MATHEMATICS AND STATISTICS

Chair	Secretary	Location	Department Phone
Dr. Richard Marchand	Liz Moyer	200 Vincent Science Center	724-738-2061

Department Web Site URL (https://www.sru.edu/academics/colleges-and-departments/ches/departments/mathematics-and-statistics/)
Department Fact Sheet URL (https://www.sru.edu/documents/programs/factsheets/undergraduate/math-fs.pdf)

Faculty

James Anthony
Instructor
Mathematics & Statistics
M.A., Penn State University
B.S., Lock Haven University

Joshua Ballew
Associate Professor
Mathematics & Statistics
Ph.D., University of Maryland College Park
B.A., St. Mary's College of Maryland

Boris Brimkov
Assistant Professor
Mathematics & Statistics
Ph.D., Rice University
M.A., Rice University
B.S., State University of New York at Buffalo

Amanda Goodrick
Assistant Professor
Mathematics & Statistics
M.S.D.A., Slippery Rock University
M.S.M., Youngstown State University
B.S., Slippery Rock University

Rachele Graham
Instructor
Mathematics & Statistics
M.S., University of Tennessee
B.S., Lambuth University

James Henderson
Instructor
Mathematics & Statistics
B.S. Mathematics, University of Oklahoma
M.S. Mathematics, University of Arkansas
Ph.D., SUNY- Buffalo

Woosuk Kim
Associate Professor
Mathematics & Statistics
Ph.D., University of Cincinnati
M.S., University of Cincinnati
M.S., Texas A &M University
B.S., Pusan National University Institution Korea

Richard Marchand
Professor
Mathematics & Statistics
Ph.D., University of Virginia
B.S., Clarion University

Kirk McDermott
Associate Professor
Mathematics & Statistics
Ph.D., Oregon State University
M.S., Oregon State University
B.A., Earlman College

J Lyn Miller
Assistant Professor
Mathematics & Statistics
Ph.D., University of Maryland
B.S., Slippery Rock University

Jeffrey Musyt
Assistant Professor
Mathematics & Statistics
Ph.D., University of Oregon
M.S., University of Oregon
B.S., University of Scranton

Dilrukshika Singhabahu
Associate Professor
Mathematics & Statistics
Ph.D., University of Pittsburgh
B.S., Slippery Rock University

Programs

Majors

- Mathematics, Bachelor of Science (BS) - Concentration in Actuarial Science (https://catalog.sru.edu/undergraduate/engineering-and-science/mathematics-and-statistics/mathematics-bs-concentration-actuarial-science/)
- Mathematics, Bachelor of Science (BS) - Concentration in Mathematical Science (https://catalog.sru.edu/undergraduate/engineering-and-science/mathematics-and-statistics/mathematics-bs-concentration-mathematical-science/)
- Mathematics, Bachelor of Science (BS) - Concentration in Secondary Education (https://catalog.sru.edu/undergraduate/engineering-and-science/mathematics-and-statistics/mathematics-bs-concentration-secondary-education/)
- Mathematics, Bachelor of Science (BS) - Concentration in Statistics (https://catalog.sru.edu/undergraduate/engineering-and-science/mathematics-and-statistics/mathematics-bs-concentration-statistics/)

Minors

- Actuarial Science, Minor (https://catalog.sru.edu/undergraduate/engineering-and-science/mathematics-and-statistics/actuarial-science-minor/)
- Elementary School Mathematics, Minor (https://catalog.sru.edu/undergraduate/engineering-and-science/mathematics-and-statistics/elementary-school-mathematics-minor/)
- Mathematics, Minor (https://catalog.sru.edu/undergraduate/engineering-and-science/mathematics-and-statistics/mathematics-minor/)

- Middle School Mathematics, Minor (https://catalog.sru.edu/undergraduate/engineering-and-science/mathematics-and-statistics/middle-school-mathematics-minor/)
- Secondary School Mathematics, Minor (https://catalog.sru.edu/undergraduate/engineering-and-science/mathematics-and-statistics/econdary-school-mathematics-minor/)
- Statistics, Minor (https://catalog.sru.edu/undergraduate/engineering-and-science/mathematics-and-statistics/statistics-minor/)

Courses

MATH Courses

MATH 113 - Mathematics as a Liberal Art
A cultural enrichment course, which introduces topics and applications from different branches of mathematics.

Prerequisites: (ACSD 110[C] or ESAP 110[C]) or minimum score of Y in 'WAIVE ACSD110 W HIGHER MATH'
[C] Requires minimum grade of C.
Credits: 3
Term(s) Typically Offered: Offered Every Term

MATH 115 - Financial Mathematics
Methods of solving problems arising from the growth of money through simple and compound interest. Savings accounts, loans, financing, mortgages, depreciation, bonds, pensions and life insurance are included.

