MATHEMATICS MAJOR

Students must also complete the Undergraduate Registration Requirement (https://catalogs.northwestern.edu/undergraduate/requirements-policies/undergraduate-registration-requirement/) and the degree requirements of their home school.

NOTE: This Catalog describes Weinberg College BA requirements that pertain to students who matriculated at Northwestern after spring quarter 2023. Refer to the Archives (https://catalogs.northwestern.edu/archives/) if you are following BA requirements described in the 2018-2019 through 2022-2023 editions.

Mathematics major requirements

The mathematics major has three components: a Basic Course requirement, a Computing requirement, and a Mathematics Concentration.

- Basic (prerequisite) course requirement. Basic courses may count toward the requirements of more than one major, minor, or program. Units vary depending on placement testing and sequence chosen.
- Computing requirement. 1 course which uses computing as a tool, chosen from list of approved courses. Students may satisfy this with a 300-level mathematics course inside their chosen concentration, or an additional course not applied to a concentration.
- Mathematics concentration. Students choose one of two options. Both consist of upper-level courses (300-level or above).
  - General Mathematics (p. 1) (9 units). Provides a general and broadly applicable course of study.[1]
  - Pure Mathematics (p. 2) (10 units). Provides a deeply conceptual and rigorous course of study.[2]

[1] With prior approval from the Director of Undergraduate Studies (https://www.math.northwestern.edu/undergraduate/advising/), the General Mathematics concentration may include as many as 3 courses offered by other departments with substantial mathematical content or that focus on serious applications of mathematics. No such course may count simultaneously toward the requirements of another major, minor, or program.

[2] Students interested in pursuing honors in mathematics should consider the Pure Mathematics concentration.

Basic Courses

Course	Title
MATH 220-1 & MATH 220-2	Single-Variable Differential Calculus and Single-Variable Integral Calculus
or MATH 218-1 & MATH 218-2 & MATH 218-3	Single-Variable Calculus with Precalculus and Single-Variable Calculus with Precalculus and Single-Variable Calculus with Precalculus
MATH 226-0	Sequences and Series
MATH 230-1 & MATH 230-2 & MATH 240-0	Multivariable Differential Calculus and Multivariable Integral Calculus and Linear Algebra
or MATH 228-1 & MATH 228-2 & GEN_ENG 205-1	Multivariable Differential Calculus for Engineering and Multivariable Integral Calculus for Engineering and Engineering Analysis I
or ES_APPM 252-1 & ES_APPM 252-2 & GEN_ENG 206-1	Honors Calculus for Engineers and Honors Calculus for Engineers and Honor Engineering Analysis
or MATH 281-1 & MATH 281-2 & MATH 281-3	Accelerated Mathematics for ISP. First Year and Accelerated Mathematics for ISP. First Year and Accelerated Mathematics for ISP. First Year
or MATH 285-1 & MATH 285-2 & MATH 285-3	Accelerated Mathematics for MMSS: First Year and Accelerated Mathematics for MMSS: First Year and Accelerated Mathematics for MMSS: First Year
or MATH 290-1 & MATH 290-2 & MATH 290-3	MENU: Linear Algebra and Multivariable Calculus and MENU: Linear Algebra and Multivariable Calculus and MENU: Linear Algebra and Multivariable Calculus
or MATH 291-1 & MATH 291-2 & MATH 291-3	MENU: Intensive Linear Algebra and Multivariable Calculus and MENU: Intensive Linear Algebra and Multivariable Calculus and MENU: Intensive Linear Algebra and Multivariable Calculus

Courses Eligible for Computing Requirement (students choose 1)

Course	Title
MATH 310-1	Probability and Stochastic Processes
MATH 310-2	Probability and Stochastic Processes
MATH 311-2	MENU: Probability and Stochastic Processes
MATH 354-0	Chaotic Dynamical Systems
MATH 360-1	MENU: Applied Analysis
MATH 360-2	MENU: Applied Analysis
COMP_SCI 111-0	Fundamentals of Computer Programming
COMP_SCI 150-0	Fundamentals of Computer Programming 1.5
GEN_ENG 205-1	Engineering Analysis I
GEN_ENG 205-2	Engineering Analysis II
GEN_ENG 206-1	Honor Engineering Analysis
GEN_ENG 206-2	Honors Engineering Analysis

General Mathematics Concentration (9 units)

- The 9 upper-level courses must include at least 1 of these three-course sequences:

Course	Title
MATH 310-1 & MATH 310-2 & MATH 310-3	Probability and Stochastic Processes and Probability and Stochastic Processes and Probability and Stochastic Processes
MATH 311-1 & MATH 311-2 & MATH 311-3	MENU: Probability and Stochastic Processes and MENU: Probability and Stochastic Processes and MENU: Probability and Stochastic Processes
MATH 320-1 & MATH 320-2 & MATH 320-3	Real Analysis and Real Analysis and Real Analysis
MATH 321-1 & MATH 321-2 & MATH 321-3	MENU: Real Analysis and MENU: Real Analysis and MENU: Real Analysis
MATH 330-1 & MATH 330-2 & MATH 330-3	Abstract Algebra and Abstract Algebra and Abstract Algebra
MATH 331-1 & MATH 331-2 & MATH 331-3	MENU: Abstract Algebra and MENU: Abstract Algebra and MENU: Abstract Algebra

