Mathematics and Statistics

Faculty: Papantonopoulou, *Chair*; Clark, Clifford, Conjura, Cunningham, Curtis, Hagedorn, Hingston, Holmes, Iannone, Jean-Michel, Kardos, Lee, Liebars, Navard, Reimer, van der Sandt, Wang, Zheng

The Department of Mathematics and Statistics offers programs in four areas: mathematics: mathematics secondary education; statistics: and mathematics education for elementary, early childhood, deaf and hard of hearing, and special education. 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 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–Secondary (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.

Mathematics Education–Elementary, Early Childhood, Deaf and Hard of Hearing, and Special Education (MATE)—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 in their respective education field. Students wishing to take the mathematics Praxis test could also be certified to teach mathematics K–12.

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 six course units in the major must be earned in the department. A minimum of four of the final six course units in the major must be earned in the department.

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

Calculus Readiness Requirement—Any student who has not satisfied the College's calculus readiness requirements is not allowed to register for any calculus course offered by the Department of Mathematics and Statistics. Students with 650 or higher math SAT scores and high school math which includes a precalculus course may register for calculus. A student with 600–640 math SAT scores may either take MAT 096: Precalculus or take the Calculus Readiness Test to determine readiness for calculus. All students with math SAT scores below 600 must take the calculus readiness test and will be placed at a level appropriate to their demonstration of readiness.

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 as many of the following courses as is possible: MAT 305/Abstract Algebra, MAT 310/Real Analysis, MAT 315/Topics in Linear Algebra, MAT 320/Complex Analysis, MAT 403/Advanced Calculus, and MAT 405/Topology.

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. Minimum grades are noted in parentheses:

For students in the mathematics (liberal arts-MATA and teaching-MATT) majors or those double majoring in mathematics (MATE) and elementary education, early childhood education, special education, or deaf and hard of hearing/elementary education

- 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": MAT 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 in a Mathematics teacher preparation program or who have a double major in mathematics and elementary, early childhood education, special education, or deaf and hard of hearing/elementary education need a GPA of 2.75 overall.

For students in the mathematics (statistics-MATC) program:

- Retention in the program is based on the following performance standards in these "critical content courses": MAT 125 or MAT 127 or MAT 128 (B–), and MAT 316 (C) *and* STA 215 (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* 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.

Study Abroad

One of the opportunities available to students pursuing a degree in Mathematics or Statistics is to study abroad for a semester or a year. Students interested in studying abroad should meet with their faculty advisor early in their college career to plan a curriculum so that they may complete their studies in four years. They will also need to meet with the Director of Global Programs. The students must receive approval from the chair of the department in order for courses taken abroad to count toward requirements for the major.

Mathematics Major: (MATA)

Requirements for the Major

All MATA students will be required to take a **minimum of 12** mathematics course units and a 0 course unit orientation. The 12 course units will consist of the following **seven required** course units:

MAT	099/Orientation to Mathematics and Statistics	0 course unit
MAT	128/Calculus B	1 course unit
MAT	200/Discrete Mathematics	1 course unit
MAT	205/Linear Algebra	1 course unit
MAT	229/Multivariable Calculus	1 course unit
MAT	305/Abstract Algebra	1 course unit
MAT	310/Real Analysis	1 course unit
MAT	320/Complex Analysis	1 course unit

and five additional course units. The five additional course units can be any MAT courses at the 300/400 level. Two of these course units must be MAT courses at the 400 level.

   The senior capstone experience requirement is fulfilled by taking a 400 level MAT course concurrently with MAT 498 (0 course units) in the senior year.

Additional Required Correlates (two course units)

Any two natural science courses that count for a science major, at least one with lab and at least one in physics.

MATA Honors

To receive MATA honors, an MATA major must complete the following requirements in addition to those required for the MATA major. They must have a 3.5 GPA in their 300- and 400- level mathematics courses and take either:

   a. An additional 400-level course (which could be an independent study) and a semester of MAT 493: Independent Research II that builds upon a previous 400-level course.
   or
   b. A full year of MAT 493: Independent Research II.

