MATHEMATICS

Message from the Director

Because of its beauty, precision, and usefulness, mathematics has always attracted not only the most profound and theoretical minds, but also pragmatic thinkers who are eager to apply its insights to the problems of the world around us.

The master's degree program in mathematics is designed for students who have a strong undergraduate background in mathematics or a related field, or evidence of an ability to think precisely and quantitatively at the level necessary for graduate work in mathematics. Our program caters to students in many different situations, including, but not limited to, teachers at the middle, high school and two-year college levels, business professionals whose work is quantitative in nature, IT and software professionals, those who deal with and analyze data, students desiring solid preparation for entrance into a doctoral program, and those who are simply attracted by the beauty of mathematics.

Full-time Fairfield University faculty members teach in the master's program, bringing a wealth of expertise to the classroom. The breadth of their specialties, together with their commitment to excellence in teaching and making a difference in individual students' lives, enriches the program and the options available to students. This benefit translates into an ability to allow our students to design individualized programs of study, in consultation with a faculty advisor, related to their background, interest, and personal goals.

The curriculum features a common core of six credits plus six credits of proof-intensive coursework, supplemented by a series of electives that make specialization possible. Because our program caters to working adults, classes mostly meet one evening per week during the fall and spring semesters and are available in the summer, as well.

As director of the graduate program in mathematics, I invite you to peruse the course descriptions and faculty credentials that follow and join us in a more focused study within the field I so enjoy.

Janet Striuli, Ph.D.
Director of the MS in Mathematics Program

Programs

- Master of Science in Mathematics
- Certificate in Applied Statistics
- Certificate in Financial Mathematics

Courses

MATH 5401 Introduction to Applied Mathematics **3 Credits**
This course provides an introduction to essential techniques in the study of ordinary differential equations, including separation of variables, characteristic equations for linear equations, variation of parameters and Laplace transforms. The course also includes an introduction to fundamentals of applied linear algebra, including solutions of systems of linear equations, vector spaces, matrices, determinants, eigenvalues and eigenvectors. Students should have a solid undergraduate background through multivariable calculus.

MATH 5417 Applied Statistics I **3 Credits**
This course introduces students to the techniques in applied statistical methods as used in the physical sciences, social sciences and business. Topics include probability (reliability, discrete and continuous distributions); descriptive and exploratory statistics using analytic and graphical tools; basic statistical testing (sampling techniques, theory of estimation and standard hypothesis testing); regression analysis (normal linear model, multivariate regression, and model building as time permits); correlation techniques; analysis of variance and factorial designs if time permits; proportion tests, chi-squared analysis and other discrete data techniques as time permits. Included is the use of computer software, such as R, SPSS, and Minitab. Students should have a solid undergraduate background through multivariable calculus.

MATH 5418 Applied Statistics II **3 Credits**
Prerequisite: MATH 5417.
This course is a continuation of MATH 5417 and covers additional statistical concepts used in the physical sciences, social sciences, business and health studies. Topics include, but are not limited to, confidence intervals, regression analysis (multiple regression, logistic regression and regression with categorical predictors), analysis of variance (two-way, factorial design, repeated measures and mixed models), analysis of categorical variables (measures of association, chi-squared tests, odds ratio, relative risk, McNemar's test) and non-parametric tests. One statistical package such as R, SPSS, and Minitab, will be used throughout the course. Students should have a laptop.

MATH 5435 Linear Algebra **3 Credits**
This graduate-level treatment of linear algebra includes general vector spaces; basis and dimension; linear transformations; linear operators and the relationship to matrices; inner product spaces and orthonormalization, least squares approximations, Hilbert spaces; diagonalization and other canonical forms for matrices; eigenvalues, eigenvectors, and applications to ordinary differential equations; and Hermitian, unitary, and positive definite matrices. The course also incorporates a discussion of the historical development of linear algebra, the relationship of linear algebra to analysis, and a coordinated introduction to a symbolic algebra program such as Maple or Mathematica. Students should have a solid background in undergraduate linear algebra or applied matrix theory, which is well-covered by MATH 5401.

MATH 5436 Abstract Algebra **3 Credits**
This graduate level treatment of abstract algebra with a focus on ring theory includes the integers, the division algorithm. divisibility criteria, primes and unique factorization; equivalence relations and congruence classes, modular arithmetic; rings, basic properties of rings, ideals, ring homeeomorphisms; ring of polynomials, division algorithm for polynomials, divisibility algorithm, irreducible elements and unique factorization properties, roots and irreducibility; quotients rings, prime and maximal ideals; Euclideian domains, principal ideals domains, factorization domains, field of quotients of an integral domain; introduction to group theory. Students should have a solid background in theoretical mathematics and linear algebra at the undergraduate level. This is a proof-intensive course.

MATH 5451 Probability Theory **3 Credits**
This graduate-level treatment of the theory of probability includes a brief review of probability spaces and finite counting techniques, random variables and distribution functions, density, mass functions, and expectation. The course also examines the standard random variables; multivariate distributions; functions and sums of random variables; limit theorems - weak and strong law of large numbers and the central limit theorem. The course also discusses the historical development of probability. Students should have a solid background in undergraduate mathematics through multivariable calculus, and some familiarity with theory and proof in mathematics.

MATH 5452 Statistics Theory **3 Credits**
Prerequisite: MATH 5451.
This graduate-level treatment of the theory of mathematical statistics includes theory of estimators, maximum likelihood techniques; theory of estimation; hypothesis testing theory - decision analysis; and Bayesian methods. The course also discusses the historical development of statistics. This is a proof intensive course.

