Applied Mathematics-Economics

The Applied Mathematics-Economics concentration is designed to reflect the mathematical and statistical nature of modern economic theory and empirical research. This concentration has two tracks. The first is the advanced economics track, which is intended to prepare students for graduate study in finance, graduate study in economics. The second is the mathematical finance track, which is intended to prepare students for careers in finance or financial engineering. Both tracks have A.B. degree versions and Sc.B. degree versions, as well as a Professional track option.

Standard Program for the A.B. degree (Advanced Economics track):

<table>
<thead>
<tr>
<th>Prerequisites:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 0100</td>
<td>Introductory Calculus, Part II</td>
</tr>
<tr>
<td>MATH 0520</td>
<td>Linear Algebra</td>
</tr>
</tbody>
</table>

Course Requirements:

Applied Mathematics Requirements

(a) 1

APMA 0350 & APMA 0360  Applied Ordinary Differential Equations and Applied Partial Differential Equations 2

Select one of the following: 1

APMA 0160  Introduction to Scientific Computing (preferred)

CSCI 0040  Introduction to Scientific Computing and Problem Solving

CSCI 0111  Computing Foundations: Data

CSCI 0150  Introduction to Object-Oriented Programming and Computer Science

CSCI 0170  Computer Science: An Integrated Introduction

Select one of the following: 1

APMA 1200  Operations Research: Probabilistic Models

APMA 1210  Operations Research: Deterministic Models

APMA 1650  Statistical Inference I 1

or APMA 1655  Statistical Inference I 1

(b) 1

Select one of the following: 1

APMA 1200  Operations Research: Probabilistic Models

APMA 1210  Operations Research: Deterministic Models

APMA 1330  Methods of Applied Mathematics

APMA 1360  Applied Dynamical Systems

APMA 1660  Statistical Inference II

APMA 1690  Computational Probability and Statistics

APMA 1720  Monte Carlo Simulation with Applications to Finance

APMA 1740  Recent Applications of Probability and Statistics

MATH 1010  Analysis: Functions of One Variable

Economics Requirements:

ECON 1130  Intermediate Microeconomics (Mathematical) 3

ECON 1210  Intermediate Macroeconomics

ECON 1630  Mathematical Econometrics I

Total Credits 13

One additional 1000-level economics course. 5 1

Two 1000-level courses from the "mathematical-economics" group: 2

ECON 1170  Welfare Economics and Social Choice Theory

ECON 1225  Advanced Macroeconomics: Monetary, Fiscal, and Stabilization Policies

ECON 1460  Industrial Organization

ECON 1470  Bargaining Theory and Applications

ECON 1490  Designing Internet Marketplaces

ECON 1640  Mathematical Econometrics II

ECON 1660  Big Data

ECON 1670  Advanced Topics in Econometrics

ECON 1750  Investments II

ECON 1820  Theory of Behavioral Economics

ECON 1850  Theory of Economic Growth

ECON 1860  The Theory of General Equilibrium

ECON 1870  Game Theory and Applications to Economics

One 1000-level course from the "data methods" group: 4 1

ECON 1301  Economics of Education I

ECON 1310  Labor Economics

ECON 1315  Health, Education, and Social Policy

ECON 1340  Economics of Global Warming

ECON 1355  Environmental Issues in Development Economics

ECON 1360  Health Economics

ECON 1375  Inequality of Opportunity in the US

ECON 1400  The Economics of Mass Media

ECON 1430  The Economics of Social Policy

ECON 1480  Public Economics

ECON 1510  Economic Development

ECON 1530  Health, Hunger and the Household in Developing Countries

ECON 1629  Applied Research Methods for Economists

ECON 1640  Mathematical Econometrics II

ECON 1660  Big Data

ECON 1670  Advanced Topics in Econometrics

ECON 1765  Finance, Regulation, and the Economy

ECON 1825  Behavioral Economics and Public Policy

ECON 1830  Behavioral Finance

Standard program for the Sc.B. degree (Advanced Economics track):

