# INFORMATION FOR STUDENTS IN MATHEMATICS AND STATISTICS

Department of Mathematics, 123 BAC, 529-5818, www.miamioh.edu/math
Department of Statistics, 311 UPH, 529-7828, www.miamioh.edu/stat

## MATHEMATICS AND STATISTICS AT MIAMI UNIVERSITY

Study in the fields of mathematics and statistics emphasizes careful problem analysis, precision of thought and expression, and the mathematical skills needed for work in many other areas. Fields in which mathematics and statistics play a major role include actuarial science, astronomy, chemistry, physics, computer science, economics, engineering, biology, geophysics, oceanography, meteorology, linguistics, cryptology, seismology and ecology.

Many important problems in government, private industry, health and environmental fields, and the academic world require sophisticated mathematical techniques for their solution. The study of mathematics and statistics provides specific analytical and quantitative tools, as well as general problem-solving skills, for dealing with these problems. Although many of these applications involve computers, there is a growing demand for graduates with broad mathematical training in addition to experience with computers.

The College of Arts and Science offers a Bachelor of Arts degree in mathematics, and three Bachelor of Science degrees in mathematics, mathematics and statistics, and statistics. The Arts degree allows a broader range of studies, and the B.S. degrees provide a more technical education. Licensure to teach mathematics in secondary schools is an integral part of the B.S. degree in mathematics offered by the School of Education. Minors are also offered in statistics, mathematics, actuarial science, and operations research methods.

*NOTE: The following document contains information regarding degrees offered in the Department of Mathematics. For information on a major or minor in statistics, please contact the Department of Statistics.

**Section headings in this document:**

## CAREER OPPORTUNITIES

What careers do math/stat majors pursue? The following table gives some of the possibilities. The next section looks at post-graduate education opportunities.

**Actuarial and Insurance**
Actuary
Accountant
Investment analyst
Benefits specialist
Financial planner

**Business / Industry**
Engineering analyst
Financial analyst
Statistician
Technical writer
Communications engineer
Fluid dynamics analyst
Consultant
Grant proposal writer
Product developer
Market researcher

**Statistics**
Analytical statistician
Theoretical statistician
Demographer
Quality control analyst
Econometrician
Psychometrician
Biometrician

**Health**
Ecologist
Biomathematician
Biomedical engineer

**Operations Research**
Operations analyst
Systems engineer

**Computer and Information Sciences**
Computer programmer
Data processor
Data base manager
Applications programmer
Systems analyst
Computer applications engineer
Control Systems engineer
Numerical analyst

**Teaching**
Teacher / junior high / high school
Secondary school teacher
Community college instructor
College and university instructor

**NOTE:** Some of the listed career options may require additional education and/or training beyond the bachelor's degree.

## GRADUATE / PROFESSIONAL SCHOOL OPPORTUNITIES

A Bachelor's degree in mathematics and/or statistics is an excellent base for students planning to pursue a master's or doctorate degree in a more specialized or technical field such as business administration, computer engineering, computer science, operations research, statistics, or economics. Additionally mathematics or statistics is an appropriate pre-professional degree for students considering fields such as law, business, or medicine.

## SOURCES OF ADDITIONAL INFORMATION

**Arts and Science Academic Advising**
146 Upham, 529-3031, http://www.cas.miamioh.edu/advising
- University & Liberal Education Requirements
- Career Decision Making

**Office of Career Services** and **Career Exploration and Testing Center**
200 Hoyt Hall, 529-3831, http://www.miamioh.edu/careers

## BACHELOR'S DEGREE ADVISING

This Information for Mathematics and Statistics Majors (IMSM) lists the requirements for the various degrees. This document is not meant to replace advising, because to know the requirements is not the same as knowing how to meet these requirements. The difficult part is knowing when someone is ready to take a given mathematics or statistics course, because this often means more than simply meeting the prerequisites. An adviser can be of great help in this regard, as well as helping insure that a student's interpretation of requirements is accurate.

Students with a major in these departments have an assigned faculty adviser with whom they are strongly encouraged to meet on a regular basis. Questions that cannot be settled with one's adviser can be taken to a Chief Departmental Adviser (CDA): Mr. Joshua Wagner (529-5810, 240 BAC, wagnerja@miamioh.edu) for mathematics; Professor Charles Dunn (529-1952, 304B UPH, dunncl@miamioh.edu) for statistics.

If every student planning to take an upper division course in mathematics or statistics were to talk that decision over with an adviser, it would help insure against problems later on. This is not to guarantee that you will do well after seeing an adviser, but your chances will improve. You will be more aware of what you are getting into and what to do if it does not work out.

## HOW TO BEGIN - THE FIRST TWO YEARS

During their first two years of study, most MTH / STA majors complete a Calculus sequence (ending with Calculus III, MTH 252 or MTH 252.H), Linear Algebra (MTH 222) and one to three additional Mathematics or Statistics courses. Students may begin the statistics sequence (STA 301, 401, …) prior to Calculus III but will need Calculus III and either MTH 222 or MTH 231 for higher-level STA courses. ***An adviser can help you choose additional courses in mathematics or statistics beyond the 200 level.***

It is a good idea to take a computer programming course, such as CSE 174, in your first year. That course will satisfy part of the Related Courses Requirement. Other electives should be carefully selected to apply toward the Foundation part of the Miami Plan, your divisional requirements, and/or to start a base for meeting the remainder of the Related Courses requirement.

