Statistics is a relatively young discipline, organized around the rapidly growing body of knowledge about principled methods for data collection and data analysis, the making of rational decisions under uncertainty, and the modeling of randomness in any quantitative inquiries, including the social, natural, and medical sciences. Statistics has a theoretical core surrounded by a large number of domains of application in fields such as anthropology, astronomy, biology, business, chemistry, computer science, economics, education, engineering, environmental sciences, epidemiology, finance, forensic science, geophysical sciences, government, history, law, linguistics, mathematics, medicine, physics, population science, psychology, sociology, and many others. A basic goal of the concentration in Statistics is to help students acquire the conceptual, computational, and mathematical tools for quantifying uncertainty and making sense of complex data arising from many applications - including statistically sound ways of collecting such data. The mathematical preparation required includes multivariable calculus and linear algebra to the level of Mathematics 19A and 19B (or preferably Mathematics 21A and 21B, or above). The computational preparation required includes Computer Science 50, or above.

A basic introduction to the field is provided by any of Statistics 100 through 104, which introduce statistical principles (without any mathematical or statistical prerequisite), with different areas of application emphasized as indicated in the descriptions. Statistics 100 through 104 fulfill the Empirical and Mathematical Reasoning requirement for General Education. A theoretical introduction is provided by Statistics 110: Introduction to Probability together with Statistics 111: Introduction to Theoretical Statistics. These courses provide grounding in traditional and modern approaches to statistical modeling and inference. They are prerequisites for most of the department’s more advanced courses, which study specific methods, models, and applications.

The Statistics concentration is a flexible program that permits as many as half of the 14 courses required for honors eligibility to be taken in departments other than Statistics. Because Statistics offers an opportunity to branch out and explore a variety of areas it appeals to students who wish to acquire core skills while preserving their chance for a broad general education. It also appeals to those with strong mathematical interests who enjoy seeing formal argument bear direct fruit in practical use.

A concentration in Statistics prepares a student for many careers in industry (in technology companies, finance, and elsewhere) and government, for graduate study in a very broad collection of engineering, social and natural sciences, and for professional study in law, medicine, business, or public administration. The demand for people with statistical training is rising in most areas.

The Statistics concentration requirements can be fulfilled via any of four tracks: a general track in core statistical principles and methods, a track in Data Science, a track in Bioinformatics and Computational Biology (BCB), and a track in Quantitative Finance. These tracks all lead to a degree in Statistics. The Data
Science, BCB, and Quantitative Finance tracks provide interdisciplinary education combining statistics with computer science, biology, and finance, respectively. The general track is the most flexible track, and provides a foundation for statistical theory, methods, and applications.

The Data Science track, newly introduced in 2016, explores the interface of statistics, computer science, and application areas, emphasizing topics such as prediction, machine learning, and analysis of massive data sets. By placing the generation and analysis of data at the center of modern analytics, data science is having a major impact in a vast array of areas, including business, government and politics, science and engineering, medicine and public health, journalism, sports, law, and education. The requirements for the Data Science Track are described in detail below.

The Bioinformatics and Computational Biology Track in Statistics is aimed at undergraduates with interest in quantitative methods and modeling applied to data from the biological, medical, and life sciences. The recent explosion of size and complexity of data in the biological and life sciences, such as the human/animal/plants genome projects with gene and protein sequences, has motivated the development of new statistical methodologies and models, such as models for gene and protein motifs search, phylogenetic reconstruction, and gene expression analysis. Core requirements in statistics emphasize statistical modeling, especially as it relates to biological systems. Additional courses in biology allow students to obtain a strong foundation in molecular and cellular biology, evolutionary biology, or ecology. The requirements for the Bioinformatics and Computational Biology Track are described in detail below.

The Quantitative Finance Track in Statistics is designed as a specialization for concentrators in Statistics with special interest in quantitative issues that arise in financial and insurance modeling. The focus is on the stochastic analysis that is relevant in these fields. The specific topics addressed include statistical inference of stochastic models that arise in financial/insurance modeling, computational techniques that have become standard in pricing, risk assessment of complex financial/insurance instruments, and analysis and predication for time series. The requirements for the Quantitative Finance Track are described in detail below.

