

# Mathematics and Statistics (MATH)

B.S. with Major in Mathematics (<https://catalog.und.edu/undergraduateacademicinformation/departmentalcoursesprograms/mathematics/math-bs/>)

Minor in Mathematics (<https://catalog.und.edu/undergraduateacademicinformation/departmentalcoursesprograms/mathematics/math-minor/>)

Minor in Mathematics for Elementary Education (<https://catalog.und.edu/undergraduateacademicinformation/departmentalcoursesprograms/mathematics/math-minor-mee/>)

Minor in Statistics (<https://catalog.und.edu/undergraduateacademicinformation/departmentalcoursesprograms/mathematics/math-minor-stat/>)

Four Year Plan - B.S. with Major in Mathematics (p. 1)

Four Year Plan - B.S. with Major in Mathematics with Secondary Education Certification (p. 1)

## Four Year Plan - B.S. with Major in Mathematics

### Freshman Year

Fall		Credits
CSCI 160	Computer Science I	4
ENGL 110	College Composition I	3
MATH 165	Calculus I	4
ES: Social Science		3
ES: Fine Arts		3
<b>Credits</b>		<b>17</b>

### Spring

MATH 207	Introduction to Linear Algebra	2
ENGL 130	Composition II: Writing for Public Audiences	3
MATH 166	Calculus II	4
ES: Lab Science		4
ES: Humanities		3
<b>Credits</b>		<b>16</b>

### Sophomore Year

Fall		Credits
MATH 265	Calculus III	4
MATH 330	Proof, Set Theory, and Logic	3
ES: Social Science		3
ES: Fine Arts/Humanities		3
General Electives		3
<b>Credits</b>		<b>16</b>

### Spring

MATH 266	Elementary Differential Equations	3
ES: Communication/Oral		3
ES: Social Science		3
General Electives		6-9
<b>Credits</b>		<b>15-18</b>

### Junior Year

Fall		Credits
MATH 421	Statistical Theory I	3
General Electives		12-15
<b>Credits</b>		<b>15-18</b>

### Spring

MATH 352	Introduction to Partial Differential Equations	3
MATH 422	Statistical Theory II	3
General Electives		9-12

**Credits 15-18**

### Senior Year

#### Fall

MATH 488	Senior Capstone	3
Math Elective		3
General Electives		9-12

**Credits 15-18**

#### Spring

Math Elective		3
General Electives		9-12

**Credits 12-15**

**Total Credits 121-136**

This is only a representative plan. This plan assumes that the student will use Math 421-Math 422 to satisfy the departmental depth requirement, Math 441 to satisfy the breadth requirement in Theoretical Mathematics, and Math 352 to satisfy the Applications of Mathematics requirement. Math 421 satisfies the Probability and Statistics requirement. Two additional three credit math electives would be required. Please consult your academic adviser to develop your individual 4-year plan.

Students must complete enough electives to bring total credit hours up to 120. Special Emphasis courses can fulfill an essential studies requirement (example-History 104, US History, will count toward the US Diversity as well as the Humanities area). Please Note: Every student must fulfill all University, Departmental, and Essential Studies requirements. (<https://und.edu/academics/essential-studies/>)

## Four Year Plan - B.S. with Major in Mathematics with Secondary Education Certification

### Freshman Year

Fall		Credits
CSCI 160	Computer Science I	4
ENGL 110	College Composition I	3
MATH 165	Calculus I	4
ES: Social Science		3
ES: Fine Arts		3
<b>Credits</b>		<b>17</b>

### Spring

ENGL 130	Composition II: Writing for Public Audiences	3
MATH 166	Calculus II	4
MATH 207	Introduction to Linear Algebra	2
ES: Lab Science		4
ES: Humanities		3

**Credits 16**

### Sophomore Year

#### Fall

MATH 208	Discrete Mathematics	3
MATH 265	Calculus III	4
T&L 250	Introduction to Education	3
ES: Social Science		3
ES: Fine Arts/Humanities		3
<b>Credits</b>		<b>16</b>

