MATHEMATICS (MAT) 452

313 Stevenson Hall, (309) 438-8781
Website: Math.IllinoisState.edu
Chairperson: George Seelinger.

For current information on faculty interests and email addresses, Mathematics programs, careers in mathematics and schedule of classes, visit website: Math.IllinoisState.edu.

General Department Information

Cooperative Education/Internship in Mathematics

The Department offers a Cooperative Education/Internship program for undergraduate Mathematics majors which provides for practical work experience in business, government, or industry. Students interested in participating in the program may secure further information by contacting the Mathe-matics Department Office.

HONORS IN MATHEMATICS

The Department offers an honors program for majors emphasizing a broad liberal arts program with requirements in Mathematics and in the General Education Program. Students interested in participating in departmental honors programs may secure further information by contacting the Undergraduate Director. In addition students must fulfill the general requirements for participation in the University Honors Program. Completion of the program will be posted on a student's transcript and diploma. The Department also offers in-course honors for students enrolled in the University Honors Program. Further details about the University Honors program are available at Honors.IllinoisState.edu.

MINOR IN COGNITIVE SCIENCE

The Department of Mathematics participates in the Minor in Cognitive Science program. Several courses offered by the Department contribute to the minor. For further information, please consult a Department advisor as well as the section entitled "Interdisciplinary Studies Programs" in this *Undergraduate Catalog.*

Mathematics Programs

Degrees Offered: B.A., B.S.

Career Information for Mathematics Majors and Minors

Career information for Mathematics Majors and Minor can be found on the website at Math.IllinoisState.edu/careers.

Students are urged to consult with the Mathematics Undergraduate Director or Mathematics faculty in planning their programs. Information on careers in Mathematics can be secured from the Mathematics Undergraduate Director and from the Mathematics Department website.

Students interested in meeting the requirements for licensure to teach secondary school Mathematics must consult with a Mathematics Education advisor to design a special program of studies.

Students preparing for a specific career are advised to include courses from the appropriate list(s) that follow. The courses with an asterisk (*) should be among those selected. Those wishing a major or minor in Mathematics should select additional courses from the list as well. (Note that some courses in the following lists may not count toward major or minor requirements.):

—**Business Management:** MAT 260, 337, 340, 350, 351*, 353, 356, 361, 362*, 363, 378.

—**Secondary Teaching:** MAT 210, 211*, 223*, 236*, 247, 260*, 268, 320, 321, 323*, 324*, 326*, 330*, 336, 347, 350, 351, 362, 378.

—**Business, Government, and Industry:** MAT 260, 337, 340*, 341, 345, 351*, 353, 356*, 361, 362, 363, 378.

—**Applications or Research in Physical Sciences:** MAT 236, 336, 337, 340*, 341*, 345*, 350, 378.

—**Applications or Research in Social Sciences:** MAT 260, 337, 340, 350*, 351*, 356*, 361, 362, 363, 378.

—**Graduate Study and Research in Mathematics:** MAT 210, 236*, 247, 260, 330, 336*, 337*, 340, 341, 345, 347*, 350, 351, 361, 363, 378.

Program Admission Requirements for New and Continuing Students:

Admission to this academic program is limited and is based on space availability and the

competitiveness of the applicant pool. Factors that may be considered include, but are not limited to: courses completed, cumulative GPA, hours completed, personal interview or written statement, and samples of work completed. For additional information on minimum requirements for admission and the application and selection process, visit IllinoisState.edu/Majors or contact the undergraduate advisor for the intended major.

Departmental requirements for admission to the University Professional Studies program include a minimum Mathematics GPA of 2.80, a cumulative GPA of 2.80 and completion of Calculus I, II, and III and MAT 223 with grades of C or better.

The term "Mathematics GPA" used above and throughout this Undergraduate Catalog means a GPA computed using all college Mathematics courses completed at Illinois State University that are eligible for credit toward the major as well as other required courses for the major.

The only Mathematics courses that are not eligible for credit toward the major are the following: MAT 102, 104, 108, 113, 119, 120, 121, 130, 131, 150, 152, 160, 162, 201, 202, 298, 298A50, 302, 304, 307, 309, 312, 314, 315, 385. In addition, MAT 280 and 283 are not eligible for credit toward MAT/MAT Education Sequences.

Graduation GPA Requirement for Majors:

The minimum graduation Mathematics GPA is 2.00 for a Mathematics Major, 2.80 for a Mathematics Teacher Education Major, 3.00 for Mathematics Major: Actuarial Science Sequence, and 2.00 for Mathematics Major: Statistics Sequence. These grade point averages are computed using the following courses taken at Illinois State: the required English and computer programming courses and all Mathematics courses that are eligible for credit toward the major.

