Applied Mathematics and Statistics (AMS)

Major and Minor in Applied Mathematics and Statistics

Department of Applied Mathematics and Statistics, College of Engineering and Applied Sciences

Chairperson: James Glimm

Undergraduate Program Director: Esther Arkin

E-mail: Esther.Arkin@stonybrook.edu

Assistant to the Chair: Janice Hackney

Office: P-139B Math Tower

Phone: (631) 632-8370

Web address: http://www.ams.stonybrook.edu

Students majoring in Applied Mathematics and Statistics often double major in one of the following: Computer Science (CSE), Economics (ECO), Information Systems (ISE)

Applied Math and Statistics (AMS)

The undergraduate program in Applied Mathematics and Statistics aims to give mathematically oriented students a liberal education in quantitative problem solving. The courses in this program survey a wide variety of mathematical theories and techniques that are currently used by analysts and researchers in government, industry, and science. Many of the applied mathematics courses give students the opportunity to develop problem-solving techniques using campus computing facilities.

About half of the Applied Mathematics majors enter graduate or professional programs, primarily in statistics, operations research, computer science, and business management. Others go directly into professional careers as actuaries, programmer analysts, management trainees, and secondary school teachers.

While some career-oriented course sequences are listed below, students are strongly encouraged to seek faculty advice in coordinating their career plans with their academic programs. In the spring of their junior year, all students contemplating graduate studies, upon graduation or at a later date, should consult with the Department's graduate placement advisor, who assists them in choice of schools and provides information about Graduate Record Examinations, etc. Students considering secondary school mathematics teaching can major in Applied Mathematics and Statistics or in Mathematics.

Requirements for the Major and Minor in Applied Math and Statistics (AMS)

Acceptance into the Applied Mathematics and Statistics Major

Qualified freshman and transfer students who have indicated their interest in the major on their applications are accepted directly into the major upon admission to the University. Students who did not apply for the major and those who were not accepted into the major when they entered the University may apply directly to the Department only after completion of AMS 161 or MAT 132 or MAT 142 or MAT 127; AMS 210 or MAT 211; and CSE 110 or CSE 114 or CSE 130 or ESG 111.

Requirements for the Major

The major in Applied Mathematics and Statistics leads to the Bachelor of Science degree. Completion of the major requires approximately 60 credits.

A. Study Within the Area of the Major

1. AMS 151, AMS 161 Applied Calculus I, II
AMS 210 or MAT 211 Applied Linear Algebra
AMS 261 or MAT 203 or MAT 205 Applied Calculus III

Note: The following alternate calculus course sequences may be substituted for AMS 151, AMS 161 in major requirements or prerequisites:

MAT 125, MAT 126, MAT 127
or MAT 131, MAT 132
or MAT 141, MAT 142
or MAT 171

2. CSE 110 Introduction to Computer Science
or CSE 114 Computer Science I
or CSE 130 Introduction to Programming in C
or ESG 111 C Programming for Engineering

3. 24 credits of AMS courses numbered 301 and above including AMS 301 Finite Mathematical Structures and either AMS 310 Survey of Probability and Statistics or AMS 311 Probability Theory. (A minimum of 18 of these 24 credits must be designated AMS courses. The

remaining six credits may be replaced by an equal number of credits taken from approved upper-division mathematically oriented courses. Typical approved substitutions are ECO 321, ECO 348, and all courses designated CSE numbered 301 and above and MAT 310 and above.)

4. Upper-Division Writing Requirement: AMS 300 Writing in Applied Mathematics

All degree candidates must demonstrate skill in written English at a level acceptable for Applied Mathematics and Statistics majors. AMS students must register for the writing course AMS 300, or submit a technical paper(s) written for other courses. The requirement may also be met by earning a grade of C or higher in a writing course approved by the Department or, if the student has a double major, by satisfying the requirement for the other major.

B.   Study in Related Areas

To gain a background in fields that generate mathematical applications, a minimum of 14 additional credits are chosen from among the course offerings in appropriate social sciences, the natural sciences, and engineering. Courses taken to satisfy item 3 above may not be used to satisfy this requirement. No more than eight of these credits may come from any one department.

Grading

All courses taken to satisfy requirements A. 1, 2, and 3 above must be taken for a letter grade and passed with a grade of D or higher.

Double Majors

The Department urges students in other majors who are considering a double major with AMS first to select individual AMS courses on the basis of their academic interests or career plans. Only after a student has taken several AMS courses should he or she decide on this as a second major.

On the other hand, AMS students are strongly encouraged to double major (or to minor) in another discipline. The most frequent choices of AMS double majors are computer science and economics.