#### Spring

MATH 266	Elementary Differential Equations	3
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MATH 330	Proof, Set Theory, and Logic	3
T&L 339	Educational Technology	2
T&L 432	Learning Environments	3
ES: Communication/Oral		3
<b>Credits</b>		<b>14</b>
<b>Junior Year</b>		
<b>Fall</b>		
MATH 321	Applied Statistical Methods	3
MATH 409	Geometry	3
T&L 319	Integrating Diverse Needs in Educational Settings	3
T&L 350	Development and Education of the Adolescent	3
ES: Social Science		3
General Elective		3
<b>Credits</b>		<b>18</b>
<b>Spring</b>		
MATH 308	History of Mathematics	3
MATH 435	Theory of Numbers	3
T&L 345	Curriculum, Instruction, and Assessment	3
T&L 433	Multicultural Education	3
MATH 399	Methods for Secondary Teachers: Mathematical Content Knowledge	3
General Electives		3-6
<b>Credits</b>		<b>18-21</b>
<b>Senior Year</b>		
<b>Fall</b>		
MATH 441	Abstract Algebra	3
MATH 488	Senior Capstone	3
T&L 400	Methods and Materials	3
T&L 486	Field Experience	1-4
General Electives		6
<b>Credits</b>		<b>16-19</b>
<b>Spring</b>		
T&L 487	Student Teaching	4-16
T&L 489	Senior Capstone: Responsive Teaching	3
<b>Credits</b>		<b>7-19</b>
<b>Total Credits</b>		<b>122-140</b>

This is only a representative plan, however there are only a limited number of options. Consult your academic adviser regularly. Students must complete enough electives to bring total credit hours up to 120. Please Note: Every student must fulfill all University, Departmental, and Essential Studies requirements. (<https://und.edu/academics/essential-studies/>)

#### **MATH 98. Intermediate Algebra. 3 Credits.**

Properties of the real number system, factoring, linear and quadratic equations, functions, polynomial and rational expressions, inequalities, systems of equations, exponents, radicals. Graphing of basic functions. Study skills and problem solving techniques will be incorporated throughout the course. Does not satisfy any requirements for graduation, nor does it transfer. Prerequisite: Appropriate ACT Math sub-score or appropriate score in the Placement Testing Program. F,S,SS.

#### **MATH 103. College Algebra. 3 Credits.**

Relations and functions, equations and inequalities, complex numbers; polynomial, rational, exponential and logarithmic functions, systems of equations, applications, and quantitative reasoning. Prerequisite: Appropriate score in the Placement Testing Program or MATH 98. F,S,SS.

#### **MATH 105. Trigonometry. 2 Credits.**

Angles, trigonometric functions and their inverses, solving triangles, trigonometric identities. Prerequisite: One year of high school geometry and either an appropriate score in the Placement Testing Program or MATH 98 or MATH 103. On demand.

#### **MATH 107. Precalculus. 4 Credits.**

Equations and inequalities; polynomial rational, exponential, logarithmic and trigonometric functions; inverse trigonometric functions; algebraic and trigonometric methods commonly needed in calculus. Prerequisite: Appropriate score in the Placement Testing Program or MATH 98 or MATH 103. F,S,SS.

#### **MATH 110. Mathematics in Society. 3 Credits.**

This course covers a broad range of mathematics that a person would encounter in their daily life. Topics include: statistical interpretation, data visualization, probability, growth models, finance, politics and voting, logic and sets, and the intersection of mathematics and the arts. Throughout, appropriate use of mathematical technology will be emphasized. Prerequisite: Appropriate score in the Placement Testing Program or MATH 98. F,S,SS.

#### **MATH 146. Applied Calculus I. 3 Credits.**

A nonrigorous introduction to differential and integral calculus. Topics include limits, continuity, differentiation and integration techniques, and applications. Prerequisite: Appropriate score in the Placement Testing Program or MATH 103 or MATH 107. F,S,SS.

#### **MATH 165. Calculus I. 4 Credits.**

Limits, continuity, differentiation, Mean Value Theorem, integration, Fundamental Theorem of Calculus. Prerequisite: Appropriate score in the Placement Testing Program or completion of MATH 107 with a grade of C or better. F,S,SS.

