

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. The concentration consists of eight courses: four economics courses and four mathematics and statistics courses.

The economics requirements are:

- ECON H201 (Analytic Methods for Economics)
- ECON H204 (Economic Statistics with Calculus) or STAT H203 (Statistical Methods and their Applications)
- Additionally, two approved courses in economics.

The mathematics and statistics requirements are:

- MATH H121 (Multivariable Calculus) or MATH H216 (Advanced Calculus)
- MATH H215 (Linear Algebra)
- MATH H317 (Analysis I)
- Additionally, one approved course in mathematics or statistics.

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 interdisciplinary 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.

Pathways through the program will vary according to the student's chosen major or focus within the major.

- For economics students: ECON H201 and ECON H204 will be completed as part of the economics major. The two approved economics courses will typically also earn credit towards the economics major. Additionally, students will take four mathematics courses.
- For mathematics students focusing in pure or applied mathematics: MATH H121, MATH H215, and MATH H317 will be completed as part of the mathematics major. The approved mathematics course will typically also earn credit towards the mathematics major. Additionally, students will take four economics courses.
- For mathematics students focusing in statistics: MATH H121, MATH H215, and ECON H204 (or STAT H203) will be completed as part of the mathematics major. MATH H218 will also be completed as part of the mathematics major, and can serve as an approved mathematics course. Additionally, students will take MATH H317 (which may earn credit towards the mathematics major) and three economics courses.

Approved Courses

The courses listed below can be used to fulfill the mathematics and economics elective requirements. Not all of the courses listed are offered every year. Students wishing to receive credit for an elective not listed below must obtain approval from the concentration coordinator.

Mathematics Courses

Code	Title	Credits
MATH/ECON H210	Linear Optimization	1.0
MATH H218	Probability	1.0
MATH H318	Analysis II: Complex Analysis	1.0
MATH/ECON H360	Mathematical Economics	1.0
MATH H361	Applied Multivariate Statistical Analysis	1.0
MATH H384	(Constrained and Combinatorial Optimization)	1.0
STAT H396	Advanced Topics in Probability and Statistics: Categorical Data Analysis,Advanced Topics: Probability and Statistics	1.0

Economics Courses

Code	Title	Credits
ECON H210	Linear Optimization	1.0
ECON H237	Game Theory in Economics	1.0
ECON H324	Advanced Econometrics	1.0
ECON H355	Advanced Microeconomics: Uncertainty	1.0

ECON/MATH H360	Mathematical Economics	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