

MATHEMATICS (MAT) COURSES

MAT-003 Pre-Calculus

This course is intended solely for those students who wish to take calculus, but whose preparation makes a refresher course in pre-calculus advisable. Topics covered include a review of algebra (solving equations and inequalities, simplification of algebraic expressions) and properties of elementary functions (polynomial, rational, exponential, logarithmic, and trigonometric functions) with special emphasis on graphing these functions. MAT 003 cannot be used for any distribution credit or any area of concentration. (For students who desire a distribution credit in mathematics but do not wish to take calculus, MAT 103, 104, 106, and 108 are recommended.)

Prerequisites: none

Credits: 0.5

MAT-010 Pre-Calc With Intro to Calculus

This course is intended solely for those students whose intended course of study requires calculus, but whose preparation makes a slower-paced course in calculus advisable. The course combines a review of pre-calculus with the beginning of an introduction to calculus. Topics include solving equations and inequalities, simplification of algebraic expressions, polynomials, rational functions, exponential functions, trigonometric functions, limits, continuity, the definition of the derivative and its geometric interpretation, and basic differentiation rules. The focus is on understanding basic concepts and gaining basic computational skills. This course cannot be used for any distribution credit nor any area of concentration. (We recommend MAT 103, 104, 106, or 108 for students who desire a distribution credit in mathematics but do not need calculus for their major or minor.) This course is offered in the fall semester.

Prerequisites: none

Corequisites: MAT-010 placement

Credit: 1

MAT-103 Probability

The course introduces students to key measures of uncertainty (probability) and long-run average (expected value). Probabilistic reasoning is applied to a wide variety of interesting in the areas of medical testing, gambling, game theory, sports, asset-price modelling, financial derivatives, insurance, and retirement annuities. MAT-103 does not count toward the mathematics major or minor. Credit cannot be given for both MAT-103 and MAT-253. The course is offered most semesters.

Prerequisites: none

Credits: 0.5

Distribution: Quantitative Literacy

MAT-104 Statistics

The course looks briefly at some standard statistics: averages, variances, standard deviations, medians, and proportions. Correlation coefficients are introduced and used for prediction. The classical p-value approach to claim testing is presented and applied to a wide variety of testing situations. In addition, the classical confidence interval approach to estimation is examined. MAT-104 does not count toward the mathematics major or minor. (MAT-103 is not a prerequisite for MAT-104). Credit cannot be given for both MAT-104 and MAT-254. The course is offered most semesters.

Prerequisites: none

Credits: 0.5

Distribution: Quantitative Literacy

MAT-106 Topics in Contemporary Math

A study of selected topics dealing with the nature of mathematical ideas. This course focuses on mathematics as a creative endeavor. Through participation and discovery, students will consider an articulation of mathematics that focuses on patterns, abstraction, and inquiry. Topics will vary, but could include logic, Euclidean geometry, algorithms, etc. This course does not count toward the major or minor in mathematics. Refer to the Course Descriptions document on the Registrar's webpage for topics and descriptions of current offerings.

Prerequisites: none

Credit: 1

Distribution: Quantitative Literacy

MAT-108 Intro to Discrete Structures

An introduction to discrete mathematics for students not planning to major in mathematics. Topics include sets and logic, proof methods, counting arguments, recurrence relations, graphs, and trees. This course may be used to meet the mathematics requirement for the computer science minor. However, it does not count toward the mathematics major or minor. Students may not present both MAT 108 and 219 for credit toward graduation.

Prerequisites: none

Credit: 1

Distribution: Quantitative Literacy

MAT-110 Calc I With Pre-Calc Review

This course is intended solely for those students who took and passed MAT-010 and students whose intended course of study requires calculus. Successful completion of this course is equivalent to completion of MAT-111. Topics covered include implicit differentiation, the graphical behavior of the derivative, applications of the derivative, an introduction to integration, the Fundamental Theorem of Calculus, and integration by substitution. The focus is on understanding basic concepts and gaining basic computational skills. This course counts as a distribution credit in mathematics. Credit cannot be given for both MAT-110 and MAT-111. This course is offered in the spring semester.

Prerequisites: MAT-010 with a minimum grade of C-

Credit: 1

Distribution: Quantitative Literacy

Equated Courses: MAT-111

MAT-111 Calculus I

This course studies the fundamentals of single-variable calculus, developing analytical and computational skills appropriate for students in quantitatively rigorous disciplines. Topics include limits, continuity, techniques of differentiation, applications of derivatives, the Mean Value Theorem, the Intermediate Value Theorem, the Fundamental Theorem of Calculus, and the method of substitution for integration.

