

APPLIED MATHEMATICS AND STATISTICS, BACHELOR OF SCIENCE

Departmental majors can earn either the B.A. or the B.S. degree by meeting the general university requirements and the general requirements of the School of Engineering (see Requirements for a Bachelor's Degree (<https://e-catalogue.jhu.edu/ksas-wse/undergraduate-policies/academic-policies/requirements-bachelors-degree/>), including Writing Requirement, in this catalogue), and the departmental requirements.

Honors

The Department of Applied Mathematics and Statistics awards departmental honors based on a number of factors, including performance in coursework and research experience. To be eligible for departmental honors a student must:

1. achieve a 3.75 GPA in AMS Department courses (EN.553) used toward major requirements 1-12; and
2. earn a C- or better in an additional one semester course in AMS (EN.553) at the 300-level or higher, or undertake significant research activity (equivalent to a 3-credit course) in applied mathematics. Such research can be conducted as an official research course, or the student may request that the research supervisor provide an assessment to AMS academic staff toward the middle of the semester of intended degree conferral.

Program Requirements

There is a minimum degree requirement of 120 credits. All courses used to meet the following departmental requirements must be taken for a letter grade and passed with a grade of C- or higher. The following requirements only apply to those matriculating in Fall 2023:

Code	Title	Credits
1. CALCULUS		12
AS.110.108	Calculus I (Physical Sciences & Engineering)	
AS.110.109	Calculus II (For Physical Sciences and Engineering)	
or AS.110.111 Honors Single Variable Calculus		
AS.110.202	Calculus III	
or AS.110.211 Honors Multivariable Calculus		
2. LINEAR ALGEBRA ¹		4
Select one of the following:		
AS.110.201	Linear Algebra	
or AS.110.211 Honors Linear Algebra		
EN.553.291	Linear Algebra and Differential Equations	
EN.553.295	Linear Algebra for Data Science	
3. DIFFERENTIAL EQUATIONS ¹		3-4
Select one of the following:		
AS.110.302	Differential Equations and Applications	
AS.110.421	Dynamical Systems	
EN.553.481	Numerical Analysis	
EN.553.491	Dynamical Systems	

EN.553.492	Mathematical Biology	
4. COMPUTER LANGUAGES AND PROGRAMMING ²		3-4
Select one of the following:		
EN.500.112	Gateway Computing: JAVA	
EN.500.113	Gateway Computing: Python	
EN.500.114	Gateway Computing: Matlab	
EN.553.281	Introduction to Mathematical Computing	
EN.601.220	Intermediate Programming	
5. COMPUTATIONAL AND NUMERICAL MATHEMATICS		4
Select one of the following:		
EN.553.385	Introduction to Computational Mathematics	
EN.553.480	Numerical Linear Algebra	
EN.553.481	Numerical Analysis	
6. DISCRETE MATHEMATICS		4
Select one of the following:		
EN.553.171	Discrete Mathematics	
or EN.553.172 Honors Discrete Mathematics		
EN.553.371	Cryptology and Coding	
EN.553.471	Combinatorial Analysis	
EN.553.472	Graph Theory	
7. PROBABILITY AND STATISTICS		8
EN.553.420	Probability	
or EN.553.421 Honors Introduction to Probability		
EN.553.430	Mathematical Statistics	
or EN.553.431 Honors Mathematical Statistics		
8. OPTIMIZATION		4
EN.553.361	Introduction to Optimization	
9. AREA OF FOCUS		
Select two courses from one of the following areas of focus. They must be distinct from those courses used to satisfy requirements 1-8.		
<i>Probability and Stochastic Processes</i>		
AS.110.405	Real Analysis I	
AS.110.445	Mathematical and Computational Foundations of Data Science	
EN.553.426	Introduction to Stochastic Processes	
EN.553.427	Stochastic Processes and Applications to Finance	
EN.553.433	Monte Carlo Methods	
EN.553.492	Mathematical Biology	
<i>Statistics and Statistical Learning</i>		
AS.110.445	Mathematical and Computational Foundations of Data Science	
EN.553.400	Mathematical Modeling and Consulting	
EN.553.402	Research and Design in Applied Mathematics: Data Mining	
EN.553.413	Applied Statistics and Data Analysis	
EN.553.414	Applied Statistics and Data Analysis II	
EN.553.432	Bayesian Statistics	
EN.553.433	Monte Carlo Methods	
EN.553.436	Introduction to Data Science	
EN.553.439	Time Series Analysis	
EN.553.450	Computational Molecular Medicine	
<i>Optimization and Operations Research</i>		

