

MATHEMATICS

Mathematics is a universal language. It is a language which can be used to concisely express ideas and relationships and a tool which can be used to investigate many applied problems in science, engineering, and other fields. Mathematics is also a subject worthy of exploration on its own and can lead students to many surprising - and surprisingly powerful - discoveries.

Students pursuing a bachelor of science degree in applied mathematics at Missouri S&T may choose to pursue emphasis areas in actuarial science, algebra/discrete mathematics, applied analysis, computational mathematics, secondary education, and statistics.

Through your study of mathematics at Missouri S&T, you will engage with a broad range of mathematics and statistics coursework. In addition, students pursuing a degree in applied mathematics complete technical coursework in other disciplines to enhance the context of their study of mathematics. Through your studies at Missouri S&T, you will find that mathematics contributes to the growth of knowledge in many areas.

The department of mathematics and statistics is housed in the Rolla Building, and classes are held in a variety of locations around campus.

Bachelor of Science Applied Mathematics

A minimum of 120 credit hours is required for a bachelor of science degree in applied mathematics. A minimum grade of "C" is required by the department in each mathematics and statistics course counted toward the B.S. in applied mathematics. Moreover, the department requires that an average of at least two grade points per credit hour must be obtained for all courses taken within the department. These requirements for the B.S. degree are in addition to credit received for algebra, trigonometry, and basic ROTC.

The applied mathematics curriculum requires fifteen semester hours of technical electives, except where this requirement is reduced to compensate for extra requirements of emphasis areas, in addition to basic required courses in the sciences and economics. Specific requirements for the bachelor's degree are outlined in the sample program below.

Freshman Year			
First Semester	Credits	Second Semester	Credits
MATH 1101 ¹	1	MATH 1215 or 1221 ¹	4
MATH 1214 or 1211 ¹	4	Science Requirement ⁵	5
OR		COMP SCI 1500	3
MATH 1208		ENGLISH 1160 or 1600 ⁸	3
ENGLISH 1120	3	Basic ROTC (if elected) ⁴	0
ECON 1100 or 1200	3		
Campus History Requirement ²	3		
Basic ROTC (if elected) ⁴	0		
	14		15

Sophomore Year			
First Semester	Credits	Second Semester	Credits
MATH 2222 ¹	4	MATH 3304 ¹	3
MATH 3108 ¹	3	MATH 3109 ¹	3
COMP SCI 1570	3	Statistics Requirement ^{1,6,7}	3

COMP SCI 1580	1	Science Requirement ⁵	4
PHYSICS 1135	4	Literature	3
Basic ROTC (if elected) ⁴	0	Basic ROTC (if elected) ⁴	0
	15		16

Junior Year			
First Semester	Credits	Second Semester	Credits
MATH 4209 ¹	3	MATH 4211 ^{1, 12}	3
SP&M S 1185 or 3245 ¹⁴	3	Humanities/Social Science Elective ³	3
Electives-Math or Stat ^{1,7,9}	3	Electives - Statistics ^{1,7,15}	3
Electives-Technical ¹⁰	3	Electives-Technical ¹⁰	3
Electives ¹³	3	Electives ¹³	3
	15		15

Senior Year			
First Semester	Credits	Second Semester	Credits
Capstone Course ^{1,7,11}	3	Electives-Math or Stat ^{1,7,9}	3
Electives-Math or Stat ^{1,7,9}	3	Electives-Technical ¹⁰	3
Electives-Technical ¹⁰	6	Electives ¹³	9
Humanities/Social Science Elective ³	3		
	15		15

