

MATHEMATICS - BACHELOR OF ARTS (BA)

The undergraduate degree in mathematics emphasizes knowledge and awareness of:

- Calculus of several variables and vector analysis.
- The structure of mathematical proofs and definitions.
- Basic linear algebra and the theory of vector spaces.
- Basic real analysis of one variable.
- At least one additional specialized area of mathematics.

In addition, students completing a degree in mathematics are expected to acquire the ability and skills to:

- Move from concrete to abstract thinking and back with facility.
- Recognize patterns and connections between areas of mathematics and between mathematics and other subjects.
- Organize and construct a logical argument, provide evidence to support arguments and articulate arguments clearly and succinctly, both verbally and in writing.

Program Tracks

The mathematics program offers five tracks that lead to the BA degree. All five tracks require Calculus 1, Calculus 2, Calculus 3, MATH 2001, MATH 2135 and MATH 3001.

Comprehensive Track

The comprehensive track emphasizes theoretical mathematics, and is aimed at students seeking a general background in mathematics or intending to pursue graduate work in mathematics.

Applicable Track

The applicable track is aimed at students seeking a background in applied and/or applicable mathematics.

Secondary Education Track

The secondary education track is designed to align with the Colorado licensure requirements for mathematics secondary education, and the university does offer a program for obtaining secondary education mathematics teaching licensure.

Computational Track

The computational track is designed for students with an interest in the intersection of mathematics and computer science.

Statistics Track

The statistics track is designed for students seeking a background in statistics and/or data science.

Requirements

Program Requirements

To earn a BA in mathematics, a student must complete the general requirements of the College of Arts and Sciences, as well as the six mathematics core courses and the five additional courses for one of the five tracks (described on the Program Tracks tab).

Students must earn a grade of C- or better in each of the mathematics core courses and the five additional courses, and have at least a C average for all attempted work in mathematics.

Required Core Courses

The following courses are required of all mathematics majors, regardless of track.

Code	Title	Credit Hours
Required Courses		
MATH 1300 or MATH 1310 or APPM 1350	Calculus 1 Calculus for Life Sciences Calculus 1 for Engineers	4-5
MATH 2300 or APPM 1360	Calculus 2 Calculus 2 for Engineers	4-5
MATH 2400 or APPM 2350	Calculus 3 Calculus 3 for Engineers	4-5
MATH 2001 or MATH 2002	Introduction to Discrete Mathematics Number Systems: An Introduction to Higher Mathematics	3
MATH 2135	Introduction to Linear Algebra for Mathematics Majors	3
MATH 3001	Analysis 1	3
Program Track Coursework		15-16
Total Credit Hours		36-40

Program Tracks

Comprehensive Track

Aimed at students seeking a general background in mathematics or intending to pursue graduate work in mathematics, in addition to the coursework required of all mathematics majors, the comprehensive track requires the following courses.

Required Courses and Credits

Code	Title	Credit Hours
Required Courses		
MATH 3140	Abstract Algebra 1	3
MATH 4140 or MATH 4001	Abstract Algebra 2 Analysis 2	3
Electives		
Three upper-division MATH or approved APPM courses (at least one at the 4000-level)		9
Total Credit Hours		15

Graduating in Four Years

Consult the Four-Year Guarantee Requirements for information on eligibility. The concept of "adequate progress," as it is used here, refers to maintaining eligibility for the four-year guarantee; it is not a requirement for the major. To maintain adequate progress in mathematics, students should meet the following requirements.

- By the beginning of the second semester, declare the major.
- By the end of the fourth semester, complete Calculus 1, Calculus 2, Calculus 3, MATH 2001 or MATH 2002, MATH 2135, and MATH 3001.

- By the end of the sixth semester, complete MATH 3140, MATH 4140 or MATH 4001, and one additional approved MATH or APPM course.
- By the end of the eighth semester, complete the major.

Applicable Track

Aimed at students seeking a background in applied and/or applicable mathematics, in addition to the coursework required of all mathematics majors, the applicable track requires the following courses.

Required Courses and Credits

Code	Title	Credit Hours
Required Courses		
MATH 4510	Introduction to Probability Theory	3
MATH 3430	Ordinary Differential Equations	3
MATH 4520 or MATH 4470	Introduction to Mathematical Statistics Partial Differential Equations	3
Electives		
Two upper-division MATH or approved APPM courses		6
Total Credit Hours		15

Graduating in Four Years

Consult the Four-Year Guarantee Requirements for information on eligibility. The concept of "adequate progress," as it is used here, refers to maintaining eligibility for the four-year guarantee; it is not a requirement for the major. To maintain adequate progress in mathematics, students should meet the following requirements.

