Mathematics and Statistics

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Golam Kibria, Associate Professor
Solange Kouemou, Instructor
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Thomas Leness, Associate Professor
Xiaosheng Li, Assistant Professor
Dane McGuckian, Instructor
Abdelhamid Meziani, Professor
Jie Mi, Professor
Richard Nadel, Instructor
Taje Ramsamujh, Associate Professor
Laura Reisert, Instructor
Alireza Rostamian, Instructor
Dev K. Roy, Associate Professor
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Richard L. Rubin, Associate Professor
Philippe Rukimbira, Professor
Samuel S. Shapiro, Professor Emeritus
Dinesh Sharma, Assistant Professor
Carmen Shershin, Instructor
Robert Storfer, Instructor
Theodore Tachim Medjo, Professor
Louis Roder Tcheugoue Tebou, Associate Professor
Enrique Villamor, Professor
Anna Wlodarczyk, Instructor
Yi Zhi Yang, Instructor
Mirroslav Yotov, Assistant Professor
Hassan Zahedi-Jasbi, Associate Professor
Noel Zuniga, Lecturer
John Zweibel, Associate Professor

Remarks: Courses completed elsewhere may be applied to the Mathematical Sciences minor, with the approval of the department. However, at least 2 of the 4 courses noted above, excluding MAC 2311-2-3, must be completed at FIU.

Bachelor of Science in Mathematics

Degree Program Hours: 120

Lower Division Preparation

To qualify for admission to the program, FIU undergraduates must have met all the lower division requirements including CLAS, completed 60 semester hours, and must be otherwise acceptable into the program.

Common Prerequisite Courses and Equivalencies

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¹a scientific programming course designed for computer science majors.
²one laboratory based science course designed for science majors.

Courses which form part of the statewide articulation between the State University System and the Community College System will fulfill the Lower Division Common Prerequisites.

For generic course substitutions/ equivalencies for Common Program Prerequisites offered at community colleges, state colleges, or state universities, visit: http://facts.org. See Common Prerequisite Manual.

Required Courses

Common Prerequisites

MAC 2311 Calculus I
MAC 2312 Calculus II
MAC 2313 Calculus III
MAP 2302 Differential Equations
COP 2210 Introduction to Programming or
COP 2250 Java Programming or
CGS 2423 C for Engineers

Completion of one of the following courses with labs:

BSC 1010 General Biology I
BSC 1010L General Biology Lab I
BSC 1011 General Biology II
BSC 1011L General Biology Lab II
CHM 1045 General Chemistry I
CHM 1045L General Chemistry Lab I
CHM 1046 General Chemistry II

Minor in Mathematical Sciences

Required Courses

MAC 2311-2-3. Calculus I,II,III (or equivalent).
Plus MAP 2302, MAS 3105, and two courses from those approved for the Mathematical Sciences Major program. A grade of ‘C’ or higher is necessary for the minor.
Courses required for the degree:
Completion of one additional science course with lab from previous list.
MAS 3105 Linear Algebra

Upper Division Program

Required Courses
MAA 3200 Introduction to Advanced Mathematics 3
MAA 4211 Advanced Calculus 3
MAS 4301 Algebraic Structures 3
MAT 4934 Senior Seminar 1
STA 4321 Mathematical Statistics I 3

In addition, three courses from each of the following lists.
List 1
MAD 4203 Introduction to Combinatorics 3
MAA 4402 Complex Variables 3
MTG 3212 College Geometry 3
MAS 4203 Number Theory 3
MMA 4212 Topics in Advanced Calculus 3
MAS 4302 Topics in Algebraic Structures 3
MTG 4302 Topology 3

List 2
MAP 4401 Advanced Differential Equations 3
MAD 3305 Graph Theory 3
MAP 3103 Mathematical Modeling 3
STA 4322 Mathematical Statistics II 3
MAD 3401 Numerical Analysis 3
MHF 4302 Mathematical Logic 3
MHF 4102 Axiomatic Set Theory 3

Electives
The balance of the 60 semester hour requirement for graduation may be chosen from any courses in the University approved by the student’s advisor. Remarks: The following courses are not acceptable for credit toward graduation, unless a student has passed the course before declaring a Mathematics major: MAC 2233, STA 1013, STA 2122, STA 3123, STA 2023, and QMB 3200 (College of Business Administration).

Combined BS in Mathematics/MS in Mathematical Sciences
This program will allow strong students in mathematics to complete a bachelor’s degree and a master’s degree in 5 years rather than the usual six. A minimum of 140 credits are required for graduation with both the bachelor’s and the master’s degree. In addition to fulfilling the requirements for the Bachelor’s degree in mathematics, these 140 credits include 30 graduate credits required for the Master’s of Science in Mathematical Sciences. A maximum of ten (10) graduate mathematics credits can be concurrently used toward the bachelor’s and master’s degrees.
To be considered for admission to the combined bachelor's/master's degree program, students must have completed at least 75-90 credits in the bachelor's degree program at FIU and meet the admissions criteria for the graduate degree program to which they are applying. Students need only apply once to the combined degree program, but the application must be submitted to Graduate Admissions before the student starts the last 30 credits of the bachelor’s degree program. A student admitted to the combined degree program will be considered to have undergraduate status until the student applies for graduation from their bachelor's degree program. Upon conferral of the bachelor's degree, the student will be granted graduate status and be eligible for graduate assistantships. Only 5000-level or higher courses, and no more than the number of credits specified by the program catalog, may be applied toward both degrees.

Admission Requirements
1. Current enrollment in a Bachelor's degree program in mathematics.
2. Current overall GPA of at least 3.2 and GPA of at least 3.2 in upper division courses.
3. Completion of 90 undergraduate credit-hours.
4. A minimum combined (verbal and quantitative) GRE score of 1000 to be obtained before entering the MS phase of the program.
5. Approval of the graduate committee.

