

## Mathematics and Statistics

*Faculty:* Conjura, *Chair:* Alves, Clark, Clifford, Cunningham, Curtis, Greenbaun, Hagedorn, Hingston, Holmes, Iannone, Kardos, Lee, Liebars, Navard, Papantonopoulou, Reimer, Solano, Wang, Zheng

The Department of Mathematics and Statistics offers programs in three areas: statistics, mathematics, and mathematics teaching. In each of these programs, students are provided with a basic mathematical background which will be utilized in advanced study in one of these areas:

*Mathematics (MATA)*—This program is built on a strong basis of mathematics including analysis and abstract algebra. Each student will develop a program, through advisement, of 18 credits of upper-level mathematics courses according to his or her own interests, which reflect the student's goal: either graduate study or preparation for employment.

*Mathematics Education (MATT)*—In this program students take mathematics and professional courses which qualify for a mathematics degree and prepare them to meet the educational requirements for the New Jersey certificate to teach mathematics K–12. Students participate in student-teaching experiences in both their junior and senior years.

*Statistics (MATC)* —This program builds upon mathematical skills acquired in the freshman and sophomore years so that students become equipped with the knowledge necessary to enable them to apply advanced statistical techniques to a wide variety of real-life problems arising in application areas such as business, government, and research. Students are prepared to enter either graduate study or employment as a statistician.

### Academic Regulations

*Departmental Grade Prerequisite Requirement*—Majors must earn a minimum grade of C– in a course which is prerequisite to another course in order to register for the subsequent course.

*Departmental Transfer Credit Policy*—Only grades of C– or better are accepted in transfer to meet the requirements of a major or minor within the department.

*Graduation Requirements*—A minimum of 21 credits in the major must be earned in the department. A minimum of 15 of the final 21 credits in the major must be earned in the department.

*Advanced Placement*—If a student has a strong background in a particular mathematics course, then he/she may achieve advanced placement in one of two ways: 1) credit by examination; or 2) waiver of the course. Students given permission to waive a course are required to replace it with an upper-level (300 or 400) major course.

*Basic Skills Testing Requirement*—Any student who has not satisfied the College basic skills requirement in mathematics is not permitted to register for any course in the Department of Mathematics and Statistics numbered 095 or above.

*Calculus Readiness Test*—All students enrolled in majors requiring calculus are tested for calculus readiness with the higher-level mathematics placement test. This test will determine placement in the course sequence which includes the calculus.

*Prerequisites*—If a student has not met the exact prerequisites of a course as stated in this bulletin, but believes that the requirements have been satisfied through equivalent experiences, the student may gain admission to the course with the approval of the department chair.

*Graduate Studies*—Students who plan to continue their math studies in graduate school should take MAT 305/Abstract Algebra, MAT 315/Topics in Linear Algebra, MAT 402/Real Analysis, MAT 403/Advanced Calculus, MATH 405/Topology, and MATH 420/Complex Variables.

### Program Entrance, Retention, and Exit Standards

Every major program at the College has set standards for allowing students to remain in that program, to transfer within the College from one program to another, and to graduate from a program. The following are the standards for programs in mathematics and statistics programs. Minimum grades are noted in parentheses:

For students with major codes MATA, MATT, ELMA, ECMA, or DHMA

- Retention in the program is based on the following performance standards in these “critical content courses”: MAT 127 or MAT 128 (B-) and MAT 200 or MAT 205 (C).
- Transfer into the program from another program within the College is based upon the following performance standards in these “foundation courses”: MATH 125 or MAT 127 or MAT 128 (B-) and MAT 200 or MAT 205 (C).

- Graduation requirements: In courses offered by the Departments of Mathematics and Statistics and Computer Science a grade of C- or better must be earned for the course to satisfy a graduation requirement of the major. For 300 or 400 level courses, at most two grades of D or D+ may be counted. Only one of these grades can be earned in required courses; but, a grade of at least C- must be earned in any required course that is a prerequisite for another course that is subsequently taken. Students with codes MATT, ELMA, ECMA, and DMHA need a GPA of 2.75 overall.

For students with the major code MATC:

- Retention in the program is based on the following performance standards in these “critical content courses”: MAT 316 (C) and STAT 116 or STAT 215 (C).
- Transfer in the program from another program within the College is based upon the following performance standards in these “foundation courses”: MATH 125 or MATH 127 or MATH 128 (B-) and STAT 116 or STA 215 (C).
- Graduation requirements: In courses offered by the Departments of Mathematics and Statistics and Computer Science a grade of C- or better must be earned for the course to satisfy a graduation requirement of the major. For 300 or 400 level courses, at most two grades of D or D+ may be counted. Only one of these grades can be earned in required courses. But, a grade of at least C- must be earned in any required course that is a prerequisite for another course that is subsequently taken.

