Statistics

Bachelor of Arts (BA)

The undergraduate major at Berkeley provides a systematic and thorough grounding in applied and theoretical statistics as well as probability. The quality and dedication of the teaching staff and faculty are extremely high. A major in Statistics from Berkeley is an excellent preparation for a career in science or industry, or for further academic study in a wide variety of fields. The department has particular strength in Machine Learning, a key ingredient of the emerging field of Data Science. It is also very useful to combine studies of statistics and probability with other subjects. Our department excels at interdisciplinary science, and more than half of the department’s undergraduate students are double or triple majors.

Students interested in teaching statistics and mathematics in middle or high school should pursue the teaching option within the major. Students interested in teaching should also consider the Cal Teach Program (http://calteach.berkeley.edu/).

Declaring the Major

Students should apply in the semester they will complete their prerequisites. For applicants with prerequisites in progress, applications will be reviewed after the grades for all prerequisites are available, 2-3 weeks after finals. For applicants who have completed all prerequisites in a previous term, applications will be reviewed and processed within a week.

For detailed information regarding the process of declaring the major, please see the Statistics Department website. (https://statistics.berkeley.edu/academics/undergrad/prospective/declare-major/)

Minor Program

The minor is for students who want to study a significant amount of statistics and probability at the upper division level. For information regarding the requirements, please see the Minor Requirements tab on this page.

For detailed information regarding the process of declaring the minor, please see the Statistics Department website. (https://statistics.berkeley.edu/academics/undergrad/prospective/declare-minor/)

In addition to the University, campus, and college requirements, listed on the College Requirements tab, students must fulfill the below requirements specific to their major program.

General Guidelines

1. All courses taken to fulfill the major requirements below must be taken for graded credit, other than courses listed which are offered on a Pass/No Pass basis only. Other exceptions to this requirement are noted as applicable.
2. No more than one upper division course may be used to simultaneously fulfill requirements for a student’s major and minor programs, with the exception of minors offered outside of the College of Letters & Science.
3. A minimum grade point average (GPA) of 2.0 must be maintained in both upper and lower division courses used to fulfill the major requirements.
4. The requirements below apply to freshmen entering Berkeley in Fall 2018, and transfer students entering in Fall 2020. Freshmen students admitted to Berkeley prior to Fall 2018 and transfer students admitted prior to Fall 2020 are required to complete the requirements as published in the 2017-18 Berkeley Academic Guide (http://guide.berkeley.edu/archive/).

For information regarding residency requirements and unit requirements, please see the College Requirements tab.

Prerequisites

Students must earn a minimum 3.2 UC grade point average in the lower division math prerequisites with no lower than a C in each. 1

- MATH 1A Calculus 4
- MATH 1B Calculus 4
- MATH 53 Multivariable Calculus 4
  - or MATH H53 Honors Multivariable Calculus 4
  - or MATH N53 Multivariable Calculus 4
- MATH W53 Multivariable Calculus 4
- MATH 54 Linear Algebra and Differential Equations 4
  - or MATH H54 Honors Linear Algebra and Differential Equations 4
  - or MATH N54 Linear Algebra and Differential Equations 4

A minimum C grade in one of the following:

- STAT/COMPSCI/ Foundations of Data Science 4
  - or DATA/INFO C8 Introduction to Probability and Statistics 4

A minimum B- grade in one of the following: 2

- STAT 134 Concepts of Probability 4
  - or STAT C140 Probability for Data Science 4
- STAT 135 Concepts of Statistics 4

Upper Division Requirements (Nine Courses)

Core Statistics Courses (3)

- STAT 133 Concepts in Computing with Data 3
- STAT 134 Concepts of Probability 3
  - or STAT C140 Probability for Data Science 4
- STAT 135 Concepts of Statistics 4

Statistics Electives (3)

Select three statistics electives from the following; at least one of the 0-12 selections must have a lab:

- STAT/DATA C102 Data, Inference, and Decisions 4
- STAT 150 Stochastic Processes 3
- STAT 151A Linear Modelling: Theory and Applications (LAB COURSE) 4
- STAT 152 Sampling Surveys (LAB COURSE) 4
- STAT 153 Introduction to Time Series (LAB COURSE) 4
- STAT 154 Modern Statistical Prediction and Machine Learning (LAB COURSE) 4
- STAT 155 Game Theory 3
- STAT 156 Causal Inference 4
- STAT 157 Seminar on Topics in Probability and Statistics 3
- STAT 158 Experimental Design (LAB COURSE) 4
two of the following; at least one course must include a lab: MATH 152 Sampling Surveys (LAB COURSE) 4 STAT 153 Introduction to Time Series (LAB COURSE) 4 STAT 154 Modern Statistical Prediction and Machine Learning (LAB COURSE) 4 STAT 155 Game Theory 3 STAT 156 Causal Inference 4 STAT 157 Seminar on Topics in Probability and Statistics 3 STAT 158 Experimental Design (LAB COURSE) 4 STAT 159 Reproducible and Collaborative Statistical Data Science (LAB COURSE) 4

Teaching Track Cluster (4)

MATH 110 Linear Algebra 4 MATH 113 Introduction to Abstract Algebra 4 MATH 151 Mathematics of the Secondary School Curriculum I 4 MATH 152 Mathematics of the Secondary School Curriculum II 4 or MATH 153 Course Not Available

Cluster Course Information

Two of the best reasons to study statistics are the immense variety of important and exciting real-world questions we can answer through careful data analysis, as well as the broad range of technical fields with close connections to statistics. No major is complete without encountering the fields that interface closely with statistics.

The applied cluster is a chance to learn about areas in which Statistics can be applied, and to learn specialized techniques not taught in the Statistics Department. Students need to design your own Cluster. The courses should have a unifying theme. Picking your own Cluster is a valuable exercise that gives you a chance to explore and refine your interests and to develop a coherent course of study. A pre-approved list has been provided. However, it is not exhaustive. Clusters may consist of courses from more than one department, but at least two must be approved courses from the same department. If students would like to use a course that is not on the list or select three courses from three different departments, the Head Undergraduate Faculty Adviser must approve the proposed cluster.

Economics and Business courses are treated as though they are in the same department for purposes of evaluating clusters. The same is true for courses in EE, CS, and EECs. Likewise, courses concerning social and ethical aspects of statistics including CYPLAN 101, INFO 188, PHILOS 121, and DATA C104 / HISTORY C184D / STS C1040 are treated as though they are in the same department even if offered in different departments.

Cluster Guidelines

Courses must be: upper division courses, at least 3 units, and must be taken for a letter grade.

Courses with statistics prerequisites are often acceptable. Courses that are similar to Statistics courses are not acceptable. If an approved cluster course has a credit restriction with another approved course, both cannot be used for the applied cluster (refer to the Berkeley Academic Guide (http://guide.berkeley.edu/courses/) for credit restrictions, click on “read more” under the course description).

Content Criteria:

Generally, to be an acceptable cluster course, a course should meet at least one of the following three criteria:

1. The course centers on questions about ethical data analysis or experimental methodology.
2. The course is focused on a substantive area of natural sciences or social sciences, and includes a significant quantitative or data analysis component as part of the course requirements.
3. The course is in a related technical field like mathematics, computer science, engineering, or operations research.

Sample Clusters

Below is a list of sample clusters for students to consider if they would like an idea of courses to combine for their cluster based on a topic of interest.

