STATISTICS

Courses offered by the Department of Statistics are listed under the subject code STATS on the Stanford Bulletin's ExploreCourses web site.

The department's goals are to acquaint students with the role played in science and technology by probabilistic and statistical ideas and methods, to provide instruction in the theory and application of techniques that have been found to be commonly useful, and to train research workers in probability and statistics. There are courses for general students as well as those who plan careers in statistics in business, government, industry, and teaching.

The department has long recognized the relation of statistical theory to applications. It has fostered this by encouraging a liaison with other departments in the form of joint and courtesy faculty appointments, as well as membership in various interdisciplinary programs: Biomedical Data Science, Bio-X, Center for Computational, Evolutionary and Human Genomics, Computer Science, Economics, Education, Electrical Engineering, Environmental Earth System Science, Genetics, Mathematics, Mathematical and Computational Finance, and Medicine. The research activities of the department reflect an interest in applied and theoretical statistics and probability. There are workshops in biology/medicine and in environmental factors in health.

In addition to courses for Statistics students, the department offers a number of service courses designed for students in other departments. These tend to emphasize the application of statistical techniques rather than their theoretical development.

The department has always drawn visitors from other countries and universities, and as a result there are a wide range of seminars offered by both the visitors and the department's own faculty.

Undergraduate Programs in Statistics

The department offers a minor in Statistics and in Data Science (https://statistics.stanford.edu/academics/undergraduate-programs). Program details can be found under the Minor section.

Undergraduates Interested in Statistics

Students wishing to build a concentration in probability and statistics are encouraged to consider declaring a major in Mathematical and Computational Science (https://mcs.stanford.edu). This interdisciplinary program is administered in the Department of Statistics and provides core training in computing, mathematics, operations research, and statistics, with opportunities for further elective work and specialization. See the "Mathematical and Computational Science" section of this bulletin.

Graduate Programs in Statistics

University requirements for the M.S. and Ph.D. degrees are discussed in the "Graduate Degrees (http://exploredegrees.stanford.edu/graduatedegrees)" section of this bulletin.

Learning Outcomes (Graduate)

The purpose of the master's program is to further develop knowledge and skills in Statistics and to prepare students for a professional career or doctoral studies. This is achieved through completion of courses, in the primary field as well as related areas, and experience with independent work and specialization.

The Ph.D. is conferred upon candidates who have demonstrated substantial scholarship and the ability to conduct independent research and analysis in Statistics. Through completion of advanced course work and rigorous skills training, the doctoral program prepares students to make original contributions to the knowledge of Statistics and to interpret and present the results of such research.

The Department of Statistics offers two minor programs for undergraduates, a minor in Data Science and a minor in Statistics. To declare either minor for a degree program, visit the Statistics website (https://statistics.stanford.edu/academic-programs/undergraduate-programs) and submit the appropriate form to the department.

Minor in Data Science

The undergraduate Data Science minor has been designed for majors in the humanities and social sciences who want to gain practical knowledge of statistical data analytic methods as it relates to their field of interest. The minor:

- provides students with the knowledge of exploratory and confirmatory data analyses of diverse data types such as text, numbers, images, graphs, trees, and binary input)
- strengthens social research by teaching students how to correctly apply data analysis tools and the techniques of data visualization to convey their conclusions.

No previous programming or statistical background is assumed.

Learning Outcomes

Students are expected to:

1. be able to connect data to underlying phenomena and to think critically about conclusions drawn from data analysis.
2. be knowledgeable about programming abstractions so that they can later design their own computational inferential procedures

All courses for the minor must be taken for a letter grade, with the exception of the Data Mining requirement.

Seven courses are required, 22 units minimum. An overall 2.75 grade point average (GPA) is required for courses fulfilling the minor.