### Mathematics Major: (MATA)

#### Requirements for the Major

All MATA students will be required to take a minimum of 12 mathematics courses. The 12 courses will consist of the eight required courses: MAT 127/Calculus A, MAT 128/Calculus B, MAT 200/Discrete Mathematics, MAT 205/Linear Algebra, MAT 229/Multivariable Calculus, MAT 305/Abstract Algebra, MAT 402/Real Analysis, MAT 420/Complex Analysis and four elective courses. The four elective courses can be any MAT course at the 300/400 level except MAT 342, 348, 386, 390. These four elective courses must be chosen so that the following two requirements are satisfied:

- Breadth Requirement. A MATA student must successfully complete one of the courses listed by the department as satisfying the breadth requirement.
- Capstone Experience Requirement. A MATA student must successfully complete either the departmental capstone seminar, a seminar course (the same course cannot also fulfill the breadth requirement in (a)), or an independent project with a departmental faculty member.

### Suggested Course Sequence

*During academic year 2003-2004, The College of New Jersey is in the process of transformative curricular change. Therefore only the course of study for the first-year students entering in 2003-2004 is set out below. These students should consult their advisors when planning courses for future years. Supplements to this online bulletin also will be available on an ongoing basis.*

#### First Year Suggested Sequence MATA

##### Fall

MATH	099/Department Orientation Seminar	0
MAT	127/Calculus A	4
MAT	128/Calculus B	4
MAT	200/Discrete Mathematics	4
WRI	102/Academic Writing	4
IDSC	151/Athens to New York	3 or 4
<i>or</i>		
FSP	101/First Year Seminar	
	Foreign Language	6
	General Education	6 to 8
	<b>Total for year</b>	<b>31 to 34</b>

## Mathematics Major: Teacher Preparation (MATT)

### Requirements for the Major

Candidates for a teacher-education certificate must have a 2.75 cumulative grade point average to successfully complete their teacher education program. They also must meet the state hygiene/physiology requirement, and pass the required Praxis assessment tests before the New Jersey State Department of Education will issue the appropriate certificate. Teacher-education candidates will receive a “certificate of eligibility with advanced standing” which requires a candidate to be provisionally certified for his or her first year of teaching. After one year of successful teaching, the candidate is eligible for a permanent certificate. The teacher candidate may also have to pay a fee during his or her first year of teaching.

All MATT students will be required to take a minimum of 12 mathematics courses. The 12 courses will consist of 11 required courses: MAT 127/Calculus A, MAT 128/Calculus B, MAT 200/Discrete Mathematics, MAT 205/Linear Algebra, MAT 229/Multivariable Calculus, MAT 301/Number Theory, MAT 305/Abstract Algebra, MAT 316/Probability, MAT 351/Geometry, MAT 355 History of Math, STA 215/Statistical Inference and one MAT/STA option which can be any MAT/STA course at the 300/400 level except MAT 342 and 386. Additional requirements include: CSC 220/Computer Science I, MAT 380/Methods of Teaching Mathematics I, MAT 390/Methods of Teaching Mathematics II (writing intensive). The following are to be taken concurrently during the last semester: MATH489/Seminar in Math Education and MATH 490/Student Teaching.

### Suggested Course Sequence

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#### First Year Suggested Sequence MATT

MATH 099/Department Orientation Seminar	0
MAT 127/Calculus A	4
MAT 128/Calculus B	4
MAT 200/Discrete Mathematics	4
STA 215/Statistical Inference	4
CSC 220/CS I: Computational Problem Solving	4
WRI 102/Academic Writing	4
IDSC 151/Athens to New York	3 or 4
<i>or</i>	
FSP 101/First Year Seminar	
Foreign Language	6
<b>Total for year</b>	<b>33 to 34</b>

## Mathematics Major: Statistics (MATC)

### Requirements for the Major

Statistics graduates need to have a strong underpinning in mathematics in addition to acquiring all the necessary statistical knowledge and skills. The 14-course major consists of the following: Nine required courses: MAT 127/Calculus A, MAT 128/Calculus B, MATH 229/Calculus C, MAT 200 Discrete Mathematics, MAT 205/Linear Algebra, STA 215/Statistical Inference, MAT 316/Probability, STA 410/Mathematical Statistics, STA 305/Regression; three of the following four courses: STA 303/Design of Experiments, STA 304/Sampling and Non-parametric Statistics, STA 306/Applied Multivariate Analysis, STA 314/Statistical Quality Control; and two Math/Stat options.

