MA-Mathematics Courses

Courses

MA 094. Basic Mathematics. 3 Hours.
Whole numbers, fractions, decimals, ratios and proportions, percentages, integers, basic geometry, and basic algebra including linear equations and applications. Designed to prepare students for MA 110, Finite Mathematics. Students preparing to take MA 102 should take MA 098. Attendance at the first meeting is mandatory. MA 094 section QL is an on-line version of MA 094 intended primarily for students who have job conflicts or live a long distance from the campus. There are no campus based meetings with the on-line class. However, students in the on-line version of MA 094 are required to interact with peers and the instructor through an on-line format and should be able to work independently and be motivated self-starters who are confident in their ability to master mathematics. Non-credit; does not contribute to any degree requirements. 0.000 Credit Hours. However, Financial Aid will count this as 3 credits towards eligibility.

MA 094L. Basic Mathematics Lab. 2 Hours.
This course is a 2 credit hours co-requisite lab designed to supplement the introduction to #nite mathematics course MA 108. The lab provides detailed and comprehensive review of whole numbers, fractions, decimals, ratios and proportions, percentages, integers, basic geometry, and basic algebra including linear equations and applications. The emphasis is on hands-on, individualized guidance for mastering the above concepts as well as problem solving and examples of applications in the topics discussed and presented in MA 108.

MA 098. Basic Algebra. 3 Hours.
Arithmetic of integers, rational numbers, real numbers, exponents, polynomial algebra, factoring, rational functions, linear and quadratic equations, elementary geometry, verbal problems. Designed to prepare students for college level math courses. Attendance at the first meeting is mandatory. MA 098 section QL is an on-line version of MA 098 and is intended primarily for students who have job conflicts or live a long distance from the campus. There are no campus based meetings with the on-line class. However, students in the on-line version of Ma098 are required to interact with peers and the instructor through an on-line format and should be able to work independently and be motivated self-starters who are confident in their ability to master mathematics. Non-credit; does not contribute to any degree requirements. 0.000 Credit Hours. However, Financial Aid will count this as 3 credits towards eligibility.

MA 102. Intermediate Algebra. 3 Hours.
Absolute values, Cartesian coordinates, graphs of linear equations, concept of a function, linear systems, algebra of polynomials, factoring of polynomials, algebra of rational expressions, literal equations, word problems involving linear, rational and quadratic models, integer and rational exponents, radical expressions, rational, radical and quadratic equations, complex numbers. 3 hours of mandatory class and lab meetings per week. Quantitative Literacy is a significant component of this course. MA 102 section QL is an on-line version of MA 102 and is intended primarily for students who have job conflicts or live a long distance from the campus. There are no campus based meetings with the on-line class. However, students in the on-line version of MA 102 are required to interact with peers and the instructor through an on-line format and should be able to work independently and be motivated self-starters who are confident in their ability to master mathematics.
Prerequisites: MA 098 [Min Grade: C] or MPL 30 or EMA E

MA 105. Pre-Calculus Algebra. 3 Hours.
Functions from algebraic, geometric (graphical), and numerical points of view, including polynomial, rational, logarithmic, and exponential functions; inverse functions; quadratic, polynomial and rational inequalities; complex and real roots of polynomials; applications and modeling, both scientific and business. Supports development of quantitative literacy. May not be enrolled in Undergraduate Certificate. Quantitative Literacy is a significant component of this course. This course meets the Blazer Core Quantitative Literacy requirement.
Prerequisites: MA 102 [Min Grade: C] or MPL 46 or EMA E

MA 106. Pre-Calculus Trigonometry. 3 Hours.
Trigonometric functions and their inverses, graphs, and properties; right triangle trigonometry and applications; analytical trigonometry, trigonometric identities and equations; polar coordinates; vectors; laws of sines and cosines; conic sections. Supports development of quantitative literacy. Quantitative Literacy is a significant component of this course. This course meets the Blazer Core Quantitative Literacy requirement.
Prerequisites: MA 105 [Min Grade: C] or MPL 61 or EMA E

MA 107. Pre-Calculus Algebra and Trigonometry. 4 Hours.
A one-semester combination of MA 105 Pre-Calculus Algebra and MA 106 Pre-Calculus Trigonometry, this course covers the basics of many types of functions including polynomial, rational, exponential, logarithmic, inverse, trigonometric and more. Analysis of graphs, modeling, and applications of functions in the modern world will be covered. This course provides a quick review of the algebra and trigonometry needed to be successful in Calculus, as well as promotes real-world problem-solving skills to serve as a Blazer Core Quantitative Literacy course.
Prerequisites: MA 102 [Min Grade: B] or MA 105 [Min Grade: C] or MPL 65

MA 108. Mathematics of Social Choice. 3 Hours.
For most people, the value of mathematics lies in applications. On the one hand, the operation of our society is based upon a great deal of technical mathematics that is mastered by a minority of the population. On the other hand, there are many applications of mathematics, in the form of whole number and rational arithmetic, and display and evaluation of data, that require only an understanding and computational familiarity with elementary mathematics. This course takes the later point of view. This course meets Blazer Core Quantitative Literacy.

