DATA SCIENCE, MASTER OF SCIENCE

https://engineering.jhu.edu/ams/academics/graduate-studies/

The Data Science Master's program at the Johns Hopkins University is a fully residential program which will provide the training in applied mathematics, statistics and computer science to serve as the basis for an understanding, and appreciation, of existing data science tools. Our program aims to produce the next generation of leaders in data science by emphasizing mastery of the skills needed to translate real-world data-driven problems in mathematical ones, and then solving these problems by using a diverse collection of scientific tools.

The final Capstone Experience in Data Science (EN.553.806) is a research-oriented project which must be approved by the research supervisor, academic advisor and the Internal Oversight Committee. The Capstone Experience can be taken in multiple semesters, but the total number of credits required for successful completion is six (6). The goal of the final course and written paper is to allow the student to apply data analysis techniques learned in the program, and possibly to extend those ideas to more general settings or to new application areas. Lastly, the paper will be summarized in a poster session organized at the end of each semester.

Students matriculating Fall 2025 or later will be able to choose from a Capstone Option and Course-Only Option. For more details, see Requirements, or view our website at https://engineering.jhu.edu/ams/academics/graduate-studies/ms-in-data-science/program-requirements-overview (https://engineering.jhu.edu/ams/academics/graduate-studies/ms-in-data-science/program-requirements-overview/)/.

STEM Approved Classification Code: 27.05.01

Fall Deadline

The deadline for a fall application is December 15 at 11:59PM Eastern Standard Time (UTC-5) for receipt of ALL application materials.

Spring Deadline

The deadline for a spring application is September 15 at 11:59PM Eastern Daylight Time (UTC-4). for receipt of ALL application materials.

Admissions Process, Materials, and Criteria

Admissions Process and Materials

To ensure timely consideration of your application, please complete the items in the following checklist at your earliest convenience.

- Complete the online application (https://engineering.jhu.edu/admissions/graduate-admissions/full-time-programs/how-to-apply/), including
  - statement of purpose
  - supplementary information section
  - non-refundable $75 application fee
  - unofficial transcripts
  - TOEFL/IELTS (for international students, see more information below)
  - 3 letters of recommendation
- If English is not your native language, arrange for TOEFL or IELTS Examination scores to be sent to the department by the testing organization. The TOEFL code for applying to Full-Time Engineering graduate programs at The Johns Hopkins University is C559. The IELTS course ID code for applying to programs at the Johns Hopkins University is **4610** or **110079**. Applicants are encouraged to take the TOEFL/IELTS as early as possible during the academic year preceding entrance. If you think you may be eligible for a TOEFL/IELTS waiver, please review the information here (https://engineering.jhu.edu/admissions/graduate-admissions/full-time-programs/how-to-apply/international-students/).
- Under University guidelines, exceptions to the TOEFL-score criteria appearing in the admissions criteria will be granted only in extraordinary cases.
- Arrange for **three** letters of recommendation from persons familiar with your abilities and achievements, especially relevant to graduate study in applied mathematics, to be submitted electronically through the online application.
- Arrange for unofficial transcripts of all undergraduate and previous graduate study to be uploaded into your online application. Applicants who have attended non-US institutions are also strongly encouraged to submit a professional credential evaluation with the unofficial transcripts. If admitted, you will be required to submit your official final documents directly to Graduate Admissions.

Limited partial financial support is available to some Master's students, and all applicants are automatically considered for any available departmental support.

Detailed information about application requirements can be found on the WSE Graduate Admissions web site (https://engineering.jhu.edu/graduate-admissions/).

If you have further questions, please contact the Graduate Admissions Office at WSEGrad-Admissions@jhu.edu.

Admissions Criteria

Prospective students for our graduate programs must have completed a Bachelor's level degree, ideally in Engineering, Mathematics, Computer Science or in the Sciences. In addition, candidates should ideally have completed undergraduate-level courses in

- Calculus, through multivariable calculus
- Linear algebra
- Differential equations
- Probability, preferably complemented with a course in Statistics
- Computer programming (e.g., in C++)
- At least one proof-writing courses

Admissions decisions are based on four major factors: Mathematical course background, grades (GPA), Graduate Record Examination (GRE) scores, and recommendation letters.

If the applicant is not a native English speaker, a minimum TOEFL score of 100 (IBT)/ 250 (CBT)/ 600 (PBT), or a minimum IELTS band score of 7 is required.

