# MATHEMATICS, B.A.

## REQUIREMENTS

## UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatestudytext) section of the *Guide*.

| | |
|---|---|
| General Education | • Breadth—Humanities/Literature/Arts: 6 credits |
| | • Breadth—Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits |
| | • Breadth—Social Studies: 3 credits |
| | • Communication Part A & Part B * |
| | • Ethnic Studies * |
| | • Quantitative Reasoning Part A & Part B * |

* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

## COLLEGE OF LETTERS & SCIENCE DEGREE REQUIREMENTS: BACHELOR OF ARTS (B.A.)

Students pursuing a bachelor of arts degree in the College of Letters & Science must complete all of the requirements below. The College of Letters & Science allows this major to be paired with either a bachelor of arts or a bachelor of science curriculum.

## BACHELOR OF ARTS DEGREE REQUIREMENTS

| | |
|---|---|
| Mathematics | Complete the University General Education Requirements for Quantitative Reasoning A (QR-A) and Quantitative Reasoning B (QR-B) coursework. |
| Foreign Language | • Complete the fourth unit of a foreign language; OR |
| | • Complete the third unit of a foreign language and the second unit of an additional foreign language. |

| | |
|---|---|
| L&S Breadth | • 12 credits of Humanities, which must include 6 credits of literature; and |
| | • 12 credits of Social Science; and |
| | • 12 credits of Natural Science, which must include one 3+ credit Biological Science course and one 3+ credit Physical Science course. |
| Liberal Arts and Science Coursework | Complete at least 108 credits. |
| Depth of Intermediate/ Advanced work | Complete at least 60 credits at the intermediate or advanced level. |
| Major | Declare and complete at least one major. |
| Total Credits | Complete at least 120 credits. |
| UW-Madison Experience | • 30 credits in residence, overall; and |
| | • 30 credits in residence after the 86th credit. |
| Quality of Work | • 2.000 in all coursework at UW–Madison |
| | • 2.000 in Intermediate/Advanced level coursework at UW–Madison |

## NON–L&S STUDENTS PURSUING AN L&S MAJOR

Non–L&S students who have permission from their school/college to pursue an additional major within L&S only need to fulfill the major requirements. They do not need to complete the L&S Degree Requirements above.

## REQUIREMENTS FOR THE MAJOR

The mathematics major requirements include exposure to at least two areas of advanced mathematics.  The program is ideal for any student who has a broad interest in mathematics both pure and applied, and functions well as a standalone or complementary program.

The mathematics major requires 7 distinct courses for at least 21 credits as described below.  Note that at most one course from each of the following groupings may be used to fulfill the minimum course and credit requirement (i.e.: seven courses and at least 21 credits): Intro Linear Algebra (MATH 320, MATH 340, MATH 341, MATH 375), Intro Differential Equations (MATH 319, MATH 320, or MATH 376), and Intro Probability (MATH/STAT  309, MATH 331, or MATH/STAT  431).

**At least seven MATH courses for at least 21 credits are required for the major as follows**[1]:

| Code | Title | Credits |
|---|---|---|
| **Linear Algebra (complete one)** [2] | | **3-5** |
| MATH 341 | Linear Algebra | |
| or MATH 320 | Linear Algebra and Differential Equations | |
| or MATH 340 | Elementary Matrix and Linear Algebra | |
| or MATH 375 | Topics in Multi-Variable Calculus and Linear Algebra | |

| Code | Title | Credits |
|---|---|---|
| **Analysis, Topology, Algebra (complete two)** | | **6** |
| MATH 521 | Analysis I | |

| Code | Title | |
|---|---|---|
| MATH 541 | Modern Algebra | |
| MATH 551 | Elementary Topology | |

## Advanced MATH Elective (complete one)

| Code | Title | Credits |
|---|---|---|
| **Complete at least one for three credits:** | | **3** |
| MATH/ COMP SCI  513 | Numerical Linear Algebra | |
| MATH/ COMP SCI  514 | Numerical Analysis | |
| MATH 519 | Ordinary Differential Equations | |
| MATH 521 | Analysis I | |
| MATH 522 | Analysis II | |
| MATH/ COMP SCI/I SY E/ STAT  525 | Linear Optimization | |
| MATH 531 | Probability Theory | |
| MATH 535 | Mathematical Methods in Data Science | |
| MATH 540 | Linear Algebra II | |
| MATH 541 | Modern Algebra | |
| MATH 542 | Modern Algebra | |
| MATH 551 | Elementary Topology | |
| MATH 552 | Elementary Geometric and Algebraic Topology | |
| MATH 561 | Differential Geometry | |
| MATH 567 | Modern Number Theory | |
| MATH 570 | Fundamentals of Set Theory | |
| MATH/ PHILOS  571 | Mathematical Logic | |
| MATH 605 | Stochastic Methods for Biology | |
| MATH 607 | Topics in Mathematics Study Abroad | |
| MATH/B M I/ BIOCHEM/ BMOLCHEM  609 | Mathematical Methods for Systems Biology | |
| MATH 619 | Analysis of Partial Differential Equations | |
| MATH 621 | Introduction to Manifolds | |
| MATH 623 | Complex Analysis | |
| MATH 627 | Introduction to Fourier Analysis | |
| MATH 629 | Introduction to Measure and Integration | |
| MATH/I SY E/ OTM/STAT  632 | Introduction to Stochastic Processes | |
| MATH 635 | An Introduction to Brownian Motion and Stochastic Calculus | |
| MATH/E C E  641 | Introduction to Error-Correcting Codes | |
| MATH 681 | Senior Honors Thesis | |
| MATH 682 | Senior Honors Thesis | |
| MATH 691 | Undergraduate Thesis | |
| MATH 692 | Undergraduate Thesis | |
| MATH 698 | Directed Study | |
| MATH 699 | Directed Study | |