MA 109. Math of Decision Making. 3 Hours.
As a First Year Experience (FYE) course, MA 109 engages students in the process of designing pathways for both their life as UAB students, future careers, and future engagements as citizens. As a mathematics course, MA 109 demonstrates that much of the value of mathematics for most citizens lies in its applications. On the one hand, the operation of our society is based upon a great deal of technical mathematics that is mastered by a minority of the population. On the other hand, there are many applications of mathematics, in the form of whole number and rational arithmetic, and display and evaluation of data, that require only an understanding and computational familiarity with elementary mathematics. This course takes the later point of view.
Prerequisites: MA 105 [Min Grade: C] or MA 107 [Min Grade: C] or (A02 23 and HSCG 3.50) or (A02 24 and HSCG 3.00) or (A02 25 and HSCG 2.50) or A02 26 or (S02 540 and HSCG 3.50) or (S02 560 and HSCG 3.00) or (S02 580 and HSCG 2.50) or S02 600 or MAC1 17

MA 110. Finite Mathematics. 3 Hours.
An overview of topics of finite mathematics and applications of mathematics for the liberal arts student. Topics include counting, permutations, combinations, basic probability, conditional probability, descriptive statistics, binomial and normal distributions, statistical inference, and additional selected topics. Students construct models of problem situations, translate verbal descriptions into mathematical form, interpret and create schematic representations of mathematical relationships, use quantitative evidence as a basis for reasoning, argument, and drawing conclusions, and communicate their results to an audience appropriately. May not be enrolled in Undergraduate Certificate. Quantitative Literacy is a significant component of this course. This course meets Blazer Core Quantitative Literacy.
Prerequisites: MA 094 [Min Grade: C] or MA 098 [Min Grade: C] or MA 102 [Min Grade: C] or MPL 30 or EMA E

MA 110L. Finite Mathematics Laboratory. 0 Hours.
This course is a zero credit hours co-requisite lab designed to supplement lectures. This course provides a hands-on, individualized overview of finite mathematics and applications of mathematics for the liberal arts student. Topics include counting, permutations, combinations, basic probability, conditional probability, descriptive statistics, binomial and normal distributions, statistical inference, and additional selected topics. Students construct models of problem situations, translate verbal descriptions into mathematical form, interpret and create schematic representations of mathematical relationships, use quantitative evidence as a basis for reasoning, argument, and drawing conclusions, and communicate their results to an audience appropriately. This course is co-requisite with MA 110. Quantitative Literacy is a significant component of this course.

MA 118. Leadership and the Mathematics of Rational Decision-Making. 3 Hours.
The purpose of this course is two-fold: 2 • To provide current and future leaders with a mathematical framework to support ethical decision-making, particularly regarding voting methods and the allocation of resources. • To give a brief introduction to some of the more technical aspects at play in our world, enough so that our future leaders have an idea of the mathematics that occur behind the scenes. As a First Year Experience (FYE) course, MA 118 engages students in the process of finding a leadership role within UAB or the greater Birmingham area, as well as analyzing the decisions which our current leaders make, judging if those decisions are rational, or what would make them more rational. To that effect, students will learn to identify the mathematical principals at play within a major decision, and predict the possible long-term impacts of these decisions. As a mathematics course, MA 118 demonstrates that much of the value of mathematics for most citizens lies in its applications. There are many common applications of mathematics, in the form of whole number arithmetic or the display and evaluation of data, which require only an understanding and computational familiarity with elementary mathematics. On the one hand, the operation of our society is based upon a great deal of technical mathematics that is mastered by a minority of the population. Responsible and ethical leaders should have at least a passing familiarity with these technicalities, which they will acquire in this course.

MA 120. Introduction to Symbolic Logic. 3 Hours.
Modern theory of deductive inference. Emphasis on recognizing valid forms of reasoning. Truth-function theory and some concepts of one-variable quantification theory. May not be used to satisfy Core Curriculum requirement in mathematics.