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Based on their research, students must also write a mathematical paper, read and approved by three members of the department, and give a departmental presentation on it.

Suggested First-Year Course Sequence (MATA)

Fall

FSP	First Seminar	1 course unit
MAT	099/Orientation to Mathematics and Statistics	0 course unit
MAT	127/Calculus A (if not exempted)*	1 course unit
MAT	200/Discrete Mathematics	1 course unit
Foreign Language (if not exempted)**		1 course unit

Spring

MAT	128/Calculus B	1 course unit
WRI	102/Academic Writing (if not exempted)**	1 course unit
Foreign Language (if not exempted)**		1 course unit
Liberal Learning (arts and humanities or social sciences and history)		1 course unit

It is recommended that students exempted from this course take either Calculus B or a liberal learning course.

***It is recommended that students exempted from these courses take other liberal learning courses.*

Mathematics Major: Teacher Preparation (MATT)

An overview of the entire secondary-level teacher preparation sequence for students can be found in the section of this bulletin for the Department of Education Administration and Secondary Education.

Students planning to teach high school mathematics should consult with advisors in both mathematics and secondary education in planning their academic program. These plans should take into account requirements for: the major, liberal learning, professional courses, and state certification. To be retained in the program, a student must earn at least a 2.5 cumulative grade point average (CGPA) before enrolling in the junior year education sequence. The student must establish a minimum 2.75 CGPA, and must have completed all required courses in the major in order to be allowed to student teach.

Candidates for a teacher-education certificate must have a 2.75 or higher cumulative grade point average to successfully complete their teacher education program. They also must meet the state hygiene/physiology requirement, and pass the appropriate Praxis examination 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.

Requirements for the Major

All MATT students will be required to take a **minimum of 12** mathematics/statistics course units, and a 0 course unit orientation. Twelve course units will consist of **10 required** course units, and 2 MAT/STA options:

MAT	099/Orientation to Mathematics and Statistics	0 course unit
MAT	128/Calculus B	1 course unit
MAT	200/Discrete Mathematics	1 course unit
MAT	205/Linear Algebra	1 course unit
MAT	229/Multivariable Calculus	1 course unit
MAT	255/Perspectives on the Development of Mathematics	1 course unit
MAT	301/Number Theory	1 course unit
MAT	305/Abstract Algebra	1 course unit
MAT	316/Probability	1 course unit
MAT	351/Geometry	1 course unit
STA	215/Statistical Inference	1 course unit
and two MAT/STA options which can be any MAT/STA course at the 300/400 level		2 course units

Content Methods and Professional Sequence Courses:

SED	224/Adolescent Learning and Development	1 course unit
EFN	299/School and Communities	1 course unit
SED	399/Pedagogy in Secondary Schools	1 course unit
SPE	323/Secondary Content Literacy in Inclusive Classrooms	1 course unit
EFN	398/Historical and Political Context of Schools	1 course unit
MTT	380/Methods of Teaching Mathematics I	1 course unit
MTT	390/Methods of Teaching Mathematics II	1 course unit
MTT	490/Student Teaching	2 course units
SED	498/Collaborative Capstone for Professional Inquiry	1 course unit

Additional Required Correlates:

CSC	220/Computer Science I	1 course unit
Science (BIO 185, CHE 201, or PHY 201)		1 course unit

Suggested First-Year Course Sequence (MATT)

Fall

FSP	First Seminar (Arts and Humanities or Social Change in Historical Perspective)	1 course unit
MAT	099/Orientation to Mathematics and Statistics	0 course unit
MAT	127/Calculus A*	1 course unit
MAT	200/Discrete Mathematics	1 course unit
Liberal Learning (Arts and Humanities or Social Change in Historical Perspective)		1 course unit

