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 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):

Prerequisites:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</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

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

Select one of the following:

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>APMA 0160</td>
<td>Introduction to Scientific Computing</td>
</tr>
<tr>
<td>&amp; CSCI 0040</td>
<td>(preferred)</td>
</tr>
<tr>
<td>APMA 0170</td>
<td>Computer Science: An Integrated Introduction</td>
</tr>
<tr>
<td>APMA 1200</td>
<td>Operations Research: Probabilistic Models</td>
</tr>
<tr>
<td>APMA 1210</td>
<td>Operations Research: Deterministic Models</td>
</tr>
<tr>
<td>APMA 1650</td>
<td>Statistical Inference I</td>
</tr>
<tr>
<td>or APMA 1655</td>
<td>Statistical Inference I</td>
</tr>
</tbody>
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</tr>
<tr>
<td>APMA 1330</td>
<td>Methods of Applied Mathematics</td>
</tr>
<tr>
<td>APMA 1360</td>
<td>Applied Dynamical Systems</td>
</tr>
<tr>
<td>APMA 1660</td>
<td>Statistical Inference II</td>
</tr>
<tr>
<td>APMA 1690</td>
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<tr>
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</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>
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<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECON 1170</td>
<td>Welfare Economics and Social Choice Theory</td>
</tr>
<tr>
<td>ECON 1220</td>
<td>Monetary and Fiscal Policy</td>
</tr>
<tr>
<td>ECON 1225</td>
<td>Advanced Macroeconomics: Monetary, Fiscal, and Stabilization Policies</td>
</tr>
<tr>
<td>ECON 1460</td>
<td>Industrial Organization</td>
</tr>
<tr>
<td>ECON 1465</td>
<td>Market Design: Theory and Applications</td>
</tr>
<tr>
<td>ECON 1470</td>
<td>Bargaining Theory and Applications</td>
</tr>
<tr>
<td>ECON 1490</td>
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<td>ECON 1640</td>
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<td>ECON 1660</td>
<td>Big Data</td>
</tr>
<tr>
<td>ECON 1670</td>
<td>Advanced Topics in Econometrics</td>
</tr>
<tr>
<td>ECON 1740</td>
<td>Mathematical Finance</td>
</tr>
<tr>
<td>ECON 1750</td>
<td>Investments II</td>
</tr>
<tr>
<td>ECON 1759</td>
<td>Data, Statistics, Finance</td>
</tr>
<tr>
<td>ECON 1810</td>
<td>Economics and Psychology</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>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Course</th>
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</tr>
</thead>
<tbody>
<tr>
<td>ECON 1301</td>
<td>Economics of Education I</td>
</tr>
<tr>
<td>ECON 1305</td>
<td>Economics of Education: Research</td>
</tr>
<tr>
<td>ECON 1310</td>
<td>Labor Economics</td>
</tr>
<tr>
<td>ECON 1355</td>
<td>Environmental Issues in Development</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>
</tr>
<tr>
<td>ECON 1410</td>
<td>Urban Economics</td>
</tr>
<tr>
<td>ECON 1480</td>
<td>Public Economics</td>
</tr>
<tr>
<td>ECON 1510</td>
<td>Economic Development</td>
</tr>
<tr>
<td>ECON 1520</td>
<td>The Economic Analysis of Institutions</td>
</tr>
<tr>
<td>ECON 1530</td>
<td>Health, Hunger and the Household in</td>
</tr>
<tr>
<td></td>
<td>Developing Countries</td>
</tr>
<tr>
<td>ECON 1629</td>
<td>Applied Research Methods for Economists</td>
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<tr>
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<td>ECON 1759</td>
<td>Data, Statistics, Finance</td>
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<tr>
<td>ECON 1765</td>
<td>Finance, Regulation, and the Economy:</td>
</tr>
<tr>
<td></td>
<td>Research</td>
</tr>
</tbody>
</table>

One additional 1000-level economics course. 1

Total Credits 13

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.

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

Prerequisites:

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Course Requirements:

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<th>Course</th>
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<tbody>
<tr>
<td>ECON 1130</td>
<td>Intermediate Microeconomics</td>
</tr>
<tr>
<td>(Mathematical)</td>
<td></td>
</tr>
<tr>
<td>ECON 1210</td>
<td>Intermediate Macroeconomics</td>
</tr>
<tr>
<td>ECON 1630</td>
<td>Mathematical Econometrics</td>
</tr>
</tbody>
</table>

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

1

Applied Mathematics-Economics 1
Applied Mathematics Requirements

(a) 1
APMA 0350  Applied Ordinary Differential Equations  2
& APMA 0360  and Applied Partial Differential Equations  1 2

Select one of the following:

APMA 0160  Introduction to Scientific Computing  1
(pREFERRED)
CSCI 0040  Introduction to Scientific Computing and
Problem Solving (preferred)
CSCI 0150  Introduction to Object-Oriented
Programming and Computer Science
CSCI 0170  Computer Science: An Integrated
Introduction

(b) 1 2
APMA 1650  Statistical Inference I  1
or APMA 1655  Statistical Inference I
APMA 1655  Statistical Inference I

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

Economics Requirements:

ECON 1130  Intermediate Microeconomics  1
ECON 1210  Intermediate Macroeconomics  1
ECON 1630  Mathematical Econometrics I  1

