COMPUTATIONAL AND APPLIED MATHEMATICS AND STATISTICS, MATHEMATICAL BIOLOGY TRACK (BS IN COMPUTATIONAL AND APPLIED MATHEMATICS AND STATISTICS)

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 major trains students in the modeling and analysis of biological processes using tools from mathematics, statistics, data science, and computer science. These techniques have both practical and theoretical applications in biological research. Applications range across all scales of biology, including simulations of cellular processes, designs for synthetic biology, analyses of genomic data, and models of ecosystems.

Course Requirements

Major Writing Requirement

The upper-division writing requirement is satisfied by one of the following ways:

- Completion of BIOL 325 Introduction to Quantitative Biology or MATH 345 Introduction to Mathematical Biology with a grade of C- or better, or
- Completion of CAMS 495 Honors and CAMS 496 Honors , which requires the writing of an Honors thesis.

Major Requirements

No course can be counted in more than one category.

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	
BIOL 203	Introduction to Molecules, Cells, Development	3
BIOL 204	Introduction to Organisms, Ecology, Evolution	3
Major Computing Requirement		
CSCI 141	Modern Programming Fundamentals	4
CSCI 241	Data Structures	3
Major Mathematics Requirement [1]		
MATH 109	Linear Algebra	3
MATH 109L	Computational Linear Algebra Lab	1
and		
MATH 212	Introduction to Multivariable Calculus	3-4
or MATH 213	Multivariable Calculus for Science and Mathematics	
Mathematical Modeling Requirement		
BIOL 325	Introduction to Quantitative Biology (only one of these may be used to count toward the minor.)	3-4
or MATH 345	Introduction to Mathematical Biology	
NSCI 351	Cellular Biophysics and Modeling	3
or MATH 356	Random Walks in Biology	
Statistics and Data Analysis Electives		
Select two of the following:		6-7
BIOL 327	Intro to Biostatistics	
MATH 351	Probability and Statistics for Scientists [2]	
MATH 352	Statistical Data Analysis	
MATH 451	Probability	
MATH 452	Mathematical Statistics	
Computational Elective		
Select one of the following:		3
CSCI 301	Software Development	
CSCI 303	Algorithms	
CSCI 426	Simulation	
CSCI 520	Elementary Topics	

DATA 302	Databases	
DATA 441	Advanced Applications of AI	
DATA 442	Neural Networks & Deep Learning	
PHYS 256	Practical Computing for Scientists and Engineers	
Biology Electives		
Select two of the following:		6
Any two 300-level or above courses with a BIOL prefix or BIOL attribute, of at least 3 credits each.		
Applications and Models Electives		
Select two of the following:		6
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 427	Biomedical Materials and Devices	
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 341	Physical and Analytical Chemistry for Life Sciences	
CHEM 314	Biochemistry	
CSCI 416	Fundamentals of Artificial Intelligence/Machine Learning	
DATA 301	Applied Machine Learning	
DATA 431	Spatial Data Discovery	
GIS 201	Introduction to Geographic Information Systems and Spatial Analysis	
MATH 302	Ordinary Differential Equations	
MATH 410	Topics in Mathematics	
MATH 413	Introduction to Numerical Analysis I	
MATH 414	Introduction to Numerical Analysis II	
MATH 441	Nonlinear Dynamics	
MATH 442	Partial Differential Equations	
PHYS 302	Fluid Mechanics	
PHYS 403	Statistical Mechanics and Thermodynamics	
Total Hours		**55-58**

[1] This is normally done by taking and passing CSCI 141 Modern Programming Fundamentals and CSCI 241 Data Structures.

[2] Note: MATH 351 Probability and Statistics for Scientists cannot be taken for credit if credit for MATH 451 Probability has already been given.

Note

Students may petition the Track Director or CAMS Director to substitute a single elective course with a research credit, independent study course, or honors thesis course. In total, at most one elective may be substituted in this manner. At the discretion of the directors, permission may be granted if the research content is considered equivalent to the elective requirement.