### Suggested Course Sequence

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#### First Year Suggested Sequence MATC

MATH 099/Department Orientation Seminar	0
MAT 127/Calculus A	4
MAT 128/Calculus B	4
MAT 200/Discrete Mathematics	4
WRI 102/Academic Writing	4
IDSC 151/Athens to New York	3 or 4
<i>or</i>	
FSP 101/First Year Seminar	
Foreign Language	6
General Education	6 to 8
<b>Total for year</b>	<b>31 to 34</b>

### **Elementary Education/Mathematics (ELMA), Early Childhood Education/Mathematics (ECMA), Deaf and Hard of Hearing/Mathematics (DHMA)**

All ELMA, ECMA, and DHMA students will be required to take a minimum of 12 mathematics courses. The 12 courses will consist of 11 required courses: MAT 127/Calculus A, MAT 128/Calculus B, MAT 200/Discrete Mathematics, MAT 205/Linear Algebra, MAT 229/Multivariable Calculus, MAT 301/Number Theory, MAT 305/Abstract Algebra, MAT 316/Probability, MAT 351/Geometry, MAT 355 History of Math, STA 215/Statistical Inference and one MAT/STA options which can be any MAT or STA course at the 300/400 level except MAT 380, 386, and 390. Additionally, the Computer Science course CSC 220/CS I: Computational Problem Solving.

### **Elementary Education M/S/T (ELST) and Early Childhood Education M/S/T (ECST) with a Mathematics Specialization**

This interdisciplinary major integrates formal study in mathematics, biology, chemistry, physics, and technology. Students electing a mathematics specialization will complete 42 credits of “core” requirements including Calculus (MATH 127–128), Principles of Biology (BIOL 181–182), Principles of Chemistry (CHEM 101–102), College Physics (PHYS 191–192), Introduction to Human Technological Behavior (TSNG 171), Principles of Structures and Mechanisms (TSNG 211), and an M/S/T-approved elective. The mathematics specialization consists of a minimum of 21 credits including the core mathematics courses, (MATH 200/Principles), (MATH 229/Calculus III), (MATH 301 or 305 Abstract Algebra), and two mathematics elective courses at the 300 level or higher.

### **Mathematics and Statistics Minors**

Students planning to minor should apply to the department as soon as possible. The minor requirements will be defined by the bulletin description at the time of application. Students must maintain the same mathematics and statistics cumulative average as required for graduation in the major.

A minimum of nine credits for the statistics minor and 12 credits for the mathematics minor must be earned at The College of New Jersey. For other requirements, see the academic rules and procedures section of this bulletin.

### **Mathematics Minor**

A student must complete any six mathematics courses satisfying the requirement that they are numbered 127 or above and are not MAT or MATH 342, 348, 386 or 390.

Minimum grade point average for the minor is the same as the major. Only courses with an earned grade of C– or higher can be used to fulfill the requirements for the minor with the following exception: Minors may count at most one D or D+ in a course at the 300 level or above from the mathematics options.

A minimum of 12 semester hours in the minor must be earned in the department.

### **Statistics Minor**

A student must complete six mathematics and statistics courses including: MAT 128 or MAT 125; STA 115 or STA 215; STA 305; and three of the following 11 courses: STA 303, 304, 306, 314, 410, 493, 494, 495, MAT 316, 317, or 318

Minimum grade point average for the minor is the same as the major. A total of at least 18 credits are required for the statistics minor. At least nine credits for the statistics minor must be completed at TCNJ. The minor program includes many courses specifically recommended for students interested in becoming Actuaries.

#### **MATH 091/Basic Math Skills 1 cr. (additive)**

(3 class hours—five-week course)  
(every semester)

Academic development course. A requirement of all students scoring below criterion on a placement test. Study of fractions, decimals, ratio, proportion, and percent. Credit for this course does not count within the 120-credit requirement for graduation.

#### **MATH 092/Basic Math Skills 2 cr. (additive)**

(3 class hours—10-week course)  
(every semester)

Academic development course. A requirement of all students scoring below criterion on a placement test. Study of elementary algebra and elementary geometry. Credit for this course does not count within the 120-credit requirement for graduation.