NOTE: Students who have taken calculus in high school may request to take a Calculus Proficiency Test. If proficiency credit is granted, students may begin their Mathematics courses with MAT 146 or a higher-level course.

To ensure proper placement, transfer students should consult with an advisor prior to registration for classes.

MAJOR IN MATHEMATICS

—A minimum of 45 hours in Mathematics required.

—Required courses with a grade of C or better: MAT 145, 146, 147, 175, 236, 247, 260, 350; ENG 145 or 249 or equivalent.

—One computer programming course from: IT 165, 168. **NOTE**: Hours taken in Information Technology do not count toward the required 45 hours in Mathematics.

—At least one course chosen from MAT 336, 337, 347, 349.

—From the following groups, select three or more courses, not all in the same group:
  Algebra group: MAT 330, 336, 337.
  Analysis group: MAT 340, 341, 345, 347, 349.
  Discrete group: MAT 361, 362, 363.
  Statistics group: MAT 351.
  Research group: MAT 268.

—Submission of senior portfolio (see advisor).

Suggested Mathematics Schedules for Majors:

Schedule (a) Students beginning with Calculus I

Schedule (b) Students beginning with Calculus II

Schedule (c) Accelerated schedule for honors students or those preparing for graduate school

Semester	(a)	(b)	(c)
1	145	146	146
2	146	147	147
3	147	175	175,260
4	175, 260	260	236
5	236, 247	236, 247	247

Mathematics Teacher Education Sequence

This sequence of the major is part of the entitlement program leading to high school mathematics teacher endorsement.

—A minimum of 50 hours in Mathematics is required with a minimum overall GPA of 2.80 and a minimum Mathematics GPA of 2.80 required for retention and graduation.

—Required Mathematics courses: MAT 145, 146, 147, 175, 211, 223, 236, 260, 320, 323, 324, 352; one mathematics elective (3 hours chosen from 200- or 300-

level mathematics courses that are offered for major/minor credit, but are not designed for the actuarial sequence); and a capstone course: one of MAT 268 or 328. **NOTE:** MAT 211; TCH 216 or equivalent, and MAT 236 (or concurrent registration) are prerequisites for MAT 323. MAT 323 must be completed before the student teaching experience. MAT 147 and 45 credit hours completed are prerequisites for MAT 223. MAT 326 can count as a mathematics elective if not used for the technology requirement.

— Technology Requirement: One of MAT 326 or IT 168 or TEC 151. **NOTE:** Hours taken to fulfill the technology requirement do not count toward the required 50 hours in Mathematics.
— Professional Education requirements (27 hours): EAF 228 or 231 or 235; PSY 215; SED 101; TCH 212, 216, 219; Student Teaching 399A27 (two sections of 5 hours each).
— Interested students should consult their advisor about opportunities for tutoring secondary school students, serving as a teaching assistant, or other relevant voluntary Clinical Experiences.
— Submission of senior portfolio.
— A grade of C or better in all required major courses, and adherence to all requirements and deadlines is required for admission to Professional Studies and Student Teaching. Application forms and information about deadlines and procedures for admission to Professional Studies and Student Teaching are available from the Cecilia J. Lauby Teacher Education Center and on the Mathematics Department website.

Admission to the Mathematics Teacher Education Sequence is limited and highly competitive.

Suggested Mathematics Schedules for Mathematics Teacher Education Sequence Majors:

Schedule (a) Students beginning with Calculus I

Schedule (b) Students beginning with Calculus II

Schedule (c) Accelerated schedule for honors students (Students beginning with Calculus III).

Semester	(a)	(b)	(c)
1	145	146	147, 175
2	146	147, 175	260, 320
3	147, 175	260, 320	211
4	233, 260, 320	211	223, 352
5	211, 352	223, 352	236 or elective
6	236, elective	236, elective	236 or elective
7	323, 326, 328	323, 326, 328	323, 326, 328
8	324	324	324

Pedagogy Emphasis Sequence

This sequence of the major is not part of the entitlement program leading to high school mathematics teacher endorsement. All requirements are the same as the Mathematics Teacher Education Sequence except for State of Illinois requirement of successful completion of the edTPA.

Actuarial Science Sequence

This sequence of the major is designed to teach the students the mathematical foundations of actuarial science, and to prepare them for careers as actuaries in a variety of fields dealing with the risk of potential financial losses, such as life insurance, health insurance, financial risk management, property/casualty/liability insurance, pensions, or employee benefits.