#### **MATH 166. Calculus II. 4 Credits.**

Techniques and applications of integration, exponential and logarithmic functions, parametric equations, infinite sequences and series. Prerequisite: Completion of MATH 165 with a grade of C or better; or permission of the Mathematics Department. F,S,SS.

#### **MATH 207. Introduction to Linear Algebra. 2 Credits.**

A computational treatment of systems of linear equations, finite dimensional vector spaces, linear transformations, determinants, matrices, eigenvalues, eigenvectors, and diagonalizability. Prerequisite: MATH 165. F,S.

#### **MATH 208. Discrete Mathematics. 3 Credits.**

Introduction to Set Theory, Functions and Relations, Permutations and Combinations, Logic, Boolean Algebra, Induction, Difference Equations. Other topics from Graphs, Finite Automata and Formal Languages. Prerequisite: Appropriate score in the Placement Testing Program or MATH 103 or MATH 107 or MATH 146 or MATH 165. F,S,SS.

#### **MATH 265. Calculus III. 4 Credits.**

Multivariate and vector calculus including partial derivatives, multiple integration, line and surface integrals, Green's Theorem, Stokes' Theorem, the Divergence Theorem. Prerequisite: MATH 166. F,S,SS.

#### **MATH 266. Elementary Differential Equations. 3 Credits.**

Solution of elementary differential equations by elementary techniques. Laplace transforms, introduction to matrix theory and systems of differential equations. Prerequisite: MATH 265. F,S,SS.

#### **MATH 277. Mathematics for Elementary School Teachers. 3 Credits.**

Development of the number systems used in elementary schools. Includes some methods and work with laboratory materials. For elementary education majors only. Prerequisite: Appropriate score in the Placement Testing Program, MATH 103, MATH 107, or MATH 110. F,S.

#### **MATH 294. Introduction to Undergraduate Research. 4 Credits.**

Introductory experience as a research assistant working alongside a faculty member. A total of 45 hours is typically required over the course of the semester per credit. Prerequisite: Consent of instructor. On demand.

#### **MATH 308. History of Mathematics. 3 Credits.**

This is a course on the conceptual and chronological history of mathematics. The course involves the interpretation and analysis of how and why mathematical ideas have developed over time, including political and cultural considerations. Topics include: numbers and counting systems, non-Western developments, mathematics of Egypt, Babylonia and Greece, early European developments, the Renaissance, the Scientific Revolution and the development of calculus, women in mathematics, twentieth century mathematics. Prerequisite: MATH 166 or equivalent, or consent of instructor. S.

#### **MATH 321. Applied Statistical Methods. 3 Credits.**

Introductory statistics for students with a background in single-variable calculus. Topics include descriptive statistics, continuous and discrete probability density functions, sampling distributions, point and interval estimation, and tests of hypotheses. Prerequisite: MATH 166. F,S.

**MATH 330. Proof, Set Theory, and Logic. 3 Credits.**

Methods of proof, axioms and operations on sets, mathematical logic, relations and functions, development of the natural and real number systems, including field axioms and the completeness axiom for the real numbers. Prerequisite: MATH 166 or consent of instructor. F,S.

**MATH 352. Introduction to Partial Differential Equations. 3 Credits.**

Partial differential equations, Fourier series, special functions, series solutions to ordinary differential equations. Prerequisite: MATH 266. S.

**MATH 355. Theory of Interest. 3 Credits.**

This course covers the concepts underlying the theory of interest and their applications to valuation of various cash flows, annuities certain, bonds, and loan repayment. This course is designed to help students prepare for the SOA/ CAS Actuarial Exam FM/2. Prerequisite: MATH 166. F.

**MATH 377. Geometry Elementary Teachers. 1-3 Credits.**

Experimental and inductive discovery in building geometric concepts at the elementary school level. Prerequisite: For elementary education majors only. S.

**MATH 395. Experiential Learning. 4 Credits.**

A practical work or volunteer experience which involves the use of mathematical approaches or techniques. Arranged by mutual agreement among student, department, and site location. A total of 45 hours is typically required over the course of the semester per credit. Prerequisite: Consent of instructor. On demand.

