

# Mathematical Sciences Major

## Program Requirements

- **Total units required:** 36

### Required Courses

- The three-course calculus sequence (9 units)\* and an introductory computer science course (3 units)\*\*:

| Code               | Title                            | Units     |
|--------------------|----------------------------------|-----------|
| Math 131           | Calculus I                       | 3         |
| Math 132           | Calculus II                      | 3         |
| Math 233           | Calculus III                     | 3         |
| CSE 131            | Introduction to Computer Science | 3         |
| <b>Total Units</b> |                                  | <b>12</b> |

\* AP credit can be applied, and students who have completed Math 203 Honors Mathematics I and Math 204 Honors Mathematics II will have this requirement waived.

\*\* This course may be waived after consultation with the director of undergraduate studies of the Department of Computer Science & Engineering.

- The following required upper-level courses (9 units):\*

| Code                     | Title   | Units |
|--------------------------|---|-------|
| Math 309                 | Matrix Algebra  | 3     |
| Math 310<br>or Math 310W | Foundations for Higher Mathematics<br>Foundations For Higher Mathematics With Writing | 3     |
| SDS 3200                 | Elementary to Intermediate Statistics and Data Analysis                               | 3     |

\* Students who take Math 203 and Math 204 can choose to take additional electives in place of Math 309 and Math 310/Math 310W.

- One of the following full-year 400-level sequences (6 units):\*

| Code                     | Title  | Units |
|--------------------------|--|-------|
| Math 4111<br>& Math 4121 | Introduction to Analysis<br>and Introduction to Lebesgue Integration | 6     |
| Math 4171<br>& Math 4181 | Topology I<br>and Topology II  | 6     |
| Math 429<br>& Math 430   | Linear Algebra<br>and Modern Algebra                                 | 6     |
| Math 449<br>& Math 450   | Numerical Applied Mathematics<br>and Topics in Applied Mathematics   | 6     |

\* Students whose primary major is secondary education may fulfill this requirement by taking Math 331 Algebraic Systems and Math 407 An Introduction to Differential Geometry (or another geometry course by departmental approval).

- At least one course from the following list that has not already been used to fulfill any of the previous requirements listed (3 units):

| Code      | Title  | Units |
|-----------|--|-------|
| Math 370  | Introduction to Combinatorics                | 3     |
| Math 371  | Graph Theory                                 | 3     |
| Math 410  | Introduction to Fourier Series and Integrals | 3     |
| Math 4111 | Introduction to Analysis                     | 3     |
| Math 415  | Partial Differential Equations               | 3     |
| Math 416  | Complex Variables                            | 3     |
| Math 4171 | Topology I                                   | 3     |
| Math 429  | Linear Algebra                               | 3     |
| Math 4351 | Number Theory and Cryptography               | 3     |
| Math 449  | Numerical Applied Mathematics                | 3     |

- Two additional upper-level electives in Mathematics or Statistics and Data Science that have not been used to fulfill any other requirement (6 units).
  - Upper-level courses have course numbers that begin with a "3" or higher. Lower-level courses do not count toward upper-level mathematics requirements, even if they are cross-listed as an upper-level course in another department or program.
- All required courses (both lower- and upper-level) must be taken for a letter grade and completed with a grade of C- or better.

## Additional Information

### Course Substitutions

At most one approved substitution can be made using a course not home-based in the Department of Mathematics.

Any course from another department that is cross-listed as a mathematics L24 course can count as an upper-level elective. Examples include Math 493C Probability, Math 495C Stochastic Processes, Math 501C Theoretical Physics, Math 502C Methods of Theoretical Physics II, and Math 523C Information Theory. Such L24 courses always end with a "C."

In general the following courses can count as upper-level mathematics electives, but specifics may vary for the various majors in the department:

- Phil 403 Mathematical Logic I and Phil 404 Mathematical Logic II
- ESE 319 Engineering Mathematics B and ESE 403 Operations Research

## Additional Requirements

1. A student cannot declare more than one major or minor in the department. This restriction includes dual majors, such as Mathematics and Economics and Mathematics and Computer Science. These majors are considered "in the department" even if they are declared in another department.
2. No **upper-level** course used to satisfy a major requirement can be counted toward the requirements of any other major or minor (i.e., no double-counting of courses).
3. At most 3 units of independent study or research work can count toward the major requirements.
4. Students may count courses from the Department of Statistics and Data Science (SDS) as Mathematics courses if at least one of the following conditions holds:
  - a. The course is cross-listed in the Department of Mathematics (e.g., Math 493C and Math 495C are cross-listed versions of SDS 493 and SDS 495).
  - b. The student matriculated in 2023-2024 or earlier, and the course was previously offered by the Department of Mathematics and Statistics, as reflected by the student's matriculation-year Bulletin.
5. At most one of the following courses can be used to fulfill major requirements: Math 308 Mathematics for the Physical Sciences or Math 318 Introduction to Calculus of Several Variables.
6. Courses transferred from other accredited colleges and universities can be counted, with the following caveats, if they receive department approval:
  - a. Courses transferred from a two-year college (e.g., a community college) cannot be used to satisfy upper-level requirements.
  - b. At least half of the upper-level units required in a major must be earned at Washington University or in a Washington University-approved overseas study program.
  - c. Courses from the School of Continuing & Professional Studies cannot be used to fulfill major requirements.