Requirements

Linear Algebra

		Units
One of the following:		
MATH 51	Linear Algebra, Multivariable Calculus, and Modern Applications	5
CME 100	Vector Calculus for Engineers	5

Programming

		Units
CS 106A	Programming Methodology	3-5

Programming in *R*

		Units
One of the following:		
STATS 32	Introduction to R for Undergraduates	1
STATS 195	Introduction to R	1
THINK 3	Breaking Codes, Finding Patterns	4
STATS 48N	Riding the Data Wave	3
Or other course that teaches proficiency in R programming.		

Data Science

		Units
STATS 101	Data Science 101	5

Statistics

		Units
One of the following:		
ECON 102A	Introduction to Statistical Methods (Postcalculus) for Social Scientists	5
PHIL 166	Probability: Ten Great Ideas About Chance	4
STATS 141	Biostatistics	3-5
STATS 191	Introduction to Applied Statistics	3-4
STATS 211	Meta-research: Appraising Research Findings, Bias, and Meta-analysis	3
STATS 216	Introduction to Statistical Learning	3

Data Mining and Analysis

STATS 202	Data Mining and Analysis (may be taken CR/NC)	3

Elective Course

		Units
One course fulfilling Data Science methodology from cognate field of interest. Suggested courses:		
CS 224W	Analysis of Networks	3-4
ECON 291	Social and Economic Networks	2-5
ENGLISH 184E	Literary Text Mining	5
LINGUIST 275	Probability and Statistics for linguists	2-4
MS&E 135	Networks	3
PHIL 50S		3
PHIL 166	Probability: Ten Great Ideas About Chance	4
POLISCI 150B	Machine Learning for Social Scientists	5
POLISCI 155		5
POLISCI 450A	Political Methodology I: Regression	5
PSYCH 109	An introduction to computation and cognition	4
PUBLPOL 105	Empirical Methods in Public Policy	4-5
SOC 126	Introduction to Social Networks	4
SOC 180A	Foundations of Social Research	4
or SOC 180B	Introduction to Data Analysis	

Minor in Statistics

The undergraduate minor in Statistics is designed to complement major degree programs primarily in the social and natural sciences. Students with an undergraduate Statistics minor should find broadened possibilities for employment. The Statistics minor provides valuable preparation for professional degree studies in postgraduate academic programs.

The minor consists of a minimum of six courses with a total of at least 20 units. There are two required courses (8 units) and four qualifying or elective courses (12 or more units). All courses for the minor must be taken for a letter grade. An overall 2.75 grade point average (GPA) is required for courses fulfilling the minor.

Required Courses

		Units
Both:		
STATS 116	Theory of Probability	4
STATS 200	Introduction to Statistical Inference	3

Qualifying Courses

At most, one of these two courses may be counted toward the six course requirement for the minor.

		Units
Choose one from the following:		
MATH 52	Integral Calculus of Several Variables	5
STATS 191	Introduction to Applied Statistics	3-4

Elective Courses

At least one of the elective courses should be a STATS 200-level course. The remaining two elective courses may also be 200-level courses. Alternatively, one or two elective courses may be approved courses in other departments. Special topics courses and seminars for undergraduates are offered from time to time by the department, and these may be counted toward the course requirement. Students may not count any Statistics courses below the 100 level toward the minor.

Examples of elective course sequences are:

		Units
Data Analysis and Applied Statistics		
STATS 202	Data Mining and Analysis	3
STATS 203	Introduction to Regression Models and Analysis of Variance	3
Statistical Methodology		
STATS 205	Introduction to Nonparametric Statistics	3
STATS 206	Applied Multivariate Analysis	3
STATS 207	Introduction to Time Series Analysis	3
Economic Optimization		
STATS 206	Applied Multivariate Analysis	3
ECON 160	Game Theory and Economic Applications	5
Psychology Modeling and Experiments		
STATS 206	Applied Multivariate Analysis	3
Signal Processing		
STATS 207	Introduction to Time Series Analysis	3
EE 264	Digital Signal Processing	3
EE 279	Introduction to Digital Communication	3
Genetic and Ecologic Modeling		
STATS 217	Introduction to Stochastic Processes I	3
BIO 283	Theoretical Population Genetics	3
Probability and Applications		
STATS 217	Introduction to Stochastic Processes I	3
STATS 218	Introduction to Stochastic Processes II	3
Mathematical Finances		
STATS 240	Statistical Methods in Finance	3-4
STATS 243	Risk Analytics and Management in Finance and Insurance	3
STATS 250	Mathematical Finance	3