Prerequisites: (ACSD 110[C] or ESAP 110[C]) or minimum score of Y in 'WAIVE ACSD110 W HIGHER MATH'
[C] Requires minimum grade of C.
Credits: 3
Term(s) Typically Offered: Offered as Needed
Thematic Thread(s): Transfer Thread Completion Course

MATH 117 - Quantitative Reasoning
Quantitative reasoning is the application of basic mathematical skills to the analysis and interpretation of real-world quantitative information to draw conclusions that are relevant to people in their daily lives. In this course, students will explore various quantitative models and their interpretations in a way that emphasizes mathematical and statistical reasoning skills. Conceptual understanding will be stressed over manipulative skills. Students will learn to create sophisticated arguments supported by quantitative evidence and clearly communicate them in a variety of formats (using words, tables, graphs, mathematical equations, etc.) as appropriate. Technology, such as spreadsheets, will also be used. This course satisfies the Quantitative Reasoning requirement in the Rock Studies Program. This course is graded A, B, C, NC.

Prerequisites: (ACSD 110[C] or ESAP 110[C]) or minimum score of Y in 'WAIVE ACSD110 W HIGHER MATH'
[C] Requires minimum grade of C.
Credits: 3

MATH 118 - Elementary Geometry
A survey of Euclidean geometry and related elementary geometrical concepts. This course is not appropriate for those planning to teach geometry at the secondary level, but would be an excellent choice for those who will be teaching mathematics in the elementary school.

Prerequisites: (ACSD 110[C] or ESAP 110[C]) or minimum score of Y in 'WAIVE ACSD110 W HIGHER MATH'
[C] Requires minimum grade of C.
Credits: 3
Term(s) Typically Offered: Offered Fall & Spring Terms
Enrollment is limited to students with a program in Early Childhood Ed (PK-4), Early Childhood Educ-Int'l Ed, School Wellness Education, Health-Physical Educ Teaching, Health and Physical Education, Early Child-Spec Ed-Intnl Ed, Early Child/Spec Ed(PK-4)PK-8), Sec Education-English(7-12), Sec Education-French (K-12), Mid Level-Engl&Lang Arts (4-8), Mid Level-Mathematics (4-8), Mid Level-Social Studies (4-8), Middle Level-Science (4-8), Sec Ed-Social Stud-Hist (7-12), Secondary Educ-Spanish (K-12), Music Education (PK-12), Music Education (K-12), Music Educ-Voice (K-12), Music Educ-Saxophone (K-12), Music Educ-Instrumental (K-12), Music Educ-Piano (K-12), Elementary School Mathematics, Middle School Mathematics or Art With Certification (K-12).

MATH 120 - Intermediate Algebra
Linear functions, equations, inequalities, polynomials, algebra of functions, rational exponents, quadratic equations and inequalities, systems of equations.

Prerequisites: (ACSD 110[C] or ESAP 110[C]) or minimum score of Y in 'WAIVE ACSD110 W HIGHER MATH' or minimum score of 30 in 'ALEKS PPL Assessment'
[C] Requires minimum grade of C.
Credits: 3
Term(s) Typically Offered: Offered Fall, Spring, & Summer

MATH 122 - Finite Mathematics with Matrices
The algebra of matrices with applications in linear optimization, algebraic and graphical solutions.

Prerequisites: MATH 120[D] or MATH 199[D] or minimum score of 60 in 'ALEKS PPL Assessment'
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered as Needed

MATH 123 - Introduction to Applied Calculus
The course is compatible with the background and interests of students not majoring in the physical sciences or mathematics. The theorem-proof approach of differential calculus is replaced with the explanation-example approach. The course includes an introduction to exponential and logarithmic functions, limits, derivatives, maxima/minima, and Lagrange multipliers, and applications from business, economics, and finance. Problem-solving with mathematical software will also be emphasized.

Prerequisites: MATH 120[D] or MATH 111[D] or MATH 199[D] or MATH 125[D] or minimum score of 60 in 'ALEKS PPL Assessment'
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered as Needed

MATH 125 - Precalculus
A bridge between high school algebra and calculus involving polynomial, trigonometric, logarithmic, exponential functions, complex numbers, and the conic sections.

Prerequisites: MATH 120[D] or MATH 199[D] or minimum score of 60 in 'ALEKS PPL Assessment'
[D] Requires minimum grade of D.
Credits: 4
Term(s) Typically Offered: Offered Fall, Spring, & Summer

MATH 131 - Discrete Mathematics
This course begins the study of the language and concepts needed for higher-level mathematics. Students will learn principles of logic, focusing on logical forms, truth tables, and statement calculus. Students will analyze examples of and complete calculations involving sets, relations, and functions. Students will also receive an introduction to counting techniques and recursion. This course is not a proof-based course.

