DEPARTMENT OF MATHEMATICS

25 University Avenue, Room 101
West Chester University
West Chester, PA 19383
610-436-2440
Department of Mathematics (http://www.wcupa.edu/mathematics/)
Dr. Kolpas (akolpas@wcupa.edu), *Chairperson*
Dr. Fisher (mfisher@wcupa.edu), *Assistant Chairperson*
Dr. Rieger (rrieger@wcupa.edu), *Graduate Coordinator - M.S. in Applied Statistics; Graduate Certificate in Applied Statistics; Post-Master's Certificate of Advanced Study in Applied Statistics*
Dr. McKibben (mmckibben@wcupa.edu), *Graduate Coordinator - M.S. in Applied and Computational Mathematics; M.A. in Mathematics (including the Mathematics Education Concentration)*
Sally Malarney (smalarney@wcupa.edu), *Administrative Assistant*

Programs of Study

The Department of Mathematics offers the master of arts degree with options in mathematics or mathematics education, the master of science degree with options in applied and computational mathematics or applied statistics, and a certificate in applied statistics.

Master of Arts in Mathematics

The M.A. in Mathematics at West Chester University is a thirty-three credit master's program, eighteen credits of core courses and fifteen credits of electives, which offers great flexibility. Elective courses may be in mathematics education, statistics, computer science, pure mathematics, applied and computational mathematics, actuarial science, business, and others. The capstone experience is either a comprehensive oral exam in three subject areas, or a thesis. By properly selecting their electives, our M.A. candidates may train for work in a large variety of fields, including, but not limited to, actuarial science, computer science, operations research, bio-mathematics, cryptography, teaching in a high school or a two-year college, research, economics, environmental mathematics, geophysical mathematics, air traffic control operations, photogrammetry, and many more. Upon completion of the M.A. in Mathematics, students are also well prepared to pursue a doctoral program in mathematics. For further information, please contact Dr. Gail Gallitano, Graduate Coordinator.

Master of Arts in Mathematics - Mathematics Education Concentration

The M.A. in Mathematics with the Mathematics Education Track is a thirty-three credit master's program which is designed to offer candidates flexibility through their elective course selection so they may select mathematics education electives. The core curriculum is six solid mathematics courses which consist of abstract algebra, real analysis, mathematical statistics, and geometry. Students in this program have fifteen credits of electives, and they may select up to four mathematics education electives, which is twelve credits and then an additional three credit elective in any area of mathematics or related field. This will help prepare them for a wide variety of job opportunities in the field of teaching and/or mathematics education. The student's capstone experience is either a thesis or an oral comprehensive exam. A thesis is recommended if a student would like to pursue a doctoral program in mathematics education or related field. For further information, please contact Dr. Gail Gallitano, Graduate Coordinator.

Master of Science in Applied and Computational Mathematics

The M.S. in Applied and Computational Mathematics program is designed to prepare students to join the workforce as a consulting mathematician or to pursue doctoral study in computational and industrial mathematics or other computationally-intensive field of study. For further information, please contact Dr. Allison Kolpas, Graduate Coordinator.

Master of Science in Applied Statistics

Applied Statistics is one of the most relevant and in-demand degrees in today's world, and this program provides a vibrant, supportive environment to learn. Vital to a wide variety of disciplines, graduates of this program have found employment in pharmaceutical research and development; government public policy; economic forecasting and analysis; market research; public health; and many other areas. The mission of the program in applied statistics is to train students to possess the applied skills necessary for immediate employment and/or provide a course of study that would make further (doctoral) study in statistics, biostatistics, data science, or other related fields feasible. The program provides strong training in statistical analysis, statistical programming, and design of scientific studies, emphasizing hands-on work with data and communication of statistical concepts. The program features an active internship program. Students can choose to pursue the degree with a concentration in biostatistics and bioinformatics; business and marketing analytics; or data science. For further information, please contact Dr. Randall Rieger, Graduate Coordinator.

Programs

Master's Programs

- M.A. in Mathematics (https://catalog.wcupa.edu/graduate/sciences-mathematics/mathematics/mathematics-ma/)
- M.A. in Mathematics - Mathematics Education Concentration (https://catalog.wcupa.edu/graduate/sciences-mathematics/mathematics/mathematics-ma-mathematics-education-concentration/)
- M.S. in Applied and Computational Mathematics (https://catalog.wcupa.edu/graduate/sciences-mathematics/mathematics/applied-computational-ms/)
- M.S. in Applied Statistics (https://catalog.wcupa.edu/graduate/sciences-mathematics/mathematics/applied-statistics-ms/)
- M.S. in Applied Statistics - Biostatistics and Bioinformatics Concentration (https://catalog.wcupa.edu/graduate/sciences-mathematics/mathematics/applied-statistics-ms-biostatistics-bioinformatics-concentration/)
- M.S. in Applied Statistics - Business and Marketing Analytics Concentration (https://catalog.wcupa.edu/graduate/sciences-mathematics/mathematics/applied-statistics-ms-business-marketing-analytics-concentration/)
- M.S. in Applied Statistics - Data Science Concentration (https://catalog.wcupa.edu/graduate/sciences-mathematics/mathematics/applied-statistics-ms-data-science-concentration/)

