APPLIED MATHEMATICS AND STATISTICS, BACHELOR OF SCIENCE

The department of Applied Mathematics and Statistics (AMS) offers a broad undergraduate and graduate curriculum that emphasizes several branches of applied mathematics:

- Probability: the mathematical representation and modeling of uncertainty
- Statistics: the analysis and interpretation of data
- Operations Research: the design, analysis, and improvement of operations and processes
- Optimization: the determination of best or optimal decisions
- Discrete Mathematics: the study of finite structures, arrangements, and relations
- Scientific Computation: all aspects of numerical computing in support of the sciences
- Financial Mathematics: deriving, analyzing, and extending mathematical models of financial markets

RESEARCH

The Applied Mathematics and Statistics faculty welcome students interested in doing research. The course 553.101 Freshman Experience in Applied Mathematics and Statistics is an excellent way to meet faculty in very small groups, and topics discussed might lead to research. Also, there is an upper-level class EN.553.401 Introduction to Research in Applied Mathematics and Statistics which guides students through the research process and has often led to publications in good journals and presentations at national conferences.

AFTER GRADUATION

Students who have graduated with a degree in AMS have gone to many different fields, such as:

- Actuarial profession
- Analyst for a financial institution
- Operations research and consulting
- Biostatistician working with a pharmaceutical company
- Information security
- Applied mathematician in industry
- Applied mathematician in a policy/regulatory agency
- Data analyst
- Graduate school
- Medical school
- Law school

The information below describes the academic requirements for students entering JHU as degree-seeking students in Fall 2024. Students who entered JHU as degree-seeking students prior to Fall 2024 should view the appropriate archived catalogue ***(***https://e-catalogue.jhu.edu/archive/***).***

Students must meet the University requirements and the Whiting School of Engineering requirements (see Requirements for a Bachelor's Degree (https://e-catalogue.jhu.edu/ksas-wse/undergraduate-policies/academic-policies/requirements-bachelors-degree/) in this catalogue), as well as the departmental major requirements, to complete a bachelor's degree.

The Bachelor of Science in Applied Mathematics and Statistics requires 120 credits.

The AMS department recognizes students with exemplary academic records by awarding Departmental Honors to students with a Grade Point Average of 3.75 or higher in AMS courses (EN.553.xxx) and meet one of the options:[1]

1. Earn a C- or better in an additional AMS course (EN.553.xxx) that is at least 300-level or higher
2. Undertake significant research activity (equivalent to a 3-credit course) in applied mathematics

[1] 02/04/2025 - Catalogue amendment:
The AMS department recognizes students with exemplary academic records by awarding Departmental Honors to students with a Grade Point Average of 3.75 or higher in AMS courses (EN.553.xxx). *This is effective beginning with students graduating in May 2025.*

UNIVERSITY AND WSE SCHOOL REQUIREMENTS

These requirements are described in this section of the catalogue **(**https://e-catalogue.jhu.edu/ksas-wse/undergraduate-policies/academic-policies/requirements-bachelors-degree/**).**

First-Year Seminar (FYS)

All students entering Hopkins from high school are required to complete a First-Year Seminar with a Satisfactory (S) grade in their first year of study. First-Year Seminars are offered only with the Satisfactory/Unsatisfactory grading system; they are not offered for letter grades.

Code	Title	Credits
One FYS course. Recommended course:		2-3
EN.501.136	FYS: Math in the Movies	
Total Credits		*2-3*

Writing Intensive for BS in Applied Mathematics and Statistics

A grade of C- or higher is required. No Satisfactory/Unsatisfactory grades will be accepted. Courses must be at least 3 credits each and courses applied here may also be used towards satisfying the Distribution requirement.

Code	Title	Credits
Two Writing Intensive (W) courses		6
Total Credits		*6*

Distribution for BS in Applied Mathematics and Statistics

A grade of D or higher is required. Satisfactory/Unsatisfactory grading is accepted as long as the student passes with a Satisfactory. Courses must be at least 3 credits each and may overlap with the Writing Intensive requirement. Elementary language courses, which do not carry an area designator, can be used to satisfy the Distribution requirement for engineering students.

