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, or 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>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 0100</td>
</tr>
<tr>
<td>MATH 0520</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 (preferred)
- 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

or 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:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECON 1130</td>
<td>1</td>
</tr>
<tr>
<td>(Mathematical) 3</td>
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</tr>
<tr>
<td>ECON 1210</td>
<td>1</td>
</tr>
<tr>
<td>ECON 1630</td>
<td>1</td>
</tr>
<tr>
<td>Two 1000-level courses from the “mathematical-economics” group: 4</td>
<td>2</td>
</tr>
</tbody>
</table>

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):

<table>
<thead>
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<th>Prerequisites:</th>
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<td>MATH 0100</td>
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<td>MATH 0520</td>
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<table>
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<tr>
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<tbody>
<tr>
<td>ECON 1170</td>
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</tr>
<tr>
<td>Welfare Economics and Social Choice Theory</td>
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<td>ECON 1220</td>
<td>1</td>
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<td>Monetary and Fiscal Policy</td>
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<tr>
<td>ECON 1225</td>
<td>1</td>
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<tr>
<td>Advanced Macroeconomics: Monetary, Fiscal, and Stabilization Policies</td>
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<tr>
<td>ECON 1460</td>
<td>1</td>
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<tr>
<td>Industrial Organization</td>
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<td>ECON 1465</td>
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<tr>
<td>Market Design: Theory and Applications</td>
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<td>ECON 1470</td>
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<tr>
<td>Bargaining Theory and Applications</td>
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<td>Designing Internet Marketplaces</td>
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<td>ECON 1640</td>
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<tr>
<td>Econometrics II</td>
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<tr>
<td>ECON 1650</td>
<td>1</td>
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<tr>
<td>Financial Econometrics</td>
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<td>ECON 1660</td>
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<tr>
<td>Big Data</td>
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<tr>
<td>ECON 1670</td>
<td>1</td>
</tr>
<tr>
<td>Advanced Topics in Econometrics</td>
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<tr>
<td>ECON 1740</td>
<td>1</td>
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<tr>
<td>Mathematical Finance</td>
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<tr>
<td>ECON 1750</td>
<td>1</td>
</tr>
<tr>
<td>Investments II</td>
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<tr>
<td>ECON 1759</td>
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<tr>
<td>Data, Statistics, Finance</td>
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<tr>
<td>ECON 1810</td>
<td>1</td>
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<tr>
<td>Economics and Psychology</td>
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<tr>
<td>ECON 1820</td>
<td>1</td>
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<tr>
<td>Theory of Behavioral Economics</td>
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<td>ECON 1850</td>
<td>1</td>
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<tr>
<td>Theory of Economic Growth</td>
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<tr>
<td>ECON 1860</td>
<td>1</td>
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<tr>
<td>The Theory of General Equilibrium</td>
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<tr>
<td>ECON 1870</td>
<td>1</td>
</tr>
<tr>
<td>Game Theory and Applications to Economics</td>
<td></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.
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 (preferred)
- 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 or APMA 1655  
  Statistical Inference I
- APMA 1655  
  Statistical Inference I

(b) \(^1\)

Select two of the following:  \(^2\)

- 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  \(^1\)
- ECON 1630  
  Mathematical Econometrics  \(^1\)

Three 1000-level courses from the “mathematical-economics” group:  \(^4\)

- 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
- 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:  \(^2\)

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) \(^1\)

- APMA 0350 & APMA 0360  
  Applied Ordinary Differential Equations and Applied Partial Differential Equations  \(^1\)

Select one of the following:  \(^1\)

- APMA 0360  
  Applied Partial Differential Equations I
- APMA 0370  
  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 (1)
- APMA 1650: Statistical Inference I (1)
or APMA 1655: Statistical Inference I

Select one of the following:
- APMA 1180: Introduction to Numerical Solution of Differential Equations (1)
- 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 (1) *(Mathematical)*
- 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 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

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. 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.

**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

**Applied Mathematics requirements:**

(a) APMA 0350 & APMA 0360: Applied Ordinary Differential Equations 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
- APMA 1650: Statistical Inference I
or APMA 1655  Statistical Inference I
APMA 1655  Statistical Inference I

(b) Select two of the following: 2

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECON 1130</td>
<td>Intermediate Microeconomics</td>
<td>1</td>
</tr>
<tr>
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<td>(Mathematical)</td>
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</tr>
<tr>
<td>ECON 1210</td>
<td>Intermediate Macroeconomics</td>
<td>1</td>
</tr>
<tr>
<td>ECON 1630</td>
<td>Mathematical Econometrics I</td>
<td>1</td>
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</table>

Select three 1000-level courses from the "financial economics" group: 3

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>ECON 1650</td>
<td>Financial Econometrics</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</td>
</tr>
<tr>
<td></td>
<td>Entrepreneurship</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>
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<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></td>
<td>Research</td>
</tr>
<tr>
<td>ECON 1770</td>
<td>Fixed Income Securities</td>
</tr>
<tr>
<td>ECON 1780</td>
<td>Advanced Topics in Corporate Finance</td>
</tr>
<tr>
<td>ECON 1790</td>
<td>Corporate Governance and Management</td>
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</table>

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>ECON 1170</td>
<td>Welfare Economics and Social Choice Theory</td>
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<td>Monetary and Fiscal Policy</td>
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<td>ECON 1225</td>
<td>Advanced Macroeconomics: Monetary, Fiscal,</td>
</tr>
<tr>
<td></td>
<td>Stabilization Policies</td>
</tr>
<tr>
<td>ECON 1460</td>
<td>Industrial Organization</td>
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<td>ECON 1465</td>
<td>Market Design: Theory and Applications</td>
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<td>Theory of Economic Growth</td>
</tr>
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<td>ECON 1860</td>
<td>The Theory of General Equilibrium</td>
</tr>
</tbody>
</table>

ECON 1870  Game Theory and Applications to Economics

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

1. APMA 0330 and APMA 0340 may be substituted with advisor approval. APMA 1910 cannot be used as an elective.
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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 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.