Department of Mathematical Sciences

Curtis Church, Chair
KOM 223D

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The purpose of the Department of Mathematical Sciences is to provide students education in the mathematical sciences necessary to function and succeed in an increasingly complex, technological world.

Courses offered by the department are designed to prepare students who plan to enter graduate schools or professional schools of medicine or engineering; to teach in elementary schools, secondary schools, or community colleges; to major in mathematics, in computer science, in the natural or physical sciences, or in other areas with mathematics requirements; or to enter careers in business, industry, or government. Courses also are provided to meet cultural and General Studies requirements.

Programs in the department lead to the Bachelor of Arts or Bachelor of Science degrees with a major in Mathematics. Students choose one of the following concentrations: Professional Mathematics, Mathematics Education, Applications of Mathematics, or Actuarial Science. Minors are offered in Mathematics; in Mathematics for Managerial, Social, and Life Sciences; and in Statistics.

The following specialized courses do not count toward a Mathematics major or minor: MATH 1410, 1730, 1710, 1720, 1420, 2090, 2130, 1610, 1010, 1810, 1820, 4010, and 1530. However, MATH 1730, 1710, 1720, 2130, 1610, 1810, 1820, and 1530 may count toward a minor in Mathematics for Managerial, Social, and Life Sciences.

In all curricular listings, (Area __) refers to the General Studies requirements as outlined on pages 59-61.

Major in Mathematics

A major in Mathematics requires the mathematics core of 21 hours plus 15 hours of specified upper-level courses in the department and 12 hours of supporting coursework (either in or out of the department). The supporting coursework must complement the student's program and be approved by the

mathematics advisor. A single minor outside the department is required.

Every Mathematics major is required to declare a concentration. Concentrations include Professional Mathematics, Mathematics Education, Applications of Mathematics, and Actuarial Science.

Every Mathematics major, excluding those in the Actuarial Science concentration, is required to complete the Seminar in Mathematics, MATH 4990. All courses in the Mathematics major or minor must be completed with a grade of C or better. All courses transferred from other institutions for credit in the Mathematics major or minor must carry a grade of C or better and be approved by the department chair.

Mathematics Core
Each student majoring in the department must complete the following core (21 hours):
MATH 1910 (Calculus I), 4 hours
MATH 1920 (Calculus II), 4 hours
MATH 3110 (Calculus III), 4 hours
MATH 2010 (Elements of Linear Algebra), 3 hours
MATH 3460 (Foundations of Higher Mathematics), 3 hours
MATH 2050 (Probability and Statistics), 3 hours*

Students in the Mathematics Education concentration must concurrently enroll in MATH 2110 (Data Analysis, 1 hour).
Students with a concentration in Actuarial Science may substitute ACSI 2020, 2030, 3020, and 3030 for MATH 1910, 1920, and 3110; STAT 3150 for MATH 2010; and ACSI 4200 for MATH 3460.

Concentration: Professional Mathematics
Students opting to study the discipline of mathematics will choose between tracks in general mathematics and advanced mathematics. In addition to the mathematics core, they will take 9 additional upper-level courses in the department chosen with the approval of the mathematics advisor. A single minor outside of the department and CSCI 1160 are required.

Advanced Mathematics Track
Students interested in preparing for a graduate degree in mathematics should pursue this track. In addition to the mathematics core, they must take MATH 3120, 4250, 4510; two courses from MATH 3260, 4230, 4270, 4420, 4530, 4700; and 12 hours of approved supporting coursework chosen from among upper-level courses in the department and CSCI 3080. The program must include at least one sequence in either algebra (4420/4510), analysis (4230-4250), or differential equations (3120-3260). Six hours of a foreign language are recommended.

Students should consult their advisors each semester to plan their schedules.

Curriculum Requirements and Recommended Sequence for Professional Mathematics-Advanced

FRESHMAN		SOPHOMORE	
ENGL 1010, 1020 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
MATH 1910, 1920	8	MATH 3110, 2010, 3460	10
MATH 2050	3	Math elective	3
CSCI 1160	4	Gen. Studies (Areas I-B, II-B,	
BIOL 1030 (Area IV-A)	4	III-A)	12
Science (Area IV-A)	4	PHED or M S (Area V)	2
PHED or M S (Area V)	2	Minor coursework	3
Minor coursework	3		**36**
	34		

JUNIOR		SENIOR	
MATH 3120, 4510	6	MATH 4250	3
Math electives	6	MATH 4990	3
Minor coursework	6	Math electives	6
Gen. Studies (Area III-B)	3	Minor coursework	6
Electives	12	Electives	12
	33		**30**

General Mathematics Track
Students desiring a broad general background in mathematics should pursue this track. In addition to the mathematics core, they must take MATH 3120, 4510; three additional courses from MATH 3260, 3400, 4230, 4250, 4270, 4310, 4320, 4420, 4530, 4700, STAT 3150, 4190; and 12 hours of approved supporting coursework chosen from among upper-level courses in the department and CSCI 3080.

Students should consult their advisors each semester to plan their schedules.

Concentration: Mathematics Education
Mathematics majors preparing to teach secondary school mathematics must complete the professional program in Mathematics Education. In addition to the mathematics core, they must take as upper-division coursework MATH 3070, 4510, 4620, 4990, and one upper-level elective in the department. Supporting coursework and/or the enhanced General Studies component consists of MATH 3320, 3330, 4540, CSCI 1170, and 7 hours of approved general education courses. A minor in Secondary Education is required (see Department of Educational Leadership for description). Completion of this 132-hour program leads to a license to teach mathematics in grades 7-12.

Students should consult their advisors each semester to plan their schedules.

