and Bayesian inference, basic linear model theory.
Prerequisite: STATS 200B.

STATS 201. Statistical Methods for Data Analysis I. 4 Units.
Introduction to statistical methods for analyzing data from experiments and surveys. Methods covered include two-sample procedures, analysis of variance, simple and multiple linear regression.
Prerequisite: Knowledge of basic statistics.
Concurrent with STATS 110.

STATS 202. Statistical Methods for Data Analysis II. 4 Units.
Introduction to statistical methods for analyzing data from surveys or experiments. Emphasizes application and understanding of methods for categorical data including contingency tables, logistic and Poisson regression, loglinear models.
Prerequisite: STATS 201.
Concurrent with STATS 111.

STATS 203. Statistical Methods for Data Analysis III. 4 Units.
Introduction to statistical methods for analyzing longitudinal data from experiments and cohort studies. Topics covered include survival methods for censored time-to-event data, linear mixed models, non-linear mixed effects models, and generalized estimating equations.
Prerequisite: STATS 202.
Concurrent with STATS 112.

STATS 205. Introduction to Bayesian Data Analysis. 4 Units.
Basic Bayesian concepts and methods with emphasis on data analysis. Special emphasis on specification of prior distributions. Development for one- two samples and on to binary, Poisson and linear regression. Analyses performed using free OpenBugs software.
Prerequisite: STATS 120C. Recommended: STATS 110 or STATS 202 or STATS 210 or STATS 211.
Concurrent with STATS 115.

STATS 210. Statistical Methods I: Linear Models. 4 Units.
Statistical methods for analyzing data from surveys and experiments. Topics include randomization and model-based inference, two-sample methods, analysis of variance, linear regression and model diagnostics.
Prerequisite: Knowledge of basic statistics, calculus, linear algebra.
STATS 211. Statistical Methods II: Generalized Linear Models. 4 Units.
Development of the theory and application of generalized linear models. Topics include likelihood estimation and asymptotic distributional theory for exponential families, quasi-likelihood and mixed model development. Emphasizes methodological development and application to real scientific problems.

Corequisite: STATS 200B.
Prerequisite: STATS 210.

STATS 212. Statistical Methods III: Methods for Correlated Data. 4 Units.
Development and application of statistical methods for analyzing correlated data. Topics covered include repeated measures ANOVA, linear mixed models, non-linear mixed effects models, and generalized estimating equations. Emphasizes both theoretical development and application of the presented methodology.

Prerequisite: STATS 211.

STATS 220A. Advanced Probability and Statistics Topics. 4 Units.
Advanced topics in probability and statistical inference including measure theoretic probability, large sample theory, decision theory, resampling and Monte Carlo methods, nonparametric methods.

Prerequisite: STATS 200C.

STATS 220B. Advanced Probability and Statistics Topics. 4 Units.
Advanced topics in probability and statistical inference including measure theoretic probability, large sample theory, decision theory, resampling and Monte Carlo methods, nonparametric methods.

Prerequisite: STATS 220A.

STATS 225. Bayesian Statistical Analysis. 4 Units.
Introduction to the Bayesian approach to statistical inference. Topics include univariate and multivariate models, choice of prior distributions, hierarchical models, computation including Markov chain Monte Carlo, model checking, and model selection.

Prerequisite: Two quarters of upper-division or graduate training in probability and statistics.

STATS 226. Advanced Topics in Modern Bayesian Statistical Inference. 4 Units.
Modern Bayesian Statistics: selected topics from theory of Markov chains, application of theory to modern methods of Markov chain Monte Carlo sampling; Bayesian non-parametric and semiparametric modeling, including Dirichlet Process Mixtures; Mixtures of Polya Trees.

Prerequisite: STATS 200C.

STATS 230. Statistical Computing Methods. 4 Units.
Numerical computations and algorithms with applications in statistics. Topics include optimization methods including the EM algorithm, random number generation and simulation, Markov chain simulation tools, and numerical integration.

Prerequisite: Two quarters of upper-division or graduate training in probability and statistics.

Overlaps with COMPSCI 206.

STATS 235. Modern Data Analysis Methods. 4 Units.
Introduces selected modern tools for data analysis. Emphasizes use of computational and resampling techniques for data analyses when the data do not conform to standard toolbox of regression models and/or complexity of modeling problem threatens validity of standard methods.

Prerequisite: STATS 120C.
Restriction: Graduate students only.

STATS 240. Multivariate Statistical Methods. 4 Units.
Theory and application of multivariate statistical methods. Topics include: statistical inference for the multivariate normal model and its extensions to multiple samples and regression, use of statistical packages for data visualization and reduction, discriminant analysis, cluster analysis, and factor analysis.

Prerequisite: STATS 120C or MATH 121A.

