

Mathematics and Statistics

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The Department of Mathematics and Statistics offers a four-year program leading to a B.A. in mathematics. In addition to meeting Departmental requirements for a major, all students must also meet the requirements of the school or college involved, and the University Core curriculum requirements.

Programs and Requirements

I. Bachelor of Arts in Mathematics

The minimum number of credits (exclusive of the University's Core curriculum) required for a bachelor of arts in mathematics is 45 (30 in foundations and 15 in one of the three concentrations listed below).

A. Foundations

As a mathematics major, a student may select one of the three concentrations described below in section B. For each concentration all majors are required to complete successfully the foundations sequence as described in this section. Each student must have an accumulative grade point average of at least 2.0 in major courses before being considered for a baccalaureate degree in mathematics.

Foundations Sequence (Required of all majors in mathematics)			(30 cr hrs)
MAT	152D	Calculus A	4 cr
MAT	153	Calculus B	4 cr
MAT	252	Calculus C	4 cr
MAT	281	Introduction to Probability	3 cr
MAT	282	Statistical Inference	3 cr
MAT	290	Foundations of Mathematics	4 cr
MAT	295	Linear Algebra	4 cr
COS	160	Structured Problem Solving: Java	3 cr
COS	170	Structured Programming Laboratory	1 cr

B. Concentrations

Each mathematics major should choose one of the following concentrations. (15 credit hours)

1. Pure Mathematics Concentration

Mathematics majors intending to pursue graduate work in mathematics should consider this concentration, and they are urged to take Real Analysis, Abstract Algebra, Topology, and one year of French or German. Those intending to teach at the secondary level should choose this concentration.

a. Successful completion of three of the courses listed below:

MAT	352	Real Analysis
MAT	355	Complex Analysis
MAT	395	Abstract Algebra
MAT	490	Topology
MAT	370, 371	Non-Euclidean or College Geometry

b. Successful completion of at least two additional mathematics courses numbered 260 or above.

2. Applied Mathematics/Operations Research Concentration

Those majors intending to enter industry or other applied fields should seriously consider this concentration. Majors who plan to prepare for the actuarial profession should be certain to include in their programs Numerical Analysis and the appropriate courses in the School of Business. Majors intending to pursue graduate work in applied mathematics are urged to take Real Analysis and Abstract Algebra.

a. Successful completion of three of the courses listed below:

MAT	350	Differential Equations
MAT	364	Numerical Analysis
MAT	366	Deterministic Models in Operations Research
MAT	383	System Modeling and Simulation
MAT	460	Mathematical Modeling

- MAT 461 Stochastic Models in Operations Research
- MAT 492 Graph Theory and Combinatorics

b. Successful completion of at least two additional mathematics courses numbered 260 or above.

3. Statistics Concentration

This concentration is aimed at preparing the undergraduate to pursue a career as a statistician in government jobs or industrial jobs or to pursue a higher degree in statistics or allied fields. Majors intending to pursue graduate work in statistics are urged to take Real Analysis and Abstract Algebra.

a. Successful completion of three of the courses listed below:

- MAT 383 System Modeling and Simulation
- MAT 384 Non-Parametric Methods
- MAT 386 Sampling Techniques
- MAT 388 Statistical Quality Control
- MAT 482 Introduction to Time Series Analysis
- MAT 484 Design and Analysis of Experiments

b. Successful completion of at least two additional mathematics courses numbered 260 or above.

II. Secondary Mathematics Education

This program is for students who want to become certified to teach 7-12 mathematics in Maine. The program has been designed jointly with the College of Education and Human Development and is an undergraduate pathway to a master's of teaching and learning (MTL) degree. After completing the program, students will need an additional 13 credit hours to complete the MTL degree. Interested students should see the secondary mathematics coordinator for full details of the program early in their time at USM. The state of Maine has a number of non-academic requirements for teacher certification (fingerprinting and passing scores on Praxis I and II, for example); only academic requirements are listed below.