Prerequisites: MATH 125[D] or MATH 225[D] or MATH 230[D] or minimum score of 75 in 'ALEKS PPL Assessment'
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Fall & Spring Terms

MATH 139 - Foundations of Academic Discovery
Foundations of Academic Discovery serves as the entry point to the Rock Integrated Studies Program. With its strong faculty-student interaction, the course promotes intellectual inquiry, critical and creative thinking, and academic excellence. Through varied content, the course introduces students to academic discourse and information literacy while exploring topics such as diversity and inclusion and global awareness. This course will set students along the path to becoming engaged with issues and scholarship important to a 21st century education while they learn about themselves and their place in the world.

Credits: 3
Term(s) Typically Offered: Offered as Needed
Enrollment limited to students with a semester level of Freshman 1 or Freshman 2.
Enrollment limited to students with the ROCK STUDIES 2 STUDENT or ROCK STUDIES STUDENT attributes.

MATH 180 - Introduction to Mathematical Software
An introduction to the appropriate use of mathematical software with emphasis on problem solving. Topics will include mathematical concepts from calculus, linear algebra, and differential equations.

Prerequisite: MATH 225 (may be taken concurrently)[D]
[D] Requires minimum grade of D.
Credits: 1
Term(s) Typically Offered: Offered as Needed

MATH 190 - Experimental
A unique and specifically focused course within the general purview of a department which intends to offer it on a "one time only" basis and not as a permanent part of the department's curriculum.

Credits: 1-3
Term(s) Typically Offered: Offered as Needed

MATH 195 - Workshop
A workshop is a program which is usually of short duration, narrow in scope, often non-traditional in content and format, and on a timely topic.

Credits: 1-6
Term(s) Typically Offered: Offered as Needed

MATH 198 - Selected Topics
A Selected Topics course is a normal, departmental offering which is directly related to the discipline, but because of its specialized nature, may not be able to be offered on a yearly basis by the department.

Credits: 1-3
Term(s) Typically Offered: Offered as Needed

MATH 210 - Mathematics for Elementary Teachers I
This course is designed for future K-8 teachers to explore number systems (including definitions, operations, and properties of whole numbers and fractions), numeration systems, proportionality, algebraic thinking, and problem-solving. Emphasis is on conceptual understanding in addition to procedural skill.

Prerequisites: (ACSD 110[D] or ESAP 110[D]) or minimum score of Y in 'WAIVE ACSD110 W HIGHER MATH'
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Fall & Spring Terms
Students with a semester level of Freshman 1 may **not** enroll.
Enrollment is limited to students with a program in Early Childhood Ed (PK-4), Early Childhood Educ-Int'l Ed, School Wellness Education, Health-Physical Educ Teaching, Health and Physical Education, Early Child/Spec Ed(PK-4)PK-8), Early Child/Spec Ed(PK-4)PK-12, Sec Education-English(7-12), Sec Education-French (K-12), Mid Level-Engl&Lang Arts (4-8), Mid Level-Mathematics (4-8), Mid Level-Social Studies (4-8), Middle Level-Science (4-8), Sec Ed-Social Stud-Hist (7-12), Secondary Educ-Spanish (K-12), Special Education (PK-12), Music Education (PK-12), Music Education (K-12), Music Educ-Voice (K-12), Music Educ-Saxophone (K-12), Music Educ-Instrumental (K-12), Music Educ-Piano (K-12), Elementary School Mathematics, Middle School Mathematics or Art With Certification (K-12).

MATH 225 - Calculus I
This course begins the study of calculus of functions of one variable. Students will study limits and continuity of real-valued functions. Students will explore the derivative as a rate of change and learn how to calculate derivatives of algebraic and transcendental functions. Applications of the derivative to various physical and other phenomena will be considered. This course also provides an introduction to Riemann integration.

Prerequisites: MATH 125[C] or minimum score of 75 in 'ALEKS PPL Assessment'
[C] Requires minimum grade of C.
Credits: 4
Term(s) Typically Offered: Offered Fall, Spring, & Summer

MATH 230 - Calculus II
This course continues the study of calculus of real-valued functions of one variable. Students will learn various techniques of evaluating antiderivatives and approximating definite integrals. These integrals will be used in various applications such as calculating areas and volumes, arc length, work, and solving simple first-order differential equations. Parametric and polar equations and their differential and integral calculus are also considered. Students will also investigate sequences and series, their convergence properties, and the use of power series to represent functions.

Prerequisite: MATH 225[C]
[C] Requires minimum grade of C.
Credits: 4
Term(s) Typically Offered: Offered Fall, Spring, & Summer

MATH 231 - Calculus III
This course continues the study of calculus with the study of functions of several variables. Students will learn about the geometry of two- and three-dimensional space, vector-valued functions, and functions of several variables. Students will investigate these functions with partial derivatives and multiple integration. Vector calculus topics such as Green's, Stokes, and the Divergence Theorems will be covered. Computer software such as Mathematica will be used in problem solving in this course.