Curriculum Requirements and Recommended Sequence for Mathematics Education

FRESHMAN		SOPHOMORE	
ENGL 1010, 1020 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
MATH 1910, 1920, 2050,		MATH 3110, 2010, 3460,	
2110	12	3070	13
FOED 1110, 2110	6	COMM 2200 (Area I-B)	3
BIOL 1030 (Area IV-A)	4	SPED 3010	3
HIST 2010 (Area III-A)	3	Gen. Studies (Area II-B)	3
PHED (Area V)	2	HIST 2020 (Area III-A)	3
	33	CSCI 1170	4
			35

JUNIOR		SENIOR	
MATH 3320, 3330, 4510,		MATH 4620, 4990,	
4540	12	math elective	9
SPSE 3220	3	READ 4460	3
YOED 3050, 3100, 4000	9	Gen. Studies (Area III-B)	3
PHED (Area V)	2	Approved elective*	3
PSCI 1030 (Area IV-A)	4	YOED 4110 (Student	
Approved electives*	4	teaching)	12
	34		**30**

Cannot be mathematics or professional education

Concentration: Applications of Mathematics

Students desiring to study applications of mathematics and statistics in business, government, and industry may choose between tracks in statistics, business, or industrial mathematics. All three tracks blend theory and practice to provide students with background for employment and background for students interested in graduate studies.

Statistics Track

The statistics track offers students a program of study in one of the broadest areas of applied mathematics. Statistical methods are used in many fields, including agriculture, business, communications, government, health, industry, public policy, sports, and science. Courses provide students the opportunity to learn the art of data analysis and to develop skills in statistical methods of wide application. Emphasizing the blend of theory and practice, the program is designed to provide students with the necessary background for employment as a statistician in the public or private sector and to provide a solid foundation for those students interested in graduate studies.

In addition to the mathematics core, students pursuing this track must take STAT 3150 and 4190 and three courses from STAT 4200, 4360, 4370, 4380, MATH 3190. One minor outside the department is required. If the minor is not Computer Science, then the supporting coursework must consist of 12 hours of computer coursework other than service courses. If the minor is Computer Science, then the supporting coursework must be 12 hours chosen with the approval of the statistics advisor from areas that significantly complement the student's program.

Students should consult their advisors each semester to plan their schedules.

Curriculum Requirements and Recommended Sequence for Applied Mathematics-Statistics

FRESHMAN		SOPHOMORE	
ENGL 1010, 1020 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
MATH 1910, 1920	8	MATH 3110, 3460	7
CSCI 1170, 2170	8	MATH 2050	3
BIOL 1030 (Area IV-A)	4	Gen. Studies (Areas I-B, II-B,	
Science (Area IV-A)	4	and III-A)	12
PHED or MS (Area V)	2	PHED or MS (Area V)	2
	32	Minor coursework	6
			36

JUNIOR		SENIOR	
MATH 2010, STAT elective	6	STAT electives	9
STAT 3150, 4190	6	MATH 4990	3
Computer Science course	3	Computer Science course	3
Gen. Studies (Area III-B)	3	Minor coursework	6
Minor coursework	6	Electives	9
Electives	12		**30**
	36		

Business Track

This track is appropriate for students who seek a broad background from such diverse, but mutually supportive, areas as mathematics, statistics, computer science, and business. The program prepares students for the job market or for further study in the more specialized areas of actuarial science, operations research, statistics, computer science, or finance.

In addition to the mathematics core, students pursuing this track must take STAT 3150 and 4190; ACSI 4200; and either STAT 4200 or 4360. The supporting coursework consists of 12 hours of computer science other than service courses. The student must complete a minor in the Jennings A. Jones College of Business as well as ACTG 2110, 2120, or 3000, 3020, ECON 2410, 2420, and Q M 4010.

Students should consult their advisors each semester to plan their schedules.

Curriculum Requirements and Recommended Sequence for Applied Mathematics-Business

FRESHMAN		SOPHOMORE	
ENGL 1010, 1020 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
MATH 1910, 1920	8	MATH 3110, 3460	7
CSCI 1170, 2170	8	MATH 2050	3
BIOL 1030 (Area IV-A)	4	Gen. Studies (Areas I-B, II-B,	
Science (Area IV-A)	4	and III-A)	12
PHED or MS (Area V)	2	PHED or MS (Area V)	2
	32	ECON 2410, 2420	6
			36

JUNIOR		SENIOR	
MATH 2010	3	ACSI 4200, MATH 4990	6
STAT 3150, 4190	6	STAT 4360 (or 4200)	3
Computer Science courses	9	Q M 4010	3
Gen. Studies (Area III-B)	3	Minor/supporting	9-12
ACTG 2110, 2120 or		Electives	8-11
3000, 3020	6		**29-35**
Minor/Supporting	6-9		
Electives	3-6		
	36-42		

Industrial Mathematics Track

The industrial mathematics track offers students a program of study that incorporates the areas of mathematics that contribute to business and industry. Coursework is designed to produce graduates who have strong qualifications that make them competitive for positions in industry, as well as providing a solid foundation for students interested in pursuing graduate study in the area. The minor must be chosen from Computer Science, Physics, Chemistry, Biology, Aerospace, or Industrial Technology.

In addition to the mathematics core, students pursuing this track must take STAT 3150, MATH 3120, 3260, 4250, and 4310. Required supporting coursework includes PHYS 2110,

2111, 2120, 2121 (counted towards satisfying the General Studies Science requirement for area IV-A) and CSCI 1170, 2170. If these courses are taken as part of a minor in Physics or Computer Science, then nine additional hours of supporting coursework must be chosen with the approval of the mathematics advisor from MATH 4601, 4230, 4270, 4320, 4700, STAT 4190. If the minor is not Computer Science, then six additional hours of supporting coursework must be chosen with the approval of the mathematics advisor from MATH 4230, 4270, 4320, 4700, STAT 4190.