Completion Requirements
Year 1 and 2:
MAC 2311 Calculus I
MAC 2312 Calculus II
MAC 2313 Calculus III
MAS 3105 Linear Algebra
STA 4322 Introduction to Mathematical Sciences I
Year 3
Fall
MAA 3200 Introduction to Advanced Mathematics
STA 4321 Introduction to Mathematical Sciences I
Spring
MAA 4211 Advanced Calculus
MAS 4301 Algebraic Structures
One course from List 1 or 2
Summer
One course from List 1 or 2 and 1 graduate course
Year 4
Fall
MAA 5616 Introduction to Real Analysis
One course from List 1 or 2
Senior Seminar (1 credit)
Spring
One graduate course
Two courses from List 1 or 2
Summer
Three graduate credits
Year 5
Fall
Nine graduate credits
Spring
Nine graduate credits
The graduate courses distribution should follow catalog descriptions of the master’s program requirements. Students must take at least 3 courses from List 1 and at least 3 courses from List 2. The balance of the 140 semester hours required for graduation may be chosen from any courses in the university, a minimum of six (6) of these should be at the upper division level or higher.

List 1
- MAD 4203 Introduction to Combinatorics 3
- MAA 4402 Complex Variables 3
- MTG 3212 College Geometry 3
- MAS 4203 Number Theory 3
- MAA 4212 Topics in Advanced Calculus 3
- MAS 4302 Topics in Algebraic Structures 3
- MTG 4302 Topology 3

List 2
- MAP 4401 Advanced Differential Equations 3
- MAD 3305 Graph Theory 3
- MAP 3103 Mathematical Modeling 3
- STA 4322 Mathematical Statistics II 3
- MAD 3401 Numerical Analysis 3
- MHF 4302 Mathematical Logic 3
- MHF 4102 Axiomatic Set Theory 3

Bachelor of Arts in Mathematics: Mathematics Education Major

Degree Program Hours: 120

Lower Division Preparation

To qualify for admission to the program, a student must have met all the lower division requirements and must be otherwise acceptable into the program. In addition to the University Core Curriculum, Foreign Language, and Common Prerequisites, requirements include a minimum overall GPA of 2.5 for all lower-division/transfer coursework and achieve the competencies of the CLAS requirement, the General Knowledge Exam, or the Praxis I.

Common Prerequisite Courses and Equivalencies

**FLU Course(s)** | **Equivalent Course(s)**
--- | ---
MAC 2311 | MACX311
MAC 2312 | MACX312
MAC 2313 | MACX313
MAP 2302 | MAPX302
COP 2250 or COP 2210 | COPX3XX¹
or CGS 2423
BSC 1010, BSC 1010L, | BSCXXXX/XXXXL² or
BSC 1011, BSC 1011L, | CHMXXXX/XXXXL² or
CHM 1045, CHM 1045L, | PHYXXXX/XXXXL²
CHM 1046, CHM 1046L, | PHY2048, PHY2048L,
PHY 2048, PHY 2048L, | PHY2049, PHY2049L

¹A scientific programming course designed for computer science majors.
²One laboratory based science course designed for science majors.

Courses which form part of the statewide articulation between the State University System and the Community System will fulfill the Lower Division Common Prerequisites.


**Common Prerequisites**
- MAC 2311 Calculus I
- MAC 2312 Calculus II
- MAC 2313 Calculus III
- MAP 2302 Differential Equations
- COP 2250 Java Programming
- COP 2210 Introduction to Programming
- CGS 2423 C for Engineers

**Completion of one of the following courses with labs:**
- BSC 1010 General Biology I
- BSC 1010L General Biology Lab I
- BSC 1011 General Biology II
- BSC 1011L General Biology Lab II
- CHM 1045 General Chemistry I
- CHM 1045L General Chemistry Lab I
- CHM 1046 General Chemistry II
- CHM 1046L General Chemistry Lab II
- PHY 2048 Physics with Calculus I
- PHY 2048L Physics with Calculus Lab I
- PHY 2049 Physics with Calculus II
- PHY 2049L Physics with Calculus Lab II

**Courses required for the degree:**
Completion of one additional science course with lab from previous list.
- MAD 2140 Discrete Math
- MAS 3105 Linear Algebra

**Upper Division Math and Statistics Core: 24**
- MAP 3103 Mathematical Modeling 3
- MAP 3103L Lab for Mathematical Modeling 1
- MAA 3200 Introduction to Advanced Mathematics 3
- MTG 3212 College Geometry 3
- MHF 3404 History of Mathematics 3
- MAS 4203 Number Theory 3
- MAT 4510 Problem Solving Seminar 3
- STA 4321 Introduction to Mathematical Statistics I 3
- STA 4321L Introduction to Mathematical Statistics I 3

**Upper Division Education Core: 28**
- MAE 4393 Nature of Math and Science 3
- MAE 4394 Perspectives in Math and Science Education 3
- MAE 3893 Mathematics Education Seminar 1
- RED 4325 Subject Area Reading 3
- MAE 3651 Learning Mathematics with Technology 3
- MAE 4330 Teaching and Learning Secondary Mathematics 4
- TSL 4324 ESOL Issues and Strategies for Content Area Teachers 3
- MAE 4942 Student Teaching 9
Minor in Mathematics

Required Courses
MAC 2311-2-3 Calculus I-I-III (or equivalent).

Plus four courses from those approved for the Mathematics Major program. MAP 2302 and MAS 3105 may be included among these four courses. A grade of ‘C’ or higher is necessary for the minor.

Remarks: Courses completed elsewhere may be applied to the Mathematics minor, with the approval of the department. However, at least 2 of the 4 courses noted above, excluding MAC 2311-2-3, must be completed at FIU.

Bachelor of Science in Statistics

Degree Program Hours: 120

Lower Division Preparation
To qualify for admission to the program, FIU undergraduates must have met all the lower division requirements including CLAS, completed 60 semester hours, and must be otherwise acceptable into the program.

