STATISTICS AND DATA SCIENCE - BACHELOR OF ARTS (BA)

The Department of Applied Mathematics offers a Bachelor of Arts degree in statistics and data science through the College of Arts and Sciences. The BA degree is designed with an emphasis on inter- and cross-disciplinary training, and is intended to prepare students for a wide range of careers in areas such as statistics, data analytics, data science, business, engineering, economics, public health, epidemiology, insurance, forestry, psychology, social justice and human rights.

Courses at the undergraduate level are designed to provide students with skills in both traditional statistical methods and cutting edge data analysis techniques. These skills are in high demand in the current job market and prepare students for desirable careers in statistics and data science. Since statisticians and data scientists are often involved in interdisciplinary work, the BA degree requires an in-depth knowledge of some area of science, engineering, social science or liberal arts that uses statistics to solve important problems. This knowledge prepares graduates to successfully communicate and collaborate with practitioners in these fields. A capstone course in statistical collaboration provides the opportunity for students to synthesize their previous coursework.

The Department of Applied Math offers a broad range of undergraduate research opportunities funded by a variety of federal agencies. Working with faculty, students interested in statistics and data science have developed solutions to various problems in fluids, dynamical systems, data analysis, probability and statistics, networks, signal processing, math biology, math education and numerics. Students can gain professional exposure through the student chapter of the Society of Industrial and Applied Mathematics (SIAM) on campus.

Outside Area of Emphasis/Application

Students will choose an outside area of emphasis/application to acquire knowledge in a discipline-specific area, where statistical applications are prevalent. Students will take a minimum of 18 credits in a department or certificate program outside of APPM/STAT, including a minimum of 6 credits at the upper-division level. Final course selection will be made in consultation with advisors and faculty from the departments, as well as faculty advisors within the Department of Applied Mathematics.

Laboratory for Interdisciplinary Statistical Analysis (LISA)

After learning the communication and collaboration skills necessary to help domain experts answer their research, business or policy questions, students have the opportunity to join LISA to gain additional practical experience. Students will collaborate with a variety of researchers around campus and in the community to apply statistics and data science to solve real problems. Students in LISA will also work with graduate students and faculty to engage in outreach activities to improve statistics and data science skills and literacy in the wider community.

Requirements

Course Requirements

To earn a BA in statistics and data science, a student must complete the requirements of the College of Arts and Sciences.

Students must earn a grade of C- or better in all coursework applied to the major, and have at least a C average for all attempted work for the major. Calculus 1 & 2 (usually APPM 1350 and APPM 1360) are considered introductory courses and are prerequisites for entry into the major.

Required Courses and Credits

Code	Title	Credit Hours
Required Courses		
Mathematical Foundations		
APPM 2350	Calculus 3 for Engineers	4
or MATH 2400	Calculus 3	
or APPM 2340	Calculus 3 for Statistics and Data Science	
APPM 3310	Matrix Methods and Applications	3
Computation		
STAT 2600	Introduction to Data Science	4
Statistics Theory		
STAT 3100	Applied Probability	3
STAT 4520	Introduction to Mathematical Statistics	3
APPM 4560	Markov Processes, Queues, and Monte Carlo Simulations	3
or STAT 4100	Markov Processes, Queues, and Monte Carlo Simulations	
Statistical Modeling		
STAT 3400	Applied Regression	3
STAT 4400	Advanced Statistical Modeling	3
STAT 4610	Statistical Learning	3
STAT 4680	Statistics and Data Science Collaboration	3
One of the following courses:		3
STAT 4630	Computational Bayesian Statistics	
STAT 4430	Spatial Statistics	
STAT 4540	Introduction to Time Series	
Three of the following courses: [1]		9
STAT 4250	Data Assimilation in High Dimensional Dynamical Systems	
STAT 4350	Applied Deep Learning 1	
STAT 4360	Applied Deep Learning 2	
STAT 4430	Spatial Statistics	
STAT 4540	Introduction to Time Series	
STAT 4630	Computational Bayesian Statistics	
STAT 4700	Philosophical and Ethical Issues in Statistics	
APPM 3650	Algorithms and Data Structures in Python	
APPM 4370	Computational Neuroscience	
APPM 4440	Undergraduate Applied Analysis 1	
APPM 4490	Theory of Machine Learning	
APPM 4515	High-Dimensional Probability for Data Science	

APPM 4530	Stochastic Analysis for Finance	
APPM 4565	Random Graphs	
Total Credit Hours		**44**

1 Any one of APPM's 3-credit special topics courses in probability or statistics may also be used to meet this requirement. STAT 4430, STAT 4540 or STAT 4630 can count toward this requirement *or* toward the Statistical Modeling requirement but not toward both requirements.