Code	Title	Credits
Six Humanities (H) or Social Science (S) courses		18
Total Credits		*18*

MAJOR REQUIREMENTS

A grade of C- or higher is required. No Satisfactory/Unsatisfactory (S/U) grade will be accepted. All 600-level courses will satisfy the requirement for their 400-level equivalents.

CALCULUS

Code	Title	Credits
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	
Total Credits		*12*

LINEAR ALGEBRA

Code	Title	Credits
Complete one of the courses:		4
AS.110.201	Linear Algebra	
or AS.110.21	Honors Linear Algebra	
EN.553.291	Linear Algebra and Differential Equations [1]	
EN.553.295	Linear Algebra for Data Science (preferred) [2]	
Total Credits		*4*

1. Students who earned credit for AS.110.302 Differential Equations and Applications cannot receive credits for EN.553.291 Linear Algebra and Differential Equations.
2. EN.553.295 Linear Algebra for Data Science is the preferred course for the Linear Algebra requirement.

DIFFERENTIAL EQUATIONS

Code	Title	Credits
Complete one of the courses:		3-4
AS.110.302	Differential Equations and Applications [1]	
AS.110.421	Dynamical Systems	
EN.553.481	Numerical Analysis	
EN.553.491	Dynamical Systems	
EN.553.492	Mathematical Biology	
Total Credits		3-4

1. Students who earned credits for EN.553.291 Linear Algebra and Differential Equations cannot receive credits for AS.110.302 Differential Equations and Applications.

COMPUTER LANGUAGES AND PROGRAMMING

Code	Title	Credits
Complete one of the courses:		3-4
EN.500.113	Gateway Computing: Python [1]	
or EN.500.11	Gateway Computing: JAVA	
or EN.500.11	Gateway Computing: Matlab	
EN.601.220	Intermediate Programming	
Total Credits		*3-4*

1. EN.500.113 Gateway Computing: Python is strongly preferred and should be taken in the first semester.

COMPUTATIONAL AND NUMERICAL MATHEMATICS

Code	Title	Credits
Complete one of the courses:		4
EN.553.385	Introduction to Computational Mathematics	
EN.553.480	Numerical Linear Algebra	
EN.553.481	Numerical Analysis	
Total Credits		*4*

DISCRETE MATHEMATICS

Code	Title	Credits
Complete one of the courses:		4
EN.553.171	Discrete Mathematics [1]	
or EN.553.17	Honors Discrete Mathematics	
EN.553.371	Cryptology and Coding	
EN.553.471	Combinatorial Analysis [2]	
EN.553.472	Graph Theory [2]	
Total Credits		*4*

1. For CS double majors: Students should take EN.553.171 Discrete Mathematics/EN.553.172 Honors Discrete Mathematics before taking EN.601.230 Mathematical Foundations for Computer Science. If EN.601.230 is taken before declaring the CS double major, students cannot take EN.553.171/172. To satisfy the Discrete Mathematics requirement, students must take either EN.553.371 Cryptology and Coding, EN.553.471 Combinatorial Analysis, or EN.553.472 Graph Theory.
2. Students planning to continue to graduate school in an applied mathematics program are encouraged to consider taking a graduate-level course in Discrete Mathematics (EN.553.671 Combinatorial Analysis or EN.553.672 Graph Theory).

PROBABILITY AND STATISTICS

Code	Title	Credits
EN.553.420	Probability [1]	4
or EN.553.421	Honors Probability	
EN.553.430	Mathematical Statistics [1]	4

or EN.553.431	Honors Mathematical Statistics	
Total Credits		*8*

[1] Students planning to continue to graduate school in an applied mathematics program are encouraged to consider taking graduate-level courses in Probability (EN.553.720 Probability Theory I or EN.553.721 Probability Theory II) and/or Statistics (EN.553.730 Statistical Theory I or EN.553.731 Statistical Theory II).

OPTIMIZATION

Code	Title	Credits
EN.553.361	Introduction to Optimization I [1]	4
Total Credits		*4*

[1] Students planning to continue to graduate school in an applied mathematics program are encouraged to consider taking a graduate-level course in Optimization (EN.553.761 Nonlinear Optimization I or EN.553.762 Nonlinear Optimization II).

