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: https://economics.sas.upenn.edu/undergraduate/majors-and-minors/mathematical-economics-major (https://economics.sas.upenn.edu/undergraduate/majors-and-minors/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.

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College General Education Requirements and Free Electives

Foundational Approaches + Sectors + Free Electives

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Major Requirements

**MATH Core Requirements**

- Select 1 Calculus II course
- Select 1 Calculus III course
- Select 1 Algebra course
- Select one of the following: 2
  - Option 1:
    - MATH 360 Advanced Calculus
    - MATH 361 and Advanced Calculus
  - Option 2:

**STAT Core Requirements**

- Select 2 course units of the following: 2
  - STAT 430 Probability
  - STAT 431 and Statistical Inference
  - ESE 301 Engineering Probability
  - ESE 402 and Statistics for Data Science
  - ECON 103 Econometric Data Science

**MATH Electives**

- Select 2 of the following: 2
  - CIS 419 Applied Machine Learning
  - CIS 519 Applied Machine Learning
  - CIS 520 Machine Learning
  - CIS 545 Big Data Analytics
  - ESE 303 Stochastic Systems Analysis and Simulation
  - 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
  - MATH 340 Discrete Mathematics
  - 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 Applied Probability
  - 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
  - STAT 516 Advanced Statistical Inference
  - STAT 520 Econometrics I

**ECON Core Requirement**

- Introduction to Micro and Macro Economics:
  - ECON 001 Introduction to Micro Economics
  - ECON 002 Introductory Economics: Macro
  - 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
- ECON 102 Intermediate Macroeconomics
- ECON 681 Microeconomic Theory
ECON Electives
Select 3 courses from the following disciplines: 3

Econometrics
- ECON 104  Econometric Methods and Models
- ECON 221  Macro-Econometric Techniques and Applications
- ECON 222  Micro-econometric Techniques and Applications
- ECON 224  Econometric Machine Learning Methods and Models
- ECON 225  Empirical Economics of Climate Change
- 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 239  The Digital Economy
- ECON 245  Mathematical Economics
- ECON 260  Decision Making Under Uncertainty
- ECON 262  Market Design
- ECON 682  Game Theory and Applications

Independent Studies
- ECON 199  Independent Study

Note: 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

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 Econometric Data Science is taken, one additional ECON or MATH course from the following: MATH 546 Advanced Applied Probability, ECON 104 Econometric Methods and Models, ECON 221 Macro-Econometric Techniques and Applications, or ECON 222 Micro-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 that count toward the major. Approved courses may be chosen from the list of Mathematical Economics electives:

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<th>Code</th>
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<tr>
<td></td>
<td>Economics courses 600-level and above</td>
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<td></td>
<td>Mathematics and Statistics courses 500-level and above</td>
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<tr>
<td>ESE 504</td>
<td>Intro to Linear, Nonlinear and Integer Optimization</td>
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<tr>
<td>ESE 605</td>
<td>Modern Convex Optimization</td>
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The degree and major requirements displayed are intended as a guide for students entering in the Fall of 2021 and later. Students should consult with their academic program regarding final certifications and requirements for graduation.