Students should consult their advisors each semester to plan their schedules.

Curriculum Requirements and Recommended Sequence for Applied Mathematics-Industrial Mathematics

FRESHMAN		SOPHOMORE	
ENGL 1010, 1020 (Area (I-A)	6	ENGL 2030, 2--- (Area II-A)	6
MATH 1910, 1920	8	MATH 3110, 3460	7
CSCI 1170, 2170	8	PHYS 2110, 2111, 2120,	
BIOL 1030 (Area IV-A)	4	2121 (Area IV-A)	8
General Studies (Area I-B)	3	MATH 2050	3
PHED or M S (Area V)	2	Gen. Studies (Areas II-B, III-B)	6
	31	PHED or M S (Area V)	2
		Minor coursework	3
			35

JUNIOR		SENIOR	
MATH 2010, 4250	6	MATH 4310	3
STAT 3150	3	MATH 4990	3
MATH 3120, 3260	6	Statistics, Math electives	3
Gen. Studies (Area III-A)	6	General electives	15-18
Minor coursework	9	Minor coursework	6
Math elective	3		**30-33**
General elective	3		
	36		

Concentration: Actuarial Science

The Actuarial Science concentration is designed for students who have a strong mathematical ability with an interest in applying their mathematical knowledge to insurance, finance, risk management, investments, and other areas of business. The program is classified by the Society of Actuaries (SOA) as an Advanced Undergraduate Actuarial Science program and is in complete compliance with the requirements set forth by the Society of Actuaries and the Casualty Actuarial Society (CAS) in the Year 2000 Syllabus and beyond. Therefore, the student can choose coursework necessary to prepare for the SOA/CAS Course/Exams 1 through 4 and SOA Course 6.

Mathematics majors preparing for the actuarial examination series and an actuarial science career should complete this professional program in Actuarial Science. The program requires that the student complete the mathematics core; 15 hours of upper-division actuarial science courses consisting of ACSI 4140, 4220, and three elective courses chosen from ACSI 4230, 4240, 4330, 4340, 4630, and 4640; and 12 hours of supporting coursework consisting of STAT 4190, 4320, and two other courses in the department as approved by the advisor. The student is required to complete ACTG 2110, 2120, ECON 2410, 2420, and at least one course from FIN 3610, 3660, or 3710. A minor from the Jennings A. Jones College of Business is required. A minor in Insurance is strongly

suggested. A Computer Science or Information Systems elective and CSCI 1170 are required.

Students should consult their advisors each semester to plan their schedules.

Curriculum Requirements and Recommended Sequence for Actuarial Science

FRESHMAN		SOPHOMORE	
ENGL 1010, 1020 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
ACSI 2020, 2030	6	ACSI 3020, 3030	6
CSCI 1170	4	MATH 2050	3
BIOL 1030 (Area IV-A)	4	Gen. Studies (Area III-A)	6
Science (Area IV-A)	4	ACTG 2110, 2120	6
CSCI or INFS elective	3	ECON 2410 (Area III-B)	3
PHED or MS (Area V)	2	ECON 2420	3
Gen. Studies (Area I-B and		PHED or MS (Area V)	2
II-B)	6		**35**
	35		

JUNIOR		SENIOR	
STAT 3150, 4190, 4320	9	ACSI electives	15
ACSI 4140, 4200, 4220	9	Minor coursework	6
FIN 3610	3	Electives	9
Minor coursework	9		**30**
Electives	3		
	33		

Minor in Mathematics

A minor in Mathematics consists of 18 semester hours including MATH 1910 and 1920. The remaining 10 hours of electives must be selected with the approval of the Mathematics minor advisor from the mathematics courses for majors and minors.

Minor in Mathematics for Managerial, Social, and Life Sciences

A minor in Mathematics for Managerial, Social, and Life Sciences consists of 18 semester hours including MATH 2020 and 2030 with the remaining 12 hours as approved by the minor advisor. The remaining courses must be selected from a list of approved courses; see the minor advisor for details. Note that a student may count Q M 2610 and 3620 as one 3-hour course, and count CSCI 1160 or 1170 as one 3-hour course.

Minor in Statistics

A minor in Statistics requires 18 semester hours and consists of STAT 3150, 4190, 4360, 4370, 4380 and one course to be selected from MATH 3190, 3120, 3260, 4310, 4320, or CSCI 3180. With advisor approval, MATH 2050 may be substituted for either STAT 4190, 4360, 4370, or 4380. Additionally, with advisor approval, one semester of calculus may be counted as the elective course.

Teacher Licensure - Secondary

Students seeking a license to teach mathematics in secondary schools (grades 7-12) must complete the concentration in Mathematics Education, the enhanced general education requirements, and a minor in professional education in ad-

dition to meeting the General Studies requirements. (See Department of Educational Leadership section of catalog for details.)

Teacher Licensure - Elementary

The Department of Mathematical Sciences offers courses required for the Interdisciplinary Studies major for students preparing to teach in grades K-8 or 5-8.