Prerequisite: MATH 230[C]
[C] Requires minimum grade of C.
Credits: 4
Term(s) Typically Offered: Offered Fall & Spring Terms

MATH 232 - Linear Algebra
In this class, students will learn techniques for solving systems of linear equations and related matrix equations. Vectors and vector spaces will be considered along with properties relating to solving matrix equations. In particular, special care will be taken with real vector spaces and inner product spaces, and how they are used to solve problems with applications in physics and other fields. The eigenvalue/eigenvector problem will also be discussed. Students will be expected to use technology to solve problems in this class.

Prerequisite: MATH 230[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Fall & Spring Terms

MATH 235 - Foundations of Mathematical Proof
This course provides a foundation for writing mathematical proofs. Students will work with common proof techniques such as direct proof, proof by contrapositive, proof by contradiction, and proof by induction, along with the logical bases supporting them. In developing their proof-writing skills, students will work with foundational mathematical concepts such as basic set theory, relations between sets, and functions.

Prerequisites: MATH 225[C] and MATH 131[C]
[C] Requires minimum grade of C.
Credits: 3
Term(s) Typically Offered: Offered Fall & Spring Terms

MATH 240 - Linear Algebra and Differential Equations
Computational aspects of matrices, determinants, systems of linear equations, vector spaces, linear dependence, Wronskian, characteristic values, elementary differential equations, separable and exact equations, linear differential equations with constant coefficients.

Prerequisite: MATH 230[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Fall & Spring Terms

MATH 280 - Theory of Interest
A rigorous, calculus-based treatment of the theory of interest, including simple and compound interest/discount, continuous force of interest, time value of money, annuities, yield rates, loan repayment, amortization schedules, bonds, yield curves, duration, convexity, immunization techniques, and practical applications. This course is intended to prepare students for the actuarial examination on the theory of interest.

Prerequisite: MATH 230 (may be taken concurrently)[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Spring Terms

MATH 281 - Actuarial Exam Preparation I
The purpose of this course is to prepare students for The Society of Actuaries" (SOA) first professional examination. Topics will be selected from the SOA syllabus which currently includes general probability theory, univariate and multivariate probability distributions (discrete and continuous), applications involving insurance and risk analysis, and supporting topics from Calculus.

Credits: 1
Term(s) Typically Offered: Offered as Needed

MATH 282 - Actuarial Exam Preparation II
The purpose of this course is to prepare students for The Society of Actuaries" (SOA) second professional examination. Topics will be selected from the SOA syllabus which currently includes time value of money, yield rates, methods of loan repayment, annuities, asset/liability management, immunization, duration, convexity, bonds, stocks, mutual funds, capital budgeting, short sales, spot and forward rates, options, derivatives, futures, and arbitrage.

Prerequisite: MATH 280[D]
[D] Requires minimum grade of D.
Credits: 1
Term(s) Typically Offered: Offered as Needed

MATH 290 - Experimental
A unique and specifically focused course within the general purview of a department which intends to offer it on a "one time only" basis and not as a permanent part of the department's curriculum.

Credits: 1-3
Term(s) Typically Offered: Offered as Needed

MATH 295 - Workshop
A workshop is a program which is usually of short duration, narrow in scope, often non-traditional in content and format, and on a timely topic.

Credits: 1-6
Term(s) Typically Offered: Offered as Needed

MATH 298 - Selected Topics
A Selected Topics course is a normal, departmental offering which is directly related to the discipline, but because of its specialized nature, may not be able to be offered on a yearly basis by the department.

Credits: 1-3
Term(s) Typically Offered: Offered as Needed

MATH 301 - Differential Equations I
First and second order differential equations, existence and uniqueness theorems, Laplace transforms, systems of linear ordinary differential equations.

Prerequisite: MATH 230[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Fall & Spring Terms
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 302 - Differential Equations II
A continuation of MATH 301. Series solutions of ordinary differential equations, non-linear systems and stability, partial differential equations.

Prerequisite: MATH 301[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Fall Terms Even
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 304 - Geometric Structures
Finite and infinite axiomatic systems, including Euclidean and projective geometrics.

Prerequisite: MATH 235[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Spring Terms Odd
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 310 - Mathematics for Elementary Teachers II
This course is designed for future K-8 teachers to continue to explore number systems (including definitions, operations, and properties of integers, rational and real numbers), descriptive statistics, basic probability, and measurement and related geometry. Emphasis is on conceptual understanding in addition to procedural skill.