- By the beginning of the second semester, declare the major.
- By the end of the fourth semester, complete Calculus 1, Calculus 2, Calculus 3, MATH 2001 or MATH 2002, MATH 2135, and MATH 3001.
- By the end of the sixth semester, complete MATH 4510, MATH 3430, and either MATH 4520 or MATH 4470.
- By the end of the eighth semester, complete the major.

Secondary Education Track

Aimed at students intending to teach mathematics at the secondary level, in addition to the coursework required of all mathematics majors, the secondary education track requires the following courses.

Required Courses and Credits

Code	Title	Credit Hours
Required Courses		
MATH 3110 or MATH 3140	Introduction to Theory of Numbers Abstract Algebra 1	3
MATH 3120	Functions and Modeling	3
MATH 3210	Euclidean and Non-Euclidean Geometry	3
MATH 3510	Introduction to Probability and Statistics	3
MATH 4820	History of Mathematical Ideas	3
Total Credit Hours		15

Note: Completion of the secondary education track does not provide the student a teaching license.

Graduating in Four Years

Consult the Four-Year Guarantee Requirements for information on eligibility. The concept of "adequate progress," as it is used here, refers to maintaining eligibility for the four-year guarantee; it is not a requirement for the major. To maintain adequate progress in mathematics, students should meet the following requirements.

- By the beginning of the second semester, declare the major.
- By the end of the fourth semester, complete Calculus 1, Calculus 2, Calculus 3, MATH 2001 or MATH 2002, MATH 2135, MATH 3001, and MATH 3120.
- By the end of the sixth semester, complete MATH 3510, MATH 3210, and either MATH 3110 or MATH 3140.
- By the end of the eighth semester, complete the major.

Computational Track

Aimed at students interested in both mathematics and computation, in addition to the coursework required of all mathematics majors, the computational track requires the following courses.

Ancillary Courses

Code	Title	Credit Hours
Ancillary Courses ¹		
CSCI 1300	Computer Science 1: Starting Computing	4
CSCI 2270	Computer Science 2: Data Structures	4
Total Credit Hours		8

¹ CSCI 1300 and CSCI 2270 do not count toward hours in the major and are not part of the major GPA.

Required Courses and Credits

Code	Title	Credit Hours
Required Courses		
CSCI 3104	Algorithms	4
MATH 3430	Ordinary Differential Equations	3
MATH/APPM 4650	Intermediate Numerical Analysis 1	3
Electives		
Two MATH or approved APPM or approved CSCI courses, at least one of which must be at the 4000-level.		6
Total Credit Hours		16

Graduating in Four Years

Consult the Four-Year Guarantee Requirements for information on eligibility. The concept of "adequate progress," as it is used here, refers to maintaining eligibility for the four-year guarantee; it is not a requirement for the major. To maintain adequate progress in mathematics, students should meet the following requirements.

- By the beginning of the second semester, declare the major.
- By the end of the fourth semester, complete Computer Science 1, Computer Science 2, Calculus 1, Calculus 2, Calculus 3, MATH 2001 or MATH 2002, MATH 2135, and MATH 3001.
- By the end of the sixth semester, complete CSCI 3104, MATH 3430, MATH 4650/APPM 4650 and one of the additionally required upper-division MATH classes.
- By the end of the eighth semester, complete the major.

Statistics Track

Aimed at students seeking a background in statistics and/or data science, in addition to the coursework required of all mathematics majors, the statistics track requires the following courses.

Required Courses and Credits

Code	Title	Credit Hours
Required Courses		
MATH 4510	Introduction to Probability Theory	3
MATH 4520	Introduction to Mathematical Statistics	3
MATH 4540	Introduction to Time Series	3
Electives		
Two of the following courses:		6
APPM 4560	Markov Processes, Queues, and Monte Carlo Simulations	
APPM 4590		
MATH 6550	Introduction to Stochastic Processes	
STAT 4000	Statistical Methods and Application I	
STAT 4010	Statistical Methods and Applications II	
STAT 4610	Statistical Learning	
Total Credit Hours		15

Graduating in Four Years

Consult the Four-Year Guarantee Requirements for information on eligibility. The concept of "adequate progress," as it is used here, refers to maintaining eligibility for the four-year guarantee; it is not a requirement for the major. To maintain adequate progress in mathematics, students should meet the following requirements.

- By the beginning of the second semester, declare the major.
- By the end of the fourth semester, complete Calculus 1, Calculus 2, Calculus 3, MATH 2001 or MATH 2002, MATH 2135, and MATH 4510.
- By the end of the sixth semester, complete MATH 3001, MATH 4520, and MATH 4540.
- By the end of the eighth semester, complete the major.

Recommended Four-Year Plan of Study

Through the required coursework for the major, students will complete the QRMS component of the Gen Ed Skills Requirement and, depending on the track of study, potentially some credit hours in the Natural Sciences and Arts & Humanities areas of the Gen Ed Distribution Requirement.