EN.553.362	Introduction to Optimization II
EN.553.400	Mathematical Modeling and Consulting
EN.553.453	Mathematical Game Theory
EN.553.463	Network Models in Operations Research
EN.553.465	Introduction to Convexity
EN.553.467	Deep Learning in Discrete Optimization

Discrete Mathematics

AS.110.401	Introduction to Abstract Algebra
EN.553.371	Cryptology and Coding
EN.553.463	Network Models in Operations Research
EN.553.471	Combinatorial Analysis
EN.553.472	Graph Theory

Financial Mathematics

EN.553.427	Stochastic Processes and Applications to Finance
EN.553.428	Stochastic Processes and Applications to Finance II
EN.553.441	Equity Markets and Quantitative Trading
EN.553.442	Investment Science
EN.553.444	Introduction to Financial Derivatives
EN.553.445	Interest Rate and Credit Derivatives
EN.553.447	Quantitative Portfolio Theory and Performance Analysis
EN.553.448	Financial Engineering and Structured Products
EN.553.449	Advanced Equity Derivatives
EN.553.488	Computing for Applied Mathematics

Computational Mathematics

AS.110.445	Mathematical and Computational Foundations of Data Science
EN.553.433	Monte Carlo Methods
EN.553.467	Deep Learning in Discrete Optimization
EN.553.480	Numerical Linear Algebra
EN.553.481	Numerical Analysis
EN.553.493	Mathematical Image Analysis

10. NATURAL SCIENCES 12

Courses coded Natural Sciences. Laboratory courses that accompany Natural Science courses may be used in reaching this total. (Courses used to meet the requirements above may be counted toward this total.)

11. QUANTITATIVE STUDIES 40

Courses coded Quantitative Studies totaling 40 credits of which at least 18 credits must be in courses numbered 300 or higher. (Courses used to meet the requirements above may be counted toward this total.)

12. HUMANITIES AND SOCIAL SCIENCES 18

6 courses that are at least 3 credits each, designated H and/or S. Although language elements courses do not carry an area designator, engineering students may use these courses as substitutes for humanities courses in meeting the distribution requirement.

13. WRITING INTENSIVE COURSES 6

students must take 2 Writing-Intensive courses. These courses may overlap with the Humanities and Social Sciences courses.

14. FREE ELECTIVES

Electives to reach 120 degree credit requirement.

TOTAL CREDITS 120

¹ A student who earns credit in EN.553.291 (<http://e-catalog.jhu.edu/search/?P=EN.553.291>) Linear Algebra and Differential Equations may not earn credit for AS.110.302 (<http://e-catalog.jhu.edu/search/?P=AS.110.302>) Differential Equations and Applications.

² Students are strongly encouraged to fulfill this element of the requirement by taking EN.500.113 Gateway Computing: Python, and to do this in their first semester at Johns Hopkins University.

The requirements above together constitute a minimal core program, allowing maximum flexibility in planning degree programs. Students often are able to complete a second major during a four-year program or to proceed to the department's combined bachelor's/master's degree program.