Prerequisite: MATH 210[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Fall & Spring Terms
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.
Enrollment is limited to students with a program in Early Childhood Ed (PK-4), Early Childhood Educ-Int'l Ed, School Wellness Education, Health-Physical Educ Teaching, Health and Physical Education, Early Child/Spec Ed(PK-4)PK-8), Early Child/Spec Ed(PK-4)PK-12, Sec Education-English(7-12), Sec Education-French (K-12), Mid Level-Engl&Lang Arts (4-8), Mid Level-Mathematics (4-8), Mid Level-Social Studies (4-8), Middle Level-Science (4-8), Sec Ed-Social Stud-Hist (7-12), Secondary Educ-Spanish (K-12), Special Education (PK-12), Music Education (PK-12), Music Education (K-12), Music Educ-Voice (K-12), Music Educ-Saxophone (K-12), Music Educ-Instrumental (K-12), Music Educ-Piano (K-12), Elementary School Mathematics, Middle School Mathematics or Art With Certification (K-12).

MATH 311 - Deterministic Models of Operations Research
Topics include deterministic methods in operations research. Linear programming, duality, integer programming, dynamic programming, nonlinear programming, inventory theory, transportation and assignment and network theory.

Prerequisites: MATH 231[C] or MATH 240[C] or (MATH 122[C] and MATH 230[C])
[C] Requires minimum grade of C.
Credits: 3
Term(s) Typically Offered: Offered Fall Terms
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 312 - Stochastic Models of Operations Research
Decision making under uncertainty. Probability, Markov Chains, Poisson processes, Survival Analysis, Queueing Systems, Random Walk, Branching.

Prerequisites: MATH 231[C] or MATH 240[C] or (MATH 122[C] and MATH 230[C])
[C] Requires minimum grade of C.
Credits: 3
Term(s) Typically Offered: Offered Spring Terms Odd
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 313 - Introductory Analysis I
This course begins the rigorous mathematical study of the real numbers. Topics include cardinality of sets; sequences of real numbers; completeness of the real numbers; topology of the real line including open sets, closed sets, and compact sets; and continuous, real-valued functions. Students will be expected to communicate using mathematical proofs throughout the course.

Prerequisites: MATH 231[C] and MATH 235[C]
[C] Requires minimum grade of C.
Credits: 3
Term(s) Typically Offered: Offered Fall Terms
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 314 - Introductory Analysis II
This course continues the rigorous mathematical treatment of the real numbers that begins in MATH 313. The concepts of differentiation and Riemann integration of real-valued functions on the real line from calculus are explored and made rigorous. Additionally, series of functions are explored, including convergence (pointwise and uniform) and Taylor series. Students will be expected to communicate using mathematical proofs throughout the course.

Prerequisite: MATH 313[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Spring Terms
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 315 - Numerical Mathematics
The mathematics of computation and approximation, interpolation, calculating the roots of equations, curve fitting linear systems, numerical differentiation and integration and error analysis.

Prerequisites: MATH 240[D] or MATH 230[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Spring Terms Odd
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.
Enrollment limited to students with the SPECIAL APPROVAL attribute.

MATH 316 - Advanced Methods of Operations Research
Topics include Brownian motion, stationary processes, weak convergence of stochastic processes, regenerative phenomena, random walks, simulations.

Prerequisite: MATH 312[C]
[C] Requires minimum grade of C.
Credits: 3
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 317 - Complex Variables
Complex numbers, analytic functions, complex integration, convergence of sequences and series, and applications.

Prerequisite: MATH 231[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Spring Terms Even
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 320 - Theory of Numbers
A study of the properties of natural numbers and number theoretic functions.

Prerequisite: MATH 235[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Spring Terms
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 325 - Abstract Algebra I
An introduction to groups. Topics include integers mod n, cyclic groups, permutation groups, normal subgroups, isomorphisms, finite Abelian groups.

Prerequisite: MATH 235[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Spring Terms
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 326 - Abstract Algebra II
An introduction to rings. Topics include integral domains, fields, polynomial rings.

Prerequisite: MATH 325[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Fall Terms
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 331 - Mathematical Methods of Physics
Applications in physical science and engineering of the following: vector analysis, complex variables, Fourier and Laplace transforms, linear algebra, and some boundary value problems. Cross-linked as PHYS 331. This course may be counted as a physics course or as a mathematics course, but not both.

Prerequisites: PHYS 211[D] and MATH 240[D] and MATH 231[*D] (may be taken concurrently).
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 335 - Mathematical Modeling
A general introduction to mathematical modeling involving optimization, dynamic and probabilistic models. Specific topics selected from dimensional analysis, optimization techniques, continuous and discrete modeling, stability analysis, linearization, eigenvalue methods, qualitative analysis, Markov chains, regression models, simulation techniques, and others as time permits.