## Additional MATH Elective to achieve 7 courses and 21 credits in the major

| Code | Title | Credits |
|---|---|---|
| **Choose from the following:** | | **9** |
| MATH/STAT  309 | Introduction to Probability and Mathematical Statistics I [3] | |
| or MATH 331 | Introductory Probability | |
| or MATH/ STAT  431 | Introduction to the Theory of Probability | |
| MATH/STAT  310 | Introduction to Probability and Mathematical Statistics II | |
| MATH 319 | Techniques in Ordinary Differential Equations [4] | |
| or MATH 376 | Topics in Multi-Variable Calculus and Differential Equations | |
| MATH 321 | Applied Mathematical Analysis | |
| MATH 322 | Applied Mathematical Analysis | |
| MATH 390 | Undergraduate Research with Madison Experimental Mathematics Lab | |
| MATH 407 | Topics in Mathematics Study Abroad | |
| MATH 415 | Applied Dynamical Systems, Chaos and Modeling | |
| MATH 421 | The Theory of Single Variable Calculus | |
| MATH/ COMP SCI/ I SY E  425 | Introduction to Combinatorial Optimization | |
| MATH/ COMP SCI/ E C E  435 | Introduction to Cryptography | |
| MATH 441 | Introduction to Modern Algebra | |
| MATH 443 | Applied Linear Algebra | |
| MATH 461 | College Geometry I | |
| MATH 467 | Introduction to Number Theory | |
| MATH/ HIST SCI  473 | History of Mathematics | |
| MATH/ COMP SCI/ STAT  475 | Introduction to Combinatorics | |
| MATH 490 | Undergraduate Seminar | |
| MATH 491 | Topics in Undergraduate Mathematics | |
| MATH/ COMP SCI  513 | Numerical Linear Algebra | |
| MATH/ COMP SCI  514 | Numerical Analysis | |
| MATH 519 | Ordinary Differential Equations | |
| MATH 521 | Analysis I | |
| MATH 522 | Analysis II | |
| MATH/ COMP SCI/I SY E/ STAT  525 | Linear Optimization | |
| MATH 531 | Probability Theory | |
| MATH 535 | Mathematical Methods in Data Science | |

| MATH 540 | Linear Algebra II |
|---|---|
| MATH 541 | Modern Algebra |
| MATH 542 | Modern Algebra |
| MATH 551 | Elementary Topology |
| MATH 552 | Elementary Geometric and Algebraic Topology |
| MATH 561 | Differential Geometry |
| MATH 567 | Modern Number Theory |
| MATH 570 | Fundamentals of Set Theory |
| MATH/ PHILOS 571 | Mathematical Logic |
| MATH 605 | Stochastic Methods for Biology |
| MATH 607 | Topics in Mathematics Study Abroad |
| MATH/B M I/ BIOCHEM/ BMOLCHEM 609 | Mathematical Methods for Systems Biology |
| MATH 619 | Analysis of Partial Differential Equations |
| MATH 621 | Introduction to Manifolds |
| MATH 623 | Complex Analysis |
| MATH 627 | Introduction to Fourier Analysis |
| MATH 629 | Introduction to Measure and Integration |
| MATH/I SY E/ OTM/STAT 632 | Introduction to Stochastic Processes |
| MATH 635 | An Introduction to Brownian Motion and Stochastic Calculus |
| MATH/E C E 641 | Introduction to Error-Correcting Codes |
| MATH 681 | Senior Honors Thesis |
| MATH 682 | Senior Honors Thesis |
| MATH 691 | Undergraduate Thesis |
| MATH 692 | Undergraduate Thesis |
| MATH 698 | Directed Study |
| MATH 699 | Directed Study |
| **Total Credits** | **9** |

## RESIDENCE AND QUALITY OF WORK

- 2.000 GPA in all MATH and major courses.
- 2.000 GPA on 15 upper-level major credits, taken in residence.[5]
- 15 credits in MATH, taken on the UW–Madison campus.