— 71 hours required.
— Required courses: MAT 145, 146, 147, 175, 280, 350, 351, 353, 380, 381, 383, 384 and ACC 131, 132; ECO 105; FIL 242, 250, 341; IT 168.
— Submission of senior portfolio (see actuarial advisor).
— Students are encouraged to take MAT 298 (professional internship), MAT 283 (actuarial computing), and intensive reviews for actuarial examinations offered through the Illinois State University Conferencing Unit.

Suggested Mathematics Schedules for Actuarial Science Majors:

Semester	Courses
1	145
2	146
3	147
4	175
5	280, 350
6	351, 380
7	381, 384
8	353, 383

Required courses in the Actuarial Science Sequence (outlined above) provide the contents of the Society of Actuaries examinations P, FM, MLC, MFE, and C, or the Casualty Actuarial Society examinations 1, 2, 3, and 4, as well as complete VEE requirements. Courses correspond to professional actuarial examinations as follows:

SOA exam P (same as CAS exam 1): MAT 350

SOA exam FM (same as CAS exam 2): MAT 280

SOA exam MLC and CAS exam 3LC: MAT 380 and MAT 381

SOA exam MFE and CAS exam 3F: MAT 383

SOA exam C (same as CAS exam 4): MAT 384

CAS exam 3ST: MAT 351

VEE Statistics: MAT 353

VEE Economics: ECO 105

VEE Finance: FIL 242 and FIL 341

Statistics Sequence

This sequence of the major is designed to prepare students for statistical work in industry and government. In addition to learning the mathematical foundation in statistics, students study at least two cognate areas of application of statistics from Biometrics, Econometrics, and Psychometrics. This will allow students to experience many fields of statistical applications and select a field of their choice for a career.

—Required courses: MAT 145, 146, 147, 175, 260, 350, 351. At least two courses from the following list: MAT 353, 356, 450, 453, 455, 456, 458 (Only senior students with good standing will be allowed to take a graduate-level course with approval of the Graduate School.)

—One computer-programming course from IT 165, 168.

—Select at least two of the following areas and complete at least two courses from the list of approved courses for each area.
   Biological Sciences: BSC 201, 203, 219, 305.
   Economics: ECO 225, 235, 238, 239, 240, 241, 320, 331, 339.
   Psychology: PSY 230, 231, 233, 331, 334.

It is to the advantage of the student to have a minor or double major in one of the above areas. However, it is not a requirement for the sequence. Senior students in good standing are encouraged to take upper level applied statistics courses from selected cognate areas.

Suggested Mathematics Schedules for the Statistics Sequence Majors:

Schedule (a) Students beginning with Calculus I

Schedule (b) Students beginning with Calculus II

Schedule (c) Students intending to pursue graduate studies

Semester	(a)	(b)	(c)
1	145	146	146
2	146	147	147
3	147, 260	260	175, 260
4	175, 350	175, 350	350
5	351	351	351, ST*
6	356, ST*	356, ST*	351, ST*
7	353, ST*	353, ST*	353, ST*
8	ST*, ST*	ST*, ST*	458*

*In the above schedule ST stands for selected courses from cognate areas. Senior students with good standing are encouraged to take upper level statistics courses. However, in order to take a graduate level course, permission is required from the respective departments and the graduate school.

MINOR IN MATHEMATICS

—22-24 hours in Mathematics required.

—Required courses (8 hours): MAT 145 and 146.

—At least four courses (14-16 hours) chosen from MAT 147, 175, 236, 247, 260, 268, 330, 336, 337, 340, 341, 345, 347, 350, 351, 361, 362, 363, 378.

CLINICAL EXPERIENCES IN TEACHER EDUCATION

A variety of clinical (pre-student teaching) experiences, as well as student teaching, are included in the teacher candidates professional preparation. Observations, small and large group instruction, tutoring, field experiences, and student teaching are included in the Clinical Experiences Program. The experiences offered prior to student teaching are integral parts of specific college courses. Clinical experiences are provided in off-campus profes-

sional development schools, local schools and campus laboratory schools, agencies and other approved non-school settings. The Cecilia J. Lauby Teacher Education Center monitors and documents all clinical experiences. Teacher candidates will show verification of having completed clinical experience commensurate with attaining local, state, and national standards. Teacher candidates must provide their own transportation to clinical experiences sites.

Candidates are required to provide documentation of meeting all State of Illinois, district, and university requirements in regard to criminal background checks BEFORE beginning any clinical experiences. Criminal background checks must remain current as of the last day of the clinical experience. Candidates should consult with clinical course faculty and the Cecilia J. Lauby Teacher Education Center well in advance of clinical experience to determine specific requirements needed each semester.

The approximate number of clinical hours associated with each course offering can be found with the appropriate course description in this *Undergraduate Catalog*. The following legend relates to the kind of activity related to a specific course.