Each year a number of students qualify for a head start in our programs by having passed an Advanced Placement Examination of the Educational Testing Service in calculus or statistics. The following table gives details:

| **Exam** | **Score** | **AP Credit** | **Starting Course** |
|---|---|---|---|
| Statistics | 3, 4 or 5 | STA 261 | STA 363 (Statistical Methods Minor) or<br>STA 401 (after completing the Calc II prerequisite) |
| Calculus AB | 3 | MTH 151 | MTH 249 (or drop back to MTH 153, see Note 2) |
| Calculus AB | 4 or 5 | MTH 151 | MTH 249 or 249.H |
| Calculus BC | 3 | MTH 151, 251 | MTH 252 (or drop back to MTH 249, see Note 3) |
| Calculus BC | 4 or 5 | MTH 151, 251 | MTH 252 or 222.T/331.T (See Note 5) |

***Notes on Fall Offerings***

1. At most 14 semester hours of calculus count towards graduation.
2. A student with AP credit for MTH 151-251 may choose to 'drop back' or repeat Calculus II by taking MTH 249. In this case, the student ends up with a total of 10 credits—5 from AP and 5 from MTH 249.
3. MTH 249 is offered Fall Term only with enrollment limited to incoming first-year students. MTH 249.H is the honors version, intended for students who have credit for MTH 151 and: have earned a 5 on the AB Advanced Placement Calculus exam, or have scored 31 or higher on the ACT, or have scored 1350 or higher on the SAT.
4. MTH 222.T and MTH 331.T are special versions of 222 and 331 that are combined to create a single 5-hour course. It is necessary to register for both courses separately, however. Students who have credit for Calculus I and II, and have shown strong interest and talent in mathematics, should consider MTH 222.T/331.T. Admission to this course requires the permission of the instructor. Contact the instructor or a mathematics adviser.

***Notes on MTH 231, 331, 347, and STA 301***

1. MTH 331 is a requirement in mathematics teacher licensure programs only. However, all students should seriously consider taking one of MTH 331 and 347. You are strongly encouraged to seek advice regarding these courses.
2. Credit towards graduation will be granted for at most one of MTH 231 and 331.
3. Requirements and restrictions covering 300-level courses vary among the math/stat degree programs. Pay close attention to the requirements in the next section (in particular, the hour requirements for the A.B.), and discuss details with an adviser.
4. The first statistics course for students majoring in mathematics or statistics is typically STA 301, not STA 261.

# MATHEMATICS AND STATISTICS DEGREE REQUIREMENTS

The Mathematics and Statistics Departments offer a Bachelor of Arts (A.B.) degree and three distinct Bachelor of Science degrees. The A.B. requires all sections of the College of Arts & Science (CAS) Requirement; B.S. degrees require only the foreign language section CAS-A. (In practice, students often satisfy much of CAS as they complete the Miami Plan Foundation.) All programs require:

1. Calculus III, MTH 252 or 252.H (4)
2. Linear Algebra, MTH 222 (3) or 222.T (2) - 331.T (3)
3. The related courses requirement.
4. All courses taken from the Mathematics or Statistics Departments to be applied to your program, as well as all courses in the subject area section of the related courses, are to be taken for grade rather than credit / no credit. In the MTH/STA courses taken your overall grade point average (GPA) must be at least 2.0.
5. Your plan of study ***must*** be approved as in A ***or*** B below:

A. If you design your own program, it must be approved by three faculty members.

1. For A.B. or B.S./MTH: the Chief Departmental Adviser for Mathematics, a second adviser, and one other member of the Department of Mathematics.
2. For B.S./STA: the Chief Departmental Adviser for Statistics, a second adviser, and one other member of the Department of Statistics.
3. For B.S./MTH & STA: both Chief Departmental Advisers and one other member of either department.

B. If your program is one of those described below, then approval is automatic.

## BACHELOR OF ARTS—MATHEMATICS MAJOR

This program requires **at least 19 semester hours** in MTH or STA courses numbered 300 or above with **at least 16 hours at the 400 level** and must include:

*A course selected from one of lines a-c:

a) MTH 421 - Introduction to Abstract Algebra (4)

b) MTH 441 - Real Analysis (3), or MTH 451 - Introduction to Complex Variables (4)

c) MTH 491 - Introduction to Topology (3)

*A course selected from one of lines d-i:

d) MTH 432 - Optimization (3)

e) MTH 437 - Game Theory (3), or MTH 438 - Theory and Application of Graphs (3), or MTH 439 - Combinatorics (3), or MTH 436 - Combinatorial Designs and Coding Theory (3)

f) MTH 447 - Topics in Mathematical Finance (3)

g) MTH 453 - Numerical Analysis (3)

h) MME/MTH 495 Introduction to Applied Nonlinear Dynamics (3)

i) STA 401 - Probability (3)

* A course selected from a line different from the previous two.

Additional courses that count in the 19 advanced hour requirement are those in the above lists together with MTH 331, 347, 410, 411, 420, 422, 425 (MPC), 435 (MPC), 440, 442, 454, 470, 483, 486, 492; STA 462, 463, 466, 467, 483, 484.

At least 10 of the hours at the 400 level must be earned in MTH courses and at least 9 hours at the 400 level must be earned at Miami (not as a Credit/No Credit).