Total Credits: 120

- A minimum grade of "C" is required by the department in each mathematics and statistics course counted toward the B.S. in applied mathematics.
- May be met by HISTORY 1200, HISTORY 1300, HISTORY 1310, or POL SCI 1200.
- The two humanities/social science electives (at least 3 credits each) are to be selected from lecture courses in ART, ENGLISH, ETYM, FRENCH, GERMAN, HISTORY, MUSIC, PHILOS, POL SCI, PSYCH, RUSSIAN, SPANISH, SP&M S, and THEATRE.
- Basic ROTC may be elected in the freshman and sophomore years, but is not creditable toward a degree. Up to six credit hours of advanced ROTC may be credited as free electives towards a degree.
- Choose two of the following:
(BIO SCI 1113 or BIO SCI 1213) plus BIO SCI 1219; or
BIO SCI 2223; or
CHEM 1100 plus CHEM 1310 plus CHEM 1319; or
CHEM 1320; or
PHYSICS 2135
- May be met by STAT 3113, STAT 3115, or STAT 3117.
- No course may be used to satisfy more than one degree requirement, except as otherwise noted.
- May also be satisfied by ENGLISH 3560.
- Select any three 4000 or 5000 level math or stat lecture courses.
Research (MATH 4099, MATH 5099, STAT 4099, STAT 5099) and seminars (MATH 4010, MATH 5010) do not fulfill this requirement. Special topics and special problems courses are acceptable.
- Courses in biology, business, chemistry, computer science, economics, education, engineering, finance, geology, geophysics, information science and technology, marketing, mechanics, physics, or technical communication approved by advisor. The general math curriculum requires 15 credit hours; actuarial science emphasis area, 9 credit hours; computational math emphasis area, 12 credit hours. All technical elective requirements are built in to the statistics emphasis area via the included computer science minor.

SP&M S 1185	3	STAT 3113, or 3115, or 3117	3
	17		15

Junior Year

First Semester	Credits	Second Semester	Credits
MATH 4209	3	MATH 4211	3
ECON 1100 or 1200	3	MATH 4530	3
ENGLISH 3170	3	EDUC 3280	3
EDUC 3216	3	EDUC 3340	3
EDUC 3298	1	PSYCH 2300 or EDUC 2102	3
POL SCI 1200	3		
	16		15

Senior Year

First Semester	Credits	Second Semester	Credits
Electives-Math or Stat ¹	6	EDUC 4298 & EDUC 4299 ³	13
PSYCH 4310 or EDUC 2310	3		
Electives ²	6		
	15		13

Total Credits: 120

¹ Any two three-hour courses from the following list with the approval of the mathematics education advisor.
MATH 5105, MATH 5106, MATH 5107, MATH 5108, MATH 5215, MATH 5222, MATH 5302, MATH 5325, MATH 5351, MATH 5483, MATH 5512, MATH 5585, MATH 5601, MATH 5602, MATH 5603, MATH 5604, MATH 5680, MATH 5737, MATH 5762, STAT 4210, STAT 5260, STAT 5290, STAT 5346, STAT 5353, STAT 5643, STAT 5644, STAT 5755, STAT 5756, STAT 5814

² Sufficient free electives to earn a minimum of 120 credit hours.

³ Student Teaching satisfies the capstone requirement for students completing this emphasis area.

Data Science and Statistics Emphasis Area

Required courses:

STAT 4210	Introduction to Statistical Data Science	3
STAT 5643	Probability And Statistics	3
STAT 5644	Mathematical Statistics	3
STAT 5346	Regression Analysis ²	3
STAT 5353	Statistical Data Analysis (Satisfies Capstone requirement) ¹	3
Select one of the following:		6
STAT 5260	Statistical Data Analysis Using SAS	3
STAT 5290	Computational Bayesian Methods using Python	3
STAT 5814	Applied Time Series Analysis	3
or another approved computational statistics course		
Complete the following CS courses (in addition to those required for all Applied Mathematics majors):		
COMP SCI 1200	Discrete Mathematics for Computer Science ²	3
COMP SCI 1575	Data Structures ²	3
COMP SCI 1585	Data Structures Laboratory ²	1
COMP SCI 2300	File Structures and Introduction to Database Systems ²	3
COMP SCI 2500	Algorithms ²	3
and one of the following two courses:		
COMP SCI 5400	Introduction To Artificial Intelligence ²	3
COMP SCI 5402	Introduction to Data Mining ²	3

¹ Satisfies Capstone requirement.

² Satisfies the requirements for a minor in Computer Science (when combined with COMP SCI 1500, COMP SCI 1570, and COMP SCI 1580 which are required for all Applied Mathematics majors).