Prerequisite: MATH 231[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 390 - Experimental
A unique and specifically focused course within the general purview of a department which intends to offer it on a "one time only" basis and not as a permanent part of the department's curriculum.

Credits: 1-3
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 395 - Workshop
A workshop is a program which is usually of short duration, narrow in scope, often non-traditional in content and format, and on a timely topic.

Credits: 1-6
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 398 - Selected Topics
A Selected Topics course is a normal, departmental offering which is directly related to the discipline, but because of its specialized nature, may not be able to be offered on a yearly basis by the department.

Credits: 1-3
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 403 - Elementary Topology
Topological properties of the real line.

Prerequisites: MATH 309[D] and MATH 313[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 406 - Intermediate Analysis
Selected topics.

Prerequisite: MATH 314[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 411 - Partial Differential Equations
This course in partial differential equations has wide-ranging applications in a variety of fields such as engineering and physics. Topics include first order equations and the method of characteristics; an introduction to Fourier series; second order equations including the heat, wave, and Laplace equations; numerical methods for computing solutions; conservation laws.

Prerequisites: MATH 231[C] and MATH 301[C]
[C] Requires minimum grade of C.
Credits: 3
Term(s) Typically Offered: Offered Fall Terms Odd
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 482 - Actuarial Mathematics
Interest rate models, including the Vasicek and Cox-Ingersoll-Ross bond price models, rational valuation of derivative securities, simulation and risk management techniques.

Prerequisites: MATH 231[D] and MATH 280[D] and (MATH 353[D] or STAT 353[D])
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Fall Terms Even
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 484 - Life Contingencies
An introduction to survival models, individual life insurance and life annuities including determining premiums and reserves using a stochastic approach. It will include multiple life theory, binomial models, geometric Brownian motion and simulation in option pricing. It will develop a theoretical basis of contingent payment models and the application of those models to insurance risk.

Prerequisites: MATH 231[D] and MATH 280[D] and MATH 353[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 490 - Independent Study
Supervised study in advanced area. Prerequisites: Two 300-level mathematics courses, a 3.000 QPA in major, permission of the instructor, departmental chairperson, and dean of the college where the study will be conducted. Independent Study courses give students the opportunity to pursue research and/or studies that are not part of the university's traditional course offerings. Students work one on one or in small groups with faculty guidance and are typically required to submit a final paper or project as determined by the supervising professor.

Credits: 1-3
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 491 - Mathematics Seminar
Designed to broaden the students' backgrounds by investigating topics in mathematics not usually taught in the regular curriculum. Students may elect to take course up to three times.

Prerequisite: MATH 235[D]
[D] Requires minimum grade of D.
Credits: 1
Term(s) Typically Offered: Offered Spring Terms
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 495 - Workshop
A workshop is a program which is usually of short duration, narrow in scope, often non-traditional in content and format, and on a timely topic.

Credits: 1-6
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

MATH 498 - Selected Topics
A Selected Topics course is a normal, departmental offering which is directly related to the discipline, but because of its specialized nature, may not be able to be offered on a yearly basis by the department.

Credits: 1-3
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

STAT Courses

STAT 124 - Introduction to Survey Methods
Introduction to Survey Methods: A 100 level course that introduces students to aspects of how surveys work. Students learn about the design, and interpretation of survey data. A range of survey strategies (e.g., telephone, face-to-face, mail and internet surveys) within the broader context of a research or evaluation project are introduced. Topics include formulation of research goals, developing an appropriate questionnaire design, protection of human subjects and proper conduct of research, sample size calculation and sample design, survey administration, construction of a survey report including basic data analysis techniques, and presentation of the results of a survey. Class topics are designed to convey practical knowledge of survey design.

Prerequisite: ACSD 110[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered as Needed

STAT 139 - Foundations of Academic Discovery
Foundations of Academic Discovery serves as the entry point to the Rock Integrated Studies Program. With its strong faculty-student interaction, the course promotes intellectual inquiry, critical and creative thinking, and academic excellence. Through varied content, the course introduces students to academic discourse and information literacy while exploring topics such as diversity and inclusion and global awareness. This course will set students along the path to becoming engaged with issues and scholarship important to a 21st century education while they learn about themselves and their place in the world.

Credits: 3
Term(s) Typically Offered: Offered as Needed
Enrollment limited to students with a semester level of Freshman 1 or Freshman 2.
Enrollment limited to students with the ROCK STUDIES 2 STUDENT or ROCK STUDIES STUDENT attributes.

STAT 152 - Elementary Statistics I
This is a course about how data inform every aspect of our lives. This course focuses on what data are collected, how they are collected, how they are summarized and interpreted, and how possible error in those data is quantified and understood. In this class, we will learn about ways in which statistics are used by businesses, governmental agencies, researchers, and practitioners to understand our world. Topics covered include descriptive statistics, bivariate and multivariate data, elementary probability, random variables, normal and binomial probability distributions, Central Limit Theorem, confidence intervals, hypothesis testing, and simple linear regression.

