

DATA SCIENCE, MASTER'S DEGREE

Program Requirements

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

Code	Title	Credits
Core Requirements		
EN.553.636	Introduction to Data Science	4.0
Core Areas		
Select one course in each of the four Core Areas:		12
		-
		16
<i>==Statistics==</i>		
EN.553.613	Applied Statistics and Data Analysis	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	4
EN.553.731	Statistical Theory II	3
EN.553.733	Nonparametric Bayesian Statistics	3
EN.553.735	Topics in Statistical Pattern Recognition	3
EN.553.738	High-Dimensional Approximation, Probability, and Statistical Learning	3
EN.553.739	Statistical Pattern Recognition Theory & Methods	3
EN.570.654	Geostatistics: Understanding Spatial Data	3
EN.601.677	Causal Inference	3
EN.625.603	Statistical Methods and Data Analysis	3
EN.625.664	Computational Statistics	3
<i>==Machine Learning==</i>		
EN.520.612	Machine Learning for Signal Processing	3
EN.520.637	Foundations of Reinforcement Learning	3
EN.520.638	Deep Learning	3
EN.520.647	Information Theory	3
EN.520.648	Compressed Sensing and Sparse Recovery	3
EN.520.651	Random Signal Analysis	4
EN.520.666	Information Extraction	3
EN.525.724	Introduction to Pattern Recognition	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.553.738	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.570.654	Geostatistics: Understanding Spatial Data	3
EN.601.634	Randomized and Big Data Algorithms	3
EN.601.674	ML: Learning Theory	3
EN.601.675	Machine Learning	3
EN.601.676	Machine Learning: Data to Models	3
EN.601.677	Causal Inference	3
EN.601.682	Machine Learning: Deep Learning	4
EN.601.779	Machine Learning: Advanced Topics	3
EN.601.780	Unsupervised Learning: From Big Data to Low-Dimensional Representations	3
EN.625.692	Probabilistic Graphical Models	3
<i>==Optimization==</i>		
EN.520.618	Modern Convex Optimization	3
EN.553.653	Mathematical Game Theory	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 & 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
<i>==Computing==</i>		
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 Additional Courses

Courses listed in the core areas may be taken to complete this requirement, provided they are not double-counted. The following provide additional options, grouped into categories (but the chosen courses may be taken from different categories).

==Computational Medicine==

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.520.659	Machine learning for medical applications	3
EN.553.650	Computational Molecular Medicine	4
EN.580.688	Foundations of Computational Biology and Bioinformatics	3
EN.601.651	Introduction to Computational Immunogenomics	3
EN.605.620	Algorithms for Bioinformatics	3
or EN.605.621	Foundations of Algorithms	
EN.605.653	Computational Genomics	3

==Computer Vision==

EN.520.614	Image Processing & Analysis	3
EN.520.615	Image Processing & Analysis II	3

EN.520.623	Medical Image Analysis	3	EN.601.666	Information Retrieval and Web Agents	3
EN.520.635	Digital Signal Processing	3	EN.650.683	Cybersecurity Risk Management	3
EN.520.646	Wavelets & Filter Banks	3	Capstone Experience		
EN.520.648	Compressed Sensing and Sparse Recovery	3	EN.553.806	Capstone Experience in Data Science	3 - 10
EN.525.733	Deep Learning for Computer Vision	3	In addition to the above course requirements, all data science master's students will complete:		
EN.553.693	Mathematical Image Analysis	4	<ul style="list-style-type: none"> 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) Course on Responsible Conduct of Research (https://engineering.jhu.edu/research/resources-policies-forms/online-training-course-responsible-conduct-of-research/) University Orientation and Academic Ethics 		
EN.601.661	Computer Vision	3	Additional Notes:		
EN.601.783	Vision as Bayesian Inference	3	<ul style="list-style-type: none"> A course grade of B- or better is required to meet all course 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 areas). 		
EN.605.626	Image Processing	3			
==Mathematical Finance==					
EN.553.627	Stochastic Processes and Applications to Finance	4			
EN.553.628	Stochastic Processes and Applications to Finance II	4			
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.553.648	Financial Engineering and Structured Products	4			
EN.553.649	Advanced Equity Derivatives	4			
EN.553.743	Equivariant Machine Learning	3			
EN.553.753	Commodity Markets and Green Energy Finance	4			
==Mathematics of Data Science==					
EN.553.633	Monte Carlo Methods	4			
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.553.792	Matrix Analysis and Linear Algebra	4			
EN.601.634	Randomized and Big Data Algorithms	3			
==Language and Speech==					
EN.520.666	Information Extraction	3			
EN.520.680	Speech and Auditory Processing by Humans and Machines	3			
EN.601.665	Natural Language Processing	3			
EN.601.668	Machine Translation	3			
EN.601.671	Natural Language Processing: Self-Supervised Models	3			
EN.601.769	Events Semantics in Theory and Practice	3			
==Additional Courses==					
EN.520.640	Machine Intelligence on Embedded Systems	3			
EN.520.650	Machine Intelligence	3			
EN.520.665	Machine Perception	3			
EN.553.653	Mathematical Game Theory	4			
EN.580.691	Learning, Estimation and Control	3			
EN.601.615	Databases	3			
EN.601.642	Modern Cryptography	3			
EN.601.663	Algorithms for Sensor-Based Robotics (Recommended pre-requisite EN.601.226)	3			
EN.601.664	Artificial Intelligence	3			