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 courses [1]

MATH 0180	Multivariable Calculus [2]	1
or MATH 0200	Multivariable Calculus (Physics/Engineering)	
or MATH 0350	Multivariable Calculus With Theory	
MATH 0520	Linear Algebra [2]	1
or MATH 0540	Linear Algebra With Theory	
APMA 0355	Applied Ordinary Differential Equations with Theory [3]	1
APMA 0365	Applied Partial Differential Equations I with Theory [4]	1
One approved course on computer programming. [5]		1
Three 1000-level or higher APMA courses. [6]		3
One 1000-level or higher APMA or MATH course. [6]		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. [7]		1
Total Credits		**10**

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 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).
2. APMA 0260 can substitute for the multivariable calculus and/or the linear algebra requirements. If it is used as a substitute for both requirements, then students must take one additional approved 1000-level APMA or MATH course not used elsewhere for concentration credit that adheres to the restrictions in footnote 6.
3. MATH 1110 may be used in place of APMA 0355. If MATH 1110 is used, then the concentration must include at least four 1000-level or higher APMA courses that adhere to the restrictions in footnote 6. These can appear anywhere in the declaration. Students matriculating prior to Fall 2025 can use APMA 0330 or APMA 0350 as a substitute for APMA 0355. Students matriculating in Fall 2025 or later who wish to use APMA 0330 or APMA 0350 must also complete the APMA 0355 online bridgework course and pass the in-person bridgework exam that is offered once per semester.
4. MATH 1120 may be used in place of APMA 0365. If MATH 1120 is used, then the concentration must include at least four 1000-level or higher APMA courses that adhere to the restrictions in footnote 6. These can appear anywhere in the declaration. Students matriculating prior to Fall 2025 can use APMA 0340 or APMA 0360 as a substitute for APMA 0365. Students matriculating in Fall 2025 or later who wish to use APMA 0340 or APMA 0360 must also complete the APMA 0365 online bridgework course and pass the in-person bridgework exam that is offered once per semester.
5. 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 0112, CSCI 0150, CSCI 0170, CSCI 0190, CSCI 0200, CPSY 0950, EEPS 0250.
6. APMA 1650 cannot be used to satisfy this requirement for students matriculating in Fall 2025 or later, unless they also complete the APMA 1655 online bridgework course and pass the in-person bridgework exam that is offered once per semester. APMA 1910, APMA 1920, MATH 1090, MATH 1910 and research/independent study courses cannot be used. At most one of APMA 1000, APMA 1001, MATH 1000, MATH 1001 and at most one of APMA 1650, APMA 1655, CSCI 1450, MATH 1210, MATH 1610 can be used for concentration credit.
7. 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 1650, APMA 1910, APMA 1920, MATH 1090, MATH 1910. 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. At most one of APMA 1910, MATH 1090, MATH 1910, at most one of APMA 1000, APMA 1001, MATH 1000, MATH 1001, and at most one of APMA 1650, APMA 1655, CSCI 1450, MATH 1210, MATH 1610 can be used for concentration credit.

Professional Track

The requirements for all undergraduate professional tracks within concentrations are standardized and additional information can be found here:

https://bulletin.brown.edu/undergradproftrack/

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.

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 courses [1]		
MATH 0180	Multivariable Calculus [2]	1
or MATH 0200	Multivariable Calculus (Physics/Engineering)	
or MATH 0350	Multivariable Calculus With Theory	
MATH 0520	Linear Algebra [2]	1
or MATH 0540	Linear Algebra With Theory	
APMA 0355	Applied Ordinary Differential Equations with Theory [3]	1
APMA 0365	Applied Partial Differential Equations I with Theory [4]	1
One approved course on computer programming. [5]		1
Four 1000-level or higher APMA courses. [6]		4
Two 1000-level or higher APMA or MATH courses. [6]		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. [7]		4
One approved capstone, senior seminar, or research-related course. [8]		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 0260 can substitute for the multivariable calculus and/or the linear algebra requirements. If it is used as a substitute for both requirements, then students must take one additional approved 1000-level APMA or MATH course not used elsewhere for concentration credit that adheres to the restrictions in footnote 6.

[3] MATH 1110 may be used in place of APMA 0355. If MATH 1110 is used, then the concentration must include at least five 1000-level or higher APMA courses that adhere to the restrictions in footnote 6.These can appear anywhere in the declaration. Students matriculating prior to Fall 2025 can use APMA 0330 or APMA 0350 as a substitute for APMA 0355. Students matriculating in Fall 2025 or later who wish to use APMA 0330 or APMA 0350 must also complete the APMA 0355 online bridgework course and pass the in-person bridgework exam that is offered once per semester.

[4] MATH 1120 may be used in place of APMA 0365. If MATH 1120 is used, then the concentration must include at least five 1000-level or higher APMA courses that adhere to the restrictions in footnote 6.These can appear anywhere in the declaration. Students matriculating prior to Fall 2025 can use APMA 0340 or APMA 0360 as a substitute for APMA 0365. Students matriculating in Fall 2025 or later who wish to use APMA 0340 or APMA 0360 must also complete the APMA 0365 online bridgework course and pass the in-person bridgework exam that is offered once per semester.

[5] 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 0112, CSCI 0150, CSCI 0170, CSCI 0190, CSCI 0200, CPSY 0950, EEPS 0250.

[6] APMA 1650 cannot be used to satisfy this requirement for students matriculating in Fall 2025 or later, unless they also complete the APMA 1655 online bridgework course and pass the in-person bridgework exam that is offered once per semester. APMA 1910, APMA 1920, MATH 1090, MATH 1910 and research/independent study courses cannot be used. At most one of APMA 1000, APMA 1001, MATH 1000, MATH 1001 and at most one of APMA 1650, APMA 1655, CSCI 1450, MATH 1210, MATH 1610 can be used for concentration credit.

[7] 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 1650, APMA 1910, APMA 1920, MATH 1090, MATH 1910. 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. At most one of APMA 1910, MATH 1090, MATH 1910, at most one of APMA 1000, APMA 1001, MATH 1000, MATH 1001, and at most one of APMA 1650, APMA 1655, CSCI 1450, MATH 1210, MATH 1610 can be used for concentration credit.

[8] The following options can be used to satisfy this requirement:
(a) A pre-approved capstone course: currently APMA 1360, APMA 193*/194* (where * is any combination of numbers and letters; these are the APMA senior seminars).
(b) A directed research/independent study course from the APMA 1970/APMA 1971 series that is used for undergraduate research. For students pursuing honors in APMA, one of the two required semesters of independent study courses can be used.
(c) A directed research/independent study course in a related discipline (i.e. STEM disciplines, ENVS, PHP, etc.) that is used for undergraduate research if the project is relevant to the student's learning goals in the concentration and with approval from the concentration advisor.
(d) An upper-level course related to the concentration (usually a 1000-level or higher APMA or MATH course) in addition to a research experience equivalent in scope and scale to work the student would pursue in an Applied Math research-related independent study course. Examples include UTRAs, LINK awards, REUs, research programs at other institutions, the APMA Directed Reading Program, etc. This

requires approval from the concentration advisor and appropriate documentation that should be uploaded to ASK.

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- 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.