Ancillary Requirements

Code	Title	Credit Hours
Computing Requirement		
APPM 1650	Python for Math and Data Science Applications [1]	4
or CSCI 1300	Computer Science 1: Starting Computing	
or CSCI 2750	Computing, Ethics and Society	
or ASEN 1320	Aerospace Computing and Engineering Applications	
Outside Area of Emphasis Requirement		
Additional coursework in a department or certificate program outside of APPM/STAT, including a minimum of 6 credits at the upper-division level. [2]		18
Total Credit Hours		**22**

1 Or another department-approved course in Python with Mathematical Applications.

2 Can be used to fulfill Gen. Ed. requirements when applicable.

Graduating in Four Years

Consult the Four-Year Guarantee Requirements for information on eligibility. The concept of "adequate progress" as it is used here only refers to maintaining eligibility for the four-year guarantee; it is not a requirement for the major. To maintain adequate progress in Statistics and Data Science, students should meet the following requirements:

- In the first semester, declare the statistics and data science major.

Students must consult with a major advisor to determine adequate progress toward completion of the major.

Recommended Four-Year Plan of Study

Through the required coursework for the major, students will fulfill 12 credits in the Natural Science area, but not the laboratory requirement, of the Gen Ed Distribution Requirement and will complete the QRMS component of the Gen Ed Skills Requirement. Students also can possibly fulfill some of the required credit hours in the other areas Gen Ed Distribution and Diversity Requirements with the courses they take to complete the required Outside Area of Emphasis.

Year One		
Fall Semester		**Credit Hours**
APPM 1350	Calculus 1 for Engineers	4
APPM 1650 or CSCI 1300	Python for Math and Data Science Applications or Computer Science 1: Starting Computing	4
Gen. Ed. Skills course (example: Lower-division Written Communication)		3
Gen. Ed. Distribution course (example: Natural Sciences with Lab)		4
	Credit Hours	**15**
Spring Semester		
APPM 1360	Calculus 2 for Engineers	4
STAT 2600	Introduction to Data Science	4
Gen. Ed. Distribution/Diversity course (example: Arts & Humanities/US Perspective)		3
Elective		4
	Credit Hours	**15**
Year Two		
Fall Semester		
APPM 2350 or APPM 2340	Calculus 3 for Engineers or Calculus 3 for Statistics and Data Science	4
STAT 3100	Applied Probability	3
Gen. Ed. Distribution course (example: Arts & Humanities)		3
Gen. Ed. Distribution/Diversity course (example: Social Sciences/Global Perspective)		3
Outside Area of Emphasis course		3
	Credit Hours	**16**
Spring Semester		
APPM 3310	Matrix Methods and Applications	3
STAT 3400	Applied Regression	3
Outside Area of Emphasis course		3
Gen. Ed. Distribution course (example: Social Sciences)		3
Elective		3
	Credit Hours	**15**
Year Three		
Fall Semester		
STAT 4520	Introduction to Mathematical Statistics	3
STAT 4610	Statistical Learning	3
Outside Area of Emphasis Course (Upper-division)		3
Gen. Ed. Skills course (example: Upper-division Written Communication)		3
Gen. Ed. Distribution course (example: Arts & Humanities)		3
	Credit Hours	**15**
Spring Semester		
STAT 4400	Advanced Statistical Modeling	3
Upper-division STAT elective		3
Outside Area of Emphasis Course (Upper-division)		3
Gen. Ed. Distribution course (example: Arts & Humanities)		3
Gen. Ed. Distribution course (example: Social Sciences)		3
	Credit Hours	**15**
Year Four		
Fall Semester		
STAT 4680	Statistics and Data Science Collaboration	3
Upper-division STAT elective		3
Gen. Ed. Distribution course (Social Sciences)		3
Outside Area of Emphasis course or elective		3

