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/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 1-12; 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 a subject related to 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 a grade of C- or higher:

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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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| 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
  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
  AS.110.302  | Differential Equations and Applications         | 3-4     |
  or EN.553.391 | Dynamical Systems                               |         |
  or EN.540.468 | Introduction to Nonlinear Dynamics and Chaos    |         |
| 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           |         |
| 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       |
  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 1-8.

  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.553.416  |                                                                                  |         |
  EN.553.417  |                                                                                  |         |
  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                |         |
12. 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.)


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 I), 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).