<table>
<thead>
<tr>
<th>Prerequisites:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 0100</td>
<td>Introductory Calculus, Part II</td>
</tr>
<tr>
<td>MATH 0520</td>
<td>Linear Algebra</td>
</tr>
</tbody>
</table>

Course Requirements:

Applied Mathematics Requirements
One 1000-level course from the "data methods" group:

- APMA 1650
- APMA 0360
- APMA 0350

Select one of the following:

- APMA 1200 Operations Research: Probabilistic Models
- APMA 1210 Operations Research: Deterministic Models
- APMA 1330 Methods of Applied Mathematics
- APMA 1360 Applied Dynamical Systems
- APMA 1660 Statistical Inference II
- APMA 1690 Computational Probability and Statistics
- APMA 1720 Monte Carlo Simulation with Applications to Finance
- APMA 1740 Recent Applications of Probability and Statistics
- MATH 1010 Analysis: Functions of One Variable

Select two of the following:

- APMA 1200 Operations Research: Probabilistic Models
- APMA 1210 Operations Research: Deterministic Models
- APMA 1330 Methods of Applied Mathematics
- APMA 1360 Applied Dynamical Systems
- APMA 1660 Statistical Inference II
- APMA 1690 Computational Probability and Statistics
- APMA 1720 Monte Carlo Simulation with Applications to Finance
- APMA 1740 Recent Applications of Probability and Statistics
- MATH 1010 Analysis: Functions of One Variable

Three 1000-level courses from the "mathematical-economics" group:

- ECON 1110 Introduction to Numerical Solution of Differential Equations
- ECON 1225 Advanced Macroeconomics: Monetary, Fiscal, and Stabilization Policies
- ECON 1460 Industrial Organization
- ECON 1470 Bargaining Theory and Applications
- ECON 1490 Designing Internet Marketplaces
- ECON 1640 Mathematical Econometrics II
- ECON 1660 Big Data
- ECON 1670 Advanced Topics in Econometrics
- ECON 1750 Investments II
- ECON 1820 Theory of Behavioral Economics
- ECON 1850 Theory of Economic Growth
- ECON 1860 The Theory of General Equilibrium
- ECON 1870 Game Theory and Applications to Economics

One 1000-level course from the "data methods" group:

- ECON 1301 Economics of Education I
- ECON 1310 Labor Economics
- ECON 1315 Health, Education, and Social Policy

ECON 1340 Economics of Global Warming
ECON 1355 Environmental Issues in Development Economics
ECON 1360 Health Economics
ECON 1375 Inequality of Opportunity in the US
ECON 1400 The Economics of Mass Media
ECON 1430 The Economics of Social Policy
ECON 1480 Public Economics
ECON 1510 Economic Development
ECON 1530 Health, Hunger and the Household in Developing Countries
ECON 1629 Applied Research Methods for Economists
ECON 1640 Mathematical Econometrics II
ECON 1660 Big Data
ECON 1765 Finance, Regulation, and the Economy
ECON 1825 Behavioral Economics and Public Policy
ECON 1830 Behavioral Finance

Two additional 1000-level economics courses

Total Credits: 16

1. No course may be used to simultaneously satisfy (a) and (b).
2. APMA 0330 and APMA 0340 may be substituted with advisor approval. APMA 1910 cannot be used as an elective.
3. Or ECON 1110 with permission.
4. No course may be used to simultaneously satisfy the "mathematical economics" and the "data methods" requirements.
5. Students may use either ECON 1070 or ECON 1090 toward the concentration, but not both. Note that ECON 1620, ECON 1960, and ECON 1970 (independent study) cannot be used for concentration credit. However, 1620 and 1960 can be used for university credit and up to two 1970s may be used for university credit.