Placement in Freshman Introductory Mathematics Courses

Academic success in mathematics requires that students accurately assess the proper level for their mathematics study. In addition to the requirements of the individual's major, this assessment includes reviewing a combination of ACT scores, the academic assessment placement test, and evaluation of the high school transcript. As many problems arise with individuals placed in courses which are at too low a level as they do with those individuals placed in courses for which they are not yet ready. The ACT scores and the academic assessment placement tests are very useful in ensuring that students are properly placed in developmental courses or college algebra and precalculus. Students who have successfully completed precalculus or a version of calculus in high school should stop by the office of the Department of Mathematical Sciences to have their transcripts evaluated to determine the proper beginning collegiate mathematics course.

All students are encouraged to take their mathematics in consecutive semesters; this will decrease the gap caused by not doing mathematics for long periods of time. It also ensures that you have your mathematics background before it is needed for other courses in the major.

Unless the academic assessment placement test places the student differently (see Developmental Studies Program, page 86), a student entering MTSU with

1. two years of algebra and a mathematics Enhanced ACT greater than 25—(Math SAT greater than 580) **or** with senior advanced mathematics should take the appropriate mathematics courses for his/her major. If in doubt, these students should consult the Department of Mathematical Sciences to select the appropriate level of mathematics courses
2. two years of algebra and a mathematics Enhanced ACT of 19-25—(Math SAT 460-580) should take MATH 1010. Such students who plan to take 1910 must complete 1730 as a prerequisite. Students preparing to become elementary school teachers should take MATH 1410 and 1420.
3. a mathematics ACT of 18 or less on the Enhanced ACT Assessment—(Math SAT less than 460) must take a COMPASS test in mathematics for proper placement. (See Developmental Studies Program, page 86.)
4. one year of algebra must take DSPM 0850 before taking other mathematics courses.
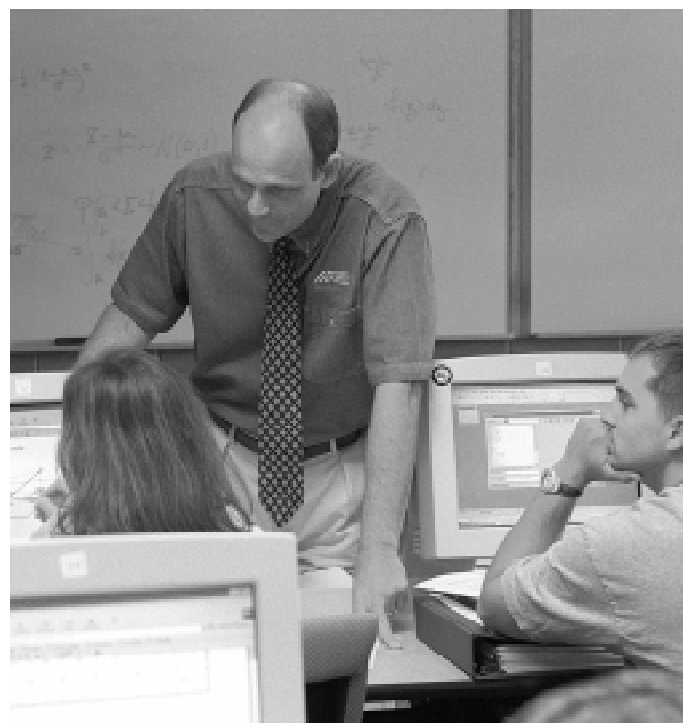5. no algebra must take DSPM 0800 and DSPM 0850 before taking other mathematics courses.

Courses in Mathematics [MATH]

1010 (300) Mathematics for General Studies. Three credits. Prerequisites: Two years of high school algebra and a MATH Enhanced ACT of at least 19 or DSPM 0850 or COMPASS placement. Course satisfies the Area IV-B General Studies requirement and is also part of the mathematics sequence for students preparing to become elementary school teachers. Topics include logic, sets, algebraic reasoning, probability, statistics, and consumer mathematics.

1410 (110) Concepts and Structure of Elementary School Mathematics. Three credits. Prerequisites: Two years of high school algebra and a Math Enhanced ACT of at least 19 or DSPM 0850 or COMPASS placement. Required for students who are preparing to become elementary school teachers. Does not satisfy the Area IV-B General Studies requirement. Topics include tools for problem solving, sets functions, logic, numeration systems, whole numbers, integers, and rationals. Successful completion of an Arithmetic Proficiency Test (APT) is required.

1420 (201) Informal Geometry. Three credits. Prerequisite: A grade of C or better in MATH 1410. Required for students who are preparing to become elementary school teachers. Does not satisfy the Area IV-B General Studies requirement. Topics include an informal study of plane, solid, and coordinate geometry, constructions, congruences, similarity, motion geometry, concepts of measurement, and LOGO.

1530 (STAT 313) Applied Statistics. Three credits. Prerequisites: Two years of high school algebra and a mathematics Enhanced ACT 19 or greater or equivalent. Descriptive statistics, probability, and statistical inference. The inference unit covers means, pro-

portions, and variances for one and two samples, and topics from one-way ANOVA, regression and correlation analysis, chi-square analysis, and nonparametrics.

1610 (243) College Mathematics for Managerial, Social, and Life Sciences. Three credits. Prerequisites: Two years of high school algebra and a Math Enhanced ACT greater than 25 or MATH 1710. Topics include solving systems of linear equations, Leontief models, linear programming, mathematics of finance, set theory, and probability theory.

1710 (141) College Algebra. Three credits. Prerequisite: DSPM 0850 or two years of high school algebra; a Math Enhanced ACT 19 or greater or COMPASS placement. Course satisfies the Area IV-B General Studies requirement. Topics include functions—linear, quadratic, exponential, and logarithmic; analysis of graphs; linear systems; inequalities; counting principles; and probability. Graphing calculator required. Course may be taken by correspondence. Not open to those who have had MATH 1730.