Program Requirements

The Data Science Master's program is designed to be completed in three semesters of **full-time residential (on campus)** graduate study. Please see our program website (https://engineering.jhu.edu/ams/data-science-masters-program/) for the most current program requirements, approved courses, and additional information.

Program requirements for students who matriculated PRIOR to Fall 2025.

1. Orientation sessions starting 2 weeks before the first day of classes.
2. EN.553.636 Introduction to Data Science.
3. One course in each of the four Core Areas (https://engineering.jhu.edu/ams/academics/graduate-studies/ms-in-data-science/approved-courses/). Courses chosen in this section must be distinct from the courses used to satisfy the 5 additional course requirements.
4. Four elective courses (https://engineering.jhu.edu/ams/academics/graduate-studies/ms-in-data-science/approved-courses/). Courses may be chosen from the Electives section or the Core Areas section, provided courses are not double-counted.
5. Data Science Capstone Experience (https://engineering.jhu.edu/ams/academics/graduate-studies/ms-in-data-science/data-science-capstone-experience/) (6 credit course), poster presentation and final paper.
6. 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/).
7. Receive a Passing grade in the mandatory Graduate Academic Ethics course, EN.500.603 (01).
8. Data Science Ethics course (https://engineering.jhu.edu/ams/academics/graduate-studies/ms-in-data-science/polices-additional/).
9. The communication skills requirement (Communication Skills Practicum)

Beginning Fall 2025, students will have the choice to complete a Capstone Option or a Course Only Option.

Program requirements for students who matriculated FALL 2025 or later: Capstone Option

1. Orientation sessions starting 2 weeks before the first day of classes.
2. EN.553.636 Introduction to Data Science -OR- EN.601.675 Machine Learning. Must be taken the first semester.
3. One course in each of the four (4) Core Areas (https://engineering.jhu.edu/ams/academics/graduate-studies/ms-in-data-science/approved-courses/). Courses chosen in this section must be distinct from the courses used to satisfy the electives requirements.
4. Three (3) elective courses (https://engineering.jhu.edu/ams/academics/graduate-studies/ms-in-data-science/approved-courses/). Courses may be chosen from the Electives section or the Core Areas section, provided courses are not double-counted.
5. Data Science Capstone Experience (https://engineering.jhu.edu/ams/academics/graduate-studies/ms-in-data-science/data-science-capstone-experience/)*. Six (6) credit course which may be taken in two semesters of 3 credits each.
6. 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/).
7. Receive a Passing grade in the mandatory Graduate Academic Ethics course, EN.500.603 (01).
8. Data Science Ethics course (https://engineering.jhu.edu/ams/academics/graduate-studies/ms-in-data-science/polices-additional/).
9. The communication skills requirement (Communication Skills Practicum)

Program Requirements for students who matriculated FALL 2025 or later: Course Only Option

1. Orientation sessions starting 2 weeks before the first day of classes.
2. EN.553.636* Introduction to Data Science OR EN.601.675 Machine Learning. Must be taken the first semester.
3. One course in each of the four (4) Core Areas (https://engineering.jhu.edu/ams/academics/graduate-studies/ms-in-data-science/approved-courses/). Courses chosen in this section must be distinct from the courses used to satisfy the 5 electives requirements.
4. Five (5) elective courses (https://engineering.jhu.edu/ams/academics/graduate-studies/ms-in-data-science/approved-courses/). Courses may be chosen from the Electives section or the Core Areas section, provided courses are not double-counted.
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. Receive a Passing grade in the mandatory Graduate Academic Ethics course, EN.500.603 (01).
7. Data Science Ethics course (https://engineering.jhu.edu/ams/academics/graduate-studies/ms-in-data-science/polices-additional/).
8. The communication skills requirement (Communication Skills Practicum)

Code	Title	Credits
Core Requirements		
EN.553.636	Introduction to Data Science	4.0
or EN.601.675	Machine Learning	
Core Areas		
Select one course in each of the four Core Areas:		12 - 16
==Statistics==		
EN.553.613	Applied Statistics & Data Analysis I	4
EN.553.614	Applied Statistics and Data Analysis II	3
EN.553.630	Mathematical Statistics (NOTE: EN.553.630 may not be taken after EN.553.730.)	4
EN.553.632	Bayesian Statistics	3
EN.553.639	Time Series Analysis	3
EN.553.730	Statistical Theory I	4
EN.553.731	Statistical Theory II	3
EN.553.733	Nonparametric Bayesian Statistics	3
EN.553.738	High-Dimensional Approximation, Probability, and Statistical Learning	3
EN.553.739	Statistical Pattern Recognition Theory & Methods	3
EN.601.677	Causal Inference	3
EN.625.603	Statistical Methods and Data Analysis	3
EN.625.664	Computational Statistics	3
==Machine Learning==		

