Department of Statistics

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Overview
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 Major in Data Science
The Data Science Major prepares students for a career in data analysis, combining foundational statistical concepts with computational principles from computer science. In the first two years of the program students will take core courses in both the Statistics and Computer Science Departments, providing a strong foundation in the principles of each field. In the 3rd and 4th years of the program, students will take more specialized courses, on topics such as design of algorithms, machine learning, information visualization, and Bayesian statistics. A major component of this degree is the final year capstone project course, a 2-quarter course that teaches students how to apply statistical and computational principles to solve large-scale real-world data analysis problems.

Admissions
Freshman Applicants: See the Undergraduate Admissions section.
Transfer Applicants: Junior-level applicants who satisfactorily complete course requirements will be given preference for admission. Applicants must satisfy the following requirements:

1. Completion of one year of college level mathematics (calculus or discrete math) and one semester of college level statistics.
2. Completion of one year of transferable Computer Science courses*; at least one of these should involve concepts such as those found in the Python and C++ programming languages, or another high-level programming language.

*NOTE: Additional Computer Science and Statistics courses beyond those above are strongly recommended, particularly those that align with the major(s) of interest. Python, C++ and R are used extensively in the curriculum; therefore, transfer students should plan to learn these by studying on their own or by completing Python, C++, and R-related programming courses prior to their first quarter at UCI. Additional courses beyond those required for admission must be taken to fulfill the lower-division degree requirements, as many are prerequisites for upper-division courses. For some transfer students, this may mean that it will take longer than two years to complete their degree.

Major and Minor Restrictions
Bren School of ICS majors (including shared majors, BIM and CSE) pursuing minors within the Bren School of ICS may not count more than five courses toward both the major and minor. Some ICS majors and minors outside of the School are not permitted due to significant overlap. Visit the ICS Student Affairs Office website for Majors and Minors restrictions. (http://www.ics.uci.edu/ugrad/degrees/MajorMinor_Restrictions_Chart.pdf) All students should check the Double Major Restrictions Chart (http://www.ics.uci.edu/ugrad/degrees/DbI_Major_Restr_Chart.pdf) and view our information page (http://www.ics.uci.edu/ugrad/degrees/Double_Majors.php) on double majoring to see what degree programs are eligible for double majoring.

Requirements for the Bachelor's Degree in Data Science
All students must meet the University Requirements.
Data Science Major Requirements

<table>
<thead>
<tr>
<th>Lower-division</th>
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<tbody>
<tr>
<td>I&amp;C SCI 6B</td>
<td>Boolean Algebra and Logic</td>
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<td>I&amp;C SCI 6D</td>
<td>Discrete Mathematics for Computer Science</td>
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<tr>
<td>I&amp;C SCI 31</td>
<td>Introduction to Programming</td>
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<td>I&amp;C SCI 32</td>
<td>Programming with Software Libraries</td>
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<td>I&amp;C SCI 33</td>
<td>Intermediate Programming</td>
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<tr>
<td>I&amp;C SCI 45C</td>
<td>Programming in C/C++ as a Second Language</td>
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<tr>
<td>I&amp;C SCI 46</td>
<td>Data Structure Implementation and Analysis</td>
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<tr>
<td>I&amp;C SCI 51</td>
<td>Introductory Computer Organization</td>
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</table>
IN4MATX 43  Introduction to Software Engineering  
MATH 2A  Single-Variable Calculus  
MATH 2B  Single-Variable Calculus  
MATH 2D  Multivariable Calculus  
MATH 3A  Introduction to Linear Algebra  
or I&C SCI 6N  Computational Linear Algebra  
STATS 5  Seminar in Data Science  
STATS 7  Basic Statistics  
STATS 68  Statistical Computing and Exploratory Data Analysis  

Upper-division:
A. Data Science core requirements:

**STATS 110**  Statistical Methods for Data Analysis I  
**STATS 111**  Statistical Methods for Data Analysis II  
**STATS 112**  Statistical Methods for Data Analysis III  
**STATS 115**  Introduction to Bayesian Data Analysis  
**STATS 120A**  Introduction to Probability and Statistics I  
**STATS 120B**  Introduction to Probability and Statistics II  
**STATS 120C**  Introduction to Probability and Statistics III  
**I&C SCI 139W**  Critical Writing on Information Technology  
**COMPSCI 122A**  Introduction to Data Management  
**COMPSCI 161**  Design and Analysis of Algorithms  
**COMPSCI 178**  Machine Learning and Data-Mining  
**IN4MATX 143**  Information Visualization  

