MATHEMATICS AND STATISTICS

Department of Mathematics and Statistics

Website: https://www.washburn.edu/academics/college-schools/arts-sciences/departments/mathematics-statistics/index.html (https://www.washburn.edu/academics/college-schools/arts-sciences/departments/mathematics-statistics/)

Faculty

Associate Professor Sarah Cook, PhD Chair
Professor Janet Sharp, PhD
Professor Jennifer Wagner, PhD
Associate Professor Gaspar Porta, PhD
Assistant Professor Guannan Hu, PhD
Assistant Professor Kosman Rajapaksha, PhD
Lecturer Todd Cooksey, MA
Lecturer Angela Crumer, PhD
Lecturer Stephanie Herbster, MS
Lecturer Beth McNamee, MA
Math Lab Manager Jillian Kimzey, MA
Math Success Coach Matthew Ellis, MS

Mission

The mission of the Department of Mathematics and Statistics is to ensure all mathematics majors obtain a comprehensive knowledge of mathematics in terms of content, problem solving, analytical skills, and abstract mathematical reasoning. All mathematics majors will be able to communicate their skills and knowledge effectively and will be able to make appropriate choices regarding the method of solution and presentation of problems. We are committed to providing high-quality instruction at all levels, in our developmental, lower division, General Education, and upper-division courses. Further, the department is committed to providing service to the community and our profession in a variety of ways, including a number of on-campus programs for grade 6-16 learners, professional consultations, involvement in professional organizations, and other outreach activities.

The Major

The Mathematics Department offers four specialties for mathematics majors: pure mathematics, actuarial science, applied statistics, and secondary education.

General Requirements

General requirements for the Bachelor degrees Bachelor of Arts, or the Bachelor of Science, Bachelor of Education are listed in the catalog. See pages listed in the index. Graphing calculators are required in all courses MA 116 College Algebra to MA 152 Calculus & Analytic Geometry II inclusive, and MA 253 Calculus/Analytic Geometry III.

Natural Science Concentration

All Bachelor of Science degrees include a required 30-hour natural science concentration, which includes courses chosen from departments in the Natural Sciences and Mathematics Division, other than the student's major department. At least 15 of these hours must be in one department. The 30 hours must be approved by the student's major department chairperson.

Natural Sciences Concentration courses for BS degrees offered by the Department of Mathematics and Statistics are limited to these courses:

- Artificial Intelligence: AI 108 AI Fundamentals: Machines, Minds, and Society or AI 208 AI Methods: From Concepts to Applications
- Astronomy: AS 101 Introduction to Astronomy/Cosmology or higher
- Biology: BI 100 Human Biology or higher
- Chemistry: CH 103 Introduction to Forensic Chemistry or higher
- Computer Information Sciences: CM 105 Introduction to Computer Science or higher;
- Physics: PS 101 Physics in Everyday Life, PS 120 Meteorology, or PS 261 College Physics I or higher.

Student Learning Outcomes

Student Learning Outcomes for each degree specialization are listed in their respective description.

Programs

- Actuarial Science Specialization, BA and BS (https://catalog.washburn.edu/undergraduate/college-arts-sciences/mathematics-statistics/actuarial-science-specialization-ba-bs/)
- Applied Statistics Specialization, BA and BS (https://catalog.washburn.edu/undergraduate/college-arts-sciences/mathematics-statistics/applied-statistics-specialization-ba-bs/)
- Mathematics, BA and BS (https://catalog.washburn.edu/undergraduate/college-arts-sciences/mathematics-statistics/mathematics-ba-bs/)
- Mathematics Secondary Education: Advanced Mathematics 6-12, BEd (https://catalog.washburn.edu/undergraduate/college-arts-sciences/mathematics-statistics/secondary-mathematics-bed/)
- Applied Statistics, Minor (https://catalog.washburn.edu/undergraduate/college-arts-sciences/mathematics-statistics/applied-statistics-minor/)
- Mathematics and Statistics, Minor (https://catalog.washburn.edu/undergraduate/college-arts-sciences/mathematics-statistics/mathematics-statistics-minor/)

