Statistics Undergraduate Major Information   2018-2019

OVERVIEW and LEARNING OUTCOMES of the STATISTICS MAJOR

Statisticians help 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 requisite quantitative and logical skills and experience that they can employ and build on in flexible ways. Majors are expected to master concepts and tools for working with data and to have experience analyzing real data that goes beyond the content of a service course in statistical methods for non-majors. Majors should understand the fundamentals of probability theory, statistical reasoning and inferential methods, statistical computing, statistical modeling and its limitations, and have skill describing, exploring and interpreting data by graphical and other means. Graduates are also expected to learn to communicate effectively.

CONTACT INFORMATION

Undergraduate Program Website: http://statistics.berkeley.edu/programs/undergrad

Undergraduate Student Services Advisors:

*Denise Yee | 369 Evans Hall | 510-643-6131 | dyee@berkeley.edu | Appointments can be scheduled through CalCentral

*Majabeen Samadi | 367A Evans Hall | 510-643-2459 | majabeen@berkeley.edu | Appointments can be scheduled through CalCentral

Undergraduate Faculty Advisors: Profs. Ani Adhikari and David Brillinger

     See *Drop-In Advising Schedule* for advising hours

Advising Schedule: http://statistics.berkeley.edu/programs/undergrad/advising

MAJOR REQUIREMENTS – ALL courses must be taken for a LETTER GRADE

PREREQUISITES

☐ Minimum 3.2 UC GPA* in the following math courses AND no lower than a C in:
> Math 1A Calculus (4 units)
> Math 1B Calculus (4 units)
> Math 53 Multivariable Calculus (4 units)
> Math 54 Linear Algebra and Differential Equations (4 units)

> Note: Effective Fall 2019, Math 1A and Math 1B cannot be taken after completing Math 53 and/or Math 54 at UCB to increase the math prerequisite GPA.

☐ Minimum C grade in Stat/Compsci/Info C8, Stat 20 or Stat 28 (effective for freshmen students entering UCB in Fall 2018 and transfer students entering in Fall 2020)

☐ B- in either Stat 134, Stat 140* or Stat 135.
> o Stat 134 (or Stat 140) MUST be attempted first before taking Stat 135.
> o No more than one repeated course allowed between Stat 134 (or Stat 140) and Stat 135

*Math prerequisite GPA is based solely on math courses taken at UC Berkeley or other UC. Students who have taken ALL FOUR prerequisite courses at non-UC institutions, are still required to take at least one Math course at Berkeley to establish a UC GPA. Students may choose Math 54 (B+ required) or Math 110 (B required).

*Due to overlap of course content, students will only receive credit for either Stat 134 or Stat 140.

UPPER DIVISION MAJOR REQUIREMENTS (9 courses)

Core Statistics Courses (3 courses):
☐ Stat 133 Concepts in Computing with Data (3 units)
☐ Stat 134 Concepts of Probability (4 units) **OR**
   Stat 140 Probability for Data Science (4 units)
☐ Stat 135 Concepts of Statistics (4 units)

Statistics Electives (3 courses*), at least 1 LAB:
Choose from:
☐ Stat 150 Stochastic Processes (3 units)
☐ Stat 151A (LAB) Linear Modeling: Theory & Applications (4 units)
☐ Stat 152 (LAB) Sampling Surveys (4 units)
☐ Stat 153 (LAB) Introduction to Time Series (4 units)
☐ Stat 154 (LAB) Modern Statistical Prediction & Machine Learning (4 units)
☐ Stat 155 Game Theory (3 units)
☐ Stat 157 Seminar on Topics in Probability and Statistics (3 units)
☐ Stat 158 (LAB) The Design and Analysis of Experiments (4 units)
☐ Stat 159 (LAB) Reproducible & Collaborative Statistical Data Science (4 units)
☐ Graduate courses require Head Undergraduate Faculty Advisor Approval

Applied Cluster (3 courses*) *either*
☐ Math 110 and two courses from the following list:
   Mathematics 104, 105, 113, 126, 128A, 185
              OR
☐ Three upper division courses from a field in which statistics is applied. A list of guidelines and approved applied cluster courses is available online:

statistics.berkeley.edu/programs/undergrad/approved-cluster-courses

*TEACHING TRACK EMPHASIS. Students interested in teaching statistics and mathematics in middle or high school have a modified upper division course load. In addition to the 3 Core Statistics Courses, 2 Statistics Electives (instead of 3) are required and 4 Math Cluster courses (instead of 3) are required: Math 110, Math 113, Math 151, and either Math 152 or Math 153.