1720 (142) Plane Trigonometry. Three credits. Prerequisite: Strong background in algebra recommended. Trigonometric functions of the acute and general angle, circular functions, graphs of trigonometric and inverse functions, identities, solutions of right and general triangles, equations, complex numbers, and vectors. Not open to those who have had MATH 1730. Graphing calculator required.

1730 (121) Algebra and Trigonometry. Four credits. Prerequisite: MATH 1710 or successful completion of high school precalculus course. An integrated and rigorous study of the algebra and trigonometry needed to successfully attempt calculus. Emphasis on functions, their analysis and their applications. Level of algebraic sophistication developed above that found in MATH 1710. Topics included exponentials and logarithms, analysis of graphs, and word problems. Graphing calculator required.

1810 (344) Calculus I for Managerial, Social, and Life Sciences. Three credits. Prerequisites: Two years of high school algebra and a mathematics Enhanced ACT greater than 25 or MATH 1710. An intuitive approach to the concepts of limits; differential and integral calculus with applications to managerial, social, and life sciences. (Not open to those who have had MATH 1910.)

1820 (345) Calculus II for Managerial, Social, and Life Sciences. Three credits. Prerequisite: MATH 1810 or equivalent. A continuation of MATH 1810. Calculus of functions of several variables, logarithms, exponential functions, series, trigonometric functions, and differential equations with applications of these and other topics to managerial, social, and life sciences.

1910 (122) Calculus I. Four credits. Prerequisite: MATH 1730 or equivalent. An introduction to calculus with an emphasis on analysis of functions, multi-disciplinary applications of calculus, and theoretical understanding of differentiation and integration. Topics include the definition of the derivative, differentiation techniques, and applications of the derivative. Calculus topics related to trigonometric, exponential, and logarithmic functions also included. Course concludes with the Fundamental Theorem of Calculus; the definition of antidifferentiation and the definite integral; basic applications of integrations; and introductory techniques of integration. Graphing calculator required.

1920 (221) Calculus II. Four credits. Prerequisite: MATH 1910. A topics course providing a wide view of different techniques and applications of Calculus in the plane. Techniques of integration and applications of integration fully developed. Power series and Taylor series included. Emphasis on multi-disciplinary ap-

plications includes Taylor series approximation; applications of integration to physics, biology, and business; and geometric and power series applications. Graphing calculator required.

2010 (312) Elements of Linear Algebra. Three credits. Prerequisite: MATH 1910. Vectors and vector spaces, matrices and systems of linear equations, geometry of vector spaces and linear transformations in a vector space.

2020 (202) Calculus of Business Engineering I. Three credits. (Same as ACSI 2020.)

2030 (203) Calculus of Business Engineering II. Three credits. (Same as ACSI 2030.)

2050 (STAT 314) Probability and Statistics. Three credits. Prerequisite: Calculus I. Data analysis, probability, and statistical inference. The inference material covers means, proportions, and variances for one and two samples, one-way ANOVA, regression and correlation, and chi-square analysis.

2090 (209) Mathematics for Health Professions. Two credits. Enables students in the health professions to apply mathematical concepts to interpret and solve drug dosage calculation problems encountered in fields such as nursing. Includes basic math review, solid and liquid doses of medications for adults and children, solutions, and IV administration. Also includes conversions from metric to household and apothecary measurements. Course may be taken by correspondence. Not open to Mathematics majors or minors.

2110 (211) Data Analysis. One credit. Grouping and classifying technical data. Curve fitting by statistical and non-statistical methods. Graphing of scientific data. Secondary education in mathematics students should take concurrent or subsequent to MATH 2050.

2130 (213) Mathematics of Finance. Three credits. Prerequisites: Two years of high school algebra and a Math Enhanced ACT 19 or greater or DSPM 0850. Investment finance, including general annuities, evaluation of bonds, and life annuities.

3020 (302) Calculus of Business Engineering III. Three credits. (Same as ACSI 3020.)

3030 (303) Calculus of Business Engineering IV. Three credits. (Same as ACSI 3030.)

3070 (307) College Geometry. Three credits. Prerequisite: MATH 3460. Advanced treatment of standard topics in Euclidean geometry using informal and axiomatic approaches. Includes proofmaking techniques, traditional and transformational geometry, finite geometries, and a brief introduction to other geometries.

3080 (308) Discrete Structures. Three credits. (Same as CSCI 3080.) Prerequisites: CSCI 1160 or 1170 and MATH 1910 or consent of instructor. Topics include formal logic, proof techniques, matrices, graphs, formal grammars, finite state machines, Turing machines, and binary coding schemes.

3110 (222) Calculus III. Four credits. Prerequisite: MATH 1920. Adjusts calculus techniques developed in the plane (Calculus I and II) to make them applicable in three-dimensional space. Introductory study of the nature of three-dimensional space and definition of the algebraic calculations in three-dimensional space. Differential and integral calculus definitions and techniques revised to appropriately transfer into this new space.

Topics include multivariate functions, partial differentiation, partial integration, multiple integration, and multidisciplinary applications.

3120   (323) Differential Equations I. Three credits. Corequisite: MATH 3110. The solution and application of ordinary differential equations with emphasis on first order equations, second order linear equations, Laplace Transform method, systems of differential equations, and numerical methods.

3180   (318) Introduction to Numerical Analysis. Three credits. (Same as CSCI 3180.) Prerequisites: MATH 1920 and CSCI 1160 or 1170. Topics include series approximation, finite differences, interpolation, summation, numerical differentiation and integration, iteration, curve fitting, systems of equations and matrices, and error analysis.