Course Offerings

MA 090 Preparation for Quantitative Reasoning Pathway (3)
Selected topics in pre-algebra, algebra, geometry and other areas designed to prepare students for quantitative reasoning and beyond. Not open to students with credit for MA 108 or above. Does not count towards degree credit hour requirements, nor general education requirements. Prerequisites: ACT English score of at least 18 or a C or better in EN 101 or EN 103

MA 095 Preparation for College Algebra Pathway (3)
Selected topics in pre-algebra, algebra, geometry and other areas designed to prepare students for college algebra and beyond. Not open to students with credit for MA 108 or above. Does not count towards degree credit hour requirements, nor general education requirements. Prerequisites: ACT English score of at least 18 or a C or better in EN 101 or EN 103

MA 108 College Algebra Preparation (3)
This course is the first of a two-semester College Algebra sequence. Topics covered include: factoring, equations (linear, quadratic, rational, absolute value, root, linear systems), functions (notation, domain), graphing (linear, quadratic, piece-wise), inequalities (linear, compound, absolute value), applications involving linear, quadratic, and rational equations. Not open to students with credit in MA 116, or any MA-designated course numbered above MA 116. Prerequisite: ACT Mathematics score of at least 18 or an equivalent background as determined by the Mathematics Department, for example, comparable score on Departmental Placement Exam, Accuplacer, or the Quantitative Section of the SAT.

MA 112 Contemporary College Mathematics (3)
This course focuses on mathematical skills and knowledge required for quantitative literacy: basic logical reasoning, understanding numerical relationships, financial mathematics, probability, statistics, mathematical communication, and/or topics related to current events. Prerequisite: A grade of A or B in MA 090 or an ACT mathematics score of at least 22 or an equivalent background as determined by the Mathematics Department, for example, comparable SAT, COMPASS, or ACCUPLACER score.
Course Attributes:
  • KBOR Gen Ed: Math and Statistics
  • Pre-AY 2024-2025 Gen Ed: Natural Science
  • USLO: Quantitative and Scientific Reasoning and Literacy

MA 113 Elementary Statistics (3)
This course is an introduction to the basic concepts of probability and statistics and is applicable to all disciplines. Topics include graphical and numerical representations of data, normal distributions, confidence intervals and hypotheses testing for a single parameter, statistical inference, and linear regression. Prerequisites: There is no prerequisite for this course. Students who do not satisfy at least one of the following are required to enroll in co-requisite support: ACT mathematics score 19 or higher, SAT quantitative score 510 or higher, ALeKS PPL 30 or higher, Accuplacer QAS 225 or higher, High school cumulative GPA of 3.00 (non-weighted) AND a C- or higher in the second semester of Algebra 2 or Integrated Math 3, Equivalent background as determined by the Mathematics Department.
Course Attributes:
  • KBOR Gen Ed: Math and Statistics
  • Pre-AY 2024-2025 Gen Ed: Natural Science
  • USLO: Quantitative and Scientific Reasoning and Literacy

MA 116 College Algebra (3)
Equations (linear system, polynomial, rational, absolute value, root, exponential, logarithmic), functions (notation, combining, domain, inverse), graphing (linear, quadratic, polynomial, piece-wise, rational, exponential, logarithmic), inequalities (compound, absolute value, polynomial, rational), logarithmic expressions, applications involving various types of equations and/or systems of equations. Not open to students with credit in MA 117, MA 123, or any course numbered above MA 140. Prerequisite: A grade of A or B in MA 095 or an acceptable (as determined by the Mathematics Department) ACT mathematics score or SAT quantitative score or Compass or Accuplacer Mathematics Placement Test score.
Course Attributes:
  • KBOR Gen Ed: Math and Statistics
  • Pre-AY 2024-2025 Gen Ed: Natural Science
  • USLO: Quantitative and Scientific Reasoning and Literacy