Year One

Fall Semester		Credit Hours
MATH 1300	Calculus 1	5
Gen. Ed. Distribution/diversity course (example: Social Sciences/Global Perspective)		3
Gen. Ed. Skills course (example: Lower-division Written Communication)		3
Elective		3
Credit Hours		14

Spring Semester

MATH 2300	Calculus 2	5
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Gen. Ed. Distribution course (example: Natural Sciences with Lab)	4
Gen. Ed. Distribution/Diversity course (example: Arts & Humanities/US Perspective)	3
Elective	3

Credit Hours 15

Year Two

Fall Semester		Credit Hours
MATH 2400	Calculus 3	5
MATH 2001 or MATH 2002	Introduction to Discrete Mathematics or Number Systems: An Introduction to Higher Mathematics	3
Gen. Ed. Distribution course (example: Natural Sciences)		3
Elective		3
Elective		3

Credit Hours 17

Spring Semester

MATH 2135	Introduction to Linear Algebra for Mathematics Majors	3
Gen. Ed. Distribution course (example: Natural Sciences)		3
Gen. Ed. Distribution course (example: Social Sciences)		3
Elective		3
Elective		3

Credit Hours 15

Year Three

Fall Semester		Credit Hours
MATH Upper Division Elective		3
Gen. Ed. Skills course (example: Upper-division Written Communication)		3
Gen. Ed. Distribution course (example: Arts & Humanities) - Upper-division		3
Upper-division Elective		3
Upper-division Elective		3

Credit Hours 15

Spring Semester

MATH 3001	Analysis 1	3
Gen. Ed. Distribution course (example: Arts & Humanities)		3
Gen. Ed. Distribution course (example: Social Sciences)		3
Upper-division Elective		3
Upper-division Elective		3

Credit Hours 15

Year Four

Fall Semester		Credit Hours
MATH Upper Division Elective		3
MATH Upper Division Elective		3
Gen. Ed. Distribution course (Natural Sciences)		3
Upper-division Elective		3
Upper-division Elective		3

Credit Hours 15

Spring Semester

MATH Upper Division Elective		3
MATH Upper Division Elective		3
Gen. Ed. Distribution course (example: Arts & Humanities)		3

Gen. Ed. Distribution course (example: Social Sciences)	3
Upper-division Elective	3
Credit Hours	15
Total Credit Hours	121

Learning Outcomes

By the completion of the program, students will be able to:

- Students will learn to formalize mathematical reasoning and processes, state problems carefully and articulate assumptions
- Students will learn to identify rigor and correctness (and their absence) in mathematical arguments
- Students will learn to write mathematical proofs
- Students will learn to recognize applications of mathematical theory beyond and between individual classes

Bachelor's–Accelerated Master's Degree Program(s)

The bachelor's–accelerated master's (BAM) degree program options offer currently enrolled CU Boulder undergraduate students the opportunity to receive a bachelor's and master's degree in a shorter period of time. Students receive the bachelor's degree first but begin taking graduate coursework as undergraduates (typically in their senior year).

Because some courses are allowed to double count for both the bachelor's and the master's degrees, students receive a master's degree in less time and at a lower cost than if they were to enroll in a standalone master's degree program after completion of their baccalaureate degree. In addition, staying at CU Boulder to pursue a bachelor's–accelerated master's program enables students to continue working with their established faculty mentors.

BA in Mathematics, MA in Mathematics or MS in Applied Mathematics

Each of the BAM degree programs offered by the Department of Mathematics allows highly motivated and successful students to experience graduate-level coursework earlier in their education than would otherwise be possible, and also allows them to obtain a master's degree in a reduced time period. Students are allowed to count 6 hours of graduate-level mathematics department coursework towards both their undergraduate and graduate degree requirements.

Admissions Requirements

In order to gain admission to the BAM programs named above, a student must meet the following criteria:

- Have a cumulative GPA of 3.0 or higher.
- Have completed a minimum of 45 credit hours of coursework.
- If a transfer student, have completed a minimum of 24 credit hours at CU Boulder.
- Have completed a minimum of two upper-division courses from the Department of Mathematics.

The earliest admission to the program is after the successful completion of at least total 45 credit hours and a minimum of two upper-division courses from the Department of Mathematics. Students must have at least one year of coursework remaining towards the completion of their undergraduate degree in order to be admitted to the program. Students

admitted to the program may not pursue a double degree or a double major; however, outside minors are allowed.

Program Requirements

Students may take up to and including 12 hours while in the undergraduate program which can later be used toward the master's degree. However, only 6 credits may be double counted toward the bachelor's degree and the master's degree. Students must apply to graduate with the bachelor's degree, and apply to continue with the master's degree, early in the semester in which the undergraduate requirements will be completed.

If you are interested in the BAM degree program, please contact the mathematics graduate program for more information.