APPLIED MATHEMATICS AND STATISTICS, MASTER OF SCIENCE IN ENGINEERING

Students may elect to work toward the master of science in engineering (M.S.E.) degree in applied mathematics and statistics. All master's degrees in the Department of Applied Mathematics and Statistics ordinarily require a minimum of two semesters of registration as a full-time resident graduate student.

Program Requirements

To obtain departmental certification for the master's degree in Applied Mathematics and Statistics, the student must:

1. Complete satisfactorily at least eight one-semester courses of graduate work in a coherent program approved by the Department Head.
   a. All 3- or 4-credit AMS Department 600-level and 700-level courses (with the exception of EN.553.604 Foundational Methods in Applied Mathematics and research/internship courses), are satisfactory for this requirement.
   b. Certain courses in other departments are also acceptable, and must be fully approved in advance. At most 3 courses outside the department may be counted toward the 8 (or 10) courses used toward Master's degree requirements.
   c. JHU courses listed as 2-credit courses (with the exception of research/internship courses) may count only as one-half course. JHU Public Health courses may count only as one-half course. JHU 1-credit courses may not be used.
2. Meet either of the following options:
   a. submit an acceptable research report based on an approved project (see Master's Student Handbook (https://engineering.jhu.edu/ams/academics/graduate-studies/ms-in-applied-mathematics-and-statistics/applied-mathematics-and-statistics-masters-student-handbook/) for details); or
   b. complete satisfactorily two additional one-semester graduate courses (with the same restrictions listed in section 1) and as approved by the faculty advisor and Department Head.
3. Satisfy the computing requirement by receiving a grade of B- or better in one of the following courses:

Code	Title	Credits
AS.110.445	Mathematical and Computational Foundations of Data Science	3
EN.553.600	Mathematical Modeling and Consulting	4
EN.553.613	Applied Statistics & Data Analysis I	4
EN.553.632	Bayesian Statistics	3
EN.553.633	Monte Carlo Methods	4
EN.553.636	Introduction to Data Science	4
EN.553.650	Computational Molecular Medicine	4
EN.553.669	Large-Scale Optimization For Data Science	3
EN.553.681	Numerical Analysis	4
EN.553.683	Numerical Methods for Partial Differential Equations	4
EN.553.688	Computing for Applied Mathematics	3
EN.553.693	Mathematical Image Analysis	4
EN.553.733	Nonparametric Bayesian Statistics	3
EN.553.740	Machine Learning I	3
EN.553.741	Machine Learning II	3
EN.553.753	Three Key Aspects of Climate Change: Energy Transition, Critical Metals and Sustainable Agriculture	3
EN.553.761	Nonlinear Optimization I	3
EN.553.762	Nonlinear Optimization II	3
EN.553.763	Stochastic Search and Optimization	3
EN.553.780	Shape and Differential Geometry	3
EN.601.675	Machine Learning	3
EN.601.682	Machine Learning: Deep Learning	4

4. Complete an area of focus by taking three courses in one of the following areas. A list of courses that can be counted toward each area of focus will be maintained and updated every year. Some courses from other departments can be eligible to count toward the area of focus. They can be used within the three-course limit specified in point 1, above. This list of courses is based on recent offerings. Not all classes are available every year and substitute classes may be accepted if approved by the advisor and the Academic Affairs Committee.

Code	Title	Credits
Select three courses in one of the following areas:		
Probability Theory		
AS.110.445	Mathematical and Computational Foundations of Data Science	
EN.553.626	Introduction to Stochastic Processes	
EN.553.627	Stochastic Processes and Applications to Finance I	
EN.553.628	Stochastic Processes and Applications to Finance II	
EN.553.633	Monte Carlo Methods	
EN.553.720	Probability Theory I	
EN.553.721	Probability Theory II	
EN.553.763	Stochastic Search and Optimization	
EN.553.764	Modeling, Simulation, and Monte Carlo	
Statistics and Statistical Learning		
AS.110.445	Mathematical and Computational Foundations of Data Science	
EN.553.602	Research and Design in Applied Mathematics: Data Mining	
EN.553.613	Applied Statistics & Data Analysis I	
EN.553.614	Applied Statistics and Data Analysis II	
EN.553.632	Bayesian Statistics	
EN.553.636	Introduction to Data Science	
EN.553.639	Time Series Analysis	
EN.553.650	Computational Molecular Medicine	
EN.553.669	Large-Scale Optimization For Data Science	
EN.553.724	Probabilistic Machine Learning	
EN.553.730	Statistical Theory I	
EN.553.731	Statistical Theory II	
EN.553.733	Nonparametric Bayesian Statistics	
EN.553.735	Topics in Statistical Pattern Recognition	