Bioinformatics Minor

Students majoring in mathematics are eligible to pursue a minor in bioinformatics. See the description of the bioinformatics minor (<http://catalog.mst.edu/undergraduate/degreeprogramsandcourses/bioinformaticsminor/>).

Mathematics Minor Curriculum

The minor will consist of at least 12 hours of mathematics/statistics courses at the 3000 or higher level*, 9 hours of which must be completed in residence at Missouri S&T and 3 hours of which must be at the 4000 or higher level, and passing all of them with at least a grade of "C". Further, MATH 3304 and MATH 3329 cannot both be counted, MATH 3103 and MATH 3108 cannot both be counted, and at most one of STAT 3111, STAT 3113, STAT 3115 and STAT 3117 may be counted. Finally, the specific choice of courses is subject to the approval of the minor advisor.

* COMP SCI 3200 Introduction To Numerical Methods may be substituted for one of these courses.

Akim Mouhamadou Adekpedjou, Professor
PHD University of South Carolina Columbia

Elvan Akin, Professor
PHD University of Nebraska Lincoln

Martin Bohner, Curators' Distinguished Professor
PHD University of Ulm, Germany

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Daozhi Han, Assistant Professor
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Xiaoming He, Associate Professor
PHD Virginia Polytechnic Institute

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PHD Kansas State University

John R Singler, Professor
PHD Virginia Polytechnic Institute

Xuerong (Meggie) Wen, Associate Professor
PHD University of Minnesota

Yanzhi Zhang, Associate Professor
PHD National University of Singapore

MATH 1000 Special Problems (IND 0.0-6.0)
Problems or readings in specific subjects or projects in the department.
Consent of instructor required.

MATH 1001 Special Topics (LAB 0.0 and LEC 0.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

MATH 1101 Introduction To Mathematics (LEC 1.0)
Introduction to the department, program of study, methods of study, and an introduction of the various areas of mathematics. Required of fall semester freshman mathematics majors.

MATH 1103 Fundamentals Of Algebra (LEC 3.0)
Basic principles of algebra including the number line and an introduction to equations and inequalities, polynomials, rational expressions, exponents and radicals, the quadratic formula and functions.
Prerequisite: Entrance requirements.

MATH 1110 Mathematical Reasoning and Modeling (LEC 3.0)
Designed for non-STEM majors, this course provides a comprehensive overview of the reasoning skills required to process, reflect upon, and apply quantitative information in making decisions. Topics include ratios, rates, percentages, units, descriptive statistics, linear and exponential modeling, correlation, logic, and probability. Technology is emphasized.
Prerequisites: Entrance requirements.

MATH 1120 College Algebra (LEC 5.0)
Contains the same topics as covered in Math 1140, and preceded by a thorough review of the basic principles of algebra. Prerequisite: A grade of "C" or better in Math 1103; or by placement examination.
MATH 1120 - MOTR MATH 130: Pre-Calculus Algebra

MATH 1140 College Algebra (LEC 3.0)
A study of linear equations, rational functions, radicals, quadratic equations, inequalities, determinants, progressions, theory of equations, permutations, combinations, and the binomial theorem. Prerequisite: By placement examination.
MATH 1140 - MOTR MATH 130: Pre-Calculus Algebra
MATH 1140 - MOTR MATH 150: Pre-Calculus

MATH 1160 Trigonometry (LEC 2.0)
A study of the trigonometric functions, radian measure, graphing trigonometric functions, identities, trigonometric equations and inverse trigonometric functions. Solutions of general triangles and trigonometric representation of complex numbers are included. Prerequisite: Math 1120 or 1140 with a grade of "C" or better; or by placement exam.
MATH 1160 - MOTR MATH 150: Pre-Calculus

MATH 1190 Success for Calculus (LAB 1.0 and LEC 3.0)
This course focuses on the use of college algebra and trigonometry skills within the context of calculus, providing students with the opportunity to improve their preparedness for future calculus coursework. Pass/Fail only. Prerequisites: Consent of instructor.

