Mathematics and Statistics

Web Site: http://www.odu.edu/math

Hideaki Kaneko, Chair
D. Glenn Lasseigne, Chief Departmental Advisor

Bachelor of Science—Mathematics Major

The Department of Mathematics and Statistics offers a program of study consisting of four optional concentrations, each of which leads to the degree of Bachelor of Science with a major in mathematics. In order to graduate from the program all students must complete the requirements of at least one of these concentrations. The optional concentrations enable students to emphasize studies in Applied Mathematics, Statistics/Biostatistics, Actuarial Mathematics or Mathematics for Secondary School Teachers. The concentration for secondary school teachers is intended for those who wish to pursue a career in teaching mathematics at the high school level and leads to teaching licensure in the Commonwealth of Virginia. The applied mathematics and statistics/biostatistics concentrations are intended for those who wish to pursue graduate work in the mathematical or statistical sciences, or otherwise obtain employment in a mathematics or statistics-related field. The actuarial mathematics concentration is specifically designed for students who wish to pursue an actuarial field, graduate work in financial mathematics, or employment in a mathematics or statistics-related field.

Students in these concentrations may also obtain teacher licensure by fulfilling the requirements of the Darden College of Education outlined under the teaching concentration. The requirements of each basic area along with the professional education courses needed for teacher licensure in the Commonwealth of Virginia are listed below.

Requirements

Lower Division General Education

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Composition</strong></td>
<td>6</td>
</tr>
<tr>
<td>Oral Communication</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>Language and Culture</td>
<td>0-6</td>
</tr>
<tr>
<td>Information Literacy and Research</td>
<td>3</td>
</tr>
<tr>
<td>CS 121G</td>
<td>3</td>
</tr>
<tr>
<td>Human Creativity</td>
<td>3</td>
</tr>
<tr>
<td>Interpreting the Past</td>
<td>3</td>
</tr>
<tr>
<td>Literature</td>
<td>3</td>
</tr>
<tr>
<td>Human Behavior</td>
<td>3</td>
</tr>
<tr>
<td>Philosophy and Ethics (PHIL 120P recommended)</td>
<td>3</td>
</tr>
<tr>
<td>The Nature of Science</td>
<td>8</td>
</tr>
<tr>
<td>Impact of Technology</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Hours: 38-44

* A grade of C or better is required in both courses.

** IT 150G is an acceptable substitute for the Actuarial Mathematics concentration.

*** ECON 202S required for Actuarial Mathematics concentration.

+ The eight credit hours of Nature of Science with labs need not be in the same science. However, PHYS 231N-PHYS 232N are recommended for the applied mathematics option; and BIOL 110N/BIOL 111N; BIOL 112N/BIOL 113N; BIOL 117N/BIOL 118N or BIOL 121N/BIOL 122N-BIOL 123N/BIOL 124N are recommended for the statistics/biostatistics option.

Other Required courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 150 Problem Solving and Programming I</td>
<td>4</td>
</tr>
</tbody>
</table>

Mathematics Core Course Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 211 Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 212 Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 307 Ordinary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 311W Abstract Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 312 Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 316 Introductory Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 317 Calculus IV: Introductory Analysis</td>
<td>3</td>
</tr>
<tr>
<td>STAT 310 Introductory Data Analysis **</td>
<td>3</td>
</tr>
<tr>
<td>or STAT 431 Theory of Statistics</td>
<td>3</td>
</tr>
<tr>
<td>STAT 330 An Introduction to Probability and Statistics ***</td>
<td>3</td>
</tr>
<tr>
<td>or STAT 331 Theory of Probability</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Hours: 34

* A grade of C+ or higher is required in these courses. In addition, a grade of C or higher is required in mathematics and statistics prerequisite courses to advance to the next course.

** Statistics/Biostatistics concentration and the Actuarial Mathematics concentration take both.

*** Statistics/Biostatistics concentration and the Actuarial Mathematics concentration take STAT 331.

All students are required to choose one of the following concentrations:

Applied Mathematics

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 401 Partial Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 408 Applied Numerical Methods I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 422 Applied Complex Variables</td>
<td>3</td>
</tr>
<tr>
<td>MATH 400-level electives:</td>
<td>9</td>
</tr>
<tr>
<td>No more than One of the following may be selected:</td>
<td></td>
</tr>
<tr>
<td>MATH 400 History of Mathematics</td>
<td></td>
</tr>
<tr>
<td>MATH 404 Fundamental Concepts of Geometry</td>
<td></td>
</tr>
<tr>
<td>MATH 406 Number Theory and Discrete Mathematics</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours: 18

Statistics/Biostatistics

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 310 Introductory Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>or STAT 431 Theory of Statistics</td>
<td>3</td>
</tr>
<tr>
<td>STAT 405 Introduction to Data Handling</td>
<td>3</td>
</tr>
<tr>
<td>STAT 400-level electives</td>
<td>12</td>
</tr>
</tbody>
</table>

Total Hours: 18

Actuarial Mathematics

The upper-division general education requirement must be satisfied by completing a Finance major with Risk Management and Insurance concentration (Option A) or by completing a Finance minor in Risk Management and Insurance (Option B).