Common Prerequisite Courses and Equivalencies

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<td>MAC 2313</td>
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</tr>
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<tr>
<td>STA 2XXX</td>
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Courses which form part of the statewide articulation between the State University System and the Community College System will fulfill the Lower Division Common Prerequisites.

For generic course substitutions/equivalencies for Common Program Prerequisites offered at community colleges, state colleges, or state universities, visit: http://facts.org. See Common Prerequisite Manual.

Common Prerequisites

| COP 2210 | Programming I |
| CGS 2423 | C for Engineers |
| MAC 2311 | Calculus I |
| MAC 2312 | Calculus II |
| MAC 2313 | Multivariable Calculus |
| STA 2XXX | Any introductory statistics course or consent of the department |
| BSC 1010 | General Biology I |
| BSC 1010L | General Biology Lab I |
| BSC 1011 | General Biology II |
| BSC 1011L | General Biology Lab II |
| BSC 2023 | Human Biology |
| BSC 2023L | Human Biology Lab |
| CHM 1032 | Chemistry & Society |
| CHM 1032L | Chemistry & Society Lab |
| CHM 1033 | Survey of Chemistry |
| CHM 1033L | Survey of Chemistry Lab |
| CHM 1045 | General Chemistry I |
| CHM 1045L | General Chemistry Lab I |
| CHM 1046 | General Chemistry II |
| CHM 1046L | General Chemistry Lab II |
| PHY 2048 | Physics with Calculus I |
| PHY 2048L | General Physics Lab I |
| PHY 2049 | Physics with Calculus II |
| PHY 2049L | General Physics Lab II |

Courses required for the degree:

MAS 3105 Linear Algebra

Upper Division Program

Required Courses: (33)

| STA 3163 | Statistical Methods I | 3 |
| STA 3164 | Statistical Methods II | 3 |
| STA 3951 | Oral Presentations in Statistics | 0 |
| STA 4321 | Introduction to Mathematical Statistics I | 3 |
| STA 4322 | Introduction to Mathematical Statistics II | 3 |
| STA 4202 | Introduction to Design of Experiments | 3 |
| STA 4234 | Introduction to Regression Analysis | 3 |
| STA 4664 | Statistical Quality Control | 3 |
| ENC 3213 | Professional & Technical Writing | 3 |

Six additional credit hours of approved statistics courses. Three additional credit hours in an approved statistics, mathematics, or computer science course. A grade of ‘C’ or higher in each of these courses is necessary for the major.

Electives

The balance of the 120 semester hour requirement for graduation may be chosen from any courses in the University approved by the student’s advisor.

Remarks: The student must consult his or her advisor to determine which courses, in addition to the required courses listed above, satisfy the requirements for a statistics major. The following courses are not acceptable for credit toward graduation, unless a student has passed the course before declaring a statistics major: MAC 2233, STA 1013, STA 2023, STA 3033, STA 3111, STA 3112, STA 2122, STA 3123, STA 3145 and QMB 3200 (College of Business Administration).

Combined Bachelor's/Master's Degree in Statistics

To be considered for admission to the combined bachelor’s/master’s degree program, students must have completed at least 75-90 credits in the bachelor’s degree program at FIU and meet the admissions criteria for the graduate degree program to which they are applying. Students need only apply once to the combined degree program, but the application must be submitted to
Graduate Admissions before the student starts the last 30 credits of the bachelor's degree program. A student admitted to the combined degree program will be considered to have undergraduate status until the student applies for graduation from their bachelor's degree program. Upon conferral of the bachelor's degree, the student will be granted graduate status and be eligible for graduate assistantships. Only 5000-level or higher courses, and no more than the number of credits specified by the program catalog, may be applied toward both degrees.

Admission Requirements

- Current enrollment in the first semester of the senior year Bachelor's Degree Program in Statistics at FIU.
- Completed or enrolled in at least 90 undergraduate credits hours
- Current GPA of 3.25 of higher
- GRE combined score of at least 1000 (quantitative and verbal)

Courses and other General Requirements

Students enrolled in the program may count up to 9 hours as credits for both the undergraduate and graduate degree programs. These courses must be taken at least at the 5000 level and can be chosen from the following list (amongst others):

- STA 5206 Design of Experiments I
- STA 5236 Regression Analysis
- STA 5507 Nonparametric Methods
- STA 5666 Advanced Quality Control
- STA 5207 Topics in Design of Experiments
- STA 7707 Multivariate Methods I
- STA 7708 Multivariate Methods II

Students who count cross listed courses towards the degree will not get credit for both the 4000 level and the 5000 level course. In fact, the students will not be allowed to take both the courses.

In addition, as part of earning the MS degree the students are required to take the following core courses:

- STA 6244 Data Analysis I
- STA 6247 Data Analysis II
- STA 6326 Mathematical Statistics I
- STA 6327 Mathematical Statistics II

The BS/MS program is designed to be a continuous program. However, upon completion of all the requirements of the undergraduate degree, students will receive the BS degree. Students in this program have up to one year after receipt of the bachelor's degree to complete the MS degree. Students who fail to meet the post BS requirement or who elect to leave the combined program at any time and earn only the BS degree will have the same access requirements to regular graduate programs as any other student but will not be able to use the 9 credits for both the bachelor's and master's degree.

Students enrolled in the program must maintain an overall GPA of 3.0 or higher and must get a minimum grade of "B" in all the core courses. Upon completion of the entire 4+1 program, students must have accumulated a minimum of 30 hours of credits at the graduate (5000+) level. In addition, to get the MS degree, the students will also be required to take a comprehensive examination or do a thesis. Students opting for the comprehensive exam will be required to take an additional 6 hours of credits at the graduate (5000+) level. All students enrolled in the program will be expected to attend the departmental seminars.