Clinical Experiences Legend

- Observation (including field trips)
- Tutoring one-on-one contact
- Non-instructional assisting
- Small group instruction
- Whole class instruction
- Work with clinic client(s)
- Graduate practicum
- Professional meeting

Mathematics Courses

—A year of high school geometry and a second year of high school algebra are highly recommended for anyone who wants to take Mathematics courses.

—Students may not enroll in a course which is prerequisite to a course that has been completed with a grade of C or better.

—Some courses may not be taken under the Passing/No Passing (P/NP) option (see course descriptions).

102 BASIC ALGEBRA
4 sem. hrs.
Introduction to the basic concepts of elementary algebra. Does not count toward graduation. CR/NC only.

102A01 BASIC ALGEBRA: DEVELOPMENTAL NUMERICAL REASONING
4 sem. hrs.
Introduction to the basic concepts of elementary algebra. Does not count toward graduation. CR/NC only.

104 INTERMEDIATE ALGEBRA
3 sem. hrs.
Intermediate course between one year of high school algebra and college algebra. Scientific calculator required. Meets 5 days a week. Does not count toward graduation. CR/NC only. Prerequisite: Mathematics placement or credit in MAT 102.

108 TRIGONOMETRY
2 sem. hrs.
Circular functions, their graphs, inverses, identities and applications. Right triangle trigonometry and applications. Department-approved graphing calculator required. Prerequisite: Mathematics placement or grade of C or better in MAT 119.

113 ELEMENTS OF MATHEMATICAL REASONING   M
4 sem. hrs.
The study of elementary counting methods, basic statistics; and elementary mathematical modeling techniques, focusing on reasoning and solving real-life problems. Department approved calculator required. Not for credit major or minor. May not be taken under the P/NP option. Prerequisite: Mathematics placement exam or MAT 104.

118 ELEMENTARY MATHEMATICAL MODELING FOR APPLIED SCIENCES AND TECHNOLOGY   M
4 sem. hrs.
Using elementary mathematical models to analyze situations and to make decisions related to problems in applied sciences and technology. Prerequisite: Mathematics placement or grade of C or better in MAT 119.

119 COLLEGE ALGEBRA
3 sem. hrs.
Functions, relations, and inverses with emphasis on polynomial, rational, exponential, and logarithmic functions. Algebra of polynomials. Solving quadratic, exponential, and logarithmic equations. Solving quadratic, rational, and absolute value inequalities. Department-approved graphing calculator required. Meets 5 days a week. Not for credit major or minor. Prerequisite: Mathematics placement or MAT 104.

120 FINITE MATHEMATICS   M
   4 sem. hrs.
   Linear functions, matrices, systems of linear equations, sets and counting, probability, statistics, and mathematics of finance. Department-approved graphing calculator required. May not be taken under the P/NP option. Not for credit major or minor. Prerequisite: Mathematics placement or grade of C or better in MAT 119.

121 APPLIED CALCULUS   QR
    4 sem. hrs.
   Non-linear functions, intuitive differential, integral, and multivariate calculus, applications. Department-approved graphing calculator required. Not for credit major/minor. May not be taken under the P/NP option. Prerequisites: Grade of C or better in MAT 119 and grade of C or better in either MAT 118 or 120.

130 DIMENSIONS OF NUMERICAL
   REASONING   M
   3 sem. hrs.
   Focus on mathematical problem-solving and reasoning with understanding of numbers and their properties through various representations. Not for credit major or minor. May not be taken under the P/NP option. Prerequisite: Mathematics placement or MAT 102A01 or 104.

131 GEOMETRIC REASONING:
   GEOMETRY AS EARTH
   MEASURES   QR
   3 sem. hrs.
   A multidimensional focus on geometry as visualization, construction of figures, the study of the physical world, and a mathematical system. Not for credit major or minor. Prerequisites: MAT 113, 120, 130, or 145.

144 PRECALCULUS
   4 sem. hrs.
   Polynomial, absolute value, rational, exponential, logarithmic, and trigonometric functions and their graphs. Properties of trigonometric and inverse trigonometric functions and their applications. Conics, translation, and rotation of axes. Department-approved graphing calculator required. Prerequisites: Mathematics placement or grade of C or better in both MAT 108 and 119.

145 CALCULUS I   M
   4 sem. hrs.
   Polynomial, exponential, logarithmic, and trigonometric functions. Differentiation with associated applications. Introduction to integration with applications. Department-approved graphing calculator required. May not be taken under the P/NP option. Prerequisite: Mathematics placement or grade of C or better in MAT 144.

