STATISTICS AND DATA SCIENCE - BACHELOR OF SCIENCE (BS)

The Department of Applied Mathematics offers Bachelor of Arts and Bachelor of Science degrees 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. The BA degree is also conducive to double majoring. The BS degree requires additional coursework in computation, statistical modeling and theory, thus giving a more advanced understanding of statistics and data science, and is appropriate for students who want a deeper statistical foundation and/or who are planning to pursue graduate studies. Courses at the undergraduate level are designed to provide foundational 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. Statisticians and data scientists are often involved in interdisciplinary work; the BA and BS degrees each require in-depth training in 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 on real-world problems and/or 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 Bayesian computation, epidemiology, statistical climatology, statistics for energy science, signal processing and image analysis, networks, machine learning for physical systems, uncertainty quantification as well as the study of collaborative research. Students can gain professional exposure through the Data Buffs, the student chapter of the American Statistical Association (ASA) on campus.

Outside Area of Emphasis/Application

Students will choose an outside area of emphasis/application to acquire knowledge in an approved discipline-specific area of their choice 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 relevant departments, as well as faculty advisors within the Department of Applied Mathematics.

Capstone/Collaboration Class

The degree culminates in a capstone experience giving students the opportunity to apply the knowledge, skills and abilities developed throughout the Statistics and Data Science major. The capstone experience can be fulfilled through a semester-long project course, or through the Laboratory for Interdisciplinary Statistical Analysis (LISA). Both options offer an opportunity to gain valuable real world experience in collaboration with domain experts from government, industry or academia.

Requirements

Course Requirements

To earn a BS 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 2340	Calculus 3 for Statistics and Data Science	4
or APPM 2350	Calculus 3 for Engineers	
or MATH 2400	Calculus 3	
APPM 3310	Matrix Methods and Applications	3
Computation		
STAT 2600	Introduction to Data Science	4
APPM 3650	Algorithms and Data Structures in Python	3
Theoretical Core		
STAT 3100	Applied Probability	3
STAT 4520	Introduction to Mathematical Statistics	3
Modeling Core		
STAT 3400	Applied Regression	3
STAT 4400	Advanced Statistical Modeling	3
APPM 4560/ STAT 4100	Markov Processes, Queues, and Monte Carlo Simulations	3
Machine Learning/Artifical Intelligence Core		
STAT 4610	Statistical Learning	3
STAT 4350	Applied Deep Learning 1	3
or CSCI 4622	Machine Learning	
Senior Capstone Project		
STAT 4640	Capstone in Statistics and Data Science	3
or STAT 4680	Statistics and Data Science Collaboration	
Four of the following courses: [1]		12
STAT 4250	Data Assimilation in High Dimensional Dynamical Systems	
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 4120	Introduction to Operations Research	
APPM 4320	Introduction to Dynamics on Networks	
APPM 4370	Computational Neuroscience	
APPM 4440	Undergraduate Applied Analysis 1	

APPM 4450	Undergraduate Applied Analysis 2	
APPM 4490	Theory of Machine Learning	
APPM 4515	High-Dimensional Probability for Data Science	
APPM 4530	Stochastic Analysis for Finance	
APPM 4565	Random Graphs	
APPM 4600	Numerical Methods and Scientific Computing	
Total Credit Hours		**50**

[1] As well as other APPM or STAT upper-division advisor-approved courses.

Ancillary Requirements

Code	Title	Credit Hours
Quantitative Skills		
APPM 1350	Calculus 1 for Engineers	4
APPM 1360	Calculus 2 for Engineers	4
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		
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. Note: Not necessarily NS/math/computing/social science. [2]		18
Total Credit Hours		**30**

[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 graduation guarantee (https://www.colorado.edu/engineering-advising/get-your-degree/first-year-freshmen/four-year-graduation-guarantee/) 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 requirement:

- 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 can also 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	Python for Math and Data Science Applications	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 2340 or APPM 2350	Calculus 3 for Statistics and Data Science or Calculus 3 for Engineers	4
STAT 3100	Applied Probability	3
Outside Area of Emphasis course		3
Gen. Ed. Distribution course (example: Arts & Humanities)		3
Gen. Ed. Distribution/Diversity course (example: Social Sciences/Global Perspective)		3
	Credit Hours	**16**
Spring Semester		
APPM 3310	Matrix Methods and Applications	3
STAT 3400	Applied Regression	3
APPM 3650	Algorithms and Data Structures in Python	3
Outside Area of Emphasis course		3
Gen. Ed. Distribution course (example: Social Sciences)		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
APPM 4560	Markov Processes, Queues, and Monte Carlo Simulations	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 4640 or STAT 4680	Capstone in Statistics and Data Science or Statistics and Data Science Collaboration	3
Upper-division STAT elective		3
Upper-division STAT elective		3
Gen. Ed. Distribution course (Social Sciences)		3
Outside Area of Emphasis (upper-division) course or elective		3
	Credit Hours	**15**
Spring Semester		
STAT 4350	Applied Deep Learning 1	3
Upper-division STAT elective		3
Upper-division STAT elective		3
Outside Area of Emphasis (upper-division) course or elective		3
Outside Area of Emphasis (upper-division) course or elective		3
	Credit Hours	**15**
	Total Credit Hours	**121**

Learning Outcomes

By the completion of the program, students will be able to:

- Demonstrate problem-solving and modeling skills that allow the student to analyze and visualize data and answer statistical questions.
- Apply foundational mathematical concepts, including calculus and linear algebra, and advanced mathematical statistical concepts, including probability, to statistics and data science.
- Demonstrate proficiency in at least two programming languages and their data science packages and the ability to write efficient, reproducible code related to data analysis.
- Demonstrate in-depth knowledge of an application area and skills to collaborate with domain experts.
- Communicate statistical results clearly and concisely in oral, written and visual forms.