APPLICATION DEADLINES. Students should apply in the semester they are finishing their last prerequisite(s). Applications will be reviewed and approved after all prerequisite grades become available. See the Statistics Undergraduate Major Application for specific application periods.

UC BERKELEY STATISTICS MAJOR COURSE DESCRIPTIONS

Students who have NOT taken prerequisites are subject to Instructor Drop.

Core Statistics Courses

Statistics 133: Concepts in Computing with Data (3 units). This course focuses on statistical computing for data analysis, including how to acquire, clean and organize data, analyze data using computationally intensive statistical methods, and report findings. Students gain experience in computing as a supporting skill for statistical practice and research. They learn how to use existing high-level general purpose software, to implement algorithms from scratch, to express statistical ideas and computations, and they learn about different data technologies and tools, when to use them, and their trade-offs. Students acquire skills in basic numeracy, graphics, modern computationally intensive methods, and simulation. Programming concepts include variables, data types, trees, control flow. Data technology topics include the digital representation of data, regular expressions, relational database management systems, eXtensible Markup Language (XML), Web services for distributed functionality and methods, and Web publication. Extensive written reports are an integral part of the course.

Statistics 134: Concepts of Probability (4 units). Prerequisites: One year of calculus. This is an introduction to probability theory, aimed at students who have had at least one year of calculus. The course covers the laws of probability, expectation, conditioning, covariance and correlation, as well as all the standard distributions of discrete and continuous random variables. Functions of random variables - sums, order statistics, and so on - are studied thoroughly, as are limit laws such as the law of large numbers and the central limit theorem, and the standard models: Bernoulli trials, sampling with and without replacement, Poisson process, univariate and bivariate normal. The course serves as preparation for more systematic study of mathematical statistics and stochastic processes. Credit restriction: Students who have earned credit for Stat 140 will not receive credit for Stat 134.

Statistics 135: Concepts of Statistics (4 units). Prerequisites: Math 54 and Stat 134 or Stat 140. Stat 133 recommended. This is a comprehensive survey course in statistical theory and methodology, aimed at understanding the fundamental principles of statistical reasoning, achieving proficiency in data analysis, and developing written communications skills. Topics include descriptive statistics and data analysis, fundamental concepts of the theory of estimation and hypothesis testing, and methodology such as sampling, goodness-of-fit testing, analysis of variance, and least squares estimation. The laboratory includes computer-based analysis of data from a variety of fields and requires written reports.

Statistics 140: Probability for Data Science (4 units). Prerequisites: Stat/CS/Info C8 and one year of calculus. An introduction to probability, emphasizing the combined use of mathematics and programming to solve problems. Random variables, discrete and continuous families of distributions. Bounds and approximations. Dependence, conditioning, Bayes methods. Convergence, Markov chains. Least squares prediction. Random permutations, symmetry, order statistics. Use of numerical computation, graphics, simulation, and computer algebra. Credit restriction: Students who have earned credit for Stat 134 will not receive credit for Stat 140.

Upper-division Statistics Elective Courses

Statistics 150: Stochastic Processes (3 units). Prerequisites: Stat 134 or Stat 140. This course is especially recommended for students with a strong interest in probability theory or stochastic models, including models in finance, ecology, epidemiology, geophysics and other fields. Topics include random walks, discrete time Markov chains, Poisson processes, continuous time Markov chains, queueing theory, point processes, branching processes, renewal theory, stationary processes, Gaussian processes.

Statistics 151A: Linear Modelling: Theory and Applications (4 units). Prerequisites: Stat 135. Math 110 and Stat 133 recommended. This course is especially recommended for students with an interest in economics, social science, or statistical models and data analysis more generally. 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.

Statistics 152: Sampling Surveys (4 units). Prerequisites: Stat 134 or Stat 140. Stat 133 and 135 recommended. This course is especially recommended for students with an interest in social science, marketing, and data collection more generally. Topics include theory and practice of sampling from finite populations; simple random, stratified, cluster, and double sampling; sampling with unequal probabilities; properties of various estimators including ratio, regression, and difference estimators; and error estimation for complex samples.