Students in the B.S. Education Integrated Mathematics program who complete MTH 408, MTH 409, and MTH 482 may count 3 hours toward the 400 level hours required for the A.B.

## BACHELOR OF SCIENCE---MATHEMATICS MAJOR

This program requires at least 28 semester hours of MTH/STA courses at the 300 level or above, with at least 22 hours at the 400 level. At least 12 of the hours at the 400 level must be earned at Miami (not for Credit/No Credit).

Theory Courses (13-14 hours):

* MTH 421 - Introduction to Abstract Algebra (4)
* MTH 441 - Real Analysis (3)
* At least two of:
  - MTH 411 - Foundations of Geometry (3)
  - MTH 422 - Linear Algebra and Fields (4)
  - MTH 438 - Theory and Application of Graphs (3)
  - MTH 442 - Real Analysis (3)
  - MTH 451 - Introduction to Complex Variables (4)
  - MTH 483 - Formal Systems and Mathematical Logic (3)
  - MTH 486 - Introduction to Set Theory (3)
  - MTH 491 - Introduction to Topology (3)

Applications Courses (6 hours):

At least two of:

- MTH 347 - Differential Equations (3)
- MTH 432 - Optimization (3)
- MTH 436 - Combinatorial Designs and Coding Theory (3)
- MTH 437 - Game Theory and Related Topics (3)
- MTH 439 - Combinatorics (3)
- MTH 447 - Topics in Mathematical Finance (3)
- MTH 453 - Numerical Analysis (3)
- MME/MTH 495 Introduction to Applied Nonlinear Dynamics (3)

Elective Courses (8-9 hours):

Additional courses to complete the 28 hours may be chosen from the lists above or from MTH 331, 410, 420, 425 (MPC), 435 (MPC), 440, 454, 470, 482 (MPC), 492; STA 401, 462. At most 2 of the 28 hours may be from 430 or Independent Studies.

## BACHELOR OF SCIENCE---STATISTICS MAJOR (Department of Statistics)

For information on a Bachelor of Science degree in Statistics, please contact the Department of Statistics, 311 UPH, 529-7828.

## BACHELOR OF SCIENCE---MATHEMATICS AND STATISTICS MAJOR

This program requires at least 31 semester hours of MTH/STA courses at the 300 level or above, with at least 22 hours at the 400 level. At least 12 of the hours at the 400 level must be earned at Miami (not for Credit/No Credit).

Mathematics Courses

All of these:

- MTH 347 - Differential Equations (3)
- MTH 421 - Introduction to Abstract Algebra (4)
- MTH 441 - Real Analysis (3) or MTH 451 - Introduction to Complex Variables (4)

At least one of these:

MTH 432 - Optimization (3)
MTH 436 - Combinatorial Designs and Coding Theory (3)
MTH 437 - Game Theory and Related Topics (3)
MTH 438 - Theory and Application of Graphs
MTH 439 - Combinatorics
MTH 447 - Topics in Mathematical Finance (3)
MTH 453 - Numerical Analysis (3)
MME/MTH 495 Introduction to Applied Nonlinear Dynamics (3)

Statistics courses

All of these:

STA 301 - Applied Statistics (3)
STA 401 - Probability (3)
STA 463 - Regression Analysis (4)

At least one of these:

STA 462 - Inferential Statistics (3)
STA 466 - Experimental Design Methods (4)

Electives:

Additional hours to complete the 31 required hours from lists above or from MTH 331, 410, 411, 420, 422, 425 (MPC), 435 (MPC), 440, 442, 454, 470, 482 (MPC), 483, 486, 491, 492; STA 402, 427, 467, 475 (MPC), 483, 484. At most two of the 31 hours may be from MTH 430 or Independent Studies.

Note: Students with previous credit for STA 261 may not take STA 301 and must take additional hours from the electives list to complete the 31 required hours.

## TEACHER LICENSURE

Most students who want to become secondary school mathematics teachers obtain teacher licensure by earning the B.S. in Integrated Mathematics Education (BS/ED) from the School of Education and Allied Professions. This degree leads to a license to teach mathematics in grades 7-12. See the School of Education section in the Miami Bulletin for details. Some teacher licensure candidates complete two degrees, the BS/ED as well as an A.B. or B.S. degree in mathematics and statistics from the College of Arts and Science. With early and careful planning, it is possible to complete these two degrees in four to four and a half years. The notes below are intended to aid in this planning effort, and they should be supplemented with advising sessions. Students who intend to earn both degrees must remember that all requirements for each degree must be satisfied.

Students who wish to combine teacher licensure with an A.B. or B.S. degree in mathematics and statistics should apply for admission to a licensure cohort as outlined in the School of Education and Allied Professions section of the Bulletin. The cohort is the group of people who take their two-semester sequence of instructional procedures (methodology) coursework together, usually in their junior year. Cohorts are selected annually and are selected a year in advance. Missing the cohort application deadline in your first year might necessitate additional time, or summer school, to complete your two degrees. Check with the Department of Teacher Education to learn the current year's application deadline.