Successful completion of the following courses:

a) Mathematics Preparation

Mathematics major specializing in any concentration but including the following required courses:

- MAT 352 Real Analysis
- MAT 371 College Geometry or
- MAT 370 Non-Euclidean Geometry
- MAT 292 Theory of Numbers or
- MAT 395 Abstract Algebra

b) Pre-candidacy Education Preparation

- EDU 210 Theoretical Foundations of Learning
- HRD 200J Human Growth and Development
- CPI 211I Culture and Community Fieldwork and Seminar*
- EDU 220 **or**
- CPI 220/221 Middle School Community
- EDU 390 Portfolio Development

c) Professional Preparation

- MME 445 Teaching 7-12 Mathematics in Maine: Curriculum and Capstone Course

Additional graduate-level education courses are also required to complete the program (MME 512: Internship; MME 552: Middle School Math Methods & Curriculum Design; MME 554: Secondary Math Methods & Curriculum Design; SED 540: Exceptionality; EDU 514: Improving Teaching in Content Areas through Literacy; EDU 541: Seminar I; EDU 542: Seminar II; EDU 613: Internship; EDU 651: Strategies in Secondary Education).

*Not subject to listed prerequisites.

III. Certificate Program in Applied Statistics

The Department of Mathematics and Statistics offers a certificate program in applied statistics, designed for people in area businesses, industry, government, and education, as well as offering to the Department's own majors an opportunity for further recognition of their skills. It is helpful for students who want to pursue a master's program in statistics but who need first to fill in some advanced undergraduate work.

The requirements for the certificate are successful completion of:

MAT 281 and MAT 282 or the equivalent and five of the following courses:

MAT	384	Non-Parametric Methods
MAT	386	Sampling
MAT	388	Statistical Quality Control
MAT	461	Stochastic Models in O.R.
MAT	482	Introduction to Time Series
MAT	484	Design and Analysis of Experiments
MAT	498	Topics

Students must contact the Department chair about application to the program. The courses are offered during the late afternoon to make them more accessible to working people.

IV. Minor in Mathematics

The minimum number of credits (exclusive of the University's Core curriculum) required for the minor: 22.

An accumulative grade point average of at least 2.0 in these courses must be maintained, and successful completion of the following courses: MAT 152D; MAT 153; MAT 290; COS 160; COS 170; plus two additional MAT courses with second digit 5 or greater.

V. Minor in Statistics

The minimum number of credits (exclusive of the University's Core curriculum) required for the minor in statistics: 18.

Students must satisfy the following requirements with a GPA of at least 2.0:

- MAT 152D and MAT 264
- Either MAT 281 or MAT 380
- Three additional courses from among MAT 282, MAT 384, MAT 386, MAT 388, MAT 461, MAT 482, and MAT 484.

VI. Master of Science in Statistics 4 + 1 Program

The Department offers a 4 + 1 master's program in statistics, where interested and qualified undergraduate students enrolled in various programs at USM can earn both an undergraduate degree and the M.S. degree in statistics in five years by carefully selecting their courses. The program offers several areas of concentration, such as applied statistics, applied mathematics, operations research, and biostatistics. For acceptance into the 4 + 1 program, students must have at least junior standing and must have completed MAT 153, MAT 281, and MAT 282, or their equivalents, with a cumulative GPA of at least 2.75. Students who enroll in the program after the junior year may not be able to complete both degrees in five years. For further information, refer to the graduate catalog or contact the Department.

It is expected that students will possess and be able to operate a basic scientific calculator if they enroll in mathematics courses.

MAT 101B College Readiness Mathematics

This course reviews and reinforces the basic arithmetic and algebra skills and concepts needed for entry into the University's general education pathways. The course is based on student learning outcomes and uses mastery learning pedagogy. A grade of C- or better is needed to meet the University's mathematics readiness requirement. Prerequisites: MAT 009 or appropriate University placement test score. Cr 4.

MAT 105D Mathematics for Quantitative Decision Making

This is an introductory course in quantitative literacy that, through lecture and lab, emphasizes critical

thinking, mathematical reasoning, and technological tools. Topics are selected to develop an awareness of the utility of mathematics in life and to instill an appreciation of the scope and nature of its decision making potential. Prerequisite: successful completion of the University's mathematics proficiency requirement. Cr 4.

MAT 108 College Algebra

A more in-depth study of the topics introduced in MAT 101B. The emphasis will be on the study of functions (polynomial, rational, logarithmic, exponential) and their graphs. Additional topics may include matrices, sequences, counting techniques, and probability. Through the activity-based lab component, applications and modeling will be stressed. Prerequisite: Successful completion of the University's college readiness requirement in mathematics. Cr 4.

MAT 120D Introduction to Statistics

An introduction to probability and statistics through lecture and lab. Particular topics include random variables and their distributions, methods of descriptive statistics, estimation and hypothesis testing, regression, and correlation. Prerequisite: successful completion of the University's mathematics proficiency requirement. Cr 4.