It is highly recommended that students develop a coherent program of study (see below) or at least take additional departmental courses, in order to establish a broad foundation for a career as an applied mathematician. Of particular importance are additional courses in optimization (EN.553.362 (<http://e-catalog.jhu.edu/search/?P=EN.553.362>) Introduction to Optimization II), stochastic processes (EN.553.426 (<http://e-catalog.jhu.edu/search/?P=EN.553.426>) Introduction to Stochastic Processes), statistics (EN.553.413 (<http://e-catalog.jhu.edu/search/?P=EN.553.413>) Applied Statistics and Data Analysis), dynamical systems (EN.553.391 (<http://e-catalog.jhu.edu/search/?P=EN.553.391>) Dynamical Systems), mathematical modeling and consulting (EN.553.400 (<http://e-catalog.jhu.edu/search/?P=EN.553.400>) Mathematical Modeling and Consulting), scientific computing (EN.553.385 (<http://e-catalog.jhu.edu/search/?P=EN.553.385>) Scientific Computing: Linear Algebra, EN.553.386 (<http://e-catalog.jhu.edu/search/?P=EN.553.386>) Scientific Computing: Differential Equations), and investment science (EN.553.442 (<http://e-catalog.jhu.edu/search/?P=EN.553.442>) Investment Science).

Students planning to continue to graduate school in an applied mathematics program are encouraged to consider taking one or more graduate-level courses in probability (EN.553.720 (<http://e-catalog.jhu.edu/search/?P=EN.553.720>) Probability Theory I, EN.553.721 (<http://e-catalog.jhu.edu/search/?P=EN.553.721>) Probability Theory II), statistics (EN.553.730 (<http://e-catalog.jhu.edu/search/?P=EN.553.730>) Statistical Theory, EN.553.731 (<http://e-catalog.jhu.edu/search/?P=EN.553.731>) Statistical Theory II), optimization (EN.553.761 (<http://e-catalog.jhu.edu/search/?P=EN.553.761>) Nonlinear Optimization I, EN.553.762 (<http://e-catalog.jhu.edu/search/?P=EN.553.762>) Nonlinear Optimization II), combinatorics (EN.553.671 (<http://e-catalog.jhu.edu/search/?P=EN.553.671>) Combinatorial Analysis), graph theory (EN.553.672 (<http://e-catalog.jhu.edu/search/?P=EN.553.672>) Graph Theory), numerical analysis (EN.553.781 (<http://e-catalog.jhu.edu/search/?P=EN.553.781>) Numerical Analysis), or matrix analysis (EN.553.792 (<http://e-catalog.jhu.edu/search/?P=EN.553.792>) Matrix Analysis and Linear Algebra).

Sample Program

First Year

First Semester	Credits	Second Semester	Credits
AS.110.109	4	AS.110.202	4
EN.553.172	4	EN.500.113	3
EN.553.101 (not required)	1	Writing Intensive	3
EN.501.130 (not required)	3	Natural Sciences	4

Humanities/Social Sciences	3		
	15		14
Second Year			
First Semester	Credits	Second Semester	Credits
EN.553.295	4	EN.553.361	4
AS.110.302	4	EN.553.385	4
EN.601.220 (not required)	4	Humanities/Social Sciences	3
Humanities/Social Sciences	3	Natural Sciences	4
	15		15
Third Year			
First Semester	Credits	Second Semester	Credits
EN.553.420	4	EN.553.430	4
Extra AMS course 300-level or higher for honors (not required)	3-4	EN.661.110 (not required)	3
Writing Intensive	3	Natural Sciences	4
Humanities/Social Sciences	3	Free elective	3
Free elective	3		
	16-17		14
Fourth Year			
First Semester	Credits	Second Semester	Credits
Area of Focus course 1	3-4	Area of Focus course 2	3-4
Humanities/Social Sciences	3	EN.553.400 (not required)	4
Free elective	3	Free elective	3
Free elective	3	Free elective	3
Free elective	3	Free elective	3
	15-16		16-17
Total Credits 120-123			