EN.553.738	High-Dimensional Approximation, Probability, and Statistical Learning	
EN.553.739	Statistical Pattern Recognition Theory & Methods	
EN.553.740	Machine Learning I	
EN.553.741	Machine Learning II	
EN.553.742	Statistical Inference on Graphs	
EN.553.743	Equivariant Machine Learning	
EN.553.767	Iterative Algorithms in Machine Learning: Theory and Applications	
EN.553.782	Statistical Uncertainty Quantification	
Optimization and Operations Research		
EN.553.600	Mathematical Modeling and Consulting	
EN.553.653	Mathematical Game Theory	
EN.553.661	Optimization in Finance	
EN.553.662	Optimization in Data Science	
EN.553.663	Network Models in Operations Research	
EN.553.665	Introduction to Convexity	
EN.553.669	Large-Scale Optimization For Data Science	
EN.553.761	Nonlinear Optimization I	
EN.553.762	Nonlinear Optimization II	
EN.553.763	Stochastic Search and Optimization	
EN.553.766	Combinatorial Optimization	
EN.553.767	Iterative Algorithms in Machine Learning: Theory and Applications	
EN.553.797	Introduction to Control Theory and Optimal Control	
Computational and Applied Mathematics		
AS.110.445	Mathematical and Computational Foundations of Data Science	
EN.553.681	Numerical Analysis	
EN.553.683	Numerical Methods for Partial Differential Equations	
EN.553.688	Computing for Applied Mathematics	
EN.553.691	Dynamical Systems	
EN.553.692	Mathematical Biology	
EN.553.693	Mathematical Image Analysis	
EN.553.780	Shape and Differential Geometry	
EN.553.784	Mathematical Foundations of Computational Anatomy	
EN.553.792	Matrix Analysis and Linear Algebra	
EN.553.793	Turbulence Theory	
EN.553.795	Matrix Analysis and Linear Algebra II	
Discrete Mathematics		
Select at least one of the following: [1]		4
EN.553.671	Combinatorial Analysis	
EN.553.672	Graph Theory	
EN.553.766	Combinatorial Optimization	
Additional Options:		
EN.601.630	Combinatorics & Graph Theory in Computer Science	
EN.601.631	Theory of Computation	
EN.601.633	Intro Algorithms	
EN.601.634	Randomized and Big Data Algorithms	
EN.601.635	Approximation Algorithms	
EN.601.645	Practical Cryptographic Systems	

5. Complete training on the responsible and ethical conduct of research. Please see WSE Policy on the Responsible Conduct of Research (https://engineering.jhu.edu/wse-research/resources-policies-forms/responsible-conduct-of-research/).
6. Complete training on academic ethics.
7. Students in the AMS MSE program are strongly encouraged to register in EN.553.801 Department Seminar in at least one semester of their program.

[1] The Discrete Mathematics area of focus requires a minimum of one Applied Mathematics and Statistics course (listed in the first section), but the other two courses may include other listed Applied Mathematics and Statistics offerings or the listed Computer Science offerings. The Computer Science courses can be used within the three-course limit specified in point 1, above.

An overall GPA of 3.0 must be maintained in courses used to meet the program requirements. At most two course grades of C or C+ are allowed to be used and the rest of the course grades must be B- or better.

Each candidate for the master's degree must submit to the department for approval a written program stating how they plan to meet their degree requirements. This should be done early in the first semester of residence.

Doctoral students in other departments may concurrently undertake a master's program in Applied Mathematics and Statistics with the permission of the AMS department through an application review. Application information is available on the department website (http://engineering.jhu.edu/ams/).