Prerequisites: none

Credit: 1

Distribution: Quantitative Literacy

Equated Courses: MAT-110

MAT-112 Calculus II

This course continues the study of calculus from MAT-111, developing analytical and computational skills appropriate for students in quantitatively rigorous disciplines. Topics include techniques and applications of integration, numerical integration, improper integrals, infinite sequences and series, Taylor series, and an introduction to multivariable calculus including partial derivatives and multiple integrals.

Prerequisites: MAT-110 or MAT-111 with a minimum grade of C-, or MAT-112 placement

Credit: 1

Distribution: Quantitative Literacy

MAT-178 Special Topics

This course is designed for the treatment of material outside the regular offerings of the department. For a given semester, the course content and other particulars will be announced before advance registration for that semester. Refer to the Course Descriptions document on the Registrar's webpage for topics and descriptions of current offerings.

Prerequisites: none

Credits: 0.5-1

Distribution: Quantitative Literacy

MAT-219 Combinatorics

This course is an introduction to combinatorial reasoning and discrete mathematics. Topics include enumeration, combinatorial identities, graph theory, generating functions, and recurrence relations. Additional topics may include graph algorithms, partitions, and partially ordered sets. Students may not present both MAT 108 and 219 for credit towards graduation. This course is offered in the spring semester.

Prerequisites: MAT-223

Credit: 1

Distribution: Quantitative Literacy

MAT-221 Geometry

This course studies aspects of the development of Euclidean and non-Euclidean geometries from a modern and/or historical viewpoint.

Prerequisites: MAT-112

Credit: 1

Distribution: Quantitative Literacy

MAT-222 Number Theory

A study of elementary number theory. Topics include divisibility, congruences, properties of prime numbers, linear Diophantine equations, the Euler phi function, primitive roots, and additional topics. Such topics may include public key cryptography, quadratic reciprocity, and Pythagorean triples. This course is offered in the spring semester.

Prerequisites: MAT-112

Credit: 1

Distribution: Quantitative Literacy

MAT-223 Linear Algebra

An introduction to linear equations and vector spaces. Topics include solving linear equations, matrix algebra, row operations, determinants, vector spaces, bases and dimension, linear transformations, eigenvalues and eigenvectors, and orthogonality. Optional topics include least squares problems, matrix factorization, and other applications. An important aspect of the course is to introduce the student to abstract thinking and proofs.

Prerequisites: MAT-112 with a minimum grade of C-, or MAT-223 placement.

Credit: 1

Distribution: Quantitative Literacy

MAT-224 Differential Equations

An introduction to ordinary differential equations. Special solution techniques and some theory for first-order and linear equations including integrating factors, constant coefficients, undetermined coefficients, variation of parameters, power series solutions, Laplace transforms, and systems of differential equations with applications. This course is offered in the spring semester.

Prerequisites: MAT-112 with a minimum grade of C-, and MAT-223.

Credit: 1

Distribution: Quantitative Literacy

MAT-225 Multivariable Calculus

This course builds on the introduction to calculus in higher dimensions in MAT-112. Topics covered include limits, continuity, differentiability, directional derivatives, constrained and unconstrained optimization, geometry of curves, multiple integrals, general coordinate systems, path and surface integrals, vector calculus, theorems of Green and Stokes, and applications. This course is offered in the fall semester.

Prerequisites: MAT-112 with a minimum grade of C-, and MAT-223

Credit: 1

Distribution: Quantitative Literacy

MAT-226 Operations Research

Linear and nonlinear optimization, linear programming, integer programming, duality, combinatorics, the simplex method and related algorithms, game theory, Markov chains, queueing theory.

Prerequisites: MAT-223

Credit: 1

Distribution: Quantitative Literacy

MAT-235 Stochastic Simulation

Interesting real world phenomena often involve randomness at some level, and this course develops mathematical and computational tools for studying these systems. In particular, students will study and implement computer simulation models of continuous and discrete stochastic processes with potential applications in physics, economics, epidemiology, networks, sports, elections, and industrial engineering. Specific topics for study include: basic probability models, pseudo-random number generation, queueing models, discrete event simulations, Poisson processes, random walks, Markov chains, Monte Carlo methods, and statistical analysis of simulated data.

Prerequisites: MAT-112 and CSC-111

Credit: 1

Distribution: Quantitative Literacy

MAT-251 Mathematical Finance

This course gives an overview of the mathematical reasoning behind the pricing of financial derivatives. Special emphasis is given to replication arguments and using risk-neutral distributions in the binomial pricing model and using risk neutral distributions in the geometric Brownian motion model. A probabilistic derivation of the Black-Scholes pricing formula for gap call options is given. Other topics covered include put-call parity, delta hedging, value at risk, and compound options. The course is typically offered every fall semester.