Actuarial Science

The AMS major covers the mathematical sciences topics tested in the first actuarial examination and part of the second actuarial examination. For more information about actuarial science as well as study materials to help prepare for actuarial examinations, students should see the Department's actuarial advisor. Also see the Web site http://www.soa.org for details.

Recommendations for Students Majoring in Applied Mathematics and Statistics

The Department encourages students to have a broad exposure to many types of mathematical reasoning and to its diverse roles in the social and natural sciences. During their first two years, students considering an AMS major are encouraged to take, in addition to the required calculus sequence, two semesters of physics numbered PHY 121 or higher; CSE 110 or CSE 113, CSE 114 or CSE 130 or ESG 111; one other computer course (competence in computer programming is essential for many professional careers); and some economics. At the end of the sophomore year or the beginning of the junior year, students begin taking upper-division AMS courses, usually starting with AMS 301 and AMS 310. At the same time, they are strongly encouraged to continue taking MAT and CSE courses and mathematically oriented courses in other departments, such as ECO 303. The following list of course sequences for certain professions is given as a preliminary guide to students with interests in these professions. Students should speak with faculty members specializing in these areas as early as possible for more information.

Statistics: AMS 301, AMS 310, AMS 311, AMS 312, AMS 315, AMS 316, another CSE course beyond CSE 110 or CSE 114 or CSE 130 or MEC 111; students considering graduate statistics programs should take MAT 310 and MAT 320.

Operations Research or Management Science: AMS 301, AMS 310, AMS 311, AMS 341, and AMS 342; students considering graduate operations research programs should take MAT 310 and MAT 320.

Programmer-Analyst: AMS 301, AMS 310, AMS 311, AMS 321, AMS 326, AMS 341, and CSE 214, CSE 220, and CSE 301.

Secondary Teaching: Students preparing for a career as a teacher of mathematics in the secondary schools enroll in the Mathematics Secondary Teacher Education Program. See the Education and Teacher Certification entry in the alphabetical listings of Approved Majors, Minors, and Programs.

Course Sequence in the Applied Mathematics and Statistics Major

Many students enter the University intending another major and change to the Applied Mathematics and Statistics major, or add it as a second major, toward the end of the sophomore year or in the junior year. Required courses for the major in the first two years are the calculus sequence and linear algebra-virtually the same mathematical requirements as found in the intended majors of students who subsequently switch to Applied Mathematics and Statistics.

The particular set of 300-level AMS courses taken in the junior and senior years by Applied Mathematics and Statistics majors, and the order in which they are taken, is very flexible. Normally, majors take AMS 301 and AMS 310 (the two required 300-level AMS courses) first. For assistance in 300-level AMS course sequences, majors are encouraged to speak with the undergraduate program director.

The Combined B.S./M.S. Program in Applied Mathematics and Statistics

The combined B.S./M.S. program in applied mathematics and statistics allows students with superior academic records to use up to nine graduate credits toward both the B.S. and M.S. degree requirements, thus reducing the normal time required to complete both programs to five years (ten semesters). For detailed program requirements, please refer to the Graduate Bulletin.

The advantage of the combined program is that the M.S. degree can be earned in less time than that required by the traditional course of study. The M.S. degree in Applied Mathematics and Statistics normally requires three to four semesters of study after completion of a bachelor's degree. The in-depth training of a master's degree is required by many employers for professional positions in applied mathematics and statistics (beyond beginning programmer analyst jobs).

For more details about the B.S./M.S. program, see the undergraduate program director or graduate studies director in the Department of Applied Mathematics and Statistics.

The Combined B.S./M.P.H. Program in Applied Mathematics and Statistics

The combined B.S./M.P.H. program allows students with superior academic records to use up to 12 graduate credits toward both the B.S. in Applied Mathematics and Statistics and the M.A. in Public Health degree requirements, thus reducing the normal time required to complete both programs to five years (ten semesters). For detailed program requirements, please refer to the Graduate Bulletin or contact the undergraduate program director in Department of Applied Mathematics and Statistics or graduate studies director in the Department of Public Health.

Requirements for the Minor

The minor in Applied Mathematics and Statistics is designed for students who take a limited amount of mathematics in their major. The AMS minor must include at least 18 credits in courses that are not used to satisfy the requirements of the student's primary major; therefore, students in majors requiring a substantial amount of mathematics may find that a double major with AMS requires fewer credits.