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 310 Introductory Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>or STAT 431 Theory of Statistics</td>
<td>3</td>
</tr>
<tr>
<td>STAT 405 Introduction to Data Handling</td>
<td>3</td>
</tr>
<tr>
<td>STAT 437 Applied Regression and Time Series Analysis</td>
<td>3</td>
</tr>
<tr>
<td>MATH 408 Applied Numerical Methods I</td>
<td>3</td>
</tr>
<tr>
<td>Two courses from the following list with at least one being a STAT course</td>
<td>6</td>
</tr>
</tbody>
</table>

Old Dominion University
Mathematics and Statistics

Mathematics for Secondary School Teachers
This concentration is for students seeking teaching licensure (see below for additional information).

Elective Credit
Elective credit may be needed to meet the minimum requirement of 120 credit hours for all concentrations.

Math Teaching Licensure
Due to changing University requirements, national accreditation standards, and the Virginia Board of Education licensure regulations, the teacher preparation programs in the College of Sciences are under constant revision. Any changes resulting from these factors supersede the program requirements described in this Catalog. Students are encouraged to obtain current program information from their advisors and the Teacher Education Services website at www.odu.edu/tes.

Admission
Students must first declare the mathematics teacher preparation concentration as their major with the mathematics departmental advisor. All students must apply for and be admitted into the approved mathematics teacher preparation program. Students must meet the required criteria for admission by passing the Virginia Board of Education prescribed assessments and earn the minimum required grade point averages (GPA).

Virginia Board of Education prescribed assessments:
Old Dominion University students seeking admission to an approved teacher education program must satisfy the Virginia Board of Education Required Assessment for Admission to an Approved Teacher Education Program. This requirement can be satisfied by meeting a passing score in one of the selected criteria below:

1. Passing PRAXIS I composite score of 532 by December 31, 2013; or
2. Passing PRAXIS Core Academic Skills Tests beginning January 1, 2014:
   - Reading Score of 156, Writing Score of 162, and Mathematics Score of 150; or
3. Approved substitute test scores:
   a. SAT score of 1000 with at least 450 verbal and 510 mathematics taken prior to April 1, 1995; or
   b. SAT score of 1100 with at least 530 verbal and 530 mathematics taken after April 1, 1995; or
   c. ACT composite score of 21 with ACT mathematics score of at least 21, and ACT English plus Reading score of at least 37, taken prior to April 1, 1995; or
   d. ACT composite score of 24 with ACT mathematics score of at least 22, and ACT English plus Reading score of at least 46, taken after April 1, 1995; or
   e. PRAXIS I Math test score of 178 by December 31, 2013 and a composite Virginia Communication and Literacy Assessment (hereafter referred to as the VCLA) score of 470; or
   f. PRAXIS Core Academic Skills Mathematics test score of 150 beginning January 1, 2014 and a VCLA score of 470; or
   g. SAT Mathematics test score of at least 510 taken prior to April 1, 1995 and a VCLA score of 470; or
   h. SAT Mathematics test score of at least 530 taken after April 1, 1995 and a composite VCLA score of 470; or
   i. ACT Mathematics test score of at least 21 taken prior to April 1, 1995 and a composite VCLA score of 470; or
   j. ACT Mathematics test score of at least 22 taken after April 1, 1995 and a composite VCLA score of 470.

For the most current information on the prescribed Virginia Board of Education admission assessment, visit the Teacher Education Services website, http://www.odu.edu/tes and review the Teacher Education Handbook.

Required grade point averages (GPA)
- A cumulative GPA of 2.75 is required.
- A major/content GPA of 2.75 is required. No grade lower than C+ is accepted for the core math courses. No grade lower than C- is accepted for the remaining math courses.
- A professional education GPA of 2.75 is required. All professional education courses must be passed with a grade of C- or higher.

Although students may enroll in a limited number of education courses, students must be admitted into the approved mathematics teacher preparation program prior to enrolling in any instructional strategies practicum education course. Students must also meet with an education advisor in the Office of Teacher Education Services.

Continuance
Students must maintain a cumulative GPA of 2.75, a major/content GPA of 2.75 and a professional education GPA of 2.75. Mathematics core courses must be passed with a grade of C+ or higher. The remaining courses required for the major and in the professional education core must be completed with a grade of C- or higher for continuance. A professional education GPA of 2.75 is required for continuance. Students must take and pass the Virginia Communication and Literacy Assessment (VCLA) and the PRAXIS II Math Content examination prior to or while enrolled in the instructional strategies course. All assessments must be passed prior to the start of the Teacher Candidate Internship Orientation session.