Minor in Statistics

Lower or Upper Division Preparation: (3 or 4)

- MAC 2312 Calculus II
- STA 2023 Statistics for Business and Economics
- STA 2122 Introduction to Statistics I
- STA 3111 Statistics I

Upper Division Program: (12)

Required Courses

- STA 3163 Statistical Methods I
- STA 3164 Statistical Methods II

Two additional courses from the following list:

- STA 3033 Introduction to Probability and Statistics for CS
- STA 4321 Introduction to Mathematical Statistics I
- STA 4322 Introduction to Mathematical Statistics II
- STA 4202 Introduction to Design of Experiments
- STA 4234 Introduction to Regression Analysis
- STA 4502 Introduction to Nonparametric Methods
- STA 4664 Statistical Quality Control

1STA 4321 has MAC 2313 as a prerequisite.

A grade of ‘C’ or higher in each of these courses is necessary for the minor.

Remarks: No courses in statistics, mathematics or computer sciences can be applied to more than one minor in these disciplines, nor can courses used to satisfy major requirements be used towards minor requirements. In the case where a course is required for both a major in one area and a minor in another, the student should see his or her advisor for an appropriate substitution for the requirement of the minor.

Certificate Program in Actuarial Studies

The department offers a certificate in Actuarial Studies. For further information refer to the Certificate section at the end of the College of Arts and Sciences’ section.

Course Descriptions

Definition of Prefixes


F-Fall semester offering; S-Spring semester offering; SS-Summer semester offering

MAA 3200 Introduction to Advanced Mathematics (3). Topics include: naive set theory, functions, cardinality,
sequences of real numbers and limits. Emphasis on formal
proofs. Prerequisite: MAC 2313. (F)

MAA 4211 Advanced Calculus (3). An intense study
of the foundations of calculus. Topics may include: the real
number system, continuity, differentiation, Riemann-
Stieltjes integration, and series of functions. Note: The
student must complete MAA 3200 before attempting this
course. Prerequisites: MAC 2313, MAS 3105 and MAA
3200. (S)

MAA 4212 Advanced Calculus II (3). A sequel to MAA
4211. Topics may include: theory of integration; analysis in
several variables; and Fourier series. Prerequisite: MAA
4211.

MAA 4402 Complex Variables (3). An introduction to
complex variables, beginning with the algebra and
gometry of the complex number system. Topics include:
complex functions; analytic functions; Cauchy's theorem
and its consequences; Taylor and Laurent series; residue
calculus; evaluation of real integrals and summation of
series; conformal mapping. Prerequisites: MAC 2313, and
MAP 2302 or MAA 4211. (F)

MAC 1105 College Algebra (3). Operations on
polynomials, rational expressions, radicals: lines, circles;
inverse functions, exponential and logarithmic functions;
systems of equations and inequalities. Students cannot
receive credit for both this course and MAC 2147.
Prerequisites: High school algebra and adequate
placement test score. (F,S,SS)

MAC 1114 Trigonometry (3). Trigonometric functions,
identities, conditional equations, polar coordinates,
vectors, polar graphs, complex numbers, DeMoivre's
Theorem, conic sections. Student cannot receive credit for
both this course and MAC 2147. Prerequisites: High school
algebra and adequate placement test score. (F,S,SS)

MAC 2147 Pre-calculus Mathematics (4). Topics to be
covered include: functions, exponential and logarithmic
functions, trigonometry and the basics of analytic
gometry. Prerequisites: Two years of high school algebra
and adequate placement test score. (F,S,SS)

MAC 2233 Calculus For Business (3). A one semester
introduction to the basic notions of calculus. Specific
topics include: Differential Calculus using polynomial,
exponential and logarithmic functions, and its application
to optimization; integral calculus with area and probability
applications. Prerequisites: Grade of "C" or higher in
College Algebra or Pre-calculus or adequate placement
test score. (F,S,SS)

MAC 2241 Calculus 1 for Biology (4). Emphasis on
applications to biological systems. Concepts of calculus
will be developed together with solutions, techniques of
both analytical and numerical nature. Prerequisite: MAC
2147.

MAC 2241L Lab for Calculus 1 for Biology (1). Review
of numerical methods used in calculus 1 by students in
QBIC program. Prerequisite: Permission of the
department.

MAC 2242 Calculus 2 for Biology (4). A continuation of
Calculus 1 for Biology. Covers calculus 2 concepts with
emphasis on biological applications. A portion of the
course deals with differential equations. Prerequisite: MAC
2241.

MAC 2242L Lab for Calculus 2 for Biology (1). Review
of numerical methods in calculus 2 by students in QBIC
program. Prerequisite: Permission of the department.

MAC 2311 Calculus I (4). Limits, derivatives and their
formulas, applications of derivatives, introduction to anti
derivatives, introduction to parametric curves.
Prerequisites: Grade of "C" or higher in Trigonometry or
Pre-calculus or adequate placement test score. (F,S,SS)

MAC 2312 Calculus II (4). Applications of the integral,
integration techniques, improper integrals, Riemann sums,
the integral, Fundamental Theorem of Calculus, infinite
series, Taylor series, polar coordinates, parametric
equations. Prerequisites: Grade of "C" or higher in
Calculus I or AP Calculus credit. (F,S,SS)

MAC 2313 Multivariable Calculus (4). This course deals
with the differential and integral calculus of real valued
multivariable functions. The topics include: directional and
partial derivatives, gradients, and their applications;
differential calculus of vector valued functions; multiple,
iterated, line, and surface integrals. Prerequisites: MAC
2312 or equivalent with a grade of 'C' or better. (F,S,SS)

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MAD 1100 Mathematics for Information Technology
(3). Introduction to discrete mathematical structures with
emphasis on applications to information technology: binary
numbers, logic, sets, functions, recursion, combinatories,
graph theory, Boolean algebra. Prerequisite: College
Algebra.