Spring

MAT	128/Calculus B	1 course unit
WRI	102/Academic Writing (if not exempted)**	1 course unit
STA	215/Statistical Inference	1 course unit
BIO	185, CHE 201, or PHY 201/Science	1 course unit

It is recommended that students exempted from this course take Calculus B
**It is recommended that students exempted from this course take another liberal learning course or a foreign language.*

Mathematics Major: Teacher Preparation for Elementary, Early Childhood, Deaf and Hard of Hearing, and Special Education majors (MATE)

Students should consult with advisors in both mathematics and in the School of Education in planning their academic program. These plans should take into account requirements for: the majors, liberal learning, professional courses, and state certification. To be retained in the program, a student must earn at least a 2.5 cumulative grade point average (CGPA) before enrolling in the junior year education sequence. The student must establish a minimum 2.75 CGPA, and must have completed all mathematics and education prerequisites in order to be allowed to student teach.

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.

Requirements for the Major

All MATE students will be required to take a **minimum of 12** mathematics/statistics course units, and a 0 course unit orientation Twelve course units will consist of **11 required** course units, and a MAT/STA option:

MAT	099/Orientation to Mathematics and Statistics	0 course unit
MAT	127/Calculus A	1 course unit
MAT	128/Calculus B	1 course unit
MAT	200/Discrete Mathematics	1 course unit
MAT	205/Linear Algebra	1 course unit
MAT	229/Multivariable Calculus	1 course unit
MAT	255/Perspectives on the Development of Mathematics	1 course unit
MAT	301/Number Theory	1 course unit
MAT	305/Abstract Algebra	1 course unit
MAT	316/Probability	1 course unit
MAT	351/Geometry	1 course unit
STA	215/Statistical Inference	1 course unit
and one MAT/STA options which can be		1 course unit
	any MAT/STA course at the 300/400 level	

Additional Required Correlate:

CSC	220/Computer Science I	1 course unit

Suggested First-Year Mathematics Course Sequence (MATE)*

Fall

MAT 127 Calculus A	1 course unit
MAT 200 Discrete Mathematics	1 course unit

Spring

MAT 128 Calculus B	1 course unit
STA 215 Statistical Inference	1 course unit

Consult individual major in the School of Education for remaining courses.

Elementary Education and M/S/T and Early Childhood Education and M/S/T with a Mathematics Specialization

This interdisciplinary major integrates formal study in mathematics, science, and technology and consists of a common "core" with a "specialization" in one of the M/S/T disciplines. Students electing a mathematics specialization will complete 10 units of common core requirements including MAT 127/128 Calculus A/B, three approved science courses, TST 171/Fundamentals of Technology, TST 181/Principles of Structures and Mechanisms, TED 460/Integrated M/S/T for the Child/Adolescent Learner, and two M/S/T approved electives. The mathematics specialization consists of completing any four MAT courses numbered above the required courses of MAT 127-128. See the M/S/T academic program coordinator for general advisement.

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 **13-course** unit sequence consists of the following:

Required Courses: **Eight required** course units and a 0 course unit orientation:

MAT 099/Orientation to Mathematics and Statistics	0 course unit
MAT 128/Calculus B	1 course unit
MAT 200/Discrete Mathematics	1 course unit
MAT 205/Linear Algebra	1 course unit
MAT 229/Multivariable Calculus	1 course unit
MAT 316/Probability	1 course unit
STA 215/Statistical Inference	1 course unit
STA 305/Regression	1 course unit
STA 410/Mathematical Statistics	1 course unit

Three options from the following:
STA 303/Design of Experiments
STA 304/Sampling and Non-Parametric Statistics
STA 306/Applied Multivariate Analysis
STA 314/Statistical Quality Control

Two MAT/STA Options

The senior capstone experience requirement is fulfilled by taking an upper-level STA course either prior to or concurrently with STA 498 (0 course units) in the senior year.