- Economics and Finance: Econ 101A, Econ 101B and UGBA 103
- Math: Math 110, Math 104, and Math 128B
- Public Health/Biostatistics graduate school: Math 110, Pb Hlth 150A, and Pb Hlth 150B
- Public Policy: Pub Policy C103, Pub Pol C142/Econ C142/Pol Sci C131A, and Pb Hlth 126
- Social and Ethical Aspects of Statistics: CYPLAN 101, INFO 188, and DATA C104 / HISTORY C184D / STS C1040

Approved Cluster Courses

Of the three applied cluster courses required for the major, at least two must be approved courses from the same department. This is not an exhaustive list.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
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<tbody>
<tr>
<td>ANTHRO C100</td>
<td>Course Not Available</td>
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<tr>
<td>ANTHRO C103</td>
<td>Course Not Available</td>
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<td>ANTHRO 115</td>
<td>Introduction to Medical Anthropology</td>
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<tr>
<td>ANTHRO 121C</td>
<td>Historical Archaeology: Historical Artifact Identification and Analysis</td>
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<td>ANTHRO C124C</td>
<td>Human Biogeography of the Pacific</td>
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<td>INTEGBI C187</td>
<td>Bioarchaeology: Introduction to Skeletal Biology and Bioarchaeology</td>
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<td>ANTHRO 127A</td>
<td>Bioarchaeology: Reconstruction of Life in Bioarchaeology</td>
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<td>ANTHRO C129D</td>
<td>Holocene Paleoenvironment: How Humans Changed the Earth</td>
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<td>INTEGBI C155</td>
<td>The Urban Community</td>
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<td>ANTHRO 132A</td>
<td>Analysis of Archaeological Materials: Ceramics</td>
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<tr>
<td>ANTHRO 135</td>
<td>Paleobotany and Archaeological Methods and Laboratory Techniques</td>
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<tr>
<td>ANTHRO 169B</td>
<td>Research Theory and Methods in Socio-Cultural Anthropology</td>
<td>5</td>
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<tr>
<td>ARCH 140</td>
<td>Energy and Environment</td>
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<td>ARCH 150</td>
<td>Introduction to Structures</td>
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<tr>
<td>ARCH 154</td>
<td>Design and Computer Analysis of Structure</td>
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<td>ASTRON 128</td>
<td>Astronomy Data Science Laboratory</td>
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<td>ASTRON 160</td>
<td>Stellar Physics</td>
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<td>ASTRON C161</td>
<td>Relativistic Astrophysics and Cosmology</td>
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<td>ASTRON C162</td>
<td>Planetary Astrophysics</td>
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<td>BIO ENG 104</td>
<td>Biological Transport Phenomena</td>
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<td>BIO ENG C112</td>
<td>Molecular Biomechanics and Mechanobiology of the Cell</td>
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<td>Structural Aspects of Biomaterials</td>
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<td>Orthopedic Biomechanics</td>
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<td>Introduction to Robotics</td>
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<td>BIO ENG C125B</td>
<td>Robotic Manipulation and Interaction</td>
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<td>BIO ENG 131</td>
<td>Introduction to Computational Molecular and Cell Biology</td>
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<td>BIO ENG C136L</td>
<td>Laboratory in the Mechanics of Organisms</td>
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<td>BIO ENG C137</td>
<td>Designing for the Human Body</td>
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<td>BIO ENG 144</td>
<td>Introduction to Protein Informatics</td>
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<td>BIO ENG C145L</td>
<td>Introductory Electronic Transducers Laboratory</td>
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<td>BIO ENG C145M</td>
<td>Introductory Microcomputer Interfacing Laboratory</td>
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<td>BIO ENG 147</td>
<td>Principles of Synthetic Biology</td>
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<td>BIO ENG 165</td>
<td>Medical Imaging Signals and Systems</td>
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<td>BIO ENG C181</td>
<td>The Berkeley Lectures on Energy: Energy from Biomass</td>
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<td>CHM ENG 140</td>
<td>Introduction to Chemical Process Analysis</td>
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<td>CHM ENG 141</td>
<td>Chemical Engineering Thermodynamics</td>
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<td>CHM ENG C195A</td>
<td>The Berkeley Lectures on Energy: Energy from Biomass</td>
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<td>CHEM C110L</td>
<td>General Biochemistry and Molecular Biology Laboratory</td>
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<td>CHEM 120A</td>
<td>Physical Chemistry</td>
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<td>Physical Chemistry</td>
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<td>CHEM C130</td>
<td>Biophysical Chemistry: Physical Principles and the Molecules of Life</td>
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<td>CHEM C138</td>
<td>The Berkeley Lectures on Energy: Energy from Biomass</td>
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<td>CY PLAN 101</td>
<td>Introduction to Urban Data Analytics</td>
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<td>CY PLAN 118AC</td>
<td>The Urban Community</td>
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<td>CY PLAN 119</td>
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<td>Engineering Analysis Using the Finite Element Method</td>
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<td>CIV ENG 155</td>
<td>Transportation Systems Engineering</td>
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<td>COG SCI C100</td>
<td>Basic Issues in Cognition</td>
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<td>Cognitive Linguistics</td>
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<td>Scientific Approaches to Consciousness</td>
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<td>COMPSCI 152</td>
<td>Computer Architecture and Engineering</td>
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<td>User Interface Design and Development</td>
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<td>COMPSCI 162</td>
<td>Operating Systems and System Programming</td>
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<td>COMPSCI 164</td>
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<td>COMPSCI 168</td>
<td>Introduction to the Internet: Architecture and Protocols</td>
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<td>Computability and Complexity</td>
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<td>COMPSCI 176</td>
<td>Algorithms for Computational Biology</td>
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<td>COMPSCI 182</td>
<td>Designing, Visualizing and Understanding Deep Neural Networks</td>
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<td>COMPSCI 184</td>
<td>Foundations of Computer Graphics</td>
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<td>COMPSCI 186</td>
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<td>Introduction to Database Systems</td>
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<td>COMPSCI 189</td>
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<td>Human Contexts and Ethics of Data - DATA/History/STS</td>
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<td>DATA C104</td>
<td>Data Mining and Analytics</td>
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<td>DATA 144</td>
<td>Introduction to Population Analysis</td>
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<td>DEMOG 110</td>
<td>Sex, Death, and Data</td>
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<td>Economic Demography</td>
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<td>DEMOG 175</td>
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<td>DEMOG 260</td>
<td>Special Topics in Demography Seminar</td>
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<td>EPS 101</td>
<td>Field Geology and Digital Mapping</td>
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<td>Biomeeteorology</td>
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<td>Air Pollution</td>
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<td>EPS C181</td>
<td>Atmospheric Physics and Dynamics</td>
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<td>ECON 101A</td>
<td>Microeconomics (Math Intensive)</td>
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<td>ECON 101B</td>
<td>Macroeconomics (Math Intensive)</td>
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ECON C102 Natural Resource Economics
ECON C103 Introduction to Mathematical Economics
ECON 104 Advanced Microeconomic Theory
ECON 119 Psychology and Economics
ECON 121 Industrial Organization and Public Policy