A.   Calculus: AMS 151, AMS 161 (See Note)
B.   Linear algebra: AMS 210 or MAT 211 (Students who took AMS 201 prior to declaring the AMS minor may substitute AMS 201)
C.   Core AMS courses: AMS 301 and AMS 310
D.   AMS electives: three additional 300-level AMS courses

Note: The following alternate calculus course sequences may be substituted for AMS 151, AMS 161 in requirements for the minor or prerequisites:

MAT 125, MAT 126, MAT 127
or MAT 131, MAT 132
or MAT 141, MAT 142
or MAT 171

Sample Course Sequence for the Major in Applied Mathematics and Statistics

Freshman Fall	Credits	Spring	Credits
First Year Seminar 101	1	First Year Seminar 102	1
D.E.C. A	3	AMS 161*	3
AMS 151*	3	D.E.C.	3
D.E.C.	3	D.E.C.	3
D.E.C.	3	CSE 110*	3
		D.E.C.	3
Total	13	Total	16
Sophomore Fall	**Credits**	**Spring**	**Credits**
AMS 210	3	AMS 301	3
AMS 261	4	AMS 310	3
D.E.C.	3	Elective	3
D.E.C.	3	AMS Upper-Division elective	3
D.E.C.	3	AMS Upper-Division elective	3
Total	16	Total	15
Junior Fall	**Credits**	**Spring**	**Credits**
AMS Upper-Division elective	3	Upper-Division elective	3

Upper-Division elective		3	Upper-Division elective		3
AMS Upper-Division elective		3	Related Area course**		3
AMS Upper-Division elective or ECO 321	3-4		D.E.C.		3
AMS Upper-Division elective		3	Elective		3
Total	15-16		Total	15	

Senior Fall	**Credits**		**Spring**	**Credits**	
AMS 300		1	Related Area course**		3
Upper-Division elective		3	Related Area course**		3
Upper-Division elective		3	Elective		3
Related Area course**		3	Elective		3
Related Area course**		3	Elective		3
Elective	3				
Total	16		Total	15	

*See A. 1. for alternate course selections.

**#Consult the department for appropriate courses.

AMS Faculty

Faculty information for this program can be found at http://www.ams.sunysb.edu/people/faculty.shtml

AMS

Applied Mathematics and Statistics

AMS 102 - C: Elements of Statistics

The use and misuse of statistics in real life situations; basic statistical measures of central tendency and of dispersion, frequency distributions, elements of probability, binomial and normal distributions, small and large sample hypothesis testing, confidence intervals, chi square test, and regression. May not be taken by students with credit for AMS 110, 310, 311, 312; ECO 320; POL 201; PSY 201; or SOC 202. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

Prerequisite: Satisfaction of entry skill in mathematics requirement (Skill 1) or satisfactory completion of D.E.C. C

3 credits

AMS 105: Introduction to Business Statistics

The application of current statistical methods to problems in the modern business environment. Topics include probability, random variables, sampling techniques, confidence intervals, hypothesis testing, and regression. Students analyze real data sets using standard statistical software, interpret the output, and write extensively about the results.

Prerequisite: BUS Maj/Min, CME Major, or ISE Major. Advisory Prerequisite: BUS 110, 111, 112 or 115, or MAT 122.
Advisory Prerequisite for BUS or ISE Major: BUS 210

3 credits

AMS 110: Probability and Statistics in the Life Sciences

A survey of probability theory and statistical techniques with applications to biological and biomedical situations. Topics covered include Markov chain models; binomial, Poisson, normal, exponential, and chi square random variables; tests of hypotheses; confidence intervals; t tests; and analysis of variance, regression, and contingency tables. May not be taken for credit in addition to AMS 310. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

Prerequisite: AMS 151 or MAT 125 or 131 or 141

3 credits

AMS 151 - C: Applied Calculus I

A review of functions and their applications; analytic methods of differentiation; interpretations and applications of differentiation; introduction to integration. Intended for CEAS majors. Not for credit in addition to MAT 125 or 126 or 131 or 141 or 171. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

Prerequisite: B or higher in MAT 123, or level 5 on the mathematics placement examination, or B or higher in MAT 122 and concurrent registration for MAT 130

3 credits

AMS 161 - C: Applied Calculus II

Analytic and numerical methods of integration; interpretations and applications of integration; differential equations models and elementary solution techniques; phase planes; Taylor series and Fourier series. Intended for CEAS majors. Not for credit in addition to MAT 126, MAT 127, MAT 132, MAT 142, or MAT 171. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

Prerequisite: C or higher in AMS 151 or MAT 131 or 141, or level 7 on the mathematics placement examination

3 credits

AMS 210: Applied Linear Algebra

An introduction to the theory and use of vectors and matrices. Matrix theory including systems of linear equations. Theory of Euclidean and abstract vector spaces. Eigenvectors and eigenvalues. Linear transformations. May not be taken for credit in addition to MAT 211.