Additional Required Correlates

CSC 220/Computer Science I	1 course unit
Any two natural science courses that count for a science major, at least one with lab.	2 course units

MATC HONORS

To receive MATC Honors, an MATC major must complete the following requirements in addition to those required for the MATC major:

They must have a 3.5 GPA in their 300-level and 400-level statistics and mathematics courses, and take a semester of STA 493 (Independent Research II). Based on this research, students must also write a statistical paper, have it read and approved by members of the Statistics Committee, and give a presentation.

Suggested First-Year Course Sequence (MATC)

Fall

FSP First Seminar	1 course unit
MAT 099/Orientation to Mathematics and Statistics	0 course unit
MAT 127/Calculus A	1 course unit
MAT 200/Discrete Mathematics	1 course unit
Foreign Language (if not exempted)*	1 course unit

Spring

MAT 128/Calculus B	1 course unit
STA 215/Statistical Inference	1 course unit
WRI 102/Academic Writing (if not exempted)*	1 course unit
Foreign Language (if not exempted)*	1 course unit

It is recommended that students exempted from these courses take other liberal learning (arts and humanities or social sciences and history) courses.

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 three course units for the statistics minor and four course units for the mathematics minor must be earned at The College of New Jersey. Only one course taken as a part of the student's major may also be counted toward the student's minor; however, correlate courses for the major may be applied freely to the minor. Multiple minors may overlap by only one course.

Mathematics Minor

For a mathematics minor, a student must complete (and earn at least a C- in) five MAT courses numbered 128 or above (except MAT 255: Perspectives on the Development in Mathematics), and at least two of these at the 300/400 level.

Statistics Minor

Required Courses: Two course units
STA   115 or STA 215/Statistics or Statistical Inference
STA   305/Regression Analysis

Three Options:
STA   303/Design of Experiments
STA   304/Sampling and Non-Parametric Statistics
STA   306/Applied Multivariate Analysis
STA   314/Statistical Quality Control
MAT   316/Probability
STA   317/Linear Programming
STA   318/Operations Research
STA   410/Mathematical Statistics
STA   492/Internship II in Statistics
STA   494/Seminar in Statistics

Total   **Five course units**

Actuarial Studies Minor

Prerequisites
     MAT 125 or 127, MAT 128, STA 215 and MAT 229

Courses for the Minor
     Students take five courses (depending on their major—see below) from the following two groups:

Group A: STA 305/Regression Analysis
              MAT 316/Probability
              STA 318/Operations Research
              STA 410/Mathematical Statistics

Group B: ECO 102/Principles of Macroeconomics
              FIN 201/Fundamental Financial Methods AND MKT 201/Marketing
                      Principles. Both of these are half-courses.
              FIN 310/Introduction to Investments and Financial Analysis
              FIN 410/Portfolio Management and Derivative Securities

For Students Majoring in Statistics:
     Students will select one course from Group A from those required in the Statistics major, which are STA 305, MAT 316 and STA 410, and double-count this course toward the minor. They will then take four courses from the remaining five from Groups A and B.

For Students Majoring in Business:

Students will be advised to take the sequence MAT 125, MAT 128 and MAT 229 to enable them to meet the prerequisites above. They will then choose one course from Group B (which will be the double-counted course), and four courses from Group A. In so doing, students will be studying STA 305 instead of ECO 231/Applied Business Statistics.

For Students Majoring in Mathematics:

Students may choose five courses from Groups A and B, but it is recommended that MAT 316 and STA 410 are among those selected.

For Students in Other Majors:

Selections from Groups A and B as advised by the Department of Mathematics advisor.

Students who achieve grades of B– or better on ECO 101 and ECO 102 will receive VEE-Economics credit from the Society of Actuaries. Similarly, a grade of B– or better on STA 305 will receive VEE-Applied Statistics credit.

MAT 095/096/and 099 courses do not count toward graduation requirements.

