

APPLIED MATHEMATICS, MS

Please click here (<http://catalog.ucdenver.edu/cu-denver/graduate/schools-colleges-departments/college-liberal-arts-sciences/mathematical-statistical-sciences/>) to see Mathematical and Statistical Sciences department information.

Introduction

Our MS in Applied Mathematics program offers a degree in applied mathematics along with specialization opportunities in many areas, including

- Applied Probability and Uncertainty Quantification
- Applied Statistics
- Data Science
- Discrete Mathematics
- Mathematics of Engineering and Science
- Numerical Analysis
- Operations Research

The program provides training in applied mathematics and/or statistics and opportunities for introductory research in collaboration with internationally recognized scholars. Students have the option to tailor their coursework with maximum flexibility or specialize in one of several concentrations of the degree. Students in all areas have the opportunity to participate in real-world research through our innovative Math Clinic and Statistical Consulting workshop. Some highlights of our exciting research projects include evolutionary dynamics, climate modeling, wildfire simulations, machine learning, genetic inheritance and association, optimization in data analysis, and more.

The degree is designed to give students a contemporary education in many areas of data science. In all of its activities, the department embodies the outlook that mathematics, statistics, computing, and data science are powerful tools that can be used to solve problems of immediate and practical importance. Our program emphasizes the training of skills valued by many employers. These skills include problem solving, critical thinking, analysis, facility with data, the ability to process quantitative information, and perhaps most important of all, the ability to learn and master new skills and concepts quickly. Many of our MS graduates have continued towards employment in the Denver business and research sectors and Denver area community colleges.

See our degree requirements section for further information about our concentration areas.

These degree requirements are subject to periodic revision by the academic department, and the College of Liberal Arts and Sciences reserves the right to make exceptions and substitutions as judged necessary in individual cases. Therefore, the College strongly urges students to consult regularly with their Applied Mathematics faculty advisor to confirm the best plans of study before finalizing them.

Graduate Education Policies and Procedures apply to this program.

Program Requirements

1. Students must complete a minimum of 30 credit hours.
2. Students must complete a minimum of 24 graduate (5000-level or higher) MATH credit hours.
3. Students must earn a minimum grade of B- (2.7) in all courses applied to the degree and must achieve a minimum cumulative GPA of 3.0.

- Students cannot complete program or ancillary course requirements as P+/P/F or S/U.
4. Students must complete all coursework with CU Denver faculty.
 5. Students must complete either a thesis or project, each with a written component and an oral presentation before a committee consisting of three graduate faculty members.

Program Restrictions, Allowances and Recommendations

1. The remaining six hours must be either MATH courses numbered 5000 or above or approved courses outside the department numbered 4000 or above.
2. Up to nine semester hours of prior course work may be transferred in (subject to approval); these must be at the 5000 level or above with a B- or better grade. Courses already applied toward another degree (graduate or undergraduate) cannot be used toward the MS degree in applied mathematics.
3. The following MATH courses will **not** count toward a graduate degree: MATH 5010 History of Mathematics, MATH 5012 An Advanced Perspective on Number and Operation, MATH 5015 Capstone Course for Secondary Teachers, MATH 5017 Topics in Mathematics for Teachers, MATH 5198 Mathematics for Bioscientists, and MATH 5830 Applied Statistics.

Code	Title	Hours
The following program requirements must be satisfied by all students in the MS in Applied Mathematics Program.		
Complete the following required courses:		6
Analysis Core Requirement		
MATH 5070	Applied Analysis	
or MATH 611 Real Analysis		
Linear Algebra Core Requirement		
MATH 5718	Applied Linear Algebra	
Complete a minimum of 24 additional graduate level credit hours of MATH coursework. ¹		24
A student must satisfy the course requirements for the MS degree in one of these areas. Substitutions or changes to the requirements may be made with the written approval of a student's academic advisor and the Graduate Committee.		
MS Degree without a Concentration Area (p. 2)		
Applied Probability and Uncertainty Quantification Concentration (p. 2)		
Applied Statistics Concentration (p. 2)		
Data Science Concentration (p. 2)		
Discrete Mathematics Concentration (p. 2)		
Mathematics of Engineering and Science Concentration (p. 2)		
Numerical Analysis Concentration (p. 3)		
Operations Research Concentration (p. 3)		
A student may devote up to 6 hours (of the 30 required hours) to the writing of a thesis, or up to 3 hours to the completion of a project. Following completion of course work, all candidates must make an oral presentation of a thesis or a project before a committee consisting of three graduate faculty members.		
Total Hours		30

¹ The following MATH courses will **not** count toward a graduate degree: MATH 5010 History of Mathematics, MATH 5017 Topics in Mathematics for Teachers, and MATH 5830 Applied Statistics.

MS Degree without a Concentration Area

Note that MATH 6131 Real Analysis can be used to satisfy both the analysis core requirement and may also count as one of the three courses satisfying this requirement.

Code	Title	Hours
Complete nine credit hours from the following courses: ¹		9
MATH 5310	Probability	
MATH 5320	Statistical Inference	
MATH 5490	Network Flows	
MATH 5593	Linear Programming	
MATH 5660	Numerical Analysis I	
Any MATH course at the 6000 level or higher (with the exception of MATH 6960 Research Methods in Mathematics and Statistics).		
Total Hours		9

¹ Additional courses may apply, given prior approval by the student's advisor and the Graduate Program Director.