- The 9 upper-level courses must include at least 1 Real Analysis course:

Course	Title
MATH 320-1	Real Analysis
or MATH 321-1	MENU: Real Analysis

- The 9 upper-level courses must include at least 1 Algebra course:

Course	Title
MATH 330-1	Abstract Algebra
or MATH 331-1	MENU: Abstract Algebra
or MATH 334-0	Linear Algebra: Second Course

Pure Mathematics Concentration (10 units)

- The 10 upper-level courses must include 1 of the following three-course sequences in Real Analysis:

Course	Title
MATH 320-1	Real Analysis
& MATH 320-2	and Real Analysis
& MATH 320-3	and Real Analysis
or MATH 321-1	MENU: Real Analysis
& MATH 321-2	and MENU: Real Analysis
& MATH 321-3	and MENU: Real Analysis

- The 10 upper-level courses must include 1 of the following three-course sequences in Abstract Algebra:

Course	Title
MATH 330-1	Abstract Algebra
& MATH 330-2	and Abstract Algebra
& MATH 330-3	and Abstract Algebra
or MATH 331-1	MENU: Abstract Algebra
& MATH 331-2	and MENU: Abstract Algebra
& MATH 331-3	and MENU: Abstract Algebra

- The 10 upper-level courses must include 1 quarter of MATH 395-0. This requirement may be waived for students who complete a project culminating in a senior thesis of appropriate quality. Consult with the Director of Undergraduate Studies (https://www.math.northwestern.edu/undergraduate/advising/) to learn more.
- The remaining 3 upper-level mathematics course may not include MATH 399-0 or additional quarters of MATH 395-0. A 300-level mathematics course used towards the computing requirement can count towards these 3.

Honors in Mathematics

The Department of Mathematics (https://www.math.northwestern.edu) nominates outstanding mathematics majors to graduate with honors in the major. Mathematics majors interested in pursuing honors should consult with the Director of Undergraduate Studies (https://www.math.northwestern.edu/undergraduate/advising/) before the end of their junior year. To be eligible for nomination a student must:

- complete 1 of the following course sequences:

Course	Title
MATH 320-1	Real Analysis
& MATH 320-2	and Real Analysis
& MATH 320-3	and Real Analysis
or MATH 321-1	MENU: Real Analysis
& MATH 321-2	and MENU: Real Analysis
& MATH 321-3	and MENU: Real Analysis

- complete 1 of the following course sequences:

Course	Title
MATH 330-1	Abstract Algebra
& MATH 330-2	and Abstract Algebra
& MATH 330-3	and Abstract Algebra
or MATH 331-1	MENU: Abstract Algebra
& MATH 331-2	and MENU: Abstract Algebra
& MATH 331-3	and MENU: Abstract Algebra

- have a grade point average greater than or equal to 3.5 in courses which satisfy major requirements (not including Basic courses),
- complete 2 quarters of MATH 399-0 with distinction, or 2 quarters of a 400 level mathematics sequence with distinction, and
- complete a project culminating in a senior thesis of appropriate quality.

For more information contact the Director of Undergraduate Studies (https://www.math.northwestern.edu/undergraduate/advising/), and see Honors in the Major under Academic Options and Support (https://catalogs.northwestern.edu/undergraduate/arts-sciences/#academicoptionstext).

Graduate Study in Mathematics

Students intending to pursue graduate study in mathematics should consider graduating with honors in mathematics. The following courses and course sequences are essential for graduate study in mathematics:

Course	Title
MATH 321-1	MENU: Real Analysis
& MATH 321-2	and MENU: Real Analysis
& MATH 321-3	and MENU: Real Analysis
or MATH 320-1	Real Analysis
& MATH 320-2	and Real Analysis
& MATH 320-3	and Real Analysis
MATH 331-1	MENU: Abstract Algebra
& MATH 331-2	and MENU: Abstract Algebra
& MATH 331-3	and MENU: Abstract Algebra
or MATH 330-1	Abstract Algebra
& MATH 330-2	and Abstract Algebra
& MATH 330-3	and Abstract Algebra
MATH 344-1	Introduction to Topology
& MATH 344-2	and Introduction to Topology
MATH 334-0	Linear Algebra: Second Course
MATH 325-0	Complex Analysis

Well-prepared students pursuing graduate study in mathematics should also consider taking the following graduate course sequences:

Course	Title
MATH 410-1	Analysis
& MATH 410-2	and Analysis
& MATH 410-3	and Introduction to Modern Analysis
MATH 470-1	Algebra
& MATH 470-2	and Algebra
& MATH 470-3	and Algebra

Secondary Teaching Licensure in Mathematics

To obtain an Illinois Professional Educator license in mathematics, a Weinberg student majoring in mathematics must apply to the Secondary Teaching (https://catalogs.northwestern.edu/undergraduate/education-social-policy/secondary-teaching/) program in the School of Education and Social Policy (SESP) (https://catalogs.northwestern.edu/undergraduate/education-social-policy/) by the fall of the junior year

and complete the requirements of that program as well as the degree requirements of Weinberg College.