#### **MATH 095/Intermediate Algebra 3 cr. (additive)**

(3 class hours)  
(every semester)

*Prerequisites:* Satisfactory completion of the academic development required in mathematics; demonstrated inadequate level of preparation for the courses MATH 120

This course is designed for students majoring in a field where at least one of the courses, Pre-Calculus (MATH 120), Calculus A (MAT 127), or Calculus for Business and the Social Sciences (MATH 125) is required. Conceptual understanding and skill development of traditional algebraic topics such as: linear equations and inequalities, exponents and polynomials, rational expressions, quadratic equations, and systems of linear equations are included.

- MATH 101/Foundations of Mathematics I**                      **3 cr.**  
 (3 class hours)  
 (every semester)  
 Provides intuitive and formal experience in development and appreciation of structural bases characteristic of mathematics. Topics from: logic, sets, geometry, graph theory, and algorithms.
- MATH 102/Foundations of Mathematics II**                      **3 cr.**  
 (3 class hours)  
 (every semester)  
 A liberal studies course providing intuitive and formal experience in development and appreciation of structural bases characteristic of mathematics. Topics from: combinatorial probability, abstract mathematical systems, and number theory.
- MAT 105/Mathematical Structures and Algorithms for Educators I**                      **4 cr.**  
 (3 class hours)  
 (every semester)  
 This course concerns the development of number systems, algebraic structures, and algorithms. The student will be required to reason mathematically, solve problems, and communicate mathematics effectively at different levels of formality, using a variety of representations of mathematical concepts and procedures. Physical materials and models will be used to explore fundamental properties of number systems, to model algorithms, and to explore selected algebraic structures. This course is especially appropriate for those students preparing to be elementary, early childhood, or special education teachers.
- MATH 106/Mathematical Structures and Algorithms for Educators II**                      **3 cr.**  
 (3 class hours)  
 (annually—spring)  
 Physical materials and models will be used to explore fundamental concepts of geometry, measurement, data analysis, statistics, and probability. The student will be required to reason mathematically, solve problems, and communicate mathematics effectively at different levels of formality, using a variety of representations of mathematical concepts and procedures. This course is especially appropriate for those students preparing to be elementary, early childhood, or special education teachers.
- MATH 120/Pre-Calculus**    **3 cr.**  
 (3 class hours)  
 (every semester)  
*Prerequisite:* MATH 095 or placement test into MATH 120  
 This course is only for students going on to calculus. Fundamentals of algebra, trigonometry, and analytic geometry. Stress is on computational and problem-solving techniques.
- MATH 125/Calculus for Business and the Social Sciences**                      **3 cr.**  
*Prerequisite:* MATH 120 or placement test into MATH 125 or MATH 127  
 A course intended for majors in business and the social sciences, and/or minors in statistics. Topics include differential calculus, integral calculus, and some linear algebra, with applications to areas of business and social science. **Not for mathematics majors.**
- MAT 127/Calculus A**    **4 cr.**  
 (4 class hours )  
 (every semester)  
*Prerequisite:* MATH 120 or placement test into MAT 127. Contact department for details.  
 This is the first semester of a four-semester sequence in Calculus for students in the mathematical and physical sciences. Some topics are presented rigorously. Topics include functions and limits, derivatives of algebraic functions, derivatives of transcendental functions, and applications of the derivative.
- MAT 128/Calculus B**    **4 cr.**  
 (4 class hours)  
 (every semester)  
*Prerequisite:* MATH 125 or MAT or MATH 127  
 Topics include: Indefinite and definite integrals, volumes of revolution, arc length, techniques of integration, improper integrals.
- MAT 200/Principles of Mathematics**                      **4 cr.**  
 (4 class hours)  
 (every semester)  
 An introduction to the methods of mathematics and mathematical thinking. Typical topics: logic, sets, methods of proof, mappings (surjective, injective, bijective), commutative diagrams, and elementary functions. For mathematics majors or minors or by permission of the department chair.