Statistics 153: Introduction to Time Series (4 units). Prerequisites: Stat 134 or Stat 140 (or consent of instructor). Stat 133 or 135 recommended. This course is especially recommended for students with an interest in physical science, communication and information theory, economics, finance, or actuarial work. An introduction to time series analysis in the time domain and spectral domain. Topics include estimation of trends and seasonal effects, autoregressive moving average models, forecasting, indicators, harmonic analysis, spectra.

Statistics 154: Modern Statistical Prediction and Machine Learning (4 units). Prerequisites: Math 53 and Math 54 or equivalents; Stat 135 or equivalent; experience with some programming language. Math 55 (or equivalent exposure to counting arguments) and Math 110 recommended but not required. Theory and practice of statistical prediction. Contemporary methods as extensions of classical methods. Topics: optimal prediction rules, the curse of dimensionality, empirical risk, linear regression and classification, basis expansions, regularization, splines, the bootstrap, model selection, classification and regression trees, boosting, support vector machines. Computational efficiency versus predictive performance. Emphasis on experience with real data and assessing statistical assumptions.

Statistics 155: Game Theory (3 units). Prerequisites: Stat 134 or Stat 140. This course is especially recommended for students with an interest in mathematics, optimization or strategy, including business decisions. General theory of zero-sum, two-person games, including games in extensive form and continuous games, and illustrated by detailed study of examples.

Statistics 157: Seminar on Topics in Probability and Statistics (3 units). Prerequisites: Math 53 and Math 54, Stat 134 or Stat 140, and consent of instructor. The topic varies considerably from semester to semester. Check with instructor to determine if you have the appropriate foundational knowledge of the topic discussed in that semester. Some Stat 157 courses will require Stat 134 or Stat 140 and 135. Some may have additional prerequisites. Topics that have been taught in recent years include, *Bayesian Statistics; Probability in the Real World; Statistics and Finance; High-Dimensional Phenomena and Regularization in Statistics; Topics in Stochastic Processes; and Computational Biology and Statistics*.

Statistics 158: The Design and Analysis of Experiments (4 units). Prerequisites: Stat 134 or Stat 140 and Stat 135 (or consent of instructor). Stat 135 may be taken concurrently. Stat 133 recommended. An introduction to the design and analysis of experiments. This course covers planning, conducting, and analyzing statistically designed experiments with an emphasis on hands-on experience. Standard designs studied include factorial designs, block designs, latin square designs, and repeated measures designs. Other topics covered include the principles of design, randomization, ANOVA, response surface methodoloy, and computer experiments.

Stat 159: Reproducible and Collaborative Statistical Data Science (4 units). Prerequisites: Stat 133, Stat 134 or Stat 140, and Stat 135 (or equivalent). 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.

Lower division and graduate course descriptions can be found in the online Berkeley Academic Guide: guide.berkeley.edu/courses.

University of California, Berkeley Department of Statistics

Statistics Undergraduate Major Application   2018-2019

WHEN TO SUBMIT APPLICATION:

Students should submit an application in the semester they are completing their last prerequisite(s). For applicants with prerequisites in progress, applications will be reviewed after the grades for all prerequisites are available (2-3 weeks after finals end). Applicants who have completed all prerequisites should schedule an appointment with a Staff Advisor during an upcoming application period.

DEADLINES
Spring 2019: Feb 4 – March 22, 2019 and April 22 – May 17, 2019
Summer 2019: accepted on a rolling basis with a final deadline of Friday, Aug 16, 2019
Fall 2019: accepted Sept 16 – Oct 4, 2019 and Nov 11 – Dec 20, 2019

HOW TO DECLARE

☐ Fill out the attached **Statistics Major Worksheet**

- o Obtain from 367 Evans or download from http://statistics.berkeley.edu/programs/undergrad/major

- o Select and list your Applied Cluster Courses. You can review the list of Approved Cluster Courses and guidelines here: http://statistics.berkeley.edu/programs/undergrad/approved-cluster-courses. If a course is not on the list and seems to meet general criteria, refer to the Head Undergraduate Faculty Advisor for approval.

☐ If transfer work is not yet available on CalCentral, attach documentation verifying completion of prerequisites.
  - o **For courses taken at a CA Community College** – attach official transcript from community college
  - o **For courses taken at another 4-year college or a community college outside of California**
    - ▪ Attach official transcript from your other college <u>AND</u>
    - ▪ Signed equivalence evaluation form from the Math Department (required even if transfer work appears on CalCentral).