MATH 1208 Calculus With Analytic Geometry I (LEC 5.0)
A study of limits, continuity, differentiation and integration of algebraic and trigonometric functions. Applications of these concepts in physical as well as mathematical settings are considered. Credit will only be given for one of Math 1208 or Math 1214. Prerequisites: Math 1160; Math 1120 or 1140, both with a grade of "C"; or better; or by placement exam.

MATH 1210 Calculus I-A (LAB 2.0 and LEC 3.0)
An introduction to differential and integral calculus for students needing extra algebra or trigonometry content. Emphasizes differential calculus along with linear, polynomial, rational, and radical functions and equations. Math 1210 and 1211 combined cover the same calculus content as Math 1214. Credit will be given for only one of Math 1210 or Math 1214. Prerequisites: A grade of "C" or better in either Math 1120 or Math 1140, or by placement exam.

MATH 1211 Calculus I-B (LAB 1.0 and LEC 3.0)
A continuation of Math 1210. Emphasizes differential and integral calculus along with exponential, logarithmic, and trigonometric functions and equations, plus trigonometric identities and solutions of general triangles. Math 1210 and 1211 combined cover the same calculus content as Math 1214. Prerequisites: A grade of "C" or better in either Math 1210 or 1214.

MATH 1212 Survey of Calculus (LAB 1.0 and LEC 3.0)

A survey of derivatives, optimization, exponential and logarithmic functions, integration, multivariate functions, partial derivatives, and Lagrange multipliers with applications in business, economics, and biology. This course is not appropriate for engineering or physical science majors. May not be used as a prerequisite for either Math 1215 or Math 1221. Prerequisites: A grade of "C" or better in either Math 1120, Math 1140, or Math 1210; or by placement exam.

MATH 1214 Calculus I (LAB 1.0 and LEC 3.0)

Introduction to limits, continuity, differentiation, and integration of algebraic and transcendental functions. Applications in physical science and engineering. Credit will be given for only one of Math 1208, 1210, or 1214. Prerequisites: A grade of "C" or better in both Math 1160 and one of Math 1120 or Math 1140; or by placement exam.

MATH 1215 Calculus II (LAB 1.0 and LEC 3.0)

Techniques of integration, sequences and series including power series, polar coordinates, polar and parametric equations. Applications in physical science and engineering. Credit will be given for only one of Math 1215 or Math 1221. Prerequisites: A grade of "C" or better in one of Math 1208 or 1214; or a grade of "C" or better in both Math 1210 and Math 1211.

MATH 1221 Calculus With Analytic Geometry II (LEC 5.0)

A continuation of Math 8; differentiation and integration of elementary transcendental functions, integration techniques, improper integrals, conic sections, polar coordinates, introduction to sequences and series. Credit will only be given for one of Math 1221 or Math 1215. Prerequisites: Math 1160 and either Math 1208 or Math 1214 both with a grade of "C" or better; or by placement exam.

MATH 2002 Cooperative Work Training (IND 0.0-6.0)

On-the-job experience gained through cooperative education with industry. Variable credit arranged with the advisor. P/F grading option is required and maximum credit per semester is 3 hrs., maximum for entire program is 6 hrs.

MATH 2222 Calculus III (LAB 1.0 and LEC 3.0)

An introduction to multivariable calculus. Vector valued functions, curves and surfaces in two and three dimensions, partial differentiation, multiple integration, line and surface integrals, the major theorems of vector calculus, and applications of these ideas are studied. Prerequisites: A grade of "C" or better in either Math 1215 or Math 1221.

MATH 3000 Special Problems (IND 0.0-6.0)

Problems or readings in specific subjects or projects in the department. Consent of instructor required.

MATH 3001 Special Topics (IND 0.0-6.0)

This course is designed to give the department an opportunity to test a new course. Variable title.

MATH 3010 Undergraduate Seminar (SEM 1.0-3.0)

Discussion of advanced or current topics. (Course cannot be used for graduate credit).

MATH 3108 Linear Algebra I (LEC 3.0)

Systems of linear equations, matrices, vector spaces, inner products, linear transformations, determinants, and eigenvalues are studied. Prerequisite: Math 1215 or 1221 or 2222 with a grade of "C" or better.