MA 117 Trigonometry (3)
Trigonometric functions, their inverses, graphs, and identities. Solving trigonometric equations. A wide variety of applications, and appropriate use of technology. Graphics calculator required. Prerequisite: A grade of C or better in MA 116 or concurrent with MA 116 or an acceptable (as determined by the Mathematics Department) ACT mathematics score or SAT quantitative score or equivalent knowledge as determined by the Mathematics Department.
Course Attributes:
  • KBOR Gen Ed: Math and Statistics
  • Pre-AY 2024-2025 Gen Ed: Natural Science
  • USLO: Quantitative and Scientific Reasoning and Literacy

MA 123 Pre-Calculus (3)
Algebraic, exponential and trigonometric functions. Topics in plane analytic geometry. Designed for the student preparing for calculus. Not open to students with credit in MA 141 or MA 151. Prerequisite: A grade of "C" or better in MA 116 or MA 117 or an acceptable ACT mathematics score or SAT quantitative score or equivalent knowledge as determined by the Mathematics Department.
Course Attributes:
  • KBOR Gen Ed: Math and Statistics
  • Pre-AY 2024-2025 Gen Ed: Natural Science
  • USLO: Quantitative and Scientific Reasoning and Literacy

MA 140 Statistics (3)
Introduction to statistics and probability with practical applications. Descriptive techniques including graphical methods, linear regression, probability distributions, sampling distributions, confidence intervals, hypothesis tests. Graphics calculator required. Prerequisite: A grade of "C" or better in either MA 116 or MA 112 or, an acceptable ACT mathematics score or SAT quantitative score or Compass or Accuplacer Mathematics Placement score.
Course Attributes:
  • KBOR Gen Ed: Math and Statistics
  • KBOR Gen Ed: Scientific Reasoning and Literacy
  • Pre-AY 2024-2025 Gen Ed: Natural Science
  • USLO: Quantitative and Scientific Reasoning and Literacy

MA 141 Applied Calculus I (3)
Definition and elementary properties of the derivative and definite integral with emphasis on the application of the derivative and integral to problems in business. Not open to students with credit in MA 151. Prerequisite: A grade of "C" or better in MA 116 or MA 123 or an acceptable ACT mathematics score or SAT quantitative score or equivalent knowledge as determined by the Mathematics Department.
Course Attributes:
  • KBOR Gen Ed: Math and Statistics
  • Pre-AY 2024-2025 Gen Ed: Natural Science
  • USLO: Quantitative and Scientific Reasoning and Literacy

MA 151 Calculus & Analytic Geometry I (5)
Differential and integral calculus of the elementary functions with applications. Prerequisite: A grade of "C" or better in MA 117 or MA 123 or an acceptable ACT mathematics score or SAT quantitative score or equivalent knowledge as determined by the Mathematics Department.
Course Attributes:
  • KBOR Gen Ed: Math and Statistics
  • Pre-AY 2024-2025 Gen Ed: Natural Science
  • USLO: Quantitative and Scientific Reasoning and Literacy

MA 152 Calculus & Analytic Geometry II (5)
A continuation of Mathematics 151. Topics in plane analytical geometry, techniques of integration with applications, and infinite series. Graphics calculator required. Prerequisite: A grade of C or better in MA 151.

MA 200 Number & Operation for Elementary Teachers (3)
Investigation of K-6 mathematical concepts and procedures for counting & cardinality, patterns & algebraic thinking, number systems, operation with whole numbers, fractions, decimals & integers. Significant emphasis on conceptual in-depth understanding of these mathematical topics and connecting concepts to a range of procedures for beginning teachers. Prerequisite: MA 112 or higher (or appropriate ACT or SAT quantitative score as determined by the Mathematics Department)

MA 201 Geometry, Proportion & Data Analysis for Elementary Teachers (3)
Investigation of K-6 mathematical concepts and procedures for geometry, measurement, proportional reasoning, and probability & statistics. Significant emphasis on conceptual in-depth understanding of these mathematical topics and connecting concepts to a range of procedures for beginning teachers. Prerequisite: MA 200 with a "C" or better.

