MATHEMATICAL ECONOMICS, BA

Economics is a social science and, as such, an important component of the liberal arts curriculum. At the core of economics are theories of how individuals, firms, and other organizations make choices and interact, taking into account constraints on their behaviors. Among the topics studied in economics are the following:

- The determination of prices and quantities in various types of markets, from perfectly competitive commodity markets to highly regulated utility markets and internet auctions.
- The effects of taxes, subsidies, and regulations.
- The determination of aggregate economic activity (e.g., GDP, unemployment).
- Inflation, monetary policy, and financial intermediation.
- Economic growth and income distribution.
- International trade and international finance (e.g., exchange rates).

The Mathematical Economics Major is intended for students with a strong intellectual interest in both mathematics and economics and, in particular, for students who may pursue a graduate degree in economics. Advanced economics makes extensive use of formal mathematical models. The major introduces undergraduate students to rigorous theoretical-quantitative and empirical-quantitative approaches to the analysis of economic problems. In comparison to the Economics Major, the Mathematical Economics Major emphasizes a more formal mathematical analysis, preparing students for academic-style research in economics.

The minimum total course units (https://www.college.upenn.edu/credits-needed-major/) for graduation in this major is 36. Double majors may entail more course units.

For more information: http://economics.sas.upenn.edu/undergraduate-program/mathematical-economics-major (http://economics.sas.upenn.edu/undergraduate-program/mathematical-economics-major/)

For information about the General Education requirements, please visit the College of Arts & Sciences Curriculum (https://www.college.upenn.edu/curriculum/) page.

Code | Title | Course Units
--- | --- | ---
--- | --- | ---
College General Education Requirements and Free Electives
Foundational Approaches + Sectors | Free Electives | 20
Major Requirements
MATH Core Requirements | 2
Select 1 Calculus II course | 1
Select 1 Calculus III course | 1
Select 1 Algebra course | 1
Select one of the following: | 2
Option 1: MATH 360 Advanced Calculus & MATH 361 and Advanced Calculus
Option 2: STAT 430 Probability & STAT 431 and Statistical Inference
MATH Electives
STAT Core Requirements
Select 1 or 2 course units of the following: | 1-2
STAT 430 Probability & STAT 431 and Statistical Inference
ESE 301 Engineering Probability & ESE 402 and Statistics for Data Science
ECON 103 Statistics for Economists
MATH Electives
Select 2 of the following: | 2
CIS 419 Applied Machine Learning
CIS 519 Applied Machine Learning
CIS 520 Machine Learning
ESE 303 Stochastic Systems Analysis and Simulation
ESE 304
ESE 504 Intro to Linear, Nonlinear and Integer Optimization
ESE 605 Modern Convex Optimization
MATH 241 Calculus, Part IV
MATH 320 Computer Methods in Mathematical Science I
MATH 340 Discrete Mathematics I
MATH 420 Ordinary Differential Equations
MATH 425 Partial Differential Equations
MATH 432 Game Theory
MATH 460 Topology
MATH 530 Mathematics of Finance
MATH 546 Advanced Probability
MATH 547 Stochastic Processes
NETS 412 Algorithmic Game Theory
STAT 432 Mathematical Statistics
STAT 433 Stochastic Processes
STAT 435 Forecasting Methods for Management
STAT 442 Introduction to Bayesian Data Analysis
STAT 475 Sample Survey Design
STAT 476 Applied Probability Models in Marketing
STAT 512 Mathematical Statistics
STAT 515 Advanced Statistical Inference I
STAT 516 Advanced Statistical Inference II
STAT 520 Applied Econometrics I
ECON Core Requirement
Introduction to Micro and Macro Economics | 6
ECON 001 Introduction to Micro Economics | 1
ECON 002 Introductory Economics: Macro | 1
Waiver Conversion Complete
Intro Micro/Macro - For WHARTON Students Only:
ECON 010 Introduction to Economics for Business
Select an additional ECON course
Intermediate Level Micro and Macro Economics
ECON 101 Intermediate Microeconomics | 1
ECON 102 Intermediate Macroeconomics | 1

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ECON 681 Microeconomic Theory 1

ECON Electives
Select 3 courses from the following disciplines: 3

Econometrics
ECON 104 Econometrics
ECON 221 Econometric Forecasting
ECON 222 Advanced Econometric Techniques and Applications
ECON 224 Statistical Learning and Causal Inference for Economics
ECON 705 Econometrics I: Fundamentals

Macroeconomics
ECON 241 Economic Growth
ECON 242 Topics in Macroeconomics
ECON 243 Monetary and Fiscal Policies
ECON 244 Macro-Modeling
ECON 246 Money and Banking

Microeconomics/Game Theory
ECON 211 Social Choice Theory
ECON 212 Game Theory
ECON 235 Industrial Organization
ECON 260 Decision Making Under Uncertainty
ECON 262 Market Design
ECON 682 Game Theory and Applications

Independent Studies
ECON 199 Independent Study

At most one independent study (ECON 199) can substitute for a 200-level course in the major. Students wishing to enroll in an Independent Study must have their outline approved and be enrolled prior to the end of the Add Period. No Independent Studies will be accepted afterwards.

Total Course Units 36-37

1 You may count no more than one course toward both a Major and a Sector requirement. For Exceptions, check the Policy Statement (http://www.college.upenn.edu/sectors-policy/).

2 Students intending to major in Mathematical Economics are encouraged to take MATH 116 Honors Calculus and to consider MATH 260 Honors Calculus, Part II.

3 NOTE: These MATH and ECON courses count toward the MATH and ECON electives.

4 If ECON 103 Statistics for Economists is taken, one additional ECON or MATH course from the following: MATH 546 Advanced Probability, MATH 547 Stochastic Processes, ECON 104 Econometrics, ECON 221 Econometric Forecasting, or ECON 222 Advanced Econometric Techniques and Applications.

5 LPS academic year courses require approval of Undergraduate Chair EXCEPT for ECON 001 Introduction to Micro Economics & ECON 002 Introductory Economics: Macro.

6 ECON 001 Introduction to Micro Economics and ECON 002 Introductory Economics: Macro are prerequisites for all economics courses. ECON 001 Introduction to Micro Economics is the prerequisite for ECON 002 Introductory Economics: Macro.

7 ECON Course Required if ECON 010 Introduction to Economics for Business is taken.

8 Requires the permission of the instructor. Please contact the instructor and be prepared to share information about the ECON and MATH courses you have taken and the grades that you have obtained in these courses. Based on this information, the instructor will determine whether the course is suitable for you.

Honors
Applicants must have a minimum GPA of 3.5 and an A- or better in 3 graduate level courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Course Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESE 605</td>
<td>Modern Convex Optimization</td>
<td>1.0</td>
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One 600 level Econ course
One 500 level Math course

The degree and major requirements displayed are intended as a guide for students entering in the Fall of 2020 and later. Students should consult with their academic program regarding final certifications and requirements for graduation.