MAT 095/Intermediate Algebra   **additive credit**
(every semester)
Prerequisites: Satisfactory completion of the academic development required in mathematics; demonstrated inadequate level of preparation for MAT 096
This course is designed for students majoring in a field where at least one of the courses, Calculus A (MAT 127) or Calculus for Business and the Social Sciences (MAT 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.

MAT 096/Pre-Calculus   **additive credit**
Formerly MATH 120
(every semester)
Prerequisite: MAT 095 or placement into MAT 096
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.

MAT 099/Orientation to Mathematics and Statistics   **0 course units**
(seven weeks)
(every semester)
Required as an entry course of all entering first-year and transfer students enrolled in majors offered by the Department of Mathematics and Statistics. Topics covered include degree requirements, general information about the College and services offered, career opportunities in mathematics and statistics, academic standards and integrity, study habits and time management, and resume development. General and personal advisement relative to pursuit of the major and the degree is also included.

MAT 101/Applied Liberal Arts Mathematics　　　　　　　**1 course unit**
(every semester)
Provides intuitive and formal experience in development and appreciation of structural bases characteristic of mathematics. Topics from: graph theory, coding, voting, and social choice and game theory.

MAT 102/Mathematics for the Liberal Arts　　　　　　　**1 course unit**
(every semester)
Provides 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　　**1 course unit**
(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.

MAT 106/Mathematical Structures and Algorithms for Educators II　　**1 course unit**
(every semester)
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.

MAT 125/Calculus for Business and the Social Sciences　　　**1 course unit**
(every semester)
Prerequisite: MAT 096 or placement into MAT 125 See
http://www.tcnj.edu/~mathstat/calcrec.html for details
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 or science majors.

MAT 127/Calculus A　　　　　　　　　　　　　　　　**1 course unit**
(every semester)
Prerequisite: MAT 096 or placement into MAT 127. See
http://www.tcnj.edu/~mathstat/calcrec.html for details
Provides students with a solid grounding in single-variable calculus. The course is designed for students in the mathematical and physical sciences. Topics include functions and limits, derivatives and differentiation rules, applications of derivatives, and an introduction to integrals and their applications.

MAT 128/Calculus B   **1 course unit**
(every semester)
Prerequisite: MAT 125 or 127
A second course in calculus covering integral calculus and series. The course will cover both the theoretical and applied aspects of calculus.

MAT 200/Discrete Mathematics   **1 course unit**
(every semester)
An introduction to discrete mathematics. Discrete topics include sets, graphs, Euler and Hamilton circuits, connectivity, planar graphs, recursion, and difference equations. Descriptions of the proof types such as direct, indirect, cases, contrapositive, and induction included whenever possible. Some optional topics which may be covered are: fractals, algorithms, combinatorial proofs, discrete codes, logic, Platonic solids, and combinatorial counting.

MAT 205/Linear Algebra   **1 course unit**
(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: systems of linear equations, matrices, linear transformations, linear independence, determinants, vector spaces, eigenvalues and eigenvectors, and orthogonality.

MAT 229/Multivariable Calculus   **1 course unit**
(every semester)
Prerequisite: MAT 128
Topics include: geometry of three dimensional space, derivatives of functions of several variables, integrals in dimension two and three, and Stoke's theorem.

MAT 255/Perspectives on the Development of Mathematics   **1 course unit**
(every semester)
The course develops a skeletal outline of the history of mathematics. Additional topics may include the history of a specific area of mathematics. Samples of topics that may be covered in the course are: ancient mathematics, the relation between Greek and Mesopotamian algebra, the growth of trigonometric ideas, the geometric solution of the cubic equations by Omar Khayyam and the algebraic solutions by Cardano, Zeno's paradox, and the development of different number systems.

MAT 301/Number Theory   **1 course unit**
(every semester)
Prerequisite: MAT 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   **1 course unit**
(every semester)
Prerequisites: MAT 200, and MAT 205 or MAT 301
An introduction to groups, rings, integral domains, and fields. Additional topics include groups of symmetries, rings of integers, rings of polynomials, and construction of the field of rational numbers.