Master of Science in Statistics

The University's basic requirements for the M.S. degree are discussed in the "Graduate Degrees" (http://exploredegrees.stanford.edu/graduatedegrees) section of this bulletin. The following are specific departmental requirements.

The M.S. in Statistics and the M.S. in Statistics, Data Science track, are intended as terminal degree programs and do not lead to the Ph.D. program in Statistics. Students interested in pursuing doctoral study in Statistics should apply directly to the Ph.D. program.

Admission

Prospective applicants should consult the Graduate Admissions (https://gradadmissions.stanford.edu) and the Statistics Department admissions

web pages (https://statistics.stanford.edu/academics/admissions) for complete information on admission requirements and deadlines.

Recommended preparatory courses include advanced undergraduate level courses in linear algebra, statistics/probability and proficiency in programming.

Stanford students interested in the Data Science subplan in Statistics must apply as external candidates. Visit Graduate Admissions (https://gradadmissions.stanford.edu) to start an application.

Coterminal Master's Program

Stanford undergraduates who want to apply for the coterminal master's degree must submit a complete application to the department by the deadline published on Statistics Department admissions web page. (https://statistics.stanford.edu/academics/ms-coterm-apply)

Applications are accepted twice a year in Autumn and Winter quarters for the coterminal master's degree program in Statistics.

Students pursuing the Statistics coterminal master's degree must follow the same curriculum requirements stated in the Requirements for the Master of Science in Statistics section.

University Coterminal Requirements

Coterminal master's degree candidates are expected to complete all master's degree requirements as described in this bulletin. University requirements for the coterminal master's degree are described in the "Coterminal Master's Program (http://exploredegrees.stanford.edu/cotermdegrees)" section. University requirements for the master's degree are described in the "Graduate Degrees (http://exploredegrees.stanford.edu/graduatedegrees/#masterstext)" section of this bulletin.

After accepting admission to this coterminal master's degree program, students may request transfer of courses from the undergraduate to the graduate career to satisfy requirements for the master's degree. Transfer of courses to the graduate career requires review and approval of both the undergraduate and graduate programs on a case by case basis.

In this master's program, courses taken three quarters prior to the first graduate quarter, or later, are eligible for consideration for transfer to the graduate career. No courses taken prior to the first quarter of the sophomore year may be used to meet master's degree requirements.

Course transfers are not possible after the bachelor's degree has been conferred.

The University requires that the graduate adviser be assigned in the student's first graduate quarter even though the undergraduate career may still be open. The University also requires that the Master's Degree Program Proposal be completed by the student and approved by the department by the end of the student's first graduate quarter.

Master of Science in Statistics

Curriculum and Degree Requirements

The department requires that a master's student take 45 units of work from offerings in the Department of Statistics (http://explorecourses.stanford.edu/search?view=catalog&filter-coursestatus-Active=on&page=0&catalog=&academicYear=&q=STATS&collapse=) or from authorized courses in other departments. With the advice of the master's program advisers, each student selects his or her own set of electives.

All requirements for a master's degree, including the coterminal master's degree, must be completed within three years after the student's first term of enrollment in the master's program. Ordinarily, four or five quarters are needed to complete all requirements. Honors Cooperative students must finish within five years.

Units for a given course may not be counted to meet the requirements of more than one degree, with the exception that up to 45 units of a Stanford M.A. or M.S. degree may be applied to the residency requirement for the Ph.D., D.M.A. or Engineer degrees. See the "Residency Policy for Graduate Students (http://exploredegrees.stanford.edu/graduatedegrees/#residencytext)" section of this Bulletin for University rules.