Three 1000-level courses from the "mathematical-economics"
group.  3

ECON 1170  Welfare Economics and Social Choice
Theory
ECON 1220  Monetary and Fiscal Policy
ECON 1225  Advanced Macroeconomics: Monetary,
Fiscal, and Stabilization Policies
ECON 1460  Industrial Organization
ECON 1465  Market Design: Theory and Applications
ECON 1470  Bargaining Theory and Applications
ECON 1490  Designing Internet Marketplaces
ECON 1640  Econometrics II
ECON 1650  Financial Econometrics
ECON 1660  Big Data
ECON 1670  Advanced Topics in Econometrics
ECON 1740  Mathematical Finance
ECON 1750  Investments II
ECON 1759  Data, Statistics, Finance
ECON 1810  Economics and Psychology
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
ECON 1301  Economics of Education I
ECON 1305  Economics of Education: Research
ECON 1310  Labor Economics
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 1410  Urban Economics
ECON 1480  Public Economics
ECON 1510  Economic Development
ECON 1520  The Economic Analysis of Institutions
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ECON 1640  Econometrics II
ECON 1650  Financial Econometrics
ECON 1660  Big Data
ECON 1759  Data, Statistics, Finance
ECON 1765  Finance, Regulation, and the Economy:
Research

Two additional 1000-level economics courses  2

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 Note that Econ 1620, 1960, and 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) 1 2
APMA 0350  Applied Ordinary Differential Equations
& APMA 0360  and Applied Partial Differential Equations

Select one of the following:

APMA 0360  Applied Partial Differential Equations I
APMA 0160  Introduction to Scientific Computing
(pREFERRED)
CSCI 0040  Introduction to Scientific Computing and
Problem Solving (preferred)
CSCI 0150  Introduction to Object-Oriented
Programming and Computer Science
CSCI 0170  Computer Science: An Integrated
Introduction
Select one 1000-level course from the "mathematical economics" group:

- APMA 1200 Operations Research: Probabilistic Models
- APMA 1650 Statistical Inference I
- or APMA 1655 Statistical Inference I

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

- APMA 1180 Introduction to Numerical Solution of Differential Equations
- APMA 1210 Operations Research: Deterministic Models
- APMA 1330 Methods of Applied Mathematics
- APMA 1360 Applied Dynamical Systems
- APMA 1660 Statistical Inference II
- APMA 1655 Statistical Inference I
- APMA 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:

- **ECON 1130** Intermediate Microeconomics (Mathematical) 1
- **ECON 1210** Intermediate Macroeconomics 1
- **ECON 1630** Mathematical Econometrics I 1

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

- ECON 1650 Financial Econometrics
- ECON 1710 Investments I
- ECON 1720 Corporate Finance
- ECON 1730 Venture Capital, Private Equity, and Entrepreneurship
- ECON 1740 Mathematical Finance
- ECON 1750 Investments II
- ECON 1759 Data, Statistics, Finance
- ECON 1760 Financial Institutions
- ECON 1765 Finance, Regulation, and the Economy: Research
- ECON 1770 Fixed Income Securities
- ECON 1780 Advanced Topics in Corporate Finance
- ECON 1790 Corporate Governance and Management

Select one 1000-level course from the "mathematical economics" group:

- ECON 1170 Welfare Economics and Social Choice Theory
- ECON 1220 Monetary and Fiscal Policy
- ECON 1225 Advanced Macroeconomics: Monetary, Fiscal, and Stabilization Policies
- ECON 1460 Industrial Organization
- ECON 1465 Market Design: Theory and Applications
- ECON 1470 Bargaining Theory and Applications
- ECON 1490 Designing Internet Marketplaces
- ECON 1640 Econometrics II
- ECON 1650 Financial Econometrics
- ECON 1660 Big Data
- ECON 1670 Advanced Topics in Econometrics
- ECON 1740 Mathematical Finance
- ECON 1750 Investments II
- ECON 1759 Data, Statistics, Finance
- ECON 1810 Economics and Psychology
- ECON 1820 Theory of Behavioral Economics

### Applied Mathematics requirements:

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

- APMA 1180 Introduction to Numerical Solution of Differential Equations
- APMA 1210 Operations Research: Deterministic Models
- APMA 1330 Methods of Applied Mathematics
- APMA 1360 Applied Dynamical Systems
- APMA 1660 Statistical Inference II
- APMA 1655 Statistical Inference I
- APMA 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

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

#### Prerequisites:

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

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

- APMA 0350 Applied Ordinary Differential Equations
- & APMA 0360 Applied Partial Differential Equations

Select one of the following:

- APMA 0160 Introduction to Scientific Computing (preferred)
- CSCI 0040 Introduction to Scientific Computing and Problem Solving (preferred)
- CSCI 0150 Introduction to Object-Oriented Programming and Computer Science
- CSCI 0170 Computer Science: An Integrated Introduction
- APMA 1200 Operations Research: Probabilistic Models
- APMA 1650 Statistical Inference I
ECON 1630  ECON 1210  ECON 1130

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

ECON 1860  ECON 1850  ECON 1820  ECON 1810  ECON 1759  ECON 1750  ECON 1740

Select two of the following:

(b)  ECON 1870  Game Theory and Applications to Economics

Select one 1000-level course from the "data methods" group: 2

ECON 1301  Economics of Education I
ECON 1305  Economics of Education: Research
ECON 1310  Labor Economics
ECON 1355  Environmental Issues in Development Economics
ECON 1360  Health Economics
ECON 1400  The Economics of Mass Media
ECON 1410  Urban Economics
ECON 1510  Economic Development
ECON 1520  The Economic Analysis of Institutions
ECON 1530  Health, Hunger and the Household in Developing Countries
ECON 1629  Applied Research Methods for Economists
ECON 1640  Econometrics II
ECON 1650  Financial Econometrics
ECON 1660  Big Data
ECON 1759  Data, Statistics, Finance
ECON 1765  Finance, Regulation, and the Economy: Research

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 the "financial economics," the "mathematical economics," or the "data methods" requirements.
3  Or ECON 1110 with permission.
4  Note that Econ 1620, 1960, and 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.