MA 125. Calculus I. 4 Hours.
Limit of a function; continuity, derivatives of algebraic, trigonometric exponential, and logarithmic functions, application of derivative to extremal problems, optimization, and graphing; Newton method; the definite integral and its application to area problems; fundamental theorem of integral calculus, average value, and substitution rule. This course meets the Blazer Core Quantitative Literacy requirement.
Prerequisites: MA 106 [Min Grade: C] or MA 107 [Min Grade: C] or MPL 76 or EMA E or A02 29 or SAT2 680

MA 125L. Calculus I Lab. 0 Hours.
This course is a zero credit hours co-requisite lab designed to supplement the lectures. The emphasis will be on problem solving and examples of applications of the concepts discussed and presented during lectures. The laboratory will also use computer programs for problem-solving, visualization, plotting and simulation. The topics covered are: Limit of a function; continuity, derivatives of algebraic, trigonometric, exponential, and logarithmic functions, application of derivative to extremal problems, optimization, and graphing; Newton method; the de#nite integral and its application to area problems; fundamental theorem of integral calculus, average value, and substitution rule. Quantitative literacy is a significant component of this course.

MA 126. Calculus II. 4 Hours.
Techniques of integration; applications in integration such as volume, arc length and work; infinite series, Taylor series; polar coordinates; parametric equations; plane and space vectors; lines and planes in space. This course meets Blazer Core Curriculum Quantitative Literacy.
Prerequisites: MA 125 [Min Grade: C] or MA 225 [Min Grade: C]

MA 160. Linear Algebra: Data and Models. 4 Hours.
The course teaches linear algebra mostly from a process point of view with multiple examples to engender conceptual understanding through noting commonalities of the basic structures of #nite-dimensional Euclidean spaces. Beginning with two and three dimensional Euclidean spaces where algebraic and geometric viewpoints can be seen to correspond, we extend processing and under-standing to higher dimensional spaces through software. The lab will run prepackaged computer programs for determining some basic structures from others. Throughout the course development, applications in areas such as analysis of data sets, biological models, genetics, imaging science, page ranking, optimization, #nancial models, cryptography, and more will be presented. No background in matrix operations or computer programming is required.
Prerequisites: MA 105 [Min Grade: C] or MPL 70

MA 168. Mathematics of Biological Systems I. 4 Hours.
The course teaches mathematical modeling as a tool for understanding the dynamics of biological systems. We will begin with the fundamental concepts of single-variable calculus, and then develop single- and multi-variable differential equation models of dynamical processes in ecology, physiology and other applications in which quantities change with time. The laboratory will run prepackaged computer programs for problem-solving, visualization, plotting and simulation. Basic programming concepts like program #ow control and data structures will be introduced. No background in computer programming is required. This course meets Blazer Core Quantitative Literacy.
Prerequisites: MA 106 [Min Grade: C] or MA 107 [Min Grade: C] or MPL 70 or A02 29 or SAT2 680

MA 180. Introduction to Statistics. 3 Hours.
Descriptive and inferential statistics, probability distributions, estimation, hypothesis testing, One-way ANOVA, and linear regression. Quantitative Literacy is a significant component of this course. This course meets Blazer Core Quantitative Literacy.
Prerequisites: MA 102 [Min Grade: C] or MA 105 [Min Grade: C] or MPL 46 or MA 106 [Min Grade: C] or MA 107 [Min Grade: C] or MA 110 [Min Grade: C] or MA 125 [Min Grade: C] or MA 225 [Min Grade: C] or MA 168 [Min Grade: C]

MA 189. Data Dive Into Birmingham. 3 Hours.
This course provides an introduction to statistical methods for data analysis and places an emphasis on real-life applications more so than traditional mathematics courses. Featured in this course are a variety of applications from companies and businesses, as well as governmental organizations, in the city of Birmingham and the surrounding area. Alumni, local industry researchers, and faculty in other departments/ colleges at UAB will be invited to present an illustration of how statistics and mathematics are used in their particular jobs and fields. The presentation form will either be in person, online, or via a pre-recorded video. Students will be asked to replicate the analysis procedures of example cases on real datasets concerning the city of Birmingham and the region using R. The focus will be on learning new techniques and discussing the details from the practical local cases. This course will cover critical concepts, techniques, and tools in statistics and applied mathematics, as well as ethical discussions and privacy and security topics related to data. This course is a part of the Blazer Core City as Classroom curriculum with flags in Collaborative Assignments and Projects, as well as Service Learning/Community-Based Learning.
Prerequisites: MA 102 [Min Grade: C] or MPL 46

MA 224. Intermediate Symbolic Logic. 3 Hours.
Full development of quantification theory, including identity and definite description, and soundness and completeness proofs. Skill in formal proof emphasized, as well as ability to express arguments from natural language in artificial language.
Prerequisites: MA 120 [Min Grade: C] or PHL 220 [Min Grade: C]