Standard program for the A.B. degree (Mathematical Finance track):

**Prerequisites:**

- MATH 0100 Introductory Calculus, Part II
- MATH 0520 Linear Algebra

**Course Requirements:** 13 Courses: 6 Applied Math and 7 Economics

**Applied Mathematics Requirements**

(a)


Select one of the following:

- APMA 0160 Introduction to Scientific Computing (preferred)
- CSCI 0040 Introduction to Scientific Computing and Problem Solving
- CSCI 0111 Computing Foundations: Data
- CSCI 0150 Introduction to Object-Oriented Programming and Computer Science
- CSCI 0170 Computer Science: An Integrated Introduction

(b)

Select one of the following:

- APMA 1180 Introduction to Numerical Solution of Differential Equations
Select one 1000-level course from the “data methods” group:

ECON 1690 Computational Probability and Statistics
APMA 1720 Monte Carlo Simulation with Applications to Finance (preferred)
APMA 1740 Recent Applications of Probability and Statistics

MATH 1010 Analysis: Functions of One Variable

**Economics Requirements:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECON 1130</td>
<td>Intermediate Microeconomics 1 (Mathematical)</td>
</tr>
<tr>
<td>ECON 1210</td>
<td>Intermediate Macroeconomics 1</td>
</tr>
<tr>
<td>ECON 1630</td>
<td>Mathematical Econometrics I 1</td>
</tr>
<tr>
<td>Select two 1000-level courses from the “financial economics” group: 2</td>
<td></td>
</tr>
<tr>
<td>ECON 1710</td>
<td>Investments I</td>
</tr>
<tr>
<td>ECON 1720</td>
<td>Corporate Finance</td>
</tr>
<tr>
<td>ECON 1730</td>
<td>Venture Capital, Private Equity, and Entrepreneurship</td>
</tr>
<tr>
<td>ECON 1750</td>
<td>Investments II</td>
</tr>
<tr>
<td>ECON 1760</td>
<td>Financial Institutions</td>
</tr>
<tr>
<td>ECON 1765</td>
<td>Finance, Regulation, and the Economy</td>
</tr>
<tr>
<td>ECON 1780</td>
<td>Advanced Topics in Corporate Finance</td>
</tr>
<tr>
<td>ECON 1830</td>
<td>Behavioral Finance</td>
</tr>
<tr>
<td>Select one 1000-level course from the “mathematical economics” group: 1</td>
<td></td>
</tr>
<tr>
<td>ECON 1170</td>
<td>Welfare Economics and Social Choice Theory</td>
</tr>
<tr>
<td>ECON 1225</td>
<td>Advanced Macroeconomics: Monetary, Fiscal, and Stabilization Policies</td>
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<td>ECON 1460</td>
<td>Industrial Organization</td>
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<td>ECON 1470</td>
<td>Bargaining Theory and Applications</td>
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<td>Designing Internet Marketplaces</td>
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<td>ECON 1640</td>
<td>Mathematical Econometrics II</td>
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<tr>
<td>ECON 1660</td>
<td>Big Data</td>
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<tr>
<td>ECON 1670</td>
<td>Advanced Topics in Econometrics</td>
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<tr>
<td>ECON 1750</td>
<td>Investments II</td>
</tr>
<tr>
<td>ECON 1820</td>
<td>Theory of Behavioral Economics</td>
</tr>
<tr>
<td>ECON 1850</td>
<td>Theory of Economic Growth</td>
</tr>
<tr>
<td>ECON 1860</td>
<td>The Theory of General Equilibrium</td>
</tr>
<tr>
<td>ECON 1870</td>
<td>Game Theory and Applications to Economics</td>
</tr>
<tr>
<td>Select one 1000-level course from the “data methods” group: 2</td>
<td></td>
</tr>
<tr>
<td>ECON 1301</td>
<td>Economics of Education I</td>
</tr>
<tr>
<td>ECON 1310</td>
<td>Labor Economics</td>
</tr>
<tr>
<td>ECON 1315</td>
<td>Health, Education, and Social Policy</td>
</tr>
<tr>
<td>ECON 1340</td>
<td>Economics of Global Warming</td>
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<tr>
<td>ECON 1355</td>
<td>Environmental Issues in Development Economics</td>
</tr>
<tr>
<td>ECON 1360</td>
<td>Health Economics</td>
</tr>
<tr>
<td>ECON 1375</td>
<td>Inequality of Opportunity in the US</td>
</tr>
<tr>
<td>ECON 1400</td>
<td>The Economics of Mass Media</td>
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<td>ECON 1430</td>
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<td>Public Economics</td>
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<td>ECON 1510</td>
<td>Economic Development</td>
</tr>
<tr>
<td>ECON 1530</td>
<td>Health, Hunger and the Household in Developing Countries</td>
</tr>
</tbody>
</table>