Concurrent with STATS 140.
STATS 245. Time Series Analysis. 4 Units.
Statistical models for analysis of time series from time and frequency domain perspectives. Emphasizes theory and application of time series data analysis methods. Topics include ARMA/ARIMA models, model identification/estimation, linear operators, Fourier analysis, spectral estimation, state space models, Kalman filter.
Prerequisite: STATS 200C.

STATS 246. Spectral Analysis . 4 Units.
Spectral methods that are most commonly utilized for analyzing univariate and multivariate time series and signals. These methods include spectral and coherence estimation, transfer function modeling, classification and discrimination of time series, non-stationary time series, time-frequency analysis, and wavelets analysis.
Prerequisite: STATS 200A and STATS 200B and STATS 210.

STATS 250. Biostatistics. 4 Units.
Statistical methods commonly used to analyze data arising from clinical studies. Topics include analysis of observational studies and randomized clinical trials, techniques in the analysis of survival and longitudinal data, approaches to handling missing data, meta-analysis, nonparametric methods.
Prerequisite: STATS 210.

STATS 255. Statistical Methods for Survival Data. 4 Units.
Statistical methods for analyzing survival data from cohort studies. Topics include parametric and nonparametric methods, the Kaplan-Meier estimator, log-rank tests, regression models, the Cox proportional hazards model and accelerated failure time models, efficient sampling designs, discrete survival models.
Prerequisite: STATS 211.

STATS 257. Introduction to Statistical Genetics. 4 Units.
Provides students with knowledge of the basic principles, concepts, and methods used in statistical genetic research. Topics include principles of population genetics, and statistical methods for family- and population-based studies.
Prerequisite: Two quarters of upper-division or graduate training in statistical methods.
Same as EPIDEM 215.

STATS 260. Inference with Missing Data. 4 Units.
Statistical methods and theory useful for analysis of multivariate data with partially observed variables. Bayesian and likelihood-based methods developed. Topics include EM-type algorithms, MCMC samplers, multiple imputation, and general location model. Applications from economics, education, and medicine are discussed.
Prerequisite: STATS 200C and STATS 210.

STATS 262. Theory and Practice of Sample Surveys. 4 Units.
Basic techniques and statistical methods used in designing surveys and analyzing collected survey data. Topics include simple random sampling, ratio and regression estimates, stratified sampling, cluster sampling, sampling with unequal probabilities, multistage sampling, and methods to handle nonresponse.
Prerequisite: STATS 120C.

STATS 265. Causal Inference. 4 Units.
Various approaches to causal inference focusing on the Rubin causal model and propensity-score methods. Topics include randomized experiments, observational studies, non-compliance, ignorable and non-ignorable treatment assignment, instrumental variables, and sensitivity analysis. Applications from economics, politics, education, and medicine.
Prerequisite: STATS 200C and STATS 210.

STATS 270. Stochastic Processes. 4 Units.
Introduction to the theory and application of stochastic processes. Topics include Markov chains, continuous-time Markov processes, Poisson processes, and Brownian motion. Applications include Markov chain Monte Carlo methods and financial modeling (for example, option pricing).
Prerequisite: STATS 120C.
Overlaps with MATH 271A, MATH 271B, MATH 271C.
STATS 275. Statistical Consulting. 4 Units.
Training in collaborative research and practical application of statistics. Emphasis on effective communication as it relates to identifying scientific objectives, formulating a statistical analysis plan, choice of statistical methods, and interpretation of results and their limitations to non-statisticians.

Prerequisite: STATS 203 or STATS 212.

Repeatability: May be taken for credit 2 times.

STATS 280. Seminar in Statistics. 0.5 Units.
Periodic seminar series covering topics of current research in statistics and its application.

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: May be repeated for credit unlimited times.

Restriction: Graduate students only.

STATS 281. Topics in Astrostatistics. 1-4 Units.
Topics in statistical methods for astronomy, astrophysics, particle physics, and solar physics, typically including spectral analysis, image processing and analysis, time series, classification, clustering, massive data, etc. Emphasizes computationally intensive methods, Bayesian and frequentist methods, machine learning, and signal processing.

Repeatability: May be repeated for credit unlimited times.

Restriction: Graduate students only.

STATS 295. Special Topics in Statistics. 4 Units.
Studies in selected areas of statistics. Topics addressed vary each quarter.

Repeatability: Unlimited as topics vary.

STATS 298. Thesis Supervision. 2-12 Units.
Individual research or investigation conducted in preparation for the M.S. thesis option or the dissertation requirements for the Ph.D. program.

Repeatability: May be repeated for credit unlimited times.

STATS 299. Individual Study. 2-12 Units.
Individual research or investigation under the direction of an individual faculty member.

Repeatability: May be repeated for credit unlimited times.