MATHEMATICS (BA)

Department Website (http://math.nyu.edu)

NYSED: 08307 **HEGIS:** 1701.00 **CIP:** 27.0101

Program Description

The undergraduate division of the Department of Mathematics offers a wide variety of courses in both pure and applied mathematics. Faculty are members of the Courant Institute of Mathematical Sciences, which has become a leading research center through its tradition of integrating mathematical theory and applications.

In addition to the Mathematics major, joint programs are available in Mathematics and (1) Computer Science, (2) Data Science, (3) Economics, and (4) Engineering. These majors lead to the BA degree in four years, with the exception of the Engineering option, which leads to the BS degree from the College of Arts and Science and the BS degree from the NYU Tandon School of Engineering in five years. An accelerated, five-year BA and MS Mathematics program is offered with the Graduate School of Arts and Science, as well as an MA in Mathematics Education program with Steinhardt. Independent study courses are available for students with special interests.

Mathematics majors are encouraged to spend a semester studying away. Currently, mathematics courses are offered at NYU Abu Dhabi, NYU London, NYU Paris, and NYU Shanghai.

Honors Program in Mathematics

The honors program is designed for students with a strong commitment to mathematics and is recommended for those who intend to pursue graduate study in this field. The requirements for admission into the honors program are:

1. a GPA of 3.65 or higher in the major (including joint honors requirements);
2. an overall GPA of 3.65 or higher; and
3. approval of the director of the honors program. Interested students must consult with the faculty honors adviser.

Like the regular major, the honors major consists of 13 4-credit courses (52 credits). However, students in the honors program must fulfill the requirements of the regular program together with the following additional requirements.

Honors Elective Requirement

Of the 13 required courses for the Math honors major, four (4) courses must be honors electives. They are listed below.

- Graduate level MATH-GA courses do not count nor substitute the honors elective requirement.
- Honors Calculus III and Honors Linear Algebra do not count towards the honors elective requirement.

Course	Title	Credits
MATH-UA 268	Honors Ordinary Differential Equations	4
MATH-UA 328	Honors Analysis I	4
MATH-UA 329	Honors Analysis II	4
MATH-UA 338	Honors Theory of Probability	4
MATH-UA 348	Honors Algebra I	4
MATH-UA 349	Honors Algebra II	4
MATH-UA 358	Honors Numerical Analysis	4
MATH-UA 393	Honors I	4
MATH-UA 394	Senior Honors II	4
MATH-UA 397	Honors III	4
MATH-UA 398	Honors IV	4

Where applicable, the same course counts toward both the advanced electives requirement of the regular major and the honors electives. Students who have taken MATH-UA 325 Analysis or MATH-UA 343 Algebra may not take the corresponding MATH-UA 328 Honors Analysis I or MATH-UA 348 Honors Algebra I to fulfill this requirement.

Honors Research Project Requirement

Students may satisfy the honors research project requirement via two routes:

1. Participating in the mathematics Summer Undergraduate Research Experience (https://math.nyu.edu/dynamic/undergrad/ba-cas/activities-research/summer-undergraduate-research-experience/) (SURE) program under faculty supervision. Students who participate in this program are expected to dedicate 30+ hours of research per week over a 10-12 week period during the summer break. Upon concluding their research, students are required to submit an abstract and present their research at Courant's undergraduate research forum in the fall semester of their senior year. This is a competitive program with only a select number of spots. Students who are selected to participate will receive financial support for the summer.
   - Honors students interested in the SURE route must apply at the beginning of the spring semester of their junior year.
2. Alternatively, students must complete two (2) semesters of research independent study (MATH-UA 0997, 0998 (https://math.nyu.edu/dynamic/undergrad/ba-cas/independent-study/)) under faculty supervision. Students are expected to dedicate 10-20 hours per week toward their research. Students must receive approval of their honors project from the honors faculty adviser, Professor Chao Li. At the conclusion of the second research independent study, students are required to submit a 15-20 page final report, with the approval of their faculty mentor, and are encouraged to present their research at the Dean's Undergraduate Research Conference (DURC) in the spring semester of their senior year.
   - All Math honors majors who are not selected for SURE must satisfy the research project requirement via the independent study route.