MA 204 Number Theory and Discrete Math for Middle School Teachers (3)
Fundamental ideas of number theory, including divisors, factorization, and modular arithmetic. An introduction to discrete mathematics, including discrete structures, enumeration, logic, and applications. Prerequisite: A grade of "C" or better in MA 201 or concurrent.

MA 206 Discrete Mathematics for Computing (3)
Discrete mathematics topics useful in computer-aided problem solving. Topics will include Boolean algebra and computer logic, graphs and trees with algorithms, and analysis of algorithm complexity. Prerequisites: CM 111 and one of the following: A "C" or better in MA 116 or MA 123, or an acceptable (as determined by the Mathematics Department) ACT mathematics score or an acceptable SAT quantitative score, or equivalent knowledge as determined by the Mathematics Department.

MA 228 Mathematics for Elementary and Middle School Educators I (4)
Concepts and procedures for rational numbers, operations, patterns, geometry, and measurement for grades K-6. Course is designed for paraprofessionals with classroom experience. Emphasis placed on analysis of their observations of these topics with K-6 learners. Prerequisite: A grade of "C" or better in MA 112 or higher, or, math ACT score or quantitative SAT score, or Compass Mathematics Placement score or equivalent knowledge as determined by the Mathematics Department.

MA 253 Calculus/Analytic Geometry III (3)
A continuation of Mathematics 152. Multivariable calculus, vectors in two and three-dimensional spaces. Graphics calculator required. Prerequisite: A grade of "C" or better in MA 152.

MA 260 Introduction to Number Theory (3)
Topics include properties of numbers (prime, composite, rational, irrational, transcendental), divisibility, congruences, Diophantine equations, and continued fractions. Prerequisites: MA 151 (or concurrent) or MA 201 (or concurrent)

MA 271 Contemporary Actuarial Concepts (1)
Current issues in Actuarial Mathematics with emphasis on the releases of the Society of Actuaries. Includes practical application to solving problems of the type included in the Society of Actuary's Course P. Prerequisite: MA 253.

MA 281 History of Early Mathematics (1)
Chronological development of early mathematics, with emphasis on the great mathematicians and the corresponding concrete & pictorial representations utilized during periods of discovery and invention. Topics include numeration systems and geometry. Focus on extending understandings from physical representations to abstract/formula representations for the mathematics of the time in history. Prerequisite: MA 116 or consent of instructor.

MA 299 Special Topics in Mathematics (1-6)
Directed study in some area of mathematics at the lower division level.

MA 301 Linear Algebra (3)
An introduction to the fundamental concepts and basic computational techniques of linear algebra. Topics investigated from both a theoretical and computational perspective include systems of linear equations, vector spaces, transformations, matrices, eigenvalues and eigenvectors, and orthogonality. Prerequisite: MA 152.

MA 307 Discrete Mathematics (3)
Logic, counting methods, induction, functions, equivalence, partial order, and congruence relations. Set up and solve recurrence relations problems. Graph theory and its applications. Significant emphasis on the format and method of mathematical proof. Prerequisites: MA 151 or MA 204 or MA 206, and PH 220 or consent of instructor.

MA 315 Seminar: Teaching Mathematics (1)
Practical applications of pedagogical techniques for teaching mathematics. Prerequisites: Concurrent with MA 316 or MA 317 or MA 318.

MA 316 Teaching Algebra (1)
Pedagogical knowledge needed for teaching algebra. Emphasis on fundamental ideas of algebra including algebraic notation; interpreting the structure of an expression in terms of its context; function families and representations; and patterns of change. Includes co-teaching an algebra-based course. Prerequisites: A grade of "C" or better in MA 151 and ED 275. A grade of "C" or better in MA 315 or taken concurrently with MA 315.