Applied Probability and Uncertainty Quantification Concentration

Code	Title	Hours
Complete all of the following courses:		12
MATH 5310	Probability	
MATH 6101	Uncertainty Quantification	
MATH 5792	Probabilistic Modeling	
or MATH 6380 Stochastic Processes		
MATH 5660	Numerical Analysis I	
or MATH 5733 Partial Differential Equations		
or MATH 6131 Real Analysis		
or MATH 7386 Monte Carlo Methods		
Total Hours		12

Applied Statistics Concentration

Code	Title	Hours
Complete all of the following courses:		12
MATH 5320	Statistical Inference	
MATH 5387	Applied Regression Analysis	
MATH 6330	Workshop in Statistical Consulting	
MATH 5310	Probability	
or MATH 5792 Probabilistic Modeling		
or MATH 6380 Stochastic Processes		
Complete one of the following courses: ¹		3
MATH 5337	Intro to Statistical and Machine Learning	
MATH 5388	Machine Learning Methods	
MATH 6101	Uncertainty Quantification	
MATH 6380	Stochastic Processes	
MATH 6384	Spatial Data Analysis	
MATH 6388	Statistical and Machine Learning	

MATH 7384	Mathematical Probability	
MATH 7386	Monte Carlo Methods	
MATH 7393	Bayesian Statistics	
MATH 7826	Topics in Probability and Statistics	
Total Hours		15

¹ Additional courses may apply, given prior approval by the student's advisor and the Graduate Program Director.

Data Science Concentration

Code	Title	Hours
Complete all of the following:		12
MATH 5387	Applied Regression Analysis	
MATH 5388	Machine Learning Methods	
MATH 5490	Network Flows	
or MATH 5593 Linear Programming		
or MATH 6593 Nonlinear Programming		
MATH 5660	Numerical Analysis I	
or MATH 5733 Partial Differential Equations		
or MATH 6101 Uncertainty Quantification		
or MATH 7386 Monte Carlo Methods		
or MATH 7663 Numerical Linear Algebra		
Complete an additional course from the above lists or from the following list:		3
MATH 5779	Math Clinic	
MATH 6131	Real Analysis	
MATH 6330	Workshop in Statistical Consulting	
MATH 6380	Stochastic Processes	
MATH 6384	Spatial Data Analysis	
MATH 6388	Statistical and Machine Learning	
MATH 6404	Applied Graph Theory	
MATH 7384	Mathematical Probability	
MATH 7385	Stochastic Differential Equations	
MATH 7393	Bayesian Statistics	
MATH 7594	Integer Programming	
Total Hours		15

Discrete Mathematics Concentration

Code	Title	Hours
Complete four of the following courses:		12
MATH 5490	Network Flows	
MATH 6404	Applied Graph Theory	
MATH 7405	Advanced Graph Theory	
MATH 7409	Applied Combinatorics	
MATH 7410	Combinatorial Structures	
MATH 7823	Topics in Discrete Math	
Total Hours		12

Mathematics of Engineering and Science Concentration

Code	Title	Hours
Complete three of the following courses:		9
MATH 5387	Applied Regression Analysis	
MATH 5660	Numerical Analysis I	

MATH 5733	Partial Differential Equations	
MATH 5779	Math Clinic	
MATH 5792	Probabilistic Modeling	
<i>Complete two of the following courses:</i>		6
MATH 5661	Numerical Analysis II	
MATH 6101	Uncertainty Quantification	
MATH 6653	Introduction to Finite Element Methods	
MATH 7386	Monte Carlo Methods	
MATH 7665	Numerical Linear Algebra	
Total Hours		15

Numerical Analysis Concentration

Code	Title	Hours
<i>Complete all of the following courses:</i>		6
MATH 5660	Numerical Analysis I	
MATH 5733	Partial Differential Equations	
<i>Complete three of the following courses:</i>		9
MATH 5593	Linear Programming	
MATH 5661	Numerical Analysis II	
MATH 6101	Uncertainty Quantification	
MATH 6595	Nonlinear Programming	
MATH 6653	Introduction to Finite Element Methods	
MATH 7386	Monte Carlo Methods	
MATH 7665	Numerical Linear Algebra	
MATH 8660	Mathematical Foundations of Finite Element Methods	
Total Hours		15

Operations Research Concentration

Code	Title	Hours
<i>Complete all of the following courses:</i>		6
MATH 5593	Linear Programming	
MATH 5792	Probabilistic Modeling	
	or MATH 6380 Stochastic Processes	
<i>Complete two of the following courses:</i>		6
MATH 5390	Game Theory	
MATH 5490	Network Flows	
MATH 5779	Math Clinic (with approval)	
MATH 6595	Nonlinear Programming	
MATH 7593	Advanced Linear Programming	
MATH 7594	Integer Programming	
MATH 7595	Advanced Nonlinear Programming	
MATH 7825	Topics in Optimization	
Total Hours		12

To learn more about the Student Learning Outcomes for this program, please visit our website (<https://clas.ucdenver.edu/mathematical-and-statistical-sciences/ms-applied-mathematics-program-goals-objectives/>).