ECON C125 Environmental Economics
ECON 131 Public Economics
ECON 136 Financial Economics
ECON 138 Financial and Behavioral Economics
ECON 139 Asset Pricing and Portfolio Choice
ECON 141 Econometrics (Math Intensive)
ECON C142 Applied Econometrics and Public Policy
ECON 157 Health Economics
ECON C171 Development Economics
ECON 174 Global Poverty and Impact Evaluation
ECON C175 Economic Demography
or ECON N175 Economic Demography
ECON C181 International Trade
ECON 182 International Monetary Economics
EL ENG 100 Course Not Available
EL ENG 105 Microelectronic Devices and Circuits
EL ENG C106A Introduction to Robotics
EL ENG C106B Robotic Manipulation and Interaction
EL ENG 113 Power Electronics
EL ENG 117 Electromagnetic Fields and Waves
EL ENG 118 Introduction to Optical Engineering
EL ENG 120 Signals and Systems
EL ENG 121 Introduction to Digital Communication Systems
EL ENG 122 Introduction to Communication Networks
EL ENG 123 Digital Signal Processing
EL ENG 127 Course Not Available
EL ENG C128 Feedback Control Systems
EL ENG 129 Course Not Available
EL ENG 130 Integrated-Circuit Devices
EL ENG 134 Fundamentals of Photovoltaic Devices
EL ENG 137A Introduction to Electric Power Systems
EL ENG 137B Introduction to Electric Power Systems
EL ENG 140 Linear Integrated Circuits
EL ENG 142 Integrated Circuits for Communications
EL ENG 143 Microfabrication Technology
EL ENG 144 Fundamental Algorithms for Systems Modeling, Analysis, and Optimization
EL ENG C145B Medical Imaging Signals and Systems
EL ENG C145L Introductory Electronic Transducers Laboratory
EL ENG C145M Introductory Microcomputer Interfacing Laboratory
EL ENG C145O Laboratory in the Mechanics of Organisms
EL ENG 147 Introduction to Microelectromechanical Systems (MEMS)
EL ENG C149 Course Not Available
ENE,RES C100 Energy and Society
ENE,RES 102 Quantitative Aspects of Global Environmental Problems
ENE,RES 131 Data, Environment and Society
ENE,RES 175 Water and Development
ENE,RES C176 Climate Change Economics
ENGIN 115 Course Not Available
ENGIN 117 Methods of Engineering Analysis
ENGIN 120 Principles of Engineering Economics
ENVECON C101 Environmental Economics
ENVECON C102 Natural Resource Economics
ENVECON C115 Modeling and Management of Biological Resources
ENVECON 131 Globalization and the Natural Environment
ENVECON 140ACEconomics of Race, Agriculture, and the Environment
ENVECON 141 Agricultural and Environmental Policy
ENVECON 142 Industrial Organization with Applications to Agriculture and Natural Resources
ENVECON 143 Economics of Innovation and Intellectual Property
ENVECON 145 Health and Environmental Economic Policy
ENVECON 147 Regulation of Energy and the Environment
ENVECON C151 Development Economics
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ENVECON 153 Population, Environment, and Development
ENVECON 154 Economics of Poverty and Technology
ENVECON 161 Advanced Topics in Environmental and Resource Economics
ENVECON 162 Economics of Water Resources
ENVECON C175 The Economics of Climate Change
ENVECON C176 Climate Change Economics
ENVECON C181 International Trade
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ESPM 100 Environmental Problem Solving
ESPM 102A Course Not Available
ESPM 102C Resource Management
ESPM 102D Climate and Energy Policy
ESPM C103 Principles of Conservation Biology
ESPM C104 Modeling and Management of Biological Resources
ESPM C107 Biology and Geomorphology of Tropical Islands
ESPM 108A Trees: Taxonomy, Growth, and Structures
ESPM 108B Environmental Change Genetics
ESPM 111 Ecosystem Ecology
ESPM 112 Microbial Ecology
ESPM 114 Wildlife Ecology
ESPM 115C Fish Ecology
ESPM 116B Grassland and Woodland Ecology
ESPM 116C Tropical Forest Ecology
ESPM 117 Urban Garden Ecosystems
ESPM 118 Agricultural Ecology
ESPM 120 Science of Soils
ESPM 121 Development and Classification of Soils
ESPM C126 Animal Behavior
ESPM C128 Chemistry of Soils
ESPM C129 Biometeorology
INTEGBI C155 Holocene Paleoecology: How Humans Changed the Earth 3
INTEGBI C156 Principles of Conservation Biology 4
INTEGBI 157LF Ecosystems of California 4
INTEGBI 158LF Biology and Geomorphology of Tropical Islands 15
INTEGBI 160 Evolution 4
INTEGBI 161 Population and Evolutionary Genetics 4
INTEGBI 162 Ecological Genetics 4
INTEGBI 164 Human Genetics and Genomics 4
INTEGBI 166 Course Not Available 4
INTEGBI 168L Plants: Diversity and Evolution 4
INTEGBI 169 Evolutionary Medicine 4
INTEGBI 173LF Mammalogy with Laboratory 5
INTEGBI 174LF Ornithology with Laboratory 4
INTEGBI 175LF Herpetology with Laboratory 4
INTEGBI 181L Paleobotany - The 500-Million Year History of a Greening Planet 4
INTEGBI 183L Evolution of the Vertebrates with Laboratory 4
INTEGBI 184L Morphology of the Vertebrate Skeleton with Laboratory 4
INTEGBI C185L Course Not Available 4
INTEGBI C187 Human Biogeography of the Pacific 3
IAS C175 The Economics of Climate Change 4
IAS C176 Climate Change Economics 4
LD ARCH 122 Hydrology for Planners 4
LD ARCH C177 GIS and Environmental Spatial Data Analysis 4
LD ARCH C188 Geographic Information Science 4
L & S C180U Wealth and Poverty 4
LEGALST 123 Data, Prediction & Law 4
LINGUIS 100 Introduction to Linguistic Science 4
LINGUIS C105 Cognitive Linguistics 4
LINGUIS 110 Phonetics 4
LINGUIS 113 Experimental Phonetics 3
LINGUIS 140 Field Methods 3
LINGUIS C146 Language Acquisition 3
LINGUIS C147 Course Not Available 4
LINGUIS C160 Quantitative Methods in Linguistics 4
MATH C103 Introduction to Mathematical Economics 4
MATH 104 Introduction to Analysis 4
MATH H104 Honors Introduction to Analysis 4
MATH 105 Second Course in Analysis 4
MATH 110 Linear Algebra 7 4
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MATH 113 Introduction to Abstract Algebra 4
MATH H113 Honors Introduction to Abstract Algebra 4
MATH 114 Second Course in Abstract Algebra 4
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MATH 118 Fourier Analysis, Wavelets, and Signal Processing 4
MATH 121A Mathematical Tools for the Physical Sciences 4
MATH 121B Mathematical Tools for the Physical Sciences 4
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MATH 125A Mathematical Logic 4
MATH 126 Introduction to Partial Differential Equations 4
MATH 127 Mathematical and Computational Methods in Molecular Biology 4
MATH 128A Numerical Analysis 4
MATH 128B Numerical Analysis 4
MATH 130 Groups and Geometries 4
MATH 135 Introduction to the Theory of Sets 4
MATH 136 Incompleteness and Undecidability 4
MATH 140 Metric Differential Geometry 4
MATH 141 Elementary Differential Topology 4
MATH 142 Elementary Algebraic Topology 4
MATH 143 Elementary Algebraic Geometry 4
MATH 170 Mathematical Methods for Optimization 4
MATH 172 Combinatorics 4
MATH 185 Introduction to Complex Analysis 4
MATH H185 Honors Introduction to Complex Analysis 4
MATH 189 Mathematical Methods in Classical and Quantum Mechanics 4
MATH 221 Advanced Matrix Computations 4
MEC ENG 101 Introduction to Lean Manufacturing Systems 3
MEC ENG 102A Course Not Available 4
MEC ENG 102B Mechatronics Design 4
MEC ENG 104 Engineering Mechanics II 3
MEC ENG 106 Fluid Mechanics 3
MEC ENG 107 Course Not Available 3
MEC ENG 108 Mechanical Behavior of Engineering Materials 4
MEC ENG 109 Heat Transfer 3
MEC ENG 110 Introduction to Product Development 3
MEC ENG C115 Molecular Biomechanics and Mechanobiology of the Cell 4
MEC ENG C117 Structural Aspects of Biomaterials 4
MEC ENG 118 Introduction to Nanotechnology and Nanoscience 3
MEC ENG 119 Introduction to MEMS (Microelectromechanical Systems) 3
MEC ENG 120 Computational Biomechanics Across Multiple Scales 3
MEC ENG 122 Processing of Materials in Manufacturing 3
MEC ENG 130 Design of Planar Machinery 3
MEC ENG 131 Vehicle Dynamics and Control 4
MEC ENG 132 Dynamic Systems and Feedback 3
MEC ENG 133 Mechanical Vibrations 3
MEC ENG C134 Feedback Control Systems 4
MEC ENG 135 Design of Microprocessor-Based Mechanical Systems 4
MEC ENG 138 Introduction to Micro/Nano Mechanical Systems Laboratory 4
MEC ENG 140 Combustion Processes 3
MEC ENG 146 Energy Conversion Principles 3
MEC ENG 150A Solar-Powered Vehicles: Analysis, Design and Fabrication 3
MEC ENG 151 Advanced Heat Transfer 3
MEC ENG 163 Engineering Aerodynamics 3
MEC ENG 164 Marine Statics and Structures 3
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<td>UGBA 132</td>
<td>Financial Institutions and Markets</td>
<td>3</td>
</tr>
<tr>
<td>UGBA 133</td>
<td>Investments</td>
<td>3</td>
</tr>
<tr>
<td>UGBA 134</td>
<td>Introduction to Financial Engineering</td>
<td>3</td>
</tr>
<tr>
<td>UGBA 136F</td>
<td>Behavioral Finance</td>
<td>3</td>
</tr>
<tr>
<td>UGBA 141</td>
<td>Production and Operations Management</td>
<td>2-3</td>
</tr>
<tr>
<td>UGBA 160</td>
<td>Customer Insights</td>
<td>3</td>
</tr>
<tr>
<td>UGBA 161</td>
<td>Market Research: Tools and Techniques for Data</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Collection and Analysis</td>
<td></td>
</tr>
<tr>
<td>UGBA 162</td>
<td>Brand Management and Strategy</td>
<td>3</td>
</tr>
<tr>
<td>UGBA 165</td>
<td>Advertising Strategy</td>
<td>3</td>
</tr>
<tr>
<td>UGBA 169</td>
<td>Pricing</td>
<td>3</td>
</tr>
<tr>
<td>UGBA 180</td>
<td>Introduction to Real Estate and Urban Land Economics</td>
<td>3</td>
</tr>
<tr>
<td>UGBA 183</td>
<td>Introduction to Real Estate Finance</td>
<td>3</td>
</tr>
<tr>
<td>UGBA 184</td>
<td>Urban and Real Estate Economics</td>
<td>3</td>
</tr>
</tbody>
</table>