The Department of Statistics also offers a secondary field. With its strong methodological and applications focus, Statistics has consequently attracted students with a primary focus in another discipline, such as psychology, economics, sociology, government, earth and planetary sciences, and biology (both OEB and MCB). The secondary field in Statistics will provide students with a solid background in statistics that they can apply in their primary field or fields of interest. For more information on the secondary field in Statistics, please see the secondary fields section of this website. See http://statistics.fas.harvard.edu/pages/undergraduate-statistics-general-information for more information about the Statistics concentration.

REQUIREMENTS
Basic Requirements: 12 courses (48 credits)
1. Required courses: Students must fulfill the requirements from one of the following four tracks.
   1. General Track
      1. Statistics 110, 111, and 139
2. Four additional Statistics courses, numbered between 100 and 299 (inclusive). Statistics 98 may also be counted toward this requirement. Only one Statistics course numbered between 100 and 109 (inclusive) can be counted for concentration credit.
3. Two mathematics courses: Mathematics 19A and 19B, Mathematics (or Applied Mathematics) 21A (or 18) and 21B, Mathematics 23A and 23C (or 23B), Mathematics 25A and 25B, or Mathematics 55A and 55B.
4. One computer science course: Computer Science 50, 51, or 61.
5. Two additional related courses, chosen from item 5A below.

2. Data Science Track
1. Statistics 110, 111, and 139
2. Computer Science 109A/Statistics 121A
3. Two mathematics courses, covering multivariable calculus and linear algebra: Mathematics 19A and 19B, Mathematics (or Applied Mathematics) 21A (or 18) and 21B, Mathematics 23A and 23C (or 23B), Mathematics 25A and 25B, or Mathematics 55A and 55B.
4. Two additional Statistics courses, chosen from Statistics 115, 117, 120, 121B, 131, 140, 149, 171, 183, 186, 201, 210, 211, 212, 213, 220, 221, 230, 240, 244.
6. One additional related course, chosen from item 5A below.

3. Bioinformatics and Computational Biology (BCB) Track
1. Statistics 110, 111, and 139.
2. Two of the four courses Statistics 115, 117, 171, and MCB 112.
3. One additional Statistics course, numbered between 100 and 299 (inclusive). Statistics 98 may also be counted toward this requirement. Only one Statistics course numbered between 100 and 109 (inclusive) can be counted for concentration credit.
4. Two mathematics courses: Mathematics 19A and 19B, Mathematics (or Applied Mathematics) 21A (or 18) and 21B, Mathematics 23A and 23C (or 23B), Mathematics 25A and 25B, or Mathematics 55A and 55B.
5. One computer science course: Computer Science 50, 51, or 61.
6. Two life sciences courses: Life Sciences 1A (or Life and Physical Sciences A), Life Sciences 1B.
7. One additional related course, chosen from item 5A below.

4. Quantitative Finance Track
1. Statistics 110, 111, and 139
2. Three additional Statistics courses, chosen from Statistics 123, 131, 149, 170, 171.
3. Two mathematics courses: Mathematics 19A and 19B, Mathematics (or Applied Mathematics) 21A (or 18) and 21B, Mathematics 23A and 23C (or 23B), Mathematics 25A and 25B, or Mathematics 55A and 55B.
4. One computer science course: Computer Science 50, 51, or 61.
5. Two economics courses: Economics 1011a, and either Economics 1723 or Economics 1745.
6. One additional related course, chosen from item 5A below.
2. Tutorial:
   2. Senior Year: Statistics 99R. Optional; SAT/UNS.
3. Thesis: None.
4. General Examination: None.
5. Other information:
   1. Related courses:
      1. Applied Mathematics 21a, 21b, 104, 105, 106, 107, 111, 115, 120, 121, 126, 201, 202, 203, 205, 207, 221, 222, 231
      2. Astronomy 100, 193
      3. Biostatistics 232, 233, 234, 235, 238, 244, 245, 250, 251
      5. Economics 1011a, 1011b, 1030, 1034, 1051, 1057, 1078, 1123, 1126, 1460, 1820, 2110, 2120, 2140, 2142, 2144, 2146, 2150, 2723, 2725, 2728
      6. Engineering Sciences 201, 202, 203, 250
      9. Molecular and Cellular Biology 111, 112, 199
     10. Organismic and Evolutionary Biology 152, 242
     11. Philosophy 150
     12. Physics 181, 262
     13. Psychology 1950,1952
     14. HGSE EDU A164
     15. MIT 6.441, 6.867, 15.097, 15.501/15.516,
     16. Statistics 91R (may be taken at most once for concentration credit; graded SAT/UNS), Statistics 98, any 100-level or 200-level Statistics courses. Only one Statistics course numbered between 100 and 109 (inclusive) can be counted for concentration credit.
     17. Other relevant courses if approved by the Co-Directors of Undergraduate Studies.
2. Pass/Fail and SAT/UNS: One course other than Statistics 99R, 110, 111, and 139 may be taken Pass/Fail or SAT/UNS and counted for concentration credit. Note that Stat 91R is graded SAT/UNS and, if taken for concentration credit, would be the one allowed Pass/Fail or SAT/UNS course for concentration credit.
3. Statistics 110 and 111 must be completed by the end of the junior year.