Admissions

New York University's Office of Undergraduate Admissions supports the application process for all undergraduate programs at NYU. For additional information about undergraduate admissions, including application requirements, see How to Apply (https://www.nyu.edu/admissions/undergraduate-admissions/how-to-apply.html).

Program Requirements

The major in Mathematics requires thirteen 4-credit courses (52 credits) numbered at or above MATH-UA 120 and completed with a grade of C or better (courses graded Pass/Fail do not count) as outlined below.

Course	Title	Credits
General Education Requirements		
First-Year Seminar		4
EXPOS-UA 1	Writing as Inquiry	4
Foreign Language [1]		16
Physical Science		4
Life Science		4
Texts and Ideas		4
Cultures and Contexts		4
Societies and the Social Sciences		4
Expressive Culture		4
Major Requirements		
Foundational Requirements [2]		
MATH-UA 120	Discrete Mathematics	4
MATH-UA 121	Calculus I	4
MATH-UA 122	Calculus II	4
MATH-UA 123	Calculus III	4
or MATH-UA 129	Honors Calculus III	
MATH-UA 140	Linear Algebra	4
or MATH-UA 148	Honors Linear Algebra	
MATH-UA 325	Analysis [3]	4
or MATH-UA 328	Honors Analysis I	
MATH-UA 343	Algebra	4
or MATH-UA 348	Honors Algebra I	
Advanced Electives Requirement		
Three (3) advanced mathematics electives from the following list:		12
MATH-UA 240	Combinatorics	
MATH-UA 248	Theory of Numbers	
MATH-UA 262	Ordinary Diff Equations	
or MATH-UA 268	Honors Ordinary Differential Equations	
MATH-UA 263	Partial Diff Equations	
MATH-UA 264	Chaos & Dynamical Systems	
MATH-UA 329	Honors Analysis II	
MATH-UA 333	Theory of Probability	
or MATH-UA 338	Honors Theory of Probability	
MATH-UA 334	Mathematical Statistics	
MATH-UA 349	Honors Algebra II	
MATH-UA 352	Numerical Analysis	
or MATH-UA 358	Honors Numerical Analysis	
MATH-UA 353	Linear and Nonlinear Optimization	
MATH-UA 375	Topology	
MATH-UA 377	Differential Geometry	
MATH-UA 382	Functions of a Complex Variable	
MATH-UA 393	Honors I	
MATH-UA 394	Senior Honors II	
MATH-UA 397	Honors III	
MATH-UA 398	Honors IV	
General Mathematics Electives		
Three (3) general Mathematics electives numbered MATH-UA 120 or higher [4]		12
Electives		
Other Elective Credits		28
Total Credits		**128**

1 The foreign language requirement is satisfied upon successful completion through the Intermediate level of a language. This may be accomplished in fewer than 16 credits, but those credits must then be completed as elective credit.

2 The Mathematics for Economics I, II, III (MATH-UA 131, 132, 133) sequence does not count toward the major in Mathematics as substitutions for the Calculus I, II, III sequence (MATH-UA 121, 122, 123). Limited exceptions may be made for students who have already taken Mathematics for Economics for their declared or intended second or joint major in economics; they must seek the approval of the Department of Mathematics for this substitution. (All other students must follow the regular calculus sequence.) Note that students are not permitted to combine or double-count between the Calculus and Mathematics for Economics sequences or register simultaneously for separate courses within the two sequences.

3 While not required, it is advised that student take Analysis as soon as possible after completing Calculus III and Linear Algebra. Additionally, it is advised that students take Analysis before Algebra.

4
- Any two computer science courses (numbered CSCI-UA 101 or higher, except CSCI-UA 380), DS-UA 112, or graduate data science (DS-GA) courses may be credited toward the general mathematics elective requirement only. However, no more than two non-mathematics classes may ever be used to fulfill the overall major requirements.
- Students may petition to enroll in graduate mathematics (MATH-GA) courses and apply them to the general mathematics elective requirement section of their major in Mathematics.
- Only students following the prehealth track (which itself is not a major) may replace no more than two MATH-UA classes with any two of the following: PHYS-UA 11 and 12 General Physics I and II or PHYS-UA 91 and 93 Physics I and II. However, if these physics courses are used towards the Mathematics major, then computer science and data science courses cannot also apply toward the major.

