

Applied Mathematics, MS (Boston)

New applications of mathematics are constantly being discovered, and established techniques are being applied in new ways and in emerging fields. Northeastern University's Master of Science in Applied Mathematics caters to students who are looking to enter or who are currently working in a variety of applied math careers such as data science and high-tech firms, computer information and software firms, financial service and investment firms, academic institutions, and research institutes. Northeastern's master's program offers students an opportunity to obtain solid knowledge of mathematical modeling, statistics, and data analysis, as well as excellent programming skills, through experiential learning and co-op experiences from industry.

Students may complete a data science concentration, an operations research concentration, or an electives option. The value of the worldwide Big Data market is growing exponentially. Data science rooted in applied mathematics is essential in exploring Big Data from a wide range of science, businesses, and industries. The operations research concentration offers students study of the analytical and computational skills necessary to enhance efficiency and support decision making across diverse industries such as logistics, finance, and engineering. The electives option allows students to personalize their education with more in-depth knowledge of data science, statistics, or other areas of interest in applied mathematics.

Data Science Concentration

Data science is an interdisciplinary field using techniques and theories drawn from mathematics, statistics, computer science, information science, and related fields to uncover insights hidden in data and to make predictions and decisions. The data science concentration offers students opportunities to learn mathematical modeling, probability, and statistics, which are the theoretical background for data science. Courses in data visualization; machine learning and deep learning; statistical inference; algorithmic, numerical, and computational thinking; experimental design; and coding are also offered. The program offers a multimodal approach including lecture courses, data-driven computer labs, and industry projects. Some courses listed for this program are in collaboration with the College of Engineering and the Khoury College of Computer Sciences.

Operations Research Concentration

The operations research concentration offers students an opportunity to obtain a deep understanding of mathematical modeling and optimization techniques to solve complex operational problems. This concentration emphasizes areas such as decision analysis, stochastic processes, and advanced optimization to prepare students to tackle real-world challenges in fields like supply chain management, finance, and systems engineering. By integrating applied mathematics with problem-solving methodologies, students may gain the analytical and computational skills needed to enhance efficiency and inform decision making in both industry and research settings. Some courses listed for this program are offered in the College of Engineering.

Electives Option

Applications of mathematical modeling and methods are widely involved in different fields such as computer science, engineering, finance, health science, social science, artificial intelligence, etc. The electives option allows students to design their advanced coursework around an area of specific interest, pursue personalized training in applied mathematics, or strengthen an application to a PhD program.

Program Requirements

Complete all courses and requirements listed below unless otherwise indicated.

Core Requirements

Code	Title	Hours
Modeling and Linear Algebra		
Complete 4 semester hours from the following:		4
MATH 5110	Applied Linear Algebra and Matrix Analysis	
MATH 5111	Algebra 1	
MATH 5131	Introduction to Mathematical Methods and Modeling	
Probability and Analysis		
Complete 4 semester hours from the following:		4
MATH 5101	Analysis 1: Functions of One Variable	
MATH 7241	Probability 1	
Statistics		
Complete 8 semester hours from the following:		8
MATH 7243	Machine Learning and Statistical Learning Theory 1	
MATH 7342	Mathematical Statistics	
MATH 7343	Applied Statistics	

Concentrations or Electives Option

A concentration is not required. Students may complete the electives option in lieu of a concentration.

- Data Science (p. 2)
- Operations Research (p. 2)
- Electives Option (p. 3)

Program Credit/GPA Requirements

32 total semester hours required

Minimum 3.000 GPA required

Concentration in Data Science

Code	Title	Hours
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No more than 8 semester hours of coursework outside of the MATH subject code may be applied to the requirements of this concentration.

Core

Complete 8 semester hours from the following (students may take other Khoury College of Computer Sciences courses not on the list in consultation with their faculty advisor): 8

CS 5800	Algorithms
CS 6140	Machine Learning
CS 6220	Data Mining Techniques
DA 5020	Collecting, Storing, and Retrieving Data
DA 5030	Introduction to Data Mining/Machine Learning
DS 5220	Supervised Machine Learning and Learning Theory
DS 5230	Unsupervised Machine Learning and Data Mining
EECE 5644	Introduction to Machine Learning and Pattern Recognition
MATH 7243	Machine Learning and Statistical Learning Theory 1

Electives

Complete 8 semester hours of courses at the 5000 level or above in the following subject area. See suggested elective course list. (p. 3) 8

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Concentration in Operations Research

Code	Title	Hours
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No more than 8 semester hours of coursework outside of the MATH subject code may be applied to the requirements of this concentration.

Core

Complete 8 semester hours from the following (students may take other College of Engineering courses not on the list in consultation with their faculty advisor): 8

IE 7200	Supply Chain Engineering
MATH 7207	Algorithms for Optimization
MATH 7234	Optimization and Complexity
MATH 7341	Probability 2
OR 6205	Deterministic Operations Research
OR 7230	Probabilistic Operation Research
OR 7235	Inventory Theory
OR 7240	Integer and Nonlinear Optimization
OR 7245	Network Analysis and Advanced Optimization
OR 7270	Convex Optimization and Applications
OR 7310	Logistics, Warehousing, and Scheduling

Electives

Complete 8 semester hours of courses at the 5000 level or above in the following subject area. See suggested elective course list. (p. 3) 8

MATH

Electives Option

Code	Title	Hours
Complete 16 semester hours in the following subject area. Students may take MATH courses at the 5000 level or above listed in other concentrations or the suggested elective course list. Courses outside of MATH may be chosen with faculty approval.		16
No more than 8 semester hours of coursework outside of the MATH subject code may be applied to requirements of this option.		
MATH		

Suggested Electives Course List

Code	Title	Hours
Students may complete other MATH courses not listed below and courses outside of MATH in consultation with their faculty advisor.		
DS 5110	Essentials of Data Science	
EECE 7205	Fundamentals of Computer Engineering	
MATH 5352	Quantum Computation and Information	
MATH 7203	Numerical Analysis 1	
MATH 7205	Numerical Analysis 2	
MATH 7207	Algorithms for Optimization	
MATH 7223	Riemannian Optimization	
MATH 7233	Graph Theory	
MATH 7234	Optimization and Complexity	
MATH 7339	Machine Learning and Statistical Learning Theory 2	
MATH 7341	Probability 2	
MATH 7342	Mathematical Statistics	
MATH 7344	Regression, ANOVA, and Design	

Additional Courses

The following are some theoretical MATH courses usually taken in the PhD program (these may not be offered every academic year):

MATH 5102	Analysis 2: Functions of Several Variables	
MATH 5112	Algebra 2	
MATH 7202	Partial Differential Equations 1	
MATH 7221	Topology 2	
MATH 7311	Commutative Algebra	
MATH 7315	Algebraic Number Theory	
MATH 7320	Modern Algebraic Geometry	
MATH 7371	Morse Theory	
MATH 7381	Topics in Combinatorics	
MATH 7741	Readings in Probability and Statistics	
MATH 8450	Research Seminar in Mathematics	