MATH 3109 Foundations Of Mathematics (LEC 3.0)

Introduction to mathematical reasoning through an axiomatic development of mathematical systems. Strong emphasis is placed on learning to understand what constitutes a sound mathematical argument. Communication, both written and spoken, is emphasized. Prerequisite: Math 1215 or 1221 with a grade of "C" or better.

MATH 3304 Elementary Differential Equations (LEC 3.0)

First order differential equations and linear differential equations of higher order are studied. The Laplace transform and systems of linear equations as well as selected physical applications are covered. Credit will not be given for both Math 3329 and Math 3304. Prerequisite: A grade of "C" or better in Math 1215.

MATH 3921 Methods of Teaching Math (LEC 3.0)

The course presents an overview of how children learn mathematics, various techniques in teaching mathematics, and examples of applying these techniques to specific mathematical concepts (such as geometry, measurement, basic operations, statistics and probability, etc.). Prerequisite: Math 1120 or Math 1140; Educ 1040. (Co-listed with Educ 3221).

MATH 3922 Geometric Concepts for Elementary Teachers (LEC 3.0)

The course covers methods of teaching the study of points, lines, polygons, similarity, congruence, constructions, and proof in Euclidean Plane Geometry. Transformational geometry and trigonometry are introduced to elementary teachers. Prerequisites: Math 1120 or Math 1140. (Co-listed with Educ 3222).

MATH 4000 Special Problems (IND 0.0-6.0)

Problems or readings on specific subjects or projects in the department. Consent of instructor required.

MATH 4001 Special Topics (LEC 0.0-6.0)

This course is designed to give the department an opportunity to test a new course. Variable title.

MATH 4010 Undergraduate Seminar (SEM 1.0-3.0)

Discussion of advanced or current topics. (Course cannot be used for graduate credit).

MATH 4096 Problem Solving In Pure Mathematics (LEC 1.0)

Problems from pure mathematics, including analysis, algebra, number theory, set theory, finite mathematics, probability and statistics. Emphasis on identifying or inventing ways to solve problems based on the student's entire mathematics background. Prerequisites: Corequisite Math 4209 and Senior standing.

MATH 4097 Problem Solving In Applied Mathematics (LEC 1.0)

Problems from applied mathematics which are open-ended, and do not always have a unique correct solution. Emphasis on developing mathematical models and writing solution narratives, including clarity, analysis, and design. Prerequisites: Math 3109 and Senior standing.

MATH 4098 Explorations in Pure Mathematics (LEC 3.0)

Students interested in pure mathematics will be encouraged to use their entire mathematics background as a context for learning about some of the great theorems which have shaped the development of mathematics and solving novel problems in areas such as, but not limited to, analysis, algebra, number theory, set theory, topology, and finite mathematics. Prerequisites: Senior standing; preceded or accompanied by Math 4209.

MATH 4099 Undergraduate Research (IND 0.0-6.0)

This course is designed for the undergraduate student who wishes to engage in research. It is not to be used for graduate credit nor for more than six credit hours of undergraduate credit. The subject and credit are to be arranged with the instructor. Prerequisite: Consent of instructor.

MATH 4209 Advanced Calculus I (LEC 3.0)

Completeness of the set of real numbers, sequences and series of real numbers, limits, continuity and differentiability, uniform convergence, Taylor series, Heine-Borel theorem, Riemann integral, fundamental theorem of calculus, Cauchy-Riemann integral. Prerequisite: Math 2222 and Math 3109, or a 4000-level or higher mathematics course, or graduate standing.

MATH 4211 Advanced Calculus II (LEC 3.0)

Euclidean n -space, differentiation and integration of scalar functions of several variables, maxima and minima theory, change of variables, differentiation and integration of vector functions of several variables, Divergence theorem, Stokes' theorem. Prerequisite: Math 4209.

MATH 4530 Topics In Geometry (LEC 3.0)

A survey of non-Euclidean geometries, finite geometries, affine and projective planes, metric postulates for the Euclidean plane, and selected topics. Credit will not be given for both Math 4530 and Math 5530. Prerequisites: MATH 3108.

