

APPLIED MATHEMATICS

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When one examines the job areas in which the largest amount of growth is expected over the next decade, the area of applied mathematics is quite notable. The ability to employ sophisticated mathematical tools and reasoning has become increasingly important in a number of seemingly different areas: prediction and rational decision making in finance, insurance, business, economic, and military strategy; sports analytics; bio- and social science research; weather and climate modeling; 3D computer graphics and animation; artificial intelligence for myriad applications ranging from manipulation of social media users, to smarter video games, to self-driving cars. Consequently, an increasing number of professions need to employ the skills of individuals with a strong background in core tools of applied mathematics. The applied mathematics major at the University of Providence is designed to guide motivated students step-by-step through the process of building a deep and broad foundation of core knowledge and skills in mathematics, statistics, and computer science to enable the student to create, implement, evaluate, and communicate complex mathematical models in a wide range of scholarly and industrial applications.

The Applied Math Major can serve as preparation for graduate study in mathematics, statistics, data science / analytics, operations research, or actuarial science, to name a few. It could also serve as a basis from which to seek 3+2 partnerships for a BS in engineering program.

The Applied Mathematics - Quantitative Business Concentration can serve as preparation for quantitatively rigorous MBA or Business PHD programs, or business analytics programs. It also includes the two courses focused towards actuarial exam preparation, and therefore it could also be a pathway to an actuarial or related career.

All courses will be available both in-person at the Great Falls campus and online through Moodle Collaborate, with the exception of laboratory science course electives.

Applied Mathematics Major - Common Learning Outcomes

In summary, the ability to create, implement, evaluate and present complex mathematical models, itemized as follows:

- A1. Proficiency with conceptual, analytical, and computational methods in calculus and calculus-based modeling.
- A2. General capability with programming syntax and structures that are relevant in computational mathematics, operations research, and data science.
- A3. Build a thorough foundation in probability theory.
- A4. With a deep understanding of the connection between algebraic and graphical representations, be able to curate and prepare visual representations of both theoretical objects/relationships and empirical data for the purposes of intuition building, visual analysis, and communication of results.
- A5. Gain extensive practice applying, combining, and innovating with problem solving strategies for both pure and applied problems, including problems for which specifically similar examples have not been provided.

Applied Mathematics Concentration - Specific Learning Outcomes

- A6. Develop and refine confident fluency in matrix algebra with theoretical rigor and familiarity with applications to scientific and

economic modeling, statistical and data analysis applications, and vectorized coding.

- A7. Broad introduction to the use of ordinary differential equations in scientific, economic, and financial modeling, with mastery of foundational analytical and computational solution methods.
- A8. Build a toolbox of relevant statistical inference methods that is well-integrated into the foundation of probability theory.
- A9. With capstone coursework or undergraduate research, focus foundational studies around a concrete area of career or academic aspiration in contemporary applied mathematics.

Quantitative Business Concentration - Specific Learning Outcomes

In summary, the ability to implement and evaluate complex mathematical models that are particular to business, economics, and finance:

- QB1. Build and practice with a mathematical toolbox for strategic/rational decision making problems, using selected tools of probability and statistics, game theory, financial analysis, and machine learning.
- QB2. Gain conceptual, conversational, and moderate computational proficiency in micro- and macro- economic problems and models.
- QB3. Develop rigorous expertise with the mathematical theory of interest and its common financial applications.
- QB4. Familiarity with essential topics, principles, and methods in management, legal, accounting, and advertising for general business administration.

Minor Learning Outcomes:

- Analysis Concentration: A1, A5, and A7
- Statistics Concentration: A1, A3, and A8
- Math for Business and Finance Concentration: A1, QB1, QB3

Degree Requirements

- Bachelor Degree Requirements

Applied Mathematics (B.A.)