Certificates

- Applied Statistics (https://catalog.wcupa.edu/graduate/sciences-mathematics/mathematics/applied-statistics-certificate/)
- Post-Master's Certificate of Advanced Study in Applied Statistics (https://catalog.wcupa.edu/graduate/sciences-mathematics/mathematics/post-masters-certificate-advanced-study-applied-statistics/)

Accelerated Bachelor's to Master's

- B.A. to M.A. in Mathematics (https://catalog.wcupa.edu/undergraduate/sciences-mathematics/mathematics/mathematics-ba/)
- B.S. in Accounting to M.S. in Applied Statistics (https://catalog.wcupa.edu/undergraduate/business-public-management/accounting/accounting-bs/)
- B.S. in Mathematics - Applied and Computational Mathematics Concentration to M.S. in Applied and Computational Mathematics

(https://catalog.wcupa.edu/undergraduate/sciences-mathematics/mathematics/mathematics-bs-applied-computational-mathematics-concentration/)

- B.S. in Mathematics - Mathematics Concentration to M.A. in Mathematics (https://catalog.wcupa.edu/undergraduate/sciences-mathematics/mathematics/mathematics-bs-mathematics-concentration/)
- B.S. in Mathematics - Statistics Concentration to M.S. in Applied Statistics (https://catalog.wcupa.edu/undergraduate/sciences-mathematics/mathematics/mathematics-bs-statistics-concentration/)

Admissions

All applicants to one of West Chester University's graduate programs will be held to the graduate admissions requirements (https://catalog.wcupa.edu/general-information/admissions-enrollment/graduate-admissions/). When applicable, additional requirements for admission into specific department program(s) may be listed below.

Admission Policy for the Master's in Mathematics Programs

M.A. in Mathematics

In addition to meeting the basic admission requirements of the University, applicants must have a bachelor's degree, or the equivalent of, in mathematics, or a related field. Applicants must schedule an interview with the graduate coordinator prior to enrollment. A full treatment of calculus along with an advanced undergraduate course in abstract algebra, linear algebra, differential equations, statistics, and geometry is recommended. Deficiencies in these areas may be removed by successfully completing appropriate courses prior to enrollment in the program.

M.A. in Mathematics - Mathematics Education Concentration

In addition to meeting the basic admission requirements of the University, applicants must have a bachelor's degree, or the equivalent of, in mathematics, or a related field. Applicants must schedule an interview with the graduate coordinator prior to enrollment. A full treatment of calculus along with an advanced undergraduate course in abstract algebra, linear algebra, differential equations, statistics, and geometry is recommended. Deficiencies in these areas may be removed by successfully completing appropriate courses prior to enrollment in the program.

Admission Policy for the M.S. in Applied and Computational Mathematics

In addition to meeting the general requirements for admission to a graduate program at West Chester University, applicants must have successfully completed the undergraduate calculus sequence, as well as courses in differential equations and linear algebra. Applicants must submit two letters of reference addressing their academic ability, and complete an in-person interview with the Graduate Coordinator.

Admission Policy for the M.S. in Applied Statistics

Application Requirements

A complete application to the Master of Applied Statistics program (all concentrations) consists of the following items:

1. All official undergraduate transcripts, and any official graduate transcripts
2. A detailed, professional essay that addresses the applicant's career plans and the applicant's relevant professional or academic background
3. Two letters of recommendation

Full Admission

Successful full admission applicants meet the following criteria. Admissions decisions are made after reviewing the totality of the applicant's file. The criteria are:

1. A bachelor's degree or above in any major/field from an accredited institution
2. A 2.8 GPA from the highest previous degree earned
3. Competency in the Prerequisite Areas of:
   a. Introductory Statistics
   b. Mathematics through Multivariable Calculus

Competency is demonstrated at the discretion of the Program Coordinator by prior coursework, by third party certifications, or by relevant experience.

Provisional Admission

Provisional admission is available to applicants at the discretion of the Program Coordinator after a complete review of the applicant's file. Provisional admission will be considered if the applicant can demonstrate substantial, but not complete, satisfaction of the requirements for full admission, and if the applicant can demonstrate the strong potential for successful completion of the program. In the case of lack of prerequisite coursework, a provisionally accepted student will be given a pathway to meet the requirements and move to Full Admission status.

Admission Policy for the Certificate in Applied Statistics

In addition to meeting the basic admission requirements of the University, applicants must have at least one undergraduate level (or higher) course in statistics.

Admission Policy for the Post-Master's Certificate for Advanced Study in Applied Statistics

Admission into the post-master's certificate program requires completion of a master's degree in statistics or closely related field, with coursework in mathematical statistics, linear models, and at least one course in statistical programming.

Coursework that counted toward a master's degree will not be considered toward completion of the certificate.