Prerequisites: (ACSD 110[C] or ESAP 110[C]) or minimum score of Y in 'WAIVE ACSD110 W HIGHER MATH'
[C] Requires minimum grade of C.
Credits: 3
Term(s) Typically Offered: Offered Every Term
Thematic Thread(s): Citizenship & Social Problems, Conservation, Technology & Imagination, Human Diversity & Well-Being, Institutions & Human Innovations, Transfer Thread Completion Course

STAT 190 - Experimental
A unique and specifically focused course within the general purview of a department which intends to offer it on a "one time only" basis and not as a permanent part of the department's curriculum.

Credits: 1-3
Term(s) Typically Offered: Offered as Needed

STAT 195 - Workshop
A workshop is a program which is usually of short duration, narrow in scope, often non-traditional in content and format, and on a timely topic.

Credits: 1-6
Term(s) Typically Offered: Offered as Needed

STAT 198 - Selected Topics
A Selected Topics course is a normal, departmental offering which is directly related to the discipline, but because of its specialized nature, may not be able to be offered on a yearly basis by the department.

Credits: 1-3
Term(s) Typically Offered: Offered as Needed

STAT 252 - Introduction to Statistical Modeling
What do we mean when we talk about "statistical modeling"? How can statistical models be used to provide evidence for scientific or social theories? In this course, we begin by reviewing hypothesis testing and learn how hypothesis testing is applied in a wide variety of statistical contexts. We then move on to the workhouse of statistical modeling, linear regression, and learn the complex methods used to determine the validity of regression models. We then touch on analysis of variance models, polynomial regression, and time series. R will be used for data analysis, but no prior knowledge of R is assumed.

Prerequisites: STAT 152[D] and ENGL 102[D] and (MATH 123[D] or MATH 125[D] or MATH 225[D])
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Fall Terms

STAT 254 - Nonparametric Statistics
Statistical models in nonparametric settings. Theory and practice using techniques requiring less restrictive assumptions about the distribution of the data. Nonparametric analogues of t- and F-tests in one and two sample settings, ANOVA, regression and correlation will be discussed.

Prerequisites: MATH 125[D] and (MATH 153[D] or STAT 153[D])
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered as Needed

STAT 256 - Statistical Computing
Statistical computing considers how data are processed and analyzed, and how statistical models are simulated, in a computational setting. The current landscape of the statistical computing community will be explored, including common statistical software, proprietary versus open-source statistical languages, and how statistical software packages are tailored for specific uses. Computationally intense statistical techniques will be discussed and programmed. At least one proprietary and one open-source statistical computing environment will be learned. Students will learn how to combine the functionality of different statistical packages to create and present a data analysis optimally. Prior experience with computer programming highly recommended.

Prerequisite: STAT 252[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Spring Terms

STAT 290 - Experimental
A unique and specifically focused course within the general purview of a department which intends to offer it on a "one time only" basis and not as a permanent part of the department's curriculum.

Credits: 1-3
Term(s) Typically Offered: Offered as Needed

STAT 295 - Workshop
A workshop is a program which is usually of short duration, narrow in scope, often non-traditional in content and format, and on a timely topic.

Credits: 1-6
Term(s) Typically Offered: Offered as Needed

STAT 298 - Selected Topics
A Selected Topics course is a normal, departmental offering which is directly related to the discipline, but because of its specialized nature, may not be able to be offered on a yearly basis by the department.

Credits: 1-3
Term(s) Typically Offered: Offered as Needed

STAT 318 - Statistical Study Design
There are five basic sources of data that can be used for a statistical study: observational data, experimental data, data from a survey or census, simulation data, and found data. In this course, we learn the strengths and weaknesses associated with each study type, exploring the concepts of randomization, representation, causality, weighting, estimation, and variance. Ethical issues associated with statistical studies will also be discussed. A working knowledge of spreadsheet software such as Microsoft Excel is assumed.

Prerequisite: STAT 152[C]
[C] Requires minimum grade of C.
Credits: 3
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

STAT 325 - Advanced Statistical Methods
Statistics is used in computer algorithms (machine learning) to enhance computer discision-making and prediction capabilities. this course will cover a wide variety of topics in statistical learning methods. Major statistical methods used in machine learning such as linear regression, survival analysis and others will be discussed. Additional topics include unsupervised learning and supervised techniques such as principal component analysis, nearest neighbor, random forest, support vector machines and neural networks. simulation methods, such as the EM algorithm, Metropolis-Hasting algorithm and the Markov Chain Monte Carlo method will also be discussed.

Credits: 3
Term(s) Typically Offered: Offered as Needed
Enrollment is limited to Graduate level students.