EN.520.612	Machine Learning for Signal Processing	3
EN.520.637	Foundations of Reinforcement Learning	3
EN.520.638	Deep Learning	3
EN.520.648	Compressed Sensing and Sparse Recovery	3
EN.520.651	Random Signal Analysis	4
EN.520.665	Machine Perception	3
EN.520.666	Information Extraction	3
EN.525.724	Introduction to Pattern Recognition (Online Course)	3
EN.530.641	Statistical Learning For Engineers	3
EN.535.741	Optimal Control and Reinforcement Learning	3
EN.553.602	Research and Design in Applied Mathematics: Data Mining	4
EN.553.724	Probabilistic Machine Learning	3
EN.553.738	High-Dimensional Approximation, Probability, and Statistical Learning	3
EN.553.740	Machine Learning I	3
EN.553.741	Machine Learning II	3
EN.553.743	Equivariant Machine Learning	3
EN.601.634	Randomized and Big Data Algorithms	3
EN.601.674	ML: Learning Theory	3
EN.601.675	Machine Learning	3
EN.601.677	Causal Inference	3
EN.601.682	Machine Learning: Deep Learning	4
EN.601.779	Machine Learning: Advanced Topics	3
EN.625.692	Probabilistic Graphical Models	3
==Optimization==		
EN.520.618	Modern Convex Optimization	3
EN.553.653	Mathematical Game Theory	4
EN.553.661	Optimization in Finance	4
EN.553.662	Optimization for Data Science	3
EN.553.665	Introduction to Convexity	4
EN.553.669	Large-Scale Optimization For Data Science	3
EN.553.761	Nonlinear Optimization I	3
EN.553.762	Nonlinear Optimization II	3
EN.553.763	Stochastic Search and Optimization	3
EN.553.766	Combinatorial Optimization	3
EN.553.797	Introduction to Control Theory and Optimal Control	3
EN.625.615	Introduction to Optimization	3
==Computing==		
EN.520.617	Computation for Engineers	3
EN.553.688	Computing for Applied Mathematics	3
EN.601.619	Cloud Computing	3
EN.601.620	Parallel Computing for Data Science	3
EN.601.633	Intro Algorithms	3
EN.601.646	Sketching and Indexing for Sequences	3
EN.601.647	Computational Genomics: Sequences	3
EN.625.664	Computational Statistics	3
EN.685.621	Algorithms for Data Science	3
4 or 5 Additional Courses (depending on whether student chooses Course Only Option or Capstone Option		

The following additional courses may be taken to fulfill the elective requirement. Courses listed in the core areas may be taken the elective requirement, however, they may not be double-counted. See our website for concentrations as well as any updates to the course listing.

AS.410.633	Introduction to Bioinformatics	4
AS.410.635	Bioinformatics: Tools for Genome Analysis	4
AS.410.671	Gene Expression Data Analysis and Visualization	4
EN.520.614	Image Processing & Analysis	3
EN.520.615	Image Processing & Analysis II	3
EN.520.623	Medical Image Analysis	3
EN.520.635	Digital Signal Processing	3
EN.520.640	Machine Intelligence on Embedded Systems	3
EN.520.646	Wavelets & Filter Banks	3
EN.520.650	Machine Intelligence	3
EN.520.659	Machine learning for medical applications	3
EN.520.661	AI and Biometric Systems: Techniques, Applications, and Ethics	3
EN.520.665	Machine Perception	3
EN.520.680	Speech and Auditory Processing by Humans and Machines	3
EN.525.733	Deep Learning for Computer Vision (Online Course)	3
EN.553.627	Stochastic Processes and Applications to Finance I	4
EN.553.628	Stochastic Processes and Applications to Finance II	4
EN.553.633	Monte Carlo Methods	4
EN.553.635	Bayesian Statistics for the Physical Sciences	3
EN.553.641	Equity Markets and Quantitative Trading	3
EN.553.642	Investment Science	4
EN.553.644	Introduction to Financial Derivatives	4
EN.553.645	Interest Rate and Credit Derivatives	4
EN.553.646	Risk Measurement/Management in Financial Markets	4
EN.553.647	Quantitative Portfolio Theory and Performance Analysis	4
EN.553.649	Advanced Equity Derivatives	4
EN.553.650	Computational Molecular Medicine	4
EN.553.689	Software Engineering for Data Science	3
EN.553.693	Mathematical Image Analysis	4
EN.553.738	High-Dimensional Approximation, Probability, and Statistical Learning	3
EN.553.744	Data Science Methods for Large Scale Graphs	3
EN.553.753	Commodity Markets: Electricity and Natural Gas, Oil, Metals, and Agriculturals	3
EN.553.792	Matrix Analysis and Linear Algebra	4
EN.580.627	Deep Learning for Medical Imaging	3
EN.580.688	Foundations of Computational Biology and Bioinformatics	3
EN.580.691	Learning, Estimation and Control	3
EN.580.709		3
EN.601.615	Databases	3
EN.601.635	Approximation Algorithms	3
EN.601.637		