**Mathematical Econometrics II:**

1 APMA 0330 and APMA 0340 may be substituted with advisor approval. APMA 1910 cannot be used as an elective.
2 No course may be used to simultaneously satisfy any two or more of the “financial economics,” “mathematical economics,” and “data methods” requirements.
3 Or ECON 1110 with permission.
4 Note that ECON 1620, ECON 1690, and ECON 1970 (independent study) cannot be used for concentration credit. However, 1620 and 1690 can be used for university credit and up to two 1970s may be used for university credit.

**Standard program for the Sc.B. degree (Mathematical Finance track):**

**Prerequisites:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 0100</td>
<td>Introductory Calculus, Part II</td>
</tr>
<tr>
<td>MATH 0520</td>
<td>Linear Algebra</td>
</tr>
</tbody>
</table>

**Course Requirements: 16 courses: 7 Applied Math and 9 Economics**

**Applied Mathematics requirements:**

(a)

<table>
<thead>
<tr>
<th>Course</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>APMA 0350</td>
<td>Applied Ordinary Differential Equations 2</td>
</tr>
<tr>
<td>&amp; APMA 0360</td>
<td>and Applied Partial Differential Equations 1</td>
</tr>
</tbody>
</table>

Select one of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Requirements</th>
</tr>
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<tbody>
<tr>
<td>APMA 0160</td>
<td>Introduction to Scientific Computing (preferred)</td>
</tr>
<tr>
<td>APMA 0040</td>
<td>Introduction to Scientific Computing and Problem Solving</td>
</tr>
<tr>
<td>CSCI 0111</td>
<td>Computing Foundations: Data</td>
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<td>CSCI 0150</td>
<td>Introduction to Object-Oriented Programming and Computer Science</td>
</tr>
<tr>
<td>CSCI 0170</td>
<td>Computer Science: An Integrated Introduction</td>
</tr>
<tr>
<td>APMA 1200</td>
<td>Operations Research: Probabilistic Models 1</td>
</tr>
<tr>
<td>APMA 1650</td>
<td>Statistical Inference I 1</td>
</tr>
<tr>
<td>or APMA 1655</td>
<td>Statistical Inference I</td>
</tr>
</tbody>
</table>

(b)

Select two of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>APMA 1180</td>
<td>Introduction to Numerical Solution of Differential Equations</td>
</tr>
<tr>
<td>APMA 1210</td>
<td>Operations Research: Deterministic Models</td>
</tr>
<tr>
<td>APMA 1330</td>
<td>Methods of Applied Mathematics</td>
</tr>
<tr>
<td>APMA 1360</td>
<td>Applied Dynamical Mathematics</td>
</tr>
<tr>
<td>APMA 1660</td>
<td>Statistical Inference II</td>
</tr>
<tr>
<td>APMA 1690</td>
<td>Computational Probability and Statistics</td>
</tr>
<tr>
<td>APMA 1720</td>
<td>Monte Carlo Simulation with Applications to Finance (preferred)</td>
</tr>
<tr>
<td>APMA 1740</td>
<td>Recent Applications of Probability and Statistics</td>
</tr>
<tr>
<td>MATH 1010</td>
<td>Analysis: Functions of One Variable</td>
</tr>
</tbody>
</table>

**Economics Requirements:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECON 1130</td>
<td>Intermediate Microeconomics (Mathematical) 3</td>
</tr>
</tbody>
</table>