1 Students who have completed any of the math prerequisites at a non-UC institution should look at the Statistics Major Frequently Asked Questions (http://statistics.berkeley.edu/programs/undergrad/major/faq/) on the Statistics Department website.
2 No more than one course repeated between STAT 134 (or STAT C140) and STAT 135.
3 Other non-statistics UC Berkeley courses, such as IND ENG 172, cannot be used to fulfill this requirement.
4 Due to overlap of course content, only one course from STAT 154, COMPSCI 182, COMPSCI 189, and IND ENG 142 can be used to satisfy Statistics major requirements.
5 Students may use UGBA 102A and/or UGBA 102B for their cluster, but may NOT use UC Berkeley Extension's XB102A nor XB102B since, effective Spring 2014, the Haas School of Business no longer deems them equivalent (see http://www.haas.berkeley.edu/Undergrad/ugbacourses.html).
6 Due to overlap of course content, only one course from ECON 136, ENGIN 120 and UGBA 103 can be used to satisfy Statistics major requirements.
7 If MATH 110 or MATH H110 has been used to satisfy the math prerequisite requirement, course cannot be used for the applied cluster.
8 MATH 170 cannot be combined with either IND ENG 160 or IND ENG 162.

Students who have a strong interest in an area of study outside their major often decide to complete a minor program. These programs
have set requirements and are noted officially on the transcript in the memoranda section, but they are not noted on diplomas.

**General Guidelines**

1. All minors must be declared no later than one semester before a student's Expected Graduation Term (EGT). If the semester before EGT is fall or spring, the deadline is the last day of RRR week. If the semester before EGT is summer, the deadline is the final Friday of Summer Sessions. To declare a minor, contact the department advisor for information on requirements, and the declaration process.

2. All courses taken to fulfill the minor requirements below must be taken for graded credit.

3. A minimum of three of the upper division courses taken to fulfill the minor requirements must be completed at UC Berkeley.

4. A minimum grade point average (GPA) of 2.0 is required for courses used to fulfill the minor requirements.

5. Courses used to fulfill the minor requirements may be applied toward the Seven-Course Breadth requirement, for Letters & Science students.

6. No more than one upper division course may be used to simultaneously fulfill requirements for a student's major and minor programs.

7. All minor requirements must be completed prior to the last day of finals during the semester in which the student plans to graduate. Students who cannot finish all courses required for the minor by that time should see a College of Letters & Science adviser.

8. All minor requirements must be completed within the unit ceiling. (For further information regarding the unit ceiling, please see the College Requirements tab.)

**Requirements**

**Lower Division Prerequisites**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 1A</td>
<td>Calculus</td>
<td>4</td>
</tr>
<tr>
<td>or MATH N1A</td>
<td>Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1B</td>
<td>Calculus</td>
<td>4</td>
</tr>
<tr>
<td>or MATH N1B</td>
<td>Calculus</td>
<td>4</td>
</tr>
<tr>
<td>or MATH H1B</td>
<td>Honors Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH 53</td>
<td>Multivariable Calculus</td>
<td>4</td>
</tr>
<tr>
<td>or MATH H53</td>
<td>Honors Multivariable Calculus</td>
<td>4</td>
</tr>
<tr>
<td>or MATH N53</td>
<td>Multivariable Calculus</td>
<td>4</td>
</tr>
<tr>
<td>or MATH W53</td>
<td>Multivariable Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH 54</td>
<td>Linear Algebra and Differential Equations</td>
<td>4</td>
</tr>
<tr>
<td>or MATH H54</td>
<td>Honors Linear Algebra and Differential Equations</td>
<td>4</td>
</tr>
<tr>
<td>or MATH N54</td>
<td>Linear Algebra and Differential Equations</td>
<td>4</td>
</tr>
</tbody>
</table>

**Upper Division Requirements**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 134</td>
<td>Concepts of Probability</td>
<td>4</td>
</tr>
<tr>
<td>or STAT C140</td>
<td>Probability for Data Science</td>
<td>4</td>
</tr>
<tr>
<td>STAT 135</td>
<td>Concepts of Statistics</td>
<td>4</td>
</tr>
</tbody>
</table>

Select three statistics electives from the following; at least one of the selections must have a lab:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT C102</td>
<td>Data, Inference, and Decisions</td>
<td>4</td>
</tr>
<tr>
<td>STAT 150</td>
<td>Stochastic Processes</td>
<td>3</td>
</tr>
<tr>
<td>STAT 151A</td>
<td>Linear Modelling: Theory and Applications (LAB COURSE)</td>
<td>4</td>
</tr>
<tr>
<td>STAT 152</td>
<td>Sampling Surveys (LAB COURSE)</td>
<td>4</td>
</tr>
<tr>
<td>STAT 153</td>
<td>Introduction to Time Series (LAB COURSE)</td>
<td>4</td>
</tr>
</tbody>
</table>

Undergraduate students must fulfill the following requirements in addition to those required by their major program.

For detailed lists of courses that fulfill college requirements, please review the College of Letters & Sciences (http://guide.berkeley.edu/undergraduate/colleges-schools/letters-science/) page in this Guide. For College advising appointments, please visit the L&S Advising (https://lssadvising.berkeley.edu/home/) Pages.

**University of California Requirements**

**Entry Level Writing** (http://writing.berkeley.edu/node/78/)

All students who will enter the University of California as freshmen must demonstrate their command of the English language by fulfilling the Entry Level Writing requirement. Fulfillment of this requirement is also a prerequisite to enrollment in all reading and composition courses at UC Berkeley.

**American History and American Institutions** (http://guide.berkeley.edu/undergraduate/colleges-schools/letters-science/american-history-institutions-requirement/)

The American History and Institutions requirements are based on the principle that a US resident graduated from an American university, should have an understanding of the history and governmental institutions of the United States.

**Berkeley Campus Requirement**

American Cultures (http://americancultures.berkeley.edu/students/courses/)

All undergraduate students at Cal need to take and pass this course in order to graduate. The requirement offers an exciting intellectual environment centered on the study of race, ethnicity and culture of the United States. AC courses offer students opportunities to be part of research-led, highly accomplished teaching environments, grappling with the complexity of American Culture.

**College of Letters & Science Essential Skills Requirements**

Quantitative Reasoning (http://guide.berkeley.edu/undergraduate/colleges-schools/letters-science/quantitative-reasoning-requirement/)

The Quantitative Reasoning requirement is designed to ensure that students graduate with basic understanding and competency in math, statistics, or computer science. The requirement may be satisfied by exam or by taking an approved course.