146 CALCULUS II   QR
   4 sem. hrs.
   Techniques and applications of integration, L'Hopital's rule, improper integrals, applications, infinite series, and Taylor's Theorem. Differential equations. Department-approved graphing calculator required. May not be taken under the P/NP option. Prerequisite: Grade of C or better in MAT 145.

147 CALCULUS III
   4 sem. hrs.
   Polar coordinates and parametric equations in the plane with applications. Vector curves and surfaces in space. Partial derivatives, gradients, directional derivatives, and tangent planes. Multiple integration and line integrals. Department-approved graphing calculator required. Prerequisite: Grade of C or better in MAT 146.

150 FUNDAMENTALS OF
   STATISTICAL REASONING   QR
   4 sem. hrs.
   Develop statistical reasoning to analyze data and use elementary probability ideas to justify the validity of the analysis. Not for credit major or minor. Prerequisite: Grade of C or better in MAT 113, 118, 120, 130 or 145.

152 DIMENSIONS OF
   MATHEMATICAL REASONING
   3 sem. hrs.
   Focus on mathematical problem-solving and reasoning while developing understanding of measurement, geometry, and algebra. Not for credit if had MAT 202. Not for credit major or minor. Prerequisite: Grade of C or better in MAT 130.

160 ELEMENTARY DISCRETE
   MATHEMATICS
   4 sem. hrs.
   Elementary introduction to discrete mathematics, comprising topics relevant to computer science. Logic, algorithms, recursion, enumeration, relations, graph theory (including trees). Not for credit major or minor. Prerequisite: Grade of C or better in MAT 120 or 145.

175 ELEMENTARY LINEAR ALGEBRA
4 sem. hrs.

Vector geometry, matrices, systems of linear equations, vector spaces, linear transformations, eigenvalues and eigenvectors, diagonalization, applications to the physical and social sciences. Department-approved graphing calculator required. Prerequisite: Grade of C or better in MAT 146; 147 is recommended.

201 TEACHING MATHEMATICS IN THE ELEMENTARY SCHOOL
3 sem. hrs.

Background for meaningful teaching of whole numbers, fractions, and geometry/measurement concepts. Emphasis on planning instruction for elementary students. May Include Clinical Experiences. Not for credit major or minor. Prerequisites: Grade of C or better in MAT 130 and MAT 152 and either Mathematics placement or a grade of C or better in MAT 119. Elementary Education major only. Completion of 60 hours and 2.50 major and overall GPA.

202 ALGEBRAIC REASONING FOR MIDDLE SCHOOL TEACHERS
4 sem. hrs.

Focus on algebraic reasoning with understanding of variables and their uses. Content includes proportional reasoning, linear and non-linear functions and inverse functions and elementary curve fitting techniques. Department-approved graphing calculator required. Not for credit major or minor. Prerequisites: Grade of C or better in MAT 130; 2.50 major GPA and either Mathematics placement or a grade of C or better in MAT 119.

211 EUCLIDEAN AND NON-EUCLIDEAN GEOMETRY
4 sem. hrs.

Inductive and deductive study of Euclidean geometry; includes transformations, tessellations, polyhedra, classical theorems, introduction to non-Euclidean geometry. Prerequisites: Grade of C or better in MAT 147 and 175. MAT 260 is recommended.

223 INTRODUCTION TO SECONDARY MATHEMATICS EDUCATION
3 sem. hrs.

Introduction to secondary mathematics teaching centered around classroom observations, discussion of teaching and learning, and doing mathematics while servicing all students. Introduction to EdTPA tasks and video analysis. Includes Clinical Experiences: 20+ hours. Prerequisites: Completion of 45 hours and grade of C or better in MAT 147 or concurrent registration.

236 ELEMENTARY ABSTRACT ALGEBRA
4 sem. hrs.

Congruence, rings, integral domains, fields, including rational, real, and complex numbers (trigonometric representation and complex roots), irreducibility of polynomials, homomorphisms. Prerequisites: Grade of C or better in MAT 175 and grade of C or better in MAT 260 or concurrent registration.

247 ELEMENTARY REAL ANALYSIS
3 sem. hrs.

Least upper bounds, greatest lower bounds; basic topology of Euclidean spaces; limits of sequences and functions, continuous functions; differentiation theorems. Prerequisites: Grade of C or better in MAT 175 and 260.

260 DISCRETE MATHEMATICS
4 sem. hrs.

Logic, sets, relations, functions, congruence, induction, recurrence relations, pigeonhole principle, inclusion-exclusion, permutations, combinations, graphs (including diagraphs), trees, and applications. Prerequisite: Grade of C or better in MAT 146.

