Mathematics

Chair: Randall Crist crist@creighton.edu
Hixson-Lied Science Building, Room 543 - Phone: 402-280-2580
Department Office: Hixson-Lied Science Building, Room 504 - Phone:
402-280-2827

Majors in Mathematics - B.S.
Specific Requirements for Admission to the Mathematics Major

Students desiring to major in mathematics should apply to the
department and be assigned a major advisor after completing MTH 245
Calculus I or MTH 246 Calculus II or its equivalent.

Those wishing to pursue a degree in secondary education – mathematics
track must do so in conjunction with the M.Ed program. Please visit
https://gradschool.creighton.edu/programs/masters-degrees/education/
secondary-school-teaching (https://gradschool.creighton.edu/programs/
masters-degrees/education/secondary-school-teaching/) or consult with
Creighton University's Department of Education for further information.

- Major in Mathematics (http://catalog.creighton.edu/undergraduate/
  arts-sciences/mathematics/mathematics-bs/)
- Major in Mathematics: Medical Mathematics Track (http://
catalog.creighton.edu/undergraduate/arts-sciences/mathematics/
  mathematics-medical-mathematics-bsmtth/)
- Major in Mathematics: Secondary Education Track (http://
catalog.creighton.edu/undergraduate/arts-sciences/mathematics/
  mathematics-secondary-education-bs/)

MINORS IN MATHEMATICS

- Mathematics minor (http://catalog.creighton.edu/undergraduate/
  arts-sciences/mathematics/mathematics-minor/)

Students who think they may teach Mathematics must consult with the
Education Department, with the Mathematics Department, and with the
appropriate agency in the state in which they intend to teach.

Associate IN Science degree (A.S.)

This department offers the following associate degree:

- Mathematics, A.S. (http://catalog.creighton.edu/undergraduate/arts-
  sciences/as-mathematics/)

Certificate Program

- Mathematics (http://catalog.creighton.edu/undergraduate/arts-
  sciences/mathematics/mathematics-cert/)

Courses

MTH 103. Intermediate Algebra. 3 credits. FA, SP, SU
Topics from second-year algebra to form an introduction to college
algebra.

MTH 105. Math for Elementary Teachers. 4 credits.
Typical elementary school topics will be reviewed and extended to
related topics of exponential notation, significant figures, measures of
change, economic principles and the normal distribution. In so doing, all
applicable NCTM Standards will be covered.

MTH 125. Practical Math. 3 credits.
To present common situations requiring quantitative analysis or
calculations, to prepare the student to think logically through these
situations, to model them mathematically, and to reach an accurate
conclusion. Two years of high school algebra is expected. This course is
repeatable to a max of 9 credits.

MTH 131. Earth Algebra. 3 credits. FA, OD
College Algebra material; environmental issues; functions; atmospheric
carbon dioxide concentration; composite functions and inverses; global
temperature and ocean level; quadratic functions; systems of linear
equations and matrices; carbon dioxide emission. P. Four semesters of
high school algebra.

MTH 139. Precalculus. 3 credits. FA, SP
This course will cover the basic concepts that are required for further
study of mathematics including a course in calculus. The course topics
include solving linear, quadratic, exponential and logarithmic equations;
linear and quadratic inequalities; properties and graphs of polynomial,
rational, exponential, logarithmic, trigonometric and inverse trigonometric
functions; angles; right triangles; trigonometric identities and equations.

MTH 141. Applied Calculus. 3 credits. FA, SP, SU
Main topic is differential and integral calculus and applications. Includes
sections on partial derivatives. P. Heider College of Business students
only.

MTH 161. Business Statistics. 3 credits.
An introduction to descriptive and inferential statistics for business.
Topics include measures of central tendency and dispersion, sampling
and estimation, confidence intervals, regression and correlation, and
relevant examples from business, finance and economics. This course for
HCOB students and Economics majors and minors in CCAS only.