Foreign Language (http://guide.berkeley.edu/undergraduate/colleges-schools/letters-science/foreign-language-requirement/)

The Foreign Language requirement may be satisfied by demonstrating proficiency in reading comprehension, writing, and conversation in a
foreign language equivalent to the second semester college level, either by passing an exam or by completing approved course work.

Reading and Composition (http://guide.berkeley.edu/undergraduate/colleges-schools/letters-science/reading-composition-requirement/)

In order to provide a solid foundation in reading, writing, and critical thinking the College requires two semesters of lower division work in composition in sequence. Students must complete parts A & B reading and composition courses in sequential order by the end of their fourth semester.

College of Letters & Science 7 Course Breadth Requirements

Breadth Requirements (http://guide.berkeley.edu/undergraduate/colleges-schools/letters-science/#breadthrequirementstext)
The undergraduate breadth requirements provide Berkeley students with a rich and varied educational experience outside of their major program. As the foundation of a liberal arts education, breadth courses give students a view into the intellectual life of the University while introducing them to a multitude of perspectives and approaches to research and scholarship. Engaging students in new disciplines and with peers from other majors, the breadth experience strengthens interdisciplinary connections and context that prepares Berkeley graduates to understand and solve the complex issues of their day.

Unit Requirements

- 120 total units
- Of the 120 units, 36 must be upper division units
- Of the 36 upper division units, 6 must be taken in courses offered outside your major department

Residence Requirements

For units to be considered in "residence," you must be registered in courses on the Berkeley campus as a student in the College of Letters & Science. Most students automatically fulfill the residence requirement by attending classes here for four years. In general, there is no need to be concerned about this requirement, unless you go abroad for a semester or year or want to take courses at another institution or through UC Extension during your senior year. In these cases, you should make an appointment to meet an adviser to determine how you can meet the Senior Residence Requirement.

Note: Courses taken through UC Extension do not count toward residence.

Senior Residence Requirement

After you become a senior (with 90 semester units earned toward your BA degree), you must complete at least 24 of the remaining 30 units in residence in at least two semesters. To count as residence, a semester must consist of at least 6 passed units. Intercampus Visitor, EAP, and UC Berkeley-Washington Program (UCDC) units are excluded.

You may use a Berkeley Summer Session to satisfy one semester of the Senior Residence requirement, provided that you successfully complete 6 units of course work in the Summer Session and that you have been enrolled previously in the college.

Modified Senior Residence Requirement

Participants in the UC Education Abroad Program (EAP), Berkeley Summer Abroad, or the UC Berkeley Washington Program (UCDC) may meet a Modified Senior Residence requirement by completing 24 (excluding EAP) of their final 60 semester units in residence. At least 12 of these 24 units must be completed after you have completed 90 units.

Upper Division Residence Requirement

You must complete in residence a minimum of 18 units of upper division courses (excluding UCEAP units), 12 of which must satisfy the requirements for your major.

Mission

Statisticians help to design data collection plans, analyze data appropriately, and interpret and draw conclusions from those analyses. The central objective of the undergraduate major in Statistics is to equip students with consequently requisite quantitative skills that they can employ and build on in flexible ways.

Learning Goals for the Major

Majors are expected to learn concepts and tools for working with data and have experience in analyzing real data that goes beyond the content of a service course in statistical methods for non-majors. Majors should understand the following:

1. The fundamentals of probability theory
2. Statistical reasoning and inferential methods
3. Statistical computing
4. Statistical modeling and its limitations

Skills

Graduates should also have skills in the following:

1. Description, interpretation, and exploratory analysis of data by graphical and other means
2. Effective communication

Major Maps help undergraduate students discover academic, co-curricular, and discovery opportunities at UC Berkeley based on intended major or field of interest. Developed by the Division of Undergraduate Education in collaboration with academic departments, these experience maps will help you:

- Explore your major and gain a better understanding of your field of study
- Connect with people and programs that inspire and sustain your creativity, drive, curiosity and success
- Discover opportunities for independent inquiry, enterprise, and creative expression
- Engage locally and globally to broaden your perspectives and change the world
- Reflect on your academic career and prepare for life after Berkeley

Use the major map below as a guide to planning your undergraduate journey and designing your own unique Berkeley experience.

View the Statistics Major Map PDF. (https://ue.berkeley.edu/sites/default/files/statistics.pdf)
### STAT 0PX Preparatory Statistics 1 Unit

**Terms offered:** Summer 2016 10 Week Session, Summer 2015 10 Week Session, Summer 2014 10 Week Session

This course assists entering Freshman students with basic statistical concepts and problem solving. Designed for students who do not meet the prerequisites for 2. Offered through the Student Learning Center.

**Preparatory Statistics:** Read More [+]

**Prerequisites:** Consent of instructor

**Hours & Format**

- **Summer:**
  - 6 weeks - 5 hours of lecture and 4.5 hours of workshop per week
  - 8 weeks - 5 hours of lecture and 4.5 hours of workshop per week

**Additional Details**

**Subject/Course Level:** Statistics/Undergraduate

**Grading/Final exam status:** Offered for pass/not pass grade only. Final exam required.

**Instructor:** Purves

Preparatory Statistics: Read Less [-]

### STAT 2 Introduction to Statistics 4 Units

**Terms offered:** Spring 2023, Fall 2022, Summer 2022 8 Week Session, Spring 2022, Fall 2021, Summer 2021 8 Week Session, Fall 2020


**Rules & Requirements**

**Credit Restrictions:** Students will receive no credit for STAT 2 after completing STAT W21, STAT 20, STAT 21, STAT 25, STAT S2, STAT 21X, STAT N21, STAT 5, or STAT 2X.

**Hours & Format**

- **Fall and/or spring:** 15 weeks - 3 hours of lecture and 2 hours of laboratory per week
- **Summer:**
  - 6 weeks - 7.5 hours of lecture and 5 hours of laboratory per week
  - 8 weeks - 5 hours of lecture and 4 hours of laboratory per week

**Additional Details**

**Subject/Course Level:** Statistics/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

Introduction to Statistics: Read Less [-]

### STAT C8 Foundations of Data Science 4 Units

**Terms offered:** Spring 2023, Fall 2022, Summer 2022 8 Week Session, Spring 2022, Fall 2021, Summer 2021 8 Week Session, Fall 2020

Foundations of data science from three perspectives: inferential thinking, computational thinking, and real-world relevance. Given data arising from some real-world phenomenon, how does one analyze that data so as to understand that phenomenon? The course teaches critical concepts and skills in computer programming and statistical inference, in conjunction with hands-on analysis of real-world datasets, including economic data, document collections, geographical data, and social networks. It delves into social and legal issues surrounding data analysis, including issues of privacy and data ownership.

**Foundations of Data Science:** Read More [+]

**Rules & Requirements**

**Prerequisites:** This course may be taken on its own, but students are encouraged to take it concurrently with a data science connector course (numbered 88 in a range of departments)

**Credit Restrictions:** Students will receive no credit for DATA C8/COMPSCI C8/INFO C8/STAT C8 after completing COMPSCI 8, or DATA 8. A deficient grade in DATA C8/COMPSCI C8/INFO C8/STAT C8 may be removed by taking COMPSCI 8, COMPSCI 8, or DATA 8.