MATH 5471 Real Analysis **3 Credits**
This graduate-level treatment of real analysis includes the completeness of the real numbers; the topology of Euclidean n-space and its generalizations to metric and topological spaces; convergence and continuous functions; sequences of functions; general differentiability; the theory of integration and the Lebesgue integral; infinite series and uniform convergence; and a discussion of the historical development of real analysis. Students should have a solid background in undergraduate mathematics through second-semester calculus and theoretical mathematics.

MATH 5472 Complex Analysis **3 Credits**
This graduate-level treatment of complex analysis includes the complex number field and its properties; complex analytic functions and their differences with real functions; the complex integral; Cauchy's Theorem and consequences; and a discussion of the historical development of complex analysis. Students should have a solid background in undergraduate mathematics through multivariable calculus and some familiarity with theory in proof in mathematics. This is a proof-intensive course.

MATH 5900 Special Topics (Shell) **3 Credits**
Mathematical topics not currently among the department's offerings may be offered once or to allow a professor the opportunity to "test drive" a course for the first time.

MATH 6510 Foundations and Set Theory **3 Credits**
The foundations of modern mathematics lie in set theory and logic. This course provides a graduate-level treatment of these areas in the foundation of theoretical mathematics. It is also a good preparation for proof-intensive courses for those without a solid undergraduate foundation in theoretical mathematics. Students should have some familiarity with theory and proof in mathematics.

MATH 6531 Dynamical Systems **3 Credits**
This course provides an introduction to the study of dynamical systems from the point of view of both continuous time and discrete time systems. Topics include fixed point and stability analysis for linear and nonlinear flows in one and two dimensions, phase plane analysis, bifurcations and limit cycles, one-dimensional maps, chaos, and Lyapunov exponents. Students should have a solid background in undergraduate mathematics through multivariable calculus, ordinary differential equations, and applied matric theory or linear algebra, which is well-covered by MATH 5401.

MATH 6532 Partial Differential Equations **3 Credits**
This graduate-level treatment of partial differential equations includes boundary value problems, Fourier series, and Fourier transforms. Students should have a solid background in undergraduate mathematics through multivariable calculus, ordinary differential equations, and applied matric theory or linear algebra, which is well-covered by MATH 5401.

MATH 6535 Advanced Abstract Algebra **3 Credits**
Prerequisite: MATH 5436.
A collection of topics in advanced abstract algebra, this course includes group theory, field extensions and Galois. Students should have a solid background in theoretical mathematics at the undergraduate level and in linear algebra. This is a proof-intensive course.

MATH 6537 Number Theory **3 Credits**
This graduate-level survey of the problems and techniques of number theory includes elementary number theory and introductions to analytic and algebraic number theory. Students should have some familiarity with theory and proof in mathematics. This is a proof-intensive course.

MATH 6550 Classical Financial Mathematics **3 Credits**
This course covers the basic mathematics of classical financial investments. It will include the basic formulas for compound interest and effective yields, infinite series and exponential functions, annuities and perpetuities, amortization and sinking funds, time value of money, and bond and stock discounts. Students should have a solid background in undergraduate mathematics through second-semester calculus.

MATH 6565 Use of Technology in the Classroom **3 Credits**
Designed for teachers, this course surveys various mathematical technology accessible various computer software mathematics packages suitable for use in the classroom, such as GeoGebra and Desmos, and also explores the integration of AI into classroom instruction. The course includes a tutorial on how to use each technology and demonstrates how they can be incorporated into a classroom setting. Students should have a solid background in undergraduate mathematics through second-semester calculus.

MATH 6577 Numerical Analysis **3 Credits**
This course provides a graduate-level treatment of numerical analysis and the numerical solution of mathematical problems and includes an introduction to computer implementation of numerical algorithms. Students should have a solid background in undergraduate mathematics through multivariable calculus.

MATH 6578 Math of Financial Derivatives **3 Credits**
Prerequisite: MATH 6550.
This course covers the theory of financial derivatives, including an explanation of option pricing theory and investments, the idea of financial derivatives, stochastic differential equations, and the Black-Scholes model.

MATH 6583 Geometry **3 Credits**
This course offers a graduate-level treatment of Euclidean and non-Euclidean geometry and is highly recommended for teachers. Students should have some familiarity with theory and proof in mathematics. This is a proof-intensive course.

MATH 6585 Topology **3 Credits**
Prerequisite: MATH 5471.
This course provides an introductory, graduate-level treatment of point-set and algebraic topology and topological methods. This is a proof-intensive course.

MATH 6990 Independent Study **3 Credits**
The Master's Degree Program in Mathematics affords each student the opportunity to do an independent study course with a professor or mentor. This can either be an existing course in the program or a course on an advanced topic in mathematics. In the latter case the syllabus and requirements are developed by the student and the faculty mentor.

MATH 6999 Capstone Project **0 Credits**
This is an independent project or presentation planned by the student with the help of a faculty mentor and produced by the student through original work. The project is typically based on the content of a course and is worked on in conjunction with that course, but students can also learn the necessary material in a three-credit independent study with their mentor.

Faculty

Professors in the program are full-time faculty of the Meditz College of Arts and Sciences, with highly regarded expertise in a wide range of areas of mathematics and a deep commitment to teaching and making a difference in individual students' lives.

Professor

Demers, d*irector*
Sawin
Staecker
Striuli
Weiss

Associate Professor

Baginski
McSweeney
Rafalski

Assistant Professor

Barba
Berikkyzy
Casement
Dumitrescu
Naples
van Wyck

Instructor of the Practice

Kapoor

Lecturer

Anderson, A.