Code	Title	Credits
CPS 161	ELEMENTARY PROGRAMMING	3
CPS 165	ADVANCED PROGRAMMING	3
CPS 301	PHYS DES & IMPLM DATA MGMT SYS	3
CPS 403	PRINCIPLES OF MACHINE LEARNING	3
MTH 177	DISCRETE MATHEMATICS	3
MTH 241	CALCULUS I	4
MTH 242	CALCULUS II	4
MTH 243	CALCULUS III	4
MTH 311	MATHEMATICAL STATISTICS I - PROBABILITY THEORY	3
Specialized Concentration		24-30
Total Credits Required:		54-60

Specialized Concentrations

Applied Mathematics Concentration

Code	Title	Credits
Upper Division Applied Math Core		
MTH 300	LINEAR ALGEBRA	3
MTH 252	STAT METHODS FOR THE SCIENCES	3

Code	Title	Credits
or MTH 312	MATHEMATICAL STATISTICS II - STATISTICAL INFERENCE	
MTH 351	DIFFERENTIAL EQUATIONS	3
MTH 400	LINEAR ALGEBRA II	3
MTH 421	MATHEMATICAL & NUMERICAL ANALYSIS	3
Electives		9
Choose from the following:		
MTH 252	STAT METHODS FOR THE SCIENCES	
MTH 312	MATHEMATICAL STATISTICS II - STATISTICAL INFERENCE *	
MTH 365	FINANCIAL MATHEMATICS *	
MTH 392	SPECIAL TOPICS - MATH	
MTH 401	REAL ANALYSIS I *	
MTH 402	REAL ANALYSIS II *	
MTH 405	MODERN ALGEBRA *	
MTH 406	GAME THEORY	
MTH 499	SENIOR THESIS	
BIO 221	CELL AND MOLECULAR BIOLOGY	
BIO 311	GENETICS	
Total Credits Required:		24

Quantitative Business Concentration

Code	Title	Credits
ACC 201	PRIN OF FINANCIAL ACCOUNTING	3
ECN 201	MACROECONOMICS	3
ECN 202	MICROECONOMICS	3
BUS 220	COMMERCIAL LAW I	3
BUS 240	LEADERSHIP & MANAGEMENT	3
BUS 241	BUSINESS RESEARCH METHODS	3
BUS 260	MARKETING	3
MTH 365	FINANCIAL MATHEMATICS	3
BUS 400	FINANCIAL ANALYSIS	3
MTH 406	GAME THEORY	3
Total Credits Required:		30

Math for Business and Finance Minor

There is enough diversity in coursework within the two major concentrations to offer 3 targeted minor concentrations.

Code	Title	Credits
MTH 106	CONTEMPORARY MATHEMATICS	3
MTH 108	ELEMENTARY STATISTICS	3
MTH 241	CALCULUS I	4
MTH 242	CALCULUS II	4
MTH 365	FINANCIAL MATHEMATICS *	3
Total Credits Required:		17

Statistics Minor

Theoretical foundations and applied methods. Intended to make more competitive and well-rounded students going into graduate study and research-oriented careers in natural and social sciences.

Code	Title	Credits
MTH 177	DISCRETE MATHEMATICS	3
MTH 241	CALCULUS I	4
MTH 242	CALCULUS II	4
MTH 252	STAT METHODS FOR THE SCIENCES	3
MTH 311	MATHEMATICAL STATISTICS I - PROBABILITY THEORY	3
Total Credits Required:		17

Mathematical Analysis Minor

Code	Title	Credits
MTH 241	CALCULUS I	4
MTH 242	CALCULUS II	4
MTH 243	CALCULUS III	4
MTH 351	DIFFERENTIAL EQUATIONS	3
Electives:		6
Choose from the following:		
MTH 177	DISCRETE MATHEMATICS	
MTH 252	STAT METHODS FOR THE SCIENCES	
MTH 300	LINEAR ALGEBRA	
MTH 311	MATHEMATICAL STATISTICS I - PROBABILITY THEORY	
MTH 312	MATHEMATICAL STATISTICS II - STATISTICAL INFERENCE *	
MTH 365	FINANCIAL MATHEMATICS *	
MTH 392	SPECIAL TOPICS - MATH	
MTH 400	LINEAR ALGEBRA II	
MTH 401	REAL ANALYSIS I *	
MTH 402	REAL ANALYSIS II *	
MTH 405	MODERN ALGEBRA *	
MTH 406	GAME THEORY	
MTH 421	MATHEMATICAL & NUMERICAL ANALYSIS	
MTH 499	SENIOR THESIS	
Total Credits Required:		21

* Courses offered on demand in directed study format.