

Mathematics Major Action Plan
Department of Mathematical Sciences

The Department of Mathematical Sciences has designed its curriculum to achieve the primary goal of preparing its students for professional careers or graduate study in mathematics, mathematics education or statistics. The Department strives to achieve this goal by building on a foundation of study in the liberal arts, which helps students develop as liberally educated persons. The faculty of the Department of Mathematical Sciences has established the following goals for the mathematics major program:

Majors in mathematics will:

1. Know the basic and intermediate concepts and methods of their major discipline. Students completing the baccalaureate program in mathematics will compare favorably with students completing similar programs nationally.
2. Be well prepared for entry-level jobs in industry or teaching.
3. Have the background necessary for graduate work in mathematics, mathematics education or statistics.
4. Be able to use their knowledge of the discipline, their oral and written communication skills, and their technological skills to analyze applied problems in their discipline.
5. Be able to effectively communicate mathematical concepts to mathematics faculty, their peers, and the college community.

These goals comport with the College's stated goal that "teaching and learning at the University of Virginia's College at Wise are transformational experiences" by enabling students to continue to educate themselves (goal 1.1), assume responsibility of citizenship (1.2), and understand the value of education (1.5). In addition, the teaching and learning of these skills contributes to the accomplishment of goals 2.7 (the College offers nationally recognized science and technology programs, which have a strong foundation in the liberal arts) and 3.3 (the College continues to strengthen the quality of K-12 education in Southwest Virginia in partnership with local schools).

All students pursuing an undergraduate degree with a major in mathematics are required to complete 32 semester hours of core required courses which includes the calculus sequence (calculus I, II, and III and vector calculus), differential equations, linear algebra, calculus based probability and statistics, advanced calculus/ real analysis, abstract algebra and the senior seminar in mathematics. An introduction to mathematical proofs course, which is a pre-requisite for most of the core courses, and at least 9 additional hours of advanced electives in mathematics are also required. The department believes the core courses and the introductory proofs course provide the student with the opportunity to achieve the departmental goals for the major.

The Department has established the following performance indicators for the five learning objectives:

Performance Indicators:

- **Content Knowledge** - This indicator includes a demonstrated understanding of the fundamental knowledge of mathematics in the core areas. Evidence of sound conceptual understanding includes familiarity with theorems, definitions, and methods covered in the core required courses.
- **Analytical Skills**– This indicator includes the ability to read and understand mathematical statements, make and test conjectures, and be able to construct and write proofs for mathematical propositions using standard methods of proof, including direct and indirect deductive proofs, construction of counterexamples, and proofs by mathematical induction. This indicator also includes the ability to demonstrate appropriate use and application of mathematical modeling to solve problems. Evidence of proper procedure or method includes modeling the problem, supporting the model with appropriate justification, and modifying the procedure to address factors inherent with the given problem. Evidence of proper application includes the use of mathematical skills and methods, often in combinations, coupled with clearly focused reasoning that leads to a correct solution of the problem or proof of a theorem.
- **Communication** – This indicator includes the ability to read, write, and speak mathematically. Students should demonstrate the ability to communicate conceptual and procedural understanding in problem solving and proofs, the ability to write project and research reports, and the ability to give oral presentations. Students should be able to read and understand mathematically based materials in journals appropriate to their level. Evidence of effective oral communication includes the fluency with which the student explains concepts and procedures used in the problem solving process or in the proof of a theorem as well as a disposition for asking and answering questions. Evidence of effective written communication includes the clarity and logical progression with which a proof or solution is given.

Assessment of student achievement for these performance indicators will be carried out as follows:

Performance Indicator	Key Courses	Assessment Tools	Performance Standard
Content Knowledge	Core required courses and introduction to mathematical proofs course	1. Satisfactory completion of core required courses 2. Major Field Achievement Test 3. Departmental Comprehensive Exam	1. All students must have a grade point average of 2.0 or higher in the major. 2. All students must have a mean score not less than one standard deviation below the national mean. 3. All students must earn a score of 50% or higher on each of the three components of the exam (objective component, problem-solving component, and proofs component).
Analytical Skills	Core required courses and introduction to mathematical proofs course	1. Satisfactory completion of core required courses 2. Major Field Achievement Test 3. Departmental Comprehensive Exam	1. All students must have a grade point average of 2.0 or higher in the major. 2. All students must have a mean score not less than one standard deviation below the national mean. 3. All students must earn a score of 50% or higher on each of the three components of the exam (objective component, problem-solving component, and proofs component).