268 INTRODUCTION TO UNDERGRADUATE RESEARCH IN MATHEMATICS
3 sem. hrs.

An introduction to mathematical discovery through participation in a departmental research program for undergraduates. Multiple enrollments are allowed if content differs; maximum 6 hours. Prerequisites: Grade of B or better in MAT 146 and consent of the instructor.

280 FINANCIAL MATHEMATICS
4 sem. hrs.

Interest rates. Accumulation function. Annuities. Amortization schedules. Bonds and other securities. Amortization and depreciation. Yield curve. Duration, convexity, and immunization. Determinants of interest rates. Swaps. Prerequisites: Grade of B or better in MAT 145 and 146 or consent of the instructor.

283 INTRODUCTION TO ACTUARIAL COMPUTING
1 sem. hr.

Basic actuarial computing models in a computer classroom setting. Present values, risk classification, data analysis for premiums and reserves. Prerequisite: Grade of C or better in MAT 280 or consent of the instructor.

298 PROFESSIONAL PRACTICE: INTERNSHIP IN MATHEMATICS
2-4 sem. hrs.

Practical experience through professionally-oriented work in business, government, or industry. One credit per month of full-time employment. Multiple enrollments are allowed; maximum 8 hours. CR/NC only. Not for credit major or minor. Prerequisites: MAT 175 plus 2 approved courses in MAT beyond 175; 2.75 overall GPA and 3.00 department GPA. Consent of department chair.

302 TEACHING MATHEMATICS IN THE MIDDLE SCHOOL
4 sem. hrs.

Problems, viewpoints, and trends in teaching middle school mathematics. Implications of research related to organization, content, and techniques for teaching mathematics. May include Clinical Experiences. Not for credit major or minor. Prerequisites: Grade of C or better in MAT 309 and 312 or concurrent registration in either MAT 309 or 312; or graduate standing. Completion of 60 hours and 2.50 major and overall GPA. Admission to Professional Studies.

304 MODERN GEOMETRY FOR MIDDLE SCHOOL TEACHERS
4 sem. hrs.

Topics include Euclidean and non-Euclidean geometries and their history, transformations with connections to matrix algebra, fractals, and projective geometry. Department-approved graphing calculator required. Not for credit major or minor. Prerequisites: Grade of B or better in MAT 131 and 202; or graduate standing. Completion of 60 hours and 2.50 major and overall GPA.

309 NUMBER THEORY FOR MIDDLE SCHOOL TEACHERS
4 sem. hrs.

Focus is on number theory concepts, including divisibility, primes, composites, special number sets, and basic counting principles. Department-approved graphing calculator required. Formerly *NUMBER THEORY FOR K-8 TEACHERS*. Not for credit major or minor. Prerequisites: Grade of B or better in MAT 131 and 202; or graduate standing. Completion of 45 hours and 2.50 major and overall GPA.

312 PROBABILISTIC AND STATISTICAL REASONING FOR MIDDLE SCHOOL TEACHERS
4 sem. hrs.

Descriptive statistics, lines of best fit, basic concepts of probability, simulation, probability distributions, expectation, and counting techniques. Department-approved graphing calculator required. Formerly *PROBABILISTIC AND STATISTICAL REASONING FOR K-8 TEACHERS*. Not for credit major or minor. Prerequisites: Grade of B or better in MAT 131 and 202; or graduate standing. Completion of 45 hours and 2.50 major and overall GPA.

314 CONCEPTS OF CALCULUS FOR MIDDLE SCHOOL TEACHERS
4 sem. hrs.

Concepts of differential and integral calculus, including limits, sequences, and transcendental functions. Emphasis on the role of calculus in Mathematics and problem-solving. Department-approved graphing calculator required. Not for credit major or minor. Prerequisites: Grade of B or better in MAT 131 and 202. Completion of 45 hours and 2.50 major and overall GPA.

315 MATHEMATICAL MODELING FOR MIDDLE SCHOOL TEACHERS
4 sem. hrs.

Mathematical modeling and problem-solving with applications involving networks and communication systems, finance, global positioning, data systems, and various branches of science. Department-approved graphing calculator required. Not for credit major or minor. Prerequisites: Grade of B or better in at least one of MAT 309 or 312 and a grade of C or better in the other; or graduate standing. Completion of 60 hours and 2.50 major and overall GPA.

320 HISTORY OF MATHEMATICS
3 sem. hrs.

History of the development of mathematical techniques and ideas from early civilization to present, including connections between mathematics and sciences. Not for credit if had MAT 321 *HISTORY OF MATHEMATICS 1600-PRESENT*. Prerequisite: Grade of C or better in MAT 147; or graduate standing.