## NAMED OPTIONS

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- MATHEMATICS: MATHEMATICS FOR DATA SCIENCE (HTTP://GUIDE.WISC.EDU/UNDERGRADUATE/LETTERS–SCIENCE/MATHEMATICS/MATHEMATICS-BA/MATHEMATICS–MATHEMATICS–DATA–SCIENCE-BA/)
- MATHEMATICS: MATHEMATICS FOR ECONOMICS AND FINANCE (HTTP://GUIDE.WISC.EDU/UNDERGRADUATE/LETTERS–SCIENCE/MATHEMATICS/MATHEMATICS-BA/MATHEMATICS–MATHEMATICS–ECONOMICS–FINANCE-BA/)
- MATHEMATICS: MATHEMATICS FOR PROGRAMMING AND COMPUTING (HTTP://GUIDE.WISC.EDU/UNDERGRADUATE/LETTERS–SCIENCE/MATHEMATICS/MATHEMATICS-BA/MATHEMATICS–MATHEMATICS–PROGRAMMING–COMPUTING-BA/)
- MATHEMATICS: MATHEMATICS FOR SECONDARY EDUCATION (HTTP://GUIDE.WISC.EDU/UNDERGRADUATE/LETTERS–SCIENCE/MATHEMATICS/MATHEMATICS-BA/MATHEMATICS–MATHEMATICS–SECONDARY–EDUCATION–BA/)
- MATHEMATICS: MATHEMATICS FOR STATISTICAL ANALYSIS AND RISK ASSESSMENT (HTTP://GUIDE.WISC.EDU/UNDERGRADUATE/LETTERS–SCIENCE/MATHEMATICS/MATHEMATICS-BA/MATHEMATICS–MATHEMATICS–STATISTICAL–ANALYSIS–RISK–ASSESSMENT-BA/)
- MATHEMATICS: MATHEMATICS FOR THE PHYSICAL AND BIOLOGICAL SCIENCES (HTTP://GUIDE.WISC.EDU/UNDERGRADUATE/LETTERS–SCIENCE/MATHEMATICS/MATHEMATICS-BA/MATHEMATICS–MATHEMATICS–PHYSICAL–BIOLOGICAL–SCIENCES-BA/)

## HONORS IN THE MAJOR

Students may declare Honors in the Major in consultation with the Mathematics Honors advisor (https://www.math.wisc.edu/undergraduate/advising/); this should be done by the start of the junior year. Honors in the major is not available in any Named Option program.

## HONORS IN THE MATHEMATICS MAJOR REQUIREMENTS

To earn Honors in the Major, students must satisfy both the requirements for the mathematics major (above) and the following additional requirements:

- Earn a 3.300 University GPA
- Earn a 3.300 GPA for all MATH courses, and all courses accepted in the major
- Complete the following courses, with individual grades of B or better:

| Code | Title | Credits |
|---|---|---|
| MATH 521 & MATH 522 | Analysis I and Analysis II (Taken for Honors) [6] | |
| MATH 541 & MATH 542 | Modern Algebra and Modern Algebra (Taken for Honors) [6] | |

Select at least two more courses from MATH 500 through MATH/E C E 641. These course must be taken for honors. The following will usually be one of the courses: [7]

| MATH 551 | Elementary Topology | |

Select one of these Capstone projects:

| MATH 681 & MATH 682 | Senior Honors Thesis and Senior Honors Thesis (For a total of 6 credits) | |

or

| A sequence of two upper-level mathematics courses deemed acceptable by the Mathematics Honors advisor [7] | | |

## FOOTNOTES

**1**

A course may only apply once toward the courses/credits required for the major.  Thus, a course used to meet the Analysis, Topology and Algebra requirement may *not* also be used to meet the requirement for MATH 500-699 requirement and a course used to meet the MATH 500-699 requirement may *not* also be used in the Additional Math requirement.

**2**

Only one of these courses will be used to fulfill minimum course/credit requirements for the major:  MATH 320, MATH 340, MATH 341, MATH 375

**3**

At most one course in Introductory Probability may be used to fulfill the course/credit requirements for the major:  MATH/STAT 309 and MATH/STAT 431.

**4**

 At most one course in Elementary Differential Equations may be used to fulfill the course/credit requirements for the major: MATH 319, MATH 320, MATH 376.

**5**

MATH courses numbered 307–699 are considered upper level in the major.

**6**

At least one of the two sequences (MATH 521–MATH 522 or MATH 541–MATH 542) must be completed prior to enrolling in the Capstone project.

**7**

Chosen in consultation with the Mathematics Honors advisor.

## UNIVERSITY DEGREE REQUIREMENTS

| Total Degree | To receive a bachelor's degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements. |
|---|---|
| Residency | Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. "In residence" means on the UW–Madison campus with an undergraduate degree classification. "In residence" credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs. |
| Quality of Work | Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation. |