To earn an A.B. degree in addition to teacher licensure, you must complete the requirements for the Bachelor of Arts degree as stated earlier, while also satisfying your professional education course requirements. As a consequence, the following courses (not all of which apply toward the A.B.) are automatically required to be in your academic program:

MTH 331 - Discrete Mathematics (3)
MTH 408 - Mathematical Problem Solving With Technology (3)
MTH 409 - Secondary Mathematics from an Advanced Perspective (3)
MTH 411 - Foundations of Geometry (3)

(list continued on next page)

MTH 421 - Introduction to Abstract Algebra (4)
MTH 482 - Great Theorems of Mathematics (3)
STA 301 - Applied Statistics (3)
STA 401 - Probability (3)

One additional course is required for completion of the A.B. degree. See the A.B. degree requirements for details about the selection of this course.

To earn a B.S. degree in addition to teacher licensure, you must complete the same list of seven courses as well as satisfy the requirements for the B.S. in Mathematics or the B.S. in Mathematics and Statistics. Either of these programs requires four or five additional courses. See the B.S. requirements for details about the selection of these courses.

A first year student who is considering teacher licensure should take the following introductory course during his/her first year:

EDT 190.A Introduction to Secondary Teaching

Two of the required courses for licensure will also count in the Miami Plan:

EDP 201 Human Development and Learning (Miami Plan – Social Science)
EDL 204 Sociocultural Studies in Education (Miami Plan – Humanities)

Completion of two majors will satisfy the thematic sequence requirement of the Miami Plan.
A student who wishes to learn more about the requirements for teacher licensure should contact the Office of Student Services in the School of Education and Allied Professions, McGuffey Hall (513-529-6418) to obtain a complete packet of information for Integrated Mathematics Education. The Departments of Mathematics, Statistics, and Teacher Education work together to help meet the advising needs of their majors. A double major will have an adviser in each major.

## Notes FOR ALL MTH/STA DEGREE PROGRAMS

1. Mathematics and Statistics majors who plan to seek jobs in business and industry should be aware that such employers often look favorably upon related courses in systems analysis, natural science, economics, accounting, and finance. Statistics and other applied mathematics courses are also recommended. Computer literacy is highly desirable if not indispensable. It is often acquired independently of formal course work and includes such things as word processing and spreadsheets. See also the section on Related Courses.
2. MTH 421 and 441 should not be taken at the same time unless your adviser grants special permission.
3. Students preparing to pursue graduate work in mathematics are advised to complete the following sequences: MTH 421, 422 and MTH 441, 442.
4. A student planning further study in statistics should minimally complete STA 301, 401, and 463. MTH 441 is also desirable for students preparing to pursue graduate work in statistics.
5. It is a general policy that a student who has done advanced work in Mathematics and Statistics cannot enroll for credit in lower level courses with similar subject material. In particular, students with experience in 400 level mathematics courses such as 421, 441, or 438 will not generally be permitted to enroll in MTH 331.

Exceptions require the *prior* approval of the CDA.

## RELATED COURSES REQUIREMENT

A program of related courses is intended to provide you with opportunities to see and do mathematics or statistics in the context of other disciplines and, perhaps, enhance your employment prospects. The Related Courses requirement is for a program of at least 15 hours. Students in the AB Math major or the BS Math major may use statistics as their related area. There is no restriction on the statistics courses that can count (service courses are ok), but courses applied to the related area cannot also be counted towards the requirements of the major. On the other hand, students in the BS Math and Stat cannot use statistics as their related area.

Each program includes two parts, as follows.

**Part I: Computer Programming Requirement**

Every major in the Departments of Mathematics and Statistics is required to demonstrate computer programming proficiency by passing an approved course. Approved courses include:
**CSE 153 Introduction to C/C++ Programming (3)**
**CSE 163 Introduction to Computer Concepts and Programming (3)**
**CSE 174 Fundamentals of Programming and Problem Solving (3)**
or any CSA course with one of these courses as a prerequisite. Other courses can be used in some cases, including
**MTH 408 Mathematical Problem Solving with Technology (3)** (Only for students who have been admitted to an AYA teacher licensure cohort.)
**PHY 286 Introduction to Computational Physics (3)** (Only for students who are also majoring in Physics.)

**Part II. Related Area Requirement**.

Every major in the Departments of Mathematics and Statistics is required to include in their program a cluster of courses in one area of study in which mathematics or statistics is used. Minimally (but see the **Related Area Reduction** below), the area is to consist of at least 12 credit hours, with at least 6 of the hours numbered 300 or higher (200 or higher in Chemistry, Physics, Engineering, or Computer Science and Software Engineering).

If your interests are not accommodated by the pre-approved programs listed below, you may elect to design your own program of related courses. Such programs must be approved by one of the Chief Departmental Advisers *in advance of applying for graduation*.

**Pre-Approved Related Areas:**

1. Actuarial Science: ECO 201, 202; ACC 221, 222; FIN 301. See ACC, FIN, or ECO descriptions of thematic sequences for expanding this program to a thematic sequence. Students interested in an actuarial career are urged to complete the Minor in Actuarial Science, which will also satisfy this Related Courses Requirement.
2. Teacher Education: The secondary licensure program in The School of Education and Allied Professions (This option is available only for Integrated Mathematics Education Majors).

*The following pre-approved programs include a Miami Plan Thematic Sequence.* (Thematic Sequence course numbers are underlined. See the Miami Bulletin for fuller descriptions of the sequences and courses).