MAD 2104 Discrete Mathematics (3). Sets, functions,
relations, permutations, and combinations, propositional
logic, matrix algebra, graphs and trees, Boolean algebra,
switching circuits. (F,S,SS)

MAD 3305 Graph Theory (3). An introduction to the study
of graphs. Topics include the following: paths and circuits,
connectedness, trees, shortest paths, networks, planar
graphs, the coloring of graphs, and directed graphs.
Applications of graphs to computer science will be
discussed. Prerequisites: COP 2210 or CGS 2420 and
either MAS 3105 or MAD 2104. (F,S,SS)

MAD 3401 Numerical Analysis (3). Basic ideas and
techniques of numerical analysis. Topics include: finite
differences, interpolation, solution of equations, numerical
integration and differentiation, applications, introduction to
applied linear algebra. This course will make extensive
laboratory use of the computer facility. Prerequisites: COP
2210 or CGS 2420 and MAD 3121. (F,S,SS)

MAD 3512 Theory of Algorithms (3). Strings, formal
languages, finite state machines, Turing machines,
primitive recursive and recursive functions, recursive
unsolvability. Prerequisite: MAD 2104. Computer Science
majors must also take COT 3420. (F,S,SS)

MAD 4203 Introduction to Combinatorics (3). A survey
of the basic techniques of combinatorial mathematics.
Topics will include the Pigeonhole Principle, Binomial
Coefficients, Inclusion-Exclusion, Recurrence Relations,
and Generating Functions. Prerequisites: MAC 2313 or
both MAC 2312 and MAD 2104. (SS)
MAE 3893 Mathematics Education Seminar (1). Provides students committed to Mathematics Education an early teaching experience and it will provide other students a low pressure opportunity to try out teaching. Prerequisite: MAC 2311.

MAE 3894 Early Teaching Experience (1). The goal of this course is to provide early in the program a unique opportunity for math education students to experience the tastes, the challenges, and the rewards involved in the teaching of math. Prerequisite: MAC 2311.

MAP 2302 Differential Equations (3). An introduction to differential equations and their applications, based upon a knowledge of calculus. Topics to include: initial value problems of the first order, numerical solutions, systems of differential equations, linear differential equations, Laplace transforms, series solutions. Prerequisite: MAC 2312 with a grade of 'C' or better. (F,S,SS)

MAP 3103 Mathematical Modeling and Applications (3). A course to provide an understanding of the use of mathematical models in the description of the real world. Basic principles in the philosophy of formal model building as well as specific models will be considered. Prerequisites: MAS 3105 and either MAC 2313 or MAP 2302.

MAP 3103L Lab for Mathematical Modeling (1). Lab sessions complement the course of mathematical modeling (MAP 3103). Computer projects using "MATLAB" will be used. Prerequisite: MAP 3103. Corequisite: MAP 3103.

MAP 3104 Topics in Mathematical Modeling (3). A sequel to MAP 3103. In-depth study of techniques listed for MAP 3103. Prerequisite: MAP 3103.

MAP 3253 Mathematical Scientific Computation (3). To acquaint students with some mathematical programming skills involving numerical computation softwares like Mathematica, Matlab, scientific document processing LaTeX, and data analysis tool Excel. Prerequisites: MAC 2312, MAS 3105.

MAP 4401 Advanced Differential Equations (3). A second course in differential equations. Topics may include: Bessel functions and other special functions arising from classical differential equations, Sturm-Liouville problems, partial differential equations, transform techniques. Prerequisites: MAP 2302 and MAC 2313. (S)

MAP 4401L Lab for Advanced Differential Equations (1). Lab sessions complement the course of advanced differential equations (MAP 4401). Computer projects using "MATLAB" will be used. Prerequisites: MAP 2302, MAC 2313. Corequisite: MAP 4401.

MAP 5117 Mathematical and Statistical Modeling (3). Study of ecological, probabilistic, and various statistical models. Prerequisites: COP 2210, MAC 2313, MAS 3105; and STA 3033 or STA 3164 or STA 4322.

MAP 5255 Mathematical Scientific Computation (3). Programming in Matlab, Graphics in Matlab, Creating GUIs in Matlab, Simulink. Prerequisites: MAC 2313, MAP 2302, MAS 3105.

MAS 3105 Linear Algebra (3). An introduction to the topics in linear algebra most often used in applications. Topics include: matrices and their applications; simultaneous linear equations and elementary operations; linear dependence; vector spaces; rank and inverses; inner products and ‘best’ approximations; numerical solutions of simultaneous linear equations; eigen-values and eigenvectors; iterative methods for calculating eigenvalues; and systems of linear equations. Prerequisite: MAC 2312. (F,S,SS)

MAS 3931 Topics in Actuarial Mathematics (1). Topics related to calculus/linear algebra such as mono-tone sequences, least upper bound, complex arithmetic, solid analytic geometry, linear transformations. Mathematics involved in insurance. Prerequisite: Admission to Actuarial Studies Certificate program.

MAS 4203 Number Theory (3). Topics to be discussed are selected from the following: congruences, Diophantine equations, distribution of primes, primitive roots, quadratic reciprocity, and classical theorems of number theory. Prerequisites: MAA 3200 or MAS 3105 or MTG 3212. (SS)

MAS 4301 Algebraic Structures (3). An introduction to abstract mathematical structures of modern algebra. Fundamental concepts of groups, rings, and fields will be studied. Note: the student must complete MAA 3200 before attempting this course. Prerequisites: MAS 3105 and MAD 3200. (S)

MAS 4302 Topics in Algebraic Structures (3). A sequel to Algebraic Structures. Topics may include: a continuation of the study of groups, rings and/or fields; polynomial domains; Euclidean domains; and Galois theory. Prerequisite: MAS 4301.