Analytical Skills Continued		4. Successful completion of the capstone course.	4. 100% of students enrolled in the capstone course will demonstrate competency in the areas of investigatory and analytical skills, creativity, and ability to present results.
Communication	Core required courses (particularly the capstone course) and introduction to mathematical proofs course	1. Satisfactory completion of core required courses 2. Oral and written communication rubrics developed by the faculty are used to evaluate the oral presentation and the research paper required in the capstone course.	1. All students must have a grade point average of 2.0 or higher in the major. 2. 80% of students enrolled in the capstone course will receive an average score of 3 or better on both the oral presentation and the research paper.

The Department has established the following plan of action to improve student achievement should the performance standards not be met:

- The Department has administered the Major Field Achievement Test (MFAT) to graduating mathematics majors since 1992. As part of the assessment of the majors, the Department does a comparison of the mean score for the mathematics majors over three year periods with the mean score for the national group of majors taking the MFAT. On a yearly basis, the test scores and departmental mean are used to determine any significant subject area weaknesses of the majors as a group and this data is used to determine subject areas where programmatic improvements may be necessary. Course content and pre-requisites may be modified to address problem areas indicated by the MFAT.
- The Department's primary use of the Departmental Comprehensive Exam as an assessment tool is to reinforce learning and measure the intended outcomes learned by the majors; therefore, the test scores on the exams are used to determine any significant weaknesses of the majors as a group and as individuals. Individual scores and departmental mean are used to determine subject area weaknesses and this data is used to determine subject areas where programmatic improvements may be needed. Course content and pre-requisites may be modified to address problem areas indicated by the Departmental Comprehensive Exams.

- The Department will administer the Departmental Comprehensive Exam earlier in the spring semester to allow for remediation for those students who do not pass all three components of the exam.
- The Departmental Comprehensive Exam is currently required during the last semester of the senior year. The Department has modified the testing policy to allow students to take the exam during the last semester of the junior year; therefore, only sections that were not passed will be required during the last semester of the senior year. The Department believes this policy will be particularly beneficial for those majors seeking secondary teaching certification. Such majors are required to complete a teaching internship in the last semester of the senior year which does not allow adequate preparation time for the departmental exam.
- The Department recently developed the MATH 111: Pre-calculus I and MATH 112: Pre-calculus II sequence for students who do not place into MATH 204: Calculus I, but are pursuing a degree within the departments of mathematical sciences or the natural sciences. The courses in this sequence were designed to ensure that students have the skills to successfully complete the calculus sequence. The content in this sequence will be analytic in nature, and emphasis will be placed on the transcendental functions, particularly the trigonometric functions. This sequence was developed to target identified (both the MFAT and Departmental Exam data) deficiencies in the areas of real valued functions of a single variable and transcendental functions (particularly the trigonometric functions).
- The Mathematics Department currently has a three semester (12hr) calculus sequence. The first semester should cover through definite integrals and applications. The second semester should cover transcendental functions, methods of integration, parametric equations and improper integrals, and the third semester should cover sequences and series and multivariable calculus up to multiple integration. In practice this syllabus has proved to be overly ambitious which means that our students have identified (both MFAT and Departmental Comprehensive Exam data) deficiencies in the area of real valued functions of several variables, including partial derivatives and multiple integration. To correct this deficiency, the Department realigned course content for the existing courses in the calculus sequence, adopted a new text-book for the calculus sequence based on the realignment, and developed a standard three hour vector calculus course which will be a core required course for the major beginning Fall 2006.
- Written and oral communication skills have been identified weaknesses for the majors and the Department's response has been to involve the communication process in more courses and to involve faculty from the Department of Language and Literature in the capstone courses.
- The Department will also modify core required courses where appropriate to include assignments that require oral presentations to provide students adequate opportunity to hone their oral communication skills. In particular, students will be required to give several oral research summaries prior to the final oral research presentation for the capstone course.

Two of the objectives for the mathematics majors are that they will be well prepared for entry-level jobs in industry or teaching, and have the background necessary for graduate work in mathematics, mathematics education or statistics. In order to more accurately track careers and graduate experiences for math graduates, the Department plans to pursue the following course of action:

- Exit interviews with graduating seniors documenting career interests or interest in graduate work.
- Post-graduation questionnaire will be given to all graduating seniors. The questionnaire will be completed as part of the final evaluation for the capstone course. One section of the questionnaire will ask students to list where they have accepted positions or where they have applied for positions (industry, education, graduate program, etc.).
- Alumni survey to include questions about: 1) reasons students were successful/unsuccessful in graduate programs to identify any potential programmatic deficiencies and to determine strengths of the program; and 2) depth and breadth of the mathematics curriculum in preparing students for careers in industry or teaching.

The Department will set assessment goals after the proposed program is in place.