3190   (319) Deterministic and Probabilistic Models. Three credits. Corequisite: MATH 2050. Linear programming, network analysis, queuing theory, dynamic programming.

3260   (326) Differential Equations II. Three credits. Prerequisite: MATH 3120. A continuation of MATH 3120 with emphasis on series solutions, method of Frobenius, orthogonal functions, equations of Bessel, Legendre, Gauss, Chebyshev; introduction to partial differential equations.

3320   (332) Teaching Mathematics in Grades 5-8. Three credits. Prerequisite: Admission to the teacher education program. Required of all Mathematics majors seeking a license to teach mathematics in grades 7-12. Strongly encouraged for elementary education majors with a 5-8 emphasis. Topics from number relationships, mental computation and estimation strategies, patterns and functions, algebra, statistics, probability, geometry, and measurement. Must be taken prior to student teaching.

3330   (333) Teaching Mathematics in Grades 9-12. Three credits. Prerequisites: Admission to teacher education, completion of the mathematics core, and MATH 3320. Required of all Mathematics majors seeking a license to teach mathematics in grades 7-12. In-depth study of mathematics learning and teaching strategies in secondary school mathematics. Selected topics from junior and senior high school curricula provide a foundation for student investigations into the conceptual nature of mathematics and applications in the secondary school curriculum. Must be taken prior to student teaching.

3400   (340) Symbolic Logic. Three credits. (Same as PHIL 3400.) The elements of propositional calculus—propositional connectives and their truth functions, validity, proof, and an introduction to quantification theory. Where appropriate and natural, parallels from elementary set theory are introduced. May count for credit in Philosophy.

3460   (346) Foundation of Higher Mathematics. Three credits. Prerequisite: MATH 1920. The language of mathematics, set theory and proof, relations and functions, number systems, mathematical structures. Focuses on the transition from lower-division study to upper-division study by actively engaging the student in problem solving, mathematical reasoning, and both informal and technical writing.

4010   (401) Selected Topics in Elementary Mathematics. Three credits. Prerequisites: MATH 1410, 1420, and 1010. Required of students who are preparing to teach grades 5-8. Does not satisfy the Area IV-B General Studies requirement. Examines in greater depth topics to which the student has prior exposure; emphasizes the relevance and implications of these topics to the middle school classroom.

4200   (439) Introduction to Mathematics of Investment. Three credits. (Same as ACSI 4200.)

4210   (421) Advanced Calculus I. Three credits. Prerequisites: MATH 3110 and 3460. Theory and application of continuity, differentiation, and integration.

4220   (422) Advanced Calculus II. Three credits. Prerequisite: MATH 4210. A continuation of MATH 4210 including theory and application of convergence.

4230   (423) Vector Analysis. Three credits. Prerequisite: MATH 3110. A review of vector algebra and vector differentiation with emphasis on aspects of these topics not covered in previous calculus courses. Stress on line and surface integrals; Divergence Theorem and Stokes' Theorem with generalizations and related topics.

4250   (425) Theory of Calculus. Three credits. Prerequisites: MATH 3110 and 3460. Theoretical development of limits, continuity, differentiation, and integration in one dimension.

4270   (427) Introduction to Topology. Three credits. Prerequisites: MATH 3110 and 3460. Fundamental concepts of topology including continuity, compactness, connectedness, separation axioms, and metric spaces.

4310   (431) Numerical Analysis I. Three credits. Prerequisites: CSCI 1170 and MATH 2010 or consent of instructor. Application of computer-oriented numerical algorithms to algebraic equations, differential and integral equations, and linear algebra. Rigorous mathematical treatment of error included.

4320   (432) Numerical Analysis II. Three credits. Prerequisite: MATH 4310. A continuation of MATH 4310.

4420   (442) Number Theory. Three credits. Prerequisite: MATH 3460. Divisibility, congruences, quadratic residues, Diophantine equations, quadratic forms, and continued fractions.

4470   (447) Introduction to Modern Algebra. Three credits. Prerequisite: MATH 3460. A treatment of sets, relations, operations, and the construction of number systems in algebra.

4510   (451) Abstract Algebra I. Three credits. Prerequisite: MATH 3460. An introduction to groups, with a brief introduction to rings, integral domains, and fields.

4530   (453) Abstract Algebra II. Three credits. Prerequisite: MATH 4510/5510. The theory of rings, fields, integral domains, and vector spaces.

4540   (454) Topics in Secondary School Mathematics. Three credits. Prerequisites: Admission to teacher education, completion of the mathematics core, MATH 3070 and 4510. Required of all Mathematics majors seeking a license to teach mathematics in grades 7-12. Examines in greater depth topics to which the student has prior exposure; emphasizes the relevance and applications of these topics to the pre-college level classroom.

4600   (460) Problems in Contemporary Mathematics. One to six credits. Pass/Fail grading in specified sections.

4601   (460D) Problems in Contemporary Mathematics—Complex Variables. Three credits. Prerequisite: MATH 3460. Fundamental principles and applications of complex variables.

4620 (462) History and Philosophy of Mathematics. Three credits. Prerequisite: MATH 3460. Background in geometry and number theory helpful. The character of mathematical thought by way of mathematical problems which have occupied successively the outstanding mathematicians of Babylon, Egypt, Greece, China, the Renaissance, and modern times paralleled with a study of three schools of mathematical philosophy: intuitionism, logicism, and formalism.

4630 (405) Mathematics of Risk Management. Three credits. (Same as ACSI 4630.)

4640 (406) Mathematics of Options, Futures, and Other Derivatives. Three credits. (Same as ASCI 4640.)