Policies

All graduate students are held to the academic policies and procedures (https://catalog.wcupa.edu/graduate/academic-policies-procedures/) outlined in the graduate catalog. Students are encouraged to review departmental handbooks for program tips, suggested course sequences, and explanations of procedures. When applicable, additional policies for specific department programs may be listed below.

Requirements for the M.A. in Mathematics

In addition to completing the course requirements, candidates must either pass a comprehensive examination or submit a thesis.

Requirements for the M.S. in Applied and Computational Mathematics

The electronic portfolio is developed cumulatively as the student progresses through curriculum of the program and must be submitted prior to graduation for approval by a faculty committee.

Requirements for the M.S. in Applied Statistics

Students must achieve a grade of B- or better in the following foundational courses: STA 504* or STA 505, STA 511, and STA 512. Per University policy, students may only repeat at most two total courses and must maintain an overall GPA of 3.0 or higher to remain in good

academic standing (*STA 504 is a 4 credit alternative and will increase the curriculum to 33 credits.).

Faculty

Professors

Brian Bowen (bbowen@wcupa.edu) (2010)
B.S.Ed., West Chester University; M.Ed., Ph.D., University of Delaware

Michael J. Fisher (mfisher@wcupa.edu) (2008)
Assistant Chairperson, Mathematics
B.S., Millersville University; M.S., Ph.D., Lehigh University

Gail M. Gallitano (ggallitano@wcupa.edu) (1992)
B.S., Monmouth University; M.S., Farleigh Dickinson University; M.A., M.Ed., Ed.D., Columbia University

Robert J. Gallop (rgallop@wcupa.edu) (2001)
B.S., Pennsylvania State University; M.S., Ph.D., Drexel University

Peter L. Glidden (pglidden@wcupa.edu) (1995)
B.A., College of Wooster; M.A., Ph.D., Columbia University

Shiv K. Gupta (sgupta@wcupa.edu) (1985)
B.S., M.S., Delhi University; M.S., University of Wisconsin; Ph.D., Case Western Reserve University

Kim Johnson (kjohnson2@wcupa.edu) (2013)
B.S., MS.Ed., Millersville University; Ph.D., Pennsylvania State University

Clifford A. Johnston (cjohnston@wcupa.edu) (1992)
B.S.E., Mansfield University; M.A., Ph.D., Temple University

Allison Kolpas (akolpas@wcupa.edu) (2011)
Chairperson, Mathematics
B.A., Revelle College; M.A., Ph.D., University of California, Santa Barbara

Scott McClintock (smcclintock@wcupa.edu) (2007)
B.S., San Jose State University; M.S., M.A., Ph.D., University of Kentucky

Mark A. McKibben (mmckibben@wcupa.edu) (2013)
Graduate Coordinator, Mathematics
B.S., M.S., Ph.D., Ohio University

James McLaughlin (jmclaughlin@wcupa.edu) (2005)
B.S., University of Ulster; M.S., Queen's University Belfast; Ph.D., University of Illinois

Scott Parsell (sparsell@wcupa.edu) (2009)
B.S., Massachusetts Institute of Technology; M.S., Ph.D., University of Michigan

Cheng Peng (cpeng@wcupa.edu) (2019)
B.A., East China Normal University; M.A., Ph.D., University of Toledo

Randall H. Rieger (rrieger@wcupa.edu) (2000)
Graduate Coordinator, Mathematics
B.A., Bowdoin College; M.S., Ph.D., University of North Carolina

Lin Tan (ltan@wcupa.edu) (1989)
B.S., M.A., Zhejian University; M.S., Ph.D., University of California, Los Angeles

Associate Professors

Jeremy Brazas (jbrazas@wcupa.edu) (2017)
B.S., M.S.Ed., Harding University; Ph.D., University of New Hampshire

Andrew Crossett (acrossett@wcupa.edu) (2012)
B.A., Canisius College; M.A., Ph.D., Carnegie Mellon University

Chuan Li (cli@wcupa.edu) (2016)
B.S., University of Science and Technology of China; M.S., Ohio University; Ph.D., University of Tennessee Knoxville

Emily K. Miller (emiller@wcupa.edu) (2016)
B.A., The College of New Jersey; M.S., Ph.D., University of Delaware

Barbara Swartz (bswartz@wcupa.edu) (2020)
B.A., M.A., Lehigh University; Ph.D., University of Virginia

Assistant Professors

Premalatha Junius (pjunius@wcupa.edu) (2014)
B.S., M.S., University of Madras; M.A., Ph.D., University of Northern Colorado

Laura Pyott (lpyott@wcupa.edu) (2017)
B.S., University of Richmond; M.S., University of Delaware

Rosemary Sullivan (rsullivan@wcupa.edu) (2008)
B.S., Pennsylvania State University; M.S., Ph.D., Lehigh University

Peter Zimmer (pzimmer@wcupa.edu) (2000)
B.S., M.S., University of Wisconsin; Ph.D., University of Kansas

Courses

MAT

MAT 500. Fundamentals of Applied Mathematics. 3 Credits.
This course is designed to provide an intense review of the core concepts essential to the study of applied mathematics. Topics include the main theorems of differential and integral calculus; techniques and theorems of vector analysis; sequences and power series; complex arithmetic and elementary complex-valued functions; first-order, second-order, and systems of linear differential equations; matrix algebra and vector spaces. The computer algebra systems Matlab and Mathematica will be introduced as computational tools for these topics.

