APPLIED MATHEMATICS AND STATISTICS, BACHELOR OF ARTS

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/engineering/full-time-residential-programs/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 1-11; 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

All courses used to meet the following departmental requirements must be taken for a letter grade and passed with grade of C- or higher.

Code	Title	Credits
1. Calculus I, II, and III		
AS.110.108	Calculus I (Physical Sciences & Engineering)	4
AS.110.109	Calculus II (For Physical Sciences and Engineering)	4
or AS.110.113	Honors Single Variable Calculus	
AS.110.202	Calculus III	4
or AS.110.211	Honors Multivariable Calculus	
2. Linear Algebra [1]		
AS.110.201	Linear Algebra	4
or AS.110.212	Honors Linear Algebra	
or EN.553.291	Linear Algebra and Differential Equations	
3. Differential Equations [1]		
AS.110.302	Differential Equations and Applications	4
or EN.553.481	Numerical Analysis	
or EN.553.491	Dynamical Systems	
4. Computer Languages and Programming		
Select one of the following: [2, 3]		
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.580.242 & EN.580.244	Biological Models and Simulations and Nonlinear Dynamics of Biological Systems	
EN.601.220	Intermediate Programming	
AS.250.205	Introduction to Computing	
5. Numerical Linear Algebra		
EN.553.385	Numerical Linear Algebra	
6. Discrete Mathematics		
Select one of the following:		
EN.553.171	Discrete Mathematics	
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		
EN.553.420	Introduction to Probability	4
or EN.553.421	Honors Introduction to Probability	
EN.553.430	Introduction to Statistics	4
or EN.553.431	Honors Introduction to Statistics	
8. Optimization		
EN.553.361	Introduction to Optimization	4
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 1-2, 4-5, 7-8.		
Probability and Stochastic Processes		
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	
Statistics and Statistical Learning		
AS.110.445	Mathematical and Computational Foundations of Data Science	
EN.553.400	Mathematical Modeling and Consulting	
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	
Optimization and Operations Research		
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	
EN.553.481	Numerical Analysis
and, one of	
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.553.493	Mathematical Image Analysis
10. Scientific Computing	
Select one of the following:	
AS.110.445	Mathematical and Computational Foundations of Data Science
EN.553.400	Mathematical Modeling and Consulting
EN.553.413	Applied Statistics and Data Analysis
EN.553.432	Bayesian Statistics
EN.553.433	Monte Carlo Methods
EN.553.436	Introduction to Data Science
EN.553.450	Computational Molecular Medicine
EN.553.463	Network Models in Operations Research
EN.553.467	Deep Learning in Discrete Optimization
EN.553.481	Numerical Analysis
EN.553.488	Computing for Applied Mathematics
EN.553.493	Mathematical Image Analysis
EN.553.494	Applied and Computational Multilinear Algebra
EN.601.433	Intro Algorithms
EN.601.475	Machine Learning
EN.601.482	Machine Learning: Deep Learning
11. Quantitative Studies	
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.)	40

[1] A student who earns credit in EN.553.291 Linear Algebra and Differential Equations may not earn credit for AS.110.302 Differential Equations and Applications.

[2] or JHU credit for AP Computer Science A.

[3] 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).