4700 (470) Combinatorics and Graph Theory. Three credits. Prerequisites: MATH 2010 and 3460. Selected topics in combinatorics and graph theory emphasizing combinatorial problem solving and algorithmic proof.

4800 (480) Seminar in Mathematics with Technology. Three credits. Prerequisite: 18 semester hours in mathematics including calculus or consent of instructor. Examine and utilize the technological tools available for doing mathematics. Emphasis on nonnumerical tools such as theorem provers and algebraic manipulation systems.

4990 (499) Seminar in Mathematics. Three credits. Open only to Mathematics majors; normally taken during last regular semester of coursework. Required of all Mathematics majors with the exception of those completing ACSI 4000. Offers graduating Mathematics majors a broad perspective of mathematics, mathematical activity, and problem solving in various areas of application; offers preparation for professional examinations; acquaints students with job possibilities and aids in career decisions; acquaints students with the nature of graduate study in mathematics. Pass/fail.

Courses in Statistics [STAT]

3150 (315) Mathematical Statistics I. Three credits. Prerequisite: Two semesters of calculus. Probability theory including basic probability laws, properties of distributions, mathematical expectation, special discrete and continuous distributions, functions of random variables, and selected applications.

4190 (419) Mathematical Statistics II. Three credits. Prerequisite: STAT 3150 or equivalent. Theory of statistical inference. Topics include sampling distributions, decision theory, estimation, test of hypothesis, regression analysis, analysis of variance, and selected applications.

4200 (420) Statistical Methods for Forecasting. Three credits. Prerequisite: STAT 4190. Topics include application of regression models in forecasting and exponential smoothing methods to forecast nonseasonal time-series, seasonal series, and globally constant seasonal models; stochastic time series models; and forecast evaluation.

4320 Probability and Stochastic Processes. Three credits. Prerequisites: Two semesters of calculus and STAT 3150 (or MATH 2050) or consent of instructor. Theoretical basis for stochastic processes and their use as models of real-world phenomena. Topics include Markov chains, Poisson processes, Brownian motion and stationary processes. Applications include Gambler's Ruin, birth and death models, hitting times, stock option pricing, and the Black-Scholes model.

4360 (436) Regression Analysis. Three credits. Prerequisite: MATH 2050 or Q M 3620. Theory and application of regression models. Approaches to model building and data analysis. Computation and interpretation of results facilitated through the use of statistical software packages.

4370 (437) Nonparametric Statistics. Three credits. Prerequisite: MATH 2050 or equivalent. Statistical tests that require no assertions about parameters or about the form of the population from which the samples are drawn. A wide range of practical problems studied.

4380 (438) Experimental Design. Three credits. Prerequisite: MATH 2050 or Q M 3620. Topics include one-way analysis of variances, multiple comparison, multifactor analysis of variance, and various practical issues in experimental design. Computation and interpretation of results facilitated through the use of statistical software packages.

4600 (460) Problems in Statistics. One to six credits. Prerequisites: Senior standing and consent of instructor. Students wishing to enroll must submit a written course/topic proposal to the department prior to the semester in which STAT 4600 is taken. Proposal must be approved prior to taking the course. At the conclusion, each enrollee must submit a written report to the department.

Courses in Actuarial Science [ACSI]

2020 (202) Calculus of Business Engineering I. Three credits. (Same as MATH 2020.) Prerequisite: Eligibility to take MATH 1710. First of a four-course sequence. Introduces the process of mathematical modeling applied to current business problems. For students majoring or minoring in the Jennings A. Jones College of Business and/or obtaining a concentration in Actuarial Science. Topics include sets, functions, inverse models, limits, continuity, first and second order model building, single variable differentiation, implicit differentiation, inverse problems (exponential and log models). First and second derivatives used to study the behavior of business models including cost, revenue, profit, and money behavior.

2030 (203) Calculus of Business Engineering II. Three credits. (Same as MATH 2030.) Prerequisite: ACSI/MATH 2020. Second of a four-course sequence. For students majoring or minoring in the Jennings A. Jones College of Business and/or obtaining a concentration in Actuarial Science. Topics include Riemann Sum, indefinite and definite integrals, modeling using substitution, differential equations with initial conditions, functions of two or more variables, level curves, feasible regions, linear objective functions, system of linear equations, annuities, partial derivatives, least squares, matrix multiplication and addition, inverse matrix, and matrix equations.

3020 (302) Calculus of Business Engineering III. Three credits. (Same as MATH 3020.) Prerequisites: ACSI/MATH 2020 and 2030. Third of a four-course sequence. For students majoring or minoring in the Jennings A. Jones College of Business and/or obtaining a concentration in Actuarial Science. Topics include additional methods of integration, approximation of a definite integral by the trapezoid rule and Simpson's Rule, practical uses of partial differentiation, sketching the region of integration for a double integral, integration of double integrals, L'Hopital's Rule, improper integrals, arithmetic sequences, geometric sequences, investigation of partial sum sequences as cumulative functions, use of bond theory or investments to illustrate cumulative functions, convergence and divergence of series, Taylor and Maclaurin series for several functions, and error of approximation.

3030 **(303) Calculus of Business Engineering IV.** Three credits. (Same as MATH 3030.) Prerequisites: ACSI/MATH 2020, 2030, and 3020. Last of a four-course sequence. For students majoring or minoring in the Jennings A. Jones College of Business and/or obtaining a concentration in Actuarial Science. Topics include differentiation and integration of trigonometric functions, vector spaces, subspaces, dot product, basis, orthonormal basis, linear transformations, kernel subspace, range subspace, matrices representing a linear transformation, return maximization of portfolio, cross product, convex combinations of vectors, affine functions, convex functions, duration and convexity of bonds, moments, moments from a convex combination point of view, and Taylor polynomials for functions of two variables.