MA 225. Calculus I - Honors. 4 Hours.
Limit of a function; continuity, derivatives of algebraic, trigonometric exponential, and logarithmic functions, application of derivative to extremal problems, optimization, and graphing; Newton method; the definite integral and its application to area problems; fundamental theorem of integral calculus, average value, and substitution rule. Students will be required to display an in-depth understanding of these topics through a complete justification of their work on tests and through participation in class projects. This course meets Blazer Core Curriculum Quantitative Literacy.
Prerequisites: MA 106 [Min Grade: C] or MA 107 [Min Grade: C] or MPL 76 or EMA E

MA 226. Calculus II - Honors. 4 Hours.
Techniques of integration; applications in integration such as volume, arc length and work; infinite series, Taylor series; polar coordinates; parametric equations; plane and space vectors; lines and planes in space. This course meets Blazer Core Curriculum Quantitative Literacy.
Prerequisites: MA 125 [Min Grade: C] or MA 225 [Min Grade: C]

MA 227. Calculus III. 4 Hours.
Vector functions, functions of two or more variables, partial derivatives, quadric surfaces, multiple integration and vector calculus, including Greens Theorem, curl and divergence, surface integrals, and Gauss' and Stokes' Theorem.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 252. Introduction to Differential Equations. 3 Hours.
First order differential equations (separable, linear, exact, and additional non-linear examples using MAPLE), modeling with first order DE's, examples of systems of first order DE's, theory of higher order linear DE's (homogeneous and non-homogeneous, superposition of solutions, linear independence and general solutions, initial and boundary value problems), solution of constant coefficient homogeneous linear equations, variation of parameters and Green's functions with complicated cases done using MAPLE. Modeling projects in the course will emphasize the use of MAPLE to do the heavy lifting. Quantitative Literacy and Writing are significant components of this course. This course meets Blazer Core Quantitative Literacy.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 260. Introduction to Linear Algebra. 3 Hours.
Linear equations and matrices; real vector spaces, basis, diagonalization, linear transformations; determinants, eigenvalues, and eigenvectors; inner product spaces, matrix diagonalization; applications and selected additional topics. This course meets Blazer Core Quantitative Literacy with a flag in Collaborative Assignments.
Prerequisites: MA 125 [Min Grade: C] or MA 225 [Min Grade: C] or MA 168 [Min Grade: C]

MA 265. Math Tools for Engineering Problem Solving. 4 Hours.
An applied mathematics course designed to utilize the terminology and problem-solving approaches inherent to engineering, while completing the mathematical preparation of most engineering students. This course includes elements of MA 227 and MA 252.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 268. Mathematics of Biological Systems II. 3 Hours.
The course MA268 is multidisciplinary in nature and targets undergraduate students in the life sciences, particularly biology, and mathematics. We re-view the biology of a variety of problems that arise in nature and medicine, and build upon the calculus ideas already developed by the students, adding additional mathematical tools as needed to facilitate the solution of these problems. The new mathematics includes introductory linear algebra (ma-trices, eigenvalues, eigenvectors) introductory multivariable calculus (linear approximation, optimization) and an introduction to the dynamics of linear and nonlinear systems of di#erential equations and mathematical chaos in bi-ological systems. Biological topics may include single species and interacting population dynamics, modeling infectious and dynamic diseases, regulation of cell function, and biological oscillators. There will also be discussions of current topics of interest such as cardiac arrhythmias and neural action potentials, HIV and AIDS, and control of the mitotic clock. For data visu-alization and computational tasks, we use the public-domain Python-based software SageMath. No prior computational expertise is assumed.
Prerequisites: MA 168 [Min Grade: C] or MA 125 [Min Grade: C] or MA 225 [Min Grade: C]

MA 298. Research in Mathematics. 1-12 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites vary with topics. Freshman or sophomore standing recommended. Prerequisites: Permission of instructor.

MA 311. History of Mathematics I. 3,4 Hours.
Development of mathematical principles and ideas from an historical viewpoint, and their cultural, educational and social significance.
Prerequisites: MA 125 [Min Grade: C] or MA 225 [Min Grade: C] or MA 168 [Min Grade: C]

MA 312. History of Mathematics II. 3 Hours.
Development of mathematical principles and ideas from an historical viewpoint, and their cultural, educational and social significance.
Prerequisites: MA 311 [Min Grade: C]

MA 313. Patterns, Functions and Algebraic Reasoning. 3 Hours.
Problem solving experiences, inductive and deductive reasoning, patterns and functions, some concepts and applications of geometry for elementary and middle school teachers. Topics include linear and quadratic relations and functions and some cubic and exponential functions. Number sense with the rational number system including fractions, decimals, and percents will be developed in problem contexts. An emphasis will be on developing algebraic thinking and reasoning.
Prerequisites: MA 102 [Min Grade: C] or MA 105 [Min Grade: C] or MA 106 [Min Grade: C] or MA 107 [Min Grade: C] or MA 110 [Min Grade: C] or MA 125 [Min Grade: C] or MA 160 [Min Grade: C] or MA 168 [Min Grade: C]

