MATHEMATICAL ECONOMICS

Department Website:
https://www.haverford.edu/mathematical-economics

Mathematics and economics are complementary disciplines. Most branches of modern economics use mathematics and statistics extensively, and some important areas of mathematical research have been motivated by economic problems. Economists and mathematicians have made important contributions to one another's disciplines. Economist Kenneth Arrow, for example, did path-breaking work in the field of mathematical optimization, and in 1994, Mathematician John Nash was awarded the Nobel Prize in economics for work he did in game theory that has become central to contemporary economic theory. Haverford's Area of Concentration in Mathematical Economics enables students in both disciplines not only to gain proficiency in the other, but also to appreciate the ways in which they are related.

Economics students with a variety of backgrounds and career interests can benefit from completing the concentration. The mathematics courses the concentration requires are extremely valuable for students interested in pursuing graduate study in economics. A strong mathematical background is also an asset for students going on to business school or graduate programs in public policy. Many economics-related jobs in government, business, and finance require strong quantitative skills, and the concentration prepares students interested in seeking such positions.

The concentration can also benefit mathematics majors. Many students find mathematics more exciting and meaningful when they see it applied to a discipline they find interesting and concrete. Almost every undergraduate mathematics course covers topics useful in economic applications: optimization techniques in multivariable calculus, quadratic forms in linear algebra, and fixed point theorems in topology. In intermediate and advanced courses in economics, mathematics majors can see how these tools and methods are applied in another discipline.

Learning Goals

Students in Area of Concentration in Mathematical Economics will:

- engage in theoretical and empirical analysis of economic problems using formal theoretical and empirical methods.
- develop tools and techniques, including the use of formal arguments, numerical computations, and empirical analysis, to understand the logic, validity and robustness of various economic ideas.
- recognize that most branches of modern economics use mathematics and statistics extensively, and that some important areas of mathematical research have been motivated by economic problems.
- understand the complementarities between the two disciplines to gain proficiency in each, and appreciate the ways in which they are related.

Haverford's Institutional Learning Goals are available on the President's website, at http://hav.to/learninggoals.

Concentration Requirements

Students enrolling in the Area of Concentration in Mathematical Economics must major in either mathematics or economics.

For students majoring in mathematics, the Concentration requires six courses:

- ECON H201 (Analytic Methods for Economics)
- ECON H204 (Economic Statistics with Calculus) or MATH H203 (Statistical Methods and Their Applications), or any applied statistics course at a higher level offered by the economics or mathematics department.
- Two approved electives in economics.
- Two approved electives in mathematics. (These courses may also be used to fulfill the requirements of the mathematics major.)

For students majoring in economics, the Concentration requires six courses:

- Three required mathematics courses:
  - MATH H121 (Multivariable Calculus) or MATH H216 (Advanced Calculus)
  - MATH H215 (Linear Algebra)
  - MATH H317 (Analysis I)
- One approved elective in mathematics.
- Two approved electives in economics. (These courses may also be used to fulfill the requirements of the economics major.)

Additional Remarks

The Area of Concentration in Mathematical Economics differs from the minors in mathematics and economics in a specific way: it focuses on the complementarities between the two disciplines; the minors in mathematics and economics are designed to provide a basic foundation in each discipline, but not necessarily an inter-disciplinary orientation.

A student majoring in economics may choose to pursue either the Area of Concentration in Mathematical Economics or a minor in mathematics,

but not both. A student majoring in mathematics may choose to pursue either the Area of Concentration in Mathematical Economics or a minor in economics, but not both. A student double-majoring in economics and mathematics may not enroll in the Area of Concentration in Mathematical Economics.

Approved Electives

The courses listed below can be used to fulfill the mathematics and economics elective requirements. Not all of the courses listed below are offered every year. In some years, courses are offered that are not on these lists but that can be used as electives in the concentration. Students wishing to receive credit for an elective not listed below must obtain approval from the concentration coordinator.

Mathematics Electives

Code	Title	Credits
MATH/ECON H210	Linear Optimization	1.0
MATH H204	Differential Equations	1.0
MATH H218	Probability	1.0
MATH H222	Scientific Computing: Continuous Systems	1.0
MATH H318	Analysis II: Complex Analysis	1.0
MATH H328	Mathematical Statistics	1.0
MATH H340	Analysis of Algorithms	1.0
MATH/ECON H360	Mathematical Economics	1.0
STAT H396	Advanced Topics in Probability and Statistics: Categorical Data Analysis,Advanced Topics: Probability and Statistics	1.0

Economics Electives

Code	Title	Credits
ECON H237	Game Theory in Economics	1.0
ECON H355	Advanced Microeconomics: Uncertainty	1.0
ECON H324	Advanced Econometrics	1.0
ECON/MATH H360	Mathematical Economics	1.0
ECON H374	Jr Research Seminar: Topics in Industrial Organization	1.0
ECON H377	Junior Research Seminar: Political Economy	1.0

Faculty

Richard Ball
Professor of Economics; Coordinator of Mathematical Economics

Robert Manning
Professor of Mathematics and Statistics; William H. and Johanna A. Harris Chair of Computational Science; Chair of Mathematics and Statistics