**MATH 397. Cooperative Education. 1-8 Credits.**

A practical work experience with an employer closely associated with the student's academic area. 1-8 credits repeatable to 18. Arranged by mutual agreement among student, department, and employer. A maximum of 6 cooperative education credits may be applied against requirements for a Math major. Prerequisite: 15 completed credits in math including MATH 165, MATH 166, and MATH 265, in addition to standard co-op requirements (see department for approval). Repeatable to 18.00 credits. S/U grading. F,S,SS.

**MATH 399. Methods for Secondary Teachers: Mathematical Content Knowledge. 3 Credits.**

National and State Standards for teaching and learning secondary mathematics. Secondary mathematics content from an advanced perspective. Technology for learning mathematics. Current issues and recent developments in mathematics curriculum and in effective instructional practices. Prerequisite: 9 hours of upper division mathematics, excluding MATH 377 and MATH 477. On demand.

**MATH 405. Selected Topics in Mathematics. 1-3 Credits.**

An introduction to selected areas of mathematics, such as algebra, analysis, combinatorics, graph theory, or topology. Prerequisite: Permission of the Mathematics Department. Repeatable to 6.00 credits. On demand.

**MATH 408. Combinatorics. 3 Credits.**

Introduction to the techniques and reasoning needed in combinatorial problem-solving. The course may include topics related to combinatorics, such as graph theory. Prerequisite: MATH 166 and MATH 208. S, odd years.

**MATH 409. Geometry. 3 Credits.**

Metric and synthetic approach to Euclidean geometry. The usual topics in elementary geometry treated in a mathematically logical way. Topics include congruence, inequalities, parallelism, similarity, area, solid geometry and the circle. Prerequisite: MATH 208 or MATH 330. F.

**MATH 412. Differential Equations. 3 Credits.**

Basic types of ordinary differential equations. Existence and uniqueness of solutions. Prerequisite: MATH 266. S, even years.

**MATH 415. Topics in Applied Mathematics. 1-3 Credits.**

An introduction to selected areas in applied mathematics chosen from a variety of topics including: Applied algebra, difference equations, linear programming, modeling and simulation, operations research, optimization, partial differential equations and computers in mathematics. Topics to be considered will be illustrated with examples and practical applications. Prerequisite: MATH 265 and consent of instructor. Repeatable to 6.00 credits. On demand.

**MATH 416. Topics in Statistics. 1-3 Credits.**

An introduction to a variety of topics in statistics including: Linear models in categorical analysis, Bayesian methods, decision theory, ridge regression, Non parametric techniques, stochastic games and models. The number of topics to be considered during a semester will be limited to permit greater depth of coverage and sufficient practical illustrations. May be repeated for credit with consent of instructor up to six credits. Prerequisite: MATH 265 and MATH 321 or consent of instructor. Repeatable to 6.00 credits. On demand.

**MATH 421. Statistical Theory I. 3 Credits.**

Discrete and continuous random variables, expectation, moments, moment generating functions, properties of special distributions, introduction to hypothesis testing, sampling distributions, Central Limit Theorem, curve of regression, correlation, empirical regression by least squares, maximum likelihood estimation, Neyman-Pearson lemma, likelihood ratio test, power function, chi-square tests, change of variable, "t" and "F" tests, one and two-way ANOVA, nonparametric methods. Prerequisite: MATH 265. F.

**MATH 422. Statistical Theory II. 3 Credits.**

Discrete and continuous random variables, expectation, moments, moment generating functions, properties of special distributions, introduction to hypothesis testing, sampling distributions, Central Limit Theorem, curve of regression, correlation, empirical regression by least squares, maximum likelihood estimation, Neyman-Pearson lemma, likelihood ratio test, power function, chi-square tests, change of variable, "t" and "F" tests, one and two-way ANOVA, nonparametric methods. Prerequisite: MATH 421. S.

**MATH 425. Cryptological Mathematics. 3 Credits.**

This course develops the math behind elementary symmetric-key cryptoschemes and a variety of public-key schemes. Modern block ciphers may be discussed. Prerequisite: MATH 208. F, odd years.

