

Applied Mathematics

Applied Mathematics has a profound impact on our daily lives. Whether it is search engines, climate modeling, weather forecasts, artificial intelligence, secure online shopping, brain imaging, or movie recommendations, none of these would work the way they do without algorithms and tools from the mathematical sciences. More generally, Applied Mathematics is an inherently interdisciplinary subject, covering problems arising in all areas of science, technology, and engineering. Our courses provide a broad qualitative and quantitative background for use in these fields.

Applied Mathematics appeals to people with a variety of different interests, ranging from those with a desire to obtain a good quantitative background for use in some future career, to those who wish to have a better understanding of the basic mathematical aspects of other fields, or to those who are interested in the fundamental mathematical techniques and approaches in themselves. The program stresses but is not limited to scientific computing, differential equations, probability, and statistics, which are areas of mathematics that are used most often in applications in science, society, and industry. Our curriculum is flexible enough to meet the goals and interests of a very wide range of students.

Students take courses in applied mathematics for many reasons, not necessarily with an applied mathematics concentration in mind. The value of learning about applied mathematics goes beyond a career opportunity. It provides an education in the use of quantitative methods in thinking about and solving problems, knowledge that is valuable in all walks of life.

We offer four concentrations for undergraduates: Applied Mathematics (A.B. & Sc.B.), Applied Mathematics-Biology (Sc.B.), Applied Mathematics-Computer Science (Sc.B.), Applied Mathematics-Economics (A.B. & Sc.B.). This page describes the concentration in Applied Mathematics.

The concentration in Applied Mathematics is the most flexible of all of our concentrations. Students are required to build a foundation in calculus, linear algebra, differential equations, and basic computer programming. Beyond these foundations, there is a great deal of flexibility as to which areas of mathematics and which areas of applications are pursued. Both the A.B. and the Sc.B. allow students to earn concentration credit by taking advanced courses in almost any of the STEM (Science, Technology, Engineering, Mathematics) disciplines. The purpose is to encourage students to develop expertise in both mathematics and an applied area that might be amenable to mathematical investigation.

Standard program for the A.B. degree.

Prerequisites - the equivalent of two semesters of single-variable calculus

Single-variable calculus is not an enforced requirement for our concentration, but it is a required prerequisite for many of our courses. At Brown, single-variable calculus consists of MATH 0090 followed by one of MATH 0100, MATH 0170, or MATH 0190.

Requirements - 10 courses¹

MATH 0180	Multivariable Calculus	1
or MATH 0200	Multivariable Calculus (Physics/Engineering)	
or MATH 0350	Multivariable Calculus With Theory	
MATH 0520	Linear Algebra	1
or MATH 0540	Linear Algebra With Theory	
APMA 0350	Applied Ordinary Differential Equations ²	1
APMA 0360	Applied Partial Differential Equations I ³	1
One approved course on computer programming. ⁴		1
Three 1000-level or higher APMA courses. ⁵		3
One 1000-level or higher APMA or MATH course. ⁵		1

One 1000-level or higher course in a STEM discipline that demonstrates depth in an area amenable to mathematical investigation and that is approved by the concentration advisor.⁶

Total Credits **10**

- A required course may be replaced by a more advanced course with concentration advisor approval. No course may be used to satisfy multiple concentration requirements. Transfer credits and courses receiving placement credit notation can satisfy concentration credit as long as they appear on the Brown internal transcript. Pursuing honors will require 12 courses – these 10 plus two additional semesters of independent study courses for the honors research project. For students with multiple concentrations, calculus, linear algebra, and at most two additional courses can be used for concentration credit in the other concentration(s).
- APMA 0330 or MATH 1110 may be used in place of APMA 0350. If MATH 1110 is used, then the concentration must include at least four 1000-level or higher APMA courses (not including APMA 1910, APMA 1920, or research/independent study courses). These can appear anywhere in the declaration.
- APMA 0340 or MATH 1120 may be used in place of APMA 0360. If MATH 1120 is used, then the concentration must include at least four 1000-level or higher APMA courses (not including APMA 1910, APMA 1920, or research/independent study courses). These can appear anywhere in the declaration.
- Concentrators are encouraged to complete the computing requirement before the end of their sophomore year. The following courses are automatically approved: APMA 0160, APMA 0200, CSCI 0111, CSCI 0150, CSCI 0170, CSCI 0190, CSCI 0200, CLPS 0950, EEPS 0250.
- APMA 1910, APMA 1920, and research/independent study courses cannot be used.
- STEM = Science, Technology, Engineering, Mathematics. Most upper-level courses in APMA, CSCI, ECON, ENGN, MATH, or any of the sciences will be approved, including APMA 1910, APMA 1920. Upper-level courses in other areas may also be approved if the connection to applied mathematics is clear. Concentration advisors may approve a group of lower-level courses as a substitute for a single upper-level course if the group collectively demonstrates depth in a STEM area. Lower-level APMA, CSCI, and MATH courses and independent study/research courses cannot be used.