As defined in the general graduate student requirements, students must maintain a grade point average (GPA) of 3.0 (or better) for courses used to fulfill degree requirements and classes must be taken at the 200 level or higher. No thesis is required.

Master's Degree Program Proposal

The Statistics Master's Degree Program Proposal form (https://statistics.stanford.edu/masters-program-proposal-form) must be submitted to the department's student services administrator prior to the end of the first quarter of enrollment in the program.

A revised program proposal must be submitted if degree plans change.

There is no thesis requirement.

For further information about the Statistics master's degree program requirements, see the department web site (https://statistics.stanford.edu/academics/ms-statistics). (https://statistics.stanford.edu/masters-program-proposal-form)

1. Statistics Core Courses (must complete all four courses):

		Units
Probability		
STATS 116	Theory of Probability [1,2]	3
Applied Statistics		
STATS 203	Introduction to Regression Models and Analysis of Variance	3
or STATS 305A	Applied Statistics I	
or STATS 191	Introduction to Applied Statistics	
Theoretical Statistics		
STATS 200	Introduction to Statistical Inference	2-3
or STATS 300A	Theory of Statistics I	
or STATS 370	A Course in Bayesian Statistics	
Stochastic Processes		
STATS 217	Introduction to Stochastic Processes I	3
or STATS 218	Introduction to Stochastic Processes II	
or STATS 219	Stochastic Processes	
or STATS 318	Modern Markov Chains	

Students with prior background may replace each course with a more advanced course from the same area, or a more advanced course offered by the department, with consent of the adviser. All must be taken for a letter grade.

2. Additional Statistics courses:

At least four additional Statistics courses must be taken from graduate offerings in the department (STATS 202 through 376A), all must be taken for a letter grade (with the exception of courses offered satisfactory/no credit only); except for the following courses that may only be used to fulfill elective credit [3]: STATS 260A Workshop in Biostatistics series, STATS 299 Independent Study, STATS 298 Industrial Research for Statisticians, and STATS 390 Consulting Workshop.

3. Linear Algebra Mathematics Requirement:

		Units
Select one of the following:		
MATH 104	Applied Matrix Theory	3
MATH 113	Linear Algebra and Matrix Theory	3
MATH 115	Functions of a Real Variable	3
MATH 171	Fundamental Concepts of Analysis	3
Substitution of more advanced courses in Mathematics, that provide similar skills, may be made with consent of the adviser. All must be taken for a letter grade, with the exception of courses offered satisfactory/no credit only.		

4. Programming Requirement:

		Units
Select one of the following:		
CS 106A	Programming Methodology	3
CS 106B	Programming Abstractions	3
CS 106X	Programming Abstractions (Accelerated)	3
CS 107	Computer Organization and Systems	3-5
CME 108	Introduction to Scientific Computing	3
Substitution more advanced courses in Computer Science, that provide similar skills, may be made with consent of the adviser. All must be taken for a letter grade, with the exception of courses offered satisfactory/no credit only.		

5. Elective Courses:

Additional elective units to complete the requirements may be chosen from the list available from the department web site (https://statistics.stanford.edu/academics/statistics-ms-electives). Other graduate courses (200 or above) may be authorized by the adviser if they provide skills relevant to degree requirements or deal primarily with an application of statistics or probability and do not overlap courses in the student's program.

There is sufficient flexibility to accommodate students with interests in applications to business, computing, economics, engineering, health, operations research, and biological and social sciences.

