MATHEMATICS

Department of Mathematics

The Department prepares its students for advanced study and research as well as for careers in business, industry, government, and teaching. Students are encouraged to seek the advice of their faculty advisor in the selection of a concentration and elective courses that will best prepare them for their career choices.

Mathematics is the language of science and also plays a key role in many of the social sciences. An understanding of mathematics provides a powerful approach to solving problems through organization, simplification, and abstraction. In today's job market, individuals with highly developed analytical and problem-solving skills are in great demand. Therefore, there are numerous career options for students who choose to major in mathematics.

The Mathematics Department offers two majors. One is a Mathematics Major with four possible concentrations: Traditional, Secondary Education, Statistics and Modeling, and Actuarial Studies. The other is Mathematics for Elementary Education which also requires a student to complete the Elementary Education Major.

Computer software is used in many courses. These programs include Maple, Geogebra, Sage, SPSS, Matlab, Geometer's Sketchpad, and DPGraph.

Mathematics Placement

All new students should take the math placement exam. Results will be used to determine appropriate course placement. To take a mathematics course (except MA-105) at Worcester State University, a student must complete the placement test process prior to registration. Students who have graduated from high school with at least a 2.7 overall high school GPA within the last three years are eligible for MA-105.

- Actuarial Mathematics Minor
- Mathematics for Elementary Education
- Mathematics Major: Concentration in Actuarial Studies
- Mathematics Major: Concentration in Secondary Education
- Mathematics Major: Concentration in Statistics and Modeling
- Mathematics Major: Concentration in Traditional Mathematics
- Mathematics Minor
- Middle School Mathematics Minor

Faculty

Kyle T. Allaire, Assistant Professor (2020), B.A., M.A., Rhode Island College; Ph.D.,University of Connecticut

Timothy Antonelli, Associate Professor (2015), B.S.E., Duke University; Ph.D., North Carolina State University

Noah Daleo, Associate Professor (2015), B.S., Kennesaw State University; Ph.D., North Carolina State University

Mary S. Fowler, Professor (2004), B.A., New York University; M.S., Ph.D., Carnegie Mellon University

Maria G. Fung, Professor (2008), B.A., Clark University; M.S., Ph.D., Cornell University

Elizabeth Gilbert, Associate Professor (2016), B.S., M.S., Villanova University; Ph.D., Temple University

Hy Ginsberg, Professor (2011), B.S., State University of New York Stony Brook; M.S., Ph.D., University of Vermont

Jason A. Hardin, Associate Professor (2014), B.A., University of Cincinnati; M.S., Ph.D., University of Nebraska Lincoln

Caitlin Krul, Associate Professor (2016), B.S., Salem State College; M.S., Ph.D., University of Rhode Island

Eileen B. Perez, Developmental Mathematics Program Director, Professor (2013), B.S., M.S. Union College; Ed.D., Nova Southeastern University

Hansun T. To, Professor (2004), B.A., Rosemont College; M.A., Ph.D., Temple University

Michael Winders, Department Chair, Professor (2004), B.S., M.S., Ph.D., University of Iowa

Courses

MA-098 Developmental Math: Arithmatic
Prerequisites: Pass math placement test with a code of 1 or above.
Whole numbers, fractions, decimals, percents, rates, ratios, proportions, word problems, graphs, tables, signed numbers, variables and expressions. [credits are developmental]
Fall and Spring and every year. 3 Credits

MA-099 Developmental Math: Algebra
Prerequisites: Pass math placement test with a code 2 or above
A review of arithmetic and elementary algebra preliminary to MA110. Three developmental credits, not counted toward degree. [credits are developmental]
Fall and Spring and every year. 3 Credits

MA-105 Survey of Mathematics
LASC Categories: QR
Prerequisites: Pass math placement test with code 3 or above
Financial management, probability theory, voting methods and other topics selected to improve the quantitative literacy of students. Not for mathematics majors.
Fall and Spring and every year. 3 Credits

MA-107 Mathematical Explorations-- Invitation To Effective Thinking
LASC Categories: QR
Prerequisites: Pass math placement exam with a code of 3.
Analysis of mathematical topics including (but not limited to) logical thinking, elementary number theory, concepts of infinity, geometry gems, modeling through graphs, fractals, and uncertainty.
Fall and Spring and every year. 3 Credits

MA-130 Number and Operations for Teachers
LASC Categories: QR
Prerequisites: Pass math placement test with code 5 or above
Develops understanding of the mathematical content of number and operations at the deep level required for successful elementary and middle school teaching.
Fall and Spring and every year. 3 Credits