MA 314. Geometric and Proportional Reasoning. 3 Hours.
Problem solving experiences, inductive and deductive reasoning, concepts and applications of geometry and proportional reasoning. Topics include analysis of one-, two- and three-dimensional features of real objects, ratio and proportionally, similarity, and congruence, linear, area, and volume measurement, and the development of mathematically convincing arguments. An emphasis will be on developing geometric and proportional thinking and reasoning.
Prerequisites: MA 313 [Min Grade: C] or MA 168 [Min Grade: C]

MA 315. Probabilistic and Statistical Reasoning. 3 Hours.
Descriptive and inferential statistics, probability, estimation, hypothesis testing. Reasoning with probability and statistics is emphasized.
Prerequisites: MA 313 [Min Grade: C]

MA 316. Numerical Reasoning. 3 Hours.
Develop an understanding of number and improve numerical reasoning skills specifically with regard to place value, number relationship that build fluency with basis facts, and computational proficiency; developing a deep understanding of numerous diverse computational algorithms; mathematical models to represent fractions, decimals and percents, equivalencies and operations with fractions, decimals and percents; number theory including order of operations, counting as a big idea, properties of number, primes and composites, perfect, abundant and significant numbers, and figurate numbers; inductive and deductive reasoning with number.
Prerequisites: MA 313 [Min Grade: C] or MA 168 [Min Grade: C]

MA 317. Extending Algebraic Reasoning. 3 Hours.
Extension of algebraic and functional reasoning to polynomials, rational, exponential, and logarithmic functions; problem-solving involving transfer among representations (equation, graph, table); proof via symbolic reasoning, contradiction, and algorithm; interpretation of key points on graphs (intercepts, slope, extrema); development of facility and efficiency in manipulating symbolic representations with understanding; appropriate use of technology and approximate versus exact solutions; functions as models.
Prerequisites: MA 313 [Min Grade: C]

MA 360. Scientific Programming. 3 Hours.
Programming and mathematical problem solving using Matlab, Python, FORTRAN or C++. Emphasizes the systematic development of algorithms and numerical methods. Topics include computers, floating point arithmetic, iteration, GNU/Linux operating system, functions, arrays, Matlab graphics, image processing, robotics, solving linear systems and differential equation arising from practical situations, use of debuggers and other debugging techniques, and profiling; use of callable subroutine packages like LAPACK and differential equation routines; parallel programming. Assignments and projects are designed to give the students a computational sense through complexity, dimension, inexact arithmetic, randomness, simulation and the role of approximation.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 361. Mathematical Modeling. 3 Hours.
Mathematical modeling using computer software, including spreadsheets, systems dynamics software, and computer algebra systems; connections to calculus and functions are emphasized. Students make presentations to the class; justification of mathematical claims and quality of student presentations are assessed. Quantitative Literacy is a significant component of this course.
Prerequisites: MA 125 [Min Grade: C] or MA 225 [Min Grade: C] or MA 168 [Min Grade: C]

MA 398. Research in Mathematics. 1-12 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Junior standing recommended. Permission of instructor required.

MA 411. Integrating Mathematical Ideas. 3 Hours.
This course will integrate ideas from algebra, geometry, probability, and statistics. Emphasis will be on using functions as mathematical models, becoming fluent with multiple representations of functions, and choosing the most appropriate representations for solving a specific problem. Students will be expected to communicate mathematics verbally and in writing through small group, whole group, and individual interactions.
Prerequisites: (MA 125 [Min Grade: C] or MA 225 [Min Grade: C] or MA 168 [Min Grade: C]) and MA 314 [Min Grade: C](Can be taken Concurrently) or MA 316 [Min Grade: C])

MA 418. Statistics for Teachers. 3 Hours.
Descriptive and inferential statistics, probability distributions, estimation, hypotheses testing, regression. Writing assignment on a project drawing from the above topics. Quantitative Literacy is a significant component of this course.
Prerequisites: MA 102 [Min Grade: C] or MPL 46 or MA 105 [Min Grade: C] or MA 106 [Min Grade: C] or MA 107 [Min Grade: C] or MA 110 [Min Grade: C] or MA 125 [Min Grade: C] or MA 225 [Min Grade: C]

MA 419. Special Topics. 1-4 Hour.
Topics vary; may be repeated for credit.
Prerequisites: MA 125 [Min Grade: C] or MA 225 [Min Grade: C] or MA 168 [Min Grade: C]