MAT 2949 Cooperative Education in Mathematical Sciences (1-3). One semester of full-time supervised work in an outside organization taking part in the University Coop program. A written report and supervisor evaluation will be required of each student. Prerequisites: Calculus I and COP 2210.

MAT 3905 Independent Study (VAR). Individual conferences, assigned readings, and reports on independent investigations.

MAT 3930 Special Topics (VAR). A course designed to give groups of students an opportunity to pursue special studies not otherwise offered.

MAT 3949 Cooperative Education in Mathematical Sciences (1-3). One semester of full-time supervised work in an outside organization taking part in the University Coop Program. Limited to students admitted to the Co-op Program. A written report and supervisor evaluation will be required of each student. Prerequisites: Calculus II and COP 2210.

MAT 4510 Problem Solving Seminar (3). To strengthen students ability in solving basic mathematics problems by teaching them more advanced techniques for dealing with challenging problems. Prerequisites: MAD 2104, MAC 2311, MAC 2312, MAC 2313, MAS 3105, MAA 3200, MTG 3212, MAS 4203 or permission of the instructor.

MAT 4905 Independent Study (VAR). Individual conferences, assigned readings, and reports on independent investigations.
MAT 4930 Special Topics (VAR). A course designed to give groups of students an opportunity to pursue special studies not otherwise offered.

MAT 4934 Senior Mathematics Seminar (1). An exploration of research topics in the student's subfield. Coursework will include a written report, oral presentation, and departmental major field test. Prerequisite: Senior standing.

MAT 4943 Mathematical Sciences Internship (VAR). A special program to encourage students to get on-the-job experience in computer sciences, statistics, or mathematics in an industrial enterprise, governmental agency or other organization. Requirements: minimum grade of 'B' or higher in all courses in the major area, and approval by Departmental Internship Committee. Application is required at least one term in advance of registration for this course.

MAT 4949 Cooperative Education in Mathematical Sciences (1-3). One semester of full-time supervised work in an outside organization taking part in the University Coop Program. Limited to students admitted to the Co-op Program. A written report and supervisor evaluation will be required of each student. Prerequisites: Calculus II, a statistics course, and COP 2210.

MGF 1106 Finite Mathematics (3). Study of concepts and applications involving finite mathematical processes such as sets, combinatorial techniques, formal logic, discrete probability, linear systems, matrices, linear programming. Prerequisite: Working knowledge of high school algebra. (F,S,SS)

MGF 1107 The Mathematics of Social Choice and Decision Making (3). Voting systems and their desirable properties. Weighted voting systems, fair division procedures, apportionment methods and game theory.

MHF 3404 History of Mathematics (3). Development of mathematical thought through the ages. Topics may include equation solving, trigonometry, astronomy, and calculus. Prerequisite: MAC 2312. (S)

MHF 4102 Axiomatic Set Theory (3). Axioms of set theory, order and well-foundedness, cardinal numbers, ordinal numbers, axiom of choice, special topics. Prerequisites: MAA 3200 or permission of the instructor. (S, alternate years)

MHF 4302 Mathematical Logic (3). A study of formal logical systems and their applications to the foundations of mathematics. Topics to be selected from the following: definition of mathematical proofs; set theory; analysis formalized with the predicate calculus; theorem of Godel and Church; recursive function theory; and idealized computers. Prerequisites: MAA 3200 or MAD 3512. (S, alternate years)

MHF 4401 Topics in the History of Modern Mathematics (3). Riemannian geometry, relativity and other topics at discretion of instructor. Prerequisites: MAC 2313, MAS 3105.

MTG 1204 Geometry for Education (3). Introduction for teachers to basic concepts of Euclidean geometry with ideas and activities adaptable to classroom. Students study and analyze pattern, learning and enhancing analytic, creative and visualization skills.

MTG 3212 College Geometry (3). A study of the basic structure of Euclidean geometry together with topics from advanced Euclidean geometry and non-Euclidean geometry. Prerequisites: Calculus II or permission of the instructor. (S)

MTG 4254 Differential Geometry (3). Hypersurfaces in R^n. Geodesics and curvature. Parametrisation of surfaces, abstract manifolds. Integration, surfaces with boundary, Stokes Theorem. Isometries and intrinsic geometry. Gauss-Bonnet Theorem. Prerequisites: MAC 2311, MAS 3105, MAP 2302 or permission of the instructor.

MTG 4302 Topology (3). An introductory course in topology requiring a prerequisite knowledge of calculus. Topics to be discussed will be selected from the following: topological spaces, metric spaces, continuity, completeness, compactness, separation axioms, products spaces, subspaces, convergence, and homotopy theory. Prerequisites: MAC 2313, MAS 3105, and MAA 3200. (SS)

STA 1013 Statistics for Social Services (3). This is an elementary course in statistics, covering graphical and numerical condensation of data as well as the most basic parametric and non-parametric methods. Emphasis is placed on the interpretation of statistical results, rather than on ways to analyze experimental data. Prerequisite: High school algebra.

STA 1061 Introduction to SPSSX for Data Analysis (1). Data coding and entry for use on the mainframe. How to input data, create variables, select subsets of data. Use procedures such as: PRINT, FORMAT, MEANS, FREQ, SUMMARIES, TEST, CORR, UNI-VARIATE and PLOT. Prerequisite: A course in statistics.

STA 1062 Introduction to SAS for Data Analysis (1). Data coding for entry use on the mainframe. SAS Data step to input data, create variables, select subsets of data, PROCs such as: PRINT, FORMAT, MEANS, FREQ, SUMMARY, TEST, CORR, UNI-VARIATE and PLOT. Prerequisite: A course in statistics.