MA-131 Patterns, Functions and Algebra for Teachers
LASC Categories: QR
Prerequisites: MA-130 Minimum grade C
Develops understanding of the mathematical content of patterns, functions and alegebra at the deep level required for successful elementary and middle school teaching. Credit will not be awarded for MA-180 (formerly MA-110) and MA 131.
Fall and Spring and every year. 3 Credits

MA-132 Geometry, Measurement, Probability and Statistics for Teachers
LASC Categories: QR
Prerequisites: MA-130 with a C or above.
Develops understanding of the mathematical content of geometry, measurement, probability and statistics at the deep level required for successful elementary and middle school teaching.
Fall and Spring and every year. 3 Credits

MA-150 Statistics I
LASC Categories: QR
Prerequisites: Pass Math Placement Test with code 4 or above
Descriptive techniques, elementary probability, distribution of the sample mean, confidence intervals, hypothesis testing of the means of one and two samples, linear regression and correlation. Credit will not be awarded for both MA-150 and MA-302.
Fall and Spring and every year. 3 Credits

MA-180 Introduction to Functions
LASC Categories: QR
Prerequisites: Pass math placement exam with a score of 5 or above.
Properties, graphing, and applications of linear, quadratic, polynomial, rational, exponential, and logarithmic functions; systems of linear equations.
Fall and Spring and every year. 3 Credits

MA-190 Pre-calculus
LASC Categories: QR, NLL
Prerequisites: MA 110 or MA-180 with a grade of at least C- or math placement exam code 6 or above
Review of exponential and logarithmic functions; trigonometric functions, identities, and equations; systems of linear equations and inequalities; and applications.
Fall and Spring and every year. 4 Credits

MA-193 Special Topics in Math for First Year Students
LASC Categories: FYS
Introductory level course covering topics of special interest to first year students. Offered only as a First Year Seminar.
3 Credits

MA-200 Calculus I
LASC Categories: QR, NLL
Prerequisites: MA 190 with a grade of at least C- or math placement exam code 7
Limits, continuity, differentiation and integration of functions, the Fundamental Theorem of Calculus, L'Hôpital's Rule, applications including related rates, optimization, and area. Credit willnot be given for both MA-200 and MA-202.
Fall and Spring and every year. 4 Credits

MA-201 Calculus II
LASC Categories: QR, NLL
Prerequisites: MA 200 with a grade of at least C-
Techniques of integration, infinite sequences and series, power series, applications including volume and functional approximation.
Fall and Spring and every year. 4 Credits

MA-202 Business Calculus
LASC Categories: QR, NLL
Prerequisites: MA-180 with a grade of at least C- or math placement exam code 6 or above
Review of functions, limits, derivatives, integration and introduction to multivariate calculus. Business applications of these topics.
Fall and Spring and every year. 4 Credits

MA-240 Theory of Proof
LASC Categories: NLL
Prerequisites: MA-200 minimum grade C-
Logic and Proof, Set Theory, Math Induction, Relations, Functions, Sequences and Convergence, Limits and Continuity, Congruences, Introductions to Groups.
Fall and Spring and every year. 4 Credits

MA-260 Linear Algebra
Prerequisites: MA 240 with a grade of at least C.
Solutions of simultaneous equations by means of matrices and determinants; vector spaces, linear transformations; also, as time permits, characteristic values, bilinear and quadratic forms.
Fall only and every year. 3 Credits

MA-302 Probability and Statistics
Prerequisites: MA 200 with a grade of at least C-
Descriptive statistics, probability theory, combinatorics, correlation, regression and inference techniques. Credit will not be awarded for both MA-150 and MA-302.
Fall and Spring and every year. 3 Credits

MA-303 Mathematical Modeling
Prerequisites: MA 201 with a grade of at least C-
The development, analysis, and application of continuous and discrete-time models from the physical, financial, and life sciences.
Fall and Spring and every year. 3 Credits

MA-304 Data Analysis
LASC Categories: NLL
Prerequisites: MA-302 CS-135 Minimum grade C-;
Case studies combining applied statistics, mathematical statistics, mathematics, computing, and communications to simulate work experience of a practicing statistician.
Spring only and every year. 4 Credits

MA-309 Topics in Mathematics for Middle and Secondary Teachers
Prerequisites: MA 240 with a grade of C or better. MA 340 is highly recommended.
Students will strengthen and expand their knowledge of the mathematics taught in middle/high school. Specific emphasis will be placed on topics in geometry and trigonometry.
Spring only and every year. 3 Credits