323 TEACHING MATHEMATICS IN THE SECONDARY SCHOOL
3 sem. hrs.

The selection, placement and teaching of secondary mathematics topics. Analysis of recent trends and practices. Department-approved graphing calculator required. Includes Clinical Experiences: 60 hours. Prerequisites: Grade of C or better in MAT 211 and 223; grade of C or better in MAT 236 or concurrent registration; or graduate standing. TCH 216. Minimum 2.80 Mathematics and overall GPA and Department approval. Admission to Professional Studies.

324 SEMINARS FOR STUDENT TEACHERS OF MATHEMATICS
3 sem. hrs.

Examines methods and materials for teaching algebra, geometry, and other secondary topics. Emphasizes content and professional aspects of mathematics teaching. Department-approved graphing calculator required. Prerequisites: Grade of C or better in MAT 236 and 323 and concurrent registration or completion of student teaching in Mathematics. Admission to Student Teaching.

326 MATHEMATICAL PROBLEM SOLVING USING TECHNOLOGY
3 sem. hrs.

An advanced exploration of secondary mathematics curriculum through the use of technology. Considers roles of technology for mathematical concept development. Formerly *TECHNOLOGY TOOLS FOR SECONDARY SCHOOL MATHEMATICS*. Department-approved graphing calculator required. Prerequisite: Grade of C or better in MAT 211; or graduate standing.

328 MATHEMATICS FOR SECONDARY TEACHER: A CAPSTONE EXPERIENCE
3 sem. hrs.

Using college-level mathematics to examine high school mathematics from an advanced perspective. Prerequisites: MAT 223 and 211 or consent of the instructor. Mathematics Education Majors only.

330 NUMBER THEORY
3 sem. hrs.

Divisibility, primes, unique factorization, linear congruences and Diophantine equations, number-theoretic functions, primitive roots, quadratic reciprocity, continued fractions or cryptography. Prerequisite: Grade of C or better in MAT 260; or graduate standing.

336 ADVANCED ABSTRACT ALGEBRA
3 sem. hrs.

Permutation, symmetry, matrix, and cyclic groups, subgroups, cosets, homomorphisms, quotient groups, the fundamental theorem of finite abelian groups, Sylow theorems. Prerequisite: Grade of C or better in MAT 236 or consent of the instructor; or graduate standing.

337 ADVANCED LINEAR ALGEBRA
4 sem. hrs.

Abstract vector spaces, linear transformations and matrices, inner product spaces, eigenvalues and eigenvectors, diagonalization. Applications to geometry, the physical and social sciences. Prerequisites: Grade of C or better in MAT 175 and senior standing; or graduate standing.

340 DIFFERENTIAL EQUATIONS I
3 sem. hrs.

First and second order differential equations, linear differential equations, power series methods, Laplace transform methods, numerical and computational methods, applications. Formerly *ELEMENTARY DIFFERENTIAL EQUATIONS I*. Prerequisites: Grade of C or better in MAT 147 and 175; or graduate standing.

341 DIFFERENTIAL EQUATIONS II
3 sem. hrs.

Linear systems of differential equations, numerical methods, Fourier series, boundary-value problems, partial and nonlinear differential equations and applications. Formerly *ELEMENTARY DIFFERENTIAL EQUATIONS II*. Prerequisites: Grade of C or better in MAT 175 and 340 or an elementary differential equation course; or graduate standing.

345 ADVANCED CALCULUS
4 sem. hrs.

Calculus of functions of several variables, Taylor's series of several variables, maxima and minima, Lagrange multipliers, inverse and implicit function theorems, multiple integration, line integrals, Green's, Stokes', and the divergence theorems. Prerequisites: Grade of C or better in MAT 147 and 175; or graduate standing.

347 ADVANCED REAL ANALYSIS
4 sem. hrs.

Topology of metric spaces, properties of sequences, continuous functions, limits of functions, differentiation, integration. Prerequisite: Grade of C or better in MAT 247 or 345 or consent of the instructor; or graduate standing.

349 INTRODUCTION TO COMPLEX ANALYSIS
4 sem. hrs.

An introduction to complex analysis, including elements of topology and geometry, with applications to advanced calculus, differential equations and physics. Prerequisite: MAT 147; or graduate standing.

350 APPLIED PROBABILITY MODELS
4 sem. hrs.

Sample spaces, discrete and continuous random variables, probability functions, density, moment generating functions, important distributions. Multivariate distributions, Central Limit Theorem. Prerequisite: Grade of C or better in MAT 147; or graduate standing.

350A01 APPLIED PROBABILITY MODELS: FOR SECONDARY MATHEMATICS EDUCATION
4 sem. hrs.