AREA OF FOCUS**

Code	Title	Credits
Complete two courses from one Area of Focus (see below)		6-8
Total Credits		*6-8*

** 04/25/2025 Correction: Statement should read "Complete two courses from Area of Focus (see below), not used to meet the above requirements".

Computational Mathematics

Code	Title	Credits
AS.110.445	Mathematical and Computational Foundations of Data Science	3
EN.553.433	Monte Carlo Methods	4
EN.553.480	Numerical Linear Algebra	4
EN.553.481	Numerical Analysis	4
EN.553.493	Mathematical Image Analysis	4

Discrete Mathematics

Code	Title	Credits
AS.110.401	Introduction to Abstract Algebra	4
AS.110.411	Honors Algebra I	4
EN.553.371	Cryptology and Coding	4
EN.553.463	Network Models in Operations Research	4
EN.553.471	Combinatorial Analysis	4
EN.553.472	Graph Theory	4

Financial Mathematics

Code	Title	Credits
EN.553.427	Stochastic Processes and Applications to Finance I	4
EN.553.441	Equity Markets and Quantitative Trading	3
EN.553.442	Investment Science	4
EN.553.444	Introduction to Financial Derivatives	4
EN.553.445	Interest Rate and Credit Derivatives	4
EN.553.447	Quantitative Portfolio Theory and Performance Analysis	4
EN.553.449	Advanced Equity Derivatives	4
EN.553.488	Computing for Applied Mathematics	3

Optimization and Operations Research

Code	Title	Credits
EN.553.362	Introduction to Optimization II	4
EN.553.400	Mathematical Modeling and Consulting	4
EN.553.453	Mathematical Game Theory	4
EN.553.463	Network Models in Operations Research	4
EN.553.465	Introduction to Convexity	4

Probability and Stochastic Process

Code	Title	Credits
AS.110.405	Real Analysis I	4
AS.110.445	Mathematical and Computational Foundations of Data Science	3
EN.553.426	Introduction to Stochastic Processes	4
EN.553.427	Stochastic Processes and Applications to Finance I	4
EN.553.433	Monte Carlo Methods	4
EN.553.492	Mathematical Biology	3

Statistics and Statistical Learning

Code	Title	Credits
AS.110.445	Mathematical and Computational Foundations of Data Science	3
EN.553.400	Mathematical Modeling and Consulting	4
EN.553.402	Research and Design in Applied Mathematics: Data Mining	4
EN.553.413	Applied Statistics & Data Analysis I	4
EN.553.414	Applied Statistics and Data Analysis II	3
EN.553.432	Bayesian Statistics	3
EN.553.433	Monte Carlo Methods	4
EN.553.436	Introduction to Data Science	4
EN.553.439	Time Series Analysis	3
EN.553.450	Computational Molecular Medicine	4

QUANTITATIVE STUDIES

A grade of C- or higher is required. No Satisfactory/Unsatisfactory (S/U) grade will be accepted. Courses used to meet the requirements above may be counted towards the 40 required credits.

Code	Title	Credits
Courses with Quantitative Studies area designation that are any level		22
Courses with Quantitative Studies area designation that are 300-level or higher		18
Total Credits		*40*

NATURAL SCIENCES

A grade of D or higher is required. Courses that are only offered as Satisfactory/Unsatisfactory (S/U) grading methods may be accepted. Courses used to meet the requirements above may be counted.*

Code	Title	Credits
Courses with Natural Science area designation		12
Total Credits		*12*

* *2/4/2025 Correction:
"A grade of C- or higher is required" is the correct grade requirement

FREE ELECTIVES

Code	Title	Credits
Elective courses to reach 120 credits		

Sample Program

First Year

First Semester	Credits	Second Semester	Credits
AS.110.109	4	AS.110.202	4
EN.501.136 (or other First Year Seminar)	3	EN.500.113	3
EN.553.101 (recommended but not required)	1	Writing Intensive	3
EN.553.172	4	Natural Sciences	4
Humanities/Social Sciences	3		
	15		**14**

Second Year

First Semester	Credits	Second Semester	Credits
AS.110.302	4	EN.553.361	4
EN.553.295	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 but if taken, will count as Humanities/Social Sciences)	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	EN.553.400 (not required)	4
Humanities/Social Sciences	3	Area of Focus course 2	3-4
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