MA-310 Calculus III
LASC Categories: NLL
Prerequisites: MA 201 with a grade of at least C-
Vectors, parametric equations, polar, cylindrical and spherical coordinates, multivariable functions, properties and applications, partial derivatives, multiple integrals.
Fall only and every year. 4 Credits

MA-320 Ordinary Differential Equations
Prerequisites: MA 310 with a grade of at least C-
Techniques for solving first- and second-order ordinary differential equations, including Laplace transformations, numerical approximations and graphical techniques.
Spring only and other or on demand. 3 Credits

MA-327 Combinatorics and Graph Theory
Prerequisites: MA-240 with a grade of C or above.
The course will examine various topics from combinatorics and graph theory, including enumeration, recurrence relations, generating functions, graphs and their properties (e.g., planarity, colorability), and trees. The course will have an emphasis on both proof writing and computation.
Spring only and every year. 3 Credits

MA-340 Modern Geometry
Prerequisites: MA 240 with a grade of at least C.
Topics from Euclidean and non-Euclidean geometry.
Spring only and every year. 3 Credits

MA-360 Number Theory
Prerequisites: MA 240 with a grade of at least C.
Divisibility properties of integers, prime numbers, the Euclidean algorithm, the unique factorization theorem, congruences, Diophantine equations, number theoretic functions.
Fall only and every year. 3 Credits

MA-380 Probability
Prerequisites: MA 310 with a grade of at least C-
Probability concepts including: counting, conditional probability, independence, expectation and variance of univariate and multivariate distributions. This is the first course in a two-course sequence that prepares students for the first actuarial exam.
Fall only and every year. 3 Credits

MA-382 Actuarial Preparation Workshop
Prerequisites: MA-310 with a B- or greater and approval of Math Chair
This course supports students as they prepare for either of the following actuarial exams: Probability Exam P or Financial Mathematics Exam FM. Focus will be on developing the required mathematical competencies, professionalism and communication of mathematical concepts consistent with actuarial industry standard, networking towards the acquisition of an internship or job in the actuarial field.
Spring only and every year. 3 Credits

MA-405 Abstract Algebra
Prerequisites: MA 240 with a grade of at least B- and MA 260 with a grade of at least C-.
Introduction to groups, rings, and fields.
Spring only and every year. 3 Credits

MA-408 Directed Study: Mathematics
Directed study offers students, who because of unusual circumstances may be unable to register for a course when offered, the opportunity to complete an existing course with an established syllabus under the direction and with agreement from a faculty member.
1-6 Credits

MA-410 Real Analysis
Prerequisites: MA 310 and MA-240 with a grade of at least B-
Rigorous treatment of sequences, topology of the real numbers, continuity; also, as time allows, differentiation, integration.
Fall only and every year. 3 Credits

MA-425 Mathematical Statistics
Prerequisites: MA-240 and MA-310 with a minimum grade of B-, and MA-380 with a minimum grade of C-
A rigorous treatment of statistical inference including: maximum likelihood estimators, sufficiency, consistency, hypothesis tests, likelihood ratio tests and Bayesian inference.
Spring only and every year. 3 Credits

MA-470 Capstone Experience
LASC Categories: CAP, WAC
Prerequisites: Senior standing within the major. EN-102 or EN-250
Students complete an independent mathematics research/problem-solving project, including oral presentations and a final written paper.
Fall only and every year. 3 Credits

MA-497 Selected Topics in Mathematics
Prerequisites or Corequisite: MA-240 and MA-260 (MA-260 may be taken concurrently). Pre-requisite will vary according to content.
Selection of topics of mutual interest to students and faculty.
3 Credits

MA-498 Internship: Mathematics
Working in and for an organization where ones skills can be tested in real-world situations. Students will have an opportunity to gain experience, to increase knowledge in various functional areas, and establish important contacts with an organization. [Consent of instructor.]
3 Credits

MA-499 Independent Study in Mathematics
Offers advanced students an opportunity to examine topics not normally covered in other mathematics courses. Geared to interests of both the student and the instructor.
Fall and Spring and every year. 1-6 Credits

Program Learning Outcomes

- Apply mathematical reasoning to critically approach, analyze, and solve problems.
- Organize mathematical thought and effectively communicate ideas using written and oral arguments.
- Use appropriate technology to explore and solve mathematical problems.
- Recognize and contribute to the various roles of mathematics in society.
- Be prepared for a career or graduate study in mathematics or a related field.