STA 2023 Statistics for Business and Economics (3). Starting with an introduction to probability, the course provides an introduction to statistical techniques used in management science. It includes descriptive statistics, probability distributions, estimation and testing of hypotheses. Subsequent credit for STA 2122 or STA 3111 will not be granted. Prerequisite: High school algebra. (F,S,SS)

STA 2122 Introduction to Statistics I (3). A course in descriptive and inferential statistics. Topics include: probability distribution of discrete and continuous random variables. Sampling distributions. Large sample estimation and hypothesis testing for means and proportions. Prerequisite: High school algebra. (F,S,SS)

STA 3033 Introduction to Probability and Statistics for CS (3). Basic probability laws, probability distributions, basic sampling theory, point and interval estimation, tests of hypotheses, regression and correlation. Prerequisite: MAC 2312. (F,S,SS)
STA 3060L Statistics Laboratory (1). A laboratory course designed to illustrate important statistical concepts through experiments. Data are analyzed using statistical software packages. Prerequisite or Corequisite: A statistics course.

STA 3111 Statistics I (3). Descriptive statistics. Basic probability rules. Discrete and continuous probability distributions. Point and interval estimation, hypothesis testing based on a single sample. Comparison of two proportions using independent and large samples. Subsequent credit for STA 2122 or STA 2023 will not be granted. Prerequisite: High school algebra. (F.S,SS)

STA 3112 Statistics II (3). Estimation and hypothesis testing based on two samples. Analysis of Variance. Simple linear regression. Linear correlation. Analysis of categorical data. Non-parametric methods. Use of statistical software packages. Subsequent credit for STA 3123 will not be granted. Prerequisite: STA 3111. (F.S,SS)

STA 3123 Introduction to Statistics II (4). Small sample statistical inference for means and variances. T, chi-square and F distributions. Analysis of variance, regression, correlation, basic nonparametric tests, goodness of fit tests and tests of independence. Prerequisites: STA 2122 or STA 2023 or equivalent. (F.S,SS)

STA 3145 Statistics for the Health Professions (3). Statistical analysis with applications in the health sciences. Binomial and normal distributions. Inferences about means and proportions. Regression, correlation, goodness of fit tests. Prerequisite: High school algebra. (F.S,SS)

STA 3153-STA 3164 Statistical Methods I and II (3-3). This course presents tools for the analysis of data. Specific topics include: use of normal distribution, tests of means, variances and proportions; the analysis of covariance and non-parametric procedures. Prerequisites: STA 3193 and permission of the instructor.

STA 3193 Statistics for Biology I (3). Graphical data analysis; probability distributions, estimation, test of hypothesis. Statistical models used in the biological sciences, and testing for distributional assumptions used with these models. Prerequisites: MAC 2312, BSC 1011 and permission of the instructor.

STA 3194 Statistics for Biology II (3). Analysis of variance, correlation, regression, discrete data analysis, analysis of covariance and non-parametric procedures. Introduction to design of experiments, bio assay, logistic regression and multivariate analysis. Prerequisites: STA 3193 and permission of the instructor.

STA 3905 Independent Study (1-6). Individual conferences, assigned readings, and reports on independent investigations.

STA 3930 Special Topics (1-6). A course designed to give groups of students an opportunity to pursue special studies not otherwise offered.

STA 3949 Cooperative Education in Statistics (1-3). One semester of either part-time or full-time work in an outside organization. Limited to students admitted to the Co-op program. A written report and supervisor evaluation are required of each student. Prerequisites: 2 courses in statistics and permission of Chairperson.

STA 3951 Oral Presentations in Statistics (0). Students are required to communicate orally all stages of a simple statistical analysis through a formal presentation in front of a group of faculty and students. Prerequisites: ENC 3213 and STA 3164 or equivalent. (F.S,SS)

STA 4102 Introduction to Statistical Computing (3). Data manipulation and statistical procedures using popular software, simulation, and statistical algorithms. Prerequisites: STA 3112 or STA 3123 or STA 3164, and COP 2210.

STA 4173-HSC 4510 Statistical Applications in Health Care (3). A course in descriptive and inferential statistics for the Health Services. Topics include probability distributions, point and interval estimation, hypothesis testing, regression and correlation, and contingency table analysis. Prerequisites: STA 1013 or equivalent college mathematics course.

STA 4182 Statistical Models (3). This is a specialized course in the use of statistical models to represent physical and social phenomena. The emphasis is on providing tools which will allow a researcher or analyst to gain some insight into phenomena being studied. An introductory knowledge of probability theory and random variables is assumed. Specific topics include: introduction to discrete and continuous probability distributions, transformation of variables, approximation of data by empirical distributions, central limit theorem, propagation of moments, Monte Carlo simulation, probability plotting, testing distributional assumptions. Prerequisites: STA 3033 or STA 4321.

STA 4202 Introduction to Design of Experiments (3). Completely randomized, randomized block, Latin square, factorial, nested and related designs. Multiple comparisons. Credit will not be given for both STA 4202 and STA 5206. Prerequisites: STA 3163 or STA 3112 or STA 3123 or STA 4322.

STA 4321-STA 4322 Introduction to Mathematical Statistics I and II (3-3). This course presents an introduction to the mathematics underlying the concepts of statistical analysis. It is based on a solid grounding in probability theory, and requires a knowledge of single and multivariable calculus. Specific topics include the following: basic probability concepts, random variables, probability densities, expectations, moment generating functions, sampling distributions, decision theory, estimation, hypothesis testing (parametric and non-parametric), regression, analysis of variance, and design of experiments. Prerequisite: STA 3112. (F,S)

STA 4234 Introduction to Regression Analysis (3). Multiple and polynomial regression, residual analysis, model identification and other related topics. Credit will not be given for both STA 4234 and STA 5236. Prerequisites: STA 3112 or STA 3123 or STA 3164.

STA 4502 Introduction to Non-parametric Methods (3). Sign, Mann-Whitney U, Wilcoxon signed rank, Kruskal-Wallis, Friedman and other distribution-free tests. Rank
correlation, contingency tables and other related topics. Credit for both STA 4502 and STA 5507 will not be granted. Prerequisite: A course in statistics.