MAT 503. History Of Mathematics. 3 Credits.
This course will cover selected topics from the history of mathematics. Many great mathematicians will be studied including Hippocrates, Euclid, Archimedes, Heron, Cardano, Newton, the Bernoulli Brothers, Euler, Gauss, and others. Mathematics problems will be approached using the methods and knowledge of the era studied. A solid background in undergraduate mathematics is required.

MAT 513. Linear Algebra. 3 Credits.
Vectors, vector spaces, determinants, linear transformations, matrices, and bilinear and quadratic forms.
MAT 513 Prerequisite: Successful completion of MAT 512, with a minimum grade of C-.

MAT 514. Theory of Numbers. 3 Credits.
This course covers divisibility, linear congruence, the Chinese Remainder Theorem, Euler's phi function, primitive roots, and quadratic reciprocity. Additional topics may include public-key cryptography, Diophantine equations, continued fractions, and the distribution of primes.
MAT 514 Prerequisite: Successful completion of MAT 200, with a minimum grade of C-.

MAT 515. Algebra I. 3 Credits.
Elements of abstract algebra, groups, commutative ring theory, modules, and associative algebras over commutative rings. Offered in fall of odd-numbered years.

MAT 516. Algebra II. 3 Credits.
A continuation of MAT 515. Vector spaces, representation theory, and Galois theory.
MAT 516 Prerequisite: Successful completion of MAT 515, with a minimum grade of C-.

MAT 517. Topics in Algebra. 3 Credits.
In this topics course students explore the details surrounding James Tanton's Exploding Dots concept. Specifically they (1) introduce the concept as a generalization of place value; (2) then generalize this notion to polynomials to investigate operations on polynomials, including polynomial long-division; (3) they go on to take a quick look at the arithmetic of infinite series; (4) then take a slight detour to look at more general "machines" (this leads them to exotic number representations such as base -3/2); (5) finally they conclude the exploration with a quick investigation of complex numbers (using the exploding dots concept).

MAT 521. Discrete Mathematics & Graph Theory. 3 Credits.
Topics from Discrete Mathematics including the study of logic, sets, relations, and counting will be introduced. Graphs and Graph Theory will be discussed, including Eulerian and Hamiltonian Graphs, Digraphs, Trees, Algorithms, Paths, Planarity, and Chromatic Numbers. Applications such as Social Network Analysis will be stressed.

MAT 532. Geometry I. 3 Credits.
This course is a rigorous introduction to geometry from a transformational point of view, emphasizing Euclidean, hyperbolic, and/or projective geometry. Other topics such as Spherical geometry, symplectic geometry, or Affine geometry may be included if time permits.

MAT 533. Geometry II. 3 Credits.
A study of geometry using calculus as our main tool. The course covers the basics of differential geometry: parametrizations, tengent spaces, curvature, geodesics; leading to Stokes theorem and the Gauss-Bonnett theorem. Several examples will be studied in depth, including the sphere and the projective plane.

MAT 535. Topology. 3 Credits.
This course is a rigorous introduction to point-set topology. Topics covered include topological spaces and continuous functions, connectedness, compactness, separation axioms, metrization theorems, and function spaces.

MAT 536. Algebraic Topology. 3 Credits.
This course is an introduction to the fundamental techniques of algebraic topology. Topics covered include fundamental groups and covering spaces, basic homological algebra, simplicial homology, singular homology, and cohomology.

MAT 543. Topics in Differential Equations. 3 Credits.
An advanced topics course. Existence and uniqueness theorems, stability theory, singular points, regular singular points, Sturm separation theorem, and the "method of Liapunov."

MAT 545. Real Analysis I. 3 Credits.
A rigorous study of real-valued functions of real variables.

MAT 546. Real Analysis II. 3 Credits.
Continuation of MAT 545.
MAT 546 Prerequisite: Successful completion of MAT 545, with a minimum grade of C-.

MAT 548. Industrial Mathematics - Continuous Models. 3 Credits.
This course is designed to provide a survey of mathematical concepts, techniques, and numerical algorithms used to study real-world continuous mathematical models. Application areas include population dynamics, climatology, feedback and control systems, traffic flow, diffusion, fluids and transport, and epidemiology. Computer software packages such as Matlab, Mathematica, and Maple will be used in the analysis of the problems.
MAT 548 Prerequisite: Successful completion of MAT 500, with a minimum grade of C-.

MAT 549. Industrial Mathematics - Discrete Models. 3 Credits.
This course is designed to provide a survey of mathematical concepts, techniques, and numerical algorithms used to study real-world discrete mathematical models. Application areas include forestation, particle dynamics, image processing, genetics, queues, efficient call and traffic routing, and optimal scheduling. Computer software packages such as Matlab, Mathematica, and Maple will be used in the analysis of the problems.
MAT 549 Prerequisite: Successful completion of MAT 500, with a minimum grade of C-.