3. Accounting (ACC1): ACC 221, 222, 468, plus 3 hours of 300+ level ACC.
4. Accounting (ACC2): ACC 221, 222, 321, 422.
5. Chemistry (CHM1): CHM 142 & 145 or 142M & 161; CHM 231 or 241 & 244 or 251 & 254: and CHM 363 & 364.
6. Chemistry (CHM2): CHM 142 & 145 or 142M & 161; CHM 231 or 241 & 244 or 251 & 254: and CHM 332 or 432 or 433.
7. Economics (ECO3): ECO 201, 202, 317, 418 or 419.
8. Physics (PHY1): PHY 182, 184, 281, 293, 286 (not 292, 294).
9. Computer Science & Software Engineering (CSE2): CSE 174, 271, 252 or 274 or 283, plus 3 hours of 174+ level CSE.
10. Computer Science & Software Engineering (CSE3): CSE 273, 372, 471, plus 3 hours of 174+ level CSE.

**Related Area Reduction**: Some students may want to have the flexibility to include in their program an additional elective course in mathematics or statistics. To that end, the cluster of related courses required can be reduced by up to 3 hours (of the 6 advanced hours) by taking the same number of hours in MTH or STA (numbered 400 or higher and not a service course). This decision should be made in consultation with your adviser or one of the CDAs.

## MINOR IN ACTUARIAL SCIENCE

This minor is designed for students who are preparing for a possible career as an actuary. The extensive prerequisites for the minor reflect the fact that most students in this program will have a major in mathematics and statistics. Courses in the minor may also be used to satisfy requirements of a major. (See Note 6 below, however.)

### REQUIREMENTS

1. At least a 2.0 GPA in all coursework to be applied to the minor. ***Courses taken on a credit/no credit basis do not apply.***
2. Completion of multivariable calculus, linear algebra, and introductory statistics.
3. All of these:
   - STA 401 Probability (3)
   - STA 463 Regression Analysis (4)
   - STA 483 Analysis of Forecasting Systems (3)
4. All of these:
   - ACC 221 Introduction to Financial Accounting (3)
   - ACC 222 Introduction to Managerial Accounting (3)
   - ECO 201 Principles of Microeconomics (3)
   - ECO 202 Principles of Macroeconomics (3)
   - FIN 301 Introduction to Business Finance (3)

***Notes***

1. Students should apply for this minor on the change-of-major form by contacting the adviser for this minor, Professor Byran Smucker (317 UPH, 9-0955, smuckerb@miamioh.edu)
2. The minor is awarded in conjunction with the baccalaureate degree and may be completed by any undergraduate. Courses taken to fulfill the requirements of this minor may be used to complete the requirements of other majors, minors, thematic sequences, etc.
3. On the student's transcript, in addition to the major(s), the Registrar places "Minor in Actuarial Science."
4. Due to action by LEC in February 2006, this minor **does** satisfy the Thematic Sequence requirement of the Miami Plan for students majoring in Mathematics and/or Statistics.
5. Students are encouraged to select MTH 447 Mathematical Finance as an elective course that will enhance this program.

## MINOR IN MATHEMATICS

The Minor in Mathematics is designed to provide students who are not mathematics, mathematics and statistics, or integrated mathematics education majors with an increased understanding of, and competence in, mathematics. Building on a base of calculus and linear algebra (already required for various majors), the program leads students through a theoretical course [from group 4 (a)], an applications oriented course [from group 4(b)], and at least one additional elective course in advanced mathematics. At least a 2.0 GPA in the collection of courses to be applied to the minor is required. ***Courses taken on a credit/no credit basis do not apply***.

## REQUIREMENTS

1. One of MTH 249, 249H, or 251.
2. One of MTH 252 or 252H.
3. One of MTH 222 or 222T/331T
4. Completion of at least 10 advanced hours in courses at the 300 level or above, including

a) At least one of MTH 411, 421, 441 or 451
b) At least one of MTH 347, 432, 435, 436, 437, 438, 439, 447, 453, or 495.
c) At least 6 hours of MTH courses at the 400 level

At most one hour from MTH 430 or MTH 477 and at most three hours from PHY 483 (previously PHY 341) may be counted toward the 10 advanced hours requirement. MTH 330 and MTH 406 may not be included. Students who have taken MTH 245 as a requirement for a major may count one hour of 245 toward the 10 hour requirement—and for you, 245 substitutes for 347 in the list of "applications" courses. See also Note 4 below.

***Notes***

1. Students should apply for this minor on the change-of-major form by contacting Dr. Hamid Rahmati (529-2275, 233 BAC, rahmath@miamioh.edu), the adviser for the minor in Mathematics. Students seeking information about this minor are encouraged to see Dr. Rahmati or any faculty member in the Department of Mathematics.
2. The minor is awarded in conjunction with the baccalaureate degree and may be completed by any undergraduate except for Mathematics majors (A&S or Ed), or Mathematics and Statistics majors (AB or BS). Courses taken to fulfill the requirements of this minor may be used to complete the requirements of other majors, minors, thematic sequences, etc.
3. On the student's transcript, in addition to the major(s), the Registrar places "Minor in Mathematics."
4. By inclusion of MTH 222 and MTH 347, students will also satisfy the requirements for the MTH 3 Thematic Sequence.