EN.601.641	Blockchains and Cryptocurrencies	3
EN.601.642	Modern Cryptography	3
EN.601.651	Introduction to Computational Immunogenomics	3
EN.601.661	Computer Vision	3
EN.601.663	Algorithms for Sensor-Based Robotics (Recommended pre-requisite EN.601.226)	3
EN.601.664	Artificial Intelligence	3
EN.601.665	Natural Language Processing	4
EN.601.666	Information Retrieval and Web Agents	3
EN.601.668	Machine Translation	3
EN.601.670	Artificial Agents	3
EN.601.671	Natural Language Processing: Self-Supervised Models	3
EN.601.690	Introduction to Human-Computer Interaction	3
EN.601.773	Machine Social Intelligence	3
EN.601.783	Vision as Bayesian Inference	3
EN.601.788	Machine Learning for Healthcare	3
EN.605.620	Algorithms for Bioinformatics	3
or EN.605.621	Foundations of Algorithms	
EN.605.621	Foundations of Algorithms	3
EN.605.626	Image Processing	3
EN.605.653	Computational Genomics	3
EN.650.683	Cybersecurity Risk Management	3
Capstone Experience		
EN.553.806	Capstone Experience in Data Science (BS/MSE students in undergraduate status must register for EN.553.506)	6

Capstone Experience

The Capstone Experience in Data Science (EN.553.806 or EN.553.506 for undergraduates) is a research-oriented project which must be approved by the research supervisor, academic advisor and the Internal Oversight Committee. The Capstone Experience can be taken in multiple semesters, but the total number of credits required for successful completion is six (6). Students must complete a Data Science Capstone Experience Proposal (https://engineering.jhu.edu/ams/mse-in-data-science-forms/) form and follow instructions below to submit for approval before enrollment in EN.553.806 will be approved by academic staff.

All students enrolled in EN.553.806 (or EN.553.506) are REQUIRED to present their research findings in poster format at the event held in their final semester. See website for a list of upcoming dates. Students must also submit a final report to their capstone supervisor. The grade for this course is based, in large part, upon the poster event and your final report. For more information on the poster and the report, please see our website (https://engineering.jhu.edu/ams/academics/graduate-studies/ms-in-data-science/mse-in-data-science-forms/).

Additional Required Courses

In addition to the above course requirements, all data science master's students will complete:

- An online Data Ethics course: Students must take an approved online data ethics course such as the one offered by Coursera (https://www.coursera.org/learn/data-science-ethics/)
- The communication skills requirement (Communication Skills Practicum)
- Online course on Responsible Conduct of Research (https://engineering.jhu.edu/research/resources-policies-forms/online-training-course-responsible-conduct-of-research/) (AS.360.624)
- University Orientation and Academic Ethics (EN.500.603) - students are automatically enrolled in their first semester

Additional Notes:

- A course grade of B- or better is required to meet all course requirements. **One** grade of C/C+, is permitted to count towards program requirements. Consult the Department/Program website for additional information regarding Minimum Grade Requirements and the Academic Probation Policy.
- Courses cannot be double-counted for different requirements (even if they appear in several core and/or elective areas).
- All students are required to submit a program plan for review. If any deviations are made from this plan, students are required to submit an updated plan for review.