Sample Plan of Study

Course	Title	Credits
1st Semester/Term		
MATH-UA 121	Calculus I	4
MATH-UA 120	Discrete Mathematics	4
Cultures and Contexts		4
First-Year Seminar		4
	Credits	**16**
2nd Semester/Term		
MATH-UA 122	Calculus II	4
MATH-UA 140 or MATH-UA 148	Linear Algebra or Honors Linear Algebra	4
Cultures and Contexts		4
EXPOS-UA 1	Writing as Inquiry	4
	Credits	**16**

3rd Semester/Term		
MATH-UA 123 or MATH-UA 129	Calculus III or Honors Calculus III	4
Expressive Culture		4
Physical Science		4
Foreign Language I		4
	Credits	**16**
4th Semester/Term		
MATH-UA 325 or MATH-UA 328	Analysis or Honors Analysis I	4
Societies and the Social Sciences		4
Life Science		4
Foreign Language II		4
	Credits	**16**
5th Semester/Term		
MATH-UA 343 or MATH-UA 348	Algebra or Honors Algebra I	4
General Math Elective (1 of 3)		4
Foreign Language III		4
Other Elective Credits		4
	Credits	**16**
6th Semester/Term		
General Math Elective (2 of 3)		4
Advanced Math Elective (1 of 3)		4
Foreign Language IV		4
Other Elective Credits		4
	Credits	**16**
7th Semester/Term		
Advanced Math Elective (2 of 3)		4
Advanced Math Elective (3 of 3)		4
Other Elective Credits		4
Other Elective Credits		4
	Credits	**16**
8th Semester/Term		
General Math Elective (3 of 3)		4
Other Elective Credits		4
Other Elective Credits		4
Other Elective Credits		4
	Credits	**16**
	Total Credits	**128**

Learning Outcomes

Upon completion of program requirements, students are expected to have acquired:

1. Proficiency in the foundations of modern mathematics, including discrete mathematics, calculus, analysis, and algebra.
2. The ability to communicate mathematically, including understanding, developing, and critiquing mathematical arguments and rigorous proofs.
3. The ability to apply mathematical ideas and methods to questions and problems both within and outside of the mathematical sciences.
4. Advanced knowledge in some specific areas of mathematics, such as differential equations, geometry and topology, complex analysis, probability and statistics, number theory, or numerical analysis.
5. Experience in using appropriate technology to calculate, visualize, and model problems.

Policies

Program Policies

Policies Applying to the Major in Mathematics

1. The Mathematics for Economics I, II, III (MATH-UA 131, 132, 133) sequence does not count toward the major in Mathematics as substitutions for the Calculus I, II, III sequence (MATH-UA 121, 122, 123). Limited exceptions may be made for students who have already taken Mathematics for Economics for their declared or intended second or joint major in Economics; they must seek the approval of the Department of Mathematics for this substitution. (All other students must follow the regular calculus sequence.) Note that students are not permitted to combine or double-count between the Calculus and Mathematics for Economics sequences or register simultaneously for separate courses within the two sequences.
2. Any two computer science courses (numbered CSCI-UA 101 or higher, except CSCI-UA 380), DS-UA 112, or graduate data science (DS-GA) courses may be credited toward the general mathematics elective requirement only. However, no more than two courses outside of MATH-UA may fulfill major requirements.
   - This specific policy is only applicable to the major in Mathematics. It does not apply to any other major or minor offered by the Department of Mathematics (including joint majors).
3. Only students following the prehealth track (which itself is not a major) may replace no more than two MATH-UA classes with any two of the following: PHYS-UA 11 and 12 General Physics I and II or PHYS-UA 91 and 93 Physics I and II. However, if these physics courses are used towards the Mathematics major, then computer science and data science courses cannot also apply toward the major.
4. Students cannot take both honors and non-honors versions of the same course.
5. Students may double-count no more than two courses with another major or a minor.
6. Courses graded Pass/Fail cannot count toward major requirements.
7. A grade of C or better is required in all courses used to fulfill major requirements.
8. Transfer students must complete at least half of the major (seven of 13 courses) in residence at CAS with MATH-UA courses.
9. Students may petition to enroll in graduate mathematics (MATH-GA) courses. If approved, students may only apply graduate mathematics courses toward the general mathematics elective requirement of this major; graduate mathematics courses cannot count toward the advanced mathematics elective requirement.
   - Note well: students must first earn a grade of A in MATH-UA 325 Analysis before they can petition to enroll in graduate mathematics courses. Please see the undergraduate section of the department's website for more information and to request permission to enroll in a graduate course.