MATH 5000 Special Problems (IND 0.0-6.0)

Problems or readings on specific subjects or projects in the department. Consent of instructor required.

MATH 5001 Special Topics (LEC 0.0-6.0)

This course is designed to give the department an opportunity to test a new course. Variable title.

MATH 5010 Graduate Seminar (SEM 1.0)

Discussion of advanced or current topics.

MATH 5040 Oral Examination (IND 0.0)

After completion of all other program requirements, oral examinations for on-campus M.S./Ph.D. students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/comprehensive examination (oral/ written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

MATH 5099 Graduate Research (IND 0.0-6.0)

Investigation of an advanced nature leading to the preparation of a MS thesis or dissertation.

MATH 5105 Modern Algebra I (LEC 3.0)

Equivalence relations and functions, basic properties of groups, subgroups, permutations, cosets and Lagrange's Theorem, homomorphisms and isomorphisms, factor groups. Prerequisite: Math 3109 or graduate standing; preceded or accompanied by Math 3108.

MATH 5106 Modern Algebra II (LEC 3.0)

This course is a continuation of Math 5105. Rings and fields are discussed. Euclidean domains, principal ideal domains, unique factorization domains, vector spaces, finite fields and field extensions are studied. Prerequisite: Math 5105.

MATH 5107 Combinatorics And Graph Theory (LEC 3.0)

Covers some basics of enumeration and graph theory. Topics are selected from the following: permutations combinations, the inclusion/exclusion principle, generating functions, recurrence relations, trees, networks, graph connectivity and graph coloring. Prerequisite: Comp Sci 1200 or Math 3109.

MATH 5108 Linear Algebra II (LEC 3.0)

Eigenvalue problems, Cayley-Hamilton theorem, Jordan normal form, linear functionals, bilinear forms, quadratic forms, orthogonal and unitary transformations, selected applications of linear algebra. Prerequisite: Math 3108.

MATH 5154 Mathematical Logic I (LEC 3.0)

A mathematical introduction to logic with some applications. Functional and relational languages, satisfaction, soundness and completeness theorems, compactness theorems. Examples from Mathematics, Philosophy, Computer Science, and/or Computer Engineering. Prerequisite: Philos 3254 or Math 5105 or Comp Sci 2500 or Comp Eng 2210. (Co-listed with Comp Eng 5803, Comp Sci 5203 and Philos 4354).

MATH 5215 Introduction To Real Analysis (LEC 3.0)

Riemann-Stieltjes integration, sequences and series of functions, uniform approximation, the Banach Space $C(a,b)$, Lebesgue measure and integration, the space $LP(a,b)$, Fourier series. Prerequisite: Math 4209.

MATH 5222 Vector And Tensor Analysis (LEC 3.0)

Vector algebra, vector differential and integral calculus, line and surface integrals, theorems of Stokes and Gauss, tensor algebra and tensor analysis, applications to problems in kinematics, elasticity theory, fluid mechanics, electromagnetic theory, relativity theory. Prerequisite: Math 2222; Math 3103 or Math 3108.

MATH 5302 Intermediate Differential Equations (LEC 3.0)

Linear differential equations, vector-matrix systems, existence and uniqueness theory, nonlinear systems, phase-plane analysis, introduction to stability theory. Prerequisite: A grade of "C" or better in Math 2222 and Math 3304.

MATH 5325 Partial Differential Equations (LEC 3.0)

Linear equations, heat equation, eigenfunction expansions, Green's formula, inhomogeneous problems, Fourier series, wave equation. Prerequisite: A grade of "C" or better in Math 2222 and Math 3304.

MATH 5351 Introduction To Complex Variables (LEC 3.0)

The basic tools of complex variables are studied. These include the Cauchy-Riemann equations, complex contour integration, the Cauchy-Goursat theorem, conformal mappings, the calculus of residues and applications to boundary value problems. Prerequisite: A grade of "C" or better in Math 2222 and Math 3304.