Outside Area of Emphasis course or elective		3
	Credit Hours	**15**
Spring Semester		
APPM 4560	Markov Processes, Queues, and Monte Carlo Simulations	3
STAT 4630	Computational Bayesian Statistics	3
Upper-division STAT elective		3
Outside Area of Emphasis course or elective		3
Outside Area of Emphasis course or elective		3
	Credit Hours	**15**
	Total Credit Hours	**121**

Content Knowledge

Students completing the undergraduate degree in statistics and data science will be broadly knowledgeable in the following areas:

- Mathematics, statistics and data science
  - Foundational knowledge in the areas of mathematics, statistics and data science that are most important to the analysis of data.
  - Statistical intuition and thinking.
  - Skills to write efficient, reproducible code related to data analysis in at least two programming languages (e.g., R, Python, C/C++, Julia, MATLAB, etc.).
  - Skills necessary to complete complex data analysis projects.
- A domain of application
  - The ability to utilize their knowledge of mathematics, statistics and computing to develop algorithms and apply methods for solving real-world data analysis problems.
  - The ability to contribute to at least one domain of application as data scientists.
- Professional skills in communication, collaboration and ethics
  - The ability to effectively communicate statistical results to experts and non-experts.
  - The ability to effectively collaborate with domain experts.
  - The ability to think critically about the relationship between data, ethics, and society.

Student Outcomes

Upon graduation, students will:

- Have acquired problem-solving and modeling skills that allow them to analyze and visualize data and answer statistical questions.
- Understand mathematical statistics, including probability.
- Have acquired foundational mathematical knowledge, including calculus and linear algebra, as it pertains to statistics and data science.
- Be proficient in at least two programming languages and their data science packages; be able to write efficient, reproducible code related to data analysis;
- Have acquired an in-depth knowledge of an area of application, as well as skills to collaborate with domain experts.
- Have the ability to clearly and concisely communicate statistical results in oral, written and visual forms.

Bachelor's–Accelerated Master's Degree Program(s)

The bachelor's–accelerated master's (BAM) degree program options offer currently enrolled CU Boulder undergraduate students the opportunity to receive a bachelor's and master's degree in a shorter period of time. Students receive the bachelor's degree first, but begin taking graduate coursework as undergraduates (typically in their senior year).

Because some courses are allowed to double count for both the bachelor's and the master's degrees, students receive a master's degree in less time and at a lower cost than if they were to enroll in a stand-alone master's degree program after completion of their baccalaureate degree. In addition, staying at CU Boulder to pursue a bachelor's–accelerated master's program enables students to continue working with their established faculty mentors.

BA in Statistics and Data Science, MS in Applied Mathematics

Admissions Requirements

In order to gain admission to the BAM program named above, a student must meet the following criteria:

- Complete a minimum of 6 credits (2 courses) of STAT coursework at the 3000 or 4000 level.
- Complete all prerequisite courses with a minimum grade of B.
- Have a cumulative GPA of 3.4 or higher.
- Have a cumulative GPA of 3.4 in all APPM and STAT coursework. If a student's cumulative GPA or APPM/STAT GPA is between 3.0 and 3.4, then one letter of reference is required. The letter can be written either by a faculty member or by a student's undergraduate academic advisor. The letter should justify why the student should be considered for admission into the program and should attest to the student's ability to complete the MS program.
- Have at least junior class standing.

Program Requirements

Students may take up to and including 12 credit hours while in the undergraduate program which can later be used toward the master's degree. However, only six credit hours may be double counted toward the bachelor's degree and the master's degree. Students must apply to graduate with the bachelor's degree, and apply to continue with the master's degree, early in the semester in which the undergraduate requirements will be completed.

Though not required for admission, students must complete APPM 4440 Undergraduate Applied Analysis 1 before they graduate with their BA.

Please see the BAM degree program (https://www.colorado.edu/amath/academics/bachelors-degree-statistics-data-science-masters-degree-applied-mathematics-specialization/)web page for more information.