Background Clearance Requirement
Old Dominion University requires a background clearance check of candidates interested in many of the professional education programs. Professional education programs have several field experiences that are required for continuance and graduation from the program. The background clearance must be successfully completed prior to a field experience placement. Candidates will be provided a field experience placement when the background check process is completed with resolution of any issues. The process to complete the ODU clearance background check is located at: http://www.odu.edu/success/academic/teacher-education/placement/background-checks. The ODU clearance process includes: an FBI fingerprint, a child protective service/social service review, and a Virginia State Police sex offender registry review. Candidates interested in the professional education programs are advised to complete this clearance process immediately upon entry into the program since the clearance process takes a minimum of eight weeks to complete.

Virginia Board of Education prescribed assessments
Virginia Communication and Literacy Assessment (VCLA) – a passing composite score of 470 is required on this reading and writing assessment
PRAXIS II Mathematics: Content Knowledge (test code: 5161) – passing score of 160 is required

To review more information on the Virginia Board of Education prescribed assessments visit the Teacher Education Services website, www.odu.edu/tes.

Graduation
Requirements for graduation include completion of ENGL 110C and ENGL 211C or 221C or 231C with a grade of C or better, completion of the Senior
Assessment, a minimum cumulative 2.75 GPA, in the major area, and in the professional education core, with no grade less than C+ in the math core courses and no grade less than C- in the remaining courses in the major and the professional education core, successful completion of the Apprentice Teaching, and a minimum of 120 credit hours to include a minimum of 30 credit hours overall and 12 credit hours in upper-level courses in the major program from Old Dominion University.

Course Requirements for the Mathematics for Secondary School Teachers Concentration

MATH 375 Advanced Concepts for Secondary Educators: Function and Modeling 3
MATH 400 History of Mathematics 3
MATH 404 Fundamental Concepts of Geometry 3
MATH 406 Number Theory and Discrete Mathematics 3
MATH 417 Intermediate Real Analysis I 3
or MATH 422 Applied Complex Variables 6
MATH 400-level electives 21

Professional Education core courses and requirements

STEM 101 Step 1 – Inquiry Approaches to Teaching 1
STEM 102 Step 2 - Inquiry Based STEM Lesson Design 1
STEM 201 Knowing and Learning in STEM Education 3
STEM 202 Classroom Interactions in STEM Education 3
STEM 401 Project Based Instruction in STEM Education 3
STEM 402 Perspectives on STEM 3
STEM 485 Apprentice Teaching 9
SCI 488 Research Methods in Math and Sciences 3

Total Hours 26

Upper Division General Education

The professional education core satisfies this requirement for students in the Mathematics for Secondary School Teachers concentration. Students in the Actuarial Mathematics concentration must complete a major or a minor in Finance with a concentration in Risk Management and Insurance to meet upper-division general education requirements.

• Option A. Approved Disciplinary Minor (a minimum of 12 hours determined by the department), or second degree or second major.
• Option B: Interdisciplinary Minor (specifically 12 hours, 3 of which may be in the major)
• Option C. International Business and Regional Courses or an approved Certification Program such as teaching licensure
• Option D. Two Upper-Division Courses from outside the College of Sciences and not required by the major (6 hours)

Requirements for graduation for the applied mathematics, statistics/biostatistics, and actuarial mathematics concentrations include a minimum cumulative grade point average of 2.00 overall and in the major with no grade less than C+ in the math core courses, 120 credit hours, which must include both a minimum 30 credit hours overall and 12 credit hours in upper-level courses in the major program from Old Dominion University, completion of ENGL 110C and ENGL 211C or 221C or 231C with a grade of C or better, and completion of the Senior Assessment.

Practicum

Any student who wishes to receive a practicum or internship experience may do so as an integral part of the degree program. Students in the secondary school teacher track are required to complete both a practicum and a student teaching internship as part of the degree requirements. Otherwise, students may substitute the practicum experience for one of the optional courses listed in the other two concentrations.

Minor in Mathematics

Students may pursue a minor in mathematics with an emphasis in one of the three following areas: applied mathematics, statistics/biostatistics or actuarial mathematics.