MAT 131 Number Systems for Elementary Teachers

This is the first course in a three-course sequence in the mathematics recommended by the Committee on the Undergraduate Mathematics Program of the Mathematical Association of America for prospective primary and elementary teachers. Major emphasis is placed on an intuitive approach to the real number system and its subsystems. Prerequisite: successful completion of the University's mathematics proficiency requirement. Cr 3.

MAT 140D Pre-Calculus Mathematics

A brief review of elementary algebra followed by a study of the algebraic, exponential, logarithmic, and trigonometric functions. Prerequisites: successful completion of the University's mathematics proficiency requirement and a passing grade on an algebra competency test which will be administered at the first class meeting. Cr 3.

MAT 145 Discrete Mathematics I

This course is an introduction to discrete mathematics necessary for a study of computer science. Topics will include a study of functions, sets, basic logic systems, and combinatorics. Prerequisite: MAT 108 or permission of instructor. Cr 3.

MAT 148D Applied Calculus

An introduction to limits and differential and integral calculus of algebraic and transcendental functions of one variable. Applications of derivatives and definite integrals with an emphasis on problems from the fields of technology will be introduced. Graphing calculators and computer technology will be used when appropriate. Prerequisite: MAT 140D. Cr 3.

MAT 152D Calculus A

The first course in a three-semester sequence covering basic calculus of real variables. Calculus A introduces the concept of limit and applies it to the definition of derivative and integral of a function of one variable. The rules of differentiation and properties of the integral are emphasized, as well as applications of the derivative and integral. This course will usually include an introduction to the transcendental functions and some use of a computer algebra system. Prerequisite: two years of high school algebra plus geometry and trigonometry, or MAT 140D. Cr 4.

MAT 153 Calculus B

The second course in a three-semester sequence covering basic calculus of real variables, Calculus B usually includes techniques of integration, indeter-

minate forms and L'Hopital's Rule, improper integrals, infinite series, conic sections, parametric equations, and polar coordinates. Prerequisite: MAT 152D. Cr 4.

MAT 201 Teaching Seminar

A seminar intended to expose students to teaching introductory college mathematics courses. Students will be expected to participate in discussions concerning issues of pedagogy and classroom management. Some classes will be student-led. Cr 1.

MAT 210D Business Statistics

This course investigates graphical and numerical methods of descriptive statistics; basal probability, discrete and continuous random variables and their distributions (binomial, hypergeometric, Poisson, uniform, and normal); sampling distributions; simple linear regression; analysis of variance; and other selected topics. Applications will be chosen primarily from business. Prerequisite: MAT 108 (may be taken concurrently). Cr 4.

MAT 220 Statistics for the Biological Sciences

This course treats basic statistical methods as applied to the biological sciences. The topics emphasized are descriptive statistics, discrete and continuous distributions, statistical estimation, hypothesis testing procedures, chi-square methods (goodness of fit and two-way tables), analysis of variance, and simple and multiple regression. Students will use at least one computer-based statistical package. Prerequisite: MAT 152D. Cr 4.

MAT 231 Algebra for Elementary Teachers

The second course in a three-course sequence in mathematics recommended by the Committee on the Undergraduate Mathematics Program of the Mathematical Association of America for prospective primary and elementary teachers. Emphasis is upon the properties of operations in several different algebraic systems. Equations are studied in finite systems as well as in conventional algebra. Prerequisite: MAT 131. Cr 3.

MAT 232 Geometry for Elementary Teachers

The third course in a three-course sequence in mathematics recommended by the Committee on the Undergraduate Mathematics Program of the Mathematical Association of America for prospective primary and elementary teachers. Emphasis is upon constructions, congruence, parallelism, and similarity. Direct and indirect methods of proof are studied, but the main approach is intuitive. Prerequisite: MAT 131. Cr 3.

MAT 242 Applied Problem Solving

This course is designed to introduce mathematical concepts and apply them to solving problems in various contexts. The focus will be on mathematical ideas required by Maine's Learning Results. Topics include sets, functions, logic, numeration systems, and number theory. Students will formulate key

questions, gather and organize data, discover patterns and similarities, and interpret and communicate information. Offered only at Lewiston-Auburn College. Prerequisite: MAT 108 Cr 3.