☐ Fill out appropriate Letters & Science form(s) based on single/double major status. Obtain these forms from 367 Evans, outside of 206 Evans, or download at https://ls.berkeley.edu/advising/tools/forms-and-petitions-ls-undergraduate-advising.

- a. For Statistics single majors only (no double/triple): complete the **Petition to Declare Major** and **Program Planning Worksheet.** On the Program Planning Worksheet, list all courses you plan to take each semester beginning with current semester until you plan to graduate. This is a rough plan and we know it is likely to change but it should account for all university, campus, college (L&S) and major requirements.

- b. For double or triple majors within the College of Letters & Science: complete the **Double Major Application Packet**. Read the instructions thoroughly and fill out every page completely.

- c. For students double majoring with a major outside of the College of Letters & Science: complete the **Simultaneous Degree Application Packet** instead of the Double Major Application Packet. Read the instructions thoroughly and fill out every page completely.

☐ Turn in all COMPLETED forms to one of the Undergraduate Staff Advisors in 367 Evans.
  - o Schedule an appointment with Denise Yee or Majabeen Samadi through CalCentral (*My Academics ➔ Advising ➔ New Appointment).*
  - o Appointments are preferred but you may also come to Drop-In hours during one of the application periods (http://statistics.berkeley.edu/programs/undergrad/advising).

Sample Program Plans for the Statistics Major

Sample Statistics Major 4-YEAR Program Plan (no prerequisites completed)

	Fall	Spring	
YR 1	Math 1A	Math 1B Stat/CS/Info C8 or Stat 20 (select C8 if planning to take Stat 140)	
YR 2	Math 53 Cluster prerequisite, if applicable	Math 54 Stat 134 or Stat 140	Declare
YR 3	Stat 133 Cluster #1	Stat 135 Cluster #2	
YR 4	Stat 15x-level elective Stat 15x-level elective (lab)	Stat 15x-level elective Cluster #3	

Sample Statistics Major 4-YEAR Program Plan (Math 1A waived due to AP credit)

	Fall	Spring	
YR 1	Math 1B Stat/CS/Info C8 or Stat 20 (select C8 if planning to take Stat 140)	Math 53 Cluster prerequisite course, if applicable	
YR 2	Math 54	Stat 134 or Stat 140 Cluster #1	Declare
YR 3	Stat 133 Stat 135	Stat 15x-level elective Cluster #2	
YR 4	Stat 15x-level elective (lab)	Stat 15x-level elective Cluster #3	

Sample Statistics Major 2-YEAR Program Plan
for Transfer Students who have completed all math prerequisites at a non-UC

	Fall	Spring	
YR 3	Math 54 or Math 110 Stat/CS/Info C8 or Stat 20 Alternative major course	Stat 133 Stat 134	Declare
YR 4	Stat 135 Stat 15x-level elective Cluster #1	Stat 15x-level elective Stat 15x-level elective (lab) Cluster #2 Cluster #3	

Sample Statistics Major 2-YEAR Program Plan
for Transfer Students who have completed only a year of calculus (Math 1A, 1B)

	Fall	Spring		Summer
YR 3	Stat/CS/Info C8 or Stat 20 Math 53 Alternative major course	Math 54 Stat 134 Cluster #1	Declare	
YR 4	Stat 133 Stat 135 Cluster #2	Stat 15x-level elective Stat 15x-level elective (lab) Cluster #3		Stat 155

The sample Program Plans above only include courses required for the Statistics major. A full-time course load in the College of Letters & Science is 13 units, so you will have space each semester to round out your schedule with courses that can fulfill other requirements or simply satisfy your intellectual curiosity. You will need to account for all university and college degree requirements, including but not limited to: Reading & Composition, 7 Breadth, minimum 120 units, etc. See degree requirements on the College of Letters & Science website: https://ls.berkeley.edu/advising/degree-requirements. Still have questions? Meet with the Statistics Undergraduate Faculty or Staff Advisor to develop a Program Plan that is both feasible and meets your needs. Consider studying abroad or engaging in undergraduate research. "

University of California, Berkeley Department of Statistics
Statistics Major Worksheet

Submission Date:
Approval Date:

Fill out this page of the application (next page is for advisor use only). For LOWER DIV PREREQUISITES and UPPER DIVISION MAJOR REQUIREMENTS, and your proposed CLUSTER OPTION, enter when you took or plan to take the courses, grade and instructor name. Leave GRADE and INSTRUCTOR blank if information is not available (DO NOT write "in progress"). If transfer work is not yet available on CalCentral, attach a copy of your most recent transcript and, if applicable, math evaluation forms verifying course equivalence. See the Math Department if you need a course evaluated *prior* to submitting this application.