Standard program for the Sc.B. degree.

Prerequisites - the equivalent of two semesters of single-variable calculus

Single-variable calculus is not an enforced requirement for our concentration, but it is a required prerequisite for many of our courses. At Brown, single-variable calculus consists of MATH 0090 followed by one of MATH 0100, MATH 0170, or MATH 0190.

Requirements - 16 courses¹

MATH 0180	Multivariable Calculus	1
or MATH 0200	Multivariable Calculus (Physics/Engineering)	
or MATH 0350	Multivariable Calculus With Theory	
MATH 0520	Linear Algebra	1
or MATH 0540	Linear Algebra With Theory	
APMA 0350	Applied Ordinary Differential Equations ²	1
APMA 0360	Applied Partial Differential Equations I ³	1
One approved course on computer programming. ⁴		1
Four 1000-level or higher APMA courses. ⁵		4
Two 1000-level or higher APMA or MATH courses. ⁵		2
Four 1000-level or higher courses in one or more STEM disciplines that demonstrate depth in areas amenable to mathematical investigation and that are approved by the concentration advisor. ⁶		4

One approved capstone, senior seminar, or research-related course.	1
--	---

Total Credits	16
----------------------	-----------

- ¹ A required course may be replaced by a more advanced course with concentration advisor approval. No course may be used to satisfy multiple concentration requirements. Transfer credits and courses receiving placement credit notation can satisfy concentration credit as long as they appear on the Brown internal transcript. Pursuing honors will require 17 courses – these 16 along with two semesters of independent study courses for the honors research project, one of which can be used to satisfy the capstone concentration requirement. For students with multiple concentrations: calculus, linear algebra, one intro CSCI course, and at most two additional courses can be used for concentration credit in the other concentration(s).
- ² APMA 0330 or MATH 1110 may be used in place of APMA 0350. If MATH 1110 is used, then the concentration must include at least five 1000-level or higher APMA courses (not including APMA 1910, APMA 1920, or research/independent study courses). These can appear anywhere in the declaration.
- ³ APMA 0340 or MATH 1120 may be used in place of APMA 0360. If MATH 1120 is used, then the concentration must include at least five 1000-level or higher APMA courses (not including APMA 1910, APMA 1920, or research/independent study courses). These can appear anywhere in the declaration.
- ⁴ Concentrators are encouraged to complete the computing requirement before the end of their sophomore year. The following courses are automatically approved: APMA 0160, APMA 0200, CSCI 0111, CSCI 0150, CSCI 0170, CSCI 0190, CSCI 0200, CLPS 0950, EEPS 0250.
- ⁵ APMA 1910, APMA 1920, and research/independent study courses cannot be used.
- ⁶ STEM = Science, Technology, Engineering, Mathematics. Most upper-level courses in APMA, CSCI, ECON, ENGN, MATH, or any of the sciences will be approved, including APMA 1910, APMA 1920. Upper-level courses in other areas may also be approved if the connection to applied mathematics is clear. Concentration advisors may approve a group of lower-level courses as a substitute for a single upper-level course if the group collectively demonstrates depth in a STEM area. Lower-level APMA, CSCI, and MATH courses and independent study/research courses cannot be used.
- ⁷ The following courses are automatically approved: APMA 1360, APMA 193*/194* (where * is any combination of numbers and letters; these are the APMA senior seminars), an independent study course used to satisfy the APMA honors requirement.

- 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.

Honors

Concentrators (A.B. or Sc.B.) that demonstrate excellence in grades and in undergraduate research can be awarded departmental honors. Complete guidelines, requirements, and deadlines for honors are published on the department website (<https://appliedmath.brown.edu/academics/undergraduate-program/honors/>). The first deadline is at the beginning of the student's senior year (i.e., the start of the penultimate semester). The main requirements include:

- Earning grades of A or S-with-distinction in at least 70% of the courses used for concentration credit, excluding calculus and linear algebra, by the end of the penultimate semester.
- Completion of an in-depth, original research project in a STEM discipline carried out under the guidance of a Brown-affiliated faculty advisor and documented with the completion of two semesters of independent study courses under the advisor's supervision.
- Completion of an honors thesis describing this research project that also demonstrates the use of mathematical methodology in the project. The honors thesis must be approved by the student's thesis advisor and a second reader, at least one of which must be faculty member in the Division of Applied Mathematics.

Professional Tracks

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

Students must complete full-time professional experiences doing work that is related to their concentration programs, totaling 2-6 months, whereby each internship must be at least one month in duration in cases where students choose to do more than one internship experience. Such work is normally done at a company, but may also be at a university under the supervision of a faculty member. Internships that take place between the end of the fall and the start of the spring semesters cannot be used to fulfill this requirement.

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

- 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?