- MAT 205/Linear Algebra I** **4 cr.**  
 (4 class hours)  
 (every semester)  
 An introduction to vector spaces and systems of linear equations essential for the understanding of both pure and applied mathematics. Selected topics include: vector spaces, linear independence, linear transformations, and matrices.
- MATH 229/Calculus III** **3 cr.**  
 (3 class hours each semester)  
 (every semester)  
*Prerequisite:* MATH 128  
 Topics include: sequences, series, partial differentiation, multiple integrals, and parametric equations.
- MATH 230/Calculus IV** **3 cr.**  
 (3 class hours each semester)  
 (every semester)  
*Prerequisite:* MATH 229  
 Topics include: Polar, cylindrical, and spherical coordinates, multiple integrals; vector calculus, line and surface integrals, Green's Theorem, Stoke's Theorem, introduction to differential equations.
- MAT 301/Number Theory** **4 cr.**  
 (3 class hours)  
 (annually—spring)  
*Prerequisite:* MAT or MATH 200  
 Divisibility, primes, unique factorization, diophantine equations, congruences, quadratic reciprocity, and such optional topics as sums of squares, number-theoretic functions, continued fractions, prime number theory, public-key encryption, and elliptic curves.
- MAT 305/Abstract Algebra** **4 cr.**  
 (3 class hours each semester)  
 (every semester)  
*Prerequisites:* MAT or MATH 200 and 205 or MAT or MATH 301  
 This first course in abstract algebra introduces the student to selected topics in theory of groups. Material will be presented in a rigorous manner. Topics will include groups of permutations, cyclic groups, Lagrange's theorem, group homomorphisms, factor groups, and isomorphism theorems.
- MAT 315/Topics in Linear Algebra** **4 cr.**  
 (3 class hours)  
 (periodically)  
*Prerequisite:* MAT or MATH 205  
 Studies vector spaces, linear transformations, matrix representations, determinants, eigenvalues and eigenvectors, inner product spaces, spectral theorem, Jordan normal form, bilinear forms, and applications.
- MATH 316/Probability** **4 cr.**  
 (3 class hours)  
 (every semester)  
*Prerequisite:* MAT or MATH 200  
*Corequisite:* MATH 229  
 Mathematical models, sample spaces, permutations and combinations, conditional probability, discrete and continuous distributions, moment-generating functions, multivariate and marginal distributions.
- MAT 317/Linear Programming** **4 cr.**  
 (3 class hours)  
 (periodically)  
*Prerequisite:* MATH 125 or MAT or MATH 127  
 Optimization using LP techniques: single/dual simplex methods, duality, degeneracy, applications to problems of transportation, trans-shipment, games.
- MATH 318/Introduction to Operations Research and Decision Theory** **3 cr.**  
 (3 class hours)  
 (periodically)  
*Prerequisite:* MATH 316  
 An introductory study into the mathematical theory and techniques of operations research. Students will become familiar with such ideas as queuing theory, inventory control, search theory, reliability, stochastic models, Monte Carlo techniques, and methods of optimization.

- MATH 320/Combinatorics** **3 cr.**  
 (3 class hours)  
 (every fall)  
*Prerequisite:* MATH 200  
 Topics such as predicate calculus, counting techniques, graphs, trees, enumeration, and binomial theorem.
- MATH 326/Differential Equations** **3 cr.**  
 (3 class hours)  
 (every spring)  
*Prerequisite:* MATH 229  
 Presentation of subject through logical and orderly approach with emphasis on general concepts rather than isolated details. Topics: first-order ordinary differential equations, linear differential equations with constant coefficients, simultaneous differential equations, hyperbolic functions, and Laplace Transforms.
- MATH 331/Numerical Mathematics I** **3 cr.**  
 (3 class hours)  
 (periodically)  
*Prerequisites:* MATH 229, CMSC 215  
 An introduction to numerical methods suitable for use on a digital computer. Topics include computer representation of numbers, round-off error in function evaluations, series approximations to functions, finding roots of functions, finding roots of polynomials, numerical integrations, and approximate numerical solutions to systems of simultaneous linear equations.
- MATH 332/Numerical Mathematics II** **3 cr.**  
 (3 class hours)  
 (periodically)  
*Prerequisites:* MATH 326, MATH 331  
 A continuation of Numerical Mathematics I. Topics include numerical solutions of ordinary differential equations, least squares, Fourier approximations, Chebyshev economization.
- MATH 342/Teaching Mathematics in Elementary School** **1 cr.**  
 (2 class hours)  
 (every semester)  
*Prerequisite:* MATH 105 or 200  
 Examines the elementary school mathematics curricula, how children learn mathematics, and methods and strategies appropriate for teaching the many topics in mathematics. Emphasizes the organization of materials and activities for effective teaching, diagnostic work, and evaluation.
- MAT 351/Geometry** **4 cr.**  
 (3 class hours)  
 (annually—fall)  
*Prerequisite:* MAT or MATH 200, MATH 229 or permission of the instructor  
 Geometry as a branch of contemporary mathematics. Topics include Axiomatic Systems, Euclid's Fifth Postulate, Euclidean, Neutral and non-Euclidean geometry.
- MATH 355/History of Mathematics** **3 cr.**  
 (3 class hours)  
 (annually—spring)  
*Prerequisites:* One year of calculus and one semester of abstract algebra  
 Origin and development of geometry, algebra, and calculus, and their interaction with science and the humanities.
- MATH 380/Teaching Mathematics in Elementary and Middle School** **4 cr.**  
 (annually—fall)  
*Prerequisite:* MAT or MATH 200, 205, and MATH 229  
 A professional course for students majoring or specializing in mathematics. Examines the content in the elementary and middle school mathematics curricula, how children learn mathematics and the rationales for developing the methods and strategies for teaching the many topics in these mathematics curricula to children of diverse cultures. Emphasizes the organization of materials for effective teaching, problem solving, diagnostic work, and evaluation.
- MATH 386/Differential Equations with Numerical Techniques** **3 cr.**  
 (3 class hours)  
 (every semester)  
*Prerequisite:* MATH 128  
 Integrated introduction to standard topics in differential equations and basic linear algebra for engineering applications.