Students may enroll in up to 6 units of the following courses: [3]

STATS 260A & STATS 260B & STATS 260C	Workshop in Biostatistics and Workshop in Biostatistics and Workshop in Biostatistics	1-2
STATS 298	Industrial Research for Statisticians	1
STATS 299	Independent Study	1-5
STATS 390	Consulting Workshop	1-3

Courses below 200 level are not acceptable, with the following exceptions; however, students are strongly advised to avoid redundancy in coursework:

		Units
STATS 191	Introduction to Applied Statistics	3-4
MATH 115	Functions of a Real Variable	3
MATH 171	Fundamental Concepts of Analysis	3
CS 106A	Programming Methodology	3-5
CS 106B	Programming Abstractions	3-5
CS 106X	Programming Abstractions (Accelerated)	3-5
CS 140	Operating Systems and Systems Programming	3-4
CS 142	Web Applications	3
CS 143	Compilers	3-4
CS 144	Introduction to Computer Networking	3-4
CS 145	Data Management and Data Systems	3-4
CS 147	Introduction to Human-Computer Interaction Design	3-5
CS 148	Introduction to Computer Graphics and Imaging	3-4
CS 149	Parallel Computing	3-4
CS 154	Introduction to Automata and Complexity Theory	3-4
CS 155	Computer and Network Security	3
CS 157	Computational Logic	3
CS 161	Design and Analysis of Algorithms	3-5
CS 170	Stanford Laptop Orchestra: Composition, Coding, and Performance	1-5
CS 181	Computers, Ethics, and Public Policy [4]	4
And at most, one of these courses ay be counted as an elective. [4]		
MATH 104	Applied Matrix Theory	3
MATH 113	Linear Algebra and Matrix Theory	3
STATS 116	Theory of Probability [2]	3

1 Students who replace STATS116 with STATS217 must take a second course in Stochastic Processes or Probability.

2 Enrollment in STATS 116 after successful completion of STATS 217, 218 and/or 219, cannot count it towards degree requirements, including as an elective.

3 Students admitted to the Statistics M.S. program prior to academic year 2018-19 fulfill the requirements in effect at the time of their admission.

4 Enrollment in a course that provides redundant coursework cannot be used to fulfill the M.S. degree requirements.

Master of Science in Statistics, Data Science Track

The Data Science track develops strong mathematical, statistical, and computational and programming skills through the general master's core and programming requirements. In addition, it provides a fundamental data science education through general and focused electives requirement from courses in data sciences and related areas. Course choices are limited to predefined courses from the data sciences and related courses group. Programming requirement (requirement 4) is extended to 6 units and includes course work in advanced scientific programming and high performance computing. The final requirement is a practical component (requirement 5) for 6 units to be completed through capstone project, data science clinic, or other courses that have strong hands-on or practical component, such as statistical consulting.

Admission

Prospective applicants should consult the Graduate Admissions (https://studentaffairs.stanford.edu/gradadmissions) and the Statistics Department admissions webpages (https://statistics.stanford.edu/academics/admissions) for complete information on admission requirements and deadlines.

Applicants apply to the Master of Science degree in Statistics and declare preference for the Data Science subplan (track) within the application ("Department Specialization" option).

Prerequisites

Recommended preparatory courses include advanced undergraduate level courses in linear algebra, probability, and introductory courses in PDEs, stochastics, numerical methods and proficiency in programming.

Curriculum and Degree Requirements

As defined in the general graduate student requirements, students must maintain a grade point average (GPA) of 3.0 or better and classes must be taken at the 200 level or higher. Students must complete 45 units of required coursework in Data Science.

A Master's Degree Program Proposal (https://statistics.stanford.edu/academics/ms-statistics-data-science)

This form must be signed and approved by the student's program adviser, is to be submitted by the student to the department's student services administrator prior to the end of the first quarter of enrollment in the program. A revised program proposal must be submitted if degree plans change.

No thesis is required.

The Data Science subplan (track) is printed on the transcript and diploma.

Requirement 1: Foundational (12 units)

Students must demonstrate foundational knowledge in the field by completing the following core courses. Courses in this area must be taken for letter grades.

		Units
CME 302	Numerical Linear Algebra	3
CME 305	Discrete Mathematics and Algorithms	3
CME 307	Optimization	3
CME 308	Stochastic Methods in Engineering	3
or CME 309	Randomized Algorithms and Probabilistic Analysis	
or STATS 310A	Theory of Probability I	

Requirement 2: Programming (6 units)

To ensure that students have a strong foundation in programming, 3 units of advanced scientific programming for letter grade at the level of CME 212 and three units of parallel computing. Courses in this area must be taken for letter grades.