B. Three elective courses from the list below:

**MATH 130B**  Probability and Stochastic Processes  
**MATH 130C**  Probability and Stochastic Processes  
**STATS 140**  Multivariate Statistical Methods  
**I&C SCI 53**  Principles in System Design  
**COMPSCI 111**  Digital Image Processing  
**COMPSCI 115**  Computer Simulation  
**COMPSCI 121**  Information Retrieval  
**COMPSCI 122B**  Project in Databases and Web Applications  
**COMPSCI 122C**  Principles of Data Management  
**COMPSCI 125**  Next Generation Search Systems  
**COMPSCI 131**  Parallel and Distributed Computing  
**COMPSCI 134**  Computer and Network Security  
**COMPSCI 163**  Graph Algorithms  
**COMPSCI 165**  Project In Algorithms And Data Structures  
**COMPSCI 169**  Introduction to Optimization  
**COMPSCI 171**  Introduction to Artificial Intelligence  
**COMPSCI 172B**  Neural Networks and Deep Learning  
**IN4MATX 131**  Human Computer Interaction  
**IN4MATX 141**  Information Retrieval  
**IN4MATX 161**  Social Analysis of Computing  

C. Data Science capstone team-based project courses: STATS 170A and STATS 170B

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**Sample Program of Study — Data Science**

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<th>Freshman</th>
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### Sophomore

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<td>STATS 120C</td>
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<td>COMPSCI 178</td>
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<td>COMPSCI 161</td>
<td>I&amp;C SCI 139W</td>
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<td>STAT 170A</td>
<td>STAT 170B</td>
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### Additional Information

#### Career Opportunities

A wide variety of careers and graduate programs are open to graduates of the Data Science major. Demand for graduates with skills in both statistics and computer science currently outpaces supply - thus, students with these skills typically find employment quickly, across a wide variety of sectors, including internet companies, finance, engineering, business, medicine, and more. Data Science graduates are well-qualified for job titles such as "data scientist," "data analyst," or "statistician," both in the public and private sectors. Graduate school in area such as Computer Science or Statistics is also a possible career path.

#### 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) 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 academic counselor of their major as early as possible to plan their course work and incorporate the required courses into their four-year academic plan.

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**

**MATH 3A**

or **I&C SCI 6N**

or **STATS 110-111**

**STATS 120A- 120B- 120C**

Select one elective from the following:  

- **I&C SCI 31**
- **MATH 130B**
- **MATH 130C**
- **STATS 7**

Introduction to Programming

Probability and Stochastic Processes

Basic Statistics (or equivalent course)
Department of Statistics

| STATS 112 | Statistical Methods for Data Analysis III |
| STATS 115 | Introduction to Bayesian Data Analysis |
| STATS 140 | Multivariate Statistical Methods |

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. Visit the ICS Student Affairs Office website for Majors and Minors restrictions. (http://www.ics.uci.edu/ugrad.degrees/MajorMinor_Restrictions_Chart.pdf)

Graduate Programs 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.

Master of Science in 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); Statistical Consulting STATS 275; four 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 are required to meet with the Vice Chair of Graduate Affairs in Statistics to register their interest with the Department. If enrollment is approved, the Vice Chair will assist in developing a program of study and establishing 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 by the end of February in the year of the exam. 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; 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, Department Chair and Professor of Statistics; Program in Public Health

Michele Guindani, Ph.D. Universita Luiga Bocconi, Associate Professor 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 Emeritus of Statistics; Cognitive Sciences

Dale J. Poirier, Ph.D. University of Wisconsin-Madison, Professor of Economics; Statistics

Babak Shahbaba, Ph.D. University of Toronto, Associate Professor of Statistics; Computer Science

Weining Shen, Ph.D. North Carolina State University, Assistant Professor of Statistics

Patrick J. Smyth, Ph.D. California Institute of Technology, Professor of Computer Science; Statistics

Hal S. Stern, Ph.D. Stanford University, Professor of Statistics; Cognitive Sciences

Jessica Utts, Ph.D. Pennsylvania State University, Professor of Statistics

Joachim S. Vandekerckhove, Ph.D. University of Leuven, Assistant Professor of Cognitive Sciences; Statistics (response time modeling, model fitting, computational statistics, psychometrics, Bayesian statistics)

Yaming Yu, Ph.D. Harvard University, Associate Professor of Statistics

Zhaoxia Yu, Ph.D. William Marsh Rice University, Associate Professor of Statistics