Prerequisite: AMS 151 or MAT 131 or 141 or corequisite MAT 126

3 credits

AMS 261: Applied Calculus III

Vector algebra and analytic geometry in two and three dimensions; multivariable differential calculus and tangent planes; multivariable integral calculus; optimization and Lagrange multipliers; vector calculus including Green's and Stokes's theorems. May not be taken for credit in addition to MAT 203 or 205.

Prerequisite: AMS 161 or MAT 127 or 132 or 142 or 171

4 credits

AMS 300: Writing in Applied Mathematics

See Requirements for the Major in Applied Mathematics and Statistics, Upper Division Writing Requirement.

Prerequisites: WRT 102; AMS major; U3 or U4 standing

1 credit, S/U grading

AMS 301: Finite Mathematical Structures

An introduction to graph theory and combinatorial analysis. The emphasis is on solving applied problems rather than on theorems and proofs. Techniques used in problem solving include generating functions, recurrence relations, and network flows. This course develops the type of mathematical thinking that is fundamental to computer science and operations research.

Prerequisite: AMS 210 or MAT 211 or AMS 361 or MAT 303

3 credits

AMS 303: Graph Theory

Paths and circuits, trees and tree based algorithms, graph coloring, digraphs, network flows, matching theory, matroids, and games with graphs.

Prerequisite: AMS 301

3 credits

AMS 310: Survey of Probability and Statistics

A survey of data analysis, probability theory, and statistics. Stem and leaf displays, box plots, schematic plots, fitting straight line relationships, discrete and continuous probability distributions, conditional distributions, binomial distribution, normal and t distributions, confidence intervals, and significance tests. May not be taken for credit in addition to ECO 320.

Prerequisite: AMS 201 or 210 or MAT 211

3 credits

AMS 311: Probability Theory

Probability spaces, random variables, moment generating functions, algebra of expectations, conditional and marginal distributions, multivariate distributions, order statistics, law of large numbers.

Prerequisites: AMS 301 and 310 or permission of instructor
Corequisites: MAT 203 or 205 or AMS 261

3 credits

AMS 312: Mathematical Statistics

Estimation, confidence intervals, Neyman Pearson lemma, likelihood ratio test, hypothesis testing, chi square test, regression, analysis of variance, nonparametric methods.

Prerequisite: AMS 311

3 credits

AMS 315: Data Analysis

Statistical analysis of data. Exploratory data analysis. Estimation. Parametric and nonparametric hypothesis tests. Power. Robust techniques. Use and interpretation of statistical computer packages, such as SPSS.

Prerequisite: AMS 102 or 310

3 credits

AMS 316: Introduction to Time Series Analysis

Trend and seasonal components of time series models, autoregressive and moving average (ARMA) models, Box-Jenkins methodology, Portmanteau test, unit-root, generalized autoregressive conditionally heteroskedasticity (GARCH) models, exponential GARCH, stochastic volatility models. This course is offered as both AMS 316 and AMS 586.

Prerequisite: AMS 311 and AMS 315

3 credits

AMS 318: Financial Mathematics

This course will focus on accumulation functions, yield rates, annuities, loan repayment, term structure of interest rates/spot rates/forward rates, options, duration/convexity. This course follows the syllabus for the Financial Mathematics (FM) Exam of the Society of Actuaries and prepares students to pass the FM Exam.

Prerequisite: AMS 310

3 credits

AMS 321: Computer Projects in Applied Mathematics

The simulation methodology for a variety of applied mathematical problems in numerical linear and nonlinear algebra, statistical modeling, and numerical differentiation and integration. Graphical representation of numerical solutions.

Prerequisites: AMS 210 or 261 or MAT 203; prior programming experience in C, FORTRAN, or Java

3 credits

AMS 326: Numerical Analysis

Direct and indirect methods for the solution of linear and nonlinear equations. Computation of eigenvalues and eigenvectors of matrices. Quadrature, differentiation, and curve fitting.

Numerical solution of ordinary and partial differential equations.

Prerequisites: AMS 210 or MAT 211; programming experience in Pascal, FORTRAN, or C

3 credits

AMS 333: Mathematical Biology

This course introduces the use of mathematics and computer simulation to study a wide range of problems in biology. Topics include the modeling of populations, the dynamics of signal transduction and gene-regulatory networks, and simulation of protein structure and dynamics. A computer laboratory component allows students to apply their knowledge to real-world problems.