Prerequisites: MAT-112

Credits: 0.5

Distribution: Quantitative Literacy

MAT-252 Mathematical Interest Theory

This course gives a thorough treatment of the mathematical theory of interest, with special attention paid to calculating present and accumulation values for annuities (series of payments made at regular time intervals). Some topics include nominal and effective rates of interest and discount, force of interest, amortization schedules, sinking funds, bonds, duration, and the use of modified duration to measure bonds' sensitivity to changes in the yield rate. This course is typically offered every fall semester.

Prerequisites: MAT-112

Credits: 0.5

Distribution: Quantitative Literacy

MAT-253 Probability Models

This course is a standard calculus-based introduction to discrete and continuous random variables. Discrete distributions considered include the hypergeometric, binomial, geometric, Poisson, and discrete uniform. Continuous distributions considered include the gamma, chi-square, normal, beta, t and F. The Central Limit Theorem is covered, as well as multivariate distributions (including the bivariate normal and multinomial distributions), and transformations of random variables. Credit cannot be given for both MAT-103 and MAT-253. This course is typically offered in the fall semester.

Prerequisites: MAT-112

Credits: 0.5

Distribution: Quantitative Literacy

MAT-254 Statistical Models

This course gives an overview of confidence intervals and classical hypothesis testing procedures: z-tests, t-tests, F-tests, Chi-square tests, and regression. An intuitive but mathematical treatment is given for all the distributions and procedures involved. Credit cannot be given for both MAT-104 and MAT-254. This course is typically offered in the spring semester.

Prerequisites: MAT-112

Credits: 0.5

Distribution: Quantitative Literacy

MAT-277 Special Topics

This course is designed for the treatment of material outside the regular offerings of the department. For a given semester, the course content and other particulars will be announced before advance registration for that semester. Refer to the Course Descriptions document on the Registrar's webpage for topics and descriptions of current offerings.

Prerequisites: none

Credit: 1

Distribution: Quantitative Literacy

MAT-287 Independent Study

Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.

Prerequisites: none

Credits: 0.5-1

MAT-314 Modeling With Differential Equations

A course to develop the basic skills of formulation, simplification, and analysis of mathematical models for describing and predicting phenomena in the natural and social sciences, with special emphasis in modeling with differential equations. Topics may be taken from fields such as physics, chemistry, biology, psychology, economics, and political science. This course is offered in the fall semester of even-numbered years.

Prerequisites: MAT-224

Credit: 1

Distribution: Quantitative Literacy

MAT-323 Topics in Linear Algebra

An in-depth study of some of the topics covered in MAT 223, including the theory of vector spaces, linear transformations, and Euclidean spaces, together with some additional topics, which may include isomorphisms, duality, canonical forms, and applications of linear algebra. Refer to the Course Descriptions document on the Registrar's webpage for topics and descriptions of current offerings.

Prerequisites: MAT-223

Credit: 1

Distribution: Quantitative Literacy

MAT-324 Topics in Differential Equations

A second course in differential equations offering study of special topics in more depth or beyond those covered in MAT 224. Topics may include existence and uniqueness theory, stability theory, Green's functions, dynamical systems, partial differential equations, and applications of differential equations. Refer to the Course Descriptions document on the Registrar's webpage for topics and descriptions of current offerings.

Prerequisites: MAT-224

Credit: 1

Distribution: Quantitative Literacy

MAT-331 Abstract Algebra I

This course is a first course in algebraic structures and higher abstract mathematics. The algebraic structures studied are groups and rings, which generalize symmetry and familiar number systems like the integers or real numbers. Topics include modular arithmetic, subgroups, quotient groups, isomorphism theorems, and permutation groups. This course has a strong emphasis placed on writing and reading mathematical proofs. This course is offered in the spring semester.

Prerequisites: MAT-223 with a minimum grade of C-

Credit: 1

MAT-332 Abstract Algebra II

This course is a continuation of MAT-331. Topics will depend on the instructor but may include fields, modules, Galois theory, algebraic geometry, Gröbner bases, or advanced topics in groups and rings. This course has a strong emphasis placed on writing and reading mathematical proofs.

Prerequisites: MAT-331

Credit: 1

MAT-333 Funct Real Variable I

A first course in the foundations of modern analysis. Topics include set theory, topology of the real numbers, sequences, series, differentiation, integration, and rigorous proofs of the major theorems of single-variable calculus. This course is offered in the fall semester.

Prerequisites: MAT-223

Credit: 1

MAT-334 Funct Real Variable II

A continuation of MAT 333. Topics will depend on the instructor but may include sequences and series of functions, Fourier analysis, elementary functional analysis, advanced multivariable calculus or metric spaces.