Required Coursework in CAS (-UA) for all Majors and Minors in Courant

At least half of the courses applied to the Courant requirements of the CAS majors and minors in Computer Science and in Mathematics (including joint programs) must be CSCI-UA and MATH-UA courses taken in New York or at NYU study away sites. This is a built-in limit on how many courses students may take in these subjects that are (for example) sponsored by NYU Abu Dhabi and NYU Shanghai under CS-UH, MATH-UH, CENG-SHU, CSCI-SHU, and MATH-SHU. Internal and external transfers must pay close attention to this policy, but it also applies to students who

matriculate as first-years. The usual CAS policies on -UA residency for the baccalaureate degree still apply.

Placement into Calculus and other Foundational Courses

To register for:

- MATH-UA 120 Discrete Mathematics
- MATH-UA 121 Calculus I
- MATH-UA 126 Introduction to Statistics & Data Analysis
- MATH-UA 131 Mathematics for Economics I
- and/or MATH-UA 140 Linear Algebra

Students must consult the website (https://math.nyu.edu/dynamic/undergrad/ba-cas/calculus-information/) of the Department of Mathematics for full details on prerequisites and placement.

Advanced Placement with Credit

1. Students with eligible AP transfer credit should first consult with their home school advising center to determine how much AP credit they are eligible to transfer in. This varies across schools at NYU.
2. A student who earns a 4 or 5 on the Calculus AB exam (or AB subscore) or a 4 on the Calculus BC exam is eligible to receive 4 credits equivalent to Calculus I (MATH-UA 121) and will be placed into Calculus II (MATH-UA 122).
3. A student who earns a score of 5 on the Calculus BC exam is eligible to receive 8 credits, equivalent to both Calculus I (MATH-UA 121) and Calculus II (MATH-UA 122), and is eligible to register for Calculus III (MATH-UA 123); students with advanced math experience are encouraged to register for Honors Calculus III (MATH-UA 129).
4. For calculus equivalencies and placement for advanced standing credit in mathematics from International Baccalaureate (HL only), A Level, and other approved international examinations, please consult the home school advising center or the admission section of this Bulletin.
5. Note that AP and other advanced standing credit by exam cannot be used to place into, or ahead in, the Mathematics for Economics I, II, III sequence (MATH-UA 131, 132, 133). These exam credits are not equivalent to any course in this sequence.

Placement Exams in Mathematics

Placement exams in mathematics (https://math.nyu.edu/dynamic/undergrad/ba-cas/placement-exams/) are offered regularly for students to take in order to:

- place into MATH-UA 121 Calculus I OR MATH-UA 131 Mathematics for Economics I
- place into MATH-UA 122 Calculus II
- place into MATH-UA 123 Calculus III
- place out of MATH-UA 123 Calculus III
- place into MATH-UA 132 Mathematics for Economics II
- place into MATH-UA 133 Mathematics for Economics III
- place out of MATH-UA 133 Mathematics for Economics III

If a student passes any of these placement exams, they are placed into the next course of the sequence. However, no course credit is ever awarded for any placement exam in the Department of Mathematics. Additionally, if a student places out of a MATH-UA course that is required for one's major and/or minor, then one must take an additional MATH-UA elective to make up for the missing credits.

NYU Policies

University-wide policies can be found on the New York University Policy pages (https://bulletins.nyu.edu/nyu/policies/).

College of Arts and Science Policies

A full list of relevant academic policies can be found on the CAS Academic Policies page (https://bulletins.nyu.edu/undergraduate/arts-science/academic-policies/).