

COMPUTATIONAL AND APPLIED MATHEMATICS AND STATISTICS-MATHEMATICAL BIOLOGY, MINOR

CAMS Program

The CAMS (Computational and Applied Mathematics and Statistics) program is by nature inter-disciplinary. In CAMS, applications are the primary driver of the research agenda for scholarly activity. The CAMS program supports a collaborative, multi-disciplinary, and integrative approach to teaching and research in applied and computational mathematics, operations research, mathematical biology and statistics. Course work and research experiences in CAMS provide a strong base in both the knowledge and practical skills necessary to make important contributions to mathematics, industry and the sciences. There are two tracks within the CAMS program: Mathematical Biology and Applied Statistics.

Mathematical Biology aims at modeling natural, biological processes using mathematical techniques and tools. It has both practical and theoretical applications in biological research. Applying mathematics to biology has a long history, but only relatively recently has there been an explosion of interest in the field. Some reasons for this include: the explosion of data-rich information sets, due to the genomics revolution, which are difficult to understand without the use of analytical tools; recent development of mathematical tools such as chaos theory to help understand complex, nonlinear mechanisms in biology; an increase in computing power which enables calculations and simulations to be performed that were not previously possible; and an increasing interest in computer experimentation due to the complications involved in human and animal research.

The Applied Statistics Track provides a major option for undergraduates with an interest in statistics, "big data", and actuarial science. As humans have developed cheaper and smaller sensors, web cameras and other data collection devices, the amount of data available to be analyzed and understood has exploded. Statistics is the mathematical science that pertains to the collection, analysis, interpretation, explanation, and presentation of data. Because of its empirical roots and its focus on applications, statistics is typically considered a distinct mathematical science rather than a branch of mathematics.

The Applied Statistics major gives students a rigorous training in the highly-interdisciplinary modern practice of statistics. The major draws upon a foundation of topics in mathematics and computer science to build a core specialization in applied and theoretical statistics and enriches this statistical knowledge with cross-disciplinary electives. Possible areas of focus within the major include: econometrics, data science, general applied statistics, and actuarial science.

The CAMS Mathematical Biology minor helps students develop skills for the modeling and analysis of biological processes. Students use their training in mathematics, statistics, and computer science to study problems in biology. Applications range across all scales of biology, from cells to ecosystems.

Click here for minor declaration form (http://www.wm.edu/offices/registrar/documents/degree/declaration_of_academic_minor.pdf).

Course Requirements

Code	Title	Hours
MATH 111	Calculus I	4
or MATH 131	Calculus I for Life Sciences	
MATH 112	Calculus II	4
or MATH 132	Calculus II for Life Sciences	
Core Requirements		
Mathematical Modeling:		
BIOL 325	Introduction to Quantitative Biology	3
or MATH 345	Introduction to Mathematical Biology	
NSCI 351	Cellular Biophysics and Modeling	3
or MATH 356	Random Walks in Biology	
Programming:		
CSCI 141	Modern Programming Fundamentals	3-4
or PHYS 256	Practical Computing for Scientists and Engineers	
Statistics and Data Analysis:		
Select one of the following:		3-4
BIOL 327	Intro to Biostatistics	
MATH 106	Elementary Probability and Statistics	
MATH 351	Probability and Statistics for Scientists	
MATH 352	Statistical Data Analysis	
PSYC 301	Elementary Statistics	
Electives		
Select one of the remaining Mathematical Modeling courses above ¹		3
At most one 300 level or above course with a BIOL prefix or BIOL attribute.		
Select one of the following:		3
APSC 327	Introduction to Laser Biomedicine	
APSC 371	Matroids: The Value of Abstraction	
APSC 377	Bioengineering and Synthetic Biology	
APSC 424	Supercomputing for Science	
APSC 430	Biofabrication in Tissue Engineering	
APSC 450	Computational Neurosci	
BIOL 404	Special Topics in Biology (Introduction to Bioinformatics)	
BIOL 445	GIS for Biologists	
CHEM 314	Biochemistry	
CHEM 341	Physical and Analytical Chemistry for Life Sciences	
CSCI 241	Data Structures	
CSCI 303	Algorithms	
CSCI 416	Fundamentals of Artificial Intelligence/Machine Learning	
CSCI 426	Simulation	
DATA 302	Databases	
DATA 301	Applied Machine Learning	
DATA 340	Special Topics in Data Application	
DATA 431	Spatial Data Discovery	
DATA 442	Neural Networks & Deep Learning	

GIS 201	Introduction to Geographic Information Systems and Spatial Analysis
MATH 302	Ordinary Differential Equations
MATH 352	Statistical Data Analysis
MATH 413	Introduction to Numerical Analysis I
MATH 414	Introduction to Numerical Analysis II
MATH 441	Nonlinear Dynamics
MATH 442	Partial Differential Equations
MATH 451	Probability
MATH 452	Mathematical Statistics
PHYS 302	Fluid Mechanics
PHYS 403	Statistical Mechanics and Thermodynamics

Total Hours	26-28
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¹ Note that only one of BIOL 325 Introduction to Quantitative Biology and MATH 345 Introduction to Mathematical Biology can count towards the minor.

Note: Students may petition the Track Director or CAMS Director to substitute a single elective course with a research credit or independent study course. At the discretion of the directors, permission may be granted if the research content is considered equivalent to the elective requirement.