- MATH 390/Teaching Mathematics in High School**      **3 cr.**  
 (3 class hours)  
 (annually—spring)  
*Prerequisite:* MATH 200 or permission of instructor  
 Professionalized subject matter. Teaching techniques and lesson planning including a variety of classroom formats. Cooperative group work, writing in the mathematics classroom, technology, and manipulatives. Curriculum trends, professional obligations and responsibilities, student assessment. Content will include discrete mathematics, problem solving, concept of proof, and mathematical modeling.
- MAT 402/Real Analysis**      **4 cr.**  
 (3 class hours per semester)  
 (annually)  
*Prerequisite:* MAT or MATH 200 and MATH 229  
 A logical development of mathematical analysis for functions of a single real variable. Topics include order, completeness, sequences, series, limits of functions, basic topology of the reals, differentiation, integration, sequences and series of functions and transcendental functions.
- MATH 403/Advanced Calculus**      **3 cr.**  
 (3 class hours per semester)  
 (periodically)  
*Prerequisite:* MATH 229  
 In this course, we explore the calculus of several variables from the point of view of the geometry of surfaces in Euclidean space. The emphasis will be on examples rather than proofs.
- MATH 405/Topology**      **3 cr.**  
 (periodically)  
*Prerequisite:* MATH 305 or permission of instructor  
 A first course in general topology. Typical topics: sets, Cartesian products, mappings, infinite sets, Cauchy sequences, connected sets, continuous functions, metric spaces, and topological spaces.
- MATH 407/Projective Geometry**      **3 cr.**  
 (3 class hours)  
 (occasionally)  
 An introduction to projective geometry. Topics include affine and projective plane, real projective plane, principle of duality, groups of automorphisms, and projective planes over division rings.
- MATH 420/Complex Variables**      **3 cr.**  
 (3 class hours)  
 (annually—spring)  
*Prerequisite:* MATH 229  
 A logical development of the classical theory of functions of a complex variable, with emphasis on those parts of the theory which are most used in modern applications of the subject. Topics include: complex numbers; analytic functions; the exponential, trigonometric, hyperbolic, and logarithmic functions and their inverses; mapping by elementary functions; integrals; the Cauchy-Goursat theorem, the Cauchy integral formula, derivatives of analytic functions; the fundamental theorem of algebra; power series; residues and poles; and isolated, essential, and removable singularities.
- MAT 440/Mathematical Logic**      **4 cr.**  
 (3 class hours)  
 (periodically)  
*Prerequisite:* Not open to freshmen. Recommended only for those with some interest in and aptitude for pure mathematics  
 This course is principally concerned with Propositional Calculus and First Order Logic, two mathematical languages that abstract many of the patterns of logical thought. The two languages will be carefully defined and applied to actual reasoning problems. For each language, we will discuss metatheorems dealing with the properties of soundness, completeness, decidability, and consistency.
- MATH 450/Honors Course in Mathematics**      **3–6 cr.**  
 (occasionally)  
*Prerequisite:* By invitation only  
 More sophisticated treatment of standard or advanced topics for carefully selected students. Exemptions from the regular courses whose syllabi are covered.