MAT 252 Calculus C

The third course in a three-semester sequence covering basic calculus of real variables, Calculus C includes vectors, curves and surfaces in space, multivariate calculus, and vector analysis. Prerequisite: MAT 153. Cr 4.

MAT 260 Technological Tools for the Mathematical Sciences

MAT 260 is designed for students in mathematics and disciplines which utilize mathematics. Specific topics will include the computer algebra system Mathematica and the technical word-processing system TEX. Prerequisite: MAT 152. Cr 2.

MAT 264 Statistical Software Packages

This course will use statistical packages such as SAS and MINITAB to introduce commonly used statistical methods in a non-theoretical manner. Particular topics might include summary measures, calculation of probabilities associated with various discrete and continuous distributions, confidence intervals and hypothesis testing, analysis of variance, regression, and various non-parametric methods. Some of these methods will be used to analyze real data collected during previous faculty consulting projects. Prerequisite: MAT 212 or consent of Department chair. Cr 2.

MAT 281 Introduction to Probability

This course will cover basic concepts of probability, including discrete and continuous random variables and their distributions, moment generating functions, and bivariate random variables and their distributions. Some basic sampling distributions will also be discussed. Prerequisite: MAT 153. Cr 3.

MAT 282 Statistical Inference

This course will examine various statistical methods and applications such as point and interval estimation; methods of estimation including methods of moments, maximum likelihood and least squares method; hypothesis testing; simple and multiple linear regression; and one-factor and two-factor ANOVA. Some statistical packages such as SAS or MINITAB will be used extensively throughout the course. Prerequisite: MAT 281 or permission of instructor. Cr 3.

MAT 290 Foundations of Mathematics

Selected topics in set theory, symbolic logic, and methods of proofs needed in more advanced mathematics courses. Prerequisite: consent of the Department chair. Cr 4.

MAT 292 Theory of Numbers

Basic course in number theory, including such topics as divisibility properties of integers, prime num-

bers, congruences, multiplicative number theoretic functions, and continued fractions. Prerequisite: COS 280 or MAT 290. Cr 3.

MAT 295 Linear Algebra

An introduction to the theory of vector spaces and linear transformations. Particular topics will include the study of systems of linear equations, matrices, determinants, Euclidean vector spaces, inner product spaces, and theory of diagonalization. Students will use a computer algebra system for projects. Prerequisite: MAT 153. Cr 4.

MAT 350 Differential Equations

A study of various methods for solving ordinary differential equations, including series methods and Laplace transforms. The course also introduces systems of linear differential equations, Fourier series, and boundary value problems. Prerequisite: MAT 252. Cr 4.

MAT 352 Real Analysis

Limits, continuity, differentiation and integration of functions of one or more real variables, infinite series, uniform convergence, and other selected topics. Prerequisites: MAT 252, and COS 280 or MAT 290. Cr 3.

MAT 355 Complex Analysis

A study of the complex number system and its applications: differentiation and integration of complex valued functions, the Cauchy integral theorem and formula, Taylor and Laurent series, singularities and residues, conformal mappings. Prerequisite: MAT 252, and COS 280 or MAT 290. Cr 3.

MAT 364 Numerical Analysis

A study of the theory and application of computational algorithms for interpolation, equation solving, matrix methods, integration; error analysis. Prerequisites: MAT 252, MAT 295, and COS 160; or permission of instructor. Cr 3.

MAT 366 Deterministic Models in Operations Research

Formulation and analysis of mathematical models for the optimal solution of decision making problems under certainty. Linear programming; the simplex method, duality and sensitivity analysis. Network analysis: shortest paths, minimal spanning tree, network flows. Introduction to non-linear optimization: convex programming, Kuhn-Tucker conditions. Applications to pricing, allocation, production planning, transportation and scheduling problems. Prerequisites: MAT 153 and MAT 295. Cr 3.

MAT 370 Non-Euclidean Geometry

A development of one or more of the non-Euclidean geometries. Prerequisite: COS 280 or MAT 290. Cr 3.

MAT 371 College Geometry

Selected topics from Euclidean geometry. Prerequisite: COS 280 or MAT 290. Cr 3.

MAT 380 Probability and Statistics

This course explores concepts and techniques of collecting and analyzing statistical data, examines some discrete and continuous probability models, and introduces statistical inference, specifically, hypothesis testing and confidence interval construction. Not for mathematics major credit. Prerequisite: MAT 153 or COS 152. Cr 3.