# MINOR IN OPERATIONS RESEARCH METHODS

Operations Research is the use of scientific methods in decision-making. It seeks to observe, understand, and predict the behavior of human-machine systems through the use of mathematical models. Techniques of operations research are designed to cope with problems of practical significance, which are often characterized by complicated and uncertain environments. These techniques have contributed to the solution of problems of choice, policy, and planning that have arisen in military, governmental, industrial, environmental, and social contexts. This minor should be considered by students who are attracted to the use of mathematics, statistics and computing in solving decision-making problems of practical significance.
This minor is available to all majors. The CSE 3 Thematic Sequence (Mathematical and Computer Modeling) is included in this program. Majors in CSE typically satisfy the MTH 2 Thematic Sequence (Basic Mathematical Tools for Science).

## REQUIREMENTS

I. The completion of at least 18 hours as specified below.
II. At least a 2.0 GPA in course work applicable to the program.
***Courses taken on a credit/no credit basis do not apply.***
III. The completion of a proposed plan of study which must be approved in one of the following two ways: either
A. by your adviser and the Applied Mathematics-Operations Research Committee if you design your own program; or (continued on next page)

B. simply by your adviser if it includes:

1. All four of these:
   - CSE 273 - Optimization Modeling (3)
   - CSE 372 - Stochastic Modeling (3)
   - CSE 471 - Simulation (3)
   - STA 463 - Regression Analysis (3)
2. At least one of these*:
   - MTH 432 - Optimization (3)
   - MTH 438 - Theory and Application of Graphs (3)
   - MTH 453 - Numerical Analysis (3)
3. A second course chosen from those in 2 above, or one of the following*:
   - MTH 435 - Modeling Capstone (3)
   - MTH 437 - Game Theory (3)
   - MTH 439 - Combinatorics (3)
   - MTH 447 - Topics in Mathematical Finance (3)
   - STA 483 - Analysis of Forecasting Systems (3)

***NOTES***

1. A student should apply for the minor on the change-of-major form by contacting the adviser for this minor, Professor Doug Ward (529-3534, 204 BAC, wardde@miamioh.edu)
2. The minor is awarded in conjunction with the Baccalaureate degree and may be completed by any student in any division/major. Courses taken to fulfill the minor requirements may be used to complete other appropriate requirements.
3. On the student's transcript, in addition to the major, the Registrar places "Minor in Operations Research Methods."
4. Students are advised to take courses in economics or business.

## MINORS IN STATISTICS (Department of Statistics)

For information on a minor in Statistics, please contact the Department of Statistics, 311 UPH, 529-7828.

## GENERAL INFORMATION

### DEPARTMENTAL HONORS

The College of Arts and Science supervises departmental honors programs within the college and allows the Mathematics and Statistics Departments to continue the successful programs we have operated for many years. In brief, our programs provide more options than the usual departmental honors program within the college. **We consider honors students to be those with a keen interest and ability in mathematics or statistics regardless of their major or year at Miami. There need be no intent to actually graduate with departmental honors.** For such a student the departments offer special honors courses and encourage participation in intercollegiate competitions and activities. Many students have enjoyed considerable success in these endeavors and have benefited from the extra competence and confidence developed through such experiences.

The departmental Honors Coordinator is responsible for identifying honors students, inviting them to enroll in the honors program, and encouraging them to take part in appropriate activities. The most common bases for these invitations are outstanding performance in departmental classes or activities and recommendations by departmental faculty. However, any student who wants to be considered for membership in our honors program is encouraged to inquire in the department office.

In order to **graduate with departmental honors,** a student must apply to the Honors Coordinator for departmental honors status (Dr. Dan Pritikin in mathematics or Dr. Charles Dunn in statistics) and perform at least two of the following three items:

I. Complete an approved sequence of mathematics and statistics courses, including some course work at the 400 level, with a GPA of at least 3.5 over all math/stat courses. Meeting the MTH/STA course requirements of one of our math or stat degrees is the usual way to complete such a sequence.

II. Give a distinguished performance in a recognized mathematics or statistics activity. The activity could be a mathematics or statistics competition, or a standardized examination such as a GRE subject exam, or the writing of a paper resulting from an undergraduate research project.

III. Make a scholarly presentation about mathematics or statistics, preferably based on the results of an independent study or research project.

A graduating undergraduate applicant in Arts and Science meeting all three of I, II and III in the judgment of the Honors Coordinator qualifies for departmental honors in Mathematics and/or Statistics. For a student meeting only two of I, II and III, it will be up to the Honors Coordinator, in consultation with two other tenure track faculty in the department, as to whether the student is awarded departmental honors based on overall strength concerning I, II and III.

Deciding whether a student meets criteria I, II and/or III is generally a judgment call on the part of the faculty involved.

Please note that students who are not majoring in Mathematics and/or Statistics can meet these requirements and have done so. Also there is no requirement to enroll in MTH/STA 480 to gain departmental honors. The Honors Coordinator maintains a list of regularly accepted ways for meeting these basic requirements and also advises members of our program about their progress towards graduation with departmental honors.

## GRADUATE SCHOOL IN MATHEMATICS OR STATISTICS AT MIAMI

Miami's Mathematics and Statistics Departments offer a Master of Arts and a Master of Science degree in Mathematics, a Master of Science degree with an option in Operations Research, a Master of Science degree in Statistics, and a Master of Arts in Teaching. Graduate teaching assistantships in all programs are available with a stipend of approximately $13,500, remission of the instructional fee, and up to $1,800 summer support.