- MATH 451/Topics in Algebra** **3 cr.**  
 (3 class hours)  
 (occasionally)  
*Prerequisites:* MATH 229 and MATH 305  
 A flexible course in which the content is selected from topics in algebra. This is an elective course designed to enrich the background of the student as well as to bridge the gap between undergraduate math and graduate math.
- MATH 452/Topics in Geometry and Topology** **3 cr.**  
 (3 class hours)  
 (occasionally)  
*Prerequisites:* MATH 229 and MATH 305  
 A flexible course in which the content is selected from topics in geometry and topology. This is an elective course designed to enrich the background of the student as well as to bridge the gap between undergraduate math and graduate math.
- MATH 453/Topics in Analysis** **3 cr.**  
 (3 class hours)  
 (occasionally)  
*Prerequisites:* MATH 229 and MATH 305  
 A flexible course in which the content is selected from topics in analysis. This is an elective course designed to enrich the background of the student as well as to bridge the gap between undergraduate math and graduate math.
- MATH 454/Topics in Applied Mathematics** **3 cr.**  
 (3 class hours)  
 (occasionally)  
*Prerequisites:* MATH 229 and MATH 305  
 A flexible course in which the content is selected from topics in applied mathematics. This is an elective course designed to enrich the background of the student as well as to bridge the gap between undergraduate math and graduate math.
- MATH 489/Seminar in Mathematics Education** **1 cr.**  
 (every semester)  
*Prerequisite:* MATH 390  
*Corequisites:* MATH 490 and SCED 489  
 A seminar fulfilling a complementary role in the mathematics student-teaching experience. Through group discussion and investigation of supporting professional literature, the student will be guided to a deeper appreciation of problems and practices in secondary mathematics education.
- MATH 490/Student Teaching: Mathematics** **10 cr.**  
 (every semester)  
*Prerequisites:* MATH 390 and meeting all the criteria for admission to student teaching including completion of all major requirements, a minimum overall GPA of 2.75  
*Corequisites:* MATH 489 and SCED 489  
 Student teaching during the senior year under supervision of approved public school teachers and general supervision of college supervisors. Observation, participation, and responsible teaching.
- MATH 493/Internship in Mathematics** **3 cr.**  
 (every semester)  
*Prerequisites:* Junior standing and permission of the department  
 Applied experience in major field of study. Consult department for details.
- MATH 496/Seminar in Mathematics** **3 cr.**  
 (3 class hours)  
 (occasionally)  
*Prerequisite:* Permission of instructor  
 Intensive study of advanced topics in mathematics. Emphasizes student activity; use of journals and monographs; and discussion, solution and presentation of problems.
- MATH 498/Independent Study in Mathematics** **1–3 cr.**  
 (every semester)  
*Prerequisite:* By invitation only  
 Student will study independently an appropriate area. A department member will be assigned to advise the student.
- STAT 115/Statistics I** **3 cr.**  
 (3 class hours)  
 (every semester)  
 General education course. Introduction to descriptive statistics and statistical inference. Topics include: averages, variability, histograms, probability, normal distribution, estimation, and hypothesis testing. **A student may not receive credit for both STAT 115 and STAT 215.**

**STAT 116/Statistics II****3 cr.**

(3 class hours)  
(every semester)

*Prerequisite:* STAT 115

The second course in descriptive statistics. Designed to enable the student to better interpret statistical data. Topics include: hypothesis testing, linear regression, correlation, analysis of variance, design of experiments, and non-parametric tests.

**STA 215/Statistical Inference****4 cr.**

(3 class hours)  
(every semester)

*Prerequisite:* MATH 125 or MAT or MATH 127 or permission of instructor

General education course. This course provides a comprehensive introduction to descriptive statistics and the essential ideas of probability. Students will study foundations of classical parametric inference: point estimation; confidence intervals; hypothesis testing; and common statistical techniques including simple regression and correlation. Examples will be drawn from a variety of social and natural sciences.

**STAT 220/Introduction to Statistical Computation****3 cr.**

(3 class hours)  
(annually—fall)

*Prerequisite:* STAT 115 or STA or STAT 215

An introduction to statistical computation using modern computer programs and packages such as SAS and Excel. This is a problem-oriented course using the case-study approach.

**STAT 303/Design of Experiments****3 cr.**

(3 class hours)  
(fall—even years)

*Prerequisites:* STAT 116 or STA or STAT 215; and MATH 125 or MAT or MATH 128

This is an introductory course on the design of experiments and its broad applications in numerous scientific disciplines. Topics include the analysis of variance, factorial design, and fractional factorial experiments. A statistical package will be used throughout the course. (SAS, SPSS, or MINITAB)

**STAT 304/Sampling and Non-Parametric Statistics** **3 cr.**

(spring—even years)

*Prerequisites:* STAT 116 or STA or STAT 215; and MATH 125 or MAT or MATH 128

This is an introductory course to the use of sampling theory and non-parametric statistics for problems that arise in scientific investigations. Topics include the design and analysis of sample surveys as well as robust statistical tests and estimation techniques that are useful in a wide range of real-world applications.