MAT 552. Operations Research. 3 Credits.
This course provides an overview of deterministic operations research methodology including linear, integer, nonlinear, and dynamic programming, and classical optimization problems. The computer algebra system MATLAB and other software will be used as an investigative tool in analyzing the problems that arise.
MAT 552 Prerequisite: Successful completion of MAT 500, with a minimum grade of C-.

MAT 553. Stochastic Modeling. 3 Credits.
This course introduces topics in stochastic optimization and control (including Markov chains, queueing theory, reliability theory, inventory theory, and forecasting), discrete-event and Monte Carlo simulation, and stochastic differential equations. Applications are drawn from manufacturing, finance, logistics, and service systems. The computer algebra system MATLAB and other software will be used as an investigative tool in analyzing these models.
MAT 553 Prerequisite: Successful completion of MAT 500, with a minimum grade of C-.

MAT 554. Scientific Computing. 3 Credits.
This case-study driven course will illustrate the use of computational tools in multiple science and engineering domains. The focus is on using MATLAB and appropriate numerical methods (including solutions of linear and nonlinear algebraic equations, solutions of ordinary and partial differential equations, finite elements, linear programming, optimization algorithms, and fast-Fourier transforms) to assist in investigating mathematical models of phenomena in the physical, ecological, and financial realms.
MAT 554 Prerequisite: Successful completion of MAT 500, with a minimum grade of C-.

MAT 555. Industrial Practicum - Continuous Models. 3 Credits.
This is a case study, team problem-solving based course focused on solving real-world problems that can be modeled using continuous mathematics techniques and that emanate from industry. Ideally, the problems would be obtained from partnerships with local industry and they will ordinarily focus on topics arising in optimization, financial mathematics, and other stochastic models.
MAT 555 Prerequisite: Successful completion of MAT 548, MAT 549; and MAT 552, MAT 553, or MAT 554, with minimum grades of C-.

MAT 556. Industrial Practicum - Discrete Models. 3 Credits.
This is a case study, team problem-solving based course focused on solving real-world problems that can be modeled using discrete mathematics techniques and that emanate from industry. Ideally, the problems would be obtained from partnerships with local industry and they will ordinarily focus on topics arising in the biological, natural, and physical sciences.
MAT 556 Prerequisite: Successful completion of MAT 548, MAT 549; and MAT 552, MAT 553, or MAT 554, with minimum grades of C-.

MAT 575. Complex Analysis I. 3 Credits.
This course covers basic properties of functions of a single complex variable. Topics include complex arithmetic, analytic functions and mappings, contour integrals, Cauchy's Theorem, Taylor and Laurent series, and the theory and application of residues.
MAT 575 Prerequisite: Successful completion of MAT 261, with a minimum grade of C-.

MAT 595. Topics in Mathematics. 1-3 Credits.
Topics announced at time of offering.
Repeatable for credit.

MAT 599. Independent Study. 3 Credits.
Students will work independently on a mathematics topic of their choice under the aegis of a Mathematics Department faculty member.

MAT 609. Thesis I. 3 Credits.
Conduct literature search, develop thesis proposal and begin research under the guidance of a mathematics department faculty member.

MAT 610. Thesis II. 3 Credits.
This course is a continuation of MAT 609. The student will continue research under the guidance of a Mathematics Department faculty member and prepare their thesis for submission.

MTE

MTE 507. Foundations of Secondary Mathematics Education. 3 Credits.
Research methods in mathematics education; forces which have shaped mathematics education; classroom implications of 20th-century learning theorists; assessment in the classroom; methods of organizing for instruction; cultural and gender considerations.

MTE 508. Jr. High School Math - Curriculum, Instruction, and Assessment. 3 Credits.
This course will focus on the curricula, methods of instruction, and assessment techniques used to teach mathematics in middle school. Course topics will include the real numbers, ratios, rates, proportions, percents, fractions, mixed numbers, pre-algebra, algebra, geometry, probability, and statistics. Teachers will also explore strategies that can be used to integrate technologies into the mathematics classroom.
MTE 508 Prerequisite: Successful completion of MTE 507, with a minimum grade of C-.

MTE 512. Sr. High School Math - Curriculum, Instruction and Assessment. 3 Credits.
This course will focus on the curricula, methods of instruction, and assessment techniques used to teach mathematics in a senior high school setting. Course topics will include geometries, algebra II, trigonometry, precalculus, and discrete mathematics. Teachers also will explore strategies that can be used to integrate the scientific and graphing calculator, computer, and the new CD-ROM technologies into the mathematics classroom.
MTE 512 Prerequisite: Successful completion of MTE 507, with a minimum grade of C-.

MTE 552. Teaching Children Mathematics II. 3 Credits.
A continuation of the pedagogical strategies and methods for teaching the topics covered in MAT 351/MTE 553 extended to topics such as real numbers, geometry, percent, proportional reasoning, measurement, and algebra.
MTE 552 Prerequisite: Successful completion of MTE 553, with a minimum grade of C-. Field Clearances.