Programming proficiency at the level of CME 211 is a hard prerequisite for CME 212 (students may only place out of 211 with prior written approval).

		Units
Advanced Scientific Programming: (3 units)		
CME 211	Software Development for Scientists and Engineers (can only be used as an elective)	3
CME 212	Advanced Software Development for Scientists and Engineers	3
Parallel Computing/HCP courses: (3 units)		
CME 213	Introduction to parallel computing using MPI, openMP, and CUDA	3
CME 323	Distributed Algorithms and Optimization	3
CME 342	Parallel Methods in Numerical Analysis	3
CS 149	Parallel Computing	3-4
CS 316	Advanced Multi-Core Systems	3

Requirement 3: Data Science Electives (12 units)

Data Science electives should demonstrate breadth of knowledge in the technical area. The elective course list is defined. Courses outside this list are subject to approval. Courses in this area must be taken for letter grades.

		Units
STATS 200	Introduction to Statistical Inference	3
or STATS 300A	Theory of Statistics I	
STATS 203	Introduction to Regression Models and Analysis of Variance	3
or STATS 305A	Applied Statistics I	
STATS 315A	Modern Applied Statistics: Learning	2-3
STATS 315B	Modern Applied Statistics: Data Mining	2-3

or equivalent courses as approved by the adviser.

Requirement 4: Specialized Electives (9 units)

Choose three courses in specialized areas from the following list. Courses outside this list are subject to approval.

		Units
BIOE 214	Representations and Algorithms for Computational Molecular Biology	3-4
BIOMEDIN 215	Data Driven Medicine	3
BIOS 221/STATS 366	Modern Statistics for Modern Biology	3
CS 224W	Analysis of Networks	3-4
CS 229	Machine Learning	3-4
CS 231N	Convolutional Neural Networks for Visual Recognition	3
CS 246	Mining Massive Data Sets	3-4
CS 448	Topics in Computer Graphics	3-4
ECON 293	Machine Learning and Causal Inference	3
ENERGY 240	Data science for geoscience	3
OIT 367	Business Intelligence from Big Data	3
PSYCH 204A	Human Neuroimaging Methods	3
STATS 290	Computing for Data Science	3

Requirement 5: Practical Component (6 units)

Students are required to take 6 units of practical component that may include any combination of:

- Project labs offered by Stanford Data Lab: ENGR 150 Data Challenge Lab, and ENGR 350 Data Impact Lab. (Limited enrollment; application required.)
- Master's research: STATS 299 Independent Study. A capstone project, supervised by a faculty member and approved by the student's adviser. The research project should be computational in nature. Students should submit a one-page proposal, supported by the faculty member and sent to the student's Data Science adviser for approval (at least one quarter prior to start of project). Should be taken for a letter grade.
- Other courses that have a strong hands-on and practical component, such as STATS 390 Consulting Workshop .

Doctor of Philosophy in Statistics

The department looks for students who wish to prepare for research careers in statistics or probability, either applied or theoretical. Advanced undergraduate or master's level work in mathematics and statistics provides a good background for the doctoral program. Quantitatively oriented students with degrees in other scientific fields are also encouraged to apply for admission. The program normally takes five years to complete.