You should be aware of the departments' five-year Master's degree programs. By carefully planning your program before or during your sophomore year, you can earn a Bachelor's degree in four years and a Master's degree in one more year. Normally, two years are required for a Master's degree after graduation with the A.B. or B.S. However, the masters can be completed in one year plus 2 full summers. Undergraduates or recent graduates who have completed almost all of the requirements for certification (except perhaps for student teaching and a course or two) may be able to complete these requirements and obtain a Master's degree in two academic years.

Students interested in graduate study at Miami or elsewhere may wish to consult with Professor Doug Ward for mathematics programs (529-3534, 285 BAC, wardde@miamioh.edu) or Professor Doug Noe for statistics programs (529-5838, 305B UPH, noeda@miamioh.edu).

## CAREER PLANNING

If you are interested in the available jobs in mathematics, statistics, and operations research, see books such as *Great Jobs for Math Majors, 101 Careers in Mathematics* and *Peterson's Guide to Engineering, Science, and Computer Jobs*. Some of these may be available for loan from one of the Chief Departmental Advisers. Also, check the information boards in Bachelor Hall and Upham Hall. As a Mathematics or Statistics major, you are in a unique position. After mastering the abstract and demanding rigor of mathematics and statistics, you are perceived by employers as someone who is intelligent, can recognize patterns, generalize, and adapt to ideas and procedures in new areas.

Students who desire assistance in finding internships and jobs should register with the Office of Career Services (OCS) in 200 Hoyt Hall or on-line at www.miamioh.edu/careers/. The beginning of the sophomore year is a good time to start looking for possible internship experiences. This office also provides job-search assistance for graduate students.

Among the OCS's more popular services are on-campus interviews with visiting employers and graduate schools, workshops on career planning and job finding, individual career counseling, assistance with resume preparation, video-taped "practice" interviews, credential services, and weekly Employment Opportunity Bulletins. The OCS also maintains a comprehensive Career Resource Center which contains material on a wide variety of careers, as well as employment directories, summer job and internship information, graduate school guides, and "recruiting literature" from literally hundreds of employers.

Students should make every attempt to attend the OCS workshop series, and appointments for career counseling should be scheduled 2-3 weeks prior to the desired appointment time.

## ACTUARIAL SCIENCE ... INSURANCE

If you are interested becoming an actuary, you should consider the Minor in Actuarial Science. Also, plan to take the first actuarial exam, which is given two times each year at Miami. The syllabus of this exam is in the area of probability and statistics. See Professor Byran Smucker (317 UPH, 9-0955, smuckerb@miamioh.edu) for details.

## TUTORING AND PAPER GRADING

Various jobs are available in the Department of Mathematics, the Department of Statistics, and the Office of Learning Assistance. For further information, ask the secretaries in the department offices 123 BAC or 311 UPH.

## MATHEMATICS AND STATISTICS COLLOQUIA AND CONFERENCES

Every fall, the Department of Mathematics and the Department of Statistics host a conference focusing on some topic of interest to the math/stat community. Nationally recognized speakers are invited, and many talks are also given by other attendees. In addition, there are special sessions of talks presented by students from Miami and other universities, with no restriction on the topic. Miami students are welcome to attend all presentations associated with the conference.

## PROBLEMS SEMINARS

Problems Seminars [MTH 330, 430; STA 471] are small informal classes concerned with challenging, nonroutine problems similar to those found on competitive exams. Problem solving skills developed or sharpened in these courses should be helpful in any mathematical research work, in consulting in business and industry, or in taking competitive exams. The mathematics courses change each semester and are open to students at all levels. STA 471 requires completion of, or concurrent registration in, STA 462.

## COMPETITIVE EXAMS

Each year, the department enters a team in the Putnam Competition, a challenging national mathematics examination taken by thousands of college students. See Professor Dan Pritikin (289 BAC, 529-5842) for more information. In addition we enter teams in the annual COMAP national mathematical modeling competition. See Professor Doug Ward (285 BAC, 529-3534) for details. Also, on a local note, the Patterson Examination and the Pi Mu Epsilon Examination are given each spring for first and second year Miami students. See below.

## PI MU EPSILON

The purpose of Pi Mu Epsilon, the national mathematics honorary, is the promotion of scholarly activities in mathematics and statistics and service to the Mathematics and Statistics Departments. At the monthly meetings, invited speakers present topics of interest to the members, generally at the undergraduate level, or discuss graduate school, jobs in industry, or material in new courses. Cash awards of up to $100 are made each year to sophomores scoring highest on an examination prepared and graded by the chapter. Members are funded to attend the national convention each summer. Each fall the chapter holds a regional student conference at Miami.

Members of the chapter are undergraduate and graduate students and faculty. An undergraduate must have completed Calculus III and either Linear Algebra (MTH 222) or Elements of Discrete Mathematics (MTH 231) or equivalents, have a cumulative average of at least 3.0 in Mathematics and Statistics, and an overall GPA of at least 3.0. Initiation dues are $35.00, which includes both the national and local levels. This also includes two issues of the national Pi Mu Epsilon *Journal.* There are no other dues. Undergraduates meeting the requirements are invited to join; please contact the department secretaries for details (529-5818, 123 BAC).