MA 317 Teaching Trigonometry (1)
Pedagogical knowledge needed for teaching trigonometry. Emphasis on fundamental ideas of trigonometry including right triangles, identities, application of periodic phenomena, and trig function families. Includes co-teaching a trigonometry-based course. Prerequisites: A grade of "C" or better in MA 151 and ED 275. A grade of "C" or better in MA 315 or taken concurrently with MA 315.

MA 318 Teaching Statistics (1)
Pedagogical knowledge needed for teaching statistics. Emphasis on fundamental ideas of statistics including variability, measures of central tendency, randomness, inference, and multiple representations. Includes co-teaching a statistics-based course. Prerequisites: C or better in MA 140, MA 151, and ED 275. A grade of "C" or better in MA 315 or taken concurrently with MA 315.

MA 320 Mathematics for Middle School Teachers (3)
The investigation of mathematical problems as a means to develop as practitioners of the discipline of mathematics. Problems rely on a wide range of math topics. The primary focus of the course is on developing expertise in doing mathematics. By solving problems, students gain expertise in reasoning, constructing arguments, modeling, using resources, being precise, noticing deep structures of problems & expressing those structures with appropriate mathematical language. Significant emphasis on conceptual understanding of mathematics, connecting concepts to a range of realistic problem situations and appropriate use of technology. Understand and develop mathematical arguments and be able to clearly communicate those arguments using multiple representations. Prerequisite: MA 201 or concurrent

MA 331 Differential Equations (3)
Methods for solving ordinary differential equations and systems of ordinary differential equations including Laplace transforms, series, numerical methods with applications. Prerequisite: MA 152

MA 340 ANOVA/Design of Experiments (3)
An introduction to the design and analysis of experiments, both single and multi-factor. Analysis of variance, both fixed effects and random effects. Topics will include Randomized Complete Block Design, the Latin Square Design, Incomplete Block Designs, Nested Designs, and the Split-Plot Design. Prerequisite: A 'C' or better in MA 140 Statistics.

MA 341 Nonparametric Tests/Quality Control (3)
An introduction to nonparametric statistical procedures including signed-rank tests, sign tests, rank and rank sum tests, along with an introduction to the use of statistical methods for the purpose of quality control, including control charts for variables, control charts for attributes, the analysis of process capability, and acceptance sampling. Prerequisite: A "C" or better in MA 140 Statistics.

MA 342 Statistical Computing (3)
An introduction to the statistical software packages SAS and R that includes basic commands and the structure, as well as data entry and manipulation, creating graphs and plots, simulation, bootstrapping, and introductory level programming. Prerequisite: A "C" or better in MA 140 Statistics.

MA 344 Mathematical Statistics I (3)
Probability, random variables and expectation, conditional distributions and stochastic independence, distributions of functions of random variables. Prerequisites: MA 253 or concurrent, and MA 140

MA 345 Mathematical Statistics II (3)
An introduction to the theoretical framework of statistical methods including: point and interval estimators, large and small sample theories, hypothesis testing methods, linear statistical models with emphasis on repression and correlation, non-parametric testing methods, brief introduction to Bayesian methods for statistical inference. Prerequisite: MA 344.

MA 346 Regression Analysis (3)
Linear regression and correlation concepts and methods, multiple regression, curvilinear regression, applications including use of statistical software. Prerequisite: MA 140 or consent of course instructor.

MA 347 Stochastic Processes (3)
Generating functions, normal processes and covariance stationary processes, Poisson processes, renewal processes, Markov chains, discrete time processes. Prerequisite: MA 344.

MA 348 Time Series Analysis (3)
Regression models with time series error, autocorrelation function, spectral density, autoregressive and moving average processes, and seasonal time series; applications including use of statistical software. Prerequisites: MA 344 or MA 346.

MA 349 Statistical Topics for Actuarial Science (1)
Emphasis on topics in probability and statistics of special importance to actuarial science students. Prerequisites: MA 140 or consent of course instructor.