**MATH 431. Introduction to Analysis I. 3 Credits.**

Development of the real number system, functions, sequences, limits, continuity, and differentiation. Prerequisite: MATH 330 or consent of instructor. On demand.

**MATH 432. Introduction to Analysis II. 3 Credits.**

A continuation of MATH 431, topics in the second semester include integration, partial differentiation, infinite series, power series and vector analysis. Prerequisite: MATH 431. On demand.

**MATH 435. Theory of Numbers. 3 Credits.**

Basic properties of numbers, including divisibility, primes, congruences, Diophantine equations and residue theory. Prerequisite: MATH 208 or MATH 330. S.

**MATH 441. Abstract Algebra. 3 Credits.**

Rings, integral domains, fields, elements of group theory. Prerequisite: MATH 330 or consent of instructor. F.

**MATH 442. Linear Algebra. 3 Credits.**

A theoretical treatment of systems of linear equations, matrices, vector spaces, linear transformations and elementary canonical forms. Prerequisite: MATH 207 and MATH 330 or consent of instructor. S.

**MATH 455. Mathematics of Finance. 3 Credits.**

The course introduces the main classes of financial securities, the mathematical tools employed to model their prices, and common models for risk and investment management. Topics covered include Derivatives, Option pricing, Hedging, Portfolio Risk, Swaps, Asset pricing models. Covers topics and problems included in the SOA/ CAS Actuarial Exam FM/2. Prerequisite: MATH 355 and MATH 421. S.

**MATH 460. Mathematical Modeling. 3 Credits.**

The primary goal of the course is to present the mathematical analysis provided in scientific modeling. Topics may include population modeling, mechanical vibrations, traffic flow, epidemic modeling, queues and decay processes. Prerequisite: MATH 266 and MATH 207 or consent of instructor. On demand.

**MATH 461. Numerical Analysis. 3 Credits.**

Numerical techniques for: the solution of equations in one or several unknowns, approximate integration, differential equations, approximation theory, optimization theory and matrix analysis. Corresponding error analysis will be investigated. Prerequisite: MATH 266 and a scientific programming language. On demand.

**MATH 471. Introduction to Complex Variables. 3 Credits.**

The complex plane, analytic functions, complex integration, power series, the theory of residues and contour integration, conformal mapping, Fourier and Laplace transformations, and applications. Prerequisite: MATH 265. F, even years.

**MATH 477. Topics in Elementary School Mathematics. 1-3 Credits.**

Selected topics from mathematical concepts appropriate to the elementary school curriculum. May be repeated for credit up to six credits. Prerequisite: Elementary education majors only. Repeatable to 6.00 credits. F.

**MATH 488. Senior Capstone. 3 Credits.**

This course is designed to help students transition into working mathematicians. Thus the course will address 1) written and oral expression of mathematical material and concepts, 2) research and problem solving in mathematics, and 3) technology in mathematics, and its appropriate use. Material will build on the core areas of calculus, linear algebra, and differential equations. Prerequisite: Senior standing with a major in mathematics. F.

**MATH 493. Instructional Experiences. 1-2 Credits.**

Students will receive training and practical experiences in providing instruction at the collegiate level, such as serving as an undergraduate teaching assistant or tutor along with a faculty mentor. Prerequisite: Junior or senior status, a grade of A earned in the course they are serving, a minimum overall GPA of 3.0, and permission of instructor. On demand.

**MATH 494. Undergraduate Research. 4 Credits.**

Advanced experience as a research assistant working alongside a faculty member. A total of 45 hours is typically required over the course of the semester per credit. Prerequisite: Consent of instructor. Repeatable to 6.00 credits. F,S,SS.

**MATH 495. Readings in Mathematics. 1-3 Credits.**

Directed individual reading on selected topics not developed in other courses. Prerequisite: Consent of instructor. Repeatable to 6.00 credits. F,S,SS.

**MATH 497. Internship. 8 Credits.**

Supervised experience consistent with a student's career objectives. Formal application and/or interview with internship site required. A total of 75 hours is typically required over the course of the semester per credit. Prerequisite: Consent of instructor. On demand.