MA 434. Algebra I: Linear. 3 Hours.
Abstract vector spaces. Linear transformations: ranges and null spaces; matrix representation; invertibility and isomorphism; the change of coordinate matrix; transformation of a matrix of a linear map under a change of basis. Elementary matrix operations and elementary matrices; column and row spaces of a matrix; rank. Theory of systems of linear equations. Inner product spaces: inner products and norms; orthogonal bases; Gram-Schmidt orthogonalization process and orthogonal complements; self-adjoint operators; spectral theorem. Generalized eigenvectors; Jordan form. Applications.
Prerequisites: MA 260 [Min Grade: C]

MA 435. Algebra II: Modern. 3 Hours.
Rings, including the rings of integers and of polynomials, integral domains, fields and groups. Homomorphism, isomorphism. As time permits, Galois theory, semi-groups, quotient groups, models, or other areas of algebra may be included. Students present proofs from a list of pre-assigned theorems to the class. Logical correctness and proper mathematical proof-writing style are assessed.
Prerequisites: MA 434 [Min Grade: C] or MA 260 [Min Grade: C]

MA 440. Advanced Calculus I. 3 Hours.
Real numbers, sequences and series, continuity, differential and integral calculus, exponential and logarithm functions, sine and cosine functions. Students present proofs from a list of pre-assigned theorems to the class. Written versions of the proofs are posted for easy access in subsequent proofs. Logical correctness and proper mathematical proof-writing style are assessed. Writing and Quantitative Literacy are significant components of the course.
Prerequisites: MA 227 [Min Grade: C]

MA 441. Advanced Calculus II. 3 Hours.
Real numbers, sequences and series, continuity, differential and integral calculus, exponential and logarithm functions, sine and cosine functions. Students present proofs from a list of pre-assigned theorems to the class. Written versions of the proofs are posted for easy access in subsequent proofs. Logical correctness and proper mathematical proof-writing style are assessed. Writing and Quantitative Literacy are significant components of the course.
Prerequisites: MA 440 [Min Grade: C]

MA 444. Vector Analysis. 3 Hours.
Review and application of multiple integrals; Jacobians and change of variables in multiple integrals; line and surface integrals; Green, Gauss, and Stokes theorems, with applications to physical sciences and computation in spherical and cylindrical coordinates.
Prerequisites: MA 227 [Min Grade: C]

MA 445. Complex Analysis. 3 Hours.
Analytic functions, complex integration and Cauchys theorem, Taylor and Laurent series, calculus of residues and applications, conformal mappings.
Prerequisites: MA 227 [Min Grade: C]

MA 453. Fourier Analysis. 3 Hours.
Fourier series, including odd/even functions expansions, complex power series, generalized Fourier series. Convergence, applications to partial di#erential equations. Fourier transform: basic prop-erties, inversion of the FT, windowing, relation to the Laplace transform. Applications to partial di#erential equations. Wavelets and signal processing basic functions, transforming wavelets, short time Fourier transform.
Prerequisites: MA 252 [Min Grade: C]

MA 454. Intermediate Differential Equations. 3 Hours.
Topics from among Frobenius series solutions, Sturm-Liouville systems, nonlinear equations, and stability theory.
Prerequisites: MA 252 [Min Grade: C]

MA 455. Partial Differential Equations I. 3 Hours.
Classification of second order partial differential equations; background on eigenfunction expansions and Fourier series; integrals and transforms; solutions of the wave equations, reflection of waves; solution of the heat equations in bounded and unbounded media; Laplaces equation, Dirichlet and Neumann problems. Written project reports required. Quantitative Literacy and Writing are significant components of this course.
Prerequisites: MA 252 [Min Grade: C]

MA 456. Partial Differential Equations II. 3 Hours.
Classification of second order partial differential equations; background on eigenfunction expansions and Fourier series; integrals and transforms; solution of the wave equations, reflection of waves; solution of the heat equation in bounded and unbounded media; Laplace's equation, Dirichlet and Neumann problems.
Prerequisites: MA 455 [Min Grade: C]

MA 460. Mathematical Game Theory. 3 Hours.
This course is an introduction to mathematical game theory for those that have good understanding of calculus. Unlike calculus and optimization, where one learns how to maximize functions when the payoff depends only on your own choices, game theory deals with situations in which payoff depends not only on your own choices but also on the choices of others. Like optimization, game theory is de#ned by the problems it deals with, not by the mathematical techniques that are used to solve them. These problems come from diverse #elds ranging from evolutionary biology and animal behavior to political science and economics. Examples are drawn from scenarios such as traffic accidents, crime-control strategies, climate change negotiations etc. The course provides substantial treatment of evolutionary game theory, where strategies are not chosen through rational analysis, but emerge by virtue of being successful. This part of game theory requires understanding of calculus and some differential equations and is the most relevant to biology. It also explains how human societies evolve. Problem sets to help develop the ability necessary to master game theory tools will be discussed and assigned at the end of each chapter. Quantitative literacy is a significant component of this course.
Prerequisites: MA 125 [Min Grade: C] or MA 225 [Min Grade: C] or MA 168 [Min Grade: C]