**STA 305/Regression Analysis****4 cr.**

(3 class hours)  
(fall—odd years)

*Prerequisites:* STAT 116 or STA or STAT 215, and MATH 125 or MAT or MATH 128 and MAT or MATH 205; or MAT or MATH 205, 316 and permission of instructor

An intermediate course on the theory and application of linear statistical models. Topics include matrix algebra, multiple regression, transformation, and weighted least squares. A statistical package will be used throughout the course (SAS, SPSS, or MINITAB).

**STAT306 /Applied Multivariate Analysis****3 cr.**

(3 class hours)  
(spring—odd years)

*Prerequisites:* STA or STAT 215 or STAT 116, and MATH 125 or MAT or MATH 128

The course will introduce students to a variety of multivariate statistical methods as aids to analyzing and interpreting large data sets. These methods will have general applications across a wide range of client disciplines. Statistical computer packages will be used throughout the course.

**STAT 314/Statistical Quality Control****3 cr.**

(3 class hours)  
(spring—odd years)

*Prerequisites:* STAT 116 or STA or STAT 215, and MATH 125 or MAT or MATH 128; or MAT or MATH 316 and permission of instructor

An introduction to modern techniques of quality control and reliability practice. Acceptance sampling, sampling plans, control charts, combinatorial reliability, failure models, and system reliability.

**STAT 393/Internship I in Statistics**                      **variable**  
(every semester)

*Prerequisites:* Junior standing and permission of department

A supervised statistics-related experience working for government or for the private sector. Based on input from the client, the student and faculty coordinator agree on the overall scope of the project including learning objectives, work plan, and expected outputs. The content of the internship should require the student to do some research and/or creative work. Students will periodically inform the coordinator of status and, on completion of the internship, will document the experience and make an oral presentation. The course counts as a general elective for the student with either a major or a minor in statistics. Grading is Pass/Unsatisfactory. Courses graded on a P/U basis are not counted as part of the 64 semester hours of letter-graded courses for graduation with honors.

**STA 410/Mathematical Statistics**                      **4 cr.**  
(3 class hours)  
(every fall)

*Prerequisites:* STA or STAT 215 and MAT or MATH 316

Typical topics: Theory of sampling, law of large numbers, central limit theorem, normal approximation to binomial and poisson distributions, estimation of population parameters, hypothesis testing, confidence methods, regression analysis, change of variable and order statistics.

**STAT 414/Time Series Analysis**                      **3 cr.**  
(3 class hours)  
(occasionally)

*Prerequisites:* STAT 116 or STA or STAT 215 and MATH 229; or MAT or MATH 316

This is an introductory course to the theory and application of statistical time-series analysis. Techniques developed in the course will be used to analyze data that arise in engineering, economics, and many branches of empirical sciences.

**STAT 415/Markov Chains and Random Processes**                      **3 cr.**  
(3 class hours)  
(occasionally)

*Prerequisites:* MAT or MATH 316 and MAT or MATH 205

An introductory course to random walks, Markov chains, and a variety of random processes. Techniques developed in the course will be used to illustrate the applications of these processes to science.

**STAT 493/Internship II in Statistics**                      **variable**  
(every semester)

*Prerequisites:* Junior standing and permission of department

A supervised statistics-related experience working for the government or the private sector, in which the student will be expected to include research as part of the project. Based on a general description of the project from the client, the student, working with the TCNJ faculty coordinator, will structure the project. The structure will include the learning objectives, the research issues, the projected work plan, and the possible results. Students will periodically inform the faculty coordinator of status and progress. On completion, the student will formally document the project for the client and TCNJ. The student will also make an oral presentation that is open to the public. The course can count as an option in the statistics major or minor or as a general elective. A letter grade will be assigned by the faculty coordinator based on input from the client, as well as from the written and oral presentation.

**STAT 494/Seminar in Statistics**                      **3 cr.**  
(3 class hours)  
(occasionally)

*Prerequisite:* Permission of instructor

An investigation of selected areas of the field through the use of journal articles and monographs, and the solution of problems which may be outside the scope of other course requirements.

**STAT 495/Independent Study in Statistics**                      **1–3 cr.**  
(every semester)

*Prerequisite:* Permission of instructor

The student will study independently a selected area of this discipline through the use of course books and journal articles coordinating this study under supervision of advisers.

**IDSC 105/Applying Computing to Mathematical  
Problem Solving**                      **3 cr.**  
(See Interdisciplinary Studies.)

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