Name: (last, first, middle)	**SID#:**
UC Berkeley E-mail : (be sure to check this account)	**Proposed Graduation Semester:**

Second Major (if applicable):

Overlapping Course(s) with major (no more than 2 allowed):

Minor (if applicable):

Overlapping Course with minor (no more than 1 allowed):

LOWER DIV PREREQUISITES Min. 3.2 math GPA with no lower than a C in each

Department	Semester	Grade	GPs (for advisor use)	Notes: (AP exam & score, name of your community college, or approved substitutions)
Math 1a				
Math 1b				
Math 53				
Math 54				
Stat/CS/Info C8, Stat 20 or Stat 28				

UPPER DIVISION MAJOR REQUIREMENTS All of these courses must be taken on a Letter Grade basis.

STATISTICS COURSES	Course & Unit Value	Semester	Grade	GPs (for advisor use)	Instructor	Notes: seminar topic, approved substitutions, etc.
3 CORE STATISTICS COURSES: • Stat 133 • Stat 134 or Stat 140 • Stat 135 Mininum B- in either 134, 140 or 135 to be eligible to declare	Stat 133 (3)					
	Stat 134 (3/4) or 140 (4)					
	Stat 135 (4)					
STATISTICS ELECTIVES: **3 Stat 15x-level courses or** **2 for Teaching Track** • at least one must have a lab • see Frequently Asked Question for approved graduate courses	Stat 150 (3)					
	Stat 151a (lab) (4)					
	Stat 152 (lab) (4)					
	Stat 153 (lab) (4)					
	Stat 154 (lab) (4)					
	Stat 155 (3)					
	Stat 157 (3)					
	Stat 158 (lab) (4)					
	Stat 159 (lab) (4)					
	Stat _____ ( )				Approved by:	

CLUSTER OPTIONS	Course & Unit Value	Semester	Grade	GPs (for advisor use)		
MATH CLUSTER: Math 110 and two of these Math courses: 104, 105, 113, 126, 128a, and 185	Math 110 (4)					
	Math _____ ( )					
	Math _____ ( )					
OR TEACHING TRACK: Math 110, 113, 151 & either Math 152 or 153	Math _____ ( ) (Teaching Track Only)					

OR						
APPLIED CLUSTER: Three courses in a field in which Statistics is applied. See Approved Cluster Course List or obtain approval from Head Faculty Advisor.	Course & Unit Value	Semester	Grade	GPs	Notes	Advisor Approval
	( )					
	( )					
	( )					

Advisor Use: ☐ Add EM _____   Lower div GPA:_____

Cluster Course Change #1

Course & Unit Value	Semester	Grade	Advisor Approval & Date
( )			
( )			
( )			

APR Updated: _____

Cluster Course Change #2

Course & Unit Value	Semester	Grade	Advisor Approval & Date
( )			
( )			
( )			

APR Updated: _____

Cluster Course Change #3

Course & Unit Value	Semester	Grade	Advisor Approval & Date
( )			
( )			
( )			

APR Updated: _____

Cluster Course Change #4

Course & Unit Value	Semester	Grade	Advisor Approval & Date
( )			
( )			
( )			

APR Updated: _____

DATE: ADVISING NOTES:

DATE: ADVISING NOTES:

Return completed application to Undergraduate Advising Staff by scheduling an appointment online (see below) OR come during Drop-in Hours: http://statistics.berkeley.edu/programs/undergrad/advising

Denise Yee dyee@berkeley.edu | 510-643-6131 **Appointments can be scheduled through CalCentral** *(My Academics ➔Advising ➔New Appointment)*	**Majabeen Samadi** majabeen@berkeley.edu | 510-643-2459 **Appointments can be scheduled through CalCentral** *(My Academics ➔Advising ➔New Appointment)*

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