MAT 383 System Modeling and Simulation

This course is designed to introduce the fundamental elements of successful system modeling using simulation. Applications to computer, communications, and inventory systems, as well as to traditional engineering problems, will be discussed. Topics include model validation and verification, input/output analysis, and the generation of various types of random data. Students are required to conduct a simulation project in their area of interest using a simulation language. Prerequisite: MAT 281 or MAT 380. Cr 3.

MAT 384 Non-Parametric Methods

Tests of goodness of fit, Pearson's Chi-square, test for multinomial populations, contingency tables, sign tests based on ranks, media test, Mann-Whitney Test, Wilcoxon Test, Spearman's Rank Correlation Coefficient, order statistics. Prerequisite: MAT 282 or MAT 380. Cr 3.

MAT 386 Sampling Techniques

Sample random sampling, stratified random sampling, sampling for proportions, estimation of sample size, systematic sampling, multistage sampling, regression and ratio estimates, non-sampling error. Prerequisite: MAT 282 or MAT 380. Cr 3.

MAT 388 Statistical Quality Control

Some aspects of quality specifications and tolerances, control charts for attributes and variables, certain inspection plans, plans by attributes and by variables, simple, double, and sequential sampling plans. Prerequisite: MAT 282 or MAT 380. Cr 3.

MAT 395 Abstract Algebra

Algebraic structures, such as groups, rings, integral domains, and fields. Prerequisite: COS 280 or MAT 290. Cr 3.

MAT 460 Mathematical Modeling

An introduction to the process of formulating problems in mathematical terms, solving the resulting mathematical model and interpreting the results and evaluating the solutions. Examples will be chosen from the behavioral, biological, and physical sciences. Prerequisites: junior or senior standing, some elementary calculus including differentiation and integration, elementary probability, and some computer programming experience. Cr 3.

MAT 461 Stochastic Models in Operations**Research**

This course applies probabilistic analysis to such nondeterministic models as queueing models, inventory control models, and reliability models. Additional topics include simulation, elements of dynamic programming, and Markov decision analysis. Prerequisite: MAT 281 or MAT 380, or permission of instructor. Cr 3.

MAT 482 Introduction to Time Series Analysis

The objectives and simple descriptive techniques of time series analysis are presented using probability models, estimation in the time domain, forecasting, Box-Jenkins methodology, and spectral analysis. Prerequisite: MAT 282 or MAT 380. Cr 3.

MAT 484 Design and Analysis of Experiments

This course is intended to acquaint students with such standard designs as one-way, two-way, and higher-way layouts, Latin-square and orthogonal Latin-square designs, BIB designs, Youdeen square designs, random effects and mixed effect models, nested designs, and split-plot designs. Prerequisites: MAT 295 and either MAT 282 or MAT 380, or permission of instructor. Cr 3.

MAT 485 Introduction to Applied Regression

This course covers simple and multiple linear regression analysis. Topics include model diagnostics using residual analysis, model selection, and model interpretation. The course emphasizes analyzing real-life data using statistical software. Prerequisite: MAT 282. Cr 3.

MAT 490 Topology

An introduction to fundamental concepts in topology, including topological spaces, mappings, convergence, separation and countability, compactness, connectedness, metrization, and other selected topics. Prerequisites: MAT 252 and COS 280 or MAT 290. Cr 3.

MAT 492 Graph Theory and Combinatorics

This course is designed to acquaint students with some fundamental concepts and results of graph theory and combinatorial mathematics. Applications will be made to the behavioral, managerial, computer and social sciences. Prerequisite: COS 280 or MAT 290. Cr 3.

MAT 497 Independent Study in Mathematics

An opportunity for juniors and seniors who have demonstrated critical and analytical capability to pursue a project independently, charting a course and exploring an area of interest within their major field. Prerequisites: junior or senior standing, permission of the instructor, and permission of the Department chair. Cr 1-3.

MAT 498 Topics

Selected topics in advanced mathematics. Prerequisite: permission of instructor. Cr 3.

Mathematics Education

**MME 445 Teaching 7-12 Mathematics in
Maine: Curriculum and Capstone Course**

Critical study of programs and techniques for teaching and learning mathematics in grades 7-12 for the

slow, average, and advanced pupil, with the use of instructional media. Prerequisites: EDU 210, HRD 200J, and 30 credit hours toward a mathematics major, or permission of the instructor. Cr 3.