MTE 553. Teaching Children Mathematics I. 3 Credits.
In-depth treatment of current pedagogical strategies and materials for teaching concepts including: early number sense; place value; addition, subtraction, multiplication, and division of whole numbers; and fractions in an elementary classroom.
MTE 553 Prerequisite: Successful completion of two mathematics courses, with minimum grades of C-.

MTE 557. Teaching Mathematics to Exceptional Children. 3 Credits.
An exploration of the literature and current practices in teaching mathematics to exceptional children in K-12 classrooms that focuses on the content, pedagogy, and pedagogical-content knowledge related to equitable and effective K-12 mathematics instruction. Emphasis on responding to interventions, assessing mathematics learning formatively, and developing strategies and interventions that target specific difficulties in learning mathematics. The activities and projects in this course are designed to develop the mathematical confidence, problem-solving skills, and communication skills of prospective teachers of exceptional students so that they can support all learners in seeing themselves as mathematicians.
MTE 557 Prerequisite: Successful completion of EDA 542, with a minimum grade of C-.
Distance education offering may be available.

MTE 595. Topics in Mathematics Education. 1-3 Credits.
Topics announced at time of offering.

MTE 599. Independent Study. 3 Credits.
Students will work independently on a mathematics education topic of their choice under the aegis of a Mathematics Department mathematics education faculty member.

MTE 604. Research Seminar. 3 Credits.
This course will focus on the study of research in mathematics education. Contemporary topics of research will be discussed and perused. Students will be expected to report on a topic of research of their choosing. In addition, empirical study and design will be discussed along with data analysis and the reporting of results.

MTE 610. Thesis. 3-6 Credits.
Students will conduct a literature search, develop a thesis proposal, and begin research under the guidance of a mathematics education faculty member.

STA

STA 501. Methodologies in Applied Statistics. 3 Credits.
This course will teach the commonly used statistical techniques that are most likely to be encountered in graduate research. Topics will include t-tests, multiple linear regression, ANOVA, chi-squared tests and power/sample size calculations.
Distance education offering may be available.

STA 502. Introduction to Python for Statistics and Data Science. 1 Credit.
In this course, students will learn to install Python and Jupyter Notebook, basic syntax, data input/output, control flows, data visualization and manipulation, along with basic descriptive statistics and statistical tests. They will also learn how to use some common libraries such as NumPy, Pandas and Maplotlib. This course will focus more on using Python as a tool for Statistics and Data Science rather than the intricacies of using an object-oriented programming language.
Distance education offering may be available.

STA 503. Introduction to R. 1 Credit.
This is an introductory course in R programming. The major topics include setting up Rstudio, R data objects, data input/output, built-in and user-defined R functions, control statement and looping, basic R plot functions, commonly used R libraries, and R markdown.
Distance education offering may be available.

STA 504. Mathematical Statistics I with Calculus Review. 4 Credits.
A rigorous treatment of probability spaces and an introduction to the estimation of parameters. This course will also review relevant calculus topics.
Distance education offering may be available.

STA 505. Mathematical Statistics I. 3 Credits.
A rigorous treatment of probability spaces and an introduction to the estimation of parameters.
Distance education offering may be available.

STA 506. Mathematical Statistics II. 3 Credits.
Continuation of STA 505. Correlation, sampling, tests of significance, analysis of variance, and other topics.
STA 506 Prerequisite: Successful completion of STA 504 or STA 505, with minimum grades of C-.
Distance education offering may be available.

STA 507. Introduction to Categorical Data Analysis. 3 Credits.
Data-driven introduction to statistical techniques for analysis of data arising from medical and public health studies. Contingency tables, logistic regression survival models, non parametric methods and other topics.
STA 507 Prerequisite: Successful completion of STA 511 and STA 512, with minimum grades of C-, or permission of instructor.
Distance education offering may be available.

STA 511. Intro Stat Computing & Data Management. 3 Credits.
This course will give students the ability to effectively manage and manipulate data, conduct statistical analysis and generate reports and graphics, primarily using the SAS Statistical Software package.
Distance education offering may be available.

STA 512. Principles of Experimental Analysis. 4 Credits.
Course provides technology-driven introduction to regression and other common statistical multivariable modeling techniques. Emphasis on interdisciplinary actions.
STA 512 Prerequisite: Successful completion of STA 511, with a minimum grade of C-, or permission of instructor.
Distance education offering may be available.

STA 513. Intermediate Linear Models. 4 Credits.
Rigorous mathematical and computational treatment of linear models.
STA 513 Prerequisite: Successful completion of STA 504 or STA 505; STA 506, STA 511, and STA 512, with minimum grades of C-, or permission of instructor.
Distance education offering may be available.