Program Summary

		Units
First-year core program		
STATS 300	Advanced Topics in Statistics (offered Summer Quarter)	2-3
STATS 300A	Theory of Statistics I	2-3
STATS 300B	Theory of Statistics II	2-4
STATS 300C	Theory of Statistics III	2-4

STATS 305A	Applied Statistics I	2-3
STATS 305B	Applied Statistics II	2-3
STATS 305C	Applied Statistics III	2-3
STATS 310A	Theory of Probability I	2-4
STATS 310B	Theory of Probability II	2-3
STATS 310C	Theory of Probability III	2-4

- Pass two of three parts of the qualifying examinations (end of first year); breadth requirement (second, third and fourth year); successfully complete the dissertation proposal meeting (early spring quarter of third year); pass the University oral examination (fourth or fifth year); dissertation (fifth year).
- In addition, students are required to take nine units of advanced topics courses offered by the department. Recommended courses include the following:

		Units
STATS 314A	Advanced Statistical Theory	3
STATS 315A	Modern Applied Statistics: Learning	2-3
STATS 315B	Modern Applied Statistics: Data Mining	2-3
STATS 317	Stochastic Processes	3
STATS 318	Modern Markov Chains	3
STATS 330	An Introduction to Compressed Sensing	3
STATS 370	A Course in Bayesian Statistics	3
STATS 376A	Information Theory	3
STATS 376B	Topics in Information Theory and Its Applications	3
EE 364A	Convex Optimization I	3

- Complete a minimum of three units of STATS 390 Consulting Workshop, taking it at least twice.
- Take STATS 319 Literature of Statistics once per year after passing the Qualifying Exam until the year after passing the dissertation proposal meeting.

First-Year Core Courses

- STATS 300A Theory of Statistics I, STATS 300B Theory of Statistics II and STATS 300C Theory of Statistics III systematically survey the ideas of estimation and of hypothesis testing for parametric and nonparametric models involving small and large samples.
- STATS 305A Applied Statistics I is concerned with linear regression and the analysis of variance.
- STATS 305B Applied Statistics II and STATS 305C Applied Statistics III survey a large number of modeling techniques, related to but going beyond the linear models of STATS 305A Applied Statistics I.
- STATS 310A Theory of Probability I, STATS 310B Theory of Probability II, and STATS 310C Theory of Probability III are measure-theoretic courses in probability theory, beginning with basic concepts of the law of large numbers and martingale theory.

Students who do not have enough mathematics background can take STATS 310A,B,C after their first year but need to have their first-year program approved by the Director of Graduate Studies.

Qualifying Examinations

These are intended to test the student's level of knowledge when the first-year program, common to all students, has been completed. There are separate examinations in the three core subjects of statistical theory and methods, applied statistics, and probability theory, and all are typically taken during the summer between the student's first and second years. Students are expected to show acceptable performance in two examinations. Letter grades are not given. After passing the qualifying exams students file for Ph.D. candidacy, a University milestone.

Breadth Requirement

Students are required to take 15 units of coursework outside of the department and are advised to choose an area of concentration in a specific scientific field of statistical applications approved by their Ph.D. program adviser.

Popular areas include: Computational Biology and Statistical Genomics, Machine Learning, Applied Probability, Earth Science Statistics, and Social and Behavioral Sciences.

Dissertation Reading Committee, Dissertation Proposal Meeting and University Oral Examinations

The dissertation reading committee consists of the student's adviser plus two faculty readers, all of whom are responsible for reading and approving the full dissertation.

The dissertation proposal meeting is intended to demonstrate students' depth in some areas of statistics, and to examine the general plan for their research. It also confirms that students have chosen a Ph.D. faculty adviser and have started to work with that adviser on a research topic. In the meeting, the student will give a 50-minute presentation and discuss their ideas for completing a Ph.D. thesis, with a committee typically consisting of the members of the dissertation reading committee. The meeting must be successfully completed by early spring quarter of the third year. "Successful completion" means that the general research plan is sound and has a reasonable chance of success. If the student does not pass, the meeting must be repeated. Repeated failure by the end of Year 3 can lead to a loss of financial support.

The oral examination/dissertation defense is scheduled when the student has finished their dissertation and is in the process of completing their final draft. The oral exam consists of a 50-minute presentation on the dissertation topic, followed by a question and answer period attended only by members of the examining committee. The questions relate both to the student's presentation and also explore the student's familiarity with broader statistical topics related to the thesis research. The oral examination is normally completed within the last few months of the student's Ph.D. period. The examining committee usually consists of at least five members: four examiners including the three members of the Dissertation Reading Committee, plus an outside chair who serves as an impartial representative of the academic standards of the University. Four out of five passing votes are required and no grades are given. Nearly all students can expect to pass this examination, although it is common for specific recommendations to be made regarding completion of the written dissertation.