MAT 310/Real Analysis **1 course unit**
(annually)
Prerequisites: MAT 200 and MAT 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.

MAT 315/Topics in Linear Algebra **1 course unit**
(periodically)
Prerequisite: MAT 205
The course consists of a collection of topics not covered in MAT 205 but built upon the material covered in MAT 205. Such topics may include: the Spectral Theorem of Symmetric Matrices, Quadratic Forms, Unitary and Hermitian Matrices, Jordan Canonical Forms, Schur's Theorem, applications to Linear Programming, and Markov chains.

MAT 316/Probability **1 course unit**
(every semester)
Prerequisites: MAT 200 and MAT 229
Topics will include counting rules to derive models for discrete variables, including the uniform, Bernoulli, binomial, geometric, negative binomial, hypergeometric, and Poisson distributions. Continuous variables will be modeled with distributions having a variety of shapes, including the uniform, exponential, gamma, beta, and normal distributions.

MAT 320/Complex Analysis **1 course unit**
(annually)
Prerequisite: MAT 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 326/Differential Equations **1 course unit**
(periodically)
Prerequisite: MAT 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.

MAT 331/Numerical Methods **1 course unit**
(periodically)
Prerequisites: MAT 229, MAT 205
Numerical Methods is a course which focuses on methods of approximating solutions to problems for which the techniques of the earlier Calculus courses fail. A course covering methods of approximation, errors in approximation, and efficiency of algorithms.

MAT 351/Geometry   **1 course unit**
(every semester)
Prerequisites: MAT 200 and MAT 229
Both Euclidean and non-Euclidean geometries are studied. Each geometry will be understood from three different perspectives: first, as the collection of theorems following from a particular set of axioms; second, as the two-dimensional geometry arising from a particular metric; and third, as the geometry obtained from a set together with a specific group of rigid motions of the set. At least one of these viewpoints will be developed in detail.

MAT 390/Mathematics Specific Research Course   **variable course units**

MAT 391/Independent Study in Mathematics   **variable course units**

MAT 392/Guided Study in Mathematics   **1 course unit**

MAT 393/Independent Research in Mathematics   **1 course unit**
(every semester)
Prerequisite: By invitation only
Student will study and/or do research independently in an appropriate area. A department member will be assigned to advise and direct the student.

MAT 399/Internship in Mathematics   **variable course units**
(every semester)
Prerequisites: Junior standing and permission of the department.
Applied experience in major field of study. Consult department for details.

MAT 403/Advanced Calculus   **1 course unit**
(periodically)
Prerequisite: MAT 229
The calculus of several variables is explored from the point of view of the geometry of surfaces in Euclidean space. The emphasis will be on examples rather than proofs. Topics will include the topology of Euclidean Space, the derivative as a linear map, the geometry of maps whose derivative have maximal rank, and Lie groups such as SL (2, R).

MAT 405/Topology   **1 course unit**
(periodically)
Prerequisite: MAT 305
Students will gain acquaintance of various aspects of topology and its connections to analysis and algebra. This will include a thorough treatment of those aspects of point-set topology that lay the foundation for graduate study; i.e., continuity, compactness, connectedness and separation axioms. Also, this course will introduce students to manifold theory, including the classification of two-dimensional manifolds. The student will understand the role of topological invariants in the classifying topological spaces. This will lead to the classification of the surfaces. Lastly, students will see categorical relationships between topological objects and algebraic objects.

MAT 407/Projective Geometry   1 course unit
(occasionally)
Prerequisite: MAT 305
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.

MAT 440/Mathematical Logic   1 course unit
(occasionally)
Prerequisites: MAT 200 and sophomore standing or above
The process, characteristics, and limits of logical reasoning. Several logical languages will be developed from first principles. Students will become familiar with theorems on consistency and independence and develop an appreciation of Godel's incompleteness theorem. An introduction to set theory will be included to discuss infinite cardinals.