**Hours & Format**

- **Fall and/or spring:** 15 weeks - 3 hours of lecture and 2 hours of laboratory per week
- **Summer:** 8 weeks - 6 hours of lecture and 4 hours of laboratory per week

**Additional Details**

**Subject/Course Level:** Statistics/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Formerly known as:** Computer Science C8/Statistics C8/Information C8

**Also listed as:** COMPSCI C8/DATA C8/INFO C8

Foundations of Data Science: Read Less [-]
STAT 20 Introduction to Probability and Statistics 4 Units
Terms offered: Spring 2023, Fall 2022, Summer 2022 8 Week Session
For students with mathematical background who wish to acquire basic concepts. Relative frequencies, discrete probability, random variables, expectation. Testing hypotheses. Estimation. Illustrations from various fields.
Introduction to Probability and Statistics: Read More [+]
Rules & Requirements
Prerequisites: Mathematics 1A, Mathematics 16A, Mathematics 10A/10B, or consent of instructor.
Credit Restrictions: Students will receive no credit for STAT 20 after completing STAT W21, STAT 2, STAT 5, STAT 21, STAT N21, STAT 2X, STAT S20, STAT 21X, or STAT 25. A deficient grade in STAT 20 may be removed by taking STAT W21, STAT 21, or STAT N21. Students who have taken 2, 2X, 5, 21, 21X, or 25 will receive no credit for 20.
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week
Summer: 8 weeks - 6 hours of lecture and 3 hours of laboratory per week
Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Introduction to Probability and Statistics: Read Less [-]

STAT 20 Introduction to Probability and Statistics 4 Units
Terms offered: Spring 2023, Fall 2022, Summer 2022 8 Week Session
For students with mathematical background who wish to acquire basic concepts. Relative frequencies, discrete probability, random variables, expectation. Testing hypotheses. Estimation. Illustrations from various fields.
Introduction to Probability and Statistics: Read More [+]
Rules & Requirements
Prerequisites: Mathematics 1A, Mathematics 16A, Mathematics 10A/10B, or consent of instructor.
Credit Restrictions: Students will receive no credit for STAT 20 after completing STAT W21, STAT 2, STAT 5, STAT 21, STAT N21, STAT 2X, STAT S20, STAT 21X, or STAT 25. A deficient grade in STAT 20 may be removed by taking STAT W21, STAT 21, or STAT N21. Students who have taken 2, 2X, 5, 21, 21X, or 25 will receive no credit for 20.
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Summer: 8 weeks - 7.5 hours of lecture per week
Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Introduction to Probability and Statistics: Read Less [-]

STAT 21 Introductory Probability and Statistics for Business 4 Units
Terms offered: Summer 2022 8 Week Session, Fall 2016, Fall 2015
Descriptive statistics, probability models and related concepts, sample surveys, estimates, confidence intervals, tests of significance, controlled experiments vs. observational studies, correlation and regression.
Introductory Probability and Statistics for Business: Read More [+]
Rules & Requirements
Prerequisites: One semester of calculus
Credit Restrictions: Students will receive no credit for STAT 21 after completing STAT 20, STAT W21, STAT 25, STAT 2X, STAT S21, STAT 5, STAT 21, or STAT N21. A deficient grade in STAT 21 may be removed by taking STAT 20, STAT W21, or STAT N21.
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Summer: 8 weeks - 7.5 hours of lecture per week
Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Introductory Probability and Statistics for Business: Read Less [-]
STAT W21 Introductory Probability and Statistics for Business 4 Units
Terms offered: Summer 2021 8 Week Session, Summer 2020 8 Week Session, Summer 2019 8 Week Session
Reasoning and fallacies, descriptive statistics, probability models and related concepts, combinatorics, sample surveys, estimates, confidence intervals, tests of significance, controlled experiments vs. observational studies, correlation and regression.
Introductory Probability and Statistics for Business: Read More [+]

Rules & Requirements

Prerequisites: One semester of calculus

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of web-based lecture per week
Summer: 8 weeks - 7.5 hours of web-based lecture per week
Online: This is an online course.

Additional Details

Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Formerly known as: N21

STAT 24 Freshman Seminars 1 Unit
Terms offered: Spring 2021, Fall 2016, Fall 2003
The Berkeley Seminar Program has been designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small-seminar setting. Berkeley seminars are offered in all campus departments, and topics vary from department to department and semester to semester. Enrollment limited to 15 freshmen.
Freshman Seminars: Read More [+]

Rules & Requirements

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of seminar per week

Additional Details

Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

STAT 33A Introduction to Programming in R 1 Unit
Terms offered: Spring 2023, Fall 2022, Spring 2022
An introduction to the R statistical software for students with minimal prior experience with programming. This course prepares students for data analysis with R. The focus is on the computational model that underlies the R language with the goal of providing a foundation for coding. Topics include data types and structures, such as vectors, data frames and lists; the REPL evaluation model; function calls, argument matching, and environments; writing simple functions and control flow. Tools for reading, analyzing, and plotting data are covered, such as data input/output, reshaping data, the formula language, and graphics models.

Introduction to Programming in R: Read More [+]

Rules & Requirements

Credit Restrictions: Students will receive no credit for STAT 33A after completing STAT 33B, or STAT 133. A deficient grade in STAT 33A may be removed by taking STAT 33B, or STAT 133.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture and 1 hour of laboratory per week
Summer: 6 weeks - 2 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
STAT 33B Introduction to Advanced Programming in R 1 Unit
Terms offered: Spring 2023, Fall 2022, Spring 2022
The course is designed primarily for those who are already familiar with programming in another language, such as python, and want to understand how R works, and for those who already know the basics of R programming and want to gain a more in-depth understanding of the language in order to improve their coding. The focus is on the underlying paradigms in R, such as functional programming, atomic vectors, complex data structures, environments, and object systems.

The goal of this course is to better understand programming principles in general and to write better R code that capitalizes on the language’s design.

Introduction to Advanced Programming in R: Read More [+]

Rules & Requirements
Prerequisites: Compsci 61A or equivalent programming background

Credit Restrictions: Students will receive no credit for STAT 33B after completing STAT 133. A deficient grade in STAT 33B may be removed by taking STAT 133.

Hours & Format
Fall and/or spring: 15 weeks - 1 hour of lecture and 1 hour of laboratory per week
Summer: 6 weeks - 2 hours of lecture and 3 hours of laboratory per week

Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Introduction to Advanced Programming in R: Read Less [-]

STAT 39D Freshman/Sophomore Seminar 2 - 4 Units
Terms offered: Fall 2008, Fall 2007
Freshman and sophomore seminars offer lower division students the opportunity to explore an intellectual topic with a faculty member and a group of peers in a small-seminar setting. These seminars are offered in all campus departments; topics vary from department to department and from semester to semester.

Freshman/Sophomore Seminar: Read More [+]

Rules & Requirements
Prerequisites: Priority given to freshmen and sophomores
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 2-4 hours of seminar per week

Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Freshman/Sophomore Seminar: Read Less [-]

STAT C79 Societal Risks and the Law 3 Units
Terms offered: Spring 2013
Defining, perceiving, quantifying and measuring risk; identifying risks and estimating their importance; determining whether laws and regulations can protect us from these risks; examining how well existing laws work and how they could be improved; evaluating costs and benefits. Applications may vary by term. This course cannot be used to complete engineering unit or technical elective requirements for students in the College of Engineering.

Societal Risks and the Law: Read More [+]

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam not required.

Also listed as: COMPSCI C79/POL SCI C79

Societal Risks and the Law: Read Less [-]

STAT C88S Probability and Mathematical Statistics in Data Science 3 Units
Terms offered: Spring 2023, Fall 2022
In this connector course we will state precisely and prove results discovered while exploring data in Data 8. Topics include: probability, conditioning, and independence; random variables; distributions and joint distributions; expectation, variance, tail bounds; Central Limit Theorem; symmetries in random permutations; prior and posterior distributions; probabilistic models; bias-variance tradeoff; testing hypotheses; correlation and the regression model.

Probability and Mathematical Statistics in Data Science: Read More [+]

Rules & Requirements
Prerequisites: Prerequisite: one semester of calculus at the level of Math 16A, Math 10A, or Math 1A. Corequisite or Prerequisite: Foundations of Data Science (COMPSCI C8 / DATA C8 / INFO C8 / STAT C8)

Credit Restrictions: Students will receive no credit for STAT 88 after completing STAT 134, STAT 140, STAT 135, or STAT 102.