STAT 350 - Applied Statistics
A calculus-based introduction to probability and statistical applications. Discrete and continuous probability and expected value. Confidence intervals and hypothesis testing for single populations. This course is not open to students who have credit for MATH 352. This course does not count as an upper division elective mathematics course for mathematics majors.

Credits: 3
Term(s) Typically Offered: Offered Spring Terms
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

STAT 352 - Mathematical Statistics I
An introduction to the mathematical foundations of probability theory including discrete and continuous probability distributions, random variables, mathematical expectation, momentuo, and moment generating functions.

Prerequisite: MATH 230[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Fall Terms
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

STAT 353 - Mathematical Statistics II
Functions of random variables, sampling distributions, introduction to mathematical theory of statistical inference, including methods of moments, estimators, maximum likelihood estimators, sufficient statistics, interval estimates, and hypothesis testing.

Prerequisites: MATH 352[D] or STAT 352[D]
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Spring Terms
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

STAT 354 - Mathematical Statistics III
Stochastic processes and statistical inference including: Type I and Type II errors, MLE, Neyman-Pearson lemma, order statistics, Poisson processes, ANOVA, nonparametric tests, comparing models and Bayesian parameter estimation.

Prerequisites: MATH 231[D] and (MATH 353[D] or STAT 353[D])
[D] Requires minimum grade of D.
Credits: 3
Term(s) Typically Offered: Offered Fall Terms Odd
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

STAT 363 - Statistical Learning
The field of statistical learning encompasses the theory and data analytic techniques developed to process and make sense of evolving data challenges arising in the fields of data science and machine learning. This course will cover the theoretical underpinnings of supervised and unsupervised learning techniques, including generalized linear models, classification, dimension reduction, and cluster analysis. R and R-studio will be used for illustrative purposes. A working knowledge of linear algebra and multivariate calculus is assumed. Previous experience suing R software package is also assumed.

Prerequisites: (MATH 309[D] or MATH 232[D]) and MATH 231[D] and STAT 252[D]
[D] Requires minimum grade of D.
Credits: 3
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

STAT 372 - Forecasting & Time Series
An introduction to creating, solving, analyzing and interpreting real-world time-series and forecasting models. Topics include linear, autoregressive, moving average and other forecasting and time-series techniques, transfer functions, multivariate model building, stationary and nonstationary techniques. Applications may include all areas where forecasting is required including transportation, finance, scheduling, networks, and supply chains. Appropriate software tools for analyzing forecasting models including software such as SAS and spreadsheet software will be taught.

Prerequisites: MATH 252[C] or STAT 252[C] or MATH 350[C] or STAT 350[C]
[C] Requires minimum grade of C.
Credits: 3
Term(s) Typically Offered: Offered Spring Terms Even
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

STAT 373 - Statistical Quality Control
A comprehensive coverage of modern quality control techniques including the design of statistical process control systems, acceptance sampling and process improvement.

Prerequisites: MATH 230[C] and (STAT 252[C] or STAT 311[C])
[C] Requires minimum grade of C.
Credits: 3
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

STAT 390 - Experimental
A unique and specifically focused course within the general purview of a department which intends to offer it on a "one time only" basis and not as a permanent part of the department's curriculum.

Credits: 1-3
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

STAT 395 - Workshop
A workshop is a program which is usually of short duration, narrow in scope, often non-traditional in content and format, and on a timely topic.

Credits: 1-6
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

STAT 398 - Selected Topics
A Selected Topics course is a normal, departmental offering which is directly related to the discipline, but because of its specialized nature, may not be able to be offered on a yearly basis by the department.

Credits: 1-3
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

STAT 490 - Independent Study
Independent Study courses give students the opportunity to pursue research and/or studies that are not part of the university's traditional course offerings. Students work one on one or in small groups with faculty guidance and are typically required to submit a final paper or project as determined by the supervising professor.

Credits: 1-3
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

STAT 491 - Statistics Seminar
In this seminar, we will explore the history of statistics and the field of statistics today. Students will learn about current topics of interest in the field—technical, ethical, and societal--and will research a current technical topic of interest. This is a capstone course for statistics students.

Credits: 1
Term(s) Typically Offered: Offered Spring Terms
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

STAT 495 - Workshop
A workshop is a program which is usually of short duration, narrow in scope, often non-traditional in content and format, and on a timely topic.

Credits: 1-6
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.

STAT 498 - Selected Topics
A Selected Topics course is a normal, departmental offering which is directly related to the discipline, but because of its specialized nature, may not be able to be offered on a yearly basis by the department.

Credits: 1-3
Term(s) Typically Offered: Offered as Needed
Students with a semester level of Freshman 1, Freshman 2 or Sophomore 1 may **not** enroll.