

MATHEMATICAL SCIENCES, B.A.

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Degrees offered: Bachelor of Arts, Undergraduate Minor

The mathematical sciences program is designed to meet the ever-increasing demands for diverse quantitative skills.

The bachelor of arts in mathematical sciences is designed to prepare students for careers using mathematics, operations research, and statistics in the fields of teaching, research, industry, insurance, and management or for graduate study in mathematical sciences or related areas.

By making different choices from technical electives, students can tailor their degrees to prepare for these various careers. Those who plan to teach mathematics or work in engineering or the physical sciences should choose mathematics courses. Those who wish to apply mathematical methods to life sciences, social sciences, or business fields should choose operations research or statistics courses. Any of these choices provide excellent preparation for graduate work in fields that need quantitative skills.

A minor in mathematical sciences augments a

student's background in mathematics by increasing knowledge of mathematics, operations research, or statistics — knowledge that is useful in careers in teaching, research, industry, or management.

Contact: Information about the mathematical sciences program is available at (217) 206-6770 and www.uis.edu/math/. Information can also be requested at mat@uis.edu.

THE BACHELOR'S DEGREE ENTRANCE REQUIREMENTS

- A. Admission to UIS.
- B. Completion of campus assessment test and entrance assessment test for majors. (Both tests are given at the beginning of each semester.)
- C. Matriculation into the mathematical sciences program. Requirements for matriculation are 1) selection of a mathematical sciences faculty adviser, 2) completion of three semesters of calculus (MAT 115, MAT 116, MAT 217), 3) ability to write computer programs in a procedural language, 4) enrollment in MAT 330 Writing Skills, and 5) completion of the B.A. matriculation form.

Note: Courses taken to satisfy matriculation requirements are not counted as part of the 48 credit hours of upper-division work needed for graduation. Students may begin work toward a degree before matriculation into the program, but matriculation should be completed before the last 16 semester hours of MAT courses needed for graduation.

PROGRAM REQUIREMENTS

Communication Skills Requirement

MAT 330 Writing Skills 0 Hrs.

Required Mathematical Sciences Courses

MAT 332 Linear Algebra 4 Hrs.

MAT 415 Advanced Calculus 4 Hrs.

MAT 431 Mathematical Statistics I 4 Hrs.

MAT 444 Operations Research Methods 4 Hrs.

Total 16 Hrs.

One of the following clusters: 16 Hrs.

Cluster A

MAT 403 Abstract Algebra 4 Hrs.



MAT 404 Geometry	4 Hrs.
Two MAT elective courses	8 Hrs.
<i>Cluster B</i>	
MAT 421 Statistical Methods	4 Hrs.
MAT 432 Mathematical Statistics II	4 Hrs.
Two MAT elective courses	8 Hrs.

UIS Requirements	12 Hrs.
General Electives	<u>16 Hrs.</u>
Total	60 Hrs.

Note: Required and elective MAT courses must be taken for a letter grade. The credit/no credit option is not acceptable.

MATHEMATICAL SCIENCES MINOR

To earn a minor in mathematical sciences, students must complete a minimum of 24 semester hours, at least 12 hours of which must be upper-division course work taken at UIS. Transfer credit for lower-division course work and for upper-division mathematics courses is evaluated on a case-by-case basis through the student petition process. Core courses include MAT 115 Calculus I, MAT 116 Calculus II, and MAT 332

Linear Algebra, or its equivalent. Students must then select an area of specialization (mathematics, operations research, or statistics) and complete 12 semester hours as follows –

A. Mathematics specialization requires:	
MAT 403 Abstract Algebra	4 Hrs.
MAT 404 Geometry	4 Hrs.
One elective from B or C	<u>4 Hrs.</u>
Total	12 Hrs.
B. Operations research specialization requires:	
MAT 442 Probability Modeling and Computer Simulation	4 Hrs.
MAT 444 Operations Research Methods	4 Hrs.
One elective from A	<u>4 Hrs.</u>
Total	12 Hrs.
C. Statistics specialization requires:	
MAT 421 Statistical Methods	4 Hrs.
MAT 431 Mathematical Statistics I	4 Hrs.
One elective from A	<u>4 Hrs.</u>
Total	12 Hrs.
Students wishing to minor in mathematical sci-	

ences should select an adviser from among the mathematical sciences faculty who will help ensure that all requirements for the minor are met.

COURSE DESCRIPTIONS

Courses with numbers less than 330 (except MAT 115, MAT 116, and MAT 217) are service courses for majors from other fields and, in general, do not require a special background in mathematical sciences. No service courses will count toward the mathematical sciences degree.

Prerequisites for MAT courses must have been met no more than seven years before enrolling in these courses. Students who have taken prerequisite courses more than seven years before enrollment must obtain the permission of the instructor.