## Latin Honors

At the time of graduation, the Department of Mathematics will recommend that a candidate receive Latin Honors (cum laude, magna cum laude, or summa cum laude) if that student has completed the department's requirements for High Distinction or Highest Distinction in Mathematics, including an Honors Thesis. The actual award of Latin Honors is managed by the College of Arts & Sciences.

## The Honors Thesis

Arts & Sciences mathematics majors who want to be candidates for Latin Honors, High Distinction, or Highest Distinction must complete an honors thesis. Writing an honors thesis involves a considerable amount of independent work, reading, creating mathematics, writing a paper that meets acceptable professional standards, and making an oral presentation of the results.

## Types of Projects

An honors thesis can take two forms:

1. A thesis that presents significant work by the student on one or more nontrivial mathematics problems.
2. A substantial expository paper that follows independent study on an advanced topic under the guidance of a department faculty member. Such a report would involve the careful presentation of ideas and the synthesis of materials from several sources.

## Process and Suggested Timeline

### Junior Year, Spring Semester:

1. Talk with a faculty advisor about possible projects.
2. Complete the Honors Proposal Form and submit it to Blake Thornton.

### Senior Year:

1. By the end of January, provide the advisor with a draft abstract and outline of the paper.
2. By the end of February, submit a rough draft, including an abstract, to the advisor.
3. The student and the advisor should agree on a date that the writing will be complete and on a date and time for the oral presentation in mid-March (the deadline is March 31).

## Departmental Prizes

Each year, the department considers graduating majors for three departmental prizes and also awards a prize to juniors. Recipients are recognized at an annual awards ceremony in April where graduating majors each receive a certificate and a set of honors cords to be worn as part of the academic dress at Commencement. Awards are noted on the student's permanent university record.

### Ross Middlemiss Prize

The Ross Middlemiss Prize is awarded to a graduating math major with an outstanding record. The award was established by former Professor Ross Middlemiss, who taught at Washington University for 40 years. Middlemiss authored several books, including a widely popular calculus text that was used in courses offered by the School of Continuing & Professional Studies until the late 1970s.

### Putnam Exam Prize

The Putnam Exam Prize is awarded to a graduating senior who has participated regularly in the Putnam Exam Competition and done exceptionally well throughout their time at Washington University.

## Martin Silverstein Award

The Martin Silverstein Award was established in memory of Professor Martin Silverstein, who, until his death in 2004, was a pioneer in work at the interface of probability theory and harmonic analysis. Graduating students completing any major we offer will be considered for this award, but preference is given to those who have done excellent work in applied mathematics or analysis.

## Brian Blank Award

The Brian Blank Award was established in memory of Professor Brian Blank, who passed away in 2018. Each year, the Department of Mathematics selects distinguished juniors majoring in mathematics for this prize.

## Distinctions in Mathematical Sciences

### Distinction

- Complete at least 33 units of upper-level mathematics courses.
- The GPA for these 33 upper-level units must be at least 3.7. If more than 33 units are taken for a letter grade, the courses with the lowest grades can be omitted when computing the GPA for this purpose.
- Complete at least five courses, each with a B or better, at level 400+.
- All of these courses must be classroom courses (not independent study or study for honors), and they must all be taken for a letter grade.

### High Distinction

- Complete all requirements for Distinction.
- Complete an honors thesis.

### Highest Distinction

- Complete all requirements for High Distinction.
- Complete at least five courses, each with a grade of B+ or better, at the 400 level or higher. These courses can be the same five courses used for the Distinction requirement, but the grades must be B+ or better.
- Complete one of the two paths described below:
  - **Graduate Qualifier Path:** Graduate qualifier courses\* in mathematics are two-semester sequences that start in the fall. In mathematics, a two-semester graduate qualifier sequence has a qualifier exam at the end of each semester. Students must complete and pass two semesters of qualifier courses\* and their corresponding exams in mathematics. (These courses can involve a single year-long sequence or be the first semesters of two different sequences.)
  - **Course Work Path:**
    - Complete at least 42 units of upper-level mathematics courses. The GPA for these 42 upper-level units must be at least 3.7. If more than 42 units are taken for a letter grade, the courses with the lowest grades can be omitted when computing the GPA for this purpose.

- Complete at least nine total courses at the 400 level or above, all with a B+ or better. These courses can include the five courses taken for distinction. All of these courses must be classroom courses (not independent study or study for honors), and they must all be taken for a letter grade.

\* These qualifier courses can count toward the additional course requirements for Distinction.

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