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

Course Requirements:

Applied Mathematics Requirements:
(a) 1
- APMA 0350 Applied Ordinary Differential Equations 2
- APMA 0360 and 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

Select one of the following:
- APMA 1210 Operations Research: Probabilistic Models
- APMA 1650 Statistical Inference I
- or APMA 1655 Statistical Inference I
(b) 1

Select one of the following:
- APMA 1200 Operations Research: Probabilistic Models
- APMA 1300 Applied Partial Differential Equations II
- APMA 1360 Topics in Chaotic Dynamics
- 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 Econometrics I
- Two 1000-level courses from the "mathematical-economics" group: 4

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

Course Requirements:

- ECON 1170 Welfare Economics and Social Choice
- 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 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
- 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

One additional 1000-level economics course

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.
3 Or ECON 1110 with permission.
4 No course may be used to simultaneously satisfy the "mathematical economics" and the "data methods" requirements.
### Applied Mathematics Requirements

<table>
<thead>
<tr>
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</tr>
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<tbody>
<tr>
<td>APMA 0350</td>
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<tr>
<td>&amp; APMA 0360</td>
<td>Applied Partial Differential Equations</td>
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</tbody>
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</tr>
<tr>
<td>CSCI 0040</td>
<td>Introduction to Scientific Computing and Problem Solving (preferred)</td>
</tr>
<tr>
<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>
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<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>
</table>

#### (b)

Select two of the following:

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<td>Applied Partial Differential Equations II</td>
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<tr>
<td>APMA 1360</td>
<td>Topics in Chaotic Dynamics</td>
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<tr>
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<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</td>
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<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:

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

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

<table>
<thead>
<tr>
<th>Course</th>
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</tr>
</thead>
<tbody>
<tr>
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<td>Welfare Economics and Social Choice Theory</td>
</tr>
<tr>
<td>ECON 1220</td>
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</tr>
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<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>
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<tr>
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<td>Economics and Psychology</td>
</tr>
<tr>
<td>ECON 1820</td>
<td>Behavioral Economics</td>
</tr>
<tr>
<td>ECON 1850</td>
<td>Theory of Economic Growth</td>
</tr>
</tbody>
</table>

**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 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 
**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 

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.
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**

<table>
<thead>
<tr>
<th>Course</th>
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</tr>
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<tbody>
<tr>
<td>APMA 0350</td>
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<tbody>
<tr>
<td>APMA 0360</td>
<td>Applied Partial Differential Equations I</td>
</tr>
<tr>
<td>APMA 0160</td>
<td>Introduction to Scientific Computing (preferred)</td>
</tr>
<tr>
<td>CSCI 0040</td>
<td>Introduction to Scientific Computing and Problem Solving (preferred)</td>
</tr>
<tr>
<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>
</tbody>
</table>
Select one 1000-level course from the "mathematical economics" group:

- APMA 1650: Statistical Inference I
- or APMA 1655: Statistical Inference I

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

- ECON 1210: Introduction to Numerical Solution of Differential Equations
- ECON 1130: Operations Research: Deterministic Models
- APMA 1330: Applied Partial Differential Equations II
- APMA 1360: Topics in Chaotic Dynamics
- 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)
- ECON 1210: Intermediate Macroeconomics
- ECON 1630: Econometrics I

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: Corporate Strategy
- ECON 1790: Corporate Governance and Management

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

- 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: Behavioral Economics

Applied Mathematics-Economics

- APMA 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 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 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: 13

1. APMA 0330 and APMA 0340 may be substituted with advisor approval.
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.

Standard program for the Sc.B. degree

Prerequisites:

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

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

Applied Mathematics requirements:

(a)

- APMA 0350: Applied Ordinary Differential Equations 2
- APMA 0360: Applied Partial Differential Equations

Select one of the following:

- APMA 0160: Introduction to Scientific Computing (preferred)
- CS1 0040: Introduction to Scientific Computing and Problem Solving (preferred)
- CS1 0150: Introduction to Object-Oriented Programming and Computer Science
- CS1 0170: Computer Science: An Integrated Introduction
- APMA 1650: Statistical Inference I
Select two of the following:

- 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 Code</th>
<th>Course Title</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECON 1130</td>
<td>Intermediate Microeconomics (Mathematical)</td>
<td>1</td>
</tr>
<tr>
<td>ECON 1210</td>
<td>Intermediate Macroeconomics</td>
<td>1</td>
</tr>
<tr>
<td>ECON 1630</td>
<td>Econometrics I</td>
<td>1</td>
</tr>
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Select three 1000-level courses from the "financial economics" group:

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<tr>
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<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>
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<td>Finance, Regulation, and the Economy: Research</td>
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<td>ECON 1780</td>
<td>Corporate Strategy</td>
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<td>ECON 1790</td>
<td>Corporate Governance and Management</td>
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</tbody>
</table>

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

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<td>ECON 1870</td>
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</table>

**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). Beginning with the class of 2016, students not writing an honors thesis must complete an alternative senior capstone project and obtain the approval of a faculty sponsor.

**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 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.