

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 must take the math placement Arithmetic test followed by the math placement Elementary Algebra test. Students who score well on these two basic tests will take an Algebra II/Pre-Calculus test called the College Level Math test. To take a mathematics course at Worcester State University, a student must complete the placement test process prior to registration. Results will be used to determine appropriate course placement.

- Financial 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, Assistant Professor (2016), B.S., M.S. Villanova University; Ph.D. Temple University

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

Eileen B. Perez, Developmental Mathematics Program Director, Associate 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: Arithmetic

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 algebra 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; conic sections; 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 will not 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 110 or 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-340 Modern Geometry

Prerequisites: MA 240 with a grade of at least C.

Topics from Euclidean and non-Euclidean geometry.

Fall only and every year. 3 Credits

MA-349 Financial Mathematics

Prerequisites: MA-310 with a grade of at least C-

Financial mathematics including present and accumulated values for various streams of cash flows for future use in: reserving, valuation, pricing, asset/liability management, investment income, capital budgeting and valuing contingent cash flows.

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.

Spring 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-381 Probability Theory for Actuarial Science

Prerequisites: MA-380 with a grade of at least C-

Probabilities, conditional probabilities, moment-generating functions, moments and expectations of specific parametric distributions including Poisson, geometric, hypergeometric, exponential, and normal. This is the second course in a two-course sequence that prepares students for the first actuarial exam.

Spring only and other or on demand. 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