MATH 5483 Operational Calculus (LEC 3.0)

The Laplace transformation, properties of the transformation, various applications to ordinary and partial differential equations, systems with step and Dirac functions as driving forces, various non-elementary functions and their transforms, problems in heat conduction and wave motion, Fourier transforms and their operational properties. Prerequisite: A grade of "C" or better in Math 2222 and Math 3304.

MATH 5512 Introduction To Differential Geometry (LEC 3.0)

Elements of the geometry of curves and surfaces in Euclidean three-space using methods of advanced calculus and vectors. Prerequisite: Math 4209 or Math 5222.

MATH 5530 Topics in Geometry - Graduate Option (LEC 3.0)

A survey of non-Euclidean geometries, finite geometries, affine and projective planes, metric postulates for the Euclidean plane, and selected topics. Students will demonstrate graduate-level mastery of the subject matter. Credit will not be given for both Math 4530 and Math 5530. Prerequisites: MATH 3108.

MATH 5585 Introduction To Topology (LEC 3.0)

Metric spaces; general topological spaces; connectedness, compactness, separation properties, functions and continuity. Prerequisite: Math 4209.

MATH 5601 Introduction to Numerical Analysis (LEC 3.0)

Mathematical foundation and theory of the basic numerical methods for nonlinear equations, function approximations, numerical differentiation/integration, ordinary differential equations, and matrix computation, including convergence, accuracy, and stability analysis; extension of the basic methods to the corresponding more advanced methods. Prerequisites: A grade of "C" or better in Math 3108 or Math 3304, and Comp Sci 1570, Comp Sci 1970, Comp Sci 1971, or Comp Sci 1972.

MATH 5602 Mathematical Foundation of Finite Element Methods (LEC 3.0)

Implementation and theoretical analysis of the finite element method for the approximate solution of partial differential equations. Implementation of finite element methods for elliptic and parabolic equations. Theoretical analysis of convergence, accuracy, and stability of approximate solutions. Prerequisites: Math 5601, or any instructor approved 4000-level or higher course from another discipline with a significant computational component.

MATH 5603 Methods of Applied Mathematics (LEC 3.0)

Methods to develop and analyze mathematical models. Topics include dimensional analysis and scaling, perturbation methods, and the construction of ordinary and partial differential equation models. Prerequisites: A grade of "C" or better in Math 2222 and Math 3304; programming competency.

MATH 5604 Introduction to Numerical Methods for Differential Equations (LEC 3.0)

An introduction to finite difference methods for ordinary and partial differential equations, including (1) the derivation of the numerical methods, (2) implementation of the methods in Matlab, and (3) the mathematical accuracy and stability analysis of the methods.

Prerequisites: A grade of "C" or better in Math 2222 and Math 3304; programming competency (preferably Matlab).

MATH 5680 Mathematics of Machine Learning (LEC 3.0)

Mathematics, programming, data analysis, and graphics associated with machine learning. Probability, Naïve Bayes classifier, stochastic gradient descent, self-organizing maps, decision trees and other tree-based methods, perception, reinforcement learning, keras, and neural networks. These topics will be treated from a mathematical viewpoint.

Prerequisites: A grade of "C" or better in Math 2222; programming competency.

MATH 5737 Financial Mathematics (LEC 3.0)

The course objective is to provide an understanding of the fundamental concepts of financial mathematics. Topics include pricing, assets-liability management, capital budgeting, valuing cash flow, bonds, futures, swaps, options. Preparation for the financial mathematics actuarial exam will be provided. Prerequisites: Math 1215 or Math 1221, Econ 1100 or Econ 1200, and one of the following: Stat 3111, Stat 3113, Stat 3115, Stat 3117 or Stat 5643. (Co-listed with Econ 5337).

MATH 5762 Marketing Revolution with Machine Learning (LEC 3.0)

This course introduces machine learning and artificial intelligence applications in marketing innovation contexts through case studies and industry collaborations, explores the underlying mathematics and implements algorithms using Python programming language.

Prerequisites: Graduate standing or one of the following: Math 1212 or Math 1214. (Co-listed with MKT 5762).