MA 461. Modeling with Partial Differential Equations. 3 Hours.
Practical examples of partial differential equations; derivation of partial differential equations from physical laws; introduction to COMSOL Multiphysics using practical examples; specialized modeling projects selected from topics such as groundwater modeling, scattering of waves, medical and industrial imaging, traffic flows, continuum mechanics and deformation of solids, Fluid mechanics including the class boat race, financial derivative modeling, and acoustic and electromagnetic wave applications. Written project reports required for homework assignments in addition to online quizzes. Quantitative Literacy and Writing are significant components of this course.
Prerequisites: MA 252 [Min Grade: C] or MA 227 [Min Grade: C]

MA 462. Intro to Stochastic Differential Equations. 3 Hours.
Stochastic differential equations arise when random effects are introduced into the modeling of physical systems. Topics include Brownian motion and Wiener processes, stochastic integrals and the Ito calculus, stochastic differential equations, and applications to financial modeling, including option pricing.
Prerequisites: MA 485 [Min Grade: C]

MA 466. Introduction to Optimization. 3 Hours.
Optimization is important in many decision making problems in various areas like engineering, economics and machine learning. Optimization theory deals with finding the best solution(s) or variables of a given objective function. Recently, the area of optimization has received much attention due to the development of highly efficient computational methods for data analysis. The scope of this course covers linear algebra, unconstrained optimization, linear programming, and nonlinear constrained optimization. The topics include linear algebra, linear program, duality, network flows, simplex method, non-simplex method, gradient and conjugate methods, neural network, genetic algorithm and convex optimization. The course will also introduce optimization algorithms and codes via python and matlab.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 467. Gas Dynamics. 3 Hours.
Euler's equations for inviscid flows, rotation and vorticity, Navier-Stokes equations for viscous flows, hyperbolic equations and characteristics, rarefaction waves, shock waves and entropy conditions, the Riemann problem for one-dimensional gas flows, numerical schemes.
Prerequisites: MA 252 [Min Grade: C] and MA 360 [Min Grade: C]

MA 468. Numerical Analysis I. 3 Hours.
Sources of error and conditioning. Solution of algebraic equations in one variable: Bisection method, Fixed point iteration method, Newton's method and its variants, and their conver-gence. Approximation and interpolation: Monomial and Lagrange interpolations, Newton's divided difference form, Hermite interpolation, and Cubic spline. Numerical differentiation: Deriving formulas using Taylor series, Truncation error, and Richardson extrapolation. Nu-merical integration: Open and closed Newton-Cotes formulas, Composite numerical inte-gration, Romberg integration, and Gaussian quadrature. Solution of Ordinary Differential Equations (ODEs): Initial value ODEs, Euler's method, Runge-Kutta methods, Multi-step methods, and Boundary value ODEs. Practice on the computer.
Prerequisites: MA 227 [Min Grade: C] or MA 252 [Min Grade: C]

MA 469. Numerical Analysis II. 3 Hours.
Direct methods for linear systems: Gaussian elimination and back substitution, Pivoting strategies, Matrix factorization: LU and Cholesky decomposition, and Estimating errors and the condition number. Iterative solution of systems of nonlinear equations: Fixed points for functions of several variables, Newton's method, Quasi-Newton methods, Steep-est Descent method. Evaluation of eigenvalues and eigenvectors of matrices: Existence and uniqueness, Orthogonal matrices and similarity transformations, Power method and vari-ants, Generalized eigenvalue problems, Householder's Method, QR algorithm, and Singular Value Decomposition (SVD). Practice on the computer.
Prerequisites: MA 468 [Min Grade: C]

MA 470. Differential Geometry. 3 Hours.
Theory of curves and surfaces: Frenet formulas for curve, first and second fundamental forms of surface; global theory; abstract surfaces, manifolds, Riemannian geometry.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 472. Geometry I. 3 Hours.
The axiomatic method; Euclidean geometry including Euclidean constructions, basic analytic geometry, transformational geometry, and Klein's Erlangen Program. Students present proofs from a list of pre-assigned theorems to the class. Logical correctness and proper mathematical proof-writing style are assessed.
Prerequisites: MA 125 [Min Grade: C] or MA 225 [Min Grade: C] or MA 168 [Min Grade: C]