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of discussion per week
Summer: 8 weeks - 6 hours of lecture and 4 hours of discussion per week

Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Statistics 88

Also listed as: DATA C88S

Probability and Mathematical Statistics in Data Science: Read Less [-]
STAT 89A Linear Algebra for Data Science 4 Units
Terms offered: Spring 2022, Spring 2021, Spring 2020
An introduction to linear algebra for data science. The course will cover
introductory topics in linear algebra, starting with the basics; discrete
probability and how probability can be used to understand high-
dimensional vector spaces; matrices and graphs as popular mathematical
structures with which to model data (e.g., as models for term-document
corpora, high-dimensional regression problems, ranking/classification
of web data, adjacency properties of social network data, etc.); and
topics in linear algebra for data science. Read More [+]

Rules & Requirements
Prerequisites: One year of calculus. Prerequisite or corequisite:
Foundations of Data Science (COMPSCI C8 / INFO C8 / STAT C8)

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of
laboratory per week

Additional Details
Subject/Course Level: Statistics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Linear Algebra for Data Science: Read Less [-]

STAT 94 Special Topics in Probability and Statistics 1 - 4 Units
Terms offered: Fall 2015
Topics will vary semester to semester. Special Topics in Probability and Statistics: Read More [+]

Rules & Requirements
Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format
Fall and/or spring: 15 weeks - 1-3 hours of lecture and 0-2 hours of
discussion per week

Additional Details
Subject/Course Level: Statistics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Special Topics in Probability and Statistics: Read Less [-]

STAT 97 Field Study in Statistics 1 - 3 Units
Terms offered: Fall 2015, Spring 2012
Supervised experience relevant to specific aspects of statistics in off-
campus settings. Individual and/or group meetings with faculty. Field Study in Statistics: Read More [+]

Rules & Requirements
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 1-3 hours of fieldwork per week
Summer:
6 weeks - 2.5-7.5 hours of fieldwork per week
8 weeks - 1.5-5.5 hours of fieldwork per week

Additional Details
Subject/Course Level: Statistics/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Field Study in Statistics: Read Less [-]

STAT 98 Directed Group Study 1 - 3 Units
Terms offered: Spring 2023, Fall 2022, Spring 2022
Must be taken at the same time as either Statistics 2 or 21. This course
assists lower division statistics students with structured problem solving,
interpretation and making conclusions. Directed Group Study: Read More [+]

Rules & Requirements
Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 2-3 hours of directed group study per
week
Summer: 8 weeks - 4-6 hours of directed group study per week

Additional Details
Subject/Course Level: Statistics/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Directed Group Study: Read Less [-]
STAT C100 Principles & Techniques of Data Science 4 Units
Terms offered: Spring 2023, Fall 2022, Summer 2022 8 Week Session, Spring 2022, Fall 2021, Fall 2020
In this course, students will explore the data science lifecycle, including question formulation, data collection and cleaning, exploratory data analysis and visualization, statistical inference and prediction, and decision-making. This class will focus on quantitative critical thinking and key principles and techniques needed to carry out this cycle. These include languages for transforming, querying and analyzing data; algorithms for machine learning methods including regression, classification and clustering; principles behind creating informative data visualizations; statistical concepts of measurement error and prediction; and techniques for scalable data processing.

Principles & Techniques of Data Science: Read More [+]
Rules & Requirements
Prerequisites: COMPSCI C8 / DATA C8 / INFO C8 / STAT C8; and COMPSCI 61A, COMPSCI 88, or ENGIN 7; Corequisite: MATH 54 or EECS 16A

Credit Restrictions: Students will receive no credit for DATA C100/STAT C100/COMPSCI C100 after completing DATA 100. A deficient grade in DATA C100/STAT C100/COMPSCI C100 may be removed by taking DATA 100.

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 1 hour of laboratory per week
Summer: 8 weeks - 6 hours of lecture, 2 hours of discussion, and 2 hours of laboratory per week

Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Formerly known as: Statistics C100/Computer Science C100
Also listed as: COMPSCI C100/DATA C100

Principles & Techniques of Data Science: Read Less [-]
STAT C131A Statistical Methods for Data Science 4 Units
Terms offered: Spring 2023, Fall 2022, Spring 2022
This course teaches a broad range of statistical methods that are used to solve data problems. Topics include group comparisons and ANOVA, standard parametric statistical models, multivariate data visualization, multiple linear regression, logistic regression and classification, regression trees and random forests. An important focus of the course is on statistical computing and reproducible statistical analysis. The course and lab include hands-on experience in analyzing real world data from the social, life, and physical sciences. The R statistical language is used. Statistical Methods for Data Science: Read More [+] Rules & Requirements
Prerequisites: Statistics/Computer Science/Information C8 or Statistics 20; and Mathematics 1A, Mathematics 16A, or Mathematics 10A/10B. Strongly recommended corequisite: Statistics 33A or Statistics 133
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week
Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Formerly known as: Statistics 131A
Also listed as: DATA C131A
Statistical Methods for Data Science: Read Less [-]

STAT 134 Concepts of Probability 4 Units
Terms offered: Spring 2023, Fall 2022, Summer 2022 8 Week Session
An introduction to probability, emphasizing concepts and applications. Conditional expectation, independence, laws of large numbers. Discrete and continuous random variables. Central limit theorem. Selected topics such as the Poisson process, Markov chains, characteristic functions. Concepts of Probability: Read More [+] Rules & Requirements
Prerequisites: One year of calculus
Credit Restrictions: Students will not receive credit for 134 after taking 140 or 201A.
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of discussion per week
Summer: 8 weeks - 6 hours of lecture and 4 hours of discussion per week
Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Concepts of Probability: Read Less [-]

STAT 135 Concepts of Statistics 4 Units
Terms offered: Spring 2023, Fall 2022, Spring 2022
A comprehensive survey course in statistical theory and methodology. Topics include descriptive statistics, maximum likelihood estimation, non-parametric methods, introduction to optimality, goodness-of-fit tests, analysis of variance, bootstrap and computer-intensive methods and least squares estimation. The laboratory includes computer-based data-analytic applications to science and engineering. Concepts of Statistics: Read More [+] Rules & Requirements
Prerequisites: STAT 134 or STAT 140; and MATH 54, EL ENG 16A, STAT 89A, MATH 110 or equivalent linear algebra. Strongly recommended corequisite: STAT 133
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week
Summer: 8 weeks - 6 hours of lecture and 4 hours of laboratory per week
Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Concepts of Statistics: Read Less [-]

STAT 133 Concepts in Computing with Data 3 Units
Terms offered: Spring 2023, Fall 2022, Spring 2022
An introduction to computationally intensive applied statistics. Topics will include organization and use of databases, visualization and graphics, statistical learning and data mining, model validation procedures, and the presentation of results. Concepts in Computing with Data: Read More [+] Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week
Summer: 10 weeks - 4 hours of lecture and 3 hours of laboratory per week
Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Concepts in Computing with Data: Read Less [-]
STAT C140 Probability for Data Science 4 Units
Terms offered: Spring 2023, Fall 2022, Spring 2022, Fall 2021

Objectives & Outcomes
Course Objectives: Data/Stat C140 is a probability course for Data C8 graduates who have taken more mathematics and wish to go deeper into data science. The emphasis on simulation and the bootstrap in Data C8 gives students a concrete sense of randomness and sampling variability. Data/Stat C140 capitalizes on this, abstraction and computation complementing each other throughout. Topics in statistical theory are included to allow students to proceed to modeling and statistical learning classes without taking a further semester of mathematical statistics.

Student Learning Outcomes: Understand the difference between math and simulation, and appreciate the power of both. Use a variety of approaches to problem solving. Work with probability concepts algebraically, numerically, and graphically.

Rules & Requirements
Prerequisites: DATA/COMPSCI/INFO/STAT C8, or both STAT 20 and one of COMPSCI 61A or COMPSCI/DATA C88C; and one year of calculus at the level of MATH 1A-1B or higher. Corequisite: MATH 54, EECS 16B, MATH 110 or equivalent linear algebra.

Credit Restrictions: Students will receive no credit for STAT C140 after completing STAT 134, or EECS 126. A deficient grade in STAT C140 may be removed by taking STAT 134.

Hours & Format
Fall and/or spring: 15 weeks - 3-3 hours of lecture, 2-2 hours of discussion, and 0-1 hours of supplement per week.

Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Probability for Data Science: Read Less [-]

STAT 150 Stochastic Processes 3 Units
Terms offered: Spring 2023, Fall 2022, Spring 2022
Random walks, discrete time Markov chains, Poisson processes. Further topics such as: continuous time Markov chains, queueing theory, point processes, branching processes, renewal theory, stationary processes, Gaussian processes.