Total Credits: 13
Select three 1000-level courses from the "financial economics" group:  

- ECON 1710 Investments I
- ECON 1720 Corporate Finance
- ECON 1730 Venture Capital, Private Equity, and Entrepreneurship
- ECON 1750 Investments II
- ECON 1760 Financial Institutions
- ECON 1765 Finance, Regulation, and the Economy
- ECON 1780 Advanced Topics in Corporate Finance
- ECON 1830 Behavioral Finance

Select two 1000-level courses from the "mathematical economics" group:  

- ECON 1170 Welfare Economics and Social Choice Theory
- ECON 1225 Advanced Macroeconomics: Monetary, Fiscal, and Stabilization Policies
- ECON 1460 Industrial Organization
- ECON 1470 Bargaining Theory and Applications
- ECON 1490 Designing Internet Marketplaces
- ECON 1640 Mathematical Econometrics II
- ECON 1660 Big Data
- ECON 1670 Advanced Topics in Econometrics
- ECON 1750 Investments II
- ECON 1820 Theory of Behavioral Economics
- ECON 1850 Theory of Economic Growth
- ECON 1860 The Theory of General Equilibrium
- ECON 1870 Game Theory and Applications to Economics

Select one 1000-level course from the "data methods" group:  

- ECON 1301 Economics of Education I
- ECON 1310 Labor Economics
- ECON 1315 Health, Education, and Social Policy
- ECON 1340 Economics of Global Warming
- ECON 1355 Environmental Issues in Development Economics
- ECON 1360 Health Economics
- ECON 1375 Inequality of Opportunity in the US
- ECON 1400 The Economics of Mass Media
- ECON 1430 The Economics of Social Policy
- ECON 1480 Public Economics
- ECON 1510 Economic Development
- ECON 1530 Health, Hunger and the Household in Developing Countries
- ECON 1629 Applied Research Methods for Economists
- ECON 1640 Mathematical Econometrics II
- ECON 1660 Big Data
- ECON 1765 Finance, Regulation, and the Economy
- ECON 1825 Behavioral Economics and Public Policy
- ECON 1830 Behavioral Finance

Total Credits: 16

1. APMA 0330 and APMA 0340 may be substituted with advisor approval. APMA 1910 cannot be used as an elective.
2. No course may be used to simultaneously satisfy any two or more of the "financial economics," "mathematical economics," and "data methods" requirements.
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4. Note that ECON 1620, ECON 1960, and ECON 1970 (independent study) cannot be used for concentration credit. However, 1620 and 1960 can be used for university credit and up to two 1970s may be used for university credit.

Honors and Capstone Requirement

Admission to candidacy for honors in the concentration is granted on the following basis: 3.7 GPA for Economics courses, and a 3.5 GPA overall. To graduate with honors, a student must write an honors thesis in the senior year following the procedures specified by the concentration (see Economics Department website).

Professional Track

The requirements for the professional track include all those of the standard track, as well as the following:

Students must complete two two-to-four month full-time professional experiences, doing work that is related to their concentration programs. Such work is normally done within an industrial organization, but may also be at a university under the supervision of a faculty member.

On completion of each professional experience, the student must write and upload to ASK a reflective essay about the experience addressing the following prompts, to be approved by the student's concentration advisor:

- Which courses were put to use in your summer's work? Which topics, in particular, were important?
- In retrospect, which courses should you have taken before embarking on your summer experience? What are the topics from these courses that would have helped you over the summer if you had been more familiar with them?
- Are there topics you should have been familiar with in preparation for your summer experience, but are not taught at Brown? What are these topics?
- What did you learn from the experience that probably could not have been picked up from course work?
- Is the sort of work you did over the summer something you would like to continue doing once you graduate? Explain.
- Would you recommend your summer experience to other Brown students? Explain.
Font Notice

This document should contain certain fonts with restrictive licenses. For this draft, substitutions were made using less legally restrictive fonts. Specifically:

Helvetica was used instead of Arial.
The editor may contact Leepfrog for a draft with the correct fonts in place.