MAT 111 Quantitative Reasoning (4 Hrs.)

Course available online; may also be available on campus. Refer to the current course schedule for further information.

This course is designed to satisfy the mathematics general education requirement and is not designed to fulfill mathematics requirements for either science or mathematics majors. Develops competency in problem solving and analysis helpful in personal decision making. Topics will include no more than four of the following: functions, graphing, counting techniques and probability, statistics, finance, modeling, estimating, geometry, game

theory, and logic. Prerequisites: Geometry and intermediate algebra with a grade of C or better, or permission of the instructor.

MAT 113 Business Calculus (4 Hrs.)

Fundamental concepts, methods, and techniques of single multivariable differential and integral calculus. Topics include introduction to derivatives, integrals and their applications, and marginal analysis. Prerequisite: College algebra with a grade of C or better.

MAT 115 Calculus I (4 Hrs.)

Limits and their properties. Definitions and some techniques of differentiation and the evaluation of definite integrals, with applications. Prerequisite: College algebra and trigonometry, or equivalent.

MAT 116 Calculus II (4 Hrs.)

Applications of integration, with some formal techniques and numerical methods. Calculus of further transcendental functions (inverse trigonometric functions, exponentials, logarithms). Improper integrals, infinite sequences and series. Prerequisite: MAT 115, or equivalent.

MAT 121 Applied Statistics (4 Hrs.)

Course available online; may also be available on campus. Refer to the current course schedule for further information.

May be used to meet the mathematics general education requirement for admission to UIS. Topics may include descriptive statistics, elementary probability, basic probability distributions, sampling, estimation, testing of hy-

potheses, simple linear regression, and correlation. Prerequisite: Intermediate algebra and geometry with grades of C or better.

MAT 217 Calculus III (4 Hrs.)

Basic analytic geometry in three dimensions, using vectors. Real-valued functions of two and three variables, partial derivatives, gradient and directional derivatives, level curves and surfaces, and maxima and minima. Parametrized curves in space, line integrals. Multiple integrals, with applications. Prerequisite: MAT 116, or equivalent.

MAT 302 Discrete Mathematics (4 Hrs.)

Topics include sets, functions, relations; propositional and predicate logic, including truth tables and valid reasoning; Boolean algebra, minimization with Karnaugh maps, and Quine McClusky method; integer, rational, real, modular arithmetic, different bases, and complementary number systems; mathematical induction; recurrence relations; graph theory; and automata theory. Prerequisite: College algebra with a grade of C or better.

MAT 323 Probability and Statistics for Computer Science (4 Hrs.)

Introduction to probability theory and statistical analysis techniques. Topics include axioms of probability, random numbers, probability functions and density functions, sampling distributions, descriptive statistics, estimations and testing hypotheses, analysis of variances, linear regression, quality control, reliability, and queu-

ing theory. Prerequisites: MAT 115, or equivalent, and CSC 325.

MAT 330 Writing Skills (0 Hrs.)

Evaluation of writing skills for mathematical sciences students. These tests should be taken during the student's first semester of enrollment as a mathematical sciences major.

MAT 332 Linear Algebra (4 Hrs.)

A theoretical course involving systems of linear equations, matrices, vectors in n -space, vector spaces, linear transformations, eigenvalues and eigenvectors, diagonalization, quadratic forms, and canonical forms. Prerequisite or corequisite: MAT 116, or equivalent.

MAT 400 Topics in Mathematics (1 to 4 Hrs.)

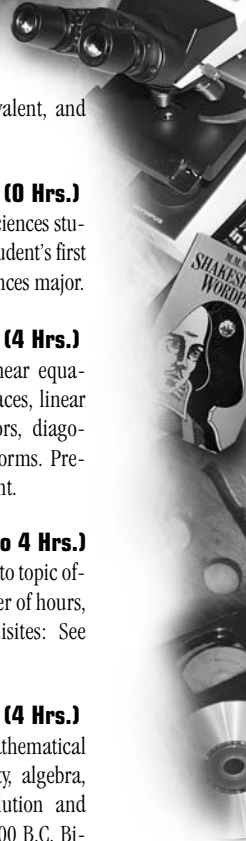
Various topics; description changes according to topic offered. May be repeated for an indefinite number of hours, but particular topics must differ. Prerequisites: See course schedule for prerequisites.

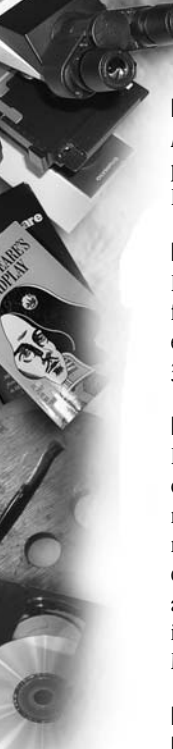
MAT 401 History of Mathematics (4 Hrs.)