The applied mathematics option consists of the following:

MATH 307 Ordinary Differential Equations 3
MATH 312 Calculus III 4
MATH 317 Calculus IV: Introductory Analysis 3

Select two of the following:

MATH 316 Introductory Linear Algebra 6
MATH 401 Partial Differential Equations
MATH 408 Applied Numerical Methods I
MATH 409 Applied Numerical Methods II
MATH 417 Intermediate Real Analysis I
MATH 420 Applied Mathematics I: Biomathematics
MATH 421 Applied Mathematics II: Mathematical Modeling
MATH 422 Applied Complex Variables
MATH 427 Applied Mathematics III: Elasticity
MATH 428 Applied Mathematics IV: Fluid Mechanics
MATH 457 Mathematics in Nature

Total Hours 16

The statistics/biostatistics option consists of 12 hours of statistics at the 300/400 level, of which at most six hours can be at the 300 level. STAT 306 cannot be applied to this option.

The actuarial mathematics option consists of the following:

MATH 312 Calculus III 4
MATH 316 Introductory Linear Algebra 3
STAT 330 An Introduction to Probability and Statistics 3
or STAT 331 Theory of Probability
MATH 408 Applied Numerical Methods I 3
or STAT 431 Theory of Statistics

Total Hours 13

At least nine credit hours in the chosen option must be taken through courses offered by Old Dominion University. Students must have an overall grade point average of at least 2.00 in the courses required for the minor in their chosen option exclusive of 100/200-level courses and prerequisite courses.

Advanced Placement

Students who have achieved a qualifying score on the Calculus AB or Calculus BC advanced placement examinations receive credit for MATH 211 (and MATH 162M and MATH 163). Credit for MATH 162M and MATH 163 is also given for qualifying scores on the placement tests administered by the University Testing Center. Refer to the Academic Testing and the Prior Learning Assessment Credit Options at the Undergraduate Level sections of this Catalog. Advanced placement credit is not available for MATH 102M.

Linked Bachelor of Science in Mathematics and Master of Science in Computational and Applied Mathematics

The linked program allows students to count up to 12 credits of graduate coursework toward both their undergraduate and master's degrees. Students must earn a minimum of 150 credits (120 for the undergraduate degree and 30 for the graduate degree).
**Admission**

To be admitted to the linked program, students must have completed at least 60 undergraduate credit hours with at least 24 credit hours from ODU. Students must have completed MATH 307, MATH 312, MATH 317 and all prerequisites for those courses. At the time of admission, they must have an overall GPA of 3.00 or better and a GPA of 3.00 or better in MATH and STAT courses.

Interested students who meet the admission requirements should apply to the graduate program director, after consulting with the undergraduate chief departmental advisor, as soon as possible upon completing the required courses and 60 credit hours. In consultation with the graduate program director, a student will:

1. Officially declare an undergraduate Mathematics major with the undergraduate chief departmental advisor.
2. Draft a schedule of graduate courses to be taken as an undergraduate to be presented to the undergraduate chief departmental advisor.
3. Apply, during their senior year, to the Office of Graduate Admissions for admission to the master's in computational and applied mathematics program.

Students who have completed at least six hours of graduate courses upon attaining senior standing (completion of 90 credit hours) and who have earned a GPA of 3.00 or better in those courses will not be required to take the Graduate Record Exam (GRE) for admission to the master's program. Otherwise, in keeping with normal admission requirements for the M.S. in computational and applied mathematics, students will take the GRE as an undergraduate and will subsequently be reevaluated for continuation into the master's program.

Once students have been awarded their bachelor's degree and fulfilled all regular admission requirements for the M.S. in computational and applied mathematics, they will be officially admitted into the M.S. program.

**Program Requirements**

Students in the program will fulfill all normal admission and curricular requirements for both a B.S. in mathematics and an M.S. in computational and applied mathematics with the following exceptions:

1. Students in the program may count up to 12 hours of 500 or 600 level graduate courses, excluding independent study, taken as an undergraduate for which they have earned a grade point average of 3.0 or greater with no course grade lower than a B- toward both the B.S. in mathematics and the M.S. in computational and applied mathematics.
2. Students in the program may substitute mathematics or statistics graduate courses for undergraduate courses according to the following schema. All students must complete an undergraduate writing intensive course in the major.
   a. All students must complete the prescribed undergraduate program including all 400-level required courses and electives.
   b. All students may substitute 500- and 600-level courses for the remaining credit hours in the 120-hour requirement in the undergraduate program so long as they have the prerequisites for those courses. 700- or 800-level courses may not be used.
   c. Students will not receive credit for both the 400 and 500 level version of the same course.
   d. Students in the program may make a written petition for other substitutions to the graduate program director, who will consider them in consultation with the chief departmental advisor and the instructor(s) of the courses involved.

**NOTES:**

1. In accordance with University policy, up to 21 hours of graduate courses taken as an undergraduate may be counted toward the bachelor's degree; however, only 12 hours of graduate courses taken as an undergraduate may also be counted toward the M.S. degree. This will limit students' scheduling flexibility subsequently.