Sample spaces, discrete and continuous random variables, probability functions, density, moment generating functions, important distributions. Multivariate distributions, Central Limit Theorem. For students preparing for Secondary Mathematics Education. Prerequisite: Grade of C or better in MAT 147.

351 STATISTICS AND DATA ANALYSIS
4 sem. hrs.

Statistical estimation. Point and interval estimators. Consistency, unbiasedness, minimum variance. Hypothesis testing. Likelihood ratio tests. Regression, analysis of variance. Prerequisite: Grade of C or better in MAT 350 or consent of the instructor, or graduate standing.

351A01 STATISTICS AND DATA ANALYSIS: FOR SECONDARY MATHEMATICS EDUCATION
4 sem. hrs.

Statistical estimation. Point and interval estimators. Consistency, unbiasedness, minimum variance. Hypothesis testing. Likelihood ratio tests. Regression, analysis of variance. For students preparing for Secondary Mathematics Education. Prerequisite: Grade of C or better in MAT 350 or consent of the instructor.

352 PROBABILITY AND STATISTICAL INFERENCE FOR EDUCATORS
4 sem. hrs.

Sample spaces, discrete and continuous random variables, distributions, Central Limit Theorem. Point and interval estimation. Hypothesis testing. Regression, analysis of variance. Not for credit if had MAT 350 or 350A01. Prerequisite: Grade of C or better in MAT 147; or graduate standing.

353 REGRESSION AND TIME SERIES ANALYSIS
4 sem. hrs.

Regression and time series methods for business and economic applications, including exponential smoothing and Box-Jenkins methods. Computer statistical package used. Also offered as ECO 353. Prerequisite: MAT 351 or equivalent or consent of the instructor; or graduate standing.

354 NONPARAMETRIC STATISTICS
3 sem. hrs.

Order statistics, run test, goodness-of-fit tests, rank test, sign test, two-sample tests, and nonparametric measures of dependence. Prerequisite: Grade of C or better in MAT 351 or equivalent or consent of the instructor; or graduate standing.

356 STATISTICAL COMPUTING
4 sem. hrs.

Application of SAS and SPSS programs to real data emphasizing regression, and analysis of variance. Prerequisites: Grade of C or better in MAT 351; or graduate standing; some facility with matrices.

361 TOPICS IN DISCRETE MATHEMATICS
2-4 sem. hrs.

Study of selected areas of discrete mathematics. Multiple enrollments are allowed if content is different. Prerequisite: Grade of C or better in MAT 260 or consent of the instructor; or graduate standing.

362 LINEAR OPTIMIZATION
4 sem. hrs.

Modeling and solution of problems using the simplex method. Duality, sensitivity, integer programming. Transportation problems. Formerly *LINEAR PROGRAMMING*. Prerequisite: Grade of C or better in MAT 175; or graduate standing.

363 GRAPH THEORY
4 sem. hrs.

Introduction to graph theory, connectivity, matchings, coloring, network flows with applications. Prerequisite: Grade of C or better in MAT 260 or consent of the instructor; or graduate standing.

380 ACTUARIAL MODELS I
4 sem. hrs.

Markov Processes. Survival distributions. Life tables. Life insurance, life annuities and pensions. Premiums and reserves. Applications of multiple states models. Prerequisites: Grade of B or better in MAT 280 and 350 or consent of the instructor; or graduate standing.

381 ACTUARIAL MODELS II
4 sem. hrs.

Multiple lives. Multiple decrements. Models including expenses. Multiple state models. Universal life insurance. Prerequisite: Grade of B or better in MAT 380 or consent of the instructor; or graduate standing.

383 ACTUARIAL MODELS III
4 sem. hrs.

Derivative securities and their actuarial models. Arbitrage-free models. Valuation of derivative securities. Elements of financial risk management. Formerly *ACTUARIAL MODELS II.* Prerequisites: Grade of B or better in MAT 280 and 350 or consent of the instructor; or graduate standing.

384 ACTUARIAL MODELING
4 sem. hrs.

Severity models. Frequency models. Aggregate loss models. Risk measures. Ruin theory. Survival models estimation. Parametric and nonparametric models estimation. Credibility theory. Simulation. Prerequisite: Grade of C or better in MAT 351 or consent of the instructor; or graduate standing.

385 ACTUARIAL EXAM PREPARATION
1 sem. hr.

Study sessions to aid preparation for professional actuarial examinations. Consult the course offerings on the ISU website at IllinoisState.edu or the actuarial adviser for the topics and section to be offered during any given semester. Not for credit major or minor. MAT 385 not for credit if had MAT 147. Prerequisite: Consent of the instructor.

390 INDEPENDENT STUDY
1-3 sem. hrs.