ACMS

Applied and Computational Mathematical Sciences
University of Washington, Seattle

What is ACMS?

The Applied and Computational Mathematical Sciences (ACMS) program is a multidisciplinary Bachelor of Science degree program in the College of Arts and Sciences, offered jointly by the Departments of Applied Mathematics, Computer Science & Engineering, Mathematics, and Statistics. It is designed for students interested in the application of mathematical and computational concepts and tools to problems in research or in the business world.

Why Choose ACMS?

Quantitative reasoning, mathematical analysis, and computational methods are becoming ever more pervasive, both in the business world and in research. The ACMS program provides students with the background and tools for success in this new environment.

Many ACMS students are double majors. Studying an area like biology, economics, or business while at the same time obtaining a solid foundation in the mathematical sciences is an excellent choice, no matter whether the next step is a job or graduate school. **Double majors are encouraged!**

"There has never been a better time to be a mathematician."
— James R. Schatz, Chief of Math Research Group, *NSA*

"The next Jonas Salk [polio vaccine] will be a mathematician, not a doctor."
— Jack Einhorn, CTO, *Inform Corporation*

"The rise of mathematics is heating up the job market for luminary quants, especially at the Internet powerhouses where new math grads land with six-figure salaries and rich stock deals."
— Stephen Baker, *BusinessWeek Magazine*, Jan 23, 2006.

What do ACMS Majors Do?

Business/Industry: Equity Derivatives Analyst Actuary • Management Consultant • Pollster Applied Decision Analyst • Systems Engineer Software Developer • Financial Analyst • Teacher Programmer • Software Marketing • Risk Analysis Budget and Cost Analyst • Admissions Counselor Real Estate Appraiser • Urban Design • Underwriter Public Utilities Analyst • Air Traffic Controller Transportation & Warehousing • Epidemiologist Aerospace • Research Assistant • Animation

Graduate Study: Applied Math • Statistics • CSE Computational Molecular Biology • Communication Managerial Economics • Biomedical Informatics Population Biology • Medical Imaging • Physics Biostatistics • Medicine • Operations Research Fluid Dynamics • Psychology • Business & Finance Digital Signal Processing • Biophysics • Engineering

ACMS vs. Alternatives

Obvious alternatives to ACMS degree: BS degrees offered by CSE and Mathematics.

- *ACMS vs. CSE*: Higher mathematics content. You will learn what constitutes a proof, as well as some basic techniques for proving theorems. Definitions and methods are primarily stated in the language of mathematics, rather than in the form of data structures and algorithms.
- *ACMS vs. Math*: More computing.
- *ACMS vs. Math*/*CSE*: Emphasis on modeling.

Modeling: Casting a real world problem into a form that makes it amenable to mathematical, statistical, or computational analysis. Modeling is a creative activity and often crucial step in understanding problems. Prototypical example: Kinetic Gas Theory—regards atoms or molecules in a gas as elastic balls moving with a certain distribution of speeds. Many properties of gases, such as the connection between pressure and temperature, can be derived from the model using mathematical arguments. Somewhat simplified, two varieties of models, *discrete*—think of DNA molecule as string over four letter alphabet— or *continuous*—think of pressure over an airplane wing as real-valued function on a two-dimensional surface. Many models (Kinetic Gas Theory, Mendel's model of inheritance) have a probabilistic component. Discrete, continuous, and probabilistic modeling are core courses of ACMS.

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Application Requirements

A minimum grade of 2.0 and a GPA of at least 2.50 is required in the following set of courses:

- First-year Calculus (Math 124/5/6)
- Computer Programming I (CSE 142)
- One of the following:
  Math 300, 307, 308, AMath 351, AMath 352

Students may apply online during autumn and spring quarter only. Advising for admission to the major is available in the ACMS Advising Office.

Structure of the ACMS Degree

The ACMS program is structured into a core and a set of options. The same set of core courses is required for all ACMS majors (with some exceptions). In addition to the admission requirements the core courses are:

- Computer Programming II (CSE 143)
- Differential Equations (Math 307 or AMath 351)
- Matrix Algebra (Math 308)
- Applied Linear Algebra & Intro to Numerical Methods (AMath 352)
- Discrete Modeling (Math 381)
- Continuous Modeling (AMath 383)
- Statistics (Stat 390)

For More Info:

ACMS website:
www.math.washington.edu/acms

ACMS Advising Office:
Padelford C-36

Options within ACMS

Each ACMS option has individual course requirements suited to the application areas:

Biological and Life Sciences: In recent years, the application of mathematical modeling and computation has paved the way for great strides in our understanding of basic biological phenomena. A solid training in mathematics is rapidly becoming essential for modern research in a wide variety of biological and medical disciplines, including developmental biology, genetics and genomics, biostatistics, ecological modeling, physiology, and biomechanics.

Mathematical Economics: In the business and financial world, mathematical and statistical models are becoming increasingly important as tools for prediction and analysis. It is ideal as a second major for students in Economics who want more mathematical training, especially those preparing for graduate school since the academic field of Economics relies heavily on mathematical models.

Social and Behavioral Sciences: Mathematical models and statistical analysis are becoming increasingly important in many social and behavioral sciences. Solving complex problems requires sophisticated approaches to gathering and analyzing large amounts of data. It is also ideal as a second major for students in social sciences who want to obtain more background in quantitative methods and mathematical techniques.

Engineering and Physical Sciences: Applied and computational mathematics are heavily used in the physical sciences and engineering. Differential equations are particularly important since they are essential in modeling mechanical systems, heat transfer, fluid dynamics, and wave motion of all kinds (electromagnetic, sound, seismic, water waves, etc.). It is ideal as a second major for students in engineering or a physical science who want to obtain a firm foundation in applied mathematics

Discrete Math and Algorithms: This Option gives students a broad background in mathematics and computation with special emphasis on discrete mathematics and its application to optimization and algorithm design. It is particularly well suited for students interested in mathematical aspects of Computer Science, or who wish to pursue a double major in this direction.

Operations Research: Operations research is concerned with system modeling and optimal decision making in a deterministic or stochastic setting, as frequently arise in the context of resource management, portfolio selection, logistics planning, vehicle routing, scheduling, and inventory control. This Option provides a firm foundation in the mathematical tools of operations research, particularly optimization and stochastic models.

Scientific Computing and Numerical Analysis: Computer simulation is heavily used in science and engineering as a tool in analysis, visualization, and design. Complex mathematical models can give very accurate prediction of real-world phenomena, but typically lead to equations that can only be solved with the aid of a computer. This Option focuses on the design, mathematical analysis, and efficient implementation of numerical algorithms for such problems.

Statistics: Statistics is concerned with methods for the acquisition, management, exploration, and use of information, in order to learn from experience and to make decisions under uncertainty. Statistical methodology is applied throughout the physical and social sciences, engineering, and business. It is ideally suited as a second major for students with a primary focus in the biological sciences, earth sciences, social sciences, engineering, or management science.