## STUDENT ADVISERY BOARD

The Department of Mathematics has a Student Advisory Board composed of four students, two undergraduates and two graduate students. Of the two undergraduate members, one is chosen by Pi Mu Epsilon from among students in the College of Arts and Science, and the other is chosen by MUCTM from among students in the School of Education, Health & Society. The two graduate student members are chosen by the graduate students in Mathematics. The Graduate Director will ensure that the selection of the graduate student members takes place by early September, and the faculty advisors of Pi Mu Epsilon and MUCTM will do the same regarding selection of undergraduate students from their respective organizations. One of the two undergraduate members of SAB serves on the Undergraduate Committee, and one of the two graduate student members of SAB serves on the Graduate Committee.

The Department of Statistics has a Student Advisory Board composed of two students, one undergraduate and one graduate student. The undergraduate student is chosen by the department chair and the graduate student is elected by the graduate students in statistics.

In both Mathematics and Statistics, the term of each student is for one year. Reappointment may be made. The members of the Student Advisory Board are invited to attend all department meetings except during the discussion and vote on student awards and faculty leaves. When in attendance they have full voting privileges except on personnel decisions.

## THE AWARDS NIGHT BANQUET

One night each April the faculty and students in Mathematics and Statistics gather for an Awards Banquet. Faculty contributions make it possible to reduce the students' dinner costs. Afterwards, the cash prizes and scholarships listed below are awarded. There are also book and journal awards and accolades for all who have been recognized by the faculty.

# PRIZES AND SCHOLARSHIPS IN MATHEMATICS AND STATISTICS

**OSMOND BARTON PRIZE** in Mathematics to an outstanding senior in mathematics, to honor Osmond Barton; by Luella Fouch, Class of 1910.

**MCFARLAND PRIZE** in Mathematics to an outstanding senior in mathematics, in memory of Professor McFarland; by the Honorable James R. Patterson, Class of 1858.

**ALUMNI SENIOR PRIZE** to an outstanding senior in Mathematics and Statistics.

**H.C. CHRISTOFFERSON MATHEMATICS EDUCATION AWARDS** to outstanding seniors who plan to teach in secondary school.

**BYRON SMITH AWARD** to an outstanding undergraduate student majoring in mathematics. The award was established in 1999 by Mr. Byron Smith III (Class of 1970).

**CORWIN SMITH PRIZES** in Mathematics to outstanding juniors in Mathematics; in memory of Mr. Corwin Smith, Class of 1919, by Hinckley Smith, Class of 1891.

**MARY JEANETTE AND CLIFFORD HARVEY SCHOLARHIPS.** Clifford Harvey was a faculty member in our department for many years. The scholarship is for the student's next academic year at the start of which a recipient must have senior standing. This scholarship is awarded to one or more students majoring in Mathematics and Statistics or in Mathematics Education, who have a grade point average of at least 3.5 overall and in MTH/STA courses.

**THE KENNETH LAST SCHOLARSHIPS.** Kenneth Last, class of '53, received a B.S. in Mathematics from Miami University. He worked for many years at Lockheed, an aerospace corporation in California. The scholarship is for the student's next academic year, at the start of which a recipient must have junior or senior standing. It is awarded to one or more students who are majoring in the Departments of Mathematics and/or Statistics and who have a grade point average of at least 3.5 overall and in MTH/STA courses.

**J. PAUL & JOHN P. ALBERT SCHOLARSHIPS.** J. Paul Albert was a faculty member in our department from 1923 until 1962. The scholarship is in memory of his many contributions to our department, and also in memory of his son, John Paul Albert Jr., Miami class of 1948. This scholarship is awarded to one or more sophomore majors in Mathematics, Statistics or Mathematics Education for the junior year. Recipients must have earned at least 45 semester hours at Miami, have been a full-time college student for no more than two years, and have an overall GPA of at least 3.7. The award winner(s) is/are selected from Miami University scholarship applicants by the Chief Departmental Adviser of the Department of Mathematics and the departmental Awards Committee based upon information provided by the Office of Student Financial Assistance as well as that from Mathematics and Statistics faculty.

**PI MU EPSILON AWARDS** in Mathematics to sophomores chosen by a written examination prepared and graded in March by the students of Miami's Ohio Delta Chapter.

**KOEHLER PRIZES** in Mathematics, in memory of Donald Otto Koehler, department member from 1968 until 1983, are awarded to outstanding first- and/or second-year students who have been nominated by their MTH 222 or MTH 331 instructors. The prize consists of a journal subscription and a small cash award.

**PATTERSON PRIZES** in Mathematics to first-year students chosen by a written examination given in March on material through second semester calculus.

**FACULTY PRIZE** in Mathematics and Statistics to an outstanding student in any class. This award is funded by department faculty contributions and need not be given each year.

**ZOLTAN BALOGH MEMORIAL AWARD** in Mathematics. Zoltan "Zoli" Balogh came to Miami University in 1988-89 as the Distinguished Visiting Professor in Mathematics and Statistics. He accepted a permanent position with the department in the fall of 1990. Already a world-class researcher in set-theoretic topology, he continued to solve famous problems in the area until his death in the summer of 2002. In these fourteen years, he also established himself as an excellent teacher and an active supporter of student projects and activities. In recognition of his work with students, a memorial fund has been established to provide a yearly prize to students who have distinguished themselves, not only by excellent course work but also by going beyond the usual requirements for the degree.