Introduction to the development of major mathematical concepts. History of computation, probability, algebra, geometry, trigonometry, and calculus. Evolution and changes in the rigor of mathematics from 1500 B.C. Biographies of male and female mathematicians are included. Prerequisite: MAT 115 or, equivalent.

MAT 403 Abstract Algebra (4 Hrs.)

Topics include group theory, rings, and fields. Prerequisite: MAT 116, or equivalent.





MAT 404 Geometry (4 Hrs.)

A systematic study of the consequences of the parallel postulate in Euclidean and non-Euclidean geometries. Prerequisite: MAT 116.

MAT 415 Advanced Calculus (4 Hrs.)

Elementary ordinary differential equations. Special functions defined by power series and by integrals, Fourier series. Prerequisites: MAT 217, or equivalent, and MAT 332.

MAT 416 Real Analysis (4 Hrs.)

Elements of set theory, numerical sequences and series convergence and divergence, continuity, uniform continuity and differentiability of real valued functions. Riemann integral and Riemann-Stieltje's integral. Sequences and series of real valued functions, and ordinary and uniform convergence. Lebesgue measure, Lebesgue integrals, and Lebesgue-Stieltje's integrals. Prerequisite: MAT 415.

MAT 420 Topics in Statistics and Probability (1 to 4 Hrs.)

Various topics; description changes according to topic offered. May be repeated for an indefinite number of hours, but particular topics must differ. Prerequisite: See course schedule for prerequisites.

MAT 421 Statistical Methods (4 Hrs.)

Introductory course for statistical analysis techniques. Topics may include review of basic statistics, multiple linear regression, analysis of enumerative data, analysis of

variance, multiple comparisons, design of experiments, and analysis of covariance. Additional topics may be chosen from principal components, factor analysis, discriminant analysis, and nonparametric tests. Prerequisite: Intermediate algebra, or permission of instructor.

MAT 423 Statistical Computation (4 Hrs.)

Exploration of the use of various statistical software packages. Topics will be selected from construction of data set, descriptive analysis, regression analysis, analysis of design experiment, multivariate analysis, categorical data analysis, discriminant analysis, cluster analysis, matrix operations, and presentation of data in graphic forms. Prerequisite: MAT 421, or equivalent.

MAT 431 Mathematical Statistics I (4 Hrs.)

Introduction to theory and application of probability models. Topics include random variables, mathematical expectation, Chebyshev's inequality, marginal and conditional distribution, independence, probability distributions and their properties, transformation of variables, moment-generating functions, limiting distribution, and central limit theorem. Prerequisite: MAT 116, or equivalent.

MAT 432 Mathematical Statistics II (4 Hrs.)

Introduction to theory and application of statistical inference. Topics include sampling distributions, point estimation, including maximum likelihood estimation and the application of criteria such as consistency, unbiasedness, and minimum variance; interval estimation, Bayesian estimation, statistical hypothesis testing, includ-

ing power functions, Type I and Type II errors, Newman-Pearson lemma, and likelihood ratio tests. Prerequisite: MAT 431.

MAT 434 Applied Regression Analysis (4 Hrs.)

Introduction to regression analysis with emphasis on simple and multiple regression analysis with applications, analysis of residuals, methods of selection of predictor variables, basic concepts of collinearity, general linear models, and nonlinear models. Prerequisites: MAT 332 and MAT 431, or permission of instructor.

MAT 436 Applied Multivariate Analysis (4 Hrs.)

Multivariate statistical methods. Topics include inferences about means and variances, confidence regions and simultaneous comparisons, discriminant analysis, principal components analysis, and factor analysis. Prerequisites: MAT 432 and MAT 434.

MAT 439 Applied Time Series Analysis (4 Hrs.)

Applications of time series regression, exponential smoothing, and Auto-Regressive Moving Average (ARMA) models in forecasting business, economic, and other time-related phenomena. Prerequisite: MAT 421, or equivalent.

MAT 442 Probability Modeling and Computer Simulation (4 Hrs.)

Explores the principles and concepts of probability theo-

ry and introduces computer simulation methodology. Topics include fundamental concepts of probability, random variables, random number generators, probability distributions, mathematical expectation, introduction of simulation, concepts in sampling, sampling models, estimation, and discrete event stochastic processes. Prerequisites: MAT 116, or equivalent, and one semester of programming language.

MAT 444 Operations Research

Methods

(4 Hrs.)

Quantitative methods necessary for analysis, modeling,

and decision making. Topics include linear programming, transportation model, network models, decision theory, games theory, PERT-CPM, inventory models, and queueing theory. Additional topics may be chosen from integer linear programming, system simulation, and nonlinear programming. Prerequisite: MAT 332, or permission of instructor. See PAD 431.