**STA 4603-STA 4604 Mathematical Techniques of Operations Research I and II (3-3).** An introduction to those topics in mathematics associated with studies in operations research. Topics include the following: linear programming and related topics, dynamic programming, queuing theory, computer simulation, network analysis, inventory theory, decision theory, integer programming. Prerequisites: MAS 3105 and either STA 3033 or STA 4322.

**STA 4664 Statistical Quality Control (3).** This course presents the simple but powerful statistical techniques employed by industry to improve product quality and to reduce the cost of scrap. The course includes the use and construction of control charts (means, percentages, number defectives, ranges) and acceptance sampling plans (single and double). Standard sampling techniques such as MIL STD plans will be reviewed. Prerequisite: A course in statistics.

**STA 4905 Independent Study (1-6).** Individual conferences, assigned readings, and reports on independent investigations.

**STA 4930 Special Topics (1-6).** Designed to give students an opportunity to pursue special studies not otherwise offered. May be repeated.

**STA 4949 Cooperative Education in Statistics (1-3).** One semester of either part-time or full-time work, in an outside organization. Limited to students admitted to the Co-op program. A written report and supervisor evaluation are required of each student. Prerequisites: STA 3164, STA 4322 and permission of Chairperson.

**STA 5065L SAS Data Analysis Lab (1).** Entering data, descriptive statistics, graphing data, crosstabulations, t-tests, correlation and regression, and analysis of variance. Prerequisites: A statistics course and graduate standing or permission of the instructor.

**STA 5105L SPSS Data Analysis Lab (1).** Topics include: Entering data from various sources, data checking, descriptive statistics, graphing data, cross tabulations, tests, correlation and regression, ANOVA, and reliability. Prerequisites: A statistics course or concurrent enrollment in a statistics course, and graduate standing or permission of the instructor. (F,S,SS)

**STA 5106 Intermediate Statistics I (3).** Power, measures of assoc., measurement, ANOVA: one-way and factorial, between and within subjects expected mean squares, planned comparisons, a-priori contrasts, fixed, random, mixed models. This course may be of particular interest to behavioral sciences. Prerequisites: STA 3111 or STA 3123 or STA 3033; and graduate standing. (F)

**STA 5107 Intermediate Statistics II (3).** Correlation and regression both simple and multiple, general linear model, analysis of covariance, analysis of nominal data, analysis of categorical data. This course may be of particular interest to behavioral sciences. Prerequisite: Permission of the instructor. (S)

**STA 5126-PSY 5206 Fundamentals of Design of Experiments (3).** CRD and RCB designs. Latin square designs. Factorial, nested and nested-factorial experiments. Fixed, random and mixed models. Split-plot designs. Covariance analysis. Prerequisites: STA 3112 or STA 3123 or STA 3163 or STA 4322 or equivalent.

**STA 5206 Design of Experiments I (3).** Design and analysis of completely randomized block, Latin square factorial, nested experiments. Multiple comparisons. Credit for only one of three STA 4202, STA 5126, and STA 5206 courses will be granted. Prerequisites: STA 3033 or STA 3164 or STA 4322 or (STA 3163 and STA 4321).

**STA 5207 Topics in Design of Experiments (3).** This applied course in design of experiments covers topics such as split-plot design, confounding, fractional replication, incomplete block designs, and response surface designs. Prerequisite: STA 5206.

**STA 5236 Regression Analysis (3).** Simple, multiple and polynomial regression, analysis of residuals, model building and other related topics. Credit for both STA 4234 and STA 5236 will not be granted. Prerequisites: STA 3112 or STA 3123 or STA 3164, or STA 6167.

**STA 5446-STA 5447 Probability Theory I and II (3-3).** This course is designed to acquaint the student with the basic fundamentals of probability theory. It reviews the basic foundations of probability theory, covering such topics as discrete probability spaces, random walk, Markov Chains (transition matrix and ergodic properties), strong laws of probability, convergence theorems, and law of iterated logarithm. Prerequisite: MAC 2313.

**STA 5507 Nonparametric Methods (3).** Distribution-free tests: sign, Mann-Whitney U, Wilcoxon signed rank, Kruskal-Wallis, Friedman, etc. Rank correlation, contingency tables and other related topics. Credit for both STA 4502 and STA 5507 will not be granted. Prerequisite: A course in statistics.

**STA 5666 Advanced Statistical Quality Control (3).** Review of statistical methods useful in quality improvement. Statistical process control. Taguchi’s and Deming’s philosophies. Control charts. Process capability analysis. Acceptance sampling plans. Prerequisites: STA 3033 or STA 3163 or STA 4321 or equivalent.

**STA 5676 Reliability Engineering (3).** The course material is designed to give the student a basic understanding of the statistical and mathematical techniques which are used in engineering reliability analysis. A review will be made of the basic fundamental statistical techniques required. Subjects covered include: distributions used in reliability (exponential, binomial, extreme value, etc.); tests of hypotheses of failure rates; prediction of component reliability; system reliability prediction; and reliability apportionment. Prerequisite: STA 4322.

**STA 5800 Stochastic Processes for Engineers (3).** Probability and conditional probability distributions of a random variable, bivariate probability distributions, multiple random variables, stationary processes, Poisson and normal processes. Prerequisites: MAC 2313, MAP 2302, STA 3033.
STA 5826 Stochastic Processes (3). This course is intended to provide the student with the basic concepts of stochastic processes, and the use of such techniques in the analysis of systems. Subjects include: Markov Processes, queuing theory, renewal processes, birth and death processes, Poisson and Normal processes. Applications to system reliability analysis, behavioral science, and natural sciences will be stressed. Prerequisite: STA 5447.

STA 5906 Independent Study (1-6). Individual conferences, assigned reading, and reports on independent investigation.