STA 514. Modern Experimental Design. 3 Credits.
Focusing on recent journal articles, this course will investigate issues associated with design of various studies and experiments. Pharmaceutical clinical trials, case-controlled studies, cohort studies, survey design, bias, causality and other topics.
STA 514 Prerequisite: Successful completion of STA 511 and STA 512, with minimum grades of C-, or permission of instructor.
Distance education offering may be available.

STA 531. Topics In Applied Statistics. 3 Credits.
Contact department for more information about this course.
Repeatable for credit.

STA 532. Survival Analysis. 3 Credits.
This course will provide students with the knowledge and tools to conduct a complete statistical analysis of time to event data. Students will get experience using common methods for survival analysis, including Kaplan-Meier Methods, Life Table Analysis, parametric regression methods, and Cox proportional Hazard Regression. Additional topics include discrete time data, competing risks, and sensitivity analysis.

STA 533. Longitudinal Data Analysis. 3 Credits.
Introduction to the application and theory of models for clustered and longitudinal data. Course will address the analysis for both continous and categorical response data. Course will be held in the statistics lab and use the statistical software package SAS. Other software such as R, HLM, SPSS, MIXORMIXREG may be introduced.
STA 533 Prerequisite: Successful completion of STA 507, STA 511, STA 512, and STA 513, with minimum grades of C-.

STA 534. Time Series. 3 Credits.
Time series analysis deals with the statistical study of random events ordered through time. This class will focus on the characteristics inherent in such processes such as repetitive cycles and deteriorating dependence. Course topics will include seasonal decomposition, exponential smoothing, and ARIMA models. Emphasis will be placed on real life data analysis and statistical communication. Data analysis will be done with a variety of programs such as SAS, R, and Excel.
STA 534 Prerequisite: Successful completion of STA 511 and STA 512, with minimum grades of C-.

STA 535. Multivariate Data Analysis. 3 Credits.
Multivariate data typically consist of many records, each with readings on two or more variables, with or without an "outcome" variable of interest. Procedures covered in this course include multivariate analysis of variance (MANOVA), principal component analysis, factor analysis and classification techniques.

STA 536. Data Mining. 3 Credits.
The purpose of this course is to give you an introduction to many of the modern techniques that are used to analyze a wide array of data sets. We will be applying these methods using the statistical programming language R.

STA 537. Advanced Statistical Programming Using SAS. 3 Credits.
This course will focus on skills and techniques considered essential to advanced SAS programming. The primary topics covered will be SAS SQL and SAS Macro Programming. Other advanced topics such as indices, efficient programming techniques, memory usage,graphics, and using best programming practices will also be covered.
STA 537 Prerequisite: Successful completion of STA 511, with a minimum grade of C-.
Distance education offering may be available.

STA 538. Statistical Programming Using R. 3 Credits.
The statistical programming language R is one of the most popular tools for data analysis. It is freely available to most common operating systems and also an extremely powerful and customizable programming language. This course will focus on performing many rigorous statistical analyses and simulating data in R. Some of the topics include: verifying concepts of statistical inference using simulations, fitting linear models, performing various statistical tests, along with advanced graphics and visualization.

STA 539. Applied Bayesian Methods. 3 Credits.
Review of conditional probability and Bayes' Theorem, conditional distributions and conditional expectations, and likelihood functions; prior and posterior distributions; conjugate priors; credible intervals; Bayes' factors; Bayesian estimation in linear models; predictive analysis; Markov Chain Monte Carlo methods. Use of appropriate technology.
STA 539 Prerequisite: Successful completion of STA 506 and STA 511, with minimum grades of C-.

STA 540. Statistical Consulting. 3 Credits.
This course will discuss the skills needed to be successful in different consulting environments. It will provide detailed instruction on use of communication skills and consulting strategies. Several interactive case studies will be presented. Then, students will be required to work as part of a team on a real consulting project. Students will be involved in a consulting session with clients, research and carry out the data analysis, and present the final results in another consulting meeting. Statistical methods from previous courses may be applied to the data for the projects. In addition, new statistical techniques may be taught as part of the class if the projects require statistical methodologies not introduced in previous classes.
STA 540 Prerequisite: Successful completion of STA 511 and STA 512, with minimum grades of C-.

STA 541. Categorical Data Analysis II. 3 Credits.
This course will extend the information presented in the STA 507 course. We will cover statistical methods for producing Receiver Operating Characteristic Curves and the Optimal operating point from logistic regression. Goodness-of-link and complex modeling issues for count data such as overdispersion and underdispersion will be presented. Students will be exposed to discussion of techniques for both cross-sectional and longitudinal count data. Techniques to assess goodness of fit for count data will be introduced. Students will be exposed to various programming techniques to fit such data within the SAS software using procedures such as PROC GENMOD, PROC COUNTREG, PROC FMM, PROC GLIMMIX, and PROC NLMIXED. Upon completion of this second part of Categorical Data Analysis, students will be comfortable with the analytical techniques for a variety of count outcomes in the real world setting. Proper communication and interpretation of these models is an essential component of the course.
STA 541 Prerequisite: Successful completion of STA 507, with a minimum grades of C-.