Prerequisites: MAT-333

Credit: 1

MAT-337 Numerical Analysis

This course provides a broad introduction to the field of numerical analysis. Topics of study include rootfinding, numerical linear algebra, function approximation, numerical differentiation and integration, and numerical methods for differential equations. The primary focus involves the derivation, analysis and implementation of numerical methods, but the course also includes discussion of uses and implications of these methods in applications. This course is offered in the fall semester of even-numbered years.

Prerequisites: CSC-111 and MAT-223

Credit: 1

Distribution: Quantitative Literacy

MAT-338 Topics Computational Math

This course develops mathematical and computational techniques in areas of mathematics or interdisciplinary study in which computation plays a central and essential role. Topics vary by semester but they may include computational geometry, computer algebra, scientific computing, and symbolic computation. This course is offered in the fall. Refer to the Course Descriptions document on the Registrar's webpage for topics and descriptions of current offerings. semester of odd-numbered years.

Prerequisites: CSC-111 and MAT-112

Credit: 1

Distribution: Quantitative Literacy

MAT-341 Topology

An introduction to point-set topology. Topics include topological spaces, continuous functions, product and quotient spaces, metric spaces, connectedness, and compactness.

Prerequisites: MAT-223

Credit: 1

MAT-344 Complex Analysis

This course develops the core analytical framework for complex functions of one variable. Topics include basic operations and properties of the complex plane, transformations of elementary functions, analytic functions, contour integrals, theory of residues, and conformal mapping. This course is offered in the spring semester of odd-numbered years.

Prerequisites: MAT-223

Credit: 1

Distribution: Quantitative Literacy

MAT-353 Probability Models II

This course is a continuation of MAT-253 (Probability Models) with a focus on applications to financial problems. Brownian motion and Ito integrals are introduced and used for ruin theory calculations and applied to some simple investment models with continuous trading. The compound Poisson, mixed, and mixture distributions are used for some insurance settings. Expected present value and variance of present value are calculated for a wide variety of life insurance and annuity problems. The course is typically offered in the fall semester.

Prerequisites: MAT-253

Credits: 0.5

Distribution: Quantitative Literacy

MAT-354 Mathematical Statistics

This course takes a more theoretical look at estimation and hypothesis testing than MAT-254 (Statistical Models). Classical estimation topics include method of moment estimators, maximum likelihood estimators (MLE's), the information inequality, and the asymptotic theory of MLE's. Classical hypothesis testing topics include using the Neyman-Pearson Lemma to find most powerful tests and uniformly most powerful tests, Likelihood ratio tests (LRT's), and the asymptotic theory of LRT's. The course also looks at the Bayesian approach to statistical inference, in particular, the situation with binomial data and beta priors. This course is typically offered in the spring semester, loosely alternating with MAT-355 Regression Models.

Prerequisites: MAT-253 and MAT-254

Credits: 0.5

Distribution: Quantitative Literacy

MAT-355 Regression Models

This course takes a mathematical, matrix-based look at regression (introduced in MAT-254, Statistical Models). The probabilistic machinery needed when working with linear combinations of normal random variables is developed, including orthant probability calculation and several results involving the chi-square distribution. A general method for hypothesis testing is presented and used in a variety of testing situations. Time series models are also looked at and maximum likelihood estimation in both regression and time series settings is considered. This course is typically offered in the spring semester, loosely alternating with MAT-354 Mathematical Statistics.

Prerequisites: MAT-223, MAT-253, and MAT-254

Credits: 0.5

Distribution: Quantitative Literacy

MAT-377 Special Topics

This course is designed for the treatment of material outside the regular offerings of the department. For a given semester, the course content and other particulars will be announced before advance registration for that semester. Refer to the Course Descriptions document on the Registrar's webpage for topics and descriptions of current offerings.

Prerequisites: none

Credits: 0.5-1

Distribution: Quantitative Literacy

MAT-378 Special Topics

This course is designed for the treatment of material outside the regular offerings of the department. For a given semester, the course content and other particulars will be announced before advance registration for that semester. Refer to the Course Descriptions document on the Registrar's webpage for topics and descriptions of current offerings.

Prerequisites: none

Credits: 0.5-1

Distribution: Quantitative Literacy

MAT-387 Independent Study

Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.

Prerequisites: none

Credits: 0.5-1

MAT-388 Independent Study

Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.

Prerequisites: none

Credits: 0.5-1

MAT-400 Seminar

Topics in the history and foundations of mathematics, the special emphasis varying from year to year. Every student will be expected to write a term paper. Please refer to the Registrar's page for course description.

Prerequisites: none

Credits: 0.5

Distribution: Quantitative Literacy