Prerequisites: AMS 161 or MAT 132; BIO 202; U3 or U4 standing; or permission of the instructor

3 credits

AMS 335: Game Theory

Introduction to game theory fundamentals with special emphasis on problems from economics and political science. Topics include strategic games and Nash equilibrium, games in coalitional form and the core, bargaining theory, measuring power in voting systems, problems of fair division, and optimal and stable matching. This course is offered as both AMS 335 and ECO 355.

Prerequisites: MAT 126 or 131 or 141 or AMS 151; C or higher in ECO 303

3 credits

AMS 341: Operations Research I: Deterministic Models

Linear programming with a view toward its uses in economics and systems analysis. Linear algebra and geometric foundations of linear programming; simplex method and its variations; primal dual programs; formulation and interpretation of linear programming models, including practical problems in transportation and production control. Optional computer projects. AMS 341 and 342 may be taken in either order, though it is recommended that AMS 341 be taken first.

Prerequisites: AMS 210 or MAT 211

3 credits

AMS 342: Operations Research II: Stochastic Models

Methods and techniques for stochastic modeling and optimization, with applications to queueing theory, Markov chains, inventory theory, games, and decisions. AMS 341 and 342 may be taken in either order, though it is recommended that AMS 341 be taken first.

Prerequisites: AMS 210 or MAT 211; AMS 311

3 credits

AMS 345: Computational Geometry

The design and analysis of efficient algorithms to solve geometric problems that arise in computer graphics, robotics, geographical information systems, manufacturing, and optimization. Topics include convex hulls, triangulation, Voronoi diagrams, visibility, intersection, robot motion planning, and arrangements. This course is offered as both AMS 345 and CSE 355.

Prerequisites: AMS 301; programming knowledge of C or C++ or Java

3 credits

AMS 351: Applied Algebra

Topics in algebra: groups, informal set theory, relations, homomorphisms. Applications: error correcting codes, Burnside's theorem, computational complexity, Chinese remainder theorem. This course is offered as both AMS 351 and MAT 312.

Prerequisite: AMS 210 or MAT 211
Advisory Prerequisite: MAT 200 or CSE 113
3 credits

AMS 361: Applied Calculus IV: Differential Equations

Homogeneous and inhomogeneous linear differential equations; systems of linear differential equations; solution with power series and Laplace transforms; partial differential equations and Fourier series. May not be taken for credit in addition to the equivalent MAT 303.

Prerequisite: AMS 161 or MAT 127 or 132 or 142 or 171

4 credits

AMS 410: Actuarial Mathematics

Integrates calculus and probability with risk assessment and insurance in a quantitative manner to prepare students for the first actuarial examination.

Prerequisites: AMS 261 or MAT 203 or 205; AMS 310; AMS 311 or 315

3 credits

AMS 441: Business Enterprise

Explores the strategy and technology of business enterprises. Integrates the practice of engineering and quantitative methods with the operations of a business in today's globalized environment, whether in product development, financial management, or e-commerce.

Prerequisite: Junior or Senior Standing

3 credits

AMS 475: Undergraduate Teaching Practicum

Students assist the faculty in teaching by conducting recitation or laboratory sections that supplement a lecture course. The student receives regularly scheduled supervision from the faculty advisor. May be used as an open elective only and repeated once.

Prerequisites: U4 standing as an undergraduate major within the college; a minimum g.p.a. of 3.00 in all Stony Brook courses and the grade of B or better in the course in which the student is to assist; permission of department

3 credits

AMS 476: Undergraduate Teaching Practicum

Students assist the faculty in teaching by conducting recitation or laboratory sections that supplement a lecture course. The student receives regularly scheduled supervision from the faculty advisor. May be used as an open elective only and repeated once.

Prerequisites: U4 standing as an undergraduate major within the college; a minimum g.p.a. of 3.00 in all Stony Brook courses and the grade of B or better in the course in which the student is to assist; permission of department

3 credits

AMS 487: Research in Applied Mathematics

An independent research project with faculty supervision. Permission to register requires a B average and the agreement of a faculty member to supervise the research. May be repeated once. Only 3 credits of research electives (AMS 487, CSE 487, MEC 499, ESE 499, ESM 499, EST 499, ISE 487) may be counted toward engineering technical elective requirements.

Prerequisites: Permission of instructor and department

0-3 credits

AMS 492: Topics in Applied Mathematics

Treatment of an area of applied mathematics that expands upon the undergraduate curriculum. Topics may include applied mathematics, statistics, or operations research and change from semester to semester. Semester supplements to this Bulletin contain specific description when course is offered. May be repeated once, as the topic changes.

Prerequisite: Permission of instructor

3 credits