MAT 451/Seminar in Algebra   1 course unit
(occasionally)
Prerequisites: MAT 229 and MAT 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.

MAT 452/Seminar in Geometry and Topology   1 course unit
(occasionally)
Prerequisites: MAT 229 and MAT 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.

MAT 453/Seminar in Analysis   1 course unit
(occasionally)
Prerequisites: MAT 229 and MAT 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.

MAT 454/Seminar in Applied Mathematics   1 course unit
(occasionally)
Prerequisites: MAT 229 and MAT 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.

MAT 493/Independent Research II in Mathematics   1 course unit
(every semester)
Prerequisite: By invitation only
Student will study and or do research independently in an appropriate area. A department member will be assigned to advise and direct the student.

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MAT 498/Capstone   **0 course unit**
(every semester)
Prerequisite: Senior standing
Intensive study of advanced topics in mathematics. Final exam or research paper required.

MTT 202/Teaching Mathematics in the Early Childhood,
Elementary, and Middle School Classroom   **1 course unit**
(with field placement)
(every semester)
Prerequisite: MAT 105, MAT 106, or MAT 200
Corequisite: MST 202
This course examines the early childhood, elementary, and middle school mathematics curricula, how children learn mathematics, methods and strategies appropriate for teaching the many topics in mathematics. Students will be introduced to national and state standards for preK–8 mathematics, and learn how to teach according to these standards. Topics include the use of manipulatives and technology in teaching mathematics, learning theories, adaptations for diverse learners, and the investigation of standards-based curricula. A field experience is a critical component of this course. The student will observe and participate in the early childhood, elementary, or middle school classroom of an exemplary mathematics teacher three hours per week.

MTT 380/Methods of Teaching Mathematics I   **1 course unit**
(every fall)
Prerequisites: MAT 200, MAT 205, and MAT 229
This is the first in a two-course sequence of professional courses for mathematics education majors. Students will be introduced to national and state standards for K-12 mathematics and learn how to teach according to these standards. Topics include the use of manipulatives and technology in teaching mathematics, learning theories, and the investigation of standards-based curricula. These topics will be mostly situated in the content of middle school mathematics.

MTT 390/Methods of Teaching Mathematics II   **1 course unit**
(every spring)
Prerequisites: MTT 380
Corequisites: SED 399 *and* SPE 323
This is the second in a two-course sequence of professional courses for mathematics education majors. Students will be familiar with the standards for 9-12 mathematics and will engage in exploring topics from Discrete Math, Algebra, Geometry, Precalculus, and Calculus. These topics will be examined with the perspective gained from MTT 380 along with that gained from research. Manipulatives, models, software, and calculators will be used to explore appropriate topics from each area. Classroom organization and management will also be explored. The course will be taken as part of a junior block of courses that share a field placement.

MTT 490/Student Teaching   **2 course units**
(every semester)
Prerequisites: MTT 390 and meeting all the criteria for admission for student teaching including completion of all required mathematics courses and cumulative average of at least 2.75.
Corequisite: SED 498
Student Teaching during the senior year under direct supervision of approved public school and general supervision of college supervisors. Observation, participation, and responsible teaching.

MTT 491/Global Student Teaching   **2 course units**
(every semester)
Prerequisites: MTT 390 and meeting all the criteria for admission for student teaching including completion of all required mathematics courses and cumulative average of at least 2.75.
Corequisite: SED 498
Student teaching abroad during the senior year under direct supervision of approved public school and general supervision of college supervisors. Observation, participation, and responsible teaching. Student will spend half of the semester abroad and half in a local school.

STA 115/Statistics   **1 course unit**
(every semester)
Introduction to descriptive statistics and statistical inference. Topics include: measures of location and variability, graphical displays, probability, normal distribution, sampling, estimation, and hypothesis testing. A student may not receive credit for both STA 115 and STA 215.

STA 215/Statistical Inference   **1 course unit**
(every semester)
Prerequisite: MAT 125 or MAT 127
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.