4140 **Mathematical Foundations of Actuarial Science.** Three credits. Prerequisites: ACSI/MATH 3020 (or MATH 3110) and STAT 3150; or consent of instructor. Integrates calculus, probability, and risk management topics into fundamental tools for assessing risk in an actuarial environment. Calculus and probability topics include derivatives, integrals, partials, random variables, distributions, and conditional probability. Risk topics include frequency and severity. Insurance concepts such as retention, deductible, coinsurance, and risk premiums. For students in Actuarial Science, a preparatory course for the Society of Actuaries/ Casualty Actuarial Society Course/Exam 1.

4200 **(439) Introduction to Mathematics of Investment.** Three credits. (Same as MATH 4200.) Prerequisites: MATH 1910 or ACSI 2020, 2030, and one semester of probability/statistics; or consent of instructor. Calculus and probability/statistics used to model and analyze investments in bonds, treasury bills, stocks, and other derivatives. Topics include obtaining the price of a bond as a function of interest rate, developing formulas for duration and convexity to study the sensitivity of price to interest rate, and mathematical modeling of investor preference and attitude toward risk.

4220 **Mathematics of Pricing Theory.** Three credits. Prerequisites: ACSI/MATH 4200 and ECON 2410, 2420; or consent of instructor. Applies calculus and theory of interest tools to intermediate topics in microeconomics. Topics include mathematics of supply, demand, and equilibrium; prices, costs, and the gains from trade; consumer behavior; elasticities; competition; monopoly; market power, collusion, and oligopoly; the mathematics of risk and uncertainty; and surplus economics. For students in Actuarial Science, a preparatory course for the Society of Actuaries/Casualty Actuarial Society Course/Exam 2.

4230 **(440) Mathematics of Compound Interest.** Three credits. Prerequisite: ACSI 4200 or consent of instructor. For students in Actuarial Science, offers preparation for the Society of Actuaries/Casualty Actuarial Society Exam No. 2. Topics include measurement of interest (including accumulated and present value factors), annuities certain, yield rates, amortization schedules, sinking funds, and bonds and related securities.

4240 **Mathematics of Interest Theory, Economics and Finance.** Three credits. Prerequisite: ACSI 4230 or consent of instructor. Applies calculus and theory of interest tools to intermediate topics in microeconomics and macroeconomics and topics in finance. Topics include pricing activities, the simplified Keynesian model, interest and discount rates, valuation of payment streams, yield rates, amortization, cash flows and internal rate of return, stock and bond valuation, portfolio risks, the Capital Asset Pricing Model (CAPM), efficient markets, capital structure, leverage, financial performance measurement, and basic option pricing and the Black-Scholes model. For students in Actuarial Science, a preparatory course for the Society of Actuaries/Casualty Actuarial Society Course/Exam 2.

4330 **(448) Actuarial Mathematics I.** Three credits. Prerequisites: ACSI 4230 and STAT 4190; or consent of instructor. First of a two-semester sequence; offers preparation for the Society of Actuaries/Casualty Actuarial Society Course/Exam No. 3. Topics include survival distributions and life tables, life insurance, life annuities, and net premiums.

4340 **(449) Actuarial Mathematics II.** Three credits. Prerequisite: ACSI 4330. Second of a two-semester sequence; offers preparation for the Society of Actuaries/Casualty Actuarial Society Course/Exam No. 3. Topics chosen from net premium reserves, multiple life functions, multiple decrement models, valuation theory and pension plans, and insurance models (including expenses and nonforfeiture benefits and dividends).

4600 **(460) Problems in Actuarial Science.** One to six credits. Prerequisites: Senior standing and consent of instructor. Students wishing to enroll must submit a written course/topic proposal to the department prior to the semester in which ACSI 4600 is taken. Proposal must be approved prior to taking the course. At the conclusion, each enrollee must submit a written report to the department.

4630 **(405) Mathematics of Risk Management.** Three credits. (Same as MATH 4630.) Prerequisite: ACSI/MATH 4200. For students in Actuarial Science, offers preparation for the Society of Actuaries/Casualty Actuarial Society Course 6. Topics include mathematical modeling of volatility; pricing of bonds, stocks, and other derivatives with uncertainty; benchmark portfolios; asset/ liability management for property/casualty insurers; liability associated with a financially distressed company. Heath-Jarrow-Morton and Cox-Ingersoll-Ross models.

4640 **(406) Mathematics of Options, Futures, and Other Derivatives.** Three credits. (Same as MATH 4640.) Prerequisites: ACSI/ MATH 4630 and 4200. For students in Actuarial Science, offers preparation for the Society of Actuaries/Casualty Actuarial Society Course 6. Topics include risk management using options, interest rate swaps, interest rate caps, Black-Scholes analysis, Taylor series expansion to obtain hedge parameters, portfolio insurance, numerical procedures, interest rate derivatives, and use of Black's model.

Honors College
Mathematics 1730, 1710, and 1010 are offered periodically for students in the MTSU Honors College who are not Mathematics majors. Mathematics 4600 is offered periodically for students in MTSU Honors who are Mathematics majors.

Cooperative Education
MATH 2930, 2940, 3970, 3980. Cooperative Education Experience I, II, III, IV. One to three credits each. Experiences must be taken in sequence. Pass/Fail.

Graduate Study
The Master of Science and Master of Science in Teaching degrees are offered in mathematics. A minor in Mathematics is offered for masters and Doctor of Arts degrees. Requirements for these degrees and a list of the courses offered for graduate credit are in the Graduate Catalog.