For further information on University oral examinations and committees, see the Graduate Academic Policies and Procedures (GAP) Handbook, section 4.7 (http://gap.stanford.edu/4-7.html) or the "University Oral Examination (http://exploredegrees.stanford.edu/graduatedegrees/#doctoraltext)" section of this bulletin.

Doctoral and Research Advisers

From the student's arrival until the selection of a research adviser, the student's academic progress is monitored by the department's Director of Graduate Studies. Each student should meet at least once a quarter with the Doctoral Adviser to discuss their academic plans and their progress towards choosing a dissertation adviser.

Financial Support

Students accepted to the Ph.D. program are offered financial support. All tuition expenses are paid and there is a fixed monthly stipend determined to be sufficient to pay living expenses. Financial support can be continued for five years, department resources permitting, for students in good standing. The resources for student financial support derive from funds made available for student teaching and research assistantships. Students receive both a teaching and research assignment each quarter

which, together, do not exceed 20 hours. Students are encouraged to apply for outside scholarships, fellowships, and other forms of financial support.

Ph.D. Minor in Statistics

Students must complete 30 total units for the Ph.D. minor. 20 units must be from Statistics courses numbered 300 and above and taken for a letter grade (minimum grade of B for each course). The remaining 10 units can be from Statistics courses numbered 200 and above, and may be taken for a letter grade (minimum grade of B for each course) or credit. Students may not include more than three units of Stats 390, Consulting Workshop, towards the 30 units. The selection of courses must be approved by the Director of Graduate Studies. The Application for the Ph.D. Minor form must be approved by both the student's Ph.D. department and the Statistics department.

For further information about the Statistics Ph.D. degree program requirements, see the department web site (https://statistics.stanford.edu/academics/doctoral-program).

Graduate Advising Expectations

The Department of Statistics is committed to providing academic advising in support of graduate student scholarly and professional development. When most effective, this advising relationship entails collaborative and sustained engagement by both the adviser and the advisee. As a best practice, advising expectations should be periodically discussed and reviewed to ensure mutual understanding. Both the adviser and the advisee are expected to maintain professionalism and integrity.

Faculty advisers guide students in key areas such as selecting courses, designing and conducting research, developing of teaching pedagogy, navigating policies and degree requirements, and exploring academic opportunities and professional pathways.

Graduate students are active contributors to the advising relationship, proactively seeking academic and professional guidance and taking responsibility for informing themselves of policies and degree requirements for their graduate program.

For a statement of University policy on graduate advising, see the "Graduate Advising (http://exploredegrees.stanford.edu/graduatedegrees/#advisingandcredentialstext)" section of this bulletin.

Faculty

Emeriti: (Professors) Jerome H. Friedman, Paul Switzer

Chair: Art Owen

Professors: Emmanuel Candès, Sourav Chatterjee, Amir Dembo, Persi Diaconis, David L. Donoho, Bradley Efron, Trevor J. Hastie, Susan P. Holmes, Iain M. Johnstone, Tze L. Lai, Andrea Montanari, Art Owen, Joseph P. Romano, Chiara Sabatti, David O. Siegmund, Jonathan Taylor, Robert J. Tibshirani, Guenther Walther, Wing H. Wong

Assistant Professors: John Duchi, Tengyu Ma, Julia Palacios

Courtesy Professors: John Ioannidis, Hua Tang

Courtesy Associate Professors: David Rogosa, Lu Tian

Courtesy Assistant Professors: Mike Baiocchi, Percy Shuo Liang, Stefan Wager

Stein Fellows: James Johndrow, Yuting Wei, Lucy Xia, Yumeng Zhang, Xiang Zhu