STA 303/Design of Experiments   **1 course unit**
(fall—even years)
Prerequisites: STA 115 and MAT 125 or MAT 127; or STA 215
An introduction to problems and techniques inherent to the design and analysis of experiments. There are broad applications across numerous disciplines in the sciences and the humanities. Topics include: analysis of variance, blocking, general factorial models, nested designs, confounding, and fractional replication. A statistical software package will be used throughout the course (SAS, SPSS, or MINITAB).

STA 304/Sampling and Nonparametric Statistics   **1 course unit**
(spring—even years)
Prerequisites: STA 115 and MAT 125 or MAT 127; or STA 215
An introduction to the use of sampling theory, the design and analysis of sample surveys, and robust statistical tests that are applicable in a wide range of real-world applications. Topics include: stratified sampling, cluster sampling, quota sampling, questionnaire design, and k-sample tests for paired and unpaired data.

STA 305/Regression Analysis   **1 course unit**
(every fall)
Prerequisites: STA 115 and MAT 125 or MAT 127; or STA 215
Regression concepts and techniques as a synthesis of theory, methods, and applications. Topics include: multiple regression, interactions, partial and multiple correlation, polynomial regression, logistic regression, and time series analysis. A statistical software package will be used throughout the course (SAS, SPSS, or MINITAB).

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STA 306/Applied Multivariate Analysis   1 course unit
(spring—odd years)
Prerequisites: STA 115 and MAT 125 or MAT 127; or STA 215
An introduction 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. Topics include: principal components analysis, cluster analysis, discriminant
analysis, multi-dimensional scaling, and correspondence analysis. A statistical software package
will be used throughout the course (SAS, SPSS, or MINITAB).

STA 314/Statistical Quality Control   1 course unit
(spring—even years)
Prerequisites: STA 115 and MAT 125 or MAT 127; or STA 215
An introduction to modern techniques of quality control and reliability practice. Topics include:
acceptance sampling, sampling plans, control charts, combinatorial reliability, failure models, and
system reliability.

STA 317/Linear Programming   1 course unit
(fall—odd years)
Prerequisites: MAT 127 and MAT 205
An introduction to the field of operations research, in particular that portion of the field which
deals with deterministic problems. Topics include optimization using linear programming
techniques, network problems, and applications to problems of transportation and trans-shipment.
Operations research software packages are integral to the course.

STA 318/Operations Research   1 course unit
(spring—odd years)
Prerequisite: MAT 316
An introduction to that portion of operations research which deals with probabilistic techniques.
Topics include: forecasting, queuing models, inventory control, and simulation. Students will
become conversant with a number of operations research software packages.

STA 390/Statistics Specific Research Course   variable course units

STA 391/Independent Study in Statistics   variable course units

STA 392/Guided Study in Statistics   1 course unit

STA 393/Independent Research in Statistics   1 course unit
(every semester)
Prerequisite: By invitation only
Student will study and/or do research independently in an appropriate area. A department member
will be assigned to advise and direct the student.

STA 399/Internship I in Statistics   variable course units
(every semester)
Prerequisites: Junior standing and permission of department
A supervised statistics-related experience working for government or 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 16 course units of letter-graded course units for graduation with honors.

STA 410/Mathematical Statistics   **1 course unit**
(every fall)
Prerequisites: STA 215 and MAT 316
Topics include: 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, change of variable, and order statistics.

STA 492/Internship II in Statistics   **variable course units**
(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.

STA 494/Seminar in Statistics   **1 course unit**
(occasionally)
Prerequisite: Permission of department
A flexible course in which the content is selected from topics in statistics. This is an elective course designed to enrich the background of the student as well as to bridge the gap between undergraduate statistics and graduate statistics.

STA 498/Capstone   **0 course unit**
(every semester)
Prerequisite: Senior standing
Intensive study of advanced topics in statistics. Final exam or research paper required.