MA 354 Abstract Algebra (3)
An introduction to abstract algebraic structures and their substructures. Emphasis on groups (including symmetry groups, cyclic groups, and permutation groups), with rings and fields as time allows. Prerequisites: MA 253 and MA 307, or consent of the instructor.

MA 361 Game Design (3)
This course offers students the necessary background to design games on their own, including an introduction to the history of game design in the last 150 years. Students are then guided through an exploration of individual game mechanics which are frequently used in highly successful games. During these explorations the game mechanics are deconstructed to understand their structure using elementary mathematical tools, techniques, and language. While making these connections and observations, students are guided through isolated examples on how to integrate these into a game design. The course culminates with a final project in the form of an original game design of the students' own making – either analogue (physical) or digital. Prerequisite: A grade of "C" or better in MA 112 or MA 116, or consent of instructor.

MA 367 Modern Geometry (3)
This course will focus on the study of geometry as an axiomatic system. Emphasis will be placed on conjecture, proof and construction utilizing both classical tools as well as appropriate technology. Geometries investigated will include Euclidean, affine, projective, hyperbolic, and elliptical. A variety of approaches (synthetic, analytical and transformation) will be used to investigate the geometries. Prerequisite: MA 151.

MA 371 Introduction to Real Analysis I (3)
Sets and functions, properties of the real number system, sequences, limits of functions and continuity of functions. Prerequisites: MA 253 and MA 307, or consent of the instructor.

MA 372 Introduction to Real Analysis II (3)
Continuity, differentiation, the Riemann integral, sequences of functions, and infinite series. Prerequisite: MA 371.

MA 380 Problem Solving Strategies (1)
Weekly problem sets require a wide variety of techniques to achieve solutions to the problems. Problem solutions may feature one or more techniques from calculus, linear algebra, discrete mathematics, statistics, geometry, and other areas. The course is repeatable up to three times. Prerequisite: A grade of "C" or better in MA 152, or consent of the instructor.

MA 381 History of Mathematics (3)
Chronological development of mathematics, with emphasis on the great mathematicians and the corresponding concrete & pictorial representations utilized during periods of discovery and invention. Topics include numeration systems, algebra, geometry, measurement, probability, and statistics. Focus on extending understandings from physical representations to abstract/formula representations for the mathematics of the time in history... Prerequisite: MA 116 or consent of instructor.

MA 384 Theory of Interest (3)
Topics include measure of interest (emphasis on continuous nature), accumulated and present value factors, annuities, yield rates, sinking funds, and bonds and related securities. Prerequisite: MA 152 or concurrent.

MA 385 Actuarial Mathematics (3)
Theory and application of contingency mathematics in the area of life and health insurance, annuities and sections from both the probabilistic and deterministic approaches. Prerequisites: MA 344, MA 384 or consent of instructor.

MA 388 Capstone Research (1)
Students must complete an individual semester project on a topic in the mathematical sciences under the guidance of one or more faculty from the department. The project serves as a culminating experience for Bachelor's degree students, requiring both a written and an oral component. A minimum of two hours of MA 380 Problem Solving Strategies are required unless permission is granted by the department Chair. Prerequisites: MA 151, MA 152, MA 253, MA 301, a minimum of two hours of MA 380; and, a total of 19 or more hours in mathematics/ statistics (MA 151 or above), at least 6 hours of which must have been completed at Washburn University; and, consent of the instructor. Students must have junior or senior standing to enroll in this course.

MA 390 Seminar (1-3)
Directed study in some advanced area. Prerequisite: Consent of instructor.

MA 400 Internship in Mathematics or Statistics (1-6)
A work experience in the area of mathematics and/or statistics performed in cooperation with a business, industrial, medical or educational institution. The internship study must provide a learning experience in the applications of mathematics or statistics. Prerequisite: Consent of Department Chair.

MA 450 Topics in Mathematics (1-6)
Directed study in some area of mathematics at the graduate level. Prerequisite: Consent of instructor.