STA 542. Statistical Methods for Observational Studies. 3 Credits.
In the assessment of the association between a predictor and a response confounding by another factor might yield wrong answers. One standard technique to protect against confounding is randomization, which is the standard for conducting randomized clinical trials (RCT). In the setting where randomization cannot be applied, such as cohort or case-control studies, the potential for confounding exists; therefore, analytical techniques must be developed to address this potential confounding. These studies where the respective predictor is observed (i.e. gender, case versus control, etc...) rather than randomized (i.e. drug versus placebo, Treatment 1 versus Treatment 2, etc...) are referred to as observational studies. This course will cover statistical methods for the design and analysis of observational studies. Students will be exposed to discussion of differences between experimental, observational, and quasi-experimental studies. Techniques to assess statistical effects while addressing confounding (both measured and unmeasured) and selection bias will be introduced. Various techniques introduced are: propensity scores, inverse probability weighting, instrumental variables, Marginal Structural Models, Structural Nested Mean Models. Students additionally will be introduced to the Rubin Causal Model framework in the assessment of Causal effects.
STA 542 Prerequisite: Successful completion of STA 511 and STA 512, with minimum grades of C-.

STA 543. Statistical Methods in Business and Finance. 3 Credits.
This course will cover the application of statistics to modeling, estimation, inference and forecasting in the business and financial world through real world problems with an emphasis on critical evaluation. It will cover selected topics from econometrics, decision theory, and financial modeling, as well as business optimization and simulation.
STA 543 Prerequisite: Successful completion of STA 504 or STA 505; STA 511, and STA 512, with minimum grades of C-.

STA 544. Applied Marketing Analytics. 3 Credits.
In this course we will learn how to provide in-depth insights about core big data assets commonly used in business analytics, as well as research in pharmaceutical, package goods, and financial industries. Additional topics will include national and customer level data assets, projection methodologies, business analytics techniques, and specific applications of statistical and analytic techniques to the marketing industry.

STA 545. Statistical Design and Analysis of Clinical Trials. 3 Credits.
This course in the statistical design and analysis of clinical trials will focus on the scientific questions each phase of clinical trials (Phase I, Phase II, and Phase III) addresses. For oncology trials, various Phase I designs will be explored, noting the strengths and weaknesses of each design. Group Sequential procedures that specify how interim analyses will be performed in Phase III trials will be explored, together with graphical methods associated with each procedure.
STA 545 Prerequisite: Successful completion of STA 511 and STA 512, with minimum grades of C.

STA 546. Foundations of Bioinformatics. 3 Credits.
Bioinformatics is an interdisciplinary field involving molecular biology, computer science, mathematics, and statistics. Most data sets are very large and so require computationally intensive algorithms. This course intends to introduce students to many areas of biological data, along with algorithms and software to help model biological processes.
STA 546 Prerequisite: Successful completion of STA 512, with a minimum grade of C.

STA 551. Foundations of Data Science. 3 Credits.
This is a data science survey course. The first part of this course will be dedicated to data science foundations. Topics include statistical models, machine learning algorithms, model performance metrics, and major resampling algorithms. The second part will focus on data science processes. Topics include data science project life cycle, model selection, validation, performance evaluation, and data science ethics. The last part of the course will discuss data science infrastructure and pipelines.
STA 551 Prerequisite: Successful completion of STA 503 and STA 506, with minimum grades of C.

STA 552. Applied Statistical Machine Learning. 3 Credits.
This course introduces commonly used models and algorithms in data science fields. Both supervised and unsupervised machine learning algorithms will be discussed. Specific topics will be selected from supervised learning (probabilistic and linear classification, neural networks, tree-based models), unsupervised learning (clustering and feature extraction), and semi-supervised learning algorithms. This course will introduce both theories and applications.
STA 552 Prerequisite: Successful completion of STA 503 and STA 506, with minimum grades of C.

STA 553. Data Visualization. 3 Credits.
This course focuses on the principles of data visualization and addresses questions about what, why, and how to visualize. Topics include visualization design elements such as colors, shapes, and movements, etc.; data exploratory visualization; statistical graphics and model visualization; process visualization; dashboard design; and the ethics of data visualization. The course will also introduce some commonly used visualization tools.
STA 553 Prerequisite: Successful completion of STA 503, with a minimum grade of C.

STA 598. Statistics Transfer Credits (Graduate). 3-9 Credits.
Transfer Credits
Repeatable for credit.

STA 599. Independent Study. 1-3 Credits.
Individual exploration of a topic in statistics.
Repeatable for credit.

STA 601. Internship In Applied Statistics. 1-6 Credits.
In cooperation with a regional industrial company student will perform an internship in applied statistics.
Repeatable for credit.

STA 609. Thesis I. 3-6 Credits.
Preliminary research under the guidance of a mathematics faculty member. Students must present oral preliminary findings before proceeding to STA 610
Repeatable for credit.

STA 610. Thesis II. 3-6 Credits.
Research project under the guidance of the mathematics faculty.
STA 610 Prerequisite: Successful completion of STA 609, with a minimum grade of C-.
Repeatable for credit.