MA 473. Geometry II. 3 Hours.
Analytical geometry, Birkhoff s axioms, and the complex plane; structure and representation of Euclidean isometries; plane symmetries; non-Euclidean(hyperbolic) geometry and non-Euclidean transformations; fractal geometry; algorithmic geometry. Course integrates intuition/ exploration and proof/ explanation.
Prerequisites: MA 472 [Min Grade: C] and (MA 260 [Min Grade: C] or MA 434 [Min Grade: C])

MA 474. Introduction to Topology I. 3 Hours.
Essence and consequences of notion of continuous function developed. Topics include metric spaces, topological spaces, compactness, connected-ness, and separation.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 475. Introduction to Topology II. 3 Hours.
Essence and consequences of notion of continuous function developed. Topics include metric spaces, topological spaces, compactness, connectedness, and separation.
Prerequisites: MA 474 [Min Grade: C]

MA 480. Introduction to Statistics. 3 Hours.
Descriptive and inferential statistics, probability distributions, estimation, hypothesis testing. Recommended that two years of high school algebra or MA 102 has been completed before taking course. MA 480 does not count toward any math major or minor.

MA 484. Mathematical Finance. 3 Hours.
The notion of no arbitrage. Interest, compounding, bonds. Review of mean, variance, and co-variance. Central limit theorem. Portfolio management: risk and return. Forwards and Futures. Put-call parity. Martingales and conditional expectation. The binomial model. Fundamental theorems of asset pricing. The Cox-Ross-Rubinstein formula. The Black-Scholes-Merton formula. Using computing programs such as Matlab and Python for more complex derivatives such as American put options.
Prerequisites: MA 125 [Min Grade: C] and MA 485 [Min Grade: C] or MA 168 [Min Grade: C]

MA 485. Probability. 3 Hours.
Combinatorics, probability spaces, combinatorics, conditional probabilities and independence, Bayes rule, discrete and continuous distributions, mean value and variance, random variables, joint distributions, correlation, Law of Large Numbers, Central Limit Theorem.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 486. Mathematical Statistics I. 3 Hours.
Sampling techniques and data analysis, Describing data distributions, Point estimation, Statistical inference, Confidence intervals, Tests for binomials, Tests for normals, Hypothesis testing, Two-factor analysis, Goodness-of-Fit test, Contingency tables.
Prerequisites: MA 485 [Min Grade: C]

MA 488. Mathematical Statistics II. 3 Hours.
The course is designed as a continuation of MA486 for higher-level undergraduate students interested in Statistics and looking to gain the skills necessary for a wide variety of professions like actuaries, analytics, banking etc. Topics to be covered: Association and prediction: general linear models (GLM), multiple regression: testing hypothesis and correlations, polynomial regression, one-way and two-way ANOVA for multiple regression, GLM assumption diagnostics, polynomial regression, best model selection, checking model adequacy.
Prerequisites: MA 486 [Min Grade: C]

MA 489. Statistical Techniques for Machine Learning and Big Data. 3 Hours.
Topics of statistical learning and how to implement these methods by using R/Python. The course will cover major statistical learning methods and concepts for both supervised and unsupervised learning, such as model assessment and selection; classification, clustering; and big data analysis.
Prerequisites: MA 486 [Min Grade: B]

MA 490. Mathematics Seminar. 1-3 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites Permission of instructor.

MA 491. Special Topics in Mathematics. 1-3 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites vary with topics.

MA 492. Special Topics in Mathematics. 1-3 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites vary with topics.

MA 493. Special Topics in Mathematics. 1-3 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites vary with topics.

MA 494. Special Topics in Mathematics. 1-6 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites vary with topics.

MA 495. Special Topics in Mathematics. 1-6 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites vary with topics.

MA 496. Special Topics in Mathematics. 1-12 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites vary with topics.

MA 497. Research Methods in Mathematics. 1-3 Hour.
Through experience in designing and carrying out investigations, learn how scientists and mathematicians gain knowledge, evaluate scientific and mathematical claims when they conduct, and design and carry out investigations to answer new questions. Work is closely coordinated with the work of students from other content disciplines so that students see the similarity and differences of research methods in their own field as compared with those of science and mathematics inquiry as a whole. Enrollment in UABTeach is required.
Prerequisites: MA 125 [Min Grade: C] or MA 225 [Min Grade: C]

MA 498. Research in Mathematics. 1-12 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites vary with topics. Senior standing recommended.

MA 499. Honors Research in Mathematics. 1-12 Hour.
Mentored research in mathematics leading to a written research report and a public presentation in the form of a talk or poster. Admission restricted to students admitted to Honors in Mathematics. Permission of instructor required.