Requirements for Honors Eligibility: 14 courses (56 credits)
1. Required courses: Same as Basic Requirements for all tracks
2. Related courses: Two additional courses, which may be from the list of related courses (see item 5a above). For students writing a senior thesis, Statistics 99R can count as one of the two additional courses for honors eligibility.
3. Tutorial: Same as Basic Requirements.
4. Note: Eligibility for honors requires either a senior thesis (see item 5 below) or following the advanced course option (see item 6 below). Eligibility for high honors or highest honors requires a senior thesis.
5. Thesis: A substantial statistical analysis of a real-life problem, a critical review of statistical methods in some problem areas, or the solution of an open statistical research problem are equally acceptable. There must be a thesis advisor or co-advisor from the Statistics department, unless approved otherwise by the Co-Directors of Undergraduate Study.
6. Advanced course option: Statistics coursework including at least 7 letter-graded Statistics courses numbered between 110 and 299 (inclusive). At least one of the 7 courses must be Statistics 210, 211, 220, 230, or 244, and a GPA of at least 3.5 in the 7 courses is required.
7. General Examination: None.
8. Other information: Same as Basic Requirements.

Requirements for Joint Concentrations
Students interested in a joint concentration should consult the Directors of Undergraduate Studies in both concentrations at an early date.

1. Statistics as the Primary Field: 14 courses (56 credits)
   1. Students must satisfy the requirements for honors eligibility. Senior thesis is required; must strongly relate to both fields. There must be a co-advisor from the Statistics department.
2. Another concentration as the Primary Field: 10 courses (40 credits)
   1. Statistics 110, 111, 139. Statistics 110 and 111 are required by the end of the junior year.
   2. Four additional courses from Statistics department 100-level or 200-level offerings. Statistics 98 may also be counted toward this requirement. Students may receive credit for only one Statistics course numbered between 100 and 109 (inclusive).
   3. Two mathematics courses are required by the end of the sophomore year: Mathematics 19A and 19B, Mathematics (or Applied Mathematics) 21A (or 18) and 21B, Mathematics 23A and 23C (or 23B), Mathematics 25A and 25B, or Mathematics 55A and 55B.
   4. One computer science course is required: Computer Science 50, 51, or 61.
   5. Senior thesis is required; must strongly relate to both fields. There must be a co-advisor from the Statistics department.

ADVISING
The Co-Directors of Undergraduate Studies are advisers to all Statistics concentrators. It is expected that students will discuss their program and review their progress with one of the Co-Directors at the beginning of each term.
For up-to-date information on advising in Statistics, please see the Advising Programs Office website.

HOW TO FIND OUT MORE For more information, please consult with the Student Programs Administrator, Kathleen Cloutier, Science Center 400E (617-496-1402, cloutier@fas.harvard.edu) and the Co-Directors of Undergraduate Studies, Professor Joseph Blitzstein, Science Center 714 (617-496-
2985, blitzstein@stat.harvard.edu) and Professor Michael Parzen, Science Center 300B (617-495-8711, mparzen@stat.harvard.edu) or the Assistant Director of Undergraduate Studies, Professor Kevin Rader, Science Center 614 (617-495-5204, krader@fas.harvard.edu), and read through the concentration webpage at http://statistics.fas.harvard.edu/pages/undergraduate-statistics-general-information.