

# APPLIED MATHEMATICS, PHD

Please click [here](#) to see Mathematical and Statistical Sciences department information.

## Introduction

Our PhD in Applied Mathematics program provides comprehensive training in applied mathematics and/or statistics and opportunities for cutting-edge research in close collaboration with internationally recognized scholars in the fields of

- Computational Mathematics
- Discrete Mathematics
- Optimization and Operations Research
- Probability
- Statistics

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. Current research funding includes grants from NSF, NIH, DoD, and NASA.

The degree is designed to give students a contemporary, comprehensive education in subjects such as high-performance computing, numerical analysis, optimization, statistical methods, and operations research. 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 most important of all, the ability to learn and master new skills and concepts quickly. These strengths make our students highly marketable for careers in industry as well as in academia. Scholarships and assistantships (<https://clas.ucdenver.edu/mathematical-and-statistical-sciences/graduate-student-financial-resources/>) for graduate students are available and awarded competitively.

The program 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 program 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 70 approved credit hours.
2. Students must complete 40 non-thesis credit hours with CU Denver faculty.
3. Students must complete a minimum of 30 dissertation credit hours.
4. Students must complete all credit hours at the graduate 5000-level and above.
5. Students must earn a minimum grade of B (3.0) or better in all core courses, a B- (2.7) in all other courses applied to the degree and must achieve a minimum cumulative program GPA of 3.0. All graded attempts in required and elective courses are calculated in the

program GPA. Courses taken using P+/P/F or S/U grading cannot apply to program requirements.

## Program Restrictions, Allowances and Recommendations

1. There are six phases of the PhD program. A candidate must fulfill course requirements, pass the preliminary examinations, establish a PhD committee, meet the academic residency requirement, pass the comprehensive examination and write and defend a dissertation.
2. The following MATH courses will NOT count toward a graduate degree: MATH 5000-5009, 5010, 5012-5015, 5017, 5198, 5250 and 5830.
3. Students must complete 40 semester hours of non-thesis course work at the graduate level (up to 30 hours of this course work may be transferred in, including courses taken as part of a master's degree). In addition, 30 hours of dissertation credit must be taken. One readings course (one semester hour each) is required as part of the formal course work. Students must also satisfy a **breadth requirement** by completing a total of six graduate math courses from among several areas of mathematics, with no more than three of these courses from any one area.
4. The preliminary examinations are designed to determine that students who intend to pursue the PhD program are qualified to do so. These four-hour written examinations are in the areas of applied analysis and applied linear algebra. Students must pass these exams by the start of their fourth semester.
5. Six semesters of full-time scholarly work are required, as specified in the Graduate Education Policies and Procedures. All students are strongly advised to spend at least one year doing full-time course work or research with no outside employment.
6. The comprehensive examination is taken after completion of the preliminary exams, completion of at least three semesters of residency, and upon completion of essentially all non-thesis coursework. The exam is designed to determine mastery of graduate-level mathematics and the ability to embark on dissertation research. It consists of a six-hour written examination and an oral follow-up examination. Students must pass the comprehensive exam by the beginning of the 4th year. Within six months after passing the comprehensive examination, the candidate must present a dissertation proposal to their dissertation committee.
7. Each student must write and defend a dissertation containing original contributions and evidence of significant scholarship. The dissertation defense is public and must be given before an approved examining committee.

For more detailed information about the Applied Mathematics PhD, see department website (<https://clas.ucdenver.edu/mathematical-and-statistical-sciences/phd-applied-mathematics/>).

Code	Title	Hours
<b>Complete the following program requirements:</b>		
<i>Students must satisfy a breadth requirement by completing a total of six graduate math courses from among several areas of mathematics, with no more than three of these courses from any one areas.</i>		18
	Computational Mathematics (p. 2)	
	Discrete Mathematics (p. 2)	
	Operations Research (p. 2)	
	Statistics (p. 2)	
	General (p. 2)	

Complete a minimum of one of the following readings courses:		1
MATH 7921	Readings in Mathematics	
MATH 7922	Rdgs:Math Fndts-Cmptr Sc	
MATH 7923	Readings: Discrete Mathematics	
MATH 7924	Rdgs:Comp Mathematics	
MATH 7925	Readings: Optimization	
MATH 7926	Rdgs:Applied Prob/Stats	
MATH 7927	Rdgs:Comp/Math Biology	
Complete an additional 21 elective credit hours of graduate level coursework, in consultation with the program director. The following courses will not count toward the Ph.D. in Applied Mathematics: MATH 5010, MATH 5012-5017, MATH 5198, MATH 5779 and MATH 5830.		21
Complete 30 dissertation credit hours.		30
MATH 8990	Doctoral Dissertation	
Total Hours		70

Computational Mathematics

Code	Title	Hours
MATH 5660	Numerical Analysis I	
MATH 5661	Numerical Analysis II	
MATH 5791	Continuous Modeling	
MATH 6101	Uncertainty Quantification	
MATH 6653	Introduction to Finite Element Methods	
MATH 6735	Continuum Mechanics	
MATH 7386	Monte Carlo Methods	
MATH 7663	Finite Difference Methods for Partial Differential Equations	
MATH 7665	Numerical Linear Algebra	
MATH 7824	Topics in Computational Mathematics	
MATH 8660	Mathematical Foundations of Finite Element Methods	
MATH 8664	Iterative Methods in Numerical Linear Algebra	

Discrete Mathematics

Code	Title	Hours
MATH 5793	Discrete Math Modeling	
MATH 6404	Applied Graph Theory	
MATH 7405	Advanced Graph Theory	
MATH 7409	Applied Combinatorics	
MATH 7410	Combinatorial Structures	
MATH 7823	Topics in Discrete Math	

Operations Research

Code	Title	Hours
MATH 5390	Game Theory	
MATH 5490	Network Flows	
MATH 5593	Linear Programming	
MATH 5792	Probabilistic Modeling	
MATH 5794	Optimization Modeling	
MATH 6595	Nonlinear Programming	
MATH 7593	Advanced Linear Programming	
MATH 7594	Integer Programming	

MATH 7595	Advanced Nonlinear Programming
MATH 7825	Topics in Optimization

Statistics

Code	Title	Hours
MATH 5320	Statistical Inference	
MATH 5337	Intro to Statistical and Machine Learning	
MATH 5387	Applied Regression Analysis	
MATH 5394	Experimental Designs	
MATH 6330	Workshop in Statistical Consulting	
MATH 6384	Spatial Data Analysis	
MATH 6388	Statistical and Machine Learning	
MATH 7393	Bayesian Statistics	

General

Code	Title	Hours
MATH 5110	Theory of Numbers	
MATH 5135	Functions of a Complex Variable	
MATH 5310	Probability	
MATH 5388	Machine Learning Methods	
MATH 5733	Partial Differential Equations	
MATH 6131	Real Analysis (Note: This course may count as a breadth course only if Math 5070 (Applied Analysis) is also taken.)	
MATH 6380	Stochastic Processes	
MATH 7101	Topology	
MATH 7132	Functional Analysis	
MATH 7384	Mathematical Probability	
MATH 7385	Stochastic Differential Equations	
MATH 7413	Modern Algebra I	
MATH 7822	Topics in Linear Algebra	

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