Rules & Requirements
Prerequisites: 101 or 103A or 134

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Stochastic Processes: Read Less [-]

STAT 151A Linear Modelling: Theory and Applications 4 Units
Terms offered: Spring 2023, Fall 2022, Fall 2021
A coordinated treatment of linear and generalized linear models and their application. Linear regression, analysis of variance and covariance, random effects, design and analysis of experiments, quality improvement, log-linear models for discrete multivariate data, model selection, robustness, graphical techniques, productive use of computers, in-depth case studies.

Rules & Requirements
Prerequisites: DATA 102 or DATA 135. DATA 133 recommended

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week

Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Linear Modelling: Theory and Applications: Read Less [-]
STAT 152 Sampling Surveys 4 Units
Terms offered: Spring 2020, Spring 2019, Spring 2018

Rules & Requirements
Prerequisites: 101 or 134, 133 and 135 recommended

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week

Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Sampling Surveys: Read More [+]
Sampling Surveys: Read Less [-]

STAT 153 Introduction to Time Series 4 Units
Terms offered: Spring 2023, Fall 2022, Spring 2022
An introduction to time series analysis in the time domain and spectral domain. Topics will include: estimation of trends and seasonal effects, autoregressive moving average models, forecasting, indicators, harmonic analysis, spectra.

Introduction to Time Series: Read More [+]

Rules & Requirements
Prerequisites: 101, 134 or consent of instructor. 133 or 135 recommended

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week

Summer: 10 weeks - 4.5 hours of lecture and 3 hours of laboratory per week

Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Introduction to Time Series: Read Less [-]

STAT 154 Modern Statistical Prediction and Machine Learning 4 Units
Terms offered: Spring 2023, Fall 2022, Spring 2022

Modern Statistical Prediction and Machine Learning: Read More [+]
Modern Statistical Prediction and Machine Learning: Read Less [-]

Rules & Requirements
Prerequisites: Mathematics 53 or equivalent; Mathematics 54, Electrical Engineering 16A, Statistics 89A, Mathematics 110 or equivalent linear algebra; Statistics 135, the combination of Data/Stat C140 and Data/Stat/Compsci C100, or equivalent; experience with some programming language. Recommended prerequisite: Mathematics 55 or equivalent exposure to counting arguments

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week

Summer: 10 weeks - 4.5 hours of lecture and 3 hours of laboratory per week

Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Modern Statistical Prediction and Machine Learning: Read Less [-]

STAT 155 Game Theory 3 Units
Terms offered: Spring 2023, Fall 2022, Spring 2022
General theory of zero-sum, two-person games, including games in extensive form and continuous games, and illustrated by detailed study of examples.

Game Theory: Read More [+]
Game Theory: Read Less [-]

Rules & Requirements
Prerequisites: 101 or 134

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Summer: 8 weeks - 6 hours of lecture per week

Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Game Theory: Read Less [-]
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
<th>Terms Offered</th>
<th>Description</th>
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<tbody>
<tr>
<td>STAT 156</td>
<td>Causal Inference</td>
<td>4</td>
<td>Fall 2022, Fall 2021, Fall 2020</td>
<td>This course will focus on approaches to causal inference using the potential outcomes framework. It will also use causal diagrams at an intuitive level. The main topics are classical randomized experiments, observational studies, instrumental variables, principal stratification and mediation analysis. Applications are drawn from a variety of fields including political science, economics, sociology, public health, and medicine. This course is a mix of statistical theory and data analysis.</td>
</tr>
<tr>
<td>STAT 157</td>
<td>Seminar on Topics in Probability and Statistics</td>
<td>3</td>
<td>Spring 2023, Spring 2022, Fall 2020</td>
<td>Substantial student participation required. The topics to be covered each semester that the course may be offered will be announced by the middle of the preceding semester; see departmental bulletins. Recent topics include: Bayesian statistics, statistics and finance, random matrix theory, high-dimensional statistics.</td>
</tr>
<tr>
<td>STAT 158</td>
<td>Experimental Design</td>
<td>4</td>
<td>Spring 2023, Spring 2021, Spring 2020</td>
<td>This course will review the statistical foundations of randomized experiments and study principles for addressing common setbacks in experimental design and analysis in practice. We will cover the notion of potential outcomes for causal inference and the Fisherian principles for experimentation (randomization, blocking, and replications). We will also cover experiments with complex structures (clustering in units, factorial design, hierarchy in treatments, sequential assignment, etc).</td>
</tr>
<tr>
<td>STAT 159</td>
<td>Reproducible and Collaborative Statistical Data Science</td>
<td>4</td>
<td>Spring 2023, Spring 2022, Spring 2021</td>
<td>A project-based introduction to statistical data analysis. Through case studies, computer laboratories, and a term project, students will learn practical techniques and tools for producing statistically sound and appropriate, reproducible, and verifiable computational answers to scientific questions. Course emphasizes version control, testing, process automation, code review, and collaborative programming. Software tools may include Bash, Git, Python, and LaTeX.</td>
</tr>
</tbody>
</table>

**Rules & Requirements**

**Prerequisites:**
- STAT 156: Statistics 135
- STAT 158: Statistics 134 and Statistics 135 and experience with Software R, or consent of instructor
- STAT 159: Statistics 133, Statistics 134, and Statistics 135 (or equivalent)

**Hours & Format**

- Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week

**Additional Details**

- Subject/Course Level: Statistics/Undergraduate
- Grading/Final exam status: Letter grade. Final exam required.
- Repeat rules: Course may be repeated for credit with instructor consent.

**Seminar on Topics in Probability and Statistics:**

- Fall and/or spring: 15 weeks - 3 hours of seminar per week

**Grading/Final exam status:**

- Letter grade. Final exam required.

**Experimental Design:**

- Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week

**Grading/Final exam status:**

- Letter grade. Final exam required.

**Reproducible and Collaborative Statistical Data Science:**

- Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week

**Grading/Final exam status:**

- Letter grade. Alternative to final exam.
STAT H195 Special Study for Honors Candidates 1 - 4 Units
Terms offered: Spring 2015, Fall 2014, Fall 2010
Special Study for Honors Candidates: Read More [+]
Rules & Requirements
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 0 hours of independent study per week
Summer:
6 weeks - 1-5 hours of independent study per week
8 weeks - 1-4 hours of independent study per week

Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Letter grade. Final exam not required.

Special Study for Honors Candidates: Read Less [-]

STAT 197 Field Study in Statistics 0.5 - 3 Units
Terms offered: Fall 2021, Fall 2020, Spring 2017
Supervised experience relevant to specific aspects of statistics in on-campus or off-campus settings. Individual and/or group meetings with faculty.
Field Study in Statistics: Read More [+]
Rules & Requirements
Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 2-9 hours of fieldwork per week
Summer:
6 weeks - 3-22 hours of fieldwork per week
8 weeks - 2-16 hours of fieldwork per week
10 weeks - 2-12 hours of fieldwork per week

Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.
Field Study in Statistics: Read Less [-]

STAT 198 Directed Study for Undergraduates 1 - 3 Units
Terms offered: Fall 2022, Spring 2022, Fall 2021
Special tutorial or seminar on selected topics.
Directed Study for Undergraduates: Read More [+]
Rules & Requirements
Prerequisites: Consent of instructor
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 1-3 hours of directed group study per week
Summer:
6 weeks - 2.5-7.5 hours of directed group study per week
8 weeks - 1.5-5.5 hours of directed group study per week

Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.
Directed Study for Undergraduates: Read Less [-]

STAT 199 Supervised Independent Study and Research 1 - 3 Units
Terms offered: Fall 2019, Fall 2018, Spring 2017
Supervised Independent Study and Research: Read More [+]
Rules & Requirements
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 1-3 hours of independent study per week
Summer:
6 weeks - 1-4 hours of independent study per week
8 weeks - 1-3 hours of independent study per week
10 weeks - 1-3 hours of independent study per week

Additional Details
Subject/Course Level: Statistics/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.
Supervised Independent Study and Research: Read Less [-]