MTH 205. Mathematics for the Modern World. 2 credits.
Foundations course in mathematics for those not needing calculus.
Topics include basic number theory, graphs, estimation, data analysis
and curve fitting, probability and analysis of risk, and fairness in voting
systems.

MTH 206. Mathematical Reasoning and Statistics. 3 credits.
This is a 3-credit online course for students not needing calculus. We will
be considering basic number theory, graphs, estimation, data analysis,
probability, statistics, and analysis of risk. You will become familiar with
these topics and demonstrate mastery via weekly homework, discussion
posts, and quizzes, two written projects, and one cumulative exam.

MTH 231. Calculus for the Biological Sciences. 3 credits.
Differential and integral calculus and a brief introduction to differential
equations, with applications to the biological sciences. NOTE: Not
intended for CHM, MTH and PHY majors.

MTH 245. Calculus I. 4 credits. FA, SP, SU
Differential and integral calculus of algebraic and transcendental
functions.

MTH 246. Calculus II. 4 credits. FA, SP, SU
Techniques of integration, infinite series, and other topics. P. MTH 245 or
equivalent.

MTH 249. Modeling the Physical World I. 3 credits.
First semester in the sequence on mathematical modeling using
calculus. Course is taught jointly with PHY 221. Topics include
elementary differential equations, techniques of integration, sequences
and series, vector analysis, and applications. This course is equivalent to
MTH 246. P. MTH 245 or permission of the instructor. CO: PHY 221.
MTH 260. Introduction to Statistics. 3 credits.
MTH 310. Introduction to Abstract Mathematics. 3 credits. FA, SP
A systematic study of the basic concepts in mathematics, including set
theory; logic; proof techniques, basic properties of integers; relations;
functions; congruences; introduction to groups; sequences and series,
and basic properties of a topological space. P MTH 246 or MTH 249 or
equivalent.

MTH 321. Euclidean and Non-Euclidean Geometry. 3 credits.
Basic geometric concepts and applications. P MTH 246 or MTH 249.

MTH 347. Calculus III. 3 credits. FA, SP
This course covers vector algebra and calculus in two- and three-
dimensional space. P MTH 246 or MTH 249 or equivalent.

MTH 349. Modeling the Physical World II. 3 credits.
Second semester in the sequence on mathematical modeling using
calculus. Course is taught jointly with PHY 222. Topics include
multivariable functions and calculus, series integration (Green’s, Stokes’,
and Divergence theorems) and applications. P MTH 246 and PHY 221.

MTH 350. Applied Linear Algebra and Differential Equations. 3 credits.
This course is a survey of the techniques to solve elementary differential
equation and linear algebra problems. Topics include solving linear
systems, eigenvalues, eigenvectors, exact equations, integrating factors,
and constant coefficient systems of ODE. The class is computational in
nature and is suitable for students in the applied sciences. P MTH 246 or
MTH 249 or equivalent.

MTH 360. Elementary Probability and Statistics. 3 credits.
Non-calculus approach with emphasis on measures of central tendency
and variability, distributions and testing of hypothesis. Designed for
students in natural and social sciences, or business. Meets requirements
for Designated Statistical Reasoning and Designated Technology. Prereq:
Mathematical Reasoning course.

MTH 361. Probability and Statistics in the Health Sciences. 3 credits.
This course covers topics in probability and statistics considered useful
to those students planning on a career in the health sciences. The
topics covered include probability principles and distributions in health
sciences, types of epidemiologic study designs, estimation of medical
parameters in defined patient populations, test of hypothesis, measures
and analysis of treatment of the sick, analysis of variance, methods of
medical outcome prediction, and prospective, retrospective and cross-
sectional studies of disease occurrence. This course meets Designated
Statistical Reasoning and Designated Technology requirements. Prereq:
Mathematical Reasoning course.

MTH 362. Statistical Modeling. 3 credits.
Inferential statistical methods, ANOVA, design and analysis of
experiments, regression and nonparametric methods. P MTH 360 or MTH
361 or instructor consent.

MTH 365. Introduction to Data Science. 3 credits.
Intro to statistical data science, using computing tools to gather, manage
and analyze large and complex data sets. Topics include data wrangling
and formatting, web scraping, data analysis, statistical modeling
techniques, text mining and language processing. P Mathematical
Reasoning; CSC 121/221 or MTH 360 or MTH 361.

MTH 366. Machine Learning. 3 credits.
Introduction to machine and statistical learning techniques. Topics
include supervised learning (regression models, kernel smoothers),
unsupervised learning (clustering or principal component analysis),
shrinkage models, additive models, and neural networks. P MTH 360 or
MTH 361 or another introductory stat course with Instructor Consent;
MTH 365.

MTH 400. Current Issues in Mathematics. 1 credit.
MTH 400 is a capstone course where students make oral presentations
of current mathematics topics. Students will be guided through picking
a topic, finding materials, writing up a presentation, and making a
presentation. The students will offer constructive criticism of each
other’s presentations. P Ethics course, Oral Communication course, MTH
310, and one of the following: MTH 347, MTH 349 or MTH 350; Junior or
Senior standing.

MTH 411. Combinatorics. 3 credits.
Basic counting methods, generating functions, spanning trees, recurrence
relations, network algorithms and the inclusion-exclusion formula,
applications to information processing and retrieval. P MTH 310 or
Instructor Consent.

MTH 429. Advanced Linear Algebra. 3 credits.
Vector spaces and subspaces; linear transformations; matrices,
eigenvalues and eigenvectors. P MTH 350.

MTH 431. Mathematical History, Philosophy And Ethics. 3 credits. OD
(= MTH 310 or MTH 347)
An examination of mathematics and mathematical ideas and their
relation to philosophical and ethical views from the ancient Babylonians
and Pythagoreans to the present. Special attention will be given to non-
Western mathematics, ethnomathematics, twentieth-century game
theory, encryption, and ethical issues facing the mathematician and
society in the past and today. The course assumes no mathematical
background beyond the Core E requirements. P Sr. stdg; PHL 250 or THL
250.

MTH 443. Numerical Analysis. 3 credits.
Numerical differentiation and integration; solutions of equations and
systems of equations; polynomial approximation; error analysis and
eigenvectors; applications to digital computers. P MTH 246 or MTH 249.

MTH 445. Advanced Differential Equations. 3 credits.
Systems of differential equations, qualitative, theory, Laplace and Fourier
transforms, partial differential equations, series solutions, Fourier series.
P MTH 350.

MTH 446. Partial Differential Equations. 3 credits.
Integral curves and surfaces of vector fields; the Cauchy-Kovalevsky
theorem; general linear PDEs, their characteristics and classification;
solutions to, and applications of, linear and quasi-linear first order and
second order PDEs; Laplace’s equation, the heat equation and the wave
equation. P MTH 445.

This course is intended to be an overview of a variety of mathematical
topics considered useful to those students intending to pursue a career in
medicine or the life sciences. The topics covered include mathematics of
populations, infectious diseases, and excitable cells. P MTH 246 or MTH
249 and a Magis Core Ethics course.
MTH 448. Mathematics in Medicine and Life Sciences II. 3 credits.
This course continues the investigation of math modeling in biomedical sciences. Biological topics include excitable cells, the cardiovascular system, tumors, and the immune system, metabolic systems, and chemotaxis; mathematical techniques include ordinary, stochastic, and partial differential equations. P: MTH 350, MTH 447 or Instructor consent.

MTH 451. Differential Geometry. 3 credits.
Calculus of curves, surfaces and manifolds; topics will include hyperbolic geometry, vectors and tensors, fundamental forms, curvature, covariant derivatives, with applications to special and general relativity. P: MTH 347 or MTH 349.

MTH 455. Chaotic Dynamical Systems. 3 credits.
This course will study discrete dynamical systems. Topics covered will include one-dimensional and higher-dimensional dynamical systems, fixed points, stability theory, linearization, phase spaces, bifurcation theory, index theory, limit cycles and periodicity, chaos, and attractors. Applications to Biology, Physics, Chemistry, and other areas will be studied. P: MTH 350; MTH 347 or MTH 349.

MTH 457. Graph Theory. 3 credits.

MTH 459. Topology. 3 credits.
Set theory; metric space; topological spaces; connectedness; compactness; selected related topics. P: MTH 246 or MTH 249.

MTH 467. Operations Research. 3 credits.
Introductory course in operations research. Linear models and solutions using the simplex method, duality theory and sensitivity analysis. P: MTH 350.

MTH 471. Mathematical Analysis. 3 credits.
Properties of Euclidean spaces and their applications to functions. P: MTH 310 and Contemporary Composition course.

MTH 472. Mathematical Analysis II. 3 credits.
Continuation of MTH 471; functions in metric space. P: MTH 471.

MTH 473. Complex Analysis. 3 credits.
Complex arithmetic, polar representations, functions of a complex variable, analyticity and the Cauchy-Riemann equations, complex integration, Cauchy Integral Formula, series, poles and residues, applications to real integration, conformal mappings. P: MTH 347 or MTH 349.

MTH 481. Modern Algebra I. 3 credits.
Groups, rings; fields; applications to coding theory. P: MTH 310.

MTH 482. Modern Algebra II. 3 credits.
Rings; ideals; field extensions; Galois theory; applications to coding theory. P: MTH 481.

MTH 492. Internship in Mathematics. 3 credits.
Internship in Mathematics.

MTH 493. Directed Independent Readings. 1-3 credits. FA, SP
May be repeated to a limit of six hours. P: DC.

MTH 495. Directed Independent Study. 1-3 credits. FA, SP
May be repeated to a limit of six hours. P: DC.

MTH 497. Directed Independent Research. 1-3 credits. FA, SP
May be repeated to a limit of six hours. P: DC.

MTH 499. Seminar. 1-3 credits. OD

MTH 509. Discrete Structures. 3 credits.
Logic; Boolean algebra; switching circuits; graphs; groups; semi-groups; finite state machines; coding theory; grammars; algorithms. P: CSC 221; 6 hrs. college MTH.

MTH 525. Automata, Computability, and Formal Languages. 3 credits. OD
Finite state concepts; acceptors; formal grammars; computability; Turing machines. P: MTH 246 or MTH 249.

MTH 541. Mathematics for Data Scientists. 3 credits.
Matrix algebra, vector spaces, bases, linear transformations, linear operators and their properties, introduction to the fundamental principles of mathematical models, especially those useful in data science. P: MTH 246 or equivalent with a grade of B or better.

MTH 561. Mathematical Statistics I. 3 credits. FA, SU (Same as STA 561)
Introduction to probability and probability distributions including techniques for finding expected values and variance of discrete and continuous variables. These distributions and their properties are examined to establish their application to applied statistical methods. P: MTH 246 or MTH 249.

MTH 562. Mathematical Statistics II. 3 credits. SP (Same as STA 562)
Using probability distributions as a foundation and random sampling, methods for estimating distribution parameters are developed with applications to hypothesis testing. The course also includes an introduction to linear models, regression analysis, analysis of variance and design of experiments. P: MTH 561.

MTH 563. Mathematical Statistics III. 3 credits. OD (Same as STA 563)
Optimal decision procedures, further normal distribution theory, noncentral chi-square and F distributions, introduction to the theoretical basis for analysis of variance, nonparametric methods. P: MTH 562.

MTH 573. Probabilistic Models. 3 credits. OD

MTH 575. Introductory Stochastic Processes. 3 credits. OD

MTH 599. Seminar. 1-3 credits. OD
Topics in advanced mathematics selected by the instructor. P: IC.

STA 355. Essentials of Epidemiology. 3 credits. (Same as HAP 355, MTH 355)
This course introduces the concepts and includes exercises related to epidemiology, the discipline that serves as the basic science of public health, or population health, by providing evidence for defining the public health problem, assessing causation, and evaluating effectiveness of potential interventions.

STA 361. Probability and Statistics in the Health Sciences. 3 credits.
This course covers topics in probability and statistics considered useful to those students planning on a career in the health sciences. The topics covered include probability principles and distributions in health sciences, types of epidemiologic study designs, estimation of medical parameters in defined patient populations, test of hypothesis, measures and analysis of treatment of the sick, analysis of variance, methods of medical outcome prediction, and prospective, retrospective and cross-sectional studies of disease occurrence. Prereq: Mathematical Reasoning course; MTH 141, MTH 201, MTH 205, MTH 245 or MTH 249.

May be repeated to a limit of six hours.
Mathematics

STA 495. Directed Independent Study. 1-3 credits.
May be repeated to a limit of six hours.

STA 497. Directed Independent Research. 1-6 credits.
May be repeated to a limit of six hours.

May be repeated to a limit of six hours. P: DC.

STA 521. Computational Methods In Statistics. 3 credits. OD
Use of packages of statistical programs, calculation of statistical tables.
Monte Carlo methods. P: A course in statistics; CSC 221.

STA 525. Nonparametric Methods. 3 credits. OD
Applications of nonparametric estimates, confidence, intervals, tests, and

STA 527. Sample Surveys. 3 credits. OD
Simple, systematic, stratified, and cluster random sampling; proportions;
ratios; selection of sample size. P: A course in statistics.

STA 561. Mathematical Statistics I. 3 credits. FA (Same as MTH 561)
Introduction to probability and probability distributions including
techniques for finding expected values and variance of discrete and
continuous variables. These distributions and their properties are
examined to establish their application to applied statistical methods. P:
MTH 246 or MTH 249.

STA 562. Mathematical Statistics II. 3 credits. SP (Same as MTH 562)
Using probability distributions as a foundation and random sampling,
methods for estimating distribution parameters are developed with
applications to hypothesis testing. The course also includes an
introduction to linear models, regression analysis, analysis of variance
and design of experiments. P: STA 561.

STA 563. Mathematical Statistics III. 3 credits. OD (Same as MTH 563)
Optimal decision procedures, further normal distribution theory,
noncentral chi-square and F distributions, introduction to the theoretical
basis for analysis of variance, nonparametric methods. P: STA 561.

STA 567. Linear Statistical Models. 3 credits. OD
Least squares method; general linear hypothesis; multiple correlation and
regression; analysis of covariance. P: STA 561; MTH 350.

STA 569. Analysis Of Variance And Design Of Experiments. 3 credits. OD
One- and two-way classifications; blocking; nesting; multiple
comparisons; incomplete designs; variance components; factorial
experiments; confounding. P: STA 561.

STA 571. Operations Research. 3 credits. OD (Same as MTH 571)
Introductory course in operations research. Linear models and solutions
using the simplex method, duality theory and sensitivity analysis. P: MTH
350.

STA 573. Probabilistic Models. 3 credits. OD
Queueing theory, inventory theory, Markov processes, simulation, and
nonlinear programming. P: STA 561.

STA 575. Introductory Stochastic Processes. 3 credits. OD
Random walk, normal processes and covariance stationary processes,
counting processes and Poisson processes, renewal counting processes,

STA 577. Applied Multivariate Analysis. 3 credits. OD
Inference about mean vectors and covariance matrices, canonical
correlation, principal components, discriminant analysis, cluster analysis,
computer techniques. P: STA 563, STA 567.

STA 579. Applied Time Series Analysis. 3 credits. OD
Forecasting; Box